

Proceeding



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Preliminary synthesis of calcium carbonate using CO_2 bubbling method for biomedical application

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ABSTRACT

INTRODUCTION : Calcium carbonate (CaCO_3) is widely used in biomedical application such as biomaterial for bone substitute, drug delivery system, calcium supplement and others. CaCO_3 natural form can be easily found either in a limestone processing. Carbonation or CO_2 bubbling method is required to obtain CaCO_3 from bulk limestone. **Objective :** The aim of this study was to synthesize CaCO_3 from Palimanan limestone by CO_2 bubbling method. **Materials and methods:** Limestone was calcinated at 900°C to get calcium oxide (CaO). Then, 84 gr CaO was hydrated in 1.5L water at 50°C in an hour to get lime slurry (Ca(OH)_2). Lime slurry carbonated by bubbling method with temperature 60°C , constant flow rate of CO_2 at 10L/min and stirred at 300 rpm to obtain CaCO_3 particles. Particles of CaCO_3 are then characterized by Energy Dispersive Spectroscopy (EDS), and X-Ray Diffraction (XRD). **Result :** Energy Dispersive Spectroscopy showed elements forming was CaCO_3 . X-Ray Diffraction pattern of CaCO_3 produced trigonal calcite crystalline structure. **Conclusion :** CaCO_3 successfully synthesized using CO_2 bubbling method. Hopefully this CaCO_3 particles might be used widely in biomedical application. Further study is awaited based on these initial findings.

Keywords: Synthesize of CaCO_3 , CO_2 bubbling, EDS, XRD

INTRODUCTION

Calcium carbonate (CaCO_3) is widely used in biomedical application. Biomaterial for bone substitute and drug delivery system for osteomyelitis during bone surgery^{1,2}. CaCO_3 can be used as abrasive material in toothpaste³. CaCO_3 also can be used as therapy for dentine hypersensitivity from prophylaxis paste. Calcite form of CaCO_3 can be used as dentifrices and polishing materials⁴. CaCO_3 natural form can be easily found either in a limestone processing⁵. Carbonation or CO_2 bubbling method is required to obtain CaCO_3 from bulk limestone⁶.

Natural CaCO_3 can be found at several forms like mollusc shells and egg shells. This shells fossil can be found in limestone which is almost 90% contain CaCO_3 . The worldwide availability of CaCO_3 , compatibility and non-toxicity towards the human body make synthesis of this material an interesting and attractive topic for scientists and researcher to delve into. Therefore, so many research have been undertaken to stabilize specific CaCO_3 polymorphs at different size and morphology⁵.

Two main CaCO_3 synthesis methods there are biomimetic method and CO_2 bubbling method. Biomimetic method attempts to imitate nature's ability to synthesize various shapes and size by using physiological parameters and soluble organics. The current industrial synthesis is CO_2 bubbling method which use CO_2 bubble into slaked lime to get CaCO_3 particles⁵.

CO_2 bubbling method is very efficient at producing micro or nano sized particles which are the most needed size in industry and research. The morphology that can mainly be achieved are cubic or rhombohedral⁵.

CaCO_3 have three polymorphs, they are calcite which is thermodynamically stable, vaterite, and aragonite^{1,7}. An important factor during carbonation process is temperature⁸. Scalenohedral CaCO_3 formed at 41-90°C⁹. Another research showed needle like form aragonite formed at 60°C¹⁰. Different shapes can be exhibited by CaCO_3 like spheres, cubes, irregular, pyramid, hollows, and many else⁵. The aim of this study was to synthesize CaCO_3 from Palimanan limestone by CO_2 bubbling method at 60°C.

METHODS

Limestone was calcinated at 900°C to get calcium oxide (CaO). Then, 84 gr CaO was hydrated in 1.5L water at 50°C in an hour to get lime slurry (Ca(OH)_2). Lime slurry carbonated by bubbling method with temperature 60°C, constant flow rate of CO_2 at 10L/min and stirred at 300 rpm until suspension reach neutral pH to obtain CaCO_3 particles. Fig.1 showed carbonation processing. Particles of CaCO_3 then characterized by Energy Dispersive Spectroscopy (EDS), and X-Ray Diffraction (XRD).

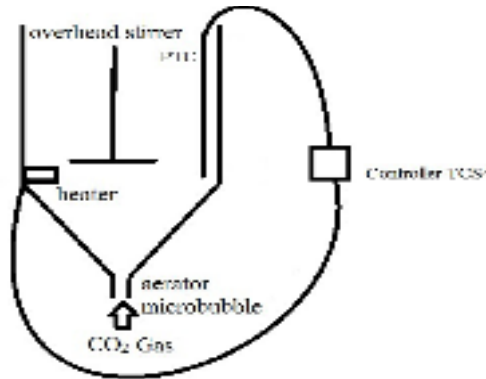
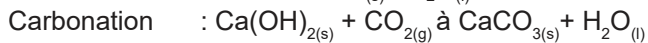
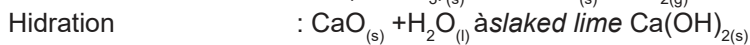
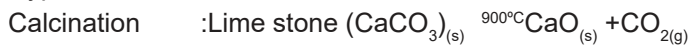
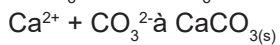
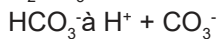
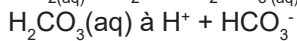
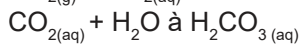
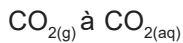


Figure 1. Carbonation or CO₂ bubbling method

Hypothesis of reactions described below:



Detailed reaction of carbonation ¹¹:



RESULTS

Carbonation process is run for 15 minutes until the suspension gets neutral pH (6, 5). Initial CaO mass is 84 gr and final CaCO₃ mass is 90,90 gr.

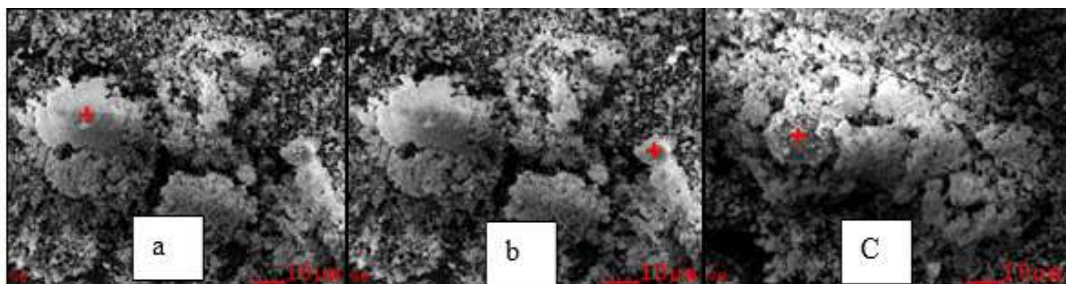


Figure 3. Three dots, during EDS characterization

Table 1. EDS result of CaCO_3

	A		B		C	
Element	Weight%	Atomic %	Weight%	Atomic %	Weight %	Atomic %
C	13,07	21,31	2,39	20,61	10,12	17,52
O	49,22	60,26	47,59	59,44	45,89	59,66
Ca	37,71	18,43	40,02	19,95	43,99	22,83

Energy Dispersive Spectroscopy showed elements forming was CaCO_3 .

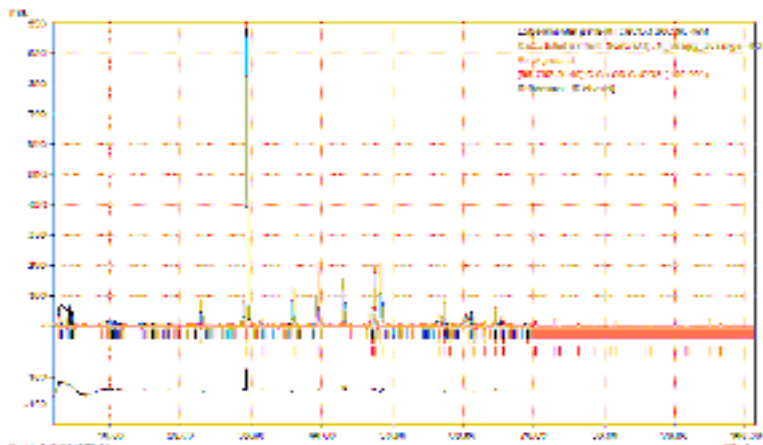


Figure 4. XRD pattern of CaCO_3

X-Ray Diffraction pattern of CaCO_3 produced trigonal calcite crystalline structure with 2.737g/cm^3 density. Fig.4 showed that the particles are 100% CaCO_3 with their peaks. The highest peak is at 2θ degree 30° . This peak same as peak of CaCO_3 in reference

DISCUSSION

CaCO₃ morphology result from this research is different from another research which shows that aragonite is formed at temperature 60°C. Beside, in this research XRD pattern showed calcite formation at the same temperature ¹². Temperature also influences particle size of CaCO₃ ⁸. Small particle (1,5µm) of CaCO₃ is formed at 25°C and the size increases due to agglomeration at 35°C and at 50°C particles begin non agglomerate until reach smallest particle size 1,2 µm at 60°C ⁸.

Biomedical products that can be obtained from this research are CaCO_3 and Ca(OH)_2 . These products can be utilized as dental products when the products meet each standard like physical properties, mechanical properties, and biocompatibility of the materials. Further research is needed to investigate if these materials are eligible as the desired materials.

CaCO_3 which used in dentifrices is different from CaCO_3 used as other dental materials. CaCO_3 is widely used as dentifrices which act as abrasive materials to remove plaque or stain and polish tooth surface. A discussion of dentifrices would not be complete without mentioning of the ADA acceptance program for these materials like abrasivity value of 250 (also limit for ISO standard) ¹³.

Recent research showed CaCO_3 role as precursor of carbonate apatite based bone cement and drug delivery system for osteomyelitis disease ^{1,14}. CaCO_3 acts as donor of CO_3^{2-} and Ca^{2+} that has similarity with inorganic content of bone ¹⁴. CaCO_3 shows unique advantages due to the potential and its ideal biocompatibility as delivery system for loading different categories of drugs. CaCO_3 is nominated as suitable drug delivery carrier because of their accessibility, slow biodegradability, osteoconductivity, safety, low cost, pH-sensitive properties and biocompatibility ¹.

Another product that can be found in this research is $\text{Ca}(\text{OH})_2$ which is widely known for its application in pulp protection as cement base materials ¹³.

CONCLUSION

CaCO_3 is successfully synthesized by CO_2 bubbling method. Hopefully this CaCO_3 particles might be used widely in biomedical application. Further study is awaited based on these initial findings.

ACKNOWLEDGEMENT

The authors are grateful to acknowledge Nanotechnology Research and Graphene Laboratory, Universitas Padjadjaran, Indonesia and to Departement of Dental Materials Science and Technology, Faculty of Dentistry, Universitas Padjadjaran, Indonesia for supporting this research.

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Comparison of the diametral tensile strength of bone cement based on carbonate apatite between micron and nano particles calcium carbonate as a precursor

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ABSTRACT

INTRODUCTION: Bone cement is inorganic material which can be used for bone substitute materials. One of the bone cement which has been attracted much attention in orthopedic and dental fields is apatite cement. As a result of apatite cement could transform to carbonate apatite (CO_3Ap) after implanted in the body, high bone replacement ability could be developed. The current study about diametral tensile strength (DTS) value of bone cement using calcium carbonate (CaCO_3) as one of the component of CO_3Ap cement is limited to submicron particles. There have been no data using CaCO_3 reduced into nano particles. Meanwhile, the studies about reduction of CaCO_3 particles into nano particles have been found by the precipitation and ultrafine grinding. **Objective:** The aim of this study is to investigate the DTS value of bone cement based on CO_3Ap between micron and nano particles using CaCO_3 as a precursor. **Materials and methods:** The powder phase of micron particles of CaCO_3 or nano particles of CaCO_3 which was milled by beads mill combined with dicalcium phosphate anhydrous (CaHPO_4) was mixed with 1 mol/L of disodium hydrogen phosphate (Na_2HPO_4) solution in 0.5 of liquid to powder ratio. The paste was packed into a split Teflon mold, covered with glass slide and kept at 37°C and 100% relative humidity for 24 hours. **Results:** The result showed that the diametral tensile strength of the set CO_3Ap cement using micron particles of CaCO_3 was 3,7787 MPa and nano particles of CaCO_3 was 2,4013 MPa. The data was analyzed statistically with t independent test ($\alpha=0,05$) which showed that the DTS between micron and nano particles of CaCO_3 was statistically significant. **Conclusion:** In conclusion, the bone cement based on CO_3Ap using micron particles of CaCO_3 has higher DTS value than bone cement based on CO_3Ap with nano particles of CaCO_3 .

Keywords: *Diametral tensile strength, bone cement, carbonate apatite, calcium carbonate*

INTRODUCTION

Bone is one of important parts in our body that support our bodies and protect vital organs such as heart, lungs, etc. Bone has limitation for self repair. When large defect bone occurs, so the repair processed need an alternative materials as a bone graft [1]. Autograft is one of the bone grafting materials which is still considered as the “golden standard” compared to other grafting materials since it shows high remodelling process performance. This material is harvested from healthy parts of the bones of the same patient. However, the availability of the healthy bone in our body is limited and this may involve massive blood loss, sepsis, and also pain [1, 2]. Therefore, the use of synthetic graft can be used as an alternative material for bone substitute [3].

Bone cement is a synthetic bone graft material (alloplastic) which can be used for bone substitute materials [4]. One of the bone cement which has been attracted much attention in orthopedic and dental fields is apatite cement (AC) [5]. The AC could transform to carbonate apatite (CO_3Ap) when implanted in the body and high bone replacement ability could be developed. Another advantages possessed by AC lies in its ability to show good osteoconductivity and excellent tissue response [6].

The candidates of starting material for fabrication of CO_3Ap cement are calcium carbonate (CaCO_3) and dicalcium phosphate anhydrous (CaHPO_4) [6]. Cahyanto *et al.* reported that CO_3Ap cement consisted of one of the polymorph of CaCO_3 which is vaterite that has the smallest particle size with the highest diametral tensile strength (DTS) [7]. However, the current study about DTS value of bone cement using CaCO_3 as one of the component of CO_3Ap cement was limited. Furthermore, there was no data using CaCO_3 reduced into nanoparticles as a precursor for CO_3Ap cement. Meanwhile, the study about reduction of CaCO_3 particles into nanoparticles has been found by the precipitation and ultrafine grinding [8]. The aim of this study was to investigate the DTS value of bone cement based on CO_3Ap between micron and nanoparticles using CaCO_3 as a precursor.

METHODS

This research was conducted by CO_3Ap based bone cement using micron and nanoparticles of CaCO_3 . The nanoparticles of CaCO_3 were derived on the basis of previous report [8]. In brief, 1.15 mL of Tween 80 as the surfactant was mixed into 568.1 mL aquadest and 5.75 g of CaCO_3 using magnetic stirrer. The grinding was conducted by beads mill for 3 hours at the slurry concentration of 5%, bead size of 300 μm , and the rotor speed 3000 rpm. The obtained particles were collected by dried at 40°C for 24 hours. Finally, each micron particles of CaCO_3 and nanoparticles of CaCO_3 were mixed with CaHPO_4 homogeneously on weight powder ratio 40:60 to obtain CO_3Ap powder.

Powder phase of CaCO_3 combined CaHPO_4 were mixed with liquid phase of 1 mol/L Na_3HPO_3 using a spatula at a L/P ratio 0.5 until it became a paste. The paste was packed into Teflon mold (6 mm in diameter x 3 mm in height). Both ends of the mold was covered

with a glass slides and clamped by a metal clip. The molds were placed inside a plastic container containing distilled water to maintain 100% relative humidity. Finally, the plastic container was placed into an incubator and kept at 37°C for 24 hours. Upon completion of the treatment times, the samples were removed from the mold and immersed in the 99% ethanol for 3 minutes then dried in the oven 80°C for 3 hours.

The mechanical strength was examined in terms of diametral tensile strength (DTS). The samples were crushed using universal testing machine (Lloyd with Nexygen Plus material test and analysis software, Florida, USA) at 1 mm/min crosshead speed. DTS values were taken from an average five samples. The data has been collected, analysed using t independent test to determine significances.

RESULTS

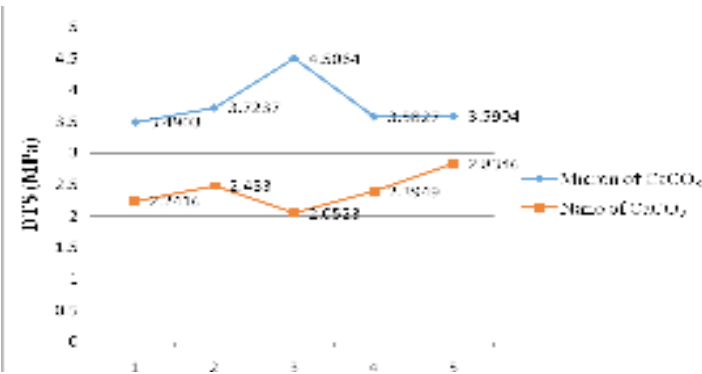


Fig. 1. DTS values of CO_3Ap cement consisted of micron particles of CaCO_3 or nanoparticles of CaCO_3 and CaHPO_4 mixed with 1 mol/L Na_2HPO_4 solution treated for 24 hours. At least five samples were measured for DTS. ($p < 0.05$)

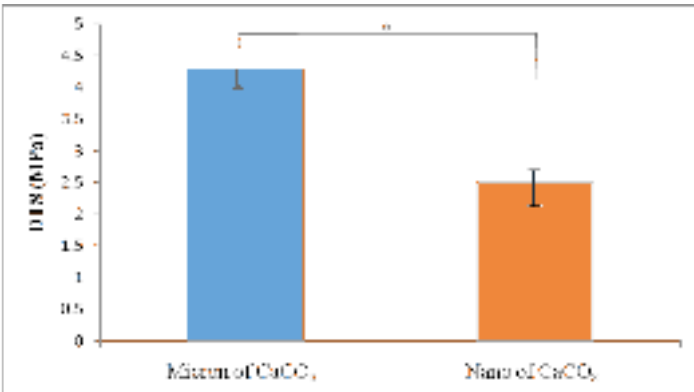


Fig. 2. The mean differences of DTS values of CO_3Ap cement consisted of micron particles of CaCO_3 or nanoparticles of CaCO_3 and CaHPO_4 mixed with 1 mol/L Na_2HPO_4 solution treated for 24 hours. At least five samples were measured for DTS. (* $p < 0.05$)

Figure 2 summarizes the DTS measurement of micron particles that have higher DTS value compared to nanoparticles sample. T-independent test showed statistically significant ($p < 0.05$). Figure 1 shows the DTS value of set CO_3Ap cement consisted of micron particles of CaCO_3 or nanoparticles of CaCO_3 and CaHPO_4 mixed with 1 mol/L Na_2HPO_4 solution after treatment at 37°C and 100% relative humidity for 24 hours. DTS value of set CO_3Ap cement was 3.78 ± 0.37 MPa for micron particles and 2.40 ± 0.26 MPa for nanoparticles.

DISCUSSION

The CO_3Ap cement with similar chemical composition may have different mechanical strengths. It may be due to additional factors such as impurities were present. Other factors which involve associated with specimen preparation and measurement procedures, such as liquid to powder (L/P) ratio. Particle size of CaCO_3 may be a major factor to be regulated for higher mechanical strength of CO_3Ap cement [7-9]. As a result, since the smaller particle size is known has the highest surface area, therefore bonding between particles will be more firm and reactive.

The low DTS value of CO_3Ap based bone cement using nanoparticles of CaCO_3 may be due to the poor handling of L/P ratio. The CO_3Ap cement which consisted of nanoparticles CaCO_3 generated higher viscosity than CO_3Ap cement which consisted of micron particles CaCO_3 . As stated previously, the smaller particle size is known to make the surface area becomes higher; therefore, it might be due to smaller particles which need more liquid to bind the entire surface area. The L/P ratio becomes necessary to have good handling mechanical property [10].

Another factor affecting the low DTS value of CO_3Ap cement using CaCO_3 particles which had been grinded into nanoparticles was the sanitation of beads mill. The result of CaCO_3 particles grinding, which uses beads mill, might be contained impurities derived from previous grinding process. This was shown in the result of grinding powder discoloured to grey. The impurities present might prevent crystal growth and result in slight decrease in mechanical strength [10].

The results of this study showed that the CO_3Ap based bone cement using micron particles and nanoparticles of CaCO_3 had DTS value relatively low. Therefore, this cement might be used for non-load-bearing applications.

CONCLUSION

The CO_3Ap based bone cement using micron particles of CaCO_3 had higher DTS value than CO_3Ap based bone cement using nanoparticles of CaCO_3 .

ACKNOWLEDGEMENT

The authors are grateful to acknowledge nanotechnology research and graphene

laboratory, Universitas Padjadjaran, Indonesia and to Departement of Dental Materials Science and Technology, Faculty of Dentistry, Universitas Padjadjaran, Indonesia for supporting this research.

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Apatite cement versus carbonate apatite cement

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ABSTRACT

Apatite cement (AC) is one of innovations utilized for bone reconstruction. It has been used in clinical application including craniofacial surgery for several decades due to its self-setting property. AC will set and form hydroxyapatite upon setting reaction. Consequently, AC shows excellent tissue response and good osteoconductivity. However, the archetype has been shifting to carbonate apatite (CO₃Ap) cement. Researches proved that AC will transform to CO₃Ap in physiological body condition. The formation of CO₃Ap has been proposed as one of the keys for the replacement of AC to new bone since CO₃Ap will be resorbed by osteoclasts and replaced to new bone. This review will focus on recent research of advance improvements in AC and CO₃Ap cement reported by *in vitro*, *in vivo*, and clinical study.

Keywords: *Apatite cement, carbonate apatite cement*

INTRODUCTION

Brown and Chow in 1986 reported an equimolar mixture of tetracalcium phosphate (TTCP: Ca₄(PO₄)₂O) and dicalcium phosphate anhydrous (DCPA: CaHPO₄) or dicalcium phosphate dehydrate (DCPD: CaHPO₄·2H₂O) set to form hydroxyapatite (HAp) in 30-60 minutes at an ambient temperature.^{1,2} Apatite Cement (AC) invented by Brown and Chow is composed of two kinds of calcium phosphate sources, TTCP and DCPA, and the setting reaction becomes more complex compared with gypsum or α-TCP. However, the setting mechanism of TTCP-DCPA based AC is the same with these gypsum or α-TCP based AC. In other words, they are based on dissolution-precipitation reaction.

When TTCP and DCPA, powder phase of TTCP-DCPA AC is mixed with an aqueous solution, both Ca^{2+} and PO_4^{3-} will be supplied, since both TTCP and DCPA have appropriate solubility. The resultant aqueous solution will be supersaturated with respect to HAp since the solubility of HAp at neutral and alkaline region is very small. As a result, HAp crystals will be precipitated and then interlocked to each other to form the set mass.

From different point of view, the replacement of AC by new bone formation is still is still debated.³⁻¹⁷ These differences could be caused different animal experimental, different bone defect area and size, different composition of the AC or different powder and liquid mixing ratio. For example, one report concluded that the size of a cranial defect is one of the factor affecting resorption and replacement to new bone.¹⁰

Although detailed mechanism of AC's replacement to bone has not been clarified up to date, it is clear that AC would be replaced to bone at certain condition. The replacement of AC to bone relates to the formation of CO_3Ap . Thus, formation of CO_3Ap may be one of the keys for the replacement of AC to new bone since CO_3Ap is known to be resorbed by osteoclasts and replaced to new bone. The aim of the present study is to give a brief review of AC and CO_3Ap cement as substitution material of bone.

DISCUSSION

First advantage of AC or CO_3Ap cement is its self-setting ability in physiological condition. Since the paste of AC or CO_3Ap cement can be set and harden in bone defects, the bone defect can be filled with AC or CO_3Ap cement without leaving a gap to adjacent bone. The cells in bone such as osteoblasts cannot migrate if there is a gap between bone substitutes and adjacent bone. Second, AC or CO_3Ap cement paste showed good injectability that allows AC or CO_3Ap cement to be implanted by minimal invasive surgery techniques, that are less traumatic, reduced blood loss, shorter hospital stay and faster recovery. Third, AC or CO_3Ap cement showed excellent osteoconductivity, as a consequence of the transformation of AC to HAp or CO_3Ap upon setting reaction. Fourth, AC or CO_3Ap cement is replaced by new bone with time even in some period of time. This property is very attractive, since sintered HAp cannot be replaced to bone. Bone are crucial not only for their mechanical role but also its biological role, such as blood formation. Therefore, bone graft that can be replaced to bone is a great deal. Fifth, the AC or CO_3Ap cement can be used to deliver drugs such as growth factor, antibiotic, anti-inflammatory, since set AC or CO_3Ap cement have micro porosity and are able to set at physiological condition.

Besides the benefits possessed by AC or CO_3Ap cement, they also have disadvantages. The lower mechanical properties of AC or CO_3Ap cement becomes an issue, limiting the use of AC or CO_3Ap cement only for non-load bearing area in clinical application. Therefore, AC or CO_3Ap cement may be better to be used in non-load bearing area such as cranial bone substitute or alveolar bone augmentation.

One of interesting manners reported for AC is the formation of CO_3Ap on the surface of AC. When TTCP-DCPA based AC was implanted at tibia of rat, CO_3Ap was found at

the surface of set AC after eight weeks implantation, despite no carbonate source was incorporated in the TTCP-DCPA based AC.¹⁷ Since no carbonate was incorporated in the cement composition, carbonate contained in the CO₃Ap was thought to be supplied from the surrounding environment such as body fluid, blood, air, etc.

It should be noted that bone apatite is the CO₃Ap with other trace element such as Na⁺, K⁺, F⁻ as shown in Table 1.¹⁸⁻¹⁹ Also, preparation of CO₃Ap powder is easy since CO₃Ap the most stable phase thermodynamically.²⁰⁻²² However, apatite powder including CO₃Ap powder causes inflammatory response called crystalline inflammatory response. Therefore, CO₃Ap should be used as cement, block or granular to arrest the response. Although CO₃Ap is the most stable calcium phosphate phase at physiological condition, it is unstable at high temperature required for sintering process and thermally decomposed to other calcium phosphate.

Table 1. Bone compositions of the human adult¹⁸⁻¹⁹

Compositions	Bone
Ca ²⁺	34.8
PO ₄ as P	15.2
Na ⁺	0.9
Mg ²⁺	0.72
K ⁺	0.03
CO ₃ ²⁻	7.4
F ⁻	0.03
Cl ⁻	0.13

Bone remodeling is a lifelong process where mature or old bone tissue is replaced by newly formed bone. In this process, two cells known as osteoclasts and osteoblasts play an imperative role. Osteoblasts forms new bone and this has close relationship with osteoconductivity of apatite. On the other hand, osteoclasts remove matured bone. Osteoclast create Howship's lacuna where inside of the lacuna is made with acidic condition (~pH 4.5).²³ It has been reported that carbonate content in apatitic structure has close relationship with the solubility of apatite in acidic condition.²⁴ Therefore, it is reasonable to say that CO₃Ap is replaced to bone even though HAp is stable at the bone defect. In fact, CO₃Ap granules fabricated based on dissolution-precipitation reaction, and implanted into the cranial bone of rats, after implantation were found to be replaced to the newly formed bone 24 weeks.²⁵ Therefore; CO₃Ap may be a key factor for bone replacement.

CONCLUSION

Although AC has the ability to transform to HAp, the CO₃Ap cement are more beneficial than AC, because they are already in CO₃Ap form, which are more easily to replace by bone.

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Bioceramics material: lifting hope in endodontics

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ABSTRACT

Achieving good and predictable results in endodontic treatment relates to awareness in science, techniques, material and procedural skills. In vital pulp therapies, the main goal of the treatment is to maintain the vitality of the pulp, as a consequence, the chosen material must provide good sealing and stimulation to the pulp cells to repair it self. Whilst in necrotic pulp, particularly in cases with periapical disease, treatment emphasizes eliminating the source of infection by proper disinfection and creating a hermetic seal in the root canal to induce healing of the periapical tissue. To achieve these goals, endodontic treatment can not be separated from disinfection and repair materials that should have good antimicrobial activity, dimensional stability, good handling characteristics, adequate adherence ability to tooth structure to provide good seal, biocompatible and able to induce tissue repair. However, until this present time, no material available could meet the needs of all ideal dental material properties. Therefore, studies to provide better material are still on going. Bioceramics has been a promising material widely used in medicine, combining biocompatibility and bioactivity. Recent delicate studies also suggested the use of bioceramics in dentistry, which has been promising in stimulating regeneration of broken tooth due to its biocompatibility and bioactive properties. This brief review will focus on advance improvements in dental materials particularly in endodontics using bioceramics including calcium hydroxide, mineral trioxide aggregates (MTA), Biodentine, iRoot SP, and BioAggregate that has been reported by laboratory and clinical studies to improve the quality of endodontic treatment.

Keywords: *Bioceramics, endodontics, regeneration, material, biocompatible*

INTRODUCTION

In recent years, the term bioceramics has been commonly mentioned in publications or even dental product advertising, with promising outcome for the use of these materials in medical and dentistry field. In medical and dental perspective, bioceramics, refers to all ceramic materials that are designed for use in medical and dental practice, this includes; alumina and zirconia, bioactive glass, glass ceramics, coatings and composites, hydroxyapatite and resorbable calcium phosphates.^{1,2} The superior properties of bioceramics are biocompatibility and the ability to conduct hard tissue formation, in other words, these materials have great tissue response and stimulates damaged mineralized tissue regeneration. The superior properties makes these materials remarkable to be applied in orthopedics applications such as artificial hip joint and bone reconstruction materials.³ In dentistry, bioceramics has been used as implant coatings and bone repair materials, more particular in endodontics, a wide range of application has been proposed from pulp capping materials, endodontic sealers, root end restoration material, to furcation or dentin repair materials. This review will present a brief discussion about bioceramics materials proposed in endodontics, from calcium hydroxide, MTA, Biodentin, iRoot SP, BioAggregate cements based on laboratory and clinical studies.

Calcium hydroxide

In endodontics, calcium hydroxide is believed to be the most frequently material used in clinical practices for the past years. Its biocompatibility to dental tissue, antibacterial properties and its ability to stimulate hard tissue formation has been favorable properties to its use in endodontics. The liberation of hydroxyl and calcium ions was believed to be its basic mechanism of action leading to antibacterial effect (due to high pH) and activation of alkaline phosphates (ALP) involved in hard tissue formation.³ Hard tissue formation is initiated by an inflammation process in the superficial layer of the injured pulp, that leads to superficial necrosis that eventually leads to stimulation of the pulp cells to form a repair reaction.^{4, 5}

Moving from the favorable properties of calcium hydroxide, studies also have reported some limitations of this compound including high solubility, degradation of material over time, weak dentinal barrier formation, poor adhesion property to tooth structure, and long uncontrolled chronic inflammation to the pulp.^{5,6,7} Lack of adhesion also lead to poor seal which contributes to failure of this material to act as a bacteriostatic seal.⁶ Moderate inflammation with no dentinal bridge formation was also observed in human premolar after 15 days capped with calcium hydroxide (Dycal) and most of the Dycal specimens showed incomplete bridge formation with more inflammation of the pulp tissue.⁷

In this present time, calcium hydroxide comes in different forms specifically designed for different purpose, an injectable calcium hydroxide commonly used for inter-appointment dressings in root canal treatment, a paste-paste form with base and catalyst to facilitate controlled setting reaction in pulp capping treatment, or in a combination with resin to be light cured and used as liners or pulp capping treatment.

Mineral Trioxide Aggregate (MTA)

MTA is a multifunctional cement design for multipurpose in endodontics, namely for pulp capping materials, pulpotomy dressings, root end fillings, furcation repair materials, dentin repair materials and apexogenesis or apexification treatment. Since firstly introduced, MTA has been intensively investing by many studies, most studies concluded that this material shown good cell growth fibroblast, osteoblast like cells and pulp cells. A study on rat dental pulp cells also showed that MTA induced reparative dentin formation with minimum apoptosis compared to calcium hydroxide.^{9,10}

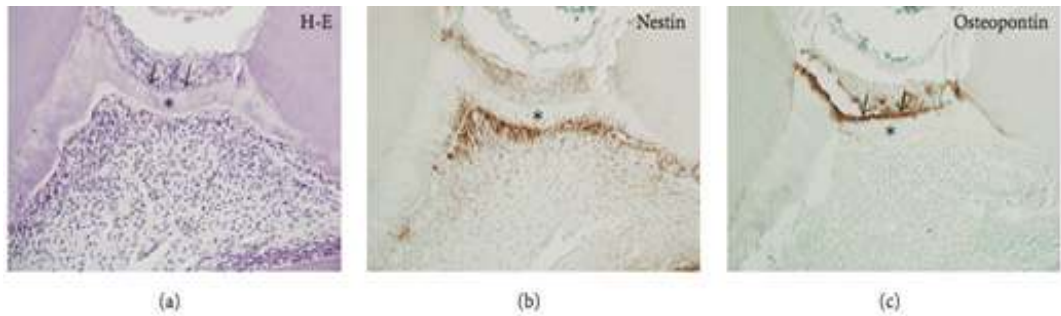


Figure 1. Dentin bridge formation in rat molar at 14 days after direct pulp capping with MTA: H-E staining (a), immunohistochemistry of nestin (b), and osteopontin (c). (a) A thin layer of fibrous matrix (arrows) is followed by a dentin-like matrix (*) with tubular structures pulpally lined with odontoblast-like cells. (b) The odontoblast-like cells intensely express nestin, an intermediate filament expressed in differentiated odontoblasts. Their processes also show immunoreactivity for nestin in the tubular matrix (*). (c) Osteopontin immunoreactivity is detected in the superficial fibrous matrix (arrows), but not in tubular dentin-like matrix (*).⁸

Biodentine

Biodentine is a calcium silicate based material consists of tricalcium silicate, dicalcium silicate, calcium carbonate and oxide filler, iron oxide shade, and zirconium oxide. The liquid used for biodentin are composed of a hydrosoluble polymer and a calcium chloride as accelerator. This material is suitable for perforation repair, retrograde filling, pulp capping, and pulptomy dressings. The strength of this material compared to other bioceramics material such as MTA is the improvement in setting time, mechanical properties and radiopacities.¹¹ Shorter setting time is a favorable property especially in the used for retrograde filling and perforation repair, this was achieve by adding calcium chloride in the liquid.

Biodentine was proven to be biocompatible and highly bioactive.^{11,12} In a 6 weeks evaluation in human maxillary and mandibular intact molar, with deliberate mechanical pulp exposure and capped with biodentine, there was no inflammatory response and a complete dentinal bridge formation.¹³ The ability of Biodentine to form reparative dentin could also be due to modulation of pulp cell TGF- β 1 secretion. When implanted in subcutaneous tissue of rats, it exhibited moderate inflameation in the first 7 days, and mild or no inflammation after 14 days, the study concluded that biodentine was biocompatible with tissue after the 14th day.¹²

BioAggregate

BioAggregate is a fine nanoparticle size, material, aluminum-free powder that is mixed with deionized water to form a bioceramic paste. The powder consists of SiO_2 (13.70%), P_2O_5 (3.92%), CaO (63.50%), and Ta_2O_5 (17%), the latter was to improve the radioopacity of the material (tantalum oxide).¹⁴ BioAggregate is indicated as pulp capping material, perforation repair as well as root-end fillings, where many in vivo reports concluded that BioAggregate are comparable to MTA.^{14,15,16}

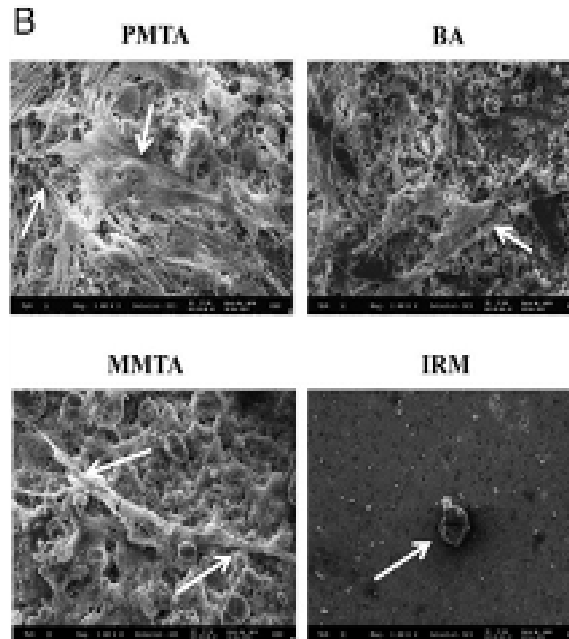


Figure 2. Effects of PMTA, BA, MMTA, and IRM on adhesion in HDPCs by MTT assay and SEM, respectively. An OS containing 50 mg/mL ascorbic acid and 10 mmol/L b-glycerophosphate was used as the positive control. Cells were incubated for 3, 7, and 14 days with the materials. SEM observation (original magnification, 1000) of HDPCs exposed to various materials was completed 2 days after incubation. Arrows indicate pulp cells. These data findings are representative of 3 independent experiments. Statistically significant difference compared with each group ($P < 0.05$).¹⁷

As for biocompatibility, on one study comparing BioAggregate (BA) to Micromega MTA (MMTA), ProRoot MTA (PMTA) and Intermediate Restorative Material (IRM) by using human dental pulp cells and concluded that the first three material exhibited equally good biocompatibility whereas IRM showed cytotoxicity (Figure 2).¹⁷ BioAggregate also increased the alkaline phosphatase activity, promote mineralization and enhance the expression of osteogenic/odontogenic markers (ALP, osteopontin, osteocalcin, dentin sialophosphoprotein and dentinal matrix protein-1).^{17,18} Collectively, the biocompatibility, odontogenic potentials, and inflammatory response of BioAggregate and MTA are equal.^{17,18,19}

iRoot SP

iRoot SP is another bioceramics material similar to MTA, it composed mainly by calcium silicates. iRoot SP are injectable, biocompatible, hydrophilic, radiopaque and insoluble and indicated for root canal sealers. In the presence of water, this material can generate calcium silicate hydrates and have highly alkaline pH which provide a detrimental environment for bacterial growth. MTA and iRoot SP also induced human Tooth Germ Stem Cells (hTGSCs) to differentiate into odontoblast like cells, while calxiym hydroxide (Dycal) caused cytotoxicity.²⁰ However according to the the same study, MTA provide more inductive potentiall and hard generate more hard tissuer deposition than iRoot SP.

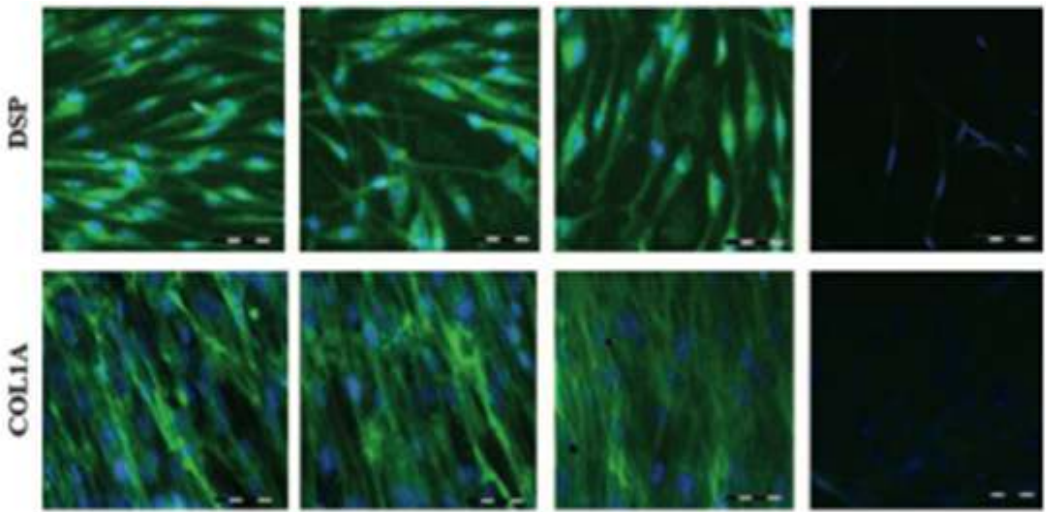


Figure 3. Immunocytochemistry staining of (a) MTA and odontogenic medium-treated cells, (b) iRoot SP and odontogenic med- ium-treated cells, (c) odontogenic differentiation medium-treated cells (PC) and (d) undifferentiated hTGSCs (NC) with DSP and COL1A antibodies. Scale bar: 100 Im.²⁰

CONCLUSION

The trend of biocompatible endodontics material has shifted from bioinert to bioactive and biodegradable materials in which the propose materials not only restore the broke part but also to stimulate the body itself to regenerate and fulfill acceptable physical and mechanical properties.

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Review on bioceramic nanofiber using electrospinning method for dental application

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ABSTRACT

Electrospinning method has been widely explored as a useful method for making fibers network. Electrospinning can produce nano size fiber from various materials and provide opportunities for application in the various fields, especially in dentistry. Furthermore, this technique has been also extended to fabricate nanofibers made of bioceramics and composite materials. Bioceramics which are brittle material had been used as a fiber in combination with a polymer to improve properties of that material. The objective of this review is about the fabrication of bioceramic nanofibers with various compositions and properties by electrospinning process in the field of dentistry. Although some articles had covered about nanofiber applications in dentistry, however, this review not only will explore particularly bioceramic nanofiber that recently research but also inform the potential of the material properties which used in dentistry.

Keywords: *Electrospinning, Nanofibers, Bioceramic*

INTRODUCTION

Bioceramics are ceramic materials which are employed to repair and reconstruction of disease and damage part of the body and produced in a variety of forms and phase. Bioceramics have several advantages such as bioinert, bioresorbable and bioactive based on the properties of remaining unchanged, dissolving or actively taking part in a physiological process. Calcium phosphates, silica glass, zirconia, alumina, titania, and pyrolytic carbons were classified as bioceramics materials^{1,2,3}.

Nowadays ceramics nanostructured are much more attractive to study then bulk counterparts because nano size have been proven to have improved properties and characteristic thus allowing for opportunities in various applications^{4,5}.

Electrospinning constitute a unique technique that uses electrostatic forces to produce fine fibers. Interestingly, electrospinning can easily fabricate one-dimensional nanostructures such as nanofibers with diameters, compositions, and morphologies could be controlled^{5,6}. Meanwhile, producing bioceramic nanofiber by electrospinning technique offers challenges to the process and control of the orientation⁷.

Electrospinning is relatively inexpensive technique that able to produce nanofibers of polymers, composites, semiconductors and ceramics. The most common electrospun material is polymer but the ceramic fiber have also been electrospun with or without the addition of polymers^{8,9}. Ceramic nanofiber produced by electrospinning nanoparticle along polymer followed by calcination at higher temperatures to remove polymer residues also reported⁷.

Basic equipments for electrospinning consist of high-voltage power supply, aluminium foil as collector, syringe pump and metallic needle/spinneret. Beginning with load the solution into the syringe, viscous solution will be held in the end of syringe because its surface tension. Once high electrostatic voltage is imposed than exceeds a critical value, the electrostatic force overcome the solution surface tension then distort into conical shape, well-known Taylor cone. Latter, a jet will be formed then undergoes a whipping motion due to bending instability than quickly transformed into a solid fiber as a result of solvent evaporation. Eventually, the fiber will deposited on collector^{5,10,11}.

Structure and properties of nanofiber resulted from electrospinning are influenced by applied voltage, spinneret-collector distance, polymer flow rate, spinning environment, solution concentration, solution conductivity and volatility of solvent⁶. The challenging to produce bioceramics nanofiber started from preparation of a suitable solution and controlling dispersion of the nanoparticle ceramic in the solution to achieved low acceptably viscosity before electrospinning process⁹.

DISCUSSION

Bioceramic nanofiber properties and application in dentistry

Recently, materials with one-dimensional nanoscale have attracted the attention of researchers due to roles of dimensionality and size that enable development an optical, electrical, and mechanical properties and also have sophisticated applications¹². The advantages of nanofiber compared regular and bulk fiber are mechanical and thermal properties that marked differences while its biological properties for medical application are largely determined by the materials' properties itself and nature^{6,7}.

In dentistry, nanofiber have been potential and progressed for many applications e.c regeneration of pulp dentin complex, guided tissue regeneration for periodontium, caries prevention, modification of resin composite, implant surface modification, cartilage regeneration, drug delivery and repair wound and oral mucosa. Most of them use polymer as main material electrospinning¹³. A brief discussion about bioceramic material on some of the applications in dentistry include the properties of the material itself will be given in the following section.

Calcium phosphate

Calcium phosphate classified into α -tricalcium phosphate, β -tricalcium phosphate, tetracalcium phosphate and hydroxyapatite (HAp) ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$). The most widely studied amongs them is hydroxyapatite because it is thermodynamically stable at physiological pH and main mineral constituent of teeth and bone thus suitable for hard tissue replacement implant. The first bioceramic nanofiber were obtained by Wu *et al*, they produced hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ (HAp) fibers by electrospinning precursor mixture of $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$, $(\text{C}_2\text{H}_5\text{O})_3\text{PO}$, and a polymer additive. Then they acquired pure HAp nanofiber after calcination at 600°C for 1 hour^{14,15}. Electrospinning HAp nanoparticle and Polyvinyl alcohol had been conducted by Kim. *et al*, they gained HAp rod-like nanofiber which have unique physiochemical feature and promising to possess dentin regenerative properties¹⁶. Further, composite HAp/Polycaprolactone/poly (lactic acid) nanofiber had been prepared for material scaffold. It showed significantly higher cell proliferation of osteoblast-like cells. It concludes that this composite bioceramic nanofiber could enhance bone regeneration therefore it shows a tremendous prospect as scaffold for bone tissue engineering¹⁷. Moreover, Titanium dental implants coated by poly(lactic-co-glycolic acid) (PLGA) /collagen fiber/hydroxyapatite nanofibers had been conducted and revealed much enhanced the adhesion of mesenchymal stem cells. It leads to increase the process of osseointegration for the dental implant treatment¹⁸. On the other hand, Jose *et al*. tried to improve the mechanical properties of composite PLGA/nano-HAp nanofiber for scaffolds application¹⁹. However, HAp positively influences adhesion and proliferation of osteoblast but the mechanical properties of amorphous HAp have been reported to be unsuitable for load-bearing applications thus it is commonly combined with natural polymer^{20,21}.

Silica glass nanofiber

Silica amorphous phases /glass is the most usually used inorganic fiber for reinforcement of dental composite. It has index refraction that greatly close to the dental resin, equipping the composite with semitransparent surface. Silica glass nanofiber with diameter of about 400 nm is much excelled than traditional glass fiber in tension and impact test. It is also raise the tensile strength, young's modulus, and work of fracture by 12%, 33%, and 52% respectively in comparison with epoxy resin^{22,23}. Meanwhile, Gao *et al*. exhibited improvement flexural strength and modulus as much as 44% and 29 % respectively while substitutions of traditional glass filler²⁴.

Silica glass that incorporated in a group of surface reactive biocompatible ceramic is named bioactive glass. It is developed at very first time by Larry Hench and colleagues at the University of Florida in the late 1960s²⁵. The first electrospinning of bioactive glass is reported by Kim *et al* with variable diameter using a sol-gel precursor of the composition $70\text{SiO}_2 \cdot 25\text{CaO} \cdot 5\text{P}_2\text{O}_5$. It showed excellent bioactivity and osteogenic potential *in vitro* by a bioactivity test and cellular response assay²⁶. Furthermore, scaffold bioactive glass nanofiber has been produced by mixing tetraethyl ortosilicate and calcium nitrate then undergo electrospinning process. Later, the nanofiber is calcinated to $600\text{--}700^\circ\text{C}$ to decomposed residual organic or inorganic group²⁷. While extensively investigated for

bone repair, bioactive glass is also researched for regeneration of soft tissue. It has shown the ability to promote angiogenesis thus optimistically could be applied to healing the soft tissue wounds²⁸. Composite nanofiber made of biopolymer blend polycaprolactone-gelatin and nanoparticle bioactive glass was investigated to study the effects of materials toward odontogenic differentiation on human dental pulp cells. The result concludes that the composite is considered to be promising scaffold for culture of human dental pulp cells and dental tissue engineering²⁹.

Zirconia

Zirconia fiber are an important category of advanced material for high strength reinforcement. There were many studies have been investigated for preparation of zirconia fiber using sol-gel spinning method and blowing spinning but only zirconia fiber 3-20 μm is diameter have been prepared. Zhang and Edirisinghe did electrospinning zirconia in instance, fiber from a suspension. The suspension containig zirconia particle 5-10 nm and combined PEO and PEG and calcinated at 1200 $^{\circ}\text{C}$ for 1 hour. Eventually, They gained zirconia fiber down to about 200nm with 150 nm size grain of zirconia were found ³⁰. Zirconia, which is studied as an alternative material alumina, it possessed good biocompatibility as ZrO_2 implant then shiwed direct bone apposition as well^{1,31}. On the other hand, Xu *et al* produced zirconia-yttria (ZY), zirconia-silika (ZS) and zirconia-yttria-silica (ZYS) nanofiber as reinforcing materials for dental composite².

Alumina

Alumina (Al_2O_3) is a bioinert ceramic with the characteristics of high abrasion resistance and chemical inertness. The biocompatibility of alumina has made it clinically reliable for more than 30 years³². Alumina nanofiber has been produced and shown increase osteoblast adhesion compared another form nanosphere alumina and promising as potensial material for dental application and bone tissue implant³³. Alumina fiber had been conducted using PVP and aluminium acetate as precursor. It resulted α -alumina crystallite phase which is the the strongest, stiffnest and the most stable then another phase. The diameter of the fiber are found in the range of 100-500 nm by TEM study. α -alumina crystalize phase had been confirmed at 1000 $^{\circ}\text{C}$ by XRD analysis ^{34,35}. Moreover hao yu et al showed alumina nanofiber with diameter ranging 150-500 nm after calcining at 1200 $^{\circ}\text{C}$. Using TEM the resulting alumina fiber were confirmed to be α -alumina crystallite phase with crystallite size were approximately 10 nm ³⁶.

Titania

Lim *et al* had successfully produced Immobilized TiO_2 nanofiber by electrospinning of sol comprising PVP and TiP for implant application³⁷. Later, Li *et al*. reported the biocompatibility of BaTiO_3 to have enhanced effects on the bioactivity of the nano-titania ceramics, which made the osteoblasts proliferate faster on the nano-titania ceramics in cell culture experiments³⁸. Silica-doped titania ($\text{SiO}_2/\text{TiO}_2$) was later reported to be biocompatible

with potential implant applications³⁹. Antimicrobial activity of Zn-doped titania by Anna *et al* showed the lowest concentration of Zn-doped titania nanofiber solution inhibiting the growth of *S. aureus* and *E. coli*⁴⁰.

Carbon

Carbon exists in a variety of forms, including vitreous carbon and pyrolytic carbon. Intrinsic brittleness and low tensile strength limit its use in major load bearing applications. The key properties of pyrolytic carbon, such as biocompatibility, thrombo-resistant, good durability, wear resistance and strength, has made it applicable in the field of biomedical engineering⁴¹. Electrospun carbon nanotubes and nylon fibers have been successfully used to reinforce resin composites⁴².

CONCLUSION

There have been many researchs proved the application of nanotechnology could greatly improve the mechanical and biological properties of materials. Electrospinning method which can produce nano size fiber gained popularity nowadays and provide opportunities for application in various field especially in dentistry. Electrospinning is able to produce nanofiber from a various material, one of them is bioceramic. Bioceramic which have shown good biocompatibility with dental tissue were fabricated based on the need and application. Bioceramic nanofiber has been used to reinforce the dental composite restoration. The mechanism is when the restoration under external pressure, it is susceptible to undergo microcrack in the body of dental matrix. When the crack is coming, the gap between crack planes bearing load constantly until bioceramic nanofiber are broken completely. So, the crack expansion is inhibited by the bioceramic nanofiber. Bioceramic nanofiber which are promising material not only to restore or replace the damage of the hard tissue such as dentin, enamel and bone but also to heal wound of soft tissue like pulp and mucosal tissue in scaffold form. The mechanical response of scaffold bioceramic nanofiber is the key for repair of loaded bone. The scaffold should have mechanical properties approach the properties of the tissue to be replaced. Bioactive glass with compressive strength and elastic modulus which are comparable to human cortical bone, have potential application in regeneration of load bearing bone. The mechanical properties of nanofiber depend on type of material, the microstructure and the fabrication method.

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Microleakage in composite restoration due to the application of carbamide peroxide bleaching material with a concentration of 10%, 15% and 20%

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ABSTRACT

Introduction: Anterior teeth bleaching process aims to improve the aesthetics and patient confidence. Often the anterior teeth that will be bleached contained composite restorations. **Objective:** The purpose of this study was to determine the effect of carbamide peroxide bleaching materials applications with a concentration of 10%, 15% and 20% of the value of microleakage of composite restorations. **Material and Methods:** The study sample consisted of four test groups: control group, the group with the application of 10% carbamide peroxide (A), 15% (B), 20% (C). Samples are first maxillary premolar teeth that were prepared are circular with a diameter of 3 mm and a depth of 2.5 mm, then restored composite. The test group A, B and C applied carbamide peroxide 8 hours a day for 5 days and immersed in the liquid methylene blue. Then microleakage composite restorations tested using a digital microscope. **Results:** Value microleakage of composite restorations group A average of 80,12µm, group B average of 90,92µm, and group C average of 201,22µm. **Conclusions:** Application of materials carbamide peroxide bleaching with a concentration of 20% lead to microleakage greater than carbamide peroxide bleaching materials applications with a concentration of 15% or 10%.

Keywords : *bleaching, microleakage, carbamide peroxide*

INTRODUCTION

Teeth discoloration creates aesthetic problems that affect a person psychologically, especially on anterior teeth discoloration. The need for aesthetics drives someone to do bleaching on their teeth¹. Bleaching is a method or attempt to get the color of teeth brighter and closer to the original tooth color through a chemical process with the aim to restore the aesthetic factor^{2,3,4}. Bleaching can be done on a tooth that has discoloration due to pulp necrosis, developmental defects such as fluoriasis, due to consumption of tetracycline, discoloration iatrogenic such as root canal treatment and amalgam restoration⁵. Bleaching is not recommended on teeth with large caries, tooth restoration, and on teeth with pulp that is still wide, as well as patients who are allergic to bleaching ingredients⁶.

Bleaching is done internally and externally. Internal bleaching (intracoronal bleaching) is performed on non-vital teeth that already had root canal treatment done well. External bleaching (extracoronal bleaching) is performed on vital teeth discoloration. External bleaching is done with two techniques which are home bleaching technique and in-office bleaching. Home bleaching technique performed by the patient themselves but still monitored by the dentist. In-office bleaching technique is performed by dentists. Home bleaching technique typically uses carbamide peroxide with low concentration, while the in-office bleaching technique typically uses hydrogen peroxide with the concentration of 15% -50%. Carbamide peroxide that can be used as a teeth whitener for in-office bleaching method has to have a high concentration from 30% -50%⁷.

Anterior teeth that had been bleached often have composite restorations. Bleaching, other than to whiten teeth, also has side effects, such as; can cause the enamel surface roughness on teeth, increase sensitivity to temperature changes and also reduce or decrease the enamel roughness while on composite restorations can cause discoloration, increased roughness, hardness reduction in the composite and can decrease the strength of the connection between teeth and restorative materials^{2,8,9,10}.

To get the desired tooth color, tooth bleaching is the most often way done recently, because it is the simple way and is not invasive. The purpose of this study was to determine the effect of carbamide peroxide applications with the concentration of 10%, 15%, and 20% against microleakage composite restorations.

MATERIALS & METHODS

Samples were divided into 4 groups, each group consisting of three pieces of specimens. The control group, Group A was applied with bleaching material carbamide peroxide 10%, group B was applied with bleaching material carbamide peroxide 15%, and group C was also applied with bleaching materials carbamide peroxide 20%.

Each specimen in group A, B and C was applied with bleaching ingredients for 8 hours daily for 5 consecutive days. After the application of bleaching materials, each specimen was put in an incubator at the temperature of 37°C. After the application of bleaching materials

for 5 days in a row, all specimens and specimens from the control group were immersed in the metylen blue liquid 0.25% and placed in an incubator at 37°C for two days. Then the specimens were removed from the incubator, rinsed under running water and dried. Each specimen was then cut in a vertical direction from labial to palatal on the corona right in the middle of composite restorations using carborundum disc.

Specimens that have been cut are then observed using a digital microscope to see their metylen blue fluid penetration between the cavity wall and composite restorations. The microleakage composite restorations are measured from the furthest distance from penetration / seepage of metylen blue liquid on the specimen (size in milimicron). Data were analyzed statistically.

RESULTS & DISCUSSION

The test results of the microleakage composite restorations in the control group and three treatment groups that are applied with bleaching ingredient carbamide peroxide 10% (group A), 15% (group B) and 20% (group C) using a digital microscope can be seen in the table below.

Table 1. Microleakage Composite Restoration Value After The Application of Carbamide Peroxide

Groups	Microleakage Value (µm)			Total	Mean
	1	2	3		
Control	0	0	0	0	0
A	89,43	73,92	77,02	240,37	80,12
B	92,84	96,06	83,86	272,76	90,92
C	219,13	213,53	170,99	603,65	201,22

Statistically, the average value of the microleakage composite restorations in the treatment group and the control group had no significant differences. In the treatment group with the application of carbamide peroxide 10%, 15%, and 20% had a mean microleakage respectively as follows 80.12 µm; 90.92 µm and 201.22 µm, while the control group had a mean of 0 µm. From these results it can be seen that the use of carbamide peroxide with the concentration of 10%, 15%, and 20% as a bleaching agent on teeth caused a microleakage composite restorations.

Microleakage composite restorations is caused due to the degradation of the the connective force between the resin composite material with enamel and dentin by carbamide peroxide. This occurs because of the residual peroxides in the dentin and email that can inhibit the polymerization of the resin composite. In addition to microleakage, the application of bleaching materials can cause surface roughness and discoloration on composite restorations¹⁰. Some other studies that use hydrogen peroxide as a bleaching material and

carbamide peroxide at different concentrations, found that increasing the concentration of the bleaching material causes enhancement of microleakage on composite restorations and the roughness of the composite restorations surface^{9,12}.

Microleakage occurs on resin tag between teeth and bonding agent that is applied after etching. Adhesions that are formed after the application of bonding agent will be destroyed by bleaching ingredients that penetrate the resin tag. Microleakage that is produced from the application of bleaching materials is caused by a chemical process that can accelerate the hydrolysis degradation of composite restorative materials. The free radicals that are released will cut the carbon cyclic bond on resin matrix. This reaction will cause the matrix bond at the coupling agent weakened and degraded. The hydrogen ions will sever the bond between the coupling agent and the filler particles. The severing of the bonds causes the filler particles apart from the matrix composites. The release of the filler particles materials from the matrix will form large holes on the surface of the composite restorations, which can cause surface roughness and micro leakage in the composite restorations^{2,11}.

Carbamide peroxide is a hydrogen peroxide dissolved in urea crystals and a weaker oxidizer but more stable than hydrogen peroxide. This material can decompose to hydrogen peroxide which can be split into water and oxygen, while the urea decomposes to ammonia and carbon dioxide. 10% carbamide peroxide is equal to 3.6% hydrogen peroxide. Teeth whitening using carbamide peroxide is made under acidic conditions to extend its working time^{13,14}. The degradation of H_2O_2 , and also carbamide peroxide would produce free radicals, which will cut the carbon cyclic bond on matrix composites. This reaction will cause the matrix composites bond weakened and degraded. The weakening of this matrix bond will cause the matrix particles and filler particles apart, causing the roughness of the composite surface, and the roughness of these surfaces will cause the micro leakage on composite restorations. The roughness of the composite restorations surface may further cause plaque retention, discoloration on the surface of restorative materials and gingival irritation. Some studies shows an increased attachment of *Streptococcus mutans* and *Streptococcus sobrius* on teeth surfaces after the application of 10% carbamide peroxide and 10% hydrogen peroxide².

Microleakage test is performed by observing the penetration of metylen blue on the border between the composite restoration material and tooth cavity wall using a digital microscope. The use of digital microscopes is aimed to ease the authors to calculate the amount of microleakage caused by the use of carbamide peroxide 10%, 15% and 20%. Results of the research that were obtained, when compared to other studies that use hydrogen peroxide 10%, 30% and 90%, it can be concluded that the enhancement of the bleaching materials concentration effect on the enhancement in the microleakage composite restorations. The higher the concentration of hydrogen peroxide, the microleakage that happens also increases. Other studies say that the application of teeth bleaching materials also increases the surface roughness of composite restorations that will reduce the holding capacity of the composite restorative materials. The application of carbamide peroxide 10% as a bleaching agent can cause micro leakage on composite restorations. This supports the

results of the authors research that the application of carbamide peroxide 10% has started to cause microleakage composite restorations. While the application of 15% carbamide peroxide may increase the microleakage on dentinal margins of composite restorations, this research also supports that the application of carbamide 15% gives greater effect to the microleakage restoration compared with the application of carbamide 10% and control group¹².

The use of carbamide peroxide that is greater than or equal to 15% is not recommended because it causes greater microleakage restoration, because the use of 10% carbamide peroxide can already cause microleakage restoration. If carbamide peroxide is still used as the bleaching material, the concentration of carbamide peroxide that can be tolerated is less than 10% in order to avoid larger microleakage restoration. This is supported by the ADA (American Dental Association) which stated that the product that is permitted as a safe home bleaching material and influential for using it outside the dental clinic is less than 10% concentration. American Dental Association (ADA) has produced a guide for teeth whitening ingredients. The definition of safe by ADA is not only clinically safe, but also safe in any biological terms. Home bleaching technique is often done because of the procedure that is simple, and it uses low concentrations of materials, safe, economical, optimum results, and can motivate patients to better maintain the health of their teeth, and less time to visit the dentist 15. In Canada, carbamide peroxide or hydrogen peroxide may be used as a bleaching agent with limited concentration, 10% and 3%, and must be considered to use no more than 14 days, unless it's under the monitoring of the dentist. When the teeth whitening treatment needs to be extended, the dentist should be monitored every 2 weeks. There is an opinion stating that the side effects are minimal, for the use of tooth whitening at home for up to 6 months. Other research that has compared the use of carbamide peroxide bleaching agent at a concentration of 10% and 15%, obtain a result that states: the effect of the bleaching using carbamide peroxide 15% is faster, but the results after 6 weeks showed no difference¹⁵.

CONCLUSION

In this research, the use of carbamide peroxide as a bleaching material with the concentration of 10%, 15%, and 20% led to the micro leakage between teeth with composite restorations. Increasing concentrations of carbamide peroxide as bleaching materials led to also increase the value of micro leakage between teeth with composite restorations. It is advised not to do bleaching using carbamide peroxide with a concentration of $\geq 10\%$ on teeth that have been restored with composite.

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Reconstruction procedure using elastomer putty materials, what type to choose?

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ABSTRACT

In order to reconstruct tooth morphology loss, an accurate impression is very helpful. Most dentists are using silicones as dental putty impression materials, which are available in two different types of polymerization. Unfortunately, there are quite a lot of choices which sometimes make it confusing to decide what materials that is suitable for their uses. The objective of this study is to provide an easy understanding of dental putty materials manipulations and usages based on their condensation or addition reactions. Condensation putty materials is the first type of silicone that is used in dentistry, but the reaction will produce a by-product. So, an addition putty material was developed and it evolved better properties than condensation silicones. Their polymerization shrinkage reduced with high filler loading, which makes this silicone type has good dimensional stability. Putty materials as index matrices are quite easy at handling since they are able to manipulate through kneading. Meanwhile, if related with their precision restorative application, light body can be added to get more accurate impressions. Therefore, it can be concluded that elastomer putty, condensation and addition silicones, materials have certain unique characteristics which should be carefully chose and considered on its applications to duplicate the oral condition.

Keywords:*Elastomer putty materials, Condensation and addition silicones, Manipulation and usage/application*

INTRODUCTION

Accurate impressions to duplicate tooth and oral conditions are important and very helpful steps in dentistry to reconstruct morphology structure ^{1,2} In order to produce an accurate impression, elastomeric materials are considered to be a choice since they have been widely used across the globe for the last 50 years and are gold standard among dental impression materials ³ Elastomeric material is a group of synthetic rubber impression materials, which were developed during World War II due to the difficulty to obtain natural rubber. These materials should be fluid enough to seep around the oral tissues and viscous enough to remain contained in the tray. They should set into a rubbery solid within a reasonable amount of time and should not distort or tear when removed from the mouth. Dental elastomers formed of molecules (polymers) that are joined to each other by crosslinking in a process known as polymerization, which can be categorized as three kinds based on their polymer compositions: polysulfide, polyether and silicones ^{1,2,4,5}.

The viscosity of impression materials is corresponding with dimensional stability of the impression material that could have an influence on the accuracy of the final restoration ⁶. The viscosity of dental impression materials can be classified based on ISO 4823; 2015 that explained about the consistencies that determined immediately after completion of mixing, which are: type 0 for very heavy consistency (putty), type 1 for heavy-bodied consistency, type 2 for medium- or regular-bodied consistency, type 3 for light-bodied consistency ^{7,8}. Viscosity of impression materials is determined by the amount of particles such as inorganic fillers. High viscosity materials (putty consistency) present greater amount of inorganic filler than the commercially corresponding materials with low viscosity (medium or light bodied consistency) of dental impression materials. Putty consistency is available in all classes of elastomeric impression materials, but most dentists are using silicones as dental putty impression materials. Silicones are available in two different types of polymerization, which are condensation and addition silicones, depending on the reaction that produces polymerization ^{1,5}.

The consistency information is very useful, since knowing dental impression materials not only the consistency as physical properties but also the advantages of its uses can be a prerequisite for adequate practical application and contributes to the success of therapy.

There are many options of material of which sometimes make it confusing to decide what materials that is suitable for their uses. Therefore, the objective of this study is to provide an easy understanding of dental putty materials manipulations and usages based on their condensation or addition reactions.

DISCUSSION

Impression materials are used extensively in restorative and prosthodontics dentistry for construction of casting, indirect esthetic restorations, bridges, implant restorations, partial denture frameworks, and complete dentures ⁹]. Orofacial imprint using dental impression

material is the first step during fabrication of indirect restoration. The dimensional stability of the impression material influences the accuracy of the final restoration ⁵

Silicone impression materials are considered to be the best in reproducing surface details. The International Organization for Standardization (ISO) states that the elastomeric impression materials must reproduce lines of 75, 50 and 20µm-width according to the classification determined by the international standard [8]. The size and amount of particles could be related to silicone rubber accuracy. Silicone materials are classified as condensation or addition silicones, depending on the reaction that produces polymerization. ^{1,4,5,10}

Condensation-cured materials are also known as polysiloxanes of alternating oxygen and silicon atoms. They are all two-component systems which consist of a base and a catalyst paste. The base contains moderately high molecular weight polymer (dimethylsiloxane) with terminal hydroxyl groups and inorganic particles, and also an orthosilicate for crosslinking. The catalyst paste contains alkylsilicate and a metal such as tin-based activator. ^{1,5,9} A thickening agent is also used when making catalyst pastes. Setting time is determined by the rate of crosslinking between the terminal hydroxyl groups and the alkyl which produces alcohol as a byproduct. As alcohol is produced in the reaction, the set material distorts as it is released. ^{1,4,11} Manipulation of condensation silicone is the same as for polysulfides, except that the silicone material may be supplied as a base paste plus a liquid catalyst. When it is supplied in this form, one drop per inch of extruded base paste is usually recommended. The setting time (6 to 8 minutes) is less than that of the polysulfides, which save some chair time. Electroplating is an option. Because of the high polymerization shrinkage, the cast or die must be poured as soon as possible. Higher temperature and humidity shorten the setting time ¹¹

Addition-cured silicones (polyvinylsiloxanes; PVS) or vinyl polysiloxanes are also two-component materials and the setting occurs by crosslinking of vinyl groups in the base material with a hydride group in the catalyst paste via a platinum catalyst. There is no reaction by-products ^{1,4} Inorganic particles are present in both pastes normally in the form of amorphous silica to add bulk and improve the properties of the paste ^{2,12}. Manipulation of addition silicones is as easy to handle as condensation silicones. Finely-divided palladium is added to some products to bond with hydrogen and prevent bubbles on forming on the stone die surface. Without a hydrogen absorber longer time (generally an hour) should pass before pouring dies. The impression should stand overnight before epoxy dies are poured. Some products provide automatic mixers that provide quick and bubble-free mixture. Electroplating with both copper and silver is a common practice to the addition silicones. There are several benefits using method namely: (1) highly accurate, (2) high dimensional stability, (3) excellent recovery from deformation on removal, (4) good viscosity so that it stays in the tray of reclined patients, (5) stain-free, (6) available in pleasant colors and scents, (7) may be used with either stock or custom tray, (8) can be poured 1 week after taking the impression and (9) multiple pours are possible. On the other hand, this method is not without drawbacks. Addition silicone is (1) expensive, almost twice the cost of polysulfides, (2) more rigid than condensation silicone thus more difficult to remove around

undercuts, (3) has moderate tear strength that increase the risk in removal from gingival retraction areas and (4) high tendency to rebound ^{9,13}

The consistency of the materials had a significant influence on elastic recovery, permanent deformation, strain in compression, tear energy, tensile strength, thermal expansion, and dimensional stability. The light bodied materials had lower elastic recovery than the heavy bodies' materials. Higher strain in compression values indicates more flexibility. In the present study, the putty or heavy bodied materials were stiffer than the light bodied materials. Furthermore, heavy bodied impression materials have been shown to have higher tear resistance than those with light body consistency. The tensile strength has been found to be higher for the heavy bodied materials than for the light bodied ones. The higher the viscosity of the impression material, the lower the thermal expansion coefficient will be. Large dimensional changes were observed for light consistency silicones compared to those with putty consistency, illustrating that the proportion of particles does modify the accuracy of the materials ^{2,5,14,15}

Table 1. Consideration for clinical use of Condensation and Addition Silicone ^{4,10-12}

Properties	Condensation Silicone			Addition Silicone
Dimensional changes	Yes, because setting or by loss of alcohol	continued	slow	Dimensionally stable impression
By-products	Yes, weight contraction of material	alcohol; loss followed the	measurable by impression	Insignificant
Hydrophobe	Hydrophobic, require dry field and difficult to pour in stone			Hydrophobic due to polymerized silicone rubber consists of siloxane bonds surrounded by aliphatic hydrocarbons
Casting time	<1 hour			>1 hour and multiple casting is possible

Condensation silicones are clean and remain favourable materials for the patient. They are highly elastic, and the setting time can be controlled with the amount of accelerator. The use of putty wash method improves accuracy and eliminates the need for a custom tray. However, it is tend to be less accurate than addition silicones ¹⁶ Immediate casting may have a negative impact on viscoelastic recovery of the impression material and on the accuracy of the working cast.

Dentists can use different techniques that employ a variety of different materials and viscosities to take impressions, but the final choice as to technique should center on which

is least problematic and most likely to produce consistent results. Traditionally, a heavy-body tray material is utilized with a lighter body wash material that is syringed around the tooth just before the tray is seated. From 1980s several putty/wash techniques have been introduced, but since the putty does not flow well, the one step technique may results in voids or a pulled appearance of the wash material where wash and putty did not flow and join together completely. With the two step technique, because the putty is set before the wash is added, any areas where the putty shows through the wash material potentially have distortion ^{9,17}

Basic putty/wash techniques can be categorized into 2 categories, which are: (1) a single-step procedure where the putty is loaded into the tray and inserted immediately after syringing a wash material around the prepared tooth or teeth, and (2) a 2-step procedure where the putty is used to take an impression before starting the preparation, allowed to set, and removed from the mouth. After tooth preparation is complete, the tooth has a wash material syringed over it, and the initial tray and putty impression are reinserted over the wash. Variations of this include routing out part of the putty impression around the prepared tooth to produce space for the wash, and relining the entire impression with wash material ^{9,17}

Statistically, laboratories see more problems with 2-step impressions than any other technique. This is a result of the difficulty in repositioning the impression in the exact same position without creating a “step” between the original putty impression and the detailed wash impression, so it still need chairside adjustment. The extremely stiff putty material, when seated in the mouth, forces the much thinner wash material away from the prepared tooth, and the resultant impression is captured in more putty than wash, but this is corroborates with ADA/ANSI specifications require that a wash material capture details to 20 µm, while tray materials are required to capture only 70 µm of detail ^{17,18}

Putty also has many uses at chairside and in the laboratory. Putty is not only used to capture an imprint of a tooth before it is prepared for a crown, but also as a shell for class IV restoration ^{9,19,20}. Even back in 1973 silicone materials have been used for complete denture impressions: a high viscosity material for border molding and a low viscosity material for secondary impression. Recently in 2003, the use of vinyl polysiloxane impression material to border-mold custom impression trays and bite registration materials ^{9,21}. Massad, in 2005, proposed the use of polyvinylsiloxanes for improving the stability of maxillary dentures ²²]. The materials available for impression tray construction are as varied as are the materials for border molding and the final impression ^{6,13}

Selection of material is left to the choice of the dentist based on their personal preference and experience. Selection of material is not only the important thing, but the concepts and principles understanding in impression making also need to be considered on its applications to duplicate the oral condition.

CONCLUSION

It can be concluded that elastomer putty, condensation and addition silicones, materials

have certain unique characteristics which should be carefully chose and considered on its applications to duplicate the oral condition.

ACKNOWLEDGEMENTS

Ministry of Research, Technology, and Higher Education for the Developmental Research Capacity Funding through Research and Community Service Directory, University of Padjadjaran.

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Effect of baggase fiber (*saccharum officinarum* l) on flexural strength of composite resin

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ABSTRACT

INTRODUCTION: Composite resin is a dental restorative material which can be used for indirect restoration. However, the use of composite resin is limited due to its inferior flexural strength. One of attempts to overcome the problem is reinforcing composite resin with synthetic fiber, but it needs high cost. In contrast, natural fibers like bagasse fiber not only have ability to withstand the forces, but also have low cost. **Objective** The aim of this study was to evaluate the effect of bagasse fibers on flexural strength of composite resin. **Materials and methods:** Specimens consisted of two groups: group 1 (control) were prepared without any fiber reinforcement (n=16) and group 2 was prepared with reinforcement of bagasse fibers on composite resin (n=16). All groups were subjected to flexural strength test using a universal testing machine. **Result:** Result of this study showed that mean of flexural strength of group 2 ($99,155 \pm 4,226$ MPa) was higher than group 1 ($93,657 \pm 6,449$ MPa). Statistical analysis with unpaired t-test showed a significant difference between groups. **Conclusion:** The conclusion of this study was addition of bagasse fibers could improve the flexural strength of composite resin.

Keywords: *composite resin, flexural strength, bagasse fiber*

INTRODUCTION

Indirect restorations such as inlays, onlays and crowns indicated for large cavities in teeth are usually made of metal, porcelain, and metal-porcelain. Metal restorations have good strength but can corrode, causing discoloration of the gingiva and induce allergic reactions. Ceramic restorations is aesthetic, but they can cause abrasion of the antagonist tooth and need high cost; whereas the porcelain fused to metal restoration, boundary between metal and ceramic often seen.¹

Fabrication of metal, porcelain and porcelain fused to metal restorations requires a long time because it must go through a laboratory process. Composite resin can be used for manufacture of indirect composite resin restorations which can be completed in one visit. This material is aesthetic and easy to manipulate, but it is a brittle material and has a low flexural strength.^{2,3} Indirect restorations in teeth with large cavities will receive a high flexural stress, so that it is necessary to improve properties of composite resins in order to be able to withstand the load. Previous study proved the addition of fiber can improve the flexural strength of composite resin.⁴

Fiber-reinforced composite is a popular technique to improve the mechanical properties of the composite resin, by adding a thin and smooth fiber layer to prevent cracks and reduce the occurrence of fracture.^{5,6} The fibers typically used are synthetic fibers, but they need high cost.⁷ To overcome this problem, the use of natural fibers can be an option, because they need lower cost when compared to synthetic fibers.

One of the natural fibers that are found in Indonesia is a bagasse fiber (*Saccharum officinarum* L). Fibers from the remains of the processing of sugar cane into sugar, proved able to increase the modulus and flexural strength of the biodegradable composite.⁸ The fibers can also be obtained from the remains of sugarcane juice beverage processing, but its use to reinforce the composite resin in the field of dentistry has not been investigated. The purpose of this study was to evaluate the effect of addition of bagasse fiber on flexural strength of composite resin.

MATERIALS AND METHODS

An experimental study with posttest only control group design was performed to evaluate the flexural strength of the composite resin. The total specimens prepared in this study were 32 pieces of composite resin specimens measuring 25mmx2mm x2mm and divided into two groups, namely composite resin without the bagasse fiber and composite resin with addition of the bagasse fiber. The materials used in this study include bagasse fiber, resin composite (Z350 XT, 3M), bonding agent (Adper Single Bond 2, 3M), aquadest, NaOH and CH₃COOH solutions. A metal mold measuring 25mmx2mm x2mm was prepared for the manufacture of composite resin specimens.

Baggase Fiber Preparation

Sugarcane was milled to separate water and fibers. Baggase was immersed for one day and then washed to remove the sweetness of the fiber. Bagasse were combed using a wire brush to remove the cork attached to the fiber, then dried for 7 days to obtain completely dry baggase. The dry baggase was combed back, and then the fiber in the stem of the cane was taken one by one manually using tweezers to get the baggase fiber yarns.⁹ The baggase fibers then soaked in a solution of NaOH 1% for 2 hours. The fibers were washed several times with water and then soaked in a solution of CH₃COOH, then the fibers were washed again with water and dried using a microwave at 70 ° C for 72 hours.¹⁰

Specimen Preparation

A commercial composite resin with a thickness of 0.5 mm was placed on the mold, then irradiated for 20 seconds.⁴ For groups without the addition of fiber, composite resin was added until the mold is fully filled and then a celluloid matrix and glass slide were placed over it and then irradiated for 20 seconds.^{4,11} Composite resin was removed from the mold and the resin excess was removed using a fine finishing bur.

For a group with the addition of fiber, after a 0.5 mm thick layer of composite resins were irradiated for 20 seconds, bagasse fibers as much as 7 strands with a length of 25 mm and has been soaked with a bonding agent for 15 minutes, arranged horizontally over the composite resin in the mold and then irradiated for 20 seconds. Composite resin is added until the mold is fully filled and then a celluloid matrix and glass slide were placed over it and then irradiated for 20 seconds.^{4,11} Composite resin was removed from the mold and the resin excess was removed using a fine finishing bur. Composite resin was soaked in distilled water for 24 hours.

Measurement of Flexural Strength

Flexural strength was measured using a universal testing machine with a cross head speed of 1 mm/min. Load which appears on the monitor is used to get the value of flexural strength by the formula ¹:

$$\sigma = \frac{3pl}{2bd^2}$$

σ : Flexural strength

b : Width

p : Load

d : Thickness

l : Length

After measurement of the flexural strength, the data were analyzed statistically using unpaired t-test.

$$\sigma = \frac{3pl}{2bd^2}$$

σ : Flexural strength

b : Width

p : Load

d : Thickness

l : Length

RESULTS

Measurement of the flexural strength of composite resin without the addition of bagasse fiber and with the addition of bagasse fiber was performed using a Universal Testing Machine. The mean of flexural strength of each group can be seen in Figure 1.

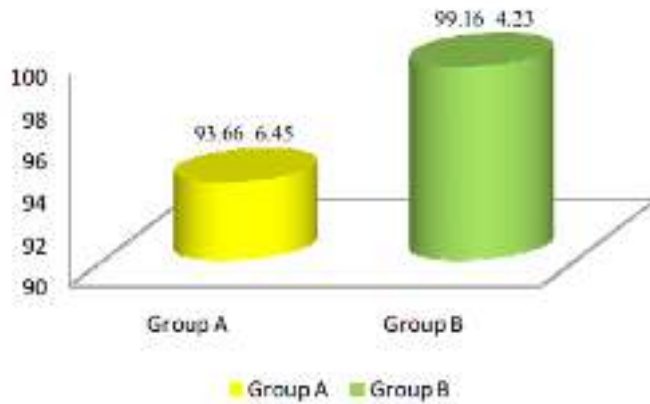


Figure 1. Flexural strength (MPa) of the composite resin without the addition of bagasse fiber (Group A) and composite resin with the addition of bagasse fiber (Group B)

Figure 1 shows the mean of flexural strength of group B (99.155 ± 4.226 MPa) was higher than group A (93.657 ± 6.449 MPa). The unpaired t-test result showed that there was a significant difference ($p < 0.05$) between the two groups. This means that the addition of bagasse fiber affect the flexural strength of composite resin.

DISCUSSION

The results of this study indicate that the flexural strength of the composite resin with the addition of bagasse fiber increased significantly compared to the composite resin

without the addition of bagasse fiber. This is caused by the better stresses distribution between the composite resin and fiber. The stresses received by the composite resin will be forwarded to the fiber and the fiber will distribute the stresses so that the bottom of the fiber will receive less stresses.¹² If the composite resin accept the stresses that exceeds their ability, then the material will crack.¹ In fiber reinforced composite, cracks will be stopped and deflected by fiber to the interfacial of fiber and composite resin. When the specimen receive flexural stress, the bottom of the specimen will be exposed to tensile stress, while the top of the specimen will be exposed to compressive stress.¹ In this study, the bagasse fibers were placed 0.5 mm from the bottom of the specimen and that area likely to receive a tensile stress. Based on Ellakwa¹⁴ study, the flexural strength of composite resin was best obtained when the fiber was placed on the side that receives the tensile stress. The fiber placed away from that side and closer towards the surface of the specimen that receives the compressive stress may decrease the flexural strength. This may be attributed to the nature of the composite resin which is a brittle material which tend to be susceptible to the tensile stress.¹

The mechanical properties of the fiber reinforced composite were influenced by the direction of the fiber arrangement, the amount of fiber, as well as the adhesion between the fiber and composite resin.² In this study, the fiber was arranged in one direction, that is horizontal. The arrangement of fiber in one direction will increase the flexural strength of the fiber reinforced composite in comparison with perpendicular direction.¹⁵ This is in accordance with Krenchel factor which is a value of reinforcement efficiency of fiber-reinforced composite. In Krenchel factors, the arrangement in one direction has a value of 1, perpendicular 0.5 and random 0.2. The fiber direction with the greatest Krenchel value demonstrates the best reinforcement effectiveness.² Based on Mosharraf¹⁶ study, the flexural strength would be better if the fibers were arranged in a horizontal direction than arranged in a vertical direction. It is thought to relate to the direction of tensile stress propagation that is horizontal.²

The number of fibers used in this study as many as 7 strands. Determination of the amount of fiber was based on trial in full filling of the specimen. Some studies of fiber-reinforced composite used different methods in determining the amount of fiber in a single specimen. Ellakwa¹⁵ in his study used synthetic fibers with uniform fiber weight in one specimen (0,01mg). Mosharraf¹⁶ homogenized glass fiber length in accordance with the specimen size (25mm). In this study, the number and length of the fiber placed in the specimen is the same, but the weight and fiber diameter is not homogenous. Bagasse fiber diameter varies between the tip and base as well as between fibers, allowing the persistence of the gap between the fibers as they are arranged in a specimen. This may affect the ability of the fiber to withstand the stresses.

A good adhesion between fiber and composite resin fiber was obtained by soaking in alkaline solution during fiber preparation, and fiber wetting before placement in specimen. Soaking the fiber in NaOH solution will remove wax, oil, and the cellulose binder material namely lignin and hemicellulose, so that the amount of cellulose that is on the surface will

increase.¹⁷ The reaction that occurs between the bagasse fibers and NaOH solution is as follows¹⁰:



The hydroxy group of NaOH will react with H atoms of the structure of the binder materials to form H₂O. This reaction results in damage to the structure of cellulose binder materials so that cellulose will have a structure like threads. This expands the surface area thereby increasing the interfacial adhesion between the fiber and composite resin.¹⁰ NaOH affects only the binder material but not against selulosa.¹⁸

Wetting of the fiber in this study uses a bonding agent. Bonding agent is a material that can attach two different substances. Bonding agent used in this study was the 5th generation. It consists of the adhesive and primer has been incorporated in a single bottle. The hydrophilic primer forms a bond with the moist tooth surface, while the hydrophobic adhesive forms a bond with the composite resin.³ In this study, the use of bonding agent is expected to bridge the gap between bagasse fiber and composite resin. Hydrophobic side of the bonding agent will bind to the composite resin, while the hydrophilic side of the bonding agent thought to bind to the cellulose of bagasse fiber which is hydrophilic because it contains a hydroxy group.

Soaking bagasse in NaOH solution during the manufacturing process as well as bagasse fiber wetting using a bonding agent before the fiber was placed on the composite resin allows the formation of good adhesion between the fibers and composite resin. It is predicted that the good adhesion results in stresses received composite resin will be distributed along the interfacial fiber and composite resin, so that resistance to flexural stress can be increased.

CONCLUSION

Within the limitations of this study, it was concluded that the addition of bagasse fiber can improve the flexural strength of the composite resin.

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The knowledge of bpjs health among bandung informal sector workers as bpjs health card owner

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ABSTRACT

INTRODUCTION: Social Security Agency of Health (BPJS Health) is a public legal council formed to organize the National Health Insurance program (JKN). All of Indonesian citizen have the same opportunity to be BPJS participant, including Bandung informal sector workers. The purpose of this research was to find out the knowledge of BPJS Health among Bandung informal sector workers as BPJS Health card owner. **Objective:** This research was a descriptive research with survey method. **Materials and methods:** The research was conducted by direct observation and questionnaire distribution to the informal sector workers as BPJS Health card owner. **Result:** The research showed that the knowledge of BPJS Health of 18.6% respondents is good, 41.4% respondents is moderate, and 40% respondents is bad. **Conclusion:** It can be concluded that the knowledge of BPJS Health among Bandung informal sector workers as BPJS Health card owner is in the moderate category. There are some socialization related things that still need to be repaired or upgraded so that Bandung informal sector workers can use their BPJS Health card to receive health services guaranteed by BPJS Health better and maximally.

Keywords : *BPJS Health, JKN, Informal sector worker*

INTRODUCTION

Bandung, the capital of West Java Province, is a city where many kinds of activities are centered including economy activities. It attracts migrants from all corners of West Java and other areas so that urbanization level increase.¹ The migrants' intentions are to get a better job and income than in their previous ones.

Employment is divided into formal sector and informal sector. Adequate level of education is needed to work in the formal sector such as professionals, technicians, etc.² Availability of formal sector employment is limited due to the increasing population growth and labor force in the urbanization destination area that is not even be in accordance with the city's ability to absorb formal sector workers.¹

According to the International Labour Organization (ILO), Informal sector is an employment sector that has some characteristics, among others: easy to enter, rely on local resources, self-owned business, operates on a small scale, labor-intensive, adaptive technology, skills needed are outside the formal education system, not exposed by direct regulation, and competitive market. Informal sector worker examples are domestic industry, pedicab drivers, farm workers, day laborers, street vendors, fishermen, craftsmen, etc.¹ As a migrants with previous low income sometimes can not meet the required skills and education level to work in the formal sector. It makes the informal sector is often selected. Approximately 30-70% of the urban labor force population works in the informal sector are migrants.¹

Informal sector workers health previously is not guaranteed by the government. They are unable to use the available health services maximally because of their limited ability to pay so that their health degrees are low. The government then launched Law No. 40 of 2004 about National Social Security System (SJSN). Then National Health Insurance (*Jaminan Kesehatan Nasional* - JKN) was launched to improve public health degrees managed by Social Security Agency of Health, BPJS Health (*Badan Penyelenggara Jaminan Sosial - Kesehatan*).³

By January 1st 2014, BPJS Health operation has started.⁴ BPJS Health has a lot of advantages. All citizens of Indonesia can be participants. The tuitions are set affordable. A wide variety of health services provided by BPJS Health, including mouth and dental health services. Those things are needed by informal sector workers. Eventually, informal sector workers enroll and have BPJS cards as proof of membership.

BPJS Health registration can be done collectively. It is probable that the participants just following the collective registration conducted by the village head or other apparatus, so it is still questionable whether informal sector worker as the card owner's knowledge of BPJS Health is good enough to be able to take advantage of health services guaranteed by BPJS Health.

Knowledge is the result of 'know' that happens after people sense on a particular object.⁵ Without adequate knowledge about BPJS Health, informal sector workers are unable to use health services guaranteed by BPJS Health maximally, especially preventive health services. Without preventive effort, the possibility of health conditions that require curative health services will increase. For example, the majority of patients who need oral and dental curative health services come to the dentist in a state that has been severe and frequency of delayed curative treatment is high. Patients do not come to the dentist before they feel pain. This will impact on the patient's general health and public health degrees.

The purpose of this research was to find out the knowledge of BPJS Health among Bandung informal sector workers as BPJS Health card owner. This research was a descriptive research with survey method and used questionnaire as data collecting tools.⁶ The research was conducted by direct observation and questionnaire distribution to the informal sector workers as BPJS Health card owner.

METHOD

The questionnaires was made by the authorsby some indicators, among others: general knowledge about BPJS Health, BPJS Health participation knowledge, knowledge of the rights and obligations of participants, knowledge of tuition amount and late payment of BPJS Health tuition, knowledge of health services which are guaranteed and unguaranteed by BPJS Health and BPJS Health service flow knowledge.

If the respondent can answer correctly, the score is 1 (one). If the respondent cannot answer correctly the score is 0 (zero). Scores will be calculated using the following formula:

$$P = \frac{X}{N} \times 100\%$$

- P : Percentage (%)
- X : Respondent total score
- N : Maximum score

Then the results of the calculation are included into the criteria of the object. It is good if the score is 76 – 100%, moderate if it is 56 – 75% and bad if it is <56%.⁷

The population criterias are Bandung informal sector workers, own a BPJS Health card and not illiterate. The accessible population of this research was the informal sector workers who were met at the BPJS Health West Java Regional Division Office and its surroundings, BPJS Health Bandung Office and its surroundings, the area around the University of Padjadjaran, the area around the Rumah Sakit Gigi dan Mulut University of Padjadjaran, and Panyileukan Subdistrict from March to May 2016.

The samples are the member of population that is willing to fill out the questionnaire according to the criteria specified. Samples were taken by Snowball sampling method as many as possible within the specified research time limit.

RESULTS AND DISCUSSION

Respondents Characteristic

The questionnaires were filled by 285 respondents, comprised of 149 male respondents and 136 female respondents, with characteristic as following:

Table 1. Based on Gender

Gender	Frequency	%
Male	149	52,28
Female	136	47,72
Total	285	100

Table 2. Based on Age

Age	Frequency	%
<21 th	11	3,86
21 – 30 th	94	32,98
31 – 40 th	76	26,66
41 – 50 th	61	21,41
51 – 60 th	31	10,87
>60 th	12	4,21
Total	285	100

Table 3. Based on Last Education

Education	Frequency	%
No education	1	0,35
Elementary School	12	4,21
Junior High School	49	17,19
Senior High School	122	42,81
Diploma	33	11,58
Bachelor	68	23,86
Total	285	100

Tabel 4. Based on Employment

Employment	Frequency	%
Entrepreneur	172	60,35
Labor/ employee	113	39,65
Total	285	100

Table 5. Based on Business Field

Business Field	F	Frequency	%
Agriculture, forestry, hunting, fishing		8	2,81
Mining and quarrying		3	1,05
Creative Industry		36	12,63
Electricity, gas and water		15	5,26
Construction		13	4,56
Trade, retail, restaurant / cafe, and rental of inn / hotel		99	34,74
Transport, storage and communications		27	9,47
Finance, insurance, leasing buildings, land, and services		12	4,21
companies Social services		68	23,86
Others		4	1,40
Total		285	100

Table 6. Based on Information Source

Information Source	F (%)
Newspaper/Magazine	6,01
TV/ Radio	17,42
Internet	10,51
BPJS Health Office	16,82
Informant	45,95
Others	3,30
Total	100

Table 7. Respondents Opinion about The Increasing BPJS Health Tuition

Category	Before		After	
	F	%	F	%
Cheap	63	22,11	39	13,68
Commensurate	173	61,05	141	49,47
Expensive	49	16,84	105	36,84
Total	285	100	285	100

The Overview of the Respondents Knowledge

Based on the questionnaire, the following result is obtained:

Table 8. The General Knowledge about BPJS Health

Item	Question	Correct		Incorrect	
		F	%	F	%
1	BPJS is a shortened form of...?	233	81,75	52	18,25
2	JKN is a shortened form of...?	230	80,70	55	19,30
3	What is BPJS Health?	88	30,88	197	69,12
4	Since when BPJS Health operated in Indonesia?	140	49,12	145	50,88
5	What is the relationship between BPJS Health and JKN ?	137	48,07	148	51,93

Table 8 shows the questions that represent the indicators of general knowledge about BPJS Health. Only two of the five questions that can be answered correctly by the majority of the respondents, which are item 1 and item 2. The researcher assumes that the respondents are aware of the existence of BPJS and JKN due to the publication carried out passionately by the government through any media information such as television. It raises the curiosity of the respondents regarding the abbreviation of those terms. Therefore, the information regarding the purpose of the agency and the program to ensure public health is known, so that it encourages respondents to be a participant.

Item 3, 4, and 5 can only be answered correctly by less than 50% of respondents. The researcher assumes that the socialization for BPJS Health is less persuasive. If it

persuasive enough, respondents will look for information about when BPJS will operate so that the respondent can register immediately.

Item 4 is about what is BPJS Health. BPJS Health is a legal entity formed to administer the health insurance program, and it started to operate on January 1, 2014.³ Item 5 is the difference between BPJS and JKN. BPJS Health is the agency, and JKN is the program. The researcher assumes that the respondents can not distinguish either a legal entity with a health facility or BPJS Health with JKN. There are still many people wondering about the differences between them. It is caused by various factors such as education, social-economic, and the general knowledge of the respondents.

Table 9. The Knowledge of BPJS Health Participation.

Item	Question	Correct		Incorrect	
		F	%	F	%
6	How is BPJS Health participation law for all Indonesia citizens?	144	50,53	141	49,47
7	BPJS Health category is divided into...?	170	59,65	115	40,35

Table 9 shows the questions that represent the indicators of the knowledge of BPJS Health participation. Both questions can be answered correctly by more than 50% but less than 60% of respondents. There are still quite a lot of respondents who has a limited knowledge that the law of BPJS Health participation for Indonesian people according to Law No. 40 of 2004 on National Social Security System is compulsory. The researcher assumes that this occurs because the respondents are less concerned with things that are not directly related to the health services. Also, they are already registered so that they think the law of the participation has no bearing on them. This compulsory law of participation is necessary to know in order to be able to share the information and invite each other to register themselves so that the target of the BPJS Health to ensure the health of the Indonesian people can be achieved no later than January 1, 2019.³

Item 7 is about categories of the participation. Based on the observations of the researcher at some locations, some people still have not registered due to the financial matters, so it has to be noted that there are two categories in the BPJS Health which are Tuition Assistance Recepients (*Penerima Bantuan Iuran* - PBI) and Non Tuition Assistance Recepients (Non-PBI). Tuition Assistance Recepients (PBI) is the categories for the poor people whose tuition was paid by the government, while for the participant who is Non Tuition Assistance Recepients (Non-PBI), consists of wage earners workers and their family members, not wage earners workers and their family members, and not permanent workers and their family members.⁸ According to the category, the informal sector workers belong to the category of not wage earners workers. The researcher assumes that there are still quite a lot of respondents unable to answer precisely because of the dissemination of information regarding the categories of recipient tuition participants of BPJS Health are still lacking.

Table 10. Knowledge of the rights and obligations of BPJS Health participants.

Item	Question	Correct		Incorrect	
		F	%	F	%
8	Do participants have rights to get health services anywhere and anytime?	95	33,33	190	66,67
9	Which one is participants obligation ?	243	85,26	42	14,74

Table 10 shows the questions that represent the knowledge of the rights and obligations of BPJS participants. Item 8 about the right of the health services that will be obtained by BPJS participant can't be answered correctly by the majority of respondents. The researcher assumes that this situation happened because the lack of socialization on how to obtain health services they must go to health facilities that is in collaboration with BPJS. Therefore, many of the respondents who thought that if they have a BPJS card, they can freely seek treatment anywhere.

BPJS Health ensures a wide range of medical services that is not even guaranteed by private insurers. However, BPJS Health also has restrictions medical services that are guaranteed and unguaranteed. In addition to getting the card as a valid evidence to obtain health services, one of the rights of the BPJS Health participant is getting treatment in the health facility that is in collaboration with BPJS Health.³ Firstly, participants should head to the first level of health facility listed on the membership card to get medical service. In other words, not all medical services are guaranteed, and it can not be obtained anywhere except in an emergency.

Item 9 on the obligations of the BPJS Health participants can be answered correctly by the majority of respondents. One of the obligations of BPJS Health participants following the registration is paying dues, which amount in accordance with the applicable regulation.³ The researcher assumes that the respondents understand their obligation to pay tuitions for BPJS. Knowing the obligations is a consideration that has been thought out prior the registration.

Table 11. Knowledge of The Tuition and Late Tuition Payment of BPJS Health

Item	Question	Correct		Incorrect	
		F	%	F	%
10	How much the tuition for class I, II, dan III before the tuition increase?	240	84,21	45	15,79
11	Is it true that tuition for class III by April 1st 2016 is IDR 25500.00?	197	69,12	88	30,88
12	Is it true that tuition for class II by April 1st 2016 is IDR 80000.00?	170	59,65	115	40,35
13	Is it true that tuition for class I by April 1st 2016 is IDR 80000.00?	174	61,05	111	38,95
14	Is it true that tuition in arrears payment should be done max. 6 (six) months?	120	42,11	165	57,89
15	If the tuition in arrears payment is late, so...?	221	77,54	64	22,46

Table 11 shows the questions that represent the indicators of knowledge of the tuition and late tuition payment of BPJS Health. Five of the six items can be answered correctly by more than 50% of respondents.

Item 10 is about the amount of the tuition before the tuition increased on April 1, 2016. The amount of the tuition to be paid by the informal sector workers as the participants of BPJS before the tuitions increased are IDR 25500.00 per person per month for the treatment rooms of Class III, IDR 42500.00 per person per month for the Class II, and IDR 59500.00 per person per month for the Class I.⁹ The researcher assumes that many respondents can answer this question correctly because they know an amount of tuitions they should pay, so it becomes their consideration before registering for BPJS Health. The ability of the respondents answered the items 11, 12, and 13 correctly supports the assumption that the respondents understand well their obligations.

Item 11, 12, and 13 are about the amount of the tuition for the BPJS Health after it increased on April 1, 2016. The tuition tuitions range from IDR 25500.00 for Class III, IDR 51000.00 for Class II, and Rp 80.000,00 for Class I.¹⁰ The respondents can answer the three questions appropriately so that the researcher assumed that the socialization on the increase of the tuition has been successful so that the respondents' knowledge about the amounts of tuitions have also been improved.

Table 12. Knowledge of The BPJS Health Services guaranteed and unguaranteed

Item	Question	Correct		Incorrect	
		F	%	F	%
16	Does BPJS Health guarantee medicine and consumable medical material?	165	57,89	120	42,11
17	Does BPJS Health guarantee medical services to cope with health problems due to deliberate self-harm?	158	55,44	127	44,56
18	Does BPJS Health guarantee dentures?	86	30,18	199	69,82
19	Does BPJS Health guarantee scaling?	102	35,79	183	64,21
20	Does BPJS Health guarantee childbirth?	240	84,21	45	15,79
21	Does BPJS Health guarantee ambulance in emergency?	109	38,25	176	61,75
22	Does BPJS Health guarantee braces/ orthodontics?	132	46,32	153	53,68
23	Does BPJS Health guarantee aesthetic purposes services?	229	80,35	56	19,65
24	Does BPJS Health guarantee baby food and formula?	214	75,09	71	24,91
25	Does BPJS Health guarantee health services to cure disorders/ diseases caused by drug addiction and/or alcohol?	172	60,35	113	39,65

The least correctly answered questions by the respondent are item 14 on late payment of tuitions. The researcher assumes this is because the majority of respondents never had dues in arrears for months which showed that the tuitions for BPJS Health are affordable. It is also because the respondents understand well the obligations as participants of BPJS Health and the consequences for being long in arrears. Item 15 is about sanctions for the

dues in arrears that are not paid. The health services will be suspended temporarily. The Researcher assumes that the openness of the BPJS parties in providing information on payment of the tuitions and explaining the consequences of late payment has been good.

Table 12 shows the questions that represent the indicators of knowledge of the health services that is guaranteed and unguaranteed by BPJS Health. The question items are created based on the Presidential Regulation No. 19 of 2016 on the second amendment of Presidential Regulation No. 12 of 2013 on Health Insurance.

Item 16 concerns the guaranteed service of medicine and medical consumables. The questions can be answered correctly by the majority of respondents. The prices of medicines and medical materials are not all affordable. There are many patients who do not fill a prescription drug because of its cost. The researcher assumes that the respondents have searched for the information about it and it became one of the main considerations of the respondents to be participants of BPJS.

Item 17 concerns about unguaranteed medical services to cope with health problems due to deliberate self-harm. The questions can be answered correctly by the majority of respondents. The money used to fund the services of BPJS participants comes from the tuition tuitions of all participants. There are many sick people who want to recover, but the person who hurt himself quite the opposite so that the researcher assumes that the respondents can tell which one is appropriate and inappropriate to get a security of medical services.

Item 18, 19, and 22 are about dental and oral health services. Item 18 is the question of denture service guarantees as the least questions answered right by the majority of respondents. Most respondents did not know. The researcher assumes that the respondents are not trying to find out since it has not needed.

Item 19 is about guaranteed of scaling once a year. The researcher assumes that the concern of respondents to the oral cavity is still lacking. Scaling is one of the preventive efforts that can prevent tooth decay and periodontal tissue damage.

Item 22 is about unguaranteed dental services such as orthodontist treatment. The majority of respondents cannot answer this question correctly. Respondents were more likely to choose the option not know in the questionnaire. The researcher assumes that they are not trying to find out because it has not needed.

The researcher concluded that the respondents do not have an awareness of dental and mouth health checked even to control the six months to the dentist. In fact, having control to the dentist every six months can help to prevent damage to the teeth and prevents pre-existing damage worse. Preventive treatment can be done immediately, and early diagnosis will facilitate curative treatments to be performed. Without ever coming to the dentist, information on dental and oral health services that are guaranteed and unguaranteed by BPJS likely not be obtained by respondents

Item 20 is the item most questions answered right by the respondents, namely item questions about childbirth service. Childbirth is an important thing that is experienced by almost all the family, and it is not rare that a participant with those reasons. The cost of labor

in adequate health facilities tends to be expensive and not affordable by all levels of society so that there are still people who choose to deliver at home or to the traditional midwife.

Childbirth has a high risk to the health of both mother and baby. If not treated in adequate health facilities by skilled medical personnel would create higher risk. The researcher assumes that the respondents have learned the importance of labor that is safe and comfortable for the mother and infant to encourage respondents to seek information on whether the service delivery is guaranteed by BPJS.

Item 21 is the guaranteed ambulance service for emergency cases by BPJS. Ambulances are given only for referrals patients from health facilities with certain conditions set by BPJS Health.³

Most respondents were unable to answer 21 items appropriately. The researcher assumes that the respondents have not used the ambulance service and have never been in a situation conditions that require emergency services by ambulance. The respondents did not seek to know because it is not necessary.

Three further questions regarding health services are not guaranteed. The majority of respondents can answer three questions correctly. Item 23 is the question regarding services that is not guaranteed for aesthetic purposes. The researcher assumes that the respondents knew that the ministry for aesthetic purposes or enhance the appearance is not of primary health services, and it is inappropriate to use the money from participants' tuitions for BPJS. Item 24 was about not guaranteed food and baby milk. The researcher assumes that the respondents could distinguish that food and baby milk instead of medical materials directly related to health. Item 25 is about health services to cure disorders/ diseases caused by drug addiction and/or alcohol. The researcher assumes respondents already know which is good and bad behavior that deserve financed by money from the tuition of all participants of BPJS.

Table 13. Knowledge BPJS Health Service Flow

Item	Question	Correct		Incorrect	
		F	%	F	%
26	If you have sore eyes and want to get treatment with BPJS Health card, what would you do?	231	81,05	54	69,47
27	Which one is an advanced-level health facilities (reference) in collaboration with Health BPJS?	198	68,95	87	30,53

Table 13 shows the indicator questions that are representing knowledge BPJS service flow. Item 26 is the first-level health facilities to be visited by the respondents in advance to get health services. The first-level health facilities BPJS participants listed on the card BPJS owned. Participants must obtain a referral from first-level health facilities to obtain health services in advanced level health facilities, except in cases of medical emergency.³ Item 27 is an item question regarding advanced level health facilities as a reference destination. The advanced level health facilities include the Hospital and Health Center.³ The researcher assumes respondents' knowledge about the health service flow BPJS either because the

direction is given by the BPJS regarding the procedures for healthservices is already good and well received by the respondent.

Table 14. Respondents' BPJS Health Knowledge Category

Category	Frequency	Percentage (%)
Good	53	18,60
Moderate	118	41,40
Bad	114	40,00
Total	285	100

Table 14 shows respondents' knowledge category as a whole. About 53 respondents (18.60%) included in the good category, 118 respondents (41.40%) included in the moderate category, and 114 respondents (40.00%) included in the bad category.

CONCLUSION

Based on the analysis results and discussion, it can be concluded that the knowledge of BPJS Health among Bandung informal sector workers as BPJS Health card owner is in the moderate category.

ACKNOWLEDGEMENT

We would like to say thanks to the entire staff of BPJS Health Head Office and BPJS Health West Java Regional Office, as well as BPJS Health Bandung Office who have given us permission to conduct this research, provided us with enough time and place so that this research could be done smoothly. We also would like to thank the entire staff of Panyileukan and Coblong Subdistrict Office who also helped us so that this research could be done smoothly.

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Oral hygiene index of quadriplegic athletes in bandung

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ABSTRACT

INTRODUCTION: Maintaining oral health is the duty of every individual, including those who have the quadriplegic disorder. **Objective:** The purpose of this study was to determine the status of oral hygiene quadriplegic athletes in Bandung. **Materials and methods** This research is descriptive with survey. Sampling was done by non-random sampling with the census technique that consists of 59 people in different quadriplegic conditions. The measurement method of oral hygiene status carried with OHI-S index by Greene and Vermillion (1964). **Result:** The result showed the average value index of 1.12 debris, calculus index of 1.05, and OHI-S index of 2.17. **Conclusion:** Conclusion from this research is that oral hygiene of quadriplegic athletes in Bandung categorized into the medium state.

Keywords: *Quadriplegic, Debris Index, Calculus Index, OHI-S*

INTRODUCTION

Indonesian Law No. 36 Year 2009 on Health states that every person is obliged to realize, maintain, and improve public health as high covers one aspect is the individual health efforts. These objectives are supported by knowledge, attitudes, and skills of the individual in maintaining their health, especially the oral health of the individual.

Based on the national socio-economic survey in 2012, the percentage of persons with disabilities by province showed that in West Java province totaled 2.22 percent of the population of West Java are persons with disabilities and 0.5 percent is quadriplegic or physically disabled, e.g. amputation of one limb or other physical disability conditions.

NPCI (National Paralympic Committee of Indonesia) in Bandung is a sport committee of disabled Indonesian that has authorities to coordinate, supervise and develop all sport activities of disabled people in Bandung, include the quadriplegic athletes with total number of 35 athletes.

In the process of training and competition the athletes usually get demands from coaches, administrators, and government. Generally, the demand experienced by these athletes is a training process that benefits the movement abilities, skills improvement and enhancement of self-control of their body with quadriplegic conditions.

NPCI Bandung has never held a counseling or dental health education to quadriplegic athletes in order to maintain and protect their oral health from a wide range of dental and oral diseases.

Health state and dental care to the persons with disabilities is reportedly worse than the general population (Vignehsa, 1991). Research in Nigeria states that 40% of persons with disabilities have poor OHI-S, 45% with medium OHI-S, and only 15% of persons with disabilities have good OHI-S (Oyapero, 2015). To keep their teeth and mouth healthy, the quadriplegic has various habits appropriate to the type of physical impairment, e.g with the condition of amputation of both hands the quadriplegic brusher his/her teeth by using the soles of his feet to grip a toothbrush or they were aided and supervised by others through special services quadriplegic this category. Nevertheless, the quadriplegic who have barriers still requires monitoring whether all the teeth have been cleaned or not (Elsässer, 2008), so it requires a change in behavior on the quadriplegic making it more convenient to keep the oral hygiene routine.

Health education is an effort to help individuals, groups or communities in improving the ability of their behavior to achieve optimal health. The result of health education is health behavior. This also applies to oral health, so that health education will have an effect on a person's oral hygiene status (Nasution, 2004).

Oral hygiene of quadriplegic athletes in Bandung is currently still a topic of research and innovation in order to be contributed to the science community dental health in Indonesia, West Java, particularly Bandung city.

The quadriplegic athletes in Bandung currently require knowledge, attitude, and action in form of health education to maintain optimal oral hygiene state and oral hygiene evaluation in the form of checks, which until now has never been done in NPCI Bandung grouply.

Based on the evaluation of oral hygiene needs of athletes with physical disabilities in the Bandung city, and no previous studies related to these problems, we are interested to research the oral hygiene index of quadriplegic athletes in Bandung.

MATERIALS AND METHODS

This research is descriptive and used non-random sampling with sensus technique, every quadriplegic athlete who was in the NPC of Bandung office and willing to be examined included to the research sample.

This study was approved by The Health Research Ethics Committee Faculty of Medicine Universitas Padjadjaran (No. 0/0/UN6.C1.3.2/KEPK/PN/2016) using survey methods to measure the OHI-S of 59 quadriplegic athletes.

Materials we used in the research are:

1. The basic dental instrument: Explorer, Cotton Forceps, and Mouth Mirror
2. Inspection Form OHI-S
3. Handscoon and Masks
4. Trashbag
5. Glass mouthwash
6. Tray
7. Wipe
8. Flashlight
9. Disclosing solution
10. Material disinfectant alcohol 70%
11. Water
12. Cotton
13. Tissue

The procedural steps of this survey were:

1. Researcher explained the research information to subjects
2. Subjects signed the *Informed consent*
3. Subjects were instructed to rinse with water to ensure that no remnants of food in the mouth of the research subjects.
4. Researcher used handschoon and masks.
5. Researcher put disclosing solution under the tongue two to three drops. Subjects were asked to close the mouth for 15-20 seconds. After rinsing it was asked to do the movement for 10-15 seconds, then the subject was asked to throw saliva into the space provided by the researcher.
6. Researcher measured the debris index using a mouth mirror and explorer at the start of the buccal teeth 16, labial 11, buccal 26, lingual 46, labial 31 and lingual 46.
7. Assistant record examination results debris index in check form OHI-S.
8. Subjects were instructed to rinse again with water to remove excess liquid disclosing solution.
9. Researchers measured the index calculus using a mouth mirror and explorer at the start of the buccal teeth 16, labial 11, buccal 26, lingual 46, labial 31 and lingual 46.
10. Assistant recorded the results of the calculus index examination.
11. Assistant calculated the OHI-S of the examination results.
12. Researcher recaps the results of examination data.
13. Researcher prepared a report of examination results.

The assessment criteria of debris index were shown in figure 1.

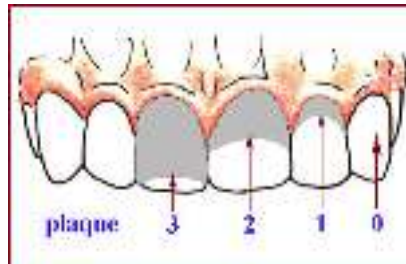


Figure 1. The assessment criteria of debris index Green and Vermillion (Hiremath, 2007)

The assessment criteria for the calculus index were:

Table 1. Assessment Criteria of Calculus Index Examination

No.	Criteria	Value
1	No calculus	0
2	No calculus covering the tooth surface until less than 1/3 of the tooth surface.	1
3	Supragingival calculus covers the surface of the teeth more than 1/3 until less than 2/3 of the tooth surface, or found subgingival calculus around the servical of the tooth.	2
4	Supragingival calculus covers more than 2/3 until the entire surface of the tooth; or found sub-gingival calculus covering and around the entire servical of the teeth	3

The following formula was used to calculate the OHI-S:

$$\text{OHI-S} = \sum \text{Debris Index (DI)} + \sum \text{Calculus Index (CI)}$$

After the assessment criteria of plaque and calculus were summed, the average yield was inserted into the category ordinal scale:

Table 2. Category of OHI-S

No.	Scale	Category
1	0,0 – 1,2	Good
2	1,3 – 3,0	Medium
3	3,1 – 6,0	Poor

The results of this research data was a description of the oral hygiene index of quadriplegic athletes in Bandung and presented in tabular form.

RESULTS

The examination was conducted to 59 people and identified 58 of them the OHI-S who had the determinant teeth and were quadriplegic athletes in Bandung city. The results of the research shows in the following data: The average value of Debris Index, Calculus Index, and OHI-S of quadriplegic athletes categorized into the medium state.

Table 3. Debris Index, Calculus Index, and OHI-S Quadriplegic Athletes in Bandung city based on WHO criteria

Index	Value	Category
Debris	1,12	Medium
Calculus	1,05	Medium
OHI-S	2,17	Medium

Based on the location of abnormality (hand, leg, and both), the debris index, calculus index, and OHI-S categorized into the medium state. Quadriplegics on leg have OHI-S score of 2.11, which means better than quadriplegics on hand (OHI-S score of 2.23) and quadriplegic on both hand and leg (OHI-S score of 2.70).

Table 4. Debris Index, Calculus Index, and OHI-S Quadriplegic Athletes based on location of abnormality

Location of Abnormality	Debris Index	Calculus Index	OHI-S
Hand	1.11	1.13	2.23
Leg	1.11	1.00	2.11
Both hand and leg	1.31	1.39	2.70

Based on the type of abnormalities, all types of quadriplegic athletes have the average OHI-S value that categorized into the medium state.

Table 5. Debris Index, Calculus Index, and OHI-S of Quadriplegic Athletes in Bandung based on the type of abnormalities

Type of Abnormality	Debris Index	Calculus Index	OHI-S
Amputation/Abnormality on 1 and 2 Legs	0.93	0.91	1.83
Amputation/Abnormality on 1 hand	1.17	1.02	2.19
Amputation/Abnormality on 2 hands	0.93	1.43	2.37
Polio	1.27	1.09	2.37
<i>Cerebral Palsy</i>	1.33	1.33	2.67
Amputation/Abnormality on 1 hand and 1 leg	1.25	1.42	2.67
Amputation/Abnormality on 2 hands and 2 legs	1.40	1.40	2.80

13.79% quadriplegic athletes have good OHI-S, 75.86% of them have medium OHI-S, and 10.34% quadriplegic athletes in Bandung city have poor OHI-S.

Table 6. The Frequency Distribution of OHI-S (Greene and Vermillion) of Quadriplegic Athletes in Bandung city based on WHO criteria

OHI-S	Criteria	Frequency	%
0,00 - 1,20	Good	8	13.79
1,30 - 3,00	Medium	44	75.86
3,10 - 6,00	Poor	6	10.34
Total		58	100

DISCUSSION

This research investigated the oral hygiene index of quadriplegic athletes in Bandung city. The results showed that the average value of OHI-S of all respondents categorized into the medium state with the value of 2.17. Oral hygiene index of quadriplegic athlete with abnormalities on the hand had an average value of 2.23, while the quadriplegic athletes with abnormalities on the leg had an average value of 2.11, and one quadriplegic athlete with abnormalities both on the hand and leg had an average value of oral hygiene index of 2.70. The average value of debris index all respondents was 1.12. Respondents with abnormalities on hands had an average value index debris of 1.11, while respondents with abnormalities on legs 1.11, and respondents with abnormalities on both hand and leg had an average value of index debris of 1.31.

This debris index was certainly associated with daily activities of the respondents. Quadriplegic athletes carry out physical exercises regularly so they have good motoric skills. In doing some daily activities, there are differences between the quadriplegic and others in general. They have to adjust their activities according to the movement in that condition, because some activities are sometimes difficult for them to do optimally.

The maintenance of oral hygiene relating to the control of plaque in the mouth, the most important treatment and must be maintained by each individual is brushing teeth. Tooth brushing is generally done by grasping tool toothbrush, either manual or electric toothbrush, using hand and fingers. Quadriplegic athletes with abnormalities on hand, especially on two hands have difficulty in practicing the technique, timing, and duration of brushing their teeth properly. Debris index of a person who had an abnormality in both hands, categorized into medium state. One reason is the difficulty of the right teeth brushing motion because they was brushing their teeth using both legs.

Respondents with amputation of fingers and toes had a debris index that categorized into the medium state. This is also in line with Oyapero's (2015) statement that for people with disabilities because of defects, oral care routine practice may be a considerable challenge, particularly evident in patients who have a disability that affects the hands.

Nonetheless, quadriplegic athlete in Bandung also had a good debris index so athletes who had worse debris index can be caused by not knowing and understanding how to brush teeth properly or lack of dental health education thus less concerned about

their mouth condition. Index calculus of quadriplegic athletes in Bandung categorized into the medium state with a value of 1.05. Respondents with abnormalities on the hand has an average index calculus of 1.13, while respondents with abnormalities on the leg have an average index calculus of 1.00, and respondents with abnormalities on both have an average index calculus of 1.39.

Calculus formed on a person's teeth can be caused by the accumulation of plaque attached to the tooth and mineralized, so the best way to remove calculus is with the help of a dentist in the treatment of scaling. Respondents who had difficulties in his movement also had difficulties in healthy behavior, include maintaining oral hygiene routine to inhibit plaque accumulation develops into calculus.

Quadriplegic athletes have to come to the dentist to clean the teeth from dental calculus. To increase the productivity as an athlete with the oral hygiene as the indicator and their must to come to the dentist needs extra effort, the solution can be making a scaling program by the dentist especially for the quadriplegic athletes. It will decrease their complaints about oral hygiene so they can improve achievements as a quadriplegic athlete. In addition, the quadriplegic athletes should increase awareness to maintain oral hygiene from dental calculus and contact the dentist as monitoring the oral health, especially their oral hygiene. The average value of oral hygiene index of quadriplegic athlete is 2.17 and categorized into the medium state.

The oral hygiene index of athletes with physical disabilities Bandung overall is not good yet because in Bandung, especially in the NPCI (National Paralympic Committee of Indonesia) Bandung and in NPCI West Java has not been implemented oral health education program for them so that knowledge in maintaining oral hygiene and coming routinely to the dentist has not been socialized. National Paralympic Committee Indonesia (NPCI) Bandung and NPCI West Java have not had a special dentist for athletes yet in addition to general doctor, which is necessary to monitor the oral health condition of the quadriplegic. It will be a solution for improving oral hygiene quadriplegic athletes in Bandung, because according to Oyapero's (2015) statement that oral health care for adults with disabilities have not received adequate attention and it is estimated that one of two persons with disabilities cannot find the professional resources to provide proper dental care and necessary.

It is difficult for athletes with physical disabilities, especially persons with abnormalities in both legs and cerebral palsy in aspects of facilities, equipment, systems and services that have not prioritized people with special needs because cerebral palsy is caused by abnormalities in motor function so that effected to a weakness, and incoordination or uncontrolled movements. This disorder may affect another parts of brain so that it can also occur disturbances in the function of vision, hearing, communication, and cognitive depending on the location of the lesions in the brain (Misdalia et al., 2012), while people with the disorder or amputee on the second leg generally have a lower height and runs using hands or with the help of other tools that will be optimized when using a prosthesis to adjust the height that will enable persons with amputee on both legs in the use of public facilities, especially in health facilities.

Quadriplegic athletes with abnormalities in both hands showed their leg skills to brush teeth, but had not the good oral hygiene based on the examination of OHI-S in this study, so it needs the innovation of tools specifically for quadriplegic with abnormalities in her hand when brushing teeth, tongue, using mouthwash and other dental care independently. Based on the author's experience as a quadriplegic, using an electric toothbrush can be the initial solution for them in tooth brushing. The author's expectation in the future is that it can be given facilities and services for persons with physical disabilities easier in order to maintain their health, especially oral health.

In fact, quadriplegic athletes has certainly a lot of demands that must be implemented with focus. Oral health conditions of quadriplegic athletes should not be problems that distract the process of exercise and other sport activities. Ideally the oral hygiene index of quadriplegic athletes have been good as an indicator to make achievements.

CONCLUSION

The results of this study can be concluded that oral hygiene index of quadriplegic athletes in Bandung categorized into the medium state.

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Severity of childhood caries in primary school

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ABSTRACT

INTRODUCTION: The severity of caries in children of primary school age children from several studies have shown increasing age of increasing severity kariesnya. Caries can be measured by the index of PUFA for children's teeth. Caries need to know to determine the success of a health program that had been implemented and to determine the condition of dental health to be used as a basis for policy making. **Objective:** Objective of research is to measure the severity of dental caries in primary school children. **Materials and methods:** material used is an index check form PUFA, mouth mirror, sonde, tweezers, tray and CPITN probe. How to research is to examine the state of all teeth in children at State Primary School Cikawiri and Mekarjaya, Village Cimenyan, Bandung regency, then the findings in the teeth was listed on the criterion P for teeth that have experienced caries marked by the entry ball end CPITN up with existing involvement pulp, the criterion u if there ulcers, if any criteria f criteria A fistula and if there is an abscess. All of the above criteria are caused by caries. **Results:** The results showed caries in SDN Cikawiri and Mekarjaya Cimenyan Desa Bandung regency at very low criteria as much as 24.2 and 31.1 percent lower criteria of 2.1 and 6.8 percent, high enough criteria for 15.3 percent and 17.6 percent, high criteria as much as 15.8 and 10.8 percent and very high criteria as much as 42.6 and 33.8 percent. **Research Conclusions:** The severity of dental caries in primary school age children in SDN Cikawiri and Mekarjaya are at very high criteria.

INTRODUCTION

Caries remains to be a major challenge for public health, and is a major problem for children. The caries lesion, the most commonly observed sign of dental caries disease, is the cumulative result of an imbalance in the dynamic demineralization and remineralization process that causes a net mineral loss over time. Dental caries remains a common chronic disease and, in the absence of treatment, it may progress until the tooth is destroyed.¹

During the last seventy years, the data of caries from throughout the world are collected by def-t/DMF-T index. This index can not provide information about dental caries with pulp involvement and the existence of dental abscess that can be more serious than the caries

itself. It results in the negligence of people to the high level of caries lesion, the severity and the correlation of the caries with the health and quality of life. A survey or research must be able to provide relevant information on the severity of illness for health policy maker. By the examination of caries using PUFA index, this necessity relevant information can be fulfilled.²

The Pulp, Ulcer, Fistula, and Abscess system (PUFA), are focused on staging the most severe levels of caries disease.¹ Index of PUFA/pufa was used to assess the severity of untreated caries.² PUFA/pufa is an index used to assess the presence of oral conditions and infections resulted from untreated caries in the primary (pufa) and permanent (PUFA) dentition.³

This index records the involvement of pulp (P/p), ulceration (U/u) of oral mucosa due to tooth fragment, fistula (F/f) and abscess (A/a).⁴ The results shows that most of the caries found involve the pulp exposure both in the permanent (P) and deciduous (p) on the entire sample. Overall caries prevalence on 6-year-old is 62% with the highest component of dental caries and there are 8 permanent teeth having caries with pulp involvement. For the age of 9-years-old, 65.8% with a 10% permanent dental caries and 12 years old is the highest prevalence of caries in permanent teeth, which is 25.3%. It is concluded that 9-year-old children in the mixed dental period shows severe caries.²(Pratiwi, 2013)

According to the above data, researcher is interested in doing the research on the severity of childhood caries in SD Mekarjaya and SD Cikawiri Bandung Regency.

MATERIALS AND METHODS

Material used in the research was assessment form of pufa index, mouth mirror, sonde, tweezers, tray and CPITN probe. The variable of the research was the severity of caries assessed by pufa index.

The research was conducted to the population of students in SDN Cikawiri and Mekarjaya Bandung, with saturated sampling technique in which all students were served as the subject of examination.⁵ The assessment of pufa index was conducted by assessing the condition of whole teeth of the students in Sekolah Dasar Negeri Cikawiri dan Mekarjaya, Desa Cimenyan, Bandung Regency. After that, the finding resulted from the assessment was recorded in pufa index assessment form. These findings then were classified as p for the teeth which have undergone caries by the entry of CPITN ball end, up to the pulp involvement. Findings were classified as u criterion for the teeth with ulcer, f criterion if there is fistel and a criterion for teeth with abscess. All the above criteria are caused by caries.⁴

Pufa index was calculated by accumulating pufa score of each individual, similar to the accumulating of DMF-T/dmf-t score. The score of each individual ranges between 0-20 for pufa of primary teeth and 0-32 for *pufa* of permanent teeth. Pufa for population was calculated from the average, and it has decimal score. The score then was classified according to the def-t index into some categories: very high, high, rather high, low, and very low.⁴ The very low criterion is with caries score ranging from 0.0 to 1.1; *the low criterion has caries severity score ranging from 1.2 to 2.6; the moderate criterion of caries severity ranges*

from 2.7 to 4.4; the criterion of high severity ranges from 4.5 to 6.5 and very high severity criterion has the score of more than 6.6.⁶

RESULTS

The results of the research on Individual Caries Severity Data assessed by pufa index are as the following:

The Data of Individual Caries Severity assessed by pufa Index

The Data of Individual Caries Severity assessed by pufa Indexin SDN Mekar Jaya and SDN Cikawiri:

Table 1.1 Individual pufa score in Mekarjaya

Assessment	Category	Numbers of students	%
Individual pufa	Very low	23	31.1
	Low	5	6.8
	moderate	13	17.6
	High	8	10.8
	Very high	25	33.8
Total		74	100

Table 5.1 indicates that the severity of caries in SDN Mekarjaya is almost the same for very low pufa score and very high pufa score, that is 31.1 percent and 33.8 percent. The percentages of low, moderate and high pufa score range between 6-18 percent.

Table 1.2 Individual pufa score of the students in SDN Cikawiri

Assessment	Category	Numbers of students	%
Individual Pufa	Very low	46	24.2
	Low	4	2.1
	moderate	29	15.3
	High	30	15.8
	Very high	81	42.6
Total		190	100

Table 5.2 indicates that most of the students of SDN Cikawiri, that is 42.6 %, undergo caries in a very high level severity. The rest are in very low, low, moderate and high criteria, range between 2.1-24.2.

DISCUSSION

Among the entire students of 6-12 years-old accessed in Desa Mekarjaya and Cikawiri, the severity of caries with the category of very high level reaches 33.8 percent and 42.6 percent, consecutively. This result is lower than the result of Pratiwi research in Pinrang Regency, North Sulawesi, in which PUFA/pufa index of 6 years-old students reach 62% and for 12 years-old students reach 39.5%.² This condition happened as a result of the clinical presentation of caries disease is a caries lesion; the severity of the disease and of individual caries lesions are as the result of complex personal, biological, behavioral, and environmental factors. Some factors are protective, such as the presence of fluoride in the biofilm, whereas others lead to hard tissue destruction, such as lower plaque pH. Caries risk assessment is the organized process of evaluating these protective and pathogenic factors and provides the foundation for selecting treatment interventions.¹

The above scores show that the severity of caries is very high in almost 40 percent of the total students accessed in both schools. This high level of severity indicates that childhood caries is often neglected. This negligence of childhood dental caries frequently result in some problems related to the health condition, significant pain, facial abscess, eating disorder, and losing of some serious school time. Some references state that there is more than 51 millions school hours have been missed in every year due to the illness related to dental problems. Caries causes not only pain and discomfort, but also financial problem for the parents.⁷

There are 264 students in both school has undergone the severity of caries, and it shows that childhood caries has been neglected. This result is almost the same as Pratiwi research which states that there are 450 students have undergone the severity of caries, in which this caries is not treated well.² Untreated caries will cause some problems, for example, if untreated caries progresses into the dental pulp there are possibly three main pathways for this association: 1) pain and discomfort result in reduced food intake; 2) reduced quality of life affects children's growth and development through restricted activity, reduced sleep, concentration deficits, and so on; and 3) odontogenic infections may result in cytokine release which might impact on growth.³

The above results are a bit difficult to be compared to the previous research. It is difficult to compare the results obtained from other studies with the present one because of the differences with respect to the methodology, age groups and cultural aspects of the various sub sets of the population both within and between countries.⁸ Various research shows that an untreated caries affects the quality of life and general growth in children; Benjian et al³ (2011) reported that children with odontogenic infections have increased risk of below normal BMI as compared to children without odontogenic infections.⁹ There is a positive correlation between the OHIP score and the PUFA score among the study population i.e. with the PUFA scores increasing, it has a detrimental effect on the oral health related quality of life of the individual. Correlation between pain and PUFA showed statistically significant relation indicating children with positive scores for PUFA had often suffered pain

in oral cavity. Whenever pain comes children are given symptomatic medication to relieve pain but no dental visit are planned or treatment is arranged for these children.¹⁰

This information gathered by PUFA/pufa for untreated caries will provide health planners with relevant information about severity of disease and help in planning measures to treat dental caries according to severity. It will also help in evaluating access to emergency treatment and exposure to fluoride as component of basic package of oral health care (BPOC).¹¹ It is imperative that dental researches, policy makers and practitioners focus on the systems which assess the consequence of untreated carious lesions and its impact on the quality of life, so that they come out with a much improvised comprehensive oral health policy to address the oral health problems of the masses in our country.⁸

CONCLUSIONS

The severity of caries of primary school students in SDN Cikawiri and Mekarjaya is categorized as high level of severity.

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The relationship between children's motivation with orthodontic treatment need in students aged 9-12 years of sdn kedungkandang 2 malang

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ABSTRACT

INTRODUCTION: Motivation is an encouragement and strength in a person to do a spesific purpose that they want to achieve. School age children 6-12 years old may be motivated because normally they have started to compare their appearance with others. Malocclusion is on of the factors that can affect the appearance. Malocclusions occurre at 10-12 years old because there is a change process of deciduous teeth become permanent teeth that cause a lot of problems. Malocclusions can be prevented by orthodontic treatmentsuch as preventive orthodontic treatment or early prevention in normal children. Measurements for orthodontic treatment need are *Aesthetic Component Index of Orthodontics Treatment Need* (AC IOTN). **Objective:** The purpose of this research was to determine the relationship of the children's motivation with orthodontic treatment need in students aged 9-12 years old of SDN Kedungkandang 2 Malang. **Materials and methods:** The study design was an observational analytic with *cross-sectional* approach. The data was assesed with motivation questionnaire and Aesthetic Component Index of Orthodontic Treatment Need (AC IOTN) which contains intraoral photos anterior part of 70 students. **Result:** The results of statistical analyzes obtained a significance of 0.000 which is smaller than (α 0,01), it indicates that there was a relationship between motivation and orthodontic treatment need. The coefficient correlation was 0.490 that include medium category. Positive figures of coefficient correlation mean that the relationship between motivation and orthodontic treatment need was directly proportional. **Conclusion:** The level of orthodontic treatment need increase student's motivation of SDN Kedungkandang 2 Malang age 9-12 years to perform orthodontic treatment.

Keywords: *motivation, malocclusion, Aesthetic Component of Index of Orthodontic Treatment Need (AC IOTN).*

INTRODUCTION

Motivation comes from the word motive which can be interpreted as the power contained within the individual, which causes the individual act or commit. The motive can not be observed directly, but can be interpreted in behavior, a stimulus encouragement, or power force emergence of a certain behavior.¹⁹ Motivation is a series of effort to provide certain conditions, so someone willing and wanting to do something and if he does not like, he will attempted to eliminate or circumvent the feelings of dislike.¹³

In compliance with James and Oliver, in research of Wijayanti et al also mention if the crowding tooth and malocclusions occurred at the age of 10-12 years. At that age was a period of mixed dentition. In this period there is a change the dimensions of the deciduous teeth become permanent teeth cause a lot of problems.²⁰ Occlusion sometimes could be incompatible that can cause crowding tooth, cross bites, open bites, deep bite and permanent tooth loss because of caries.¹⁰

Mixed dentition period is the time in the oral cavity that have a mixture of deciduous teeth and permanen teeth.¹¹ Dias PF and Gleiser R in 2009 at Brazil did research of orthodontic treatment needs children aged 9-12 years with the reasons for the evaluation of orthodontic treatment needs should be considered not just from the characteristic of the severity of malocclusion, but also the age group and the period of children's teeth to be treated.³

Malocclusion can be defined as a mismatch of the tooth or jaw relationship that deviates from normal.²⁰ Malocclusion may emerge since children and abnormalities may develop with increasing of children's age if they do not immediately get good treatment.⁶

Malocclusions have been seen at the period of mixed dentition if not treated from an early age it will lead to more severe condition in the permanent teeth period. In an effort to prevent that we needed orthodontic treatment like prevention or early prevention in normal children.²⁰ To determine orthodontic treatment need, some indices have been developed, one of that is the Index of Orthodontics Treatment Need (IOTN), IOTN is a quite simple index, objective and practical. This index aims to classify malocclusion based on dentition abnormalities composition and aesthetic imperfections individually according to classify individuals who would benefit the most by orthodontic treatment.⁶

The location was used for this study is SDN Kedungkandang 2, because based on the dental malocclusion data from each primary health care in 2014 from Malang Public Health Service showed that primary health care of Kedungkandang subdistrict have highest malocclusion data.

MATERIALS AND METHODS

The study design was an observational analytic because researchers working to find the relationships between the variables that will be performed on the data that has been gathered.¹⁸

The method was cross-sectional, because researchers do the observation or variable measurement at a given moment. In this case, the entire population or partially elected as a sample research data will answer the questions that related to the research.¹⁴

The sample in this study were students aged 9-12 years who are in the 3-5 grade at SDN Kedungkandang 2, Malang, East Java. Measurement for the sample use Lameshow formula with total respondent 70 students. This research was conducted in SDN Kedungkandang 2, Malang, East Java. The study was conducted in February 2016.

Prior to this research to determine the extent of the validity of the research instrument (questionnaire), then used the validity and reliability test. The formula can be used to determine validity test is product moment correlation formula. The formula can be used to determine reliability test questionnaire is Cronbach Alph formula.¹²

Index of orthodontic treatment needs to be measured by charging sheet Aesthetic Component Index of Orthodontic Treatment Need. Motivation variable was measured through a questionnaire of motivation withthe total of 11 questions. The data analysis was also done using likert scale.¹⁷ Data was processed using Spearman correlation test.

RESULTS

Respondents in this study were students of class three, four and five that were aged 9-12 years. The number of respondents that used in this research are 70 people with the distribution as follows:

Table 5.1FrequencyDistribution of Respondents by Gender in SDN Kedungkandang 2 Malang

Gender	Total	Percentage (%)
Male	33	47,1
Female	37	52,9
Total	70	100

Table 5.2 Student Motivation SDN Kedungkandang 2 Malang

Criteria	Range	L	P	Total	Percentage (%)
Less Motivated	19,8-24,1	17	7	24	34,3
Motivated	24,2-28,5	10	18	28	40,0
Very Motivated	28,6-33	6	12	18	25,7
Total		33	37	70	100

Based on Table 5.1 it can be seen that the female respondents more than male respondent, as many as 37 people or 52.9%, while the number of male respondents 33 people or 47.1%. The motivation of students to perform orthodontic treatment obtained by distributing questionnaires and then the results can be seen in the following table:

According to the Table 5.2 shows that most respondents who follow the research is motivated to perform of orthodontic treatment, as many as 28 people or 40.0% with the details of 10 men and 18 women.

Orthodontic treatment need in students aged 9-12 years old of SDN Kedungkandang 2 class 3-5 are seen from Aesthetic Component Index of Orthodontic Treatment Need (AC-IOTN). The measurement results can be seen from student's intraoral photos of anterior part and then compared it with the photograph index of AC IOTN.

Table 5.3 Di Frequency Distribution of Respondents by Level of Orthodontic Treatment Need views from AC IOTN

Level of Orthodontic Treatment Need	Total	Percentage (%)
No treatment required	15	21,4
Little treatment required	34	48,6
Moderate treatment required	17	24,3
Great need for treatment	4	5,7
Total	70	100

According to Table 5.3 shows that most respondents amounted to 34 people or 48.6%, a slight require of orthodontic treatment seen by Aesthetic Component Index of Orthodontic Treatment Need (AC IOTN).

Hypothesis test used in this study is the Spearman correlation test. The relationship between motivation with orthodontic treatment need in students aged 9-12 years SDN Kedungkandang 2 Malang can be seen in Table 5.4:

Tabel 5.4 Motivation Relationships with Student's Orthodontic Treatment Need SDN Kedungkandang 2 Malang

Motivation's Criteria	Level of Orthodontic Treatment Need										Sig.	Corelation Coefficient
	No		Little		Moderate		Great		Total			
	Treatment		Treatment		Treatment		Need for					
	Required		Required		Required		Treatment		N	%		
	N	%	N	%	N	%	N	%	N	%		
Less Motivated	10	14,3	11	15,7	3	4,3	0	0	24	34,3	0,000	0,490
Motivated	5	7,1	16	22,9	6	8,6	1	1,4	28	40,0		
Very Motivated	0	0	7	10	8	11,4	3	4,3	18	25,7		
Total	15	21,4	34	48,6	17	24,3	4	5,7	70	100		

Based on Table 5.4 it can be seen that as many as 10 people or 14.3% respondents who are less motivated because they does not need orthodontic treatment, while as many as 16 people or 22.9% respondents with a little treatment required are motivated to perform orthodontic treatment, 8 people or 11.4% of respondents with moderate treatment required are highly motivated to perform orthodontic treatment, 3 or 4.3 % of respondents categorized as great need for treatment are highly motivated to perform orthodontic treatment. Most of the children belong to motivated category to perform orthodontic treatment.

Based on Table 5.4 it can be seen that the results of statistical analysis obtained significance of 0.000 which is smaller than (α 0.01). This shows that there is a relationship between motivation and orthodontic treatment need in students aged 9-12 years SDN Kedungkandang 2 Malang. The correlation coefficient obtained was 0.490 indicates that the direction of a positive correlation with the moderate corelation strength. Positive figures correlation coefficient means that the relationship between motivation and orthodontic treatment need is directly proportional. This indicates that the level of treatment need affect children's motivation to perform orthodontic treatment. So that means the higher the score orthodontic treatment needs, the higher children's motivation to perform orthodontic treatment.

DISCUSSION

Student's Motivation Aged 9-12 Years SDN Kedungkandang 2 Malang

According to Johnson in 2002 most children have the external motivation, motivation from parents or motivation from environment that can be family or friends.⁴ Motivation in children aged 9-12 years student of Kedungkandang 2 Malang related to the needs of the social compatibility and love. The needs of social and love is composed of love, affection, security, social acceptance and the need of identity.⁷

In this study, motivation of children expected to emerge as the encouragement of the child's need to be accepted into the surrounding environment where children begin to consider the other person's perspective on her appearance, the child began to notice the shortcomings of the arrangement of teeth that can be seen from the photos AC IOTN.

Based on the research, as many as 28 respondents (40.0%) consisted of 10 men and 18 women who are motivated to perform orthodontic treatment. Compared with previous studies similarities can be seen that not all students have the motivation to perform orthodontic treatment. In previous research related to motivation Children In dental health maintenance of the status of dental health in students of class III-A private primary schools Intelligent Nation 2014 results are as follows, from 38 respondents obtained 14 votes (36%) with both criteria, 22 (57%) with moderate criteria and 2 (5%) with poor criteria. Motivating children is being seen more categories is 22 people (57%), indicating that not all students have the motivation of health care giginya.¹⁵

In this study may be noted that women are more motivated to perform orthodontic treatment compared to men. A woman tends to keep up appearances to satisfy her need

to earn the respect of others.¹⁶ Based on the research that has been conducted in Japan, Sweden, Jordan, Kuwait, Palestine and Libya which consistently show that women have the attention and positive attitude in maintaining dental and oral health.¹

Orthodontic Treatment Need on Students Aged 9-12 Years SDN Kedungkandang 2 Malang

The results of this research obtained as much as 21.4% of respondents with the category no treatment required, 48.6% of respondents with a category little treatment required, 24.3% of respondents with moderate treatment required and 5.7% of respondents categorized as great need for treatment. This represents the same percentage as the previous study, the percentage of children with little treatment required are the most meanwhile the percentage of children categorized great need for treatment are the least.

In a previous study by Oley et al 2015 in Indonesia obtained the distribution of Aesthetic Component (AC) with little need treatment category were 18 people (20.32%), moderate treatment required category were 6 (9.37%) and great need for treatment were 3 people (4.69%), based on this study can be seen that most students have little need of orthodontic treatment categories and only a few students in a category great need for orthodontic treatment.⁸

Orthodontic treatment needs in this study can be seen by Aesthetic Component Index of Orthodontic Treatment Need (AC IOTN). This index is significantly classify malocclusion in occlusal variations for oral health individually and estetik perception.⁵ Index of Orthodontic Treatment Need is used to assess the need and feasibility of doing orthodontic treatment in children under 18 years for the treatment of dental health reasons.²¹ Index of orthodontic Treatment Needs (IOTN) has two components, namely aesthetic component (AC) which are seen by the state of aesthetic and dental health component (DHC) are seen by the dental and oral heath.⁵

The excess of Dental Health Component (DHC) Index of Orthodontic Treatment Needs (IOTN) are good for epidemiological surveys, simple, short examination time and can be used for larger samples. Shortage Dental Health Component (DHC) Index of Orthodontic Treatment Needs (IOTN) can not be done by a layman. The excess Aesthetic Component (AC) Index of Orthodontic Treatment Needs (IOTN) are an easy, simple, short examination time and can be done by a layman. Shortage Aesthetic Component (AC) Index of Orthodontic Treatment Needs (IOTN) results are considered subjective.

In this study used AC IOTN due in accordance with the purpose of research is to see the orthodontic treatment need through intraoral photos of anterior part that serves as the main force of motivation in children.

The Relationship of Motivation with Orthodontic Treatment Need In Students Aged 9-12 Years of SDN Kedungkandang 2 Malang

Based on test results using Spearman correlation test is known that there is a relationship between motivation and orthodontic treatment need in students of SDN

Kedungkandang 2 Malang aged 9-12 years. The relationship included in the category of moderate and proportional, meaning that the high level of orthodontic treatment need will also be followed by an increase in motivation to perform orthodontic treatment.

In this study before the children filled out a motivation questionnaire, children are shown the state of anterior teeth to make the motivation of the child. There are some children who are less motivated to perform orthodontic treatment, it is likely due to the children are still in the young age so that awareness will improve the appearance has not been too great. Psychosocial or emotional barriers caused by the appearance of teeth that are not aesthetic is also affected by maturity. It is similar to the results of a survey conducted by Uncuncu 2001 Pertiwi and Latif cited in 2008 showed 90.4% of school children do not express a desire to get ortodonti treatment.⁹

The results showed a total of 78.6% of respondents in need of orthodontic treatment (little required, moderate required, desperately required), while there are as many as 40.0% of respondents are motivated to perform orthodontic treatment. This shows that the relationship between the level of need for orthodontic treatment with the motivation to perform orthodontic treatment. Similar to previous studies, it can be seen that the force factors associated with student's motivation.

The results of the study that are expected from researchers is that many students are included in the category of requiring orthodontic treatment entirely motivated to perform orthodontic treatment, but based on the results of the research there are still students who need orthodontic treatment, but less motivated to perform treatment. That is because there are some students in this study do not feel the need for orthodontic treatment to improve her appearance. This is most likely due to students are still in the young age. Awareness of the performance will increase with increasing of the age. Low level of student's knowledge of the orthodontic treatment can also affect students' lack of motivation to do the treatment ortodonti.²

CONCLUSIONS

Based on the results of the data analysis of the relationship of motivation with a orthodontic treatment need in students of SDN Kedungkandang 2 Malang, it can be concluded that: Students aged 9-12 years old of SDN Kedungkandang 2 Malang are motivated to perform orthodontic treatment. Students aged 9-12 years of SDN Kedungkandang 2 Malang based Aesthetic Component Index of Orthodontic Treatment Need (AC IOTN) require orthodontic treatment. The higher level of orthodontic treatment need, the higher the level of student's motivation aged 9-12 years of SDN Kedungkandang 2 Malang to perform orthodontic treatment.

SUGGESTIONS

For Health Institutions, Expected health intitutions can improve education about oral health to the community for increase dental and oral heath in community, but it is

also expected to further promote the health institutions on the importance of oral health examination. For Educational Institutions, Need to improve oral health education in schools, the school is expected to cooperate with the health institutions concerned to conduct a dental examination and mouth regularly For Further Research, The next researchers are expected to be able to examine the relationship between motivation and orthodontic treatment needs seen by Aesthetic Component (AC) Index of Orthodontic Treatment Need (IOTN) and Dental Health Component (DHC).

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Customer Trust Of Outpatient On Dental And Oral Clinic At Some Hospitals In Bandung

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ABSTRACT

INTRODUCTION: Doctor-patient relationship is affected by the behaviour of service providers, in this case is hospital. **Objective :** The purpose of the study was to determine the outpatient trust of dental and oral clinic at some hospitals in Bandung. The research is explanatory research with survey method. **Materials and methods:** The research also used unit of analysis which is a hospital located in Bandung, observation unit is outpatient user of dental and oral clinic at hospital, it also used purposive sampling with n = 289 respondents and a questionnaire as research tool. **Result:** The results showed that 89.7% of respondents have a good trust to the hospital. Dimensions which has the greatest role in this research is a benevolence. **Conclusion:** Conclusion from this research show the outpatient trust come from benevolence given by the hospital to help patients or users in solving health problems.

Keywords: *customer trust; hospitals*

INTRODUCTION

Customer trust is a tribute to officers or institutions performances and sacrifices. In the health system marketing, relationship among health workers, especially between doctor and patients or health service users is essential. Guenzi P, Laurent G¹ said "Customer trust is key the mechanisms of interpersonal relationship and development". The relationship is indicated by the interaction between doctor and patient. This interaction helps to build user's trust in their doctors and the quality of medical services provided by the service provider². The result of the interaction between the doctor as a service provider with a patient (user) both create value simultaneously which have an influence on the users trust. Grayson K, Johnson D, Chen DR³ said " Customer trust is belief that an exchange partner is benevolent and honest". Trust of the customer would be built if the process of interaction

between organizations and consumers, both trying to create value that will automatically provide benefits. The customer's trust is not easy to get, because in every interaction or transaction between the organization and the customer is not always generate value.

The quality of health care is an issue that continuously increasing. Health care affects quality of life more than any other service⁴. Health care is a service with a high trust level known with its uncertainties and risks. Patients or their families (users) do not have expert knowledge to assess the quality service provided during the act of serving and even after receiving the service. Users assess the quality of health care services based on their interaction, or known as the service meeting with health care providers; their doctor. Doctor's behavior is an instrument to create effective relationships with patients and would increase patients' trust with the service provider; hospital.

In accordance with the Hospital Law Article 2 Number 44 Year 2009, quoting: "Hospitals are organized on foundation of Pancasila and value of humanity, ethics and professionalism, benefits, justice, equality and anti-discrimination, equity, patient protection and safety, along with the social function." Hospital, as one of the health care service subsystems, delivers public service with the form of services value, namely health care and administrative services. The value of services provided by hospitals supported by reliable human resources,;medical staff, medical support staff, administrative staff, technology and adequate infrastructure.

Public trust is an essential element since the loss of public trust will affect the hospital. it is also improvident act. The hospital has allocate much money to finance public health services, especially on dental and oral sector. It causes as a result of trust based on past experience with the hospital services give bad impression. Long waiting times burden the patients because they lose their working time which means decrease the income (money).

The importance of health services that provide value to the people will give improvement on people's health status along with the image of the hospital managers and patients' trust as users of health services in hospitals and government health programs. If the hospital is committed to serve patient care excellently, automatically staffs and doctors will be obedient to the policy defined by the hospital. Therefore, the existence of adequate hospitals with great human resources is necessary. It is important to improve the public health level, especially in the city of Bandung.

The low level of health is a measure of the low quality of life. The low quality of life cannot be separated from the low health service coverage. The lack of health care availability is influenced by socioeconomic problems (in per capita income, education, health behaviors), government policies, payment mechanisms, health organizations, environmental and public trust in the health services⁵. Improving health services based human resources and the quality of health providers in hospital is a priority of health programs. With good interaction between the providers of health services in hospital with the service users and the experience will spread. Users will get such experience and benefit from the hospital services. Moreover, marketing relation has been recommended as an important strategic way for companies, especially the hospitals for a better position, for those in the market

and to engage further. Any complaint from a patient will be granted if such interaction has come to an end between the user as a recipient of the service and the hospital as a service provider. Public trust to hospital for health care, especially dental and oral health will give such benefit and welfare to its employees and also assist the government in empowering the community.

In order to improve the quality of medical services (doctors and nurses), the health care personnel have to be eligible to the standards of the profession as regulated in the Law Number 36 Year 2009 on Health, pronouncing that health workers should “respect the rights of patients” and “asking for an approval for any medical procedure to undergo”. This professional standards underlying a service oriented on satisfaction and trust of users or patients. Based on the description above research INTRODUCTION, the purposes of this research are:

How do the users or outpatients trust at several hospitals in Bandung? Which dimensions and indicators from the research variables that is most responsible for the research on Dental and Oral Sector I Bandung?

MATERIALS AND METHODS

This research is an explanatory research which examines and analyzes researched variable to give an answer of proposed problems by hypothesis testing. In accordance with the research objectives as stated previously, the method used in this research is survey method. Aaker DA, Kumar V, Day GS, Leone RP⁶ says exploratory research is used when someone is looking for general insight of an issue, possible decision alternatives, and relevant variables which need consideration. Meanwhile, to collect data research, a survey is conducted. Meanwhile, Hair Jr JF, Bush RP, Ortnou D.⁷ says the survey is a method, a research procedure. This research is a descriptive method to gain an overview of the results of the collection of raw data using the format of questions and answers.

Variables in this research is customer trust, symbolized by CT, which is a measure of real success that can be achieved by each hospital as research subjects based on the following dimension: benevolence and honesty.

Data types in this research are primary and secondary data. Primary data are obtained by questionnaire and direct data entry by respondents and also field observation. Therefore, dental and oral clinic in hospitals, which are observed by questionnaire to the customer are dental and oral clinic at private and government hospitals. Questionnaires are arranged by ordinal scale. Primary data which are collected directly could be obtained from the patients or their families who accompany them, taking care of their affair and directly involved with the dental and oral clinic services. If patient refused to cooperate, then the escort would be interviewed. Surveyor gave explanation the necessity of filling the questionnaire to the outpatient to persuade the respondents to answer objectively, avoiding misunderstanding and miscommunication in filling the questionnaire. In sampling technique research, the sample which is used is purposive sample. At the first stage, samplings are done randomly.

At the second stage, based on the acquired sample size $n = 289$ respondents. Data are distributed and allocated proportionately to each hospital. Wilcoxon Signed Rank Test and T-Test are used as statistical analysis.

RESULTS AND DISCUSSION

The limitation of this research is to not include the hospital officer as research subjects. However, writer will explain a little bit of this subject since it is not only the patients or doctors which are a necessity in hospital context. The results showed that 89.7% of customer trust are in the good category, while 0.3% said very good; 2.1% is good enough; 4.5 less good and bad 3.4% Customers' trusts are tested using median test per sample using Wilcoxon Signed Rank test. Assuming that the median for medium and maximum score are 3.5, the hypothesis is

Ho. $Me \leq 3.5$: Customer Trust is low

Ho. $Me \leq 3.5$: Customer Trust is good

Based on the processing data of customer trust, the results are

Table 1. Descriptive Hypothesis Testing of Customer Trust Wilcoxon Signed Rank Test: Customer Trust

Test of median = 3.500 versus median > 3.500

N for	Wilcoxon	Estimated		
N	Test	Statistic	P	Median
Trust	289	1023	762868.0	0.000 4.500

It is acquired that value of estimated median is 4.5 with p-value is 0.000 based on result test of customer trust. Because $p\text{-value } 0.000 < 0.05$, then 5% error rate of Ho is rejected and Ha is accepted, therefore, it can be implied that customer trust is good. Trust of outpatient of dental and oral clinic at several hospitals are based on direct observation, information are received from outside source or certain process which can be concluded variationally about dental and oral clinic in several hospitals in Bandung City. A "Goof Grade" of customer trust of dental and oral clinic's outpatient is the result of the stakeholder's hard work, including the cooperation between the hospitals management and customers. The health professional (doctors, nurses, pharmacist, etc) are bounded by profession oath to not differ social status in patient care services. Customer or patient are also wanted to be treated humanely. If the customer are not well-treated by the hospital, the hospital will suffer the loss of customer trust. The patients or customers will not think twice to revisit the same dental and oral clinic. This is a bad precedent to the success and achievement of improved health status of society. In the other hand, if the customers or outpatients are well-treated by the hospital, it will have high customer trust.

Table 2. Measurement of Variable of Customer Trust

	<i>Order Measurement Equations I</i>		<i>Order Measurement Equations II</i>
Benevolence (Z ₁)	$Z_1 = 0.913 \square_2$	<i>Hospital's Dental and oral clinic officers have concern about our condition (customer) (Z_{1.1})</i>	$Z_{1.1} = 0.803 Z_1$
		<i>Hospital's Dental and oral clinic officers are tolerant towards our condition (customer) (Z_{1.2})</i>	$Z_{1.2} = 0.807 Z_1$
		<i>Giving explanation about patient's condition (Z_{1.3})</i>	$Z_{1.3} = 0.814 Z_1$
		<i>Giving steps of treatment regarding patient's condition (Z_{1.4})</i>	$Z_{1.4} = 0.811 Z_1$
Honesty (Z ₂)	$Z_2 = 0.901 \square_2$	<i>Tustable (Z_{2.1})</i>	$Z_{2.1} = 0.738 Z_2$
		<i>Honest (Z_{2.2})</i>	$Z_{2.2} = 0.790 Z_2$
		<i>Openness about patient's condition (Z_{2.3})</i>	$Z_{2.3} = 0.806 Z_2$
		<i>Understanding customer/ patient with National Health Insurance (Jamkesmas) (Z_{2.4})</i>	$Z_{2.4} = 0.816 Z_2$

In the next table, the data will be analysed based on the dimension.

High customer trust on certain hospital will make people to have a commitment on the hospital and recommend the hospital to other customers and to the public. Customer trust is considered as an important variable to keep the relationship between hospital and customers and increasing relationship and reducing perception of risk effectively. It is also a foundation of inter-personal relationship as a condition to cooperate in the next and also as a foundation of stabilization of relationship in social institution and market competition.

In the following table, the structural equation for first and second model is provided.

Based on the table, five indicators which are used to measure benevolence dimension have more loading factor than 0.5 and higher t-value than 1.96 and also coefficient reliability close to one. In conclusion, these indicators are valid and reliable in measuring the benevolence dimension. The most dominant indicator in measuring these dimensions are the "Hospital's dental and oral clinic officers give explanations about the patient condition" indicator (Z_{1.3}) with 0.814 loading factor and 0.662 R² value or in other hand 66.2% of respondents' variability of answer regarding the hospital's dental and oral clinic officers who give explanation about the patients' condition are influenced by the benevolence

factor. Benevolence of the hospitals is to solve patients' or customers' problem concerning the patient's health. It is the form of responsibility of the hospital's dental and oral clinic officers to increase the patients' or customers' prosperity and to be motivated to act based on the larger public's interest. Benevolence is very important in loyalty building process and the trust of hospital's customer and also as an active indication about specific strategic communication of the hospital.

As shown in the table above, five indicators are used to measure the dimensions of honesty, has a value of loading factor greater than 0.5, t value greater than 1.96, and reliability coefficient value close to one. So we can conclude all indicators are valid and reliable to measure the dimension of honesty. The most dominant indicator in measuring this dimension is an officer of dental and oral clinic who understand the condition of the patient's hospital ($Z_{2.5}$) with loading factor value at 0.812 and R2 value at 0.649 or in other words, 64.9% of respondent's variability of answer about an officer of dental and oral clinic in hospital ($Z_{2.4}$) is affected by honesty. It means that outpatient of dental and oral clinic at several hospitals in Bandung knowing well the condition of other user medically and economically. Officers handle patients professionally.

Table 3. Measurement Model of Benevolence Dimension

Indicator	Loading Factor	R ²	VE	T-Statistic	Note
Hospital's Dental and oral clinic officers have concern about our condition (customer) ($Z_{1.1}$)	0.803	0.645	0.301	42.106	Valid
Hospital's Dental and oral clinic officers are tolerant towards our condition (customer) ($Z_{1.2}$)	0.807	0.651	0.297	40.823	Valid
Indicator	Loading Factor	R ²	VE	T-Statistic	Note
Hospital's Dental and oral clinic officers give explanations about the patient condition ($Z_{1.3}$)	0.814	0.662	0.281	41.796	Valid
Hospital's Dental and oral clinic officers give steps of treatment regarding patient's condition ($Z_{1.4}$)	0.811	0.645	0.290	38.135	Valid
Composite Reliability	0.921				Reliabel
Variance Extracted	0.706				Reliabel
Cronbach's Alpha	0.865				Reliabel

Table 4. Measurement Model of Honesty(Z_2)

<i>Indicator</i>	<i>Loading Factor</i>	<i>R²</i>	<i>VE</i>	<i>T-Statistic</i>	
<i>Reliable Hospital's Dental and oral clinic officers ($Z_{2.1}$)</i>	0.738	0.545	0.341	43.042	Valid
<i>Honest Hospital's Dental and oral clinic officers ($Z_{2.2}$)</i>	0.790	0.524	0.326	43.528	Valid
<i>Hospital's Dental and oral clinic officers who has openness about patient condition($Z_{2.3}$)</i>	0.806	0.650	0.300	43.558	Valid
<i>Hospital's Dental and oral clinic officers who understand patient condition ($Z_{2.4}$)</i>	0.812	0.649	0.282n of Oral	45.436	Valid
<i>Composite Reliability</i>	0.92				Reliable
<i>Variance Extracted</i>	0.702				Reliable
<i>Cronbach's Alpha</i>	0.893				Reliable

Source: Results of Data Processing 2012

Table 5. Measurement Model of Customer Trust(h2)

Dimension	Loading Factor	R²	VE	T-Statistic	Information
Benevolence (Z_1)	0.942	0.887	0.075	424.508	Valid
Honesty (Z_2)	0.940	0.883	0.073	409.386	Valid
Composite Reliability	0.953				Reliable
Variance Extracted	0.919				Reliable
Cronbach's Alpha	0.921				Reliable

Source: Result of Data Processing 2012

As shown in the table above, five indicators are used to measure the dimensions of honesty, has a value of loading factor greater than 0.5, t value greater than 1.96, and reliability coefficient value close to one. So we can conclude all indicators are valid and

reliable to measure the dimension of honesty. The most dominant indicator in measuring this dimension is an officer of dental and oral clinic who understand the condition of the patient's hospital ($Z_{2.5}$) with loading factor value at 0.812 and R2 value at 0.649 or in other words, 64.9% of respondent's variability of answer about an officer of dental and oral clinic in hospital ($Z_{2.4}$) is affected by honesty. It means that outpatient of dental and oral clinic at several hospitals in Bandung knowing well the condition of other user medically and economically. Officers handle patients professionally.

Honesty is given by the hospital to the patient as an important component of patient treatment services to explain the concept of nursing such as helping patients, officers telling the truth about the condition of the patient as well as acting properly on the patient's condition. Encouraging the patient to have full spirit to heal and have a better quality of life is a reflection of officers, clinic, and hospital professionalism to the patients. Besides that, honesty given by the hospital to the patient is part of benevolent ethics or moral character of the hospital. The relationships between patients and officers at several hospitals in Bandung are supported by trust that the hospital has a moral to express honesty because that is the essential key to establish human relationships.

Customer trust variable measured with two dimensions. Both dimension is dominant in measuring customer trust variable with loading factor value which relatively similar. Each dimension has a value of 0.942 for benevolence and 0.940 for honesty. Both dimensions also have the same value in measuring customer trust.

As shown in customer trust variable, dimension of benevolence and honesty has high value and relatively similar. Overall, outpatient of dental and oral clinic in several hospitals in Bandung make inter-personal relationship with hospital by being cooperative so patient treatment process is going as expected, and that means there are factor of benevolence and honesty given by the Officer of dental oral clinic at several hospitals in Bandung.

Outpatients of dental and oral clinic have a belief that dental and oral clinic in hospital are generous, honest, good quality, and good satisfaction. Benevolence given by dental and oral clinic in several hospitals in Bandung has a purpose to help patients in solving problems that are concerned with patient's oral health. It is also aims to improve the quality of patient's life and motivate them to act based on greater public interest.

CONCLUSION

Benevolence is important aspect to building customer loyalty and trust especially for the hospital. It is also become a sign of active communication strategies specifically for the hospital. By honesty given by the operator of dental and oral clinic at several hospitals in Bandung, the processes of patient treatment become more valuable. Patient gets benefit because they are saving time, cost, and energy. Patient is motivated to heal faster than before. It impacts on operational expenses, accommodation, and other expenses during process of medical treatment will be cheaper, it also makes an officer of dental and oral clinic feel satisfied because of their action to the patient. After patients finished their medical

treatment, they share their good experiences and feeling to other patients or to general public or sometimes they recommend to others. In conclusion, patient has been practicing hospital marketing indirectly.

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The Synergistic Relationship Between Hiv-1 And Cytomegalovirus In Oral Epithelial Cell Monolayers:an In Vitro Study

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ABSTRACT

INTRODUCTION: Cytomegalovirus (CMV) is the common opportunistic viral pathogen and a major cause of morbidity and mortality among human immunodeficiency virus type1 (HIV-1)-infected individuals. One of the clinical symptoms of CMV infection may be a lesion in the oral cavity. *The relationship* between CMV and HIV-1 within the oral epithelium remains obscure.**Objectives:**To examine the *in vitro* relationship between HIV-1 and CMV within oral epithelial cell monolayers.**Materials and methods:**Polarized oral epithelial cell were established on Transwell insert and treated with HIV-1 Tat, gp120, and virions. *Transepithelial resistance (TER)* was measured using an epithelial Millicell-ERS voltohmmeter. Paracellular permeability *was determined by measuring horseradish peroxide leakage*. *Tight junctions* were identified by *immunofluorescence assay*. Human Foreskin Fibroblast cells monolayer were grown to evaluate CMV infectivity. In the reverse experiment, epithelial monolayers were exposed to CMV. The TZM-bl assay and ELISA for HIV-1 p24 antigen were performed to determine the number of HIV-1 migration.**Results:**TheHIV-1 Tat and gp120 led to *decrease* in TER, increase paracellular permeability, and disrupt tight junctions (claudin-1, ZO-1, occludin) of epithelial monolayers. These epithelial barrier impairments contribute to CMV passage through paracellular route. Similar results were obtained when epithelial monolayers treated with HIV-1 virions (HIV-1_{SF33}) and UV-irradiated HIV-1. The reverse experiments showed that epithelial monolayers damage induced *by CMV* allowing *HIV-1* migration *from* the apical to the basal surface.**Conclusions:**There is a substantial *link between* CMV and the HIV-1 within oral epithelial cell monolayers and such synergistic relationship might operate within the oral epithelium.

Keywords:*Cytomegalovirus, HIV, oral epithelium*

INTRODUCTION

Cytomegalovirus (CMV) is one of the most important major opportunistic pathogens and a major cause of morbidity and mortality among HIV-1 infected persons in the highly active anti-retroviral therapy (HAART) era.^{1,2} Epidemiologic studies showed that seroprevalence of CMV infection in HIV-1 infected patients is high, range from 50% to above 90%.^{3,4} Previous studies have shown that CMV-seropositive HIV-infected patients have an increased risk for progression to AIDS. However, several studies have produced conflicting results.^{5,6} On the other hand, it has been reported that *HIV-1* infection has a higher risk for the *acquisition/transmission* of *CMV*.⁷ These data suggested that there is a strong relationship between CMV and HIV-1. It has been suggested that the oral mucosa surfaces are susceptible to a wide range of viral infections in HIV-infected persons,⁸ however the mechanism by which CMV can interact with HIV-1 in oral epithelium is still unclear.

Previous studies showed that HIV-1 proteins (Tat and gp120) could directly breach the integrity of mucosal epithelial barrier.^{9,10,11} We postulated that HIV-1 may also *disrupt tight junctions* of oral *epithelium* and reduce its *barrier* function. The TJ, which is the most apical component of the junctional complex, represents the anatomic substrate of the oBRB. The composition of TJs, which has been unraveled over the past few years, is dominated by two main transmembrane proteins, occludin and claudin, which appear to be important to the tissue and cell-specific function of TJs.^{12,13} The consequences of alteration of the oral epithelial barrier may lead to the opening of paracellular spaces and the re-entry of human herpes viruses (HHVs), including CMV, which can be secreted at high levels into saliva. *It is suggested that* saliva is a potential risk factor for the acquisition/transmission of multiple HHVs, including CMV. Previous studies reported that CMV was detected frequently in saliva on 12.5-46% in HIV-infected persons and more often when CD4 counts were low.^{14,15}

On the other hand, it has been shown that CMV infection can cause epithelial *damage, mucosal erosion* or *ulceration* in the *major human body systems and organs, including in oral cavity*. CMV can lead to widespread oral mucosal *ulceration*. There is a reasonable speculation that CMV-related oral ulcer might provide a portal of entry for HIV-1 or new strains of HIV. It has been demonstrated in the number of cases that oral ulcers in AIDS patients associated with cytomegalovirus.¹⁶ Several studies also demonstrated that cytomegalovirus was detected in 18-53% of cases with oral mucosal ulcers in AIDS patients.^{17,18} Cytomegalovirus infections in AIDS patients may appear as recurrent aphthous ulceration and HIV-associated periodontal disease.^{19,20} It has been suggested that important to recognize that CMV associated oral mucosal ulceration may be the initial manifestation of human immunodeficiency virus (HIV) infection. Moreover, the finding of *CMV* in *oral ulcers* should alert one to the *possibility* of an *immunocompromised state*. Oral ulceration caused by cytomegalovirus should be considered in assessing patients who are severely immunocompromised.

Although numerous studies have implicated cytomegalovirus (CMV) as a cofactor in the pathogenesis of the acquired immunodeficiency syndrome (AIDS), a reciprocal

relationship between the two viruses in oral epithelium has not been determined. The aim of this study is to study the interaction between CMV and HIV-1 in cultured polarized oral epithelial cells as a model that can mimic natural infection in human tissues. Understanding the mechanism of the interaction between CMV and HIV-1 infection is central in the prevention of CMV-associated diseases and HIV *disease progression*.

MATERIALS AND METHODS

Assay for CMV passage through paracellular route of oral epithelial cells monolayers

Polarized oral epithelial cell monolayers in 12-wells plates were treated with HIV-1 SF₃₃, and UV-irradiated HIV-1 SF₃₃ at a concentration of 20ng/ml respectively for 5 days in duplicate. Medium was changed with proteins and virus every day. For CMV paracellular passage assay, CMV AD-169 obtained from American Type Culture Collection (ATCC) at MOI of 20 was added to the top of polarized monolayers and incubated at 37°C and 5% CO₂ for 1, 2, 4, and 6 hours respectively. After incubation, a 100- μ L *aliquot* of the culture medium was collected from the bottom.

Human foreskin fibroblast (HFF) cells (passage 8) were used in this study. HFF cells were obtained from ATCC. HFF were grown in Dulbecco's modified Eagle's medium (DMEM)-H21 (UCSF Cell Culture Facility, San Francisco, CA) supplemented with 10% Fetal Bovine Serum (FBS) (Thermo Scientific) and 100 U/ml penicillin and 100 μ g/ml streptomycin (UCSF Cell Culture Facility) in a T-75 culture flask (BD Falcon) and incubated at 37°C in 5% CO₂ *until cells reached confluency*. To determine the passage of CMV, HFF cells were seeded on cover slips into 24-well plates (Corning Inc., USA) at a density of 10⁵ cells per well and incubated for 24 h. 100- μ L *aliquot* collected before were poured off to confluent HFF cells to each well in duplicate. Mock infections were carried out in parallel. The cells were incubated for 3 days at 37°C in 5% CO₂. Then cells were *fixed, permeabilized, stained* for expression of CMV glycoprotein B (gB). The percentage CMV-infected cells were calculated compared to untreated cells as a control.

Assay for the passage of HIV-1 across oral epithelial cell monolayers

Confluent monolayers of polarized oral epithelial cells were established on Transwell insert and exposed to CMV (at MOI of 20 and 40) at the upper chamber. At day 3, 30ng/ml of HIV_{SF33} were added to the upper chamber of epithelial monolayers and incubated at 37°C in humidified incubator containing 5% CO₂ for the following times 1, 2, 4, and 6 hour. After incubation, a 200- μ L *aliquot* of culture medium was collected from the lower chamber for HIV-infectivity assay and detecting HIV-1 p24 antigen. Mocks were carried out in parallel. The TZM-bl assay was performed to measure *HIV-1 infectivity*. TZ-Mbl cells, obtained from ATCC, were grown in D-MEM 10% FBS heat in-activated and 10 mM L-glutamine (all from HyClone, Logan, UT) culture medium. Furthermore, TZM-bl cells were seeded *into 96 well plates (10000 cells/well)* and incubated overnight at 37°C. A 100 μ L *aliquot* collected before was added to each well in duplicate and the cells were incubated for 3 days. HIV-1 infectivity

was determined using the Tropix Gal-Screen assay kit (Applied Biosystems, Carlsbad, CA). To confirm the amount of passaged-HIV_{SF33}, we also performed ELISA for detecting HIV-1 p24 antigen according to the manufacturer's instruction.

Immunofluorescence assay

Epithelial monolayers were fixed with 4% paraformaldehyde for 20 minutes, permeabilized with 0.05% Triton, and washed three times with PBS. Cells were incubated with primary antibody of tight junctions: mouse anti-ZO-1, (Cat. 33-9100), mouse anti-occludin (Cat. 71-1500), and rabbit anti-claudin-7 (Cat. 34-9100) for 25 min in room temperature. Antibodies were obtained from Invitrogen (Carlsbad, CA). All antibodies were diluted 1:50 in blocking solution (3% bovine serum albumin and 0.003% saponin in PBS). Monolayers were washed and then incubated for 25 min with secondary antibody anti-mouse IgG (green, Cat. DI-2488) and anti-rabbit IgG (red, Cat. DI-1549), purchased from Vector Laboratories, Inc. (Burlingame, CA). After washings in PBS three times, cell nuclei were stained with Sytox green (Invitrogen, Cat. S7020) diluted 1:5000 in PBS and Propidium Iodide solution (Sigma-Aldrich, Cat. P4864) diluted 1:1000 in PBS. After monolayers were washed three times, they were mounted with Vectashield mounting medium (Vector Lab., Cat. H-1000).

For visualization of CMV gB antibody, HFF cells were incubated with primary antibodies mouse CMV gB Antibody (CH177) (Novus Biologicals, Cat. NB110-57371) diluted 1:50 in PBS for 25 min in room temperature. Cells then were washed three times with PBS and incubated with secondary antibodies Dylight[®] 549 (red) anti mouse IgG (Vector Laboratories, Inc., Cat. DI-2549) or Dylight[®] 488 anti mouse IgG (green) (Vector Laboratories Inc., Cat. DI-2488), for 25 minutes was diluted 1:100 in PBS. Cells then were washed again three times with PBS. Cell nuclei were stained with Sytox[®] green nucleic acid (Invitrogen, Cat. S 7020) diluted 1:5000 in PBS or with Propidium Iodide solution (red) diluted 1:1000 in PBS for 10 minutes. Finally the cells were mounted with Vectashield mounting medium (Vector Lab., Cat. H-1000) and observed under a fluorescence microscope.

Statistical Analysis

The data are from three experiments with duplicate samples and are presented as the mean \pm SE (standard error of the mean). The differences between two groups were analyzed using one-way analysis of variance (ANOVA) using SPSS 13.0. Differences with $p < 0.05$ were regarded as statistically significant.

RESULT

HIV-1 virions alter the tight junction integrity allowing the passage of CMV through paracellular route of oral epithelial cell monolayers

We established polarized epithelial cells monolayers to determine whether HIV-1 could alter the integrity of oral epithelial barrier and contribute to the passage of CMV. Polarized oral epithelial cell monolayers were exposed to HIV-1_{SF33} and UV-irradiated HIV-

1_{SF33} at concentration of 20ng/ml for 5 days. Then, the amount of CMV AD 169 at MOI of 20 and 40 were added to the upper chamber and an aliquot of culture medium in the lower chamber were collected for CMV infectivity assay. The results showed that treating cultured oral epithelial cells monolayers with both HIV-1_{SF33} and UV-irradiated HIV-1_{SF33} decreased the TER, increased the permeability and disrupted the tight junctions of the epithelial monolayers. The TER gradually decreased every day from 100% to 5% (Fig. 1a). In contrast, paracellular permeability of epithelial monolayers was increased by around 30% when the cells were exposed to both HIV-1_{SF33} and UV-irradiated HIV-1_{SF33} (Fig. 1b). Statistical significance ($P < 0.05$) in TER and paracellular permeability compared with control group. By immunofluorescent staining of claudin-1, ZO-1, and occludin, we found all

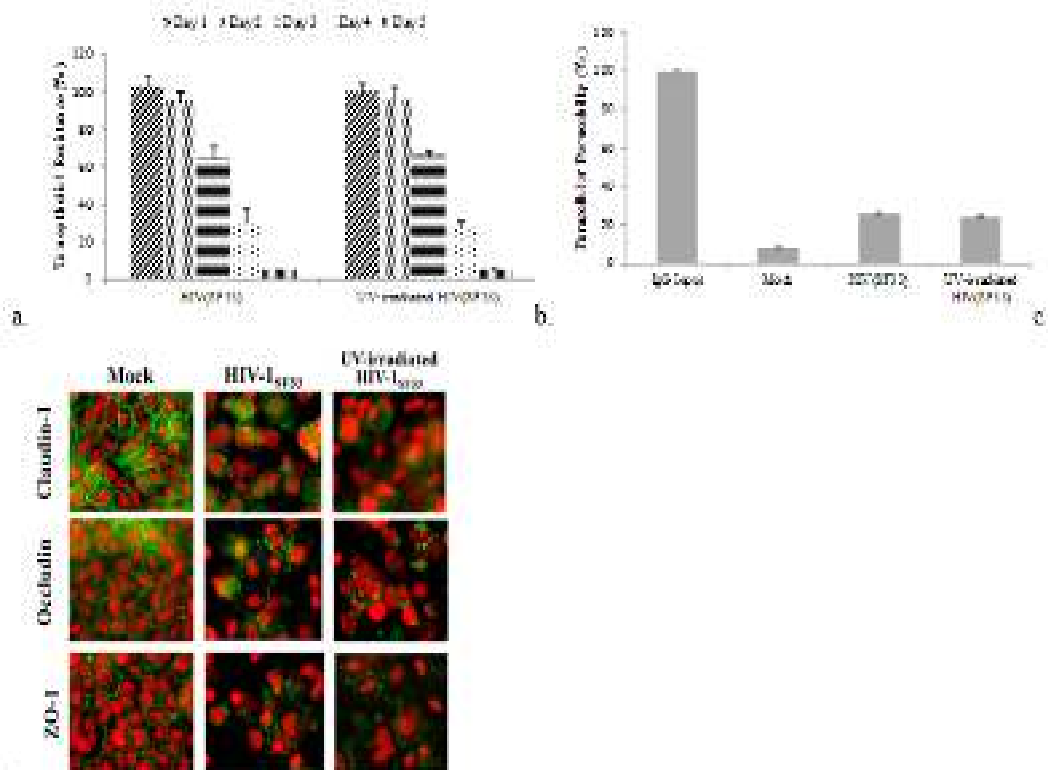


Figure 1. HIV-1_{SF33} and UV-irradiated HIV-1_{SF33}-induced barrier integrity of polarized oral epithelial cells. (a) Epithelial monolayers were exposed to HIV-1_{SF33} and UV-irradiated HIV-1_{SF33} for 5 days. Transepithelial resistance was measured every day to monitor their effects. TER values were compared with control group (100% of TER). (b) Paracellular permeability assay was performed at day 5. Data was compared to IgG input (100%) as positive control. * $P < 0.05$, significantly different when compared with control (mock group). Values shown represent the mean \pm S.E. of two independent experiments carried out in duplicate. (c) All epithelial monolayers were immunostained for a tight junction marker protein with rabbit anti claudin-1 antibody, mouse anti ZO-1 antibody, and mouse anti occludin antibody (green), and the nuclei were stained with Propidium Iodide solution (red). Original magnification 40x.

tight junctions protein were disrupted in the both HIV-1_{SF33} & UV-irradiated HIV-1_{SF33}-treated groups(Fig. 1c). These results also indicate that both of HIV_{SF33} virion and inactivated HIV-1 impaired the epithelial barrier integrity of oral epithelial cell monolayers.

We therefore sought to determine whether a disruption of tight junctions allows leakage of CMV. The CMV infectivity assay showed the expressions of glycoprotein B (gB) in CMV-infected cells among HIV-1_{SF33} & UV-irradiated HIV-1_{SF33}-treated cells. After incubating for 1 hour, we found 2% of passage of CMV and gradually increased to approximately 12% after 6 hours incubation in HIV-1_{SF33} treated cells and 8% UV-irradiated HIV-1_{SF33}-treated cells. There were no CMV passages in the mock group (Fig. 2b). Similar data were obtained from two independent experiments in duplicate. This study showed that the disruption of tight junctions induced by both HIV-1_{SF33} and UV-irradiated HIV-1_{SF33} leading to CMV cross epithelia through the paracellular space.

CMV-induced disruption of oral epithelial cell monolayers and facilitate HIV-1 migration

A number of studies reported that CMV infection may increase risk of HIV transmission. It is suggested that having active CMV makes it easier to pass HIV to others. In this study, we evaluate the potential of CMV to enhance the migration of HIV through epithelial in vitro. We established polarized oral epithelial cell monolayers and exposed to CMV AD 169 for 3 days at two different concentrations as describe at methods sections. Then, HIV-1_{SF33} virions were

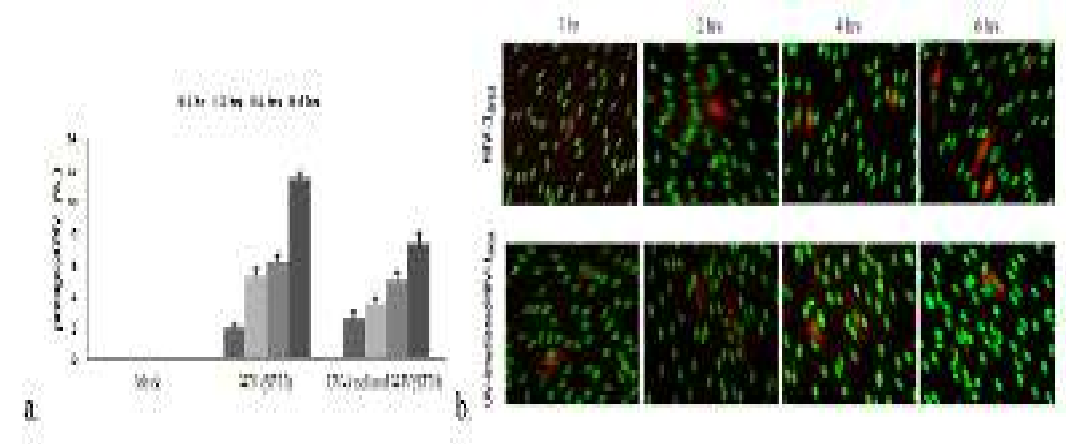


Figure 2. The passage of CMV through paracellular route of epithelial monolayers disruption induced by HIV-1_{SF33} and UV-irradiated HIV-1_{SF33}. (a) CMV were added to the upper chamber, incubated for 1, 2, 4, and 6 hours, then an aliquot of culture from the lower chambers were collected to determine the paracellular passage of CMV by . Human foreskin fibroblast (HFF) cells were used for CMV infectivity assay. The figures represent passaged-CMV following the time of incubation. The percentage of CMV-infected cells was calculated compared to input virus (100%). (b) Immunofluorescence assay for detection of gB (red) was performed. Cell nuclei were stained using SYTOX® green nucleic acid (green). Values indicate mean ± standard error of duplicates. The data is representative of two independent experiments. *P < 0.05 as compared with control. We counted CMV infection cells per coverslip in 10 randomly chosen microscopic fields at 40× magnification.

added to the top and an aliquot of culture medium from the lower chamber was collected to determine the amount of HIV-1 passage across epithelial monolayers. Compare to mock group, we found TER *decreased gradually from around 70% at day 1 to 15% at day 3* after 100ul of CMV inoculation. When cells were inoculated with CMV at concentration greater than before (at 200ul), the TER decreased from 40-10% for 3 day (Fig. 3a). The *permeability* of the epithelial monolayers was *increased* around 15-20% in both CMV-induced groups (Fig. 3b). Fluorescence *microscopic* observation *showed* that epithelial damage in some areas when cells exposed to CMV. Interestingly, the tight junctions protein (claudin-1, occludin, ZO-1) of epithelial monolayers remained *intact* (Fig. 3c). Immunofluorescence assay showed HFF cells expressing on CMV-infected cells proteins (Fig. 3d).

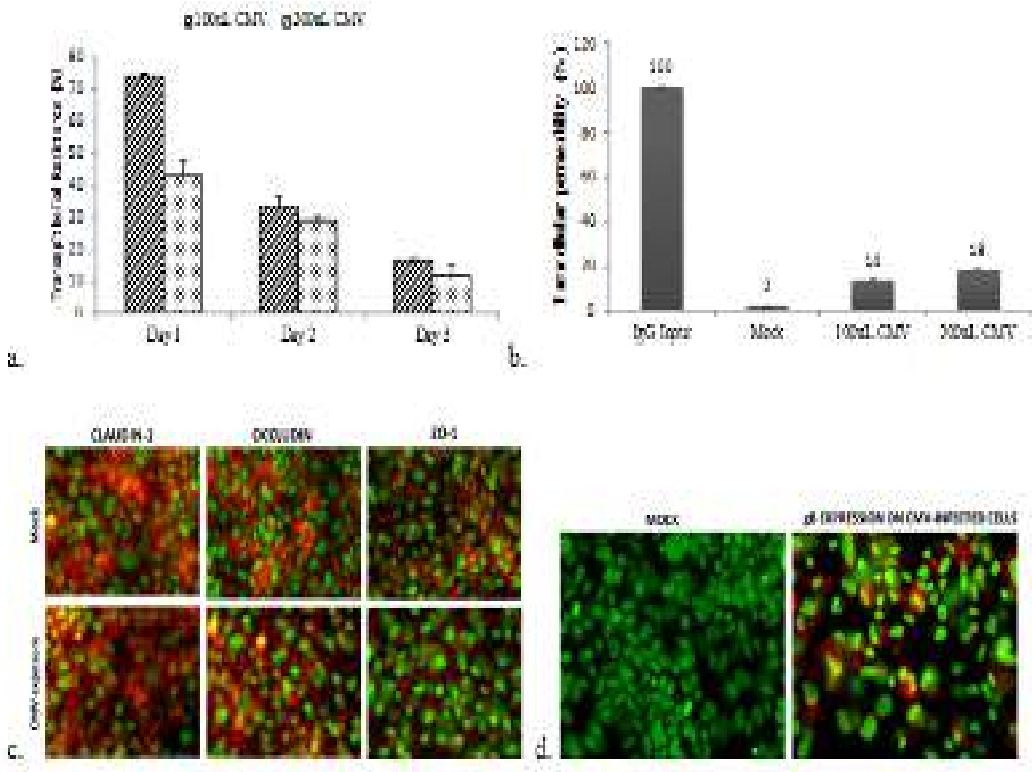


Figure 3. Alteration of TER and paracellular permeability induced by CMV without disrupting tight junctions. (a) Confluent of polarized oral epithelial cell monolayers were exposed to CMV AD 169 at MOI of 10 and 20 for 3 days and TER were measured everyday. All samples were measured three times in duplicate (b) Paracellular permeability was determined by measuring HRP leakage. Values indicate mean \pm standard error of duplicates. The data is representative of two independent experiments. *P < 0.05 as compared with control. (c) Tight junctions formation in epithelial monolayers. Epithelial monolayers were stained for ZO-1 (green), claudin-1 and occludin (red). The nuclei were stained with SYTOX® Green nucleic acid stains (green) and PI (red). (d) CMV infection was confirmed by detection of gB of CMV (red) using immunofluorescence assay. SYTOX® Green nucleic acid stains (green) were used to visualize nuc

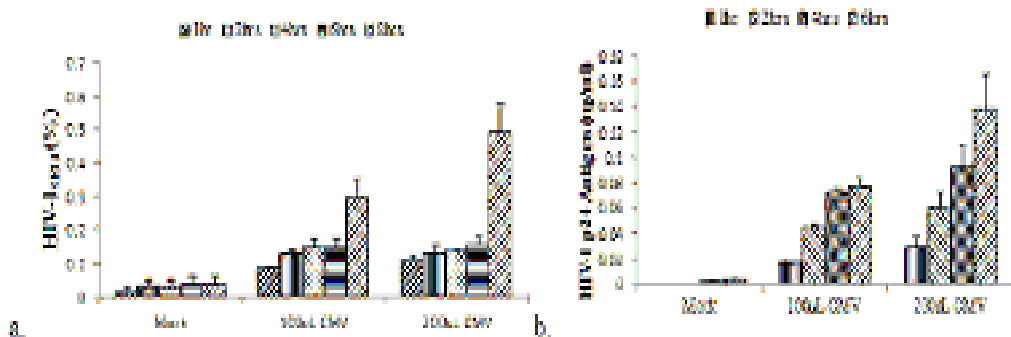


Figure 4. The passage of HIV-1_{SF33} through epithelial monolayers disruption induced by CMV. (a) The number of HIV-1_{SF33} migration from apical to basal of epithelial monolayers using TBM-bl cells assay (b) ELISA was performed for detection of HIV-1 p24 antigen. The percentage of infected cells was calculated compared to input virus (100%). Values indicate mean \pm standard error of duplicates. The data is representative of two independent experiments. *P < 0.05, significantly different when compared to control.

To determine the passage of HIV-1_{SF33} through the epithelial monolayers, we performed TBM-bl infectivity assay and ELISA. Compared to mock group, the amount of HIV-1_{SF33} passage almost three-fold higher when cells induced with CMV at MOI of 10, and five-fold higher when cells induced with CMV at MOI of 20 (Fig. 4a). Similar data were obtained when confirmed by ELISA, the numbers of HIV-1 p24 antigen increased significantly with increasing incubation time up to 6 hrs (Fig. 4b). Compare to control group, the number of HIV-1 p24 antigen was found 8-fold higher when cells exposed to CMV at MOI of 10 and 14-fold higher at MOI of 20 after 6 hour incubation. The difference was significant (P < 0.05). Similar data were obtained from two independent experiments in duplicate. Our findings confirm that CMV-induced epithelial damage lead to HIV-1 migration through epithelial monolayers and this is a good model to study the potential role of CMV in increasing risk to HIV acquisition and transmission.

DISCUSSION

Investigation of the role of HIV and CMV in barrier integrity of oral epithelia may elucidate the possible mechanism of HIV-associated susceptibility of oral mucosa to infection by CMV and vice versa. Using a polarized oral epithelial cells model, we were able to show that HIV-1 can directly decreased the transepithelial resistance, and correlated with tight junction protein disruption and increased permeability, indicating functional impairment of the barrier. Disruption of this barrier facilitates the migration of HIV-1 through paracellular space. The results are consistent with previous study that has found exposure to HIV-1 can directly breach the mucosal epithelial barrier integrity.¹¹ Our findings showed that oral

epithelial cell monolayers exposed to HIV-1_{SF33} virion led to alter the *epithelial barrier integrity*. The mechanism of HIV-induced epithelial barrier alteration may be due to mucosal cytokines produced by epithelial cells themselves that cause impairment of the epithelial barrier function by triggering epithelial apoptosis and alteration of the tight junction structure.²¹ The recent study demonstrated that the HIV-induced barrier defect of the intestinal mucosa might arise from increased epithelial apoptosis, induced by perforin-positive mucosal cytotoxic T cells.²² It is increasingly recognized that cytokines have an important physiological and pathological effect on tight junction (TJ) barrier.²³ The data also showed that UV-irradiated HIV-1_{SF33}-treated cells had a similar effect on barrier epithelial impairment as HIV-1_{SF33} virion-treated cells. It has been shown that ultrafiltration of HIV-1 able to maintain gp120 as a high molecular-weight structure in association with virion particles.²⁴ Therefore, it is possible that UV-irradiated HIV-1_{SF33} were still able to interact with cell surface, stimulate cytokine release and induce epithelial barrier disruption.

To determine *whether a reciprocal relationship existed between CMV and HIV*, we attempted to *investigate the effects of CMV* on HIV-1 migration in polarized oral epithelial cell monolayers. The results showed that *CMV-induced epithelial monolayers led to TER and paracellular permeability changes*. There were *epithelial disruptions* in some areas. Interestingly, we found the localization of claudin-1, ZO-1 and occludin was not altered indicating that the tight junction was still intact, except in *epithelial disruption areas*. *CMV infection leads to epithelial monolayers damage, causing a breakdown of barrier integrity*. A previous finding showed that CMV was transmitted from cell to cell before tight junctions were altered. Tight junction complexes of polarized epithelial cells were gradually altered following HCMV infection and becoming more permeable at late times.²⁵ Fluorescence microscopy showed damage of epithelial monolayers in some areas. Viruses may be able to produce local damage of the epithelial monolayers by direct lytic effect. A present study demonstrated that active CMV replication led to lysis of infected cells, damage of tissues, and reduced thickness of the cornified cell layers in the cultured gingival tissues.²⁶ Similar observations are found in vivo that uncontrolled replication of HCMV leads to lesions and ulcers in the oral epithelia.²⁷ CMV may be able to produce local damage of oral epithelia by direct lytic effect and *gives rise to ulcerative oral lesions in immunocompromised patients*. Thus, HCMV infection in cultured oral tissues appears to cause similar cytopathic effects and pathological changes as found in vivo. It has been reported that *CMV-specific T cell responses* are 3-5 fold *higher in HIV-infected individuals*,²⁸ and high *T-cell response to human cytomegalovirus induces production of chemokine that can cause endothelial cell damage*.^{29,30} In addition, this study implies that the passages of HIV-1 across the epithelial monolayer occur *as a consequence of epithelial damage induced by CMV*. This finding suggested that in the presence of oral epithelia damage due to CMV infection might have an impact on the risk of HIV-1 acquisition and transmission. *This study provides the first evidence* experimental demonstration that cultured oral epithelial monolayers may provide a good model for studying CMV and HIV interaction in vitro.

CONCLUSION

To our knowledge, the data presented here are the first reported evidence for the reciprocal and synergistic relationships between CMV and HIV in the polarized oral epithelial cell monolayers. The results of this study have implications for understanding the pathogenesis of the interaction between CMV and HIV in the oral cavity. However it *still need*sto be confirmed *in vivo* situation. These findings underscore the importance of controlling CMV in HIV-infected persons. On the basis of *this in vitro* study, early**recognition** and treatment may **helppreventmorbidity**and mortality caused by **CMV in HIV-infected persons**.

ACKNOWLEDGMENTS

The authors would like to thank Joel M. *Palefsky* and the staff of Department of Medicine, Division of Infectious Diseases, University of California, San Francisco, for their *support*. We would also like to acknowledge Sunardhi Widyaputra and Tony S. Djajakusumah for the useful discussion. This project was supported by *Directorate General of Higher Education, Ministry of National EducationIndonesia*.

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Evaluation Of Antibacterial Activity And Acute Toxicity Of Pomegranate (*Punica Granatum L.*) Seed Ethanolic Extracts In Swiss Webster Mice

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ABSTRACT

INTRODUCTION : Pomegranate (*Punica granatum L.*) is a versatile fruit which contain phenols, flavonoids, alkaloids, tannins. and saponins. Flavonoids and tannins have antibacterial activity. The LD₅₀ for the toxicity evaluation of pomegranate extract is necessary to give an assurance of safety for developing herb medicine. **Objectives :** To evaluate the safety of a pomegranate seeds ethanolic extract in Swiss Webster mice. **Materials and methods :** Pomegranate seed ethanolic extracts were prepared and evaluated for Minimum Inhibitory Concentration against *Streptococcus sanguis*, using microdiluted method through 96 wells microplate. In acute toxicity test, twelve females and 12 males Swiss Webster mice weighing 20 – 30 grams were divided into four groups, each consisting of 3 females and 3 males. Three groups were respectively orally given of sample with concentrations 0,2% which was equivalent to 40 mg/kg mice, 0,4% equivalent to 80 mg/kg and 0,8% equivalent to 160 mg/kg , while the control group were given distilled water. Observations were made at 30, 60, 90 minutes, 24 hours and 7 days. **Results :** MIC against *Streptococcus sanguis* was on 2.000 ppm concentration and until 24 hours observation no lethal effect on the mice, but at the 7 days observation in the group of 0,8%/kg body weight concentration, the lethal effect occurred at one mice only. **Conclusion :** Pomegranate seeds ethanolic extract has antibacterial effect and no acute systemic toxicity, can be considered save on the use as oral topical since the toxic dose is greater than 160 mg/kg of body weight.

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Keywords : *Pomegranate, ethanolic, acute systemic toxicity*

INTRODUCTION

Pomegranate (*Punica granatum L.*), one of the fruit plants often grows in the garden as ornamental tree and the fruit is edible as well. Pomegranate contains several major active components including flavonoids, a group of phenolic compounds found in nature and tannins a polyphenol compound found in plants.^{1,2,3,4,5}

The benefits of flavonoids were as antibacterial, antiviral, antiinsecticide and anti-inflammatory while the tannin substances as hemostatic, antibacterial, antioxidant and anti-inflammatory.^{6,7} The existence of flavonoids and tannins in pomegranate (*Punica granatum L.*) which serves as antibacterial was suspected can fight bacteria *Streptococcus sanguis*.^{8,9,10,11} There are 3 types of pomegranates grow in Indonesia, grouped based on the color of the fruit, i.e. red, white and purple pomegranate. Red pomegranates sweet in taste, the skin was red with beautiful seeds of glowing red fruit, rich in vitamins, minerals and other compounds that are beneficial for health. The white pomegranate has white colored, flowers are whitish, yellowish-green fruit, and less sweet. While the purple pomegranate have blackish purple peel, dark purple colored seeds but they are now difficult to find.^{2,3}

The pomegranate fruit is often used as a traditional medicine, but it has not carried out an evaluation on the security level, so the use of this plant should be through a series of tests such as the test of efficacy, toxicity, and clinical trials. Toxicity is defined as everything that has harmful effects of chemical substances or drugs on target organisms.

The primary aim of toxicological assessment of any herbal medicine is to identify adverse effects and to determine limits of exposure level at which such effects occur. Two important factors which are taken into consideration in evaluating the safety of any herbal drug are the nature and significance of the adverse effect and in addition, the exposure level where the effect is observed. Toxicity testing can reveal some of the risks that may be associated with use of herbs especially in sensitive populations.¹²

The whole animal is usually presumed to be closely correlated to human toxicity as the system incorporates pharmacokinetic (absorption, distribution, metabolism) disposition of the test substance when administered by a route similar to its intended use. It also takes into consideration, other physiological events in an organism that influence toxicity.¹²

Toxicity tests consist of two types, namely general toxicity (acute, chronic, disease/subchronic) and special toxicity (teratology, mutagenic and carcinogenic).¹³ Acute toxicity is the compound's degrees of toxic effects that occur in brief (24 hours) after a single dose administration. Acute toxicity test is one of the pre-test clinics, conducted to measure the degree of the effect of toxic compounds occurring in the short time given in a single dose in animals, the observations were conducted on the first 24 hours after treatment and was done only in one time.^{14,15,16}

Acute toxicity test of quantitative data can be obtained through two ways, i.e., the lethal dose (LD_{50}) and the toxic dose (TD_{50}). But the most frequently used method is the determination of the LD_{50} .¹² LD_{50} test is the early stage to know the safety materials to be used by humans in determining the magnitude of the dose that causes the death of 50% in

test animals after a single dose administration. The LD₅₀ of medicinal ingredient absolutely must be specified because this value is used in the assessment of the ratio of benefit (efficacy) and the power of the poison that is expressed as an index of drug therapy (LD₅₀/LE₅₀). The greater the therapeutic index, the more secure the medicine if used.¹⁷

Acute toxicity test (lethal dose) pomegranate fruit has already been done, one of which is the pomegranate peel toxicity tests conducted by Dian Sundari, et. al against the bacteria causing diarrhea. The results showed that the pomegranate were moderately toxic (830.2 mg/kg), and the use of this material is still in the safe limit.¹⁸ Bhandary, et al (2013) stated that the ethanol extract of pomegranate whole fruit and seeds and synthetic ellagic acid is practically non toxic at single dose oral administration in mice. No mortality observed at the end of 24 hours period and the LD₅₀ thought to be greater than 2000 mg.¹⁹

Since there are limited information available on its toxicity, despite the widespread use of this medicinal plant, this study investigate acute toxicity of pomegranate seed extract to find its lethal dose values. The objective of this study was to investigate potential adverse effects, if any, of a pomegranate seeds ethanolic extract in Swiss Webster mice following Acute Systemic Toxicity Testing.

MATERIALS AND METHODS

This experimental research was carried out in the laboratory of Chemistry Padjadjaran University and in The Pharmacology and Laboratory Faculty of Medicine Padjadjaran University. The pomegranate fruits were collected from the region of Cisarua Lembang, dried under the sun, mashed it into powder and subjected to extraction with 70% ethanol. The powder were soaked in 70% ethanol for 24 hours, the macerat were screened then evaporated with the rotary evaporator to obtained a stable extract pomegranate seeds.

Minimum Inhibitory Concentration Growth (MIC) and Minimum Bactericide Concentration (MBC) of pomegranate seed extract against bacteria *Streptococcus sanguis* ATCC 10556 were determined through several stages i.e rejuvenating the bacteria, making the Mueller Hinton culture media (MH), determining the Optical Density (OD), Disc Diffusion method test. Determination of MIC carried out using microdiluted method through 96 wells microplate. Every two rows of wells used duplo data, namely media and samples in series 1 and 2. The media and the solvent are on a series 3 and 4. Media, sample and bacteria *S. sanguis* are in series 5 and 6. Last, filled with media, solvents and the bacteria *S. sanguis* are on series 7 and 8. Dilution is carried out in stages starting from 8000 ppm concentration. Pomegranate seeds ethanolic extract solution were made with the concentration of 0.2%/kg BW equivalent to 40 mg/kg BW, 0.4%/kg BW equivalent to 80 mg/kg BW and 0.8%/kg BW equivalent to 160 mg/kg BW.

Acute systemic toxicity test of pomegranate seeds ethanolic extract in twelve male and 12 female Swiss Webster mice are weighing 20 – 30 grams. The mice were housed under standard animal house conditions, fed with standard laboratory pellets and water for one week. Four hours prior the test, the mice were fasting but still were given drinking and

their behaviour were observed. They were randomly divided into 4 groups of 3 males and 3 females each. Group A (control) group, were administered orally with aquadest, group B administered 0.2%/kg, group C administered 0.4% /kg, group D administered 0.8%/kg. The test material were orally forcibly given using spuit 1 ml appropriate with the mice's weight and the effects observed in 30, 60 and 120 minutes. The observed effects included: motoric activity, the straub phenomenon, piloerection, ptosis, midriasis, grooming, urination, defecation and salivation. Data of the dead mice were taken up to 24 hours after the giving of the extract, the surviving mice were observed for up to 7 days, then anesthetized intra muscullary using HCl Kethamine 45 mg/kg body weight and the dead mice were cremated.

RESULTS

The Major Active Components of Pomegranate Seeds

Our previous study showed that the seeds of pomegranate fruit contain phenolic substances, flavonoids, alkaloids, saponins and tannins.

Table 1. The secondary metabolite screening results

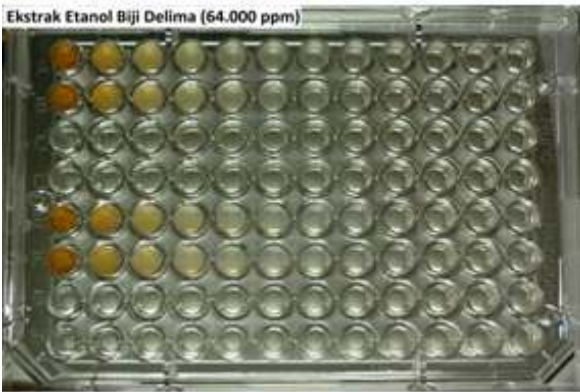
No.	Secondary Metabolite	Test Methods	Results
1.	Phenolic	FeCl ₃ 5% Reagent	+
2.	Flavonoids	Conc HCl + Mg Reagent	+
		H ₂ SO ₄ 2N Reagent	+
		NaOH 10% Reagent	-
3.	Alkaloids	Dragendorf Reagent	-
4.	Steroids	Lieberman-Burchard Reagent	+
5.	Triterpenoids		-
6.	Saponins	HCl + H ₂ O Reagent	+
7.	Tannins	FeCl ₃ 1% Reagent	+

The Minimum Inhibitory Concentration (MIC) of Ethanolic Extract Pomegranate Seeds Antibacterial Properties against *S. sanguis*

In our prior study, we found that the minimum inhibitory concentration (MIC) of ethanolic extract pomegranate seeds against *Streptococcus sanguis* was on concentration of 2.000 ppm.

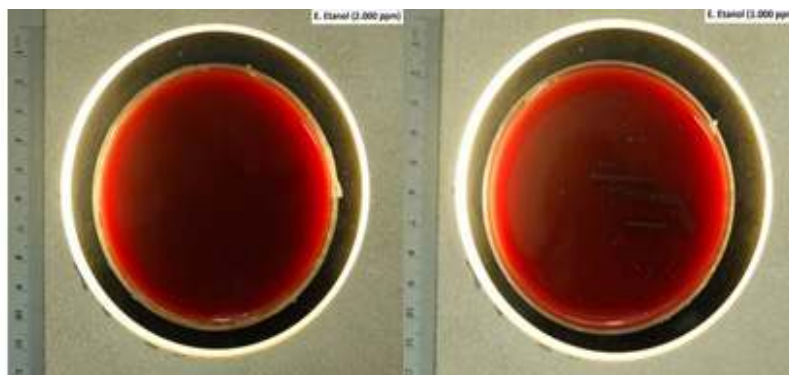
Table 2. The results of MIC analysis of Ethanolic Extracts Pomegranate Seeds against *S. sanguis*

Well	Concentration											
	32000	16000	8000	4000	2000	1000	500	250	125	62,5	31,25	15,63
Media + Sample	1,242	1,009	0,768	0,496	0,303	0,204	0,144	0,105	0,079	0,066	0,057	0,051
	1,251	1,059	0,774	0,494	0,31	0,208	0,147	0,106	0,078	0,064	0,057	0,054
Media + Solvent	0,075	0,049	0,049	0,047	0,048	0,049	0,047	0,049	0,051	0,05	0,049	0,049
	0,064	0,049	0,048	0,047	0,046	0,046	0,047	0,046	0,047	0,048	0,049	0,048
Media + Sample + Bacteria	1,261	1,151	0,837	0,506	0,302	0,212	0,156	0,13	0,098	0,082	0,073	0,067
	1,33	1,068	0,78	0,473	0,29	0,218	0,174	0,122	0,098	0,08	0,071	0,069
Media + Solvent + Bacteria	0,06	0,053	0,052	0,053	0,054	0,058	0,061	0,063	0,066	0,065	0,067	0,065
	0,069	0,052	0,051	0,052	0,055	0,057	0,058	0,058	0,059	0,063	0,062	0,064
% Bacterial death	979,5	-2156,8	-1250	100,6	140,8	-89	-155	-156	-143	-105	-95,2	-95,3
	1,2465	1,034	0,771	0,495	0,307	0,206	0,146	0,106	0,079	0,065	0,057	0,053
	0,0695	0,049	0,049	0,047	0,047	0,048	0,047	0,048	0,049	0,049	0,049	0,049
	1,2955	1,1095	0,809	0,49	0,296	0,215	0,165	0,126	0,098	0,081	0,072	0,068
	0,0645	0,0525	0,052	0,053	0,055	0,058	0,06	0,061	0,063	0,064	0,065	0,065
64000	979,5	-2156,8	-1250	100,6	140,8	-89	-155	-156	-143	-105	-95,2	-95,3
	32000	16000	8000	4000	2000	1000	500	250	125	62,5	31,25	15,63



Picture 1. MIC of Ethanolic Extract Pomegranate Seeds against *S. sanguis*

Table 2 shows that pomegranate seeds ethanolic extract have bacteriostatic activity against bacteria *Streptococcus sanguis* ATCC 10556 with a minimum concentration of 2,000 ppm (at the 5th dilution), but not obvious seen (Picture 1) because the sample were colored and not clear thereby disrupting the analysis results and solvent (ethanol) gave influence (inhibits the growth of bacteria *Streptococcus sanguis*) to the 1st dilution. MBC value showed no occurrence of bacterial growth in the media at the minimum concentration. The MBC value of pomegranate seeds ethanolic extract against bacteria *Streptococcus Sanguis* was 2000 ppm.



Picture 2. MBC Of Pomegranate Seeds Ethanolic Extract Against *S. Sanguis*

Acute Toxicity of pomegranate seeds ethanolic extract in Swiss Webster mice.

Lethal Dose test (LD_{50}) of pomegranate seeds ethanolic extract on the Swiss Webster mice.

1. Prior to test. All the mice in the control group and group of ethanolic with varying levels of concentration have normal motor activities, did not experience the straub phenomenon, piloerection, ptosis, midriasis, grooming, urination, defecation or salivation.

Post test

Table 3. The observed effects after 30,60 and 90 minutes

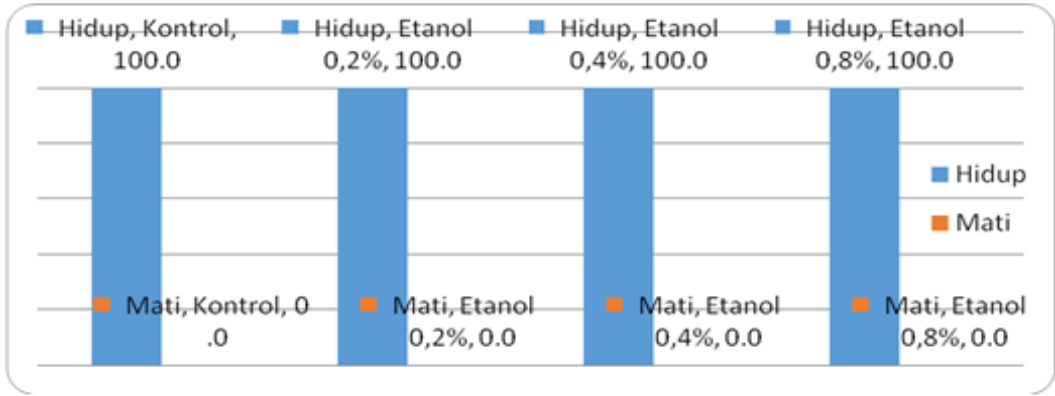
	Mot or acti vity	Straub Phenome non	Piloerec tion	Ptosis	Midriasis	Groomi ng	Urinati on	Defection	Saliv ation
Control	30' ✓	-	-	-	-	-	-	-	-
	60' ✓	-	-	-	-	-	-	-	-
	90' ✓	-	-	-	-	-	-	-	-
0,2% Ethanol	30' □	-	-	-	-	-	-	-	-
	60' ✓	-	-	-	-	-	-	-	-
	90' ✓	-	-	-	-	-	-	-	-
0,4% Ethanol	30' □	-	-	-	-	-	-	-	-
	60' ✓	-	-	-	-	-	-	-	-

Table 3 describes the effects after 30, 60 and 90 minutes being given the test, all the mice in the control group showed normal motor activities. In the ethanolic extract group, all mice experienced decreased motor activity (the movement were reduced) at the beginning of the test, but after 60 minutes the mice were active again. All mice both in control and ethanolic extract group were not experiencing the straub phenomenon, piloerection, ptosis, midriasis, grooming, urination, defecation or salivation.

Based on the results of observation in 24 hours, all of the mice (100%) in each group's test were lived and did not experience any disruptions.

Table 4. Observations in 24 hours

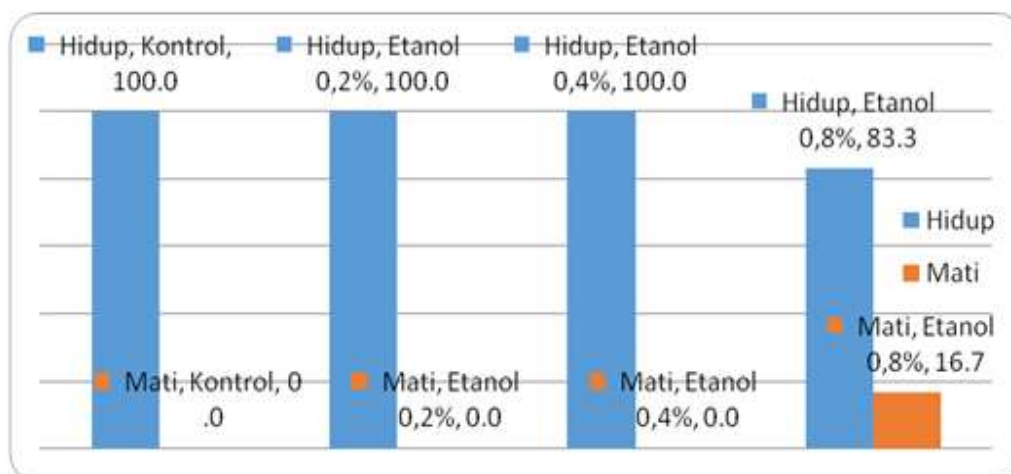
	Alive		Die		Total	
	n	%	n	%	N	%
Control	6	100,0	0	0,0	6	100,0
0,2% Ethanol	6	100,0	0	0,0	6	100,0
0,4% Ethanol	6	100,0	0	0,0	6	100,0
0,8% Ethanol	6	100,0	0	0,0	6	100,0



Picture 3. The results of observations in 24 hours

Table 5. Observations in 7 days

	Alive		Die		Total	
	n	%	N	%	n	%
Control	6	100,0	0	0,0	6	100,0
0,2% Ethanol	6	100,0	0	0,0	6	100,0
0,4% Ethanol	6	100,0	0	0,0	6	100,0
0,8% Ethanol	5	83,3	1	16,7	6	100,0



Picture 4. The results of observations in 7 days

Based on observations during 7 days, all the mice (100%) in the control group, 0.2% and 0.4% ethanolic extract still alive and did not experience any disruptions. While at the 0.8% ethanolic extract, 5 mice (83,3%) were still alive and 1 mice (16.7%) died.

DISCUSSION

The MIC concentration of pomegranate seeds ethanolic extract is 2000 ppm and the MBC is 2,000 ppm means ethanolic extract have bacteriostatic and bactericidal activity against bacteria *Streptococcus sanguis* ATCC 10556 with a minimum concentration of 2,000 ppm. The value of MIC and MBC is the principle base to determine the extract concentration used in acute toxicity test. The MBC value of pomegranate seeds ethanolic extract is 2000 ppm, equivalent to 0.2% which is the reason why the concentration of extracts will be used in this study is at minimum of 0.2%.

The result of LD₅₀ toxicity test of pomegranate seeds ethanolic extract showed that there was one mice died after the 7th day of test, at the 0.8% concentration equivalent to 160 mg/kg body weight which was given systemically. When the dose is converted in an adult human body weight calculations, e.g. 60 kg, the limit toxic dose is 9600 mg. This result indicated that death occurs at a very high systemic dose and it is a safe material especially if used topically. This is in accordance with Dian Sundari, et. al. which have already done the acute toxicity test (lethal dose) pomegranate peel against bacteria causing diarrhea, they stated that the pomegranate were moderately toxic (830.2 mg/kg), and the use of this material is still in the safe limit.¹⁸ Bhandary, et al (2013) also stated that the ethanol extract of pomegranate whole fruit and seeds and synthetic ellagic acid is practically non toxic at single dose oral administration in mice. No mortality observed at the end of 24 hours period and the LD₅₀ thought to be greater than 2000 mg.¹⁹

MBC concentration is 2000 ppm or equivalent to 2000 mg/kg and also 2000 mg/l. If the extract is used as a mouth rinse (topical) and available in bottles of 60 ml, then the required weight extract is 120 mg to achieve a concentration of 2,000 ppm. Based on these calculations, the bactericide effect arises in 120 mg in 60 ml mouthwash for topical use, which is far from the toxic dose at 9600 mg.

CONCLUSION

Based on the discussion, pomegranate seeds ethanolic extract has antibacterial effect and has passed the toxicity test, proven by the concentration of toxic dose which is greater than 160 mg/kg of body weight with effective minimum dose at 120mg/60 ml.

ACKNOWLEDGEMENT

First of all, the authors would like to thank the Lord Almighty for given us the opportunity to complete this research. We also would like thank the Dean of Faculty of Dentistry, University of Padjadjaran, who facilitated us with funding for this research, and to all staffs, laboratory workers at the chemical laboratory of the Faculty of Mathematics and Natural Sciences of University of Padjadjaran, and the Animal Laboratory Pharmacology and Therapy Department of Medical Faculty of University of Padjadjaran, for helping us in conducting this research.

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Various Oral Lesions Due To Micronutrient Deficiencies (Literature Review)

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ABSTRACT

Nutrition is an important factor for health, as well as on oral health. Nutritional factors greatly affect the integrity of the oral mucosa. Nutritional disorder in the body can affect the integrity of the mucosal surface epithelium and cause changes and facilitate the invasion of pathogenic organisms, thus triggering the onset of various disorders of oral mucosa. In this paper will discuss the update of signs and symptoms of oral lesions due to micronutrient deficiencies, includes vitamin (vitamin B12 and folic acid) and mineral deficiencies (Fe, and Zinc). This literature review prepared by collecting various related papers published in the online journals and printed textbooks in the last 10 years. Nutritional disorders in the body can be affected by two factors, the primary factor is the disruption intake of nutrients into the body, while the secondary factor related with underlying systemic disease. Various oral lesions due to micronutrients deficiencies can be found as recurrent aphthous stomatitis, glossitis, angular cheilitis, and burning sensation. Diagnosis procedure has always been a major concern in dealing with cases of oral lesions, including in the case of micronutrient deficiencies. Complete history taking, and careful examination of both clinical and laboratory can greatly help lead to the correct diagnosis.

Keywords : *micronutrient deficiencies, oral lesion*

INTRODUCTION

The World Health Organization (WHO) considers that micronutrient deficiencies have increased greatly over the last few years, more than 2 billion people worldwide suffer from vitamin and mineral deficiencies primarily iodine, iron, vitamin A and zinc, with important health consequences.¹ Micronutrient deficiencies are silent epidemics of vitamin and mineral deficiencies affecting people of all genders and ages, as well as certain risk groups. Nutritional deficiencies can not only causes specific diseases, but also can act as exacerbating factors in infectious and chronic diseases, greatly impacting morbidity, mortality, and quality of life.²

Nutritional deficiencies of vitamins and minerals can result from reduced intake, impaired absorption, or increased use (relative to the amount consumed), eating disorders, fad diets, debilitated states, alcoholism, and can be related with underlying systemic disease. Vitamins and minerals are essential for development, maturation and functioning of oral.^{3,4} Vitamins are catalysts for all metabolic reactions using proteins, fats and carbohydrates for energy, growth and cell maintenance.⁴

The rate of epithelial cell turnover of the oral mucous membranes is much more rapid than that of skin.⁵ As a result, the oral cavity often demonstrates early signs and symptoms of metabolic alteration, one of the causes is nutritional deficiencies. Nutritional deficiencies may affect the oral health and a poor oral health in turn, may lead to malnutrition. Various oral manifestations related to nutritional deficiencies, such as glossitis, atrophy of papillae of the tongue, and oral ulceration. Some symptoms may occur such as glossopyrosis, and burning sensation of oral mucosa.^{3,4}

Micronutrient deficiencies have become more prevalent following economic stress and food insecurities faced by population in some countries. Most at risk groups include children less than 5 years of age, adolescents, women of childbearing age, particularly the pregnant and lactating, refugees and victims of famine.⁶ Micronutrient deficiencies may alter the homeostasis, which can lead to disease progression of the oral cavity, reduce the resistance to the microbial biofilm and reduce the capacity of tissue healing.⁷

In this paper will discuss the review of oral lesions due to micronutrients deficiencies includes vitamin B12, folic acid, iron, and zinc.

DISCUSSION

Vitamin B12 serves as a cofactor for several essential biochemical reactions in humans. Vitamin B12 consists of a porphyrin-like ring with a central cobalt attached to a nucleotide. Various organic groups may be covalently bound to the cobalt atom, forming different cobalamins. Deoxyadenosylcobalamin and methylcobalamin are the active forms of the vitamin in humans. Cyanocobalamin and hydroxocobalamin (both available for therapeutic use) and other cobalamins found in food sources are converted to the active forms. The average diet in the USA contains 5-30 mcg of vitamin B12 daily, 1-5 mcg of which is usually absorbed. The vitamin stored in the liver. Only trace amounts of vitamin B12 are normally lost in urine and stool. Because the normal daily requirements of vitamin B12 are only about 2 mcg.⁸ Vitamin B12 is essential for making red blood cells and for myelin synthesis. Myelin is the lipid substance that insulates nerve fibers and affects transmission of nerve impulses. Neurological symptoms, such as numbness or tingling, occur as consequences of demyelination of the nerves.⁴

Folic acid (pteroylglutamic acid) is composed of a heterocycle (pteridine), *p*-aminobenzoic acid, and glutamic acid. The average diet in USA contains 500-700 mcg of folates daily, 50-200 mcg of which is usually absorbed, depending on metabolic requirements. Various forms of folic acid are present in a wide variety of plant and animal tissue; the

richest sources are yeast, liver, kidney, and green vegetables. Normally, 5-20 mg of folates are stored in the liver and other tissues. Folate are excreted in the urine and stool and are destroyed by catabolism, so serum levels fall within a few days when intake is diminished.⁸ The generic term folate encompasses several constituents that have nutritional properties similar to those of folic acid. Several different metabolically active forms have been identified. Folate deficiency, the most common vitamin deficiency among the B complex vitamins, may occur secondary to excessive alcohol consumption, vegan, pregnancy/lactation, kidney dialysis, liver disease, inadequate dietary intake, gastrointestinal disease or medications that interfere with folate absorption or metabolism.^{4,9}

Iron forms the nucleus of the iron-porphyrin heme ring, which together with globin chains forms hemoglobin. Hemoglobin reversibly binds oxygen and provides the critical mechanism for oxygen delivery from lungs to other tissues. In the absence of adequate iron, small erythrocytes with insufficient hemoglobin are formed, giving rise to microcytic hypochromic anemia. The average diet in the USA contains 10-15 mg of elemental iron daily. A normal individual absorbs 5-10% of this iron, or about 0,5-1 mg daily. Iron is normally absorbed in the duodenum and proximal jejunum. Iron is available in a wide variety of food but especially abundant in meat.⁸ Iron is essential regulation of cell differentiation and cell growth. In iron deficiency state, the levels of cytochrome oxidase are low, consequently



Figure 1. Depapillated area on dorsum of tongue.¹⁶



Figure 2. Recurrent aphthous stomatitis of the tongue and floor of the mouth.¹⁸

leading to epithelial atrophy. An atrophic epithelium makes the oral mucosa vulnerable to the soluble irritants. Lack of iron in tissues causes improper vascular channel formation resulting in decreased vascularity. This lead to derangement in the inflammatory-reparative response of the lamina propia resulting in defective healing.¹¹

Zinc (Zn) is an essential nutrient for all forms of life and its importance lies in the fact that many body functions are linked to zinc containing enzymes. It is the most abundant intracellular metal ion found in cytosol, vesicles, organelles and in the nucleus. The best food sources of zinc include meat based products, but fruits and vegetables are poor sources. Recommended daily allowance (RDA) varies from 5mg in infants to 15mg in adult. RDI (Recommended Daily Intake) and RDA numbers are a statistical estimate of the amounts that prevent individuals from manifesting deficiency signs and symptoms. About 25-66% of dietary zinc is absorbed mainly from jejunum and ileum. The total body zinc content has been estimated to be about 2.5 g in men and 1.5g in women. There is no specific zinc store. Zinc is present in all body tissues and fluids.¹² Zinc is an essential component of more than 300 metalloenzymes participating in the synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids as well as in the metabolism of other micronutrients. At the cellular level, the function of zinc can be categorised into catalytic, structural and regulatory.⁸ Catalytic means various enzymes depend on zinc for their ability to catalyze vital chemical reactions within body. Zinc dependent enzymes can be found in all known classes of enzymes.

Structural function, means zinc plays an important role in the structure of proteins and cell membrane. The structure and function of cell membranes are also affected by zinc. Loss of zinc from biological membranes increases their susceptibility to oxidative damage and impairs their functions. Regulatory function means zinc finger proteins have been found to regulate gene expression by acting as transcription factors. Zinc also plays a role in cell signaling and has been found to influence hormone release and transmission of nerves impulse.¹² Adequate intakes of micronutrients like iron and zinc are required for the immune systems to function efficiently. Micronutrients contribute to the body's natural defences on three levels by supporting physical barriers skin/mucosa, cellular immunity and antibody production. Micronutrient deficiency suppresses immunity by affecting innate, T cell mediated and adaptive antibody responses, leading to dysregulation of the balanced host response.¹³

Initial oral symptoms of vitamin B12 deficiency present with glossopyrosis (unexplained pain of the tongue), followed by swelling and pallor with eventual disappearance of the filiform and fungiform papillae. The tongue may be completely smooth, shiny, and deeply reddened with a loss or distortion of taste. Bright red, diffuse, excruciating painful lesions may occur in the buccal and pharyngeal mucosa and undersurface of the tongue. An oral examination may reveal stomatitis or a pale or yellowish mucosa, xerostomia, cheilosis, hemorrhagic gingiva and bone loss.⁴ Glossitis is usually present in persons with vitamin B, folic acid and iron deficiency.^{4,7} The tongue becomes fiery red and papillae are absent or thinning epithelium (mucosal atrophy). (Figure 1)^{4,14,15} A wide range of oral signs and symptoms may appear in anemic patients as a result of basic changes in the metabolism

of oral epithelial cells. These changes give rise to abnormalities in cell structure and the keratinization pattern of the oral epithelium leading to a “beefy” red and inflamed tongue with erythematous macular lesions on the dorsal and border surfaces because of marked epithelial atrophy and reduced thickness of the epithelial layer.¹⁵ Folic acid deficiency impairs immune responses and resistance of the oral mucosa to penetration by pathogenic organisms such as candida.⁴

Nutrition or haematinic deficiency is found in up to 20% of patients with recurrent aphthous stomatitis (RAS).¹³ RAS is recognized as the most common oral mucosal disease. Epidemiologic studies indicate that prevalence of RAS is between 25-30% in general population. RAS is characterised by recurrent, small, round, or ovoid ulcers often multiple with circumscribed margins, erythematous haloes, and yellow or grey floors (Figure 2) that present first in childhood or adolescence.^{14,15,18}

Deficiencies of certain micronutrients such as vitamins, zinc, and iron can also influence the amount and the composition of the saliva, thus limiting the protective effects in the oral cavity.¹⁹ Hyposalivation may lead to burning sensation, beside other factor that can influence the occurrence of burning mouth syndrome (BMS) - also known as glossopyrosis, glossodynia, oral dysaesthesia or stomatodynia. This term used when symptoms described usually as a burning sensation, exist in the absence of identifiable organic aetiological factors: it is a medically unexplained symptom (MUS). A haematological deficiency state (deficiencies in iron, folic acid, or vitamin B) in about 30% can cause symptoms similar to BMS.³ Acquired form of zinc deficiency also most common found in patients with Crohn's disease. Oral features include crusting, scaling rash of lips as well as ulcers, erosions and fissures.²⁰

CONCLUSION

There are sign and symptoms of oral lesions related micronutrient deficiencies such as glossitis and glossodynia, both are classic condition of vitamin B12 deficiency. It is important for dentist to be aware of these symptoms in conjunction with other oral signs such as recurrent oral ulcers, and a burning mouth. Early detection of oral lesions means a lot for patient's quality of life.

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The Difference Of Salivary Ph And Viscosity After Consuming White Rice (*Oryza Sativa*), Cilembu Sweet Potato (*Ipomoea Batatas* Cultivar Cilembu) And Purple Sweet Potato (*Ipomoea batatas* cultivar ayumurasaki)

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ABSTRACT

INTRODUCTION : Saliva is a liquid substance which is secreted by salivary glands and it plays a significant role in protecting the mucosa of oral cavity by maintaining pH as well as viscosity levels. Therefore saliva acidity level (pH) and its viscosity can be used to indicate oral cavity condition. Food plays an important role to affect the salivary pH and viscosity. **Objective** : to determine the difference of salivary pH and viscosity after consuming white rice, cilembu sweet potato and purple sweet potato. **Materials and methods**: an experimental clinical study with pre-post time series design. Ten subjects consumed 100 grams of the selected food and the saliva would be taken at 5, 15, 30, 45, and 60 minutes. The foods would be changed every 7 days. **Result** : Consuming both sweet potatoes able to show low pH level compare to that of consuming rice. **Conclusion** : there was a significant higher pH and viscosity difference after consuming cilembu sweet potato and purple sweet potato compare to that of white rice.

Keywords: *cilembu sweet potato, purple sweet potato, salivary pH, white rice, salivary viscosity*

INTRODUCTION

Saliva is a liquid substance which is secreted by the salivary glands that moistens and coats the human oral cavity. Saliva is one important element in the oral cavity, which has several functions, such as to keep the moisture in the oral cavity, lubricate and soften the food so that facilitate swallowing and tasting the taste of food, cleaning the oral cavity of the leftovers, cells, and bacteria so it can reduce the accumulation of plaque. [1]

Saliva as a liquid substance has viscosity and acidity (pH). The viscosity of saliva normally plays a role in digestion of food and motor functions such as mastication, speech and swallowing. The degree of acidity (pH) of saliva has a role as an inhibitor of decalcification process. [2]

The sweet potato is a carbohydrate -producing food that could potentially be an alternative staple food. Sweet potato varieties that are widely known by the people of Indonesia are Cilembu and purple sweet potatoes. In addition to high-carbohydrate, sweet potatoes are also rich in fiber and contain a number of vitamins and minerals. Sweet potato also has sweeter flavor than the white rice. However, in Indonesia sweet potato is often considered a lower-class society food because it is cheap and easy to grow. [3]

The sweet potato is known to have high fiber content and a sweet taste. High fiber content and clay-like consistency causes the process of mastication to be harder and thus require longer mastication time. Longer mastication time can stimulate the salivary glands to produce saliva. In a stimulated state, parotid salivary glands have a greater contribution in producing saliva than other salivary glands. Stimulation of the parotid salivary gland can cause a drop in the viscosity of saliva because of the parotid salivary glands producing saliva with low viscosity. Low viscosity causes high salivary flow rate which can maximize the cleaning process of the oral cavity so that the food is not attached to the teeth too long and cause caries. [4]

MATERIALS AND METHODS

This research is a clinical experimental research with pre and post test design. The study was conducted at Bioscience Laboratory of Faculty of Dentistry, University of Jember on 10 respondents. The respondents were asked to fast for 12 hours before consuming foodstuffs. Respondents' oral hygiene was then measured using Simplified Oral Hygiene Index (OHI-S) and then asked to brush their teeth before then checked using disclosing agent. Given foods are white rice, Cilembu and purple sweet potato. Respondents then were asked to consume a food type in 10 minutes. Food type was then changed every 1 week. Respondents were asked to collect saliva to examine the pH and viscosity before and 5, 10, 15, 30, 45, and 60 minutes after food consumption.

RESULTS

Results of research conducted on 10 respondents in the Bioscience Laboratories Faculty of Dentistry, University of Jember. Measurements are shown in Tables 1, 2 and 3.

Tables 1, 2 and 3 show the test food ingredients. The greatest decrease in pH found in subjects who consume cilembu sweet potato, amounting to 6.2 followed by the subjects who consumed the purple sweet potato amounting to 6.4 and white rice at 6.493. In all three test food ingredients, salivary pH decrease occurred in the 5th minute and been rising over the next minute until the pH of saliva gradually returned to normal.

Salivary viscosity measurements are performed before and after the test subjects consume food. The results of viscosity measurement of saliva in all three test food ingredients can be seen in Figure 1.

Table 1. The results of measurement of salivary pH after consuming white rice (*Oryza sativa*) for 60 minutes

N	Time (in minutes)						
	0	5	10	15	30	45	60
1	7,08	6,55	6,68	7,01	7,06	6,98	6,96
2	6,98	6,46	6,65	7,03	7,05	6,97	7,00
3	6,93	6,50	6,72	6,94	6,97	6,98	7,02
4	7,02	6,47	6,69	6,93	7,00	6,89	6,97
5	6,95	6,43	6,70	6,98	7,01	7,07	6,99
6	7,03	6,50	6,64	7,02	6,98	7,03	7,09
7	7,06	6,52	6,71	7,10	7,03	6,97	7,08
8	6,97	6,53	6,71	7,07	6,99	7,02	7,01
9	7,03	6,49	6,69	6,96	7,04	6,93	6,98
10	6,90	6,48	6,70	6,94	7,00	6,95	7,06
Mean	7,00	6,50	6,699	7,00	7,01	6,98	7,01
Standard of Deviation	0,59	0,35	0,26	0,58	0,31	0,52	0,46

Annotation : N : number of subject; Standard of deviation : amount of dispersion

Table2. The results of measurement of salivary pH after consuming cilembu sweet potato (*Ipomoea batatas* cultivar cilembu) for 60 minutes

N	Time (in minutes)						
	0	5	10	15	30	45	60
1	6,93	6,18	6,39	6,73	7,02	6,97	7,00
2	6,96	6,20	6,35	6,70	7,03	6,95	7,02
3	7,01	6,23	6,39	6,74	6,96	7,00	6,98
4	6,94	6,16	6,32	6,72	7,01	7,03	6,95
5	6,98	6,24	6,33	6,72	7,04	6,99	7,03
6	6,99	6,17	6,31	6,78	6,95	7,03	6,99
7	6,93	6,22	6,36	6,73	6,96	7,01	6,94
8	7,02	6,20	6,34	6,75	7,01	7,02	6,99
9	7,03	6,18	6,36	6,70	7,02	6,98	7,02
10	6,94	6,22	6,35	6,72	7,05	6,99	7,03
Mean	6,97	6,20	6,35	6,73	7,01	7,00	7,00
Standard of Deviation	0,38	0,27	0,27	0,24	0,36	0,26	0,32

Table3. The results of measurement of salivary pHAfter consuming purple sweet potato (Ipomoea batatas cultivar ayumurasaki) for 60 minutes

N	Time (in minutes)						
	0	5	10	15	30	45	60
1	7,05	6,35	6,55	6,83	7,04	6,99	7,03
2	7,09	6,42	6,63	6,89	7,05	7,02	6,97
3	7,08	6,39	6,68	6,77	6,99	7,04	7,06
4	6,97	6,36	6,59	6,72	7,02	6,97	7,05
5	6,96	6,45	6,54	6,78	7,03	6,99	7,02
6	7,04	6,43	6,60	6,84	6,94	6,92	6,99
7	6,97	6,48	6,63	6,79	6,97	7,05	6,95
8	7,09	6,37	6,53	6,77	6,96	7,01	7,03
9	7,02	6,30	6,53	6,83	7,01	7,05	6,98
10	7,06	6,45	6,67	6,86	7,03	7,06	6,99
Mean	7,033	6,400	6,595	6,808	7,004	7,010	7,007
Standard of Deviation	0,5078	0,5558	0,5662	0,5073	0,3718	0,4372	0,3622

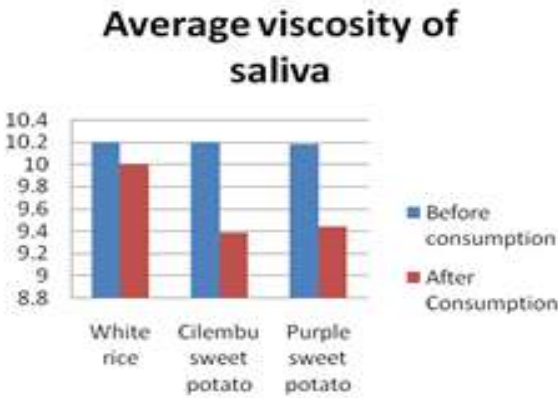


Figure 1. Average viscosity of saliva

Figure 1 shows the change in the viscosity of saliva before and after consuming all three foods and a decrease in the value of salivary viscosity after eating. The highest viscosity after eating are found in subjects who consume white rice, while the lowest viscosity found in subjects who consume cilembu sweet potato.

Data analysis

Normality test results in salivary pH (Appendix B) showed $p > 0.05$, which means the data are normally distributed. Results of homogeneity test with 95% significance level (α

= 0.05) at pH of saliva showed $p = 0.056$ on white rice, $p = 0.324$ on cilembu sweet potato and $p = 0.5331$ in purple sweet potato which means that the data is homogeneous. Anova parametric test at pH indicate $p < 0.05$, which means there is a significant difference to the pH of saliva after consuming white rice, cilembu sweet potato and purple sweet potato. Parametric test results on the viscosity of saliva using paired T-test showed no correlation on the viscosity of saliva before and after consuming all three food ingredients, but there were significant differences after consuming all three food ingredients, namely white rice cilembu sweet potato and purple sweet potato.

DISCUSSION

Saliva is a liquid substance that can be found in the oral cavity of humans and animals, which is secreted by the salivary glands. As a liquid substance, the salivary has a degree of acidity which is called the pH of the salivary. Saliva has a buffer properties, which is a tendency of fluids to maintain its pH to be in a normal value. In normal individuals, the salivary pH ranging from 6.2 to 7.4. The value may decreased 15 minutes after a person consumes a food substance. The level of reduction in salivary pH can vary, depending on the type of food consumed, however, presence of buffer properties possessed by the saliva resulted in the pH of saliva returns to normal 30-60 minutes after eating.[5]

Results of research conducted on salivary pH after consuming white rice, Cilembu sweet potato and purple sweet potato indicates similarities, namely the existence of significant decrease in pH on the 5th minute. In white rice, Cilembu sweet potato and purple sweet potato, the pH of saliva in the 5th minute towards 10th minute showed a significant increase, as well as from the 10th minute towards 15th minute. In the 15th minute to the 30th minute, there was no significant increase in salivary pH of of subjects who consumed white rice, whereas in subjects who consumed purple sweet potato and Cilembu sweet potato there is still a significant increase in salivary pH. In the 30th minute towards 60th there were no significant differences in the pH subjects who consume Cilembu sweet potato and purple sweet potato. This indicates that the pH of subjects who consumed white rice returned to normal on the 15th minute, while the the pH of subjects who consumed purple sweet potato and Cilembu sweet potato returned to normal on the 30th minute.

Results of research on the viscosity of saliva showed that the viscosity of saliva is highest in subjects who consumed white rice, which means that the viscosity of saliva is more viscous in subjects who consume white rice. This is due to cooked rice contains less fiber than sweet potatoes. In subjects who consumed sweet potatoes, there is a lower viscosity of saliva, which means more watery saliva. This is due to sweet potatoes contains a lot of fiber, in which subjects had to chew a lot more to soften the the food before swallowing. No significant difference between the viscosity of saliva in the consumption of purple sweet potato with a viscosity of saliva in the consumption of Cilembu sweet potato. This is due to purple sweet potato and Cilembu sweet potato has about the same texture so that mechanical stimuli generated from consuming both types of sweet potatoes did not differ significantly [6].

CONCLUSION

Conclusions from the study “The Difference of salivary pH and Viscosity After Consuming White Rice (*Oryza sativa*), Cilembu Sweet Potato (*Ipomoea batatas cultivar cilembu*) and Purple Sweet Potato (*Ipomoea batatas cultivar ayumurasaki*)” is there are differences in pH and viscosity of saliva before and after taking the three types of food.

SUGGESTION

Suggestions from this study is there needs to be more research to better understand the factors that affect salivary pH and salivary viscosity and the relationship between the consumption of foods and salivary pH and viscosity.

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Salivary Flow In Patient With Type 2 Diabetes Mellitus Based On The Characteristics Of the subject

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ABSTRACT

INTRODUCTION: Diabetes mellitus is a metabolic disease caused by a defect in insulin secretion, insulin action, or both. Polyuria which is one of the common symptoms in patients with diabetes mellitus causes an imbalance of body fluid to intracellular and extracellular dehydration. The condition leads to reduced production of saliva of major and minor salivary glands. **Objective:** The purpose of this study is to determine salivary flow in patients with type 2 diabetes mellitus based on the characteristic subject. **Materials and methods :** This is a descriptive study with consecutive sampling techniques with the data being presented in tables and graphs. The population consisted of 60 patients, divided into two equally sized groups – those with type 2 controlled and those with uncontrolled type 2 diabetes mellitus. **Result:** The results of patient with controlled type 2 diabetes mellitus, 11 people (36.67%) showed normal salivary flow rate, 10 people (33.33%) had low salivary rate, another 9 people (30%) suffered from hyposalivation. **Conclusion:** In the group of patients with uncontrolled type 2 diabetes mellitus, as many as one person (3.33%) showed normal salivary flow rate, 16 people (53.33%) is low, and 13 (43.33%) hyposalivation. It can be concluded from this study the salivary rate of patients with uncontrolled type 2 diabetes mellitus is less than that of controlled type 2 diabetes mellitus patients.

Keywords : *salivary flow, xerostomia.*

INTRODUCTION

Diabetes mellitus (DM) is a disease characterized by defect in the metabolism of carbohydrates, proteins, and fats as a result of hyperglycemia caused by a defect in insulin secretion, insulin action, or both¹. The prevalence of diabetes mellitus worldwide is expected to exceed 114 % in 2030². In Indonesia, the WHO predicts an increase in the number of people with diabetes from 8.4 million in 2000 to approximately 21.3 million in 2030 (an increase of 43.4 %).

Various epidemiological studies on the incidence and prevalence of DM prove that DM is a global public health problem that requires special attention. Such attention is warranted as in 95% of cases type 2 diabetes mellitus, in which insulin resistance is accompanied by

defects in insulin secretion with varying degrees usually occurs in middle age with a peak onset at age 60 years covering 95 % of all cases³.

Polyuria, one of the common symptoms in patients with DM causes an imbalance of body fluid, leading to intracellular and extracellular dehydration⁴. This condition leads to reduced production of saliva (Hyposalivation) by major and minor salivary glands. Furthermore, decreases in salivary flow may cause of a dry sensation in the mouth, called xerostomia^{5,6}. Research shows that xerostomia occurs around 40-80% in diabetic patients⁷. Salivary secretion is an important factor in maintaining oral health. The cleaning action of saliva eliminates the desquamation of oral epithelial cells, colonies of bacteria and food debris. In the event of a reduction in salivary flow, oral tissues are often ulcerated and infected, usually accompanied by rampaging prevalence of dental caries⁸.

MATERIALS AND METHODS

The working of the study is approved by the institutional review board of The University of Padjadjaran. The study populations were type 2 diabetic patients divided into two groups. The first group consisted of 30 controlled diabetic patients with treatment in form of oral hypoglycemic agents, insulin, or on dietary control. The second group had 30 uncontrolled diabetic patients, who were not consuming drugs, or not on treatment and without dietary control⁹.

The type 2 diabetic patients at the Endocrine Polyclinic Dr. Hasan Sadikin Hospital, Bandung examined in June 2015, with consecutive sampling technique. Agreement to participate and informed consent in the survey were obtained from each patient. Type 2 diabetic patients with impaired cognitive function and currently in radiation therapy were excluded. A pooled whole saliva sample from 60 type 2 diabetic patients was used throughout the experiment. Measurement of salivary flow with the spitting method, respondent instructed not to eat and drink 1 hour before the research: (1) subjects in a relaxed and keep the mouth shut and not swallowing for 1 minute (2) spit saliva collected and accommodated in a measuring cup, performed 5 times (for a total collection time 5 minutes) (3) the volume of saliva in the measuring cup is recorded based on the numbers on the measuring cup. (4) Salivary flow rate measurement of the distribution of the volumes of saliva per unit time (ml/ 5 min). $\frac{\text{saliva volume (ml)}}{\text{time (5 minutes)}}$ A person's average salivary flow rate should be between 0.5-1.5 liters per day¹⁰. Salivary flow rates category (1) normal 0.3 ml/minutes (2) low 0.1-0.25 ml/minutes (2) very low (hyposalivation) below 0.1 ml/minutes¹¹. The data collected were entered into a computer and presented in tables.

RESULTS AND DISCUSSIONS

Based on the results of research by the author to 60 patients with type 2 diabetes who were treated at the Endocrine Clinic Hospital Dr. Hasan Sadikin, the authors obtained data that will be presented with the following description

Table 1 shows the gender distribution of respondents. Characteristics of respondents by gender shows that type 2 diabetes patients are most common from women group. Overall patients with type 2 diabetes 23 people (38.33 %) are men and 37 people (61.67 %) are women.

Previous research conducted by Ekpenyong et al. in 2011, showed similar results. Minimal physical activity of women than men is closely linked to the high incidence of type 2 diabetes in women. Fat distribution in women is more widespread, especially in the abdominal and overall obesity is a predisposing factor for type 2 diabetes abdominal fat affects insulin metabolism by releasing free fatty acids. Free fatty acids reduce the cleaning action of insulin by the liver that can lead to insulin resistance and hyperinsulinemia. In addition, fat cells secrete several factors that affect signal transmission processes such as leptin, adiponectin, interleukin 6, and tumor necrosis factor involved in the development of insulin resistance.

Table 2 and 3 shows the frequency distribution of salivary flow in patients with controlled type 2 diabetes and uncontrolled type 2 diabetes. The results obtained from studies of groups of patients with controlled type 2 diabetes, 11 (36.67 %) showed normal salivary flow rate with an average of 0.50 ml / min, 10 people (33.33 %) is said to be low with an average of 0.23 ml/min, 9 (30 %) experienced an average hyposalivation with 0.06 ml/min. In the group of patients with uncontrolled type 2 diabetes, as many as 1 person (3.33%) showed normal salivary flow rate with an average of 0.4 ml/min, 16 people (53.33 %) is low with an average of 0.25 ml/min, and 13 (43.33 %) with an average hyposalivation 0.06 ml/min.

The data obtained from the results in Table 2 and Table 3 show that in the group of patients with controlled type 2 diabetes, the number of respondents who experienced hyposalivation fewer than the number of patients with uncontrolled type 2 diabetes. In the group of patients with uncontrolled type 2 diabetes is more common respondents with normal salivary flow. This is consistent with previous research that has been done by Shrimali, et al. (2011) that patients with uncontrolled type 2 diabetes are more prone to experience a decrease in salivary flow rate compared to patients with controlled type 2 diabetes. This condition is caused by medicines consumed by patients with type 2 diabetes a continuous basis as well as other suggestions such as diet and lifestyle changes that can restore the patient's obedient performed blood glucose levels to the normal rate¹².

The main action of drugs consumed by patients with type 2 diabetes is to improve the regulation of carbohydrate metabolism by binding to insulin receptors on muscle and fat cells and lower blood glucose levels by facilitating the uptake of cellular glucose, while inhibiting the release of glucose from the liver¹³.

In contrast to the group of patients with uncontrolled type 2 diabetes who do not consume drugs and other therapy that blood glucose levels tend to be high (hyperglycemia). Blood glucose levels in diabetic patients related to salivary flow. The occurrence of diuresis associated with a decrease in extracellular fluid caused by hyperglycemia due to a direct effect on the amount of saliva produced⁸. In addition, a decrease in salivary flow increased

Table 1. Table Characteristics of Respondents by Gender

Gender	Frequency	%
Men	23	38,33
Women	37	61,67
Σ	60	100

Table 2. Distribution of Salivary Flow Rates in Controlled Type 2 Diabetes

Salivary Flow	Frequency	Average (ml/min)	%
Normal (0.3 ml/min)	1	0.4	3,33
Low (0.1-0.25 ml/min)	16	0.25	53,33
Hyposalivation (<0.1 ml/min)	13		43,33
Σ	30	0.236	100

Table 3. Distribution of Salivary Flow Rates in Uncontrolled Type 2 Diabetes

Salivary Flow	Frequency	Average	%
Normal (0.3 ml/min)	11	0.50	36,67
Low (0.1-0.25 ml/min)	10	0.23	33,33
Hyposalivation (<0.1 ml/min)	9	0.06	30
Σ	30	0.752	100

Table 4. Distribution of Type 2 Diabetes Patients with Xerostomia Complaint based on Gender

Xerostomia Complaints	Frequency	%
Men	14	23.33
Women	21	35
Without complain	25	41.67
Σ	60	100

by 30 % at age 65 years and older because at least in the elderly , patients had been taking at least one medication that can alter the function of salivation^{15,16}.

In this study also showed in the group of patients with controlled type 2 diabetes are respondents who had low salivary flow rate value even very low (Hyposalivation) . This phenomenon can be caused because there are other factors that also affect salivary flow. Consumption of other drugs such as antidepressants, sympathomimetics, diuretics, anticholinergics, antihistamines, anti- Parkinson agents psycho-tropic, cardiovascular agents, and muscle relaxants may interfere with the autonomic nervous system, altering the composition of fluids and electrolytes, and affects blood flow to the glands so effects diminished salivary flow^{17,18}.

Table 4 illustrates the frequency distribution of type 2 diabetes patients with xerostomia complaints based on gender . It appears that in patients with type 2 diabetes mellitus women are more prone to subjective symptoms such as dry mouth (xerostomia). In the group of patients with type 2 diabetes are male , as many as 14 people (23.33 %) complained of xerostomia, whereas the group of patients with type 2 diabetes women carrying 21 people (35 %) complained of xerostomia.

From the results of the study, 35 patients complaining of symptoms of dry mouth (xerostomia). Xerostomia is a subjective complaint, is not a synonym for Hyposalivation since xerostomia may occur because of changes in the quality of saliva, but does not change the quantity. Often patients complain of dry mouth but show the value of a good salivary flow rate, and vice versa¹⁸. Patients who complain of dry mouth (xerostomia) is known that the group of patients with diabetes mellitus women more often complain of symptoms of dry mouth (xerostomia) than among male patients with diabetes mellitus. This is according to research conducted by Borgnakke et al. in 2010, that the prevalence of women who complain of symptoms of dry mouth is higher than men. This condition is often associated with menopause condition that occurs in women^{19,20}. Decreasing levels of estrogen receptor β in menopausal women results in salivary gland hypofunction²¹. Estrogen plays a role in regulating cell growth, differentiation and tissue function mediated by oral estrogen receptor (ER), which consists of two subtypes, namely ER α and ER β . However, only ER β is contained in the oral tissues, including the oral epithelium and salivary glands. Deficiency of the hormone estrogen that occurs during menopause causes disruption of epithelial oral physiology and affecting the salivary glands and salivary secretion can result in xerostomia^{22,23}.

CONCLUSION

Salivary flow reduction frequently occur in diabetic patient and cause discomfort in the oral cavity and the effect on oral health and overall health, the necessary amount of saliva adequate both in quantity and quality²⁴. Salivary flow rate in the group of patients with uncontrolled type 2 diabetes is lower than the rate of salivary flow controlled type 2 diabetes patients. Salivary secretion itself plays an important role in maintaining oral health.

The cleaning action of saliva eliminates the desquamation of oral epithelial cells, colonies of bacteria and food debris. Therefore, improvement in the quality of dental services to diabetic patients oral conditions especially reduction in salivary flow and additional education regarding oral health in patients with type 2 diabetes would be necessary.

ACKNOWLEDGE

This study was supported by the Universitas Padjajaran, the Indonesian Ministry of Education for Higher Education and to whom the authors gratefully acknowledged.

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Sweet Taste Threshold On Kretek Filter-Smoking Labors

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ABSTRACT

Smoking habits has many bad effects to the body. Besides systemic effect that cause by smoking habit, other effect that someone doesn't realize is decreasing taste sensation. One of indicator that represents decreasing of taste sensation is elevating sweet taste threshold.

Objective: Therefore the aim of this study is to get data about sweet taste threshold on kretek filter- smoking labors. **Materials and methods :** This study is descriptive with consecutive technique sampling method. Samples consist of 29 manufacturing labor that has smoking habit of kretek filter at PT Karisma Abadi Sentosa. Sweet taste threshold is measured objectively by one series sucrose solution consists of vary concentration, other data about smoking habit can be known by filling questioners. **Result:** The result said that subject has higher sweet taste threshold than control. Mean value of taste threshold on kretek filter- smoking labors is 0.0273M, while sweet taste threshold on non-smoker control is 0.015M. **Conclusion:** The conclusion of this study shows that sweet taste threshold on kretek filter - smoking labors higher than sweet taste threshold on non-smoker control.

Key Words: taste threshold, kretek filter, smokers

INTRODUCTION

Indonesia is ranked 3rd after China and India for the highest cigarette consumption²⁹. According to their professions, smokers are mainly working as farmers, fishermen, and factory labors. Cigarettes that usually found in the market in Indonesia are kretek, lintingan, cigar, and white cigarette¹⁸. According to filter utilization, cigarette can be distinguished to cigarette with filter and cigarette without filter. Kretek filter cigarette is the most common cigarette to be consumed⁹.

Cigarette contains at least 7000 toxic chemical substances and carcinogenic agent. These substances cause vary negative effects to oral cavity and body system⁴. One of the effects that often unrecognized by smokers is decreasing in taste sensation.

Hot smoke and nicotine consisted in cigarette are the most enchanting substances that cause taste alteration. Hot smoke from cigarette may cause decreasing length of

tongue papillae. High nicotine level of cigarette can irritate taste bud and interfere nerve impulse to the brain. Beside, that substance can also interfere saliva secretion so that may cause decreasing taste sensation⁷.

Someone can feel taste sensation if the taste reaches the taste threshold. Decreasing tongue taste sensation can be identified by measure vary taste threshold using some solutions with vary concentrations. The ability to taste sweetness in human is located on the tip of the tongue. In smokers, cigarette's smoke that enters oral cavity will directly expose tongue tip. This can frankly alter sweet taste sensation, which causes increasing sweet taste threshold. Sucrose sweet taste threshold in human is 0.01M¹⁰.

Increasing sweet taste threshold in smokers can change food intake pattern. Increasing sugar consumption can occur in someone who experiences increasing sweet taste threshold, and will indirectly increasing the risk of diabetes. Another effect cause inflicted by increasing sweet taste threshold in smokers tongue is decreasing taste sensation ability. This can cause decreasing appetite in smokers. The one who experiences this, consequence sooner or later may suffer from malnutrition, and also can affect someone's quality of life. The aim of this study is to get data about sweet taste threshold on kretek filter- smoking labors.

MATERIALS AND METHODS

This study is categorized as descriptive study. Sample population in this study are kretek filter - smoking labors who fulfill inclusion criteria and willing to participate in this study. Sampling technique in this study is consecutive. Data were collected using questionnaires and measurement of sweet taste threshold.

The minimum number of samples used in this study follows Slovin's theory. From total 30 populations with 5% standard deviation, minimum sample calculated is 28⁵.

Criteria sample in this study are:

Labors who have smoking habit for more than 1 year.

Labors who have smoking habit everyday.

Age below 45years old.

Labors who have salary below average.

Labors without systemic or local disease that may alter tongue taste sensory ability such as ageusia, disgeusia, diabetes, and Sjögren Syndrome.

This study using 11 sucrose solutions that arranged from lower concentration to the highest concentration starting from 0.0060M to 0.0550M. Sucrose was used to create the sweet solution because sucrose is the standard substance for measuring sweet taste threshold.

Preparation of the solution by dissolving sucrose powder into water is following this formula²⁵:

$$n = \frac{\text{mass}}{Mr} \qquad M = \frac{n}{\text{Volume}}$$

Based on formulas above, if we want to make 0.01M sucrose solution, we should dissolved 3.42gram sucrose powder into 1L distilled water.

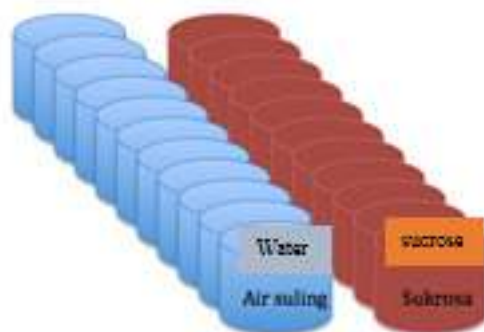


Figure 1 Arrangement of Water and Sucrose Solution

Subjects and control were instructed to fill in questioner and informed consent. Measuring sweet taste thresholds in subjects and controls were carried out with 11 sucrose solution intercalated with distilled water. Thirty minutes before the measurement begin, subjects are not allowed to eat, drink or smoke. These instructions are given in order to get more accurate result. This study was done with single blind method meaning that subjects must use blindfold during the measurement period. Subjects were asked to drink sample solution from lower concentration then gargled with water. Subjects were asked to drink sample solution from lower concentration then gargled with water. All those sample solutions have 15mL volume. Subjects drink sample solutions until subject can certainly recognize what taste does subjects drink. Operator must take a note on sucrose concentration level where subjects can certainly recognize what taste does subject drink. Taste threshold is a concentration where subjects can certainly recognize what taste does subject drink⁷. All those notes were analyzed and inserted into the table.

RESULT AND DISCUSSION

The measurement results of sweet taste threshold from subjects and controls are summarized at Table 1. The number of samples (n), mean, standard deviation (Sd), median value, modus value, and range are calculated. Measurements were carried out from 29 - smoking labors and 27 non-smoker control. The data shows that the average sweet taste threshold in subject is 0.0273M while the average sweet taste threshold in control is 0.015M. Standard deviation of sweet taste threshold in subject is 0.0060 while in control is 0.0036. Median and modus value in subject are 0.025M while in control are 0.0175M. Range values in subject and control are 0.0225M and 0.0075M, respectively.

Table 1 Measurement Result Sweet Taste Threshold in Kretek filter - smoking labors

	n	Mean	Sd	Median	Modus	Range
Data Subject	29	0.0273	0.0060	0.025	0.0250	0.0225
Data Control	27	0.0150	0.0036	0.0175	0.0175	0.0075

Standard deviation value in subject is higher compared to control data. This means sweet taste threshold value in subject is more diverse than control data. How every people smoke can determine this diversity. Recent study shows that several smokers who consume 5 until 9 cigarettes per day smoke higher level nicotine than smokers who consume more than 20 cigarettes a day. This means that the nicotine level in the body depends on how deep does smokers inhale the cigarette smoke. Mean, median, and modus values in subject describe sweet taste threshold in kretek filter - smoking labors tend to higher if compare to control who don't smoke. Diagram below shows that kretek filter smoker tend to have lower taste sensation compare to control.

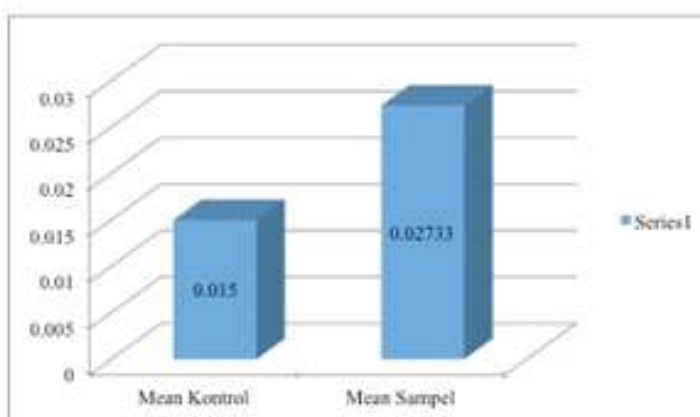


Diagram 1 Comparison Sweet Taste Threshold Mean Value in Control and Sample

CONCLUSION

Sweet taste threshold in kretek filter - smoking labors in PT Karisma Abadi Sentosa according to objective measurement data tend to increase compare to control who don't smoke. Sweet taste threshold in kretek filter - smoking labors have modus value of 0.025M whereas control that don't smoke have modus values of 0.0175M. Based on those results, it can be concluded that there is decreasing of sweet taste sensation in kretek filter - smoking labors.

ACKNOWLEDGEMENT

In this opportunity I want to thank God because his blessing I'm able to done this study in time. And of course this study would not have been possible without the support of many

people too. I wishes to express my gratitude to my supervisor, Dr. drg. Sri Tjahajawati., M.Kes, AIFM and drg. Ervin Rizali, M.Kes., AIFM who were abundantly helpful and offered invaluable assistance, support and guidance. Special thanks also to Kartika and Prapitta for sharing the literature and invaluable assistance. Not forgetting to my best friends who always been there. I wishes to express my love and gratitude to my beloved parents and siblings; for your understanding & endless love, through the duration of my studies.

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- 29.

The Relation Of Interalar Width To Inter canine Distance Among The Races Of Malay, Chinese And Indian

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ABSTRACT

INTRODUCTION: The interalar width is the distance between the most lateral aspects of the nose. As for inter canine distance, it is defined as the mesiodistal width of the six maxillary anterior teeth which are the central incisors, lateral incisors and canines. **Objectives:** The goal of this research is to find out whether there is a relation of interalar width to inter canine distance between different races of Malay, Chinese and Indian. **Materials and methods:** The method used for this research was descriptive study with analytical statistical approach. Stratified random sampling technique was used to determine the sample size from the total population of Malaysian female Malay, Chinese and Indian students of Faculty of Dentistry from batch 2011 to 2015. The data was analyzed using Kolmogorov-Smirnov test, Shapiro-Wilk test and Levene test. **Results:** The result shows that there is positive correlation between interalar width and inter canine distance among the races of Malay, Chinese and Indian students. **Conclusions:** In conclusion, there is a relation of interalar width and inter canine distance among the races of Malay, Chinese and Indian.

Keywords: *Interalar Width, Inter canine Distance, Malay, Chinese, Indian*

INTRODUCTION

Presently in the modern field of dentistry, many authors and researches have emphasized that the interalar width is that the distance measured from the most lateral most aspect of one ala nasi to the other ala nasi as one of the most routinely used methods in determining the width of maxillary anterior teeth. The nasal width continues to increase with age due to the continuous changes of soft tissues. Lee and Picard estimated that the distance between the outer surfaces of the nose was same as that between the tips of canines.¹ Mavroskouf and Richiedemonstrated some relationship between nasal width and inter canine distance which suggested its use to establish the width of anterior teeth. Wehner suggested that by extending parallel lines from lateral surfaces of nose alar onto labial surfaces of maxillary occlusal rim will determine the inter canine cusp tips. The distance

between intercanine cusp tips must be emphasized as the need to achieve a proportionate mesiodistal dimension of maxillary anterior teeth as it is the key element for esthetic purposes. In many previous researches, interalar width has always been continuously used to relate to the intercanine distance.²

Nose shape gives information about race, ethnicity, age and gender. On the other hand, there have been reported regarding the studies on the interalar width and intercanine distance for several populations including the Brazilians, North Americans and the Saudi Arabians. In order to estimate the maxillary canine distance, the interalar width had to be multiplied by a factor of 0.91 for Brazilians, 1.03 for North Americans and 1.56 for Saudi Arabians. Nose is the uppermost part of the respiratory tract and the organ responsible for the sense of smell. The anatomy of the nose consists of the nasal bridge, slope of the tip, septum and nares. The nasal width which is the distance between the most lateral aspects of the nose continues to increase with age due to the continuous changes of soft tissues.² Nose shape gives information about race, ethnicity, age and gender. The size, shape and proportions of the nose provide a visual basis suggesting the character of the person.³

Teeth are the hardest and chemically the most stable tissues in the body where they are one of the most used elements in identifying a lot of aspects including anthropological, genetic, and odontologic and not to mention, they play an important role in providing the most pleasant facial and dental esthetics. For example, if the width of maxillary anterior teeth is selected to bear resemblance to their predecessors, patient acceptance is much greater and an improved esthetic outcome can be successfully achieved. Maxillary central incisors especially are known to be one of the most essential teeth to fulfill the esthetics requirements where the width is considered to be more critical than the length when it comes to providing the highest level of esthetics. Often, when patient complains of anterior Based on previous studies, intercanine width is known to correlate well with several facial measurements, where one of them is the interalar width.⁴

The studies performed by many researches above show that there is a difference of interalar width and intercanine distance among different racial group. From a study on this relation conducted by Latta et al., it showed that there is no correlation between intercommisural width, interalar width, interpupillary width and position of canine in the North Americans. Varjao and Nogueira found a weak correlation between intercommisural width and distal surfaces of canines for different racial groups. However, a positive correlation between intercanine distance and interalar width has been shown on the studies of Hasanreisoglu et al., al-el-Sheikh and al-Athel. It is shown that the position of the canine can be based on the facial anatomical structures and this measurement will be differing among races. Unfortunately, there are not many studies regarding this relationship performed in Asian people.^{5,6} Due to the scarcity of this research, a study of relation of interalar width to intercanine width will be conducted among Malay, Chinese and Indian ethnics.

The assumption of this research is that there is a relation of the interalar width and intercanine distance among the three races, Malay, Chinese and Indian. This is because ethnic influences can result in the different appearances of the nose which classified nose

into three major groups. For example, Caucasians belong to the leptorrhine group where the nose is finer with nasal index of 69.9 or less. Most Asians fall under the mesorrhine which is known as moderately broad nose where the nasal index ranges from 70.0 to 84.9. Whereas, the Africans and the indigenous Australian are platyrrhine as they have broad noses with nasal index of 85.0 and above.⁷ Not only that, ethnicity appear to have synergistic effect on mesiodistal width of maxillary anterior teeth. For example, people of African descent have greater mesiodistal tooth dimensions than those of European descent.⁸

METHOD

This research is a descriptive study with analytical statistical approach. This approach involves collecting and scrutinizing every data sample in a set of items from which samples can be drawn. The data collected from the selected samples of the Malaysian female Malay, Chinese and Indian students in Faculty of Dentistry in Universitas Padjadjaran will be evaluated and assessed statistically to see whether there is a relation of interalar width and intercanine distance. The population of this research would be of Malaysian students studying in Universitas Padjadjaran. The samples which will be participated in this research is consists of Malaysian female Malay, Chinese and Indian students from the Faculty of Dentistry. The sample size determination technique used would be stratified random sampling. This method involves the division of a population into smaller groups known as strata. In this sampling technique, the strata are formed based on members' shared characteristics. Then, a random sample from each stratum is taken to participate in this research. The inclusion criteria of sample includes female, the age of 18 to 25 years old, those who had complete set of permanent dentition, no morphological developmental anomalie. The research exludes those whose permanent dentitions have not been fullu erupted, who are edentulous and those who have congenital facial defect. The variables of the research comprises the independent variable is that race and the dependent variables are those interalar width and intercanine distance.



Gambar 1. Interalar width



Gambar 2. Intercanine distance.4

The samples are asked to fill inform consent as an agreement that they agree to conjoint on the research. The samples are seated at an upright position on a chair and asked to look straight forward with the head in the correct anatomical position. By using the eyeliner is subsequently marked two point at the alae of the nose while the samples are asked to hold their breath during measurment. The digital vernier caliper is adjusted to the marked point on the nose to measure the maximum nasal breadth by placing both divider arm of the vernier caliper at the right angle to the nasal height from ala to ala of the nose and the data that are gained is recorded.

The mesiodistal width of each maxillary central incisor, lateral incisors and canines are measured intraorally by using digital vernier caliper as well. The internal jaw of the venier caliper is placed in the labial embrasures of the widest mesiodistal measurement of each tooth. The measurements of each maxillary anterior teeth widths are recorded on the examination paper. The meassurements are taken three times for each parameter by the same operator and with the same equipments. The mean value of each parameter is calculated and recorded.

RESULT

The results were collected from 51 samples of Malaysian female Malay, Chinese and Indian students who are studying in Fakultas Kedokteran Gigi Universitas Padjadjaran from batch 2011 to 2015. The sample size determination technique that is used is stratified random sampling method. The data will be analyzed by carrying out by analytical cross-sectional of the samples.

The table above shows the data of interalar width and intercanine distance of Malaysian female Malay. Based on the data collected from the 16 samples, it is known that the mean value of interalar width is 3,500; with the minimum value of 3,000; maximum value of 3,800 and the standard deviation of 0,242. As for intercanine distance, the mean value is 3,525; with the minimum value of 2,500; maximum value of 4,300 and standard deviation of 0,497.

Table 1. Data of Interalar Width and Inter canine Distance of Malaysian Female Malays

No	Interalar Width (cm)	Inter canine Distance (cm)
Mean	3,227	3,709
Min	2,600	2,300
Max	3,600	4,400
Stdev	0,251	0,557

Table 2. Data of Interalar Width and Inter canine Distance of Malaysian Female Chinese

No	Interalar Width (cm)	Inter canine Distance (cm)
Mean	3,227	3,709
Min	2,600	2,300
Max	3,600	4,400
Stdev	0,251	0,557

Table 3. Data of Interalar Width and Inter canine Distance of Malaysian Female Indians

No	Interalar Width (cm)	Inter canine Distance(cm)
Mean	3,031	3,354
Min	2,500	2,600
Max	3,500	3,900
Stdev	0,281	0,452

Table 4. Analysis of correlation of interalar width and inter canine distance among Malaysian Female Malay, Chinese and Indian using Pearson

Race	Variables	R	t value	t table	Result	Significance	Coefficient Determination
Malay	Interalar width and Inter canine Distance	0,625	2,996	2,145	Ho is not accepted	Significant	39,1%
Indian	Interalar width and Inter canine Distance	0,52	2,278	2,201	Ho is not accepted	Significant	27,0%
Chinese	Interalar width and Inter canine Distance	0,720	3,882	2,086	Ho is not accepted	Significant	51,8%

The table above shows the data of interalar width and inter canine distance of Malaysian female Chinese. Based on the data collected from the 22 samples, it is known that the mean value of interalar width is 3,227; with the minimum value of 2,600; maximum value of 3,600 and the standard deviation of 0,251. As for inter canine distance, the mean value is 3,709; with the minimum value of 2,300; maximum value of 4,400 and standard deviation of 0,557.

The table above shows the data of interalar width and inter canine distance of Malaysian female Indians. Based on the data collected from the 13 samples, it is known

that the mean value of interalar width is 3,031; with the minimum value of 2,500; maximum value of 3,500 and the standard deviation of 0,281. As for intercanine distance, the mean value is 3,354; with the minimum value of 2,600; maximum value of 3,900 and standard deviation of 0,452.

The relation of interalar width and intercanine distance among Malaysian Malays is strong is that 0,625, this indicates that there is a positive relation interalar width and intercanine distance among Malaysian Malays. The standard deviation is 39,1% showing that the intercanine distance is influenced by interalar width. The relation of interalar width and intercanine distance among Malaysian Chinese is strong as well is that 0,720 with standard deviation is 51.8%. exhibiting the intercanine distance is influenced by interalar width. On the other hand, the relation of interalar width and intercanine distance among Malaysian Indians is 0,520 with the standard deviation is 37,0% meaning that the intercanine distance is influenced by interalar width.

DISCUSSION

The interalar width can be influenced by various factors. However, in this research, racial influence on interalar width is very much focused and emphasized. The Malays belong to two of the major geographical races of mankind which are the Mongoloids and Austroloids, known as Paleomongoloids with the Mongoloid trait much dominant than the latter.⁹ The traits of the pygmies which are the African-Negroes can be found in the Malays as Austroloids constitutes the Eastern branch of the Negroid.¹⁰ The majority of the Mongoloids have mesorrhine types of nose. As for the Austroloids and Negroids, they possess platyrrhine nose types. As for the Austroloids and Negroids, they possess platyrrhine nose types. The Chinese are of the Mongoloid origin.¹¹ The Mongoloids feature the Mesorrhine nose type where nose is moderately broad. The Indians are a mixture of the "Dravidian race" with an Austroid grouping, sub-race to the Caucasoid race and also a trace of Mongoloids. Basically, Malaysian Indians are a mixture of all major types. Carlestone Coon considerably amended his views, acknowledging that India is the easternmost outpost of the Caucasoid racial region. This means that Malaysian Indians have the most distinctive feature of the Caucasoids where they possess noses with long, narrow, high in both root and bridge.¹¹

Based on a research by Mar Mar Wai et al., it is stated that the Malays have an average nasal index of 81.00, the Chinese with a mean nasal index of 79.56 and Indians with nasal index of 76.27. These results show that the dominant nose type in all three races is the Mesorrhine nose types. This is because all three races have traits of the Mongoloids. However, from the nasal indices shown, the Malays have the highest nasal index, followed by the Chinese and then the Indians. This shows that the Indians are more to the leptorrhine nose type while the Malays are more to the platyrrhine nose type due to the mixture of the racial origin the three races have.¹²

According to the data obtained, it can be concluded that these measurements can indeed be used for determining the intercanine distance. The measurements can vary due

to the ethnic differences. For female Malay, the mean value for intercanine distance and interalar width is 3.525 cm and 3.500 cm respectively. This indicates that the intercanine distance can be obtained by multiplying the interalar width the value of 1.007 for this race. As for female Chinese, the values, 3.709 cm and 3.227 cm are the values for intercanine distance and interalar width respectively. Based on this, the intercanine distance can be gained by multiplying the interalar width with the ratio of 1.149. Last but not least, the mean value for intercanine distance and interalar width for female Indians are 3.354 cm and 3.031 cm respectively. As a result, it is known that the intercanine distance can be obtained by multiplying the interalar width with the ratio of 1.106.

CONCLUSION

Base on the experiment yield, it can be expressed that there is a positive correlation between interalar width and intercanine distance of the maxilla among the races of Malay, Chinese and Indian.

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The Effectiveness Of White Cambodia Flower Extract (*Plumeria alba* L.) As A Denture Cleanser To Decrease The Number Of *Candida Albicans* In Soft Liner

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ABSTRACT

INTRODUCTION: Soft liner is a material used to prevent soreness of denture due to excessive bone resorption which sharpens the alveolar ridge. However, soft liner has been proven to be easily contaminated with *Candida albicans*. We need to clean it with denture cleanser to overcome this problem. However, chemical denture cleanser is known could change the physical properties of soft liner. **Objective:** To find out the effectiveness of white cambodia flower extract as a denture cleanser to decrease the number of *C. albicans* in soft liner. **Material and Methods:** Soft liner was soaked in sterile distilled water and white cambodia flower extract in different concentrations (25%, 50%, 75% and 100%). Then, the absorbance value of *C. albicans* was measured using a spectrophotometer to determine the concentration. **Results:** The concentration of *C. albicans* on soft liner in sterile distilled water and white cambodia flower extract in different concentrations (25%, 50%, 75% and 100%) are 1,576x10⁸ CFU/ml, 1,334x10⁸ CFU/ml, 0,896x10⁸ CFU/ml, 0,464x10⁸ CFU/ml, and a 0,035x10⁸ CFU/ml respectively. **Conclusions** It is shown that the concentrations of *C. albicans* decreased with the increasing of the concentrations of white cambodia flower extract. Therefore, white cambodia flower extract is proven to be effective against *C. albicans*.

Keywords: *Candida albicans*, denture cleanser, *Plumeria alba*, soft liner, spectrophotometer

INTRODUCTION

On the use of denture, it is often obtained that the condition of denture support tissue is not optimal caused by the excessive of bone resorption. In certain cases, the resorption pattern of alveolar ridge causes sharp or knife-edge form.¹ It can cause pain in patients when using denture. Therefore, denture needs to be coated with a soft material such as soft liner to provide comfort during use denture and prevent the continuation of bone resorption.

Soft liner is a material that is used to prevent chronic pain because of using denture, because it reduces occlusal forces, also help maintaining the support structure of denture in the oral cavity.² Soft liner is used to create a comfortable adhesion between the denture surface and the soft tissues in oral cavity, reduce the trauma of occlusal loaded in patients who experience severe alveolar bone resorption and the area that is in the wound healing process after surgery.³ However, the previous studies stated that the average number of *Candida albicans* on acrylic resin plate with using soft liner is higher than without the use of soft liner.⁴ In fact, *C. albicans* is the cause due to the use of denture stomatitis (denture stomatitis) that is most common occurred.⁵ Therefore, denture that uses soft denture liner is necessary to keep it clean by soaking it in denture cleaner. However, denture cleaner with chemicals is not recommended for soft liner because it can alter the hardness surface of soft liner itself.⁶

Therefore, we need a natural material instead of chemical-based denture cleanser to reduce the number of *C. albicans* on a soft liner. The purpose of this study was to determine the effectiveness of white cambodia flower extract as a denture cleanser to decrease the number of *C. albicans* on the soft liner.

METHODS

This research used laboratories experimental research. This research was done at the Laboratory of Bioscience and Laboratory of Microbiology, Faculty of Dentistry, University of Jember, and the Laboratory of Biology Faculty of Pharmacy, University of Jember. The research was conducted in September-December, 2015. The study began with the manufacture of white cambodia flower extract by maceration method. The white cambodia flower that had been washed and then dried without exposure to the sunlight. Furthermore, white cambodia flower dried was shattered using blender to be soft powder. The extraction is done with the immersion technique (maceration) in 70% methanol solution, closed and stored in the dark room for 3 days and stirred once in a day. Then, the filtrate was taken, evaporated and heated, so that the extract became viscous consistency. Furthermore, the dilution was done and based on respective groups of samples that had been determined.

After making the complete extract, it was continued to make 25 samples of rectangular plate soft liner with size 10x10x2 mm, then divided into five groups. Plate soft liner was made using square mold with size 10x10x2 mm that was placed on the glass plate. Then, soft liner stirred accordance to powder and liquid ratio due to the factory provisions until it was homogeneous. Then, the soft liner was placed in mold before undergoing to setting process, then mold and soft liner stacked on glass plate so that the surface became flat and smooth. After setting, glass plate was released and the soft liner plate was removed from the mold, and then washed with water to remove dirt. Then, each sample was immersed in sterile artificial saliva for 1 hour. After that, the sample was rinsed with Phosphate Buffer Saline (PBS) solution, and then it was contaminated by *C. albicans* suspension for 24 hours. After that, the samples were re-rinsed with PBS solution, and then immersed each sample in sterile

distilled water and white cambodia flower extract in different concentrations corresponding to treatment groups for 30 minutes. In group I, the sample was stored in sterile distilled water (control group). In group II, III, IV, and V, the samples immersed in white cambodia flower extracts with respected concentrations of 25%, 50%, 75% and 100%. Then, each sample was rinsed with PBS solution, then put in 2 ml of Sabouraud's Dextrose Broth (SDB) and vibrated with Thermolyne for 30 seconds. After that, the reading of *C. albicans* absorbance value was done in spectrophotometer to determine concentration.

RESULT

Table 1. Results of the concentration calculation of *C. albicans* in the Sabouraud's Dextrose Broth (SDB) media

Group	Average
Group I	1,576x10 ⁸ CFU/ml
Group II	1,334x10 ⁸ CFU/ml
Group III	0,896x10 ⁸ CFU/ml
Group IV	0,464x10 ⁸ CFU/ml
Group V	0,035x10 ⁸ CFU/ml

Information:

1. Group I: Soft liner plate soaked in sterile distilled water (negative control) scored the concentration of *C. albicans* 1,575x10⁸ CFU / ml on sample 1, 1,599x10⁸ CFU / ml on the sample 2, 1,653x10⁸ CFU / ml on the sample 3, 1,461 x10⁸ CFU / ml on sample 4, and 1,590x10⁸ CFU / ml in sample 5.
2. Group II: Soft liner plate soaked in white cambodia flower extract 25% gain value 1,320x10⁸ concentration of *C. albicans* CFU / ml on sample 1, 1,347x10⁸ CFU / ml on sample 2, 1,404x10⁸ CFU / ml on sample 3, 1,278 x10⁸ CFU / ml on sample 4, and 1,320x10⁸ CFU / ml on sample 5.
3. Group III: Soft liner plate soaked in white cambodia flower extract 50% gain value 0,867x10⁸ concentration of *C. albicans* CFU / ml on sample 1, 0,894x10⁸ CFU / ml on sample 2, 0,990x10⁸ CFU / ml on sample 3, 0.846 x10⁸ CFU / ml on sample 4, and 0,882x10⁸ CFU / ml on sample 5.
4. Group IV: Soft liner plate soaked in white cambodia flower extract 75% gain value 0,555x10⁸ concentration of *C. albicans* CFU / ml on sample 1, 0,513x10⁸ CFU / ml on sample 2, 0,486x10⁸ CFU / ml on sample 3, 0.411 x10⁸ CFU / ml on sample 4, and 0,354x10⁸ CFU / ml on sample 5.
5. Group V: Soft liner plate soaked in white cambodia flower extract 100% gain value 0,030x10⁸ concentration of *C. albicans* CFU / ml on sample 1, 0,024x10⁸ CFU / ml on sample 2, 0,045x10⁸ CFU / ml on sample 3, 0,054 x10⁸ CFU / ml on sample 4, and 0,024x10⁸ CFU / ml on sample 5.

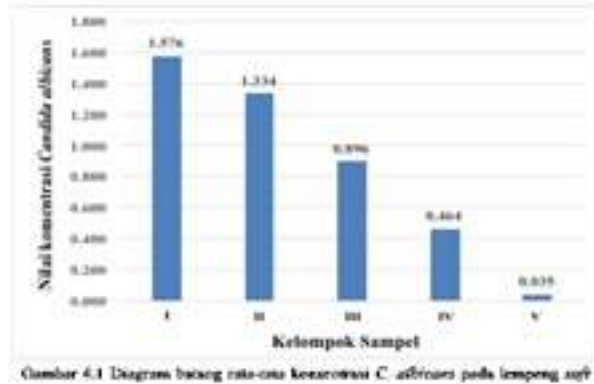


Figure 1. Diagram rod average concentration of *C. albicans* on soft liner plate after soaking in distilled water, 0.2% chlorhexidine gluconate and white cambodia flower extract (n x 108 CFU / ml)

The research data was tested by normality test using the Kolmogorov-Smirnov test and tested its homogeneity using Levene test, it was obtained the distributed normal data and homogeneous data. Furthermore, the data was tested the different test used One-Way ANOVA test followed Least Significant Difference (LSD) to determine differences in the data on each research group with 95% confidence level ($p = 0.05$).

LSD test results showed that there were significant differences in each group treated with significance value of 0.000 ($p < 0.05$). It showed that the higher concentration of white cambodia flower extract could make the concentration value of *C. albicans* became lower.

DISCUSSION

Based on research that had been done, the *C. albicans* concentration appeared to have the highest number in the first group or the control group. In group I, the soft liner plates were soaked in sterile distilled water. It was because the sterile distilled water used to soak the control group did not have antimicrobial and antifungal effects. In group II, the soft liner plate was soaked in white cambodia flower extract with concentration of 25%. In this group, *C. albicans* had lower concentration when it compared with group I. It showed that white cambodia flower extract could reduce the number of *C. albicans*, although the *C. albicans* concentrations did not much decrease from the first group due to the low concentration of the extract. In group III, the soft liner plate was soaked in white cambodia flower extract with concentration of 50%. In this group, the *C. albicans* concentration decreased when compared to group II. It caused by the increase extract concentration, so that the antifungal chemical composition in white cambodia flower extract also increased. In group IV, soft liner plate was soaked in white cambodia flower extract with concentration of 75%. In this group, the *C. albicans* concentration was also decreased when compared to group III. It occurred because of the presence of increasing concentrations on white cambodia flower extract. In group V, the soft liner plate was soaked in white cambodia flower extract with 100%

concentration. The average value of *C. albicans* concentration was the lowest number when it compared to other groups. It showed that the concentration of white cambodia flower extract was higher and it made the antifungal effect was also higher, so that the *C. albicans* concentration would be lower on soft liner plate.

The lower value of *C. albicans* concentration on soft liner plates can exist because white cambodia flower extract has active compounds that can inhibit the attachment of *C. albicans* on the soft liner plate such as tannins, flavonoids, saponins and alkaloids. Thus, the higher concentration of white cambodia flower extract can provide the higher active compound contained therein.

The white cambodia flower extract is effective against decrease in the number of *C. albicans* because it has four chemical compounds that has antifungal effect, such as tannins, flavonoids, saponins and alkaloids. It is supported by Sibi's research which proves that white cambodia flower extract (*P. alba*) contains four chemical compounds such antifungals.⁷ Research by Sibi also proves that white cambodia flower extract is effective for inhibiting the fungi growth, where the fungi that used in the study was *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus terreus*, *Penicillium digitatum*, and *Rhizopus arrhizus*. These fungus is pathogenic on citrus sinensis fruit. Chemical compounds that are contained in white cambodia flower extracts work with interfering the permeability of fungal cells, damage the fungal cell's protein structure, lower the surface tension of fungal cells and disrupt peptidoglycan components of fungal cell.

Tannins is a secondary metabolic compound in plant and it is one phenol group. Tannins have antimicrobial effect because it has astringent compounds. Astringent compounds in tannins could be expected to interfere the cell wall activity and *C. albicans* cell membrane.⁸ Its mechanism is occurred when tannin attaches to the *C. albicans* cell wall, further morphologic change cell wall becomes thicker so that there is a change in the space between the cell wall and plasma membrane permeability commonly referred as interference. Permeability disorders can cause cell activity disrupted so that the cells become brittle and eventually die.⁹

Flavonoid compounds can damage the fungal cell by penetrating into the cell membrane, it causes the coagulation of protein (enzyme) in the cell membrane and it affects the protein structure becomes damaged. The instability in the cell wall and cell membrane of fungal cause selective permeability function, activate transport function, and control the composition of proteins from the yeast cells to be disrupted, which can make result a loss of form and lyse cell.¹⁰ Meanwhile, saponin can work as an antifungal by lowering the surface tension of the fungal cell wall that disrupt cell permeability.¹¹

The forth chemical compound that contains antimicrobial and antifungal in white cambodia flower extract is alkaloid. Alkaloid is organic compound that exists in nature and it has alkaline characteristic. Olivia et al. states that the alkaloids are active substances from plants that have function as drugs, and have strong activator of the immune cells that destroy bacteria, viruses, fungal and cancer cells. According Aniszewski, the suspected alkaloid mechanism is interfered with DNA chain components in the cell nucleus.^{12,13} Microbial DNA

in the cells is damaged by the alkaloids. If the basic groups contact with the microbes, the basic groups will react with the compound of amino acids that make up the cell walls and DNA for making up the cell nucleus. This reaction causes a change in the composition of DNA chain, resulting DNA damage and ultimately lead to lysis. It makes the cell wall layers are not fully formed, and lead to death in these cells.

The effectiveness of tannin, flavonoid, saponin and alkaloid in inhibiting the growth of *C. albicans* was supported by Arundhina's research using alamanda leaves extract to inhibit the growth of *C. albicans* and *Pityrosporum ovale*.¹⁴ In his research, Arundhina explained that Alamanda leaves contain certain chemical compounds that are antifungal such as tannin, flavonoid, saponin, and alkaloid, the same as white cambodia flower which also contain with all four of these compounds.

These compounds are contained in a solution that also can enter the microporosity gap on the surface of soft liner materials. This is also supported by the opinion of Anusavice which states that a fluid can enter the gap on soft liner coating material microporosity diffusion.¹⁵ Diffusion is the ability of a fluid to enter the cavity provided by the use of passive energy.

The high number of *C. albicans* in the soft liner surface is supported by Listya's research which states that there are differences in the number of *C. albicans* with the use and without the use of soft liner on acrylic resin plate.⁴ The average number of *C. albicans* on acrylic resin plate with the use of soft liner is higher than without the use of soft liner. *C. albicans* colonization on a soft liner is due to the saliva and pellicle that is overlying on soft liner in the oral cavity of patients.¹⁶ In fact, *C. albicans* is the cause due to the use of denture stomatitis that is the most common occurred.⁵ To prevent the increase of *C. albicans*, we need denture cleanser materials to reduce *C. albicans* colonization in denture mainly covered by soft liner. However, Yilmaz (2004) states that the chemical denture cleanser can increase the hardness surface and water absorption of soft liner itself. Therefore, the existence of alternative denture cleanser from natural ingredients such as white cambodia flower extract that is expected to reduce the number of *C. albicans* on soft liner denture, so that it can reduce the risk of denture stomatitis.

Adherence of *C. albicans* on soft liner is influenced by several factors such as surface roughness and chemical constituents of soft liner.¹⁷ Soft liner is encountered in commercial ethanol content that is ranging between 4-20%, although it finds some materials contained ethyl alcohol of more than 40%.¹⁸ Excess ethyl alcohol on soft liner can evaporate. Ethyl alcohol vapor formed will influence the faster compaction process and formed polymer porous as ethyl alcohol vapor is trapped in the solid polymer.¹⁹

The surface roughness on soft liner is due to the application of soft liner with the gel form that allows the plate surface shape on both sides on the acrylic resin becomes uneven. It is corroborated by the opinions of Lundin and Emilson which states that the rougher or not the surface, it can make the plaque attached more increase.¹⁹

The attachment mechanism of *C. albicans* on soft liner can be caused by attachment of *C. albicans* on the soft liner surface that occurs through hydrophobic interactions. Hydrophobic interactions occur because of *C. albicans* has hydrophilic relative characteristic

which requires water or saliva that serves as media for a place to live and breed so that it easily attaches to the soft liner materials, while the soft liner has hydrophobic properties.¹⁹

CONCLUSIONS AND SUGGESTIONS

Based on the research above, it can be seen that the higher concentration of white cambodia flower extract is on the lower concentration of *Candida albicans*. So that, it can be concluded that white cambodia flower extract is effective in reducing the number of *C. albicans*.

For those who will continue this research, it is advisable to find out more about the biocompatibility tests of white cambodia flower extract to the oral tissues. Secondly, it is advisable also to study the effectiveness of white cambodia flower extract using other extraction methods.

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Antibacterial Effect Of Gambir Extract (*Uncaria Gambir* [Roxb.]) To Bacterial Colonies In Male Wistar Strain Rats

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ABSTRACT

INTRODUCTION : Gambir (*Uncaria Gambir* [Roxb.]) is useful as a natural antibacterial agent. It contains catechin that can kill bacteria including antibiotic resistant bacteria. The aim of this study was to determine antibacterial effects of gambir extract in saliva of male Wistar rats. **Material and method :** This experimental study with pretest-posttest control Group design has been done on Februari-Maret 2016 at Balai Besar Laboratorium Kesehatan Provinsi Sumatera Selatan. Subjects were 30 male rats, divided into 5 Groups negative control (aquadest), positive control (cefradoxil 13 mg), gambir extract 6 mg, 12 mg, and 24 mg. The number of bacterial colonies was counted from saliva of subjects before and after treatment. Data were analyzed by using SPSS 2.2 vers. **Result :** The mean of bacterial colonies decreased significantly between before and after treatment in all Groups ($p < 0,05$), except in negative control Group. It also showed that the higher concentration of gambir extract, the fewer bacterial colonies it had. There were significant differences between the Groups after treatment, except between positive control Group and gambir extract 25 mg. **Conclusion :** Gambir extract as an antibacterial effective for decreasing the number of bacterial colonies on male Wistar rats and had dose dependent effect. Antibacterial effect of gambir extract 24 mg was not significantly different with cefadroxil 13 mg.

Keywords: *gambir extract, anti bacteria, bacterial colonies*

INTRODUCTION

Dental caries is a major problem that is found in both children and adults. Based on the results of the Household Health Survey Ministry of Health in 2004, the prevalence of caries in Indonesia reached 90.05%. The figure shows that the number of people in Indonesia is very high.¹ Bacteria built up on plaque on the tooth surface may lead dental caries.²

Bacteria play an important role in the process of dental caries and periodontal disease. The number of microorganisms depends on a person's health and oral hygiene, while different types of bacteria stay in different places of oral cavity.³ *Streptococcus*,

Stafilococcus, *Lactobacillus*, and other filament bacteria can often be isolated from caries lesions. Among the groups, *Streptococcus* is mostly found in caries, so it is said that these bacteria play an important role in diseases of the dental pulp. The types of this *Streptococcus* is *Streptococcus mutan*.^{4,5}

Colonies of *Streptococcus mutants* in oral cavity can produce the enzyme glucosyltransferase and fructosyltransferases. These enzymes change the sucrose and form extracellular polysaccharide glucan and fruktan.⁴ Glucan is sticky so that it can support the attachment of bacteria in early colonization of plaque formation. Colonies of *Streptococcus mutants* in the oral cavity also produces lactic acid that can cause plaque pH to be down. If the plaque pH decrease occurs continuously, it will cause demineralization of the tooth surface and caries.⁵

Dental plaque is a soft layer consists of a collection of bacteria on a matrix, formed and firmly attached to the tooth surface that is not properly cleaned. Dental plaque is one factor in the caries process and soft tissue inflammation.⁶ Plaque formation process begin with the formation of dental pellicle, then be wrapped by glycoprotein pellicle. The pellicle is derived from the saliva, sulcular fluid, and products of bacterial cells, host, and debris. Bacterial colonization will be found within a few hours on dental pellicle. This process is dominated by facultative gram-positive bacteria, such as *Actinomyces viscosus*, *Streptococcus sanguis* and *Streptococcus sp.* Plaque will mature along with the growth of bacteria attached, colonized and grown. The final stage will take place secondary colonization and plaque maturation. Secondary colonizers are bacteria that do not participate as an early colonizers of the tooth surface, including *Prevotella intermedia*, *Prevotella loescheii*, *Capnocytophaga* species, *Fusobacterium nucleatum* and *Porphyromonas gingivalis*.⁷

The efforts of taking care of oral health can be done by reducing the number of bacteria colonies in the oral cavity. One of them is to use an antibacterial material. Along with the slogan "back to nature", the public interest of using natural materials increases. This nowadays is proved by the industries, both small and large, that are widely use herbs as medicine. According Siswanto (1997), the use of natural materials has its own advantages compared with chemicals. That is because the natural materials are more acceptable to the body and provided a lot in nature. Catechin is natural products contained in gambir plant (*Uncaria gambier* [Roxb.]) and can be used as antibacterial agent.⁸

Gambir (*Uncaria gambier* [Roxb.]) is a medicinal plant that has long been known and used by the people of Indonesia as a mixture of betel nut and has function as an antibacterial. The active substance of gambir is catechin, either in the form of pure catechin or katekol.⁹ Catechins can prevent the formation of extracellular glucan functioning to attach the bacteria on tooth surface and capable of inhibiting activity of the enzyme glucosyltransferase. The enzymes associated with the formation of plaque.¹⁰

In recent years, the benefits of gambir (*Uncaria gambier* [Roxb.]) as antibacterial agent have been widely studied. According to Sakanaka (1989) reported that catechins could destroy cariogenic bacteria producing glucan.¹¹ Cao Jin (2004) from Hunn Medical University, China, examined the effect of catechin on oral cavity and concluded that the

number of bacteria, plaque and the formation of extracellular glucan declined.^{12,13} The aim of this study was to know the antibacterial effect of gambir (*Uncaria gambir* [Roxb.]) to bacterial colonies in male wistar strain rats. Mostly previous researches showed the antibacterial effect of gambir extract (*Uncaria gambir* [Roxb.]) in vitro. This study will be examined the effectiveness of antibacterial extract Gambir (*Uncaria Gambir* [Roxb.]) towards a decrease in the number of bacterial colonies in vivo in the saliva of male Wistar rats.

MATERIAL AND METHODS

The research was conducted in the Laboratory of Chemistry of Sriwijaya University, Province's Health Laboratory (BBLK) in Palembang, and Animal House of the Faculty of Medicine University of Sriwijaya. The study was done on January 2016. The population was a white male rat *Rattus norvegicus* obtained from the animal house of Pharmacology Laboratory of the University of Sriwijaya Palembang

MATERIAL

The equipment for this research are mouse cages, gloves, masks, bottles covered with aluminum foil, glass bottles as containers extracts, glass beaker, evaporator (Yamato®, Japan), a glass funnel, filter paper Whattman no. 125, Erlenmeyer flasks, beakers, measuring flask of 50 ml, tweezers, tube 50 ml, refrigerator (Philips®, Japan), test tubes, test tube rack, micropipette, a petri dish, and incubators. The materials used are ethanol 96%, CMC 1%, gambier, sterile cotton, Plate Count Agar (PCA), cefadroxil 13 mg, spirit, pellets (rat food, and Phosphate Buffered Saline (PBS).

The samples were divided randomly into 5 groups, Group I: the negative control group, Group II :positive control group (cefradoxil 13 mg), Group III: 6 mg extract gambir, Group IV: 12 mg extract gambir, Group V: 24 mg extract gambir. Treatment was given every day in the morning (at 8 am) and afternoon (at 4 pm) for 7 days.

Preparation

Gambir extract was made by sochletation method and divided into 3 doses, that is doses of 6 mg / 200 g BB rat, 12 mg / 200 g BB rats, and 24 mg / 200 g BB rats. Human dose conversion factor weighing 70 kg to 200 g rat body weight is 0,018, then the cefradroxil dose for rats (200 g) is $500 \text{ mg} \times (70\text{kg} / 50\text{kg}) \times 0.018 = 12.6 \text{ mg} / 200 \text{ grams BB} \approx 13 \text{ mg} / 200 \text{ gr BB}$.¹⁵ cefadroxil made into oral preparations, namely mixing CMC 1% 2 ml to 13 mg cefadroxil.

Collecting saliva on rats

Collecting saliva on rats was performed in two times, before treatment (pretest) and after 7 days (posttest). Saliva mice in each group were taken with a sterile pipette and

placed in each tube and labeled. Saliva taken inserted into the medium that has been provided.

Dilution of bacteria

The dilution of bacteria were performed up to 100000 times the concentration of 10^{-5} in the reaction tubes.

Observation of bacteria

Saliva that has been diluted with a concentration of 10^{-5} , was taken with a sterile pipette and then plated on media Plate Count Agar (PCA). Further included in the incubator 37°C in anaerobic atmosphere for 24 hours. The next stage was counting bacterial colonies. It was done by manual calculation using a magnifying glass (magnifying glass). Small and smooth dots on a petri dish showed bacterial colonies, to facilitate counting bacterial colonies can create auxiliary lines on a petri dish, it is to reduce errors in calculating.

Statistical Analysis

All recorded data were drawn in the form, processed, and analyzed. Before further processing, first of all, data were tested with Levene's test to know the homogeneity of samples. If $p > 0.05$, meant data were homogen. Extended Paired t-test was used to compare the changes between "before and after" experiments. Independent t-test was examined to compare the efficacy between groups in this study. One way Anova was used for significance of difference in all groups. To know the compatibility dose, Post Hoc test was used. Statistical significance was assembled as $p < 0.05$. SPSS 22 vs. (IBM® inc.pvt ltd.) and Microsoft Excel (Microsoft inc®) were used for statistical analysis.

RESULTS

The research of the effectiveness of the gambier extract as an antibacterial in male rats' wistar strain had been done. Gambier extract as an antibacterial effectiveness was identified by counting the number of bacterial colonies conducted pre and post treatment. Normality test was first performed on the acquired data. Normality test results indicated that the data were normally distributed ($p > 0.05$) so that it could proceed with parametric testing, T test, paired and unpaired. Data analysis was then followed by paired T test between groups before the treatment group after treatment. Paired T test was performed to determine an average ratio of the number of bacterial colonies before and after being given treatment. Data paired T test results can be seen in Table 1.

Tabel 1. The number of bacteria colonies within groups

Group	Pre-test (cfu/ml)	Post-test (cfu/ml)	p
G I	459±24,5	426,67±44,9	0,272
G II	395,67±46,5	198,5±24,4	0,000*
G III	431,17±28,3	369±23,5	0,007*
G IV	419,67±32,6	295,17±47,7	0,002*
G V	423,83±83,1	199,5±24,7	0,002*

Paired t-test, p=0,050

Explanation:

G I = Group I, the negative control group

G II = Group II, positive control group (cefradoxil 13 mg)

G III = Group III, 6 mg extract gambir

G IV = Group IV, 12 mg extract gambir,

G V = Group V, 24 mg extract gambir

From the table, it showed that the decrease of the number of bacterial colonies with $p < 0.05$ in the entire Group, except in Group I. This means that there were significantly differences in the average number of bacterial colonies on each of the group, except in the negative control group.

Tabel 2. The number of bacteria colonies between groups

Group	p
G I	G II 0,000*
	G III 0,019*
	G IV 0,001*
	G V 0,000*
G II	G III 0,000*
	G IV 0,001*
	G V 0,945
G III	G IV 0,007*
	G V 0,000*
G IV	G V 0,001*

Independent t-test, p=0,050

Comparison of the average number of bacterial colonies among the group after the treatment showed a value of $p < 0.05$ in the entire Group, except between Group II and Group V. This means that there are differences in the average number of bacteria colonies after treatment in the entire Group, except between positive control group and 24 mg gambir extract group.

The data analyzed followed by homogeneity test. Results of homogeneity test data showed that the data were homogene ($p > 0.05$). One way ANOVA test was performed to determine an average ratio of the number of bacterial colonies among the groups after the treatment. The test results of one way ANOVA, p value = 0.000 which means that the average ratio of the number of bacterial colonies among the groups after treatment were significantly different.

Post hoc test Least Significance Difference (LSD) was done to determine the influence of each groups treatment. Post hoc test results can be seen in Table 3.

Table 3. The antibacterial effect among the groups to bacterial colonies

Variabel	GI	GII	GIII	GIV	GV
GI		0,000	0,008	0,000	0,000
GII	0,000		0,000	0,000	0,961
GIII	0,008	0,000		0,001	0,000
GIV	0,000	0,000	0,001		0,000
GV	0,000	0,961	0,000	0,000	

Post Hoc Least Significance Difference, $p=0,050$

Table 3 showed the difference of the number of bacterial colonies among the group after the treatment, and it could be seen that all the groups had significantly difference each other, except the positive control group and 24 mg of extract gambir group.

DISCUSSION

Based on this study, the average number of bacterial colonies before treatment in all the group was 425.8 cfu/ml. The average number of bacteria colonies after treatment in all the Group were decreased, except in the negative control group. It showed that 13 mg cefradoxil given in the positive control group as well as 6 mg, 12 mg, and 24 mg gambir extract had antibacterial effect. The content of gambir which had antibacterial effect was catechin which is the main compound of gambir.¹⁶ Gambir containing catechin have ability in damaging the membrane or cell wall of bacteria that interfere with the permeability of cell. As a result of disruption of the permeability, the cell can not perform life activities that are stunted or even die. Catechins has antibacterial activity of the protein precipitate manner, because catechins has the same effect with a compound fenolik.¹⁷ Catechins can inhibit the enzyme activities and inhibits glucan glukotransferase extracellular polysaccharides which can prevent the adhesion of bacteria to the tooth enamel and plaque.¹⁸

Pembayun *et al* (2007) described that the antibacterial properties of gambir extract to test bacteria gram-positive *Streptococcus mutans*, *Staphylococcus aureus*, and *Bacillus*

subtilis showed that the extracts with ethyl acetate solvent had strongest antibacterial effect compare to another solvents.¹⁹ Pembayun (2015) stated that consumption of candy containing gambir extract can significantly lower the amount of plaque and decline the bacterial colonies.²⁰

Another study reported by Puspa Dewi (2016) states that 60% Gambir extract has the same effect as 500 mg cefradroxil in reducing micropores in enamel, lowering bacterial colonies, and declining the solution of calcium. Praptiwi (2013) informed that gambier extracts have antibacterial effect against seven species of pathogenic bacteria (*Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Micricoccus huteus*, *Shigella flexneri*, *Proteus vulgaris* and *P. mirabilis*).²¹

CONCLUSION

Gambir extract as an antibacterial agent is effective in decreasing the number of bacterial colonies on male wistar rats and has dose dependent effect. 24 mg gambir extract has equal effect to Cefradroxil 13 mg.

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The Effectiveness Of Gambier Extract (*Uncaria Gambir* [Roxb.]) As An Anti-Inflammatory Agent In Wistar Male Rats (*Rattus Norvegicus* L.)

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ABSTRACT

INTRODUCTION: Inflammation is often found in the field of dentistry, such as aphtous stomatitis, pulpitis, gingivitis, and periodontitis. Anti-inflammatory drugs which were usually used have many side effects. Gambier plant contains catechin which is known to have anti-inflammatory effects with minimal side effects. **Objective:** The purpose of this research was to determine the effectiveness of Gambier extract as an anti-inflammatory by decreasing the number of segmented neutrophil cells in wistar male rats. **Materials and methods :** This research was a laboratory experimental in vivo with study design pre-test and post-test control group design. This study used 30 wistar male rats which were divided into 5 groups, namely negative control group (distilled water), positive control (potassium diclofenac), and gambier extract doses of 6 mg, 12 mg, and 24 mg/200 g BW rats. Labial of mandible gingival rats induced by carrageenan, then blood sampling was done, followed by giving treatment for 4 days, then post-treatment blood sampling was done. The results were statistically analyzed using paired t-test, independent t-test, one way ANOVA and Post Hoc. **Results :** The result showed that gambier extract and the positive control group showed that the decrease of segmented neutrophil cell counts were greater than the negative control group with a significance of $p < 0.05$, however, the decrease of segmented neutrophil cell counts in potassium diclofenac group were greater than gambier extract. Gambier extract with dose of 24 mg/200 g BW rats showed that the decrease of segmented neutrophil cell counts were greater than any other two doses. **Conclusion :** Gambier extract dose of 24 mg/200 g BW rats is the most effective as an anti-inflammatory in male wistar rats compared to dose of 6 mg with a difference of 7.4% and 12 mg with a difference of 4.5%, but less effective when compared to potassium diclofenac.

Keywords: *Anti-inflammatory, Gambier, Neutrophil*

INTRODUCTION

Inflammation is a living tissue response to injury. Inflammation can occur due to microorganisms, mechanical trauma, chemical substances, as well as the physical influence.^{1,2} Inflammation encountered in dentistry usually caused by mechanical trauma and microorganisms. Mechanical trauma to oral mucosa, such as bitten, hit, and accident which by a instrument for dental care can lead traumatic lesions that show signs of inflammation, for example stomatitis aftosa.^{3,4} Microorganisms can also cause inflammation in the oral cavity, such as inflammation of the gums (gingivitis), periodontal (periodontitis), and dental pulp (pulpitis).⁵ Anti inflammatory medicine are needed to reduce inflammation, but most of them have side effects to the body.

Currently, using of a herbal plant extracts has a many appeal in Indonesia because they have little side effects to body.⁶ According to Mota et al. (2015), showed green tea had anti-inflammatory effect because it contents flavonoids, catechins.⁷ The extract dose of 0,14g / kg of green tea in these studies indicated that it had anti-inflammatory effects. Other plant which catechins and serve as anti-inflammatory agent is gambier (*Uncaria gambier* [Roxb.]) Of familia Rubiaceae.⁸

Gambier (*Uncaria gambier* [Roxb.]) is a plant that can be found in Indonesia, particularly in Sumatera Barat.⁹ Many studies have been conducted to determine the efficacy of gambier as traditional medicine, like antibacteria,^{10,11} antioxydant,^{10,12} antiinflammatory,⁸ analgesic,¹³ hepatoprotection,¹⁴ and antihipercolesterolemia.¹⁵ The primary contain in gambier which has an important role in traditional medicine is catechins.¹⁶

Catechins is a polyphenol compound that belongs to a class of flavonoids and serve as antiinflammatory agents.^{8,17} Some studied showed that catechins can inhibit many action of transcription factors like pro-inflammatory cytokines called Nuclear Factor Kappa Beta (NF-Kb), enzyme phospholipase, lipooxygenase, and cyclooxygenase. Therefore, the synthesis of inflammatory mediators weren't formed.^{7,18,19}

Putri *et al.* (2012) reported that a mixture of extract of gambier, betel leaf, lime and betel at a dose of 482mg / kg had anti-inflammatory effect because the contained of flavonoids.⁸ Antiinflammatory effect of extracts gambier could be seen through the number of segmented neutrophil cells.^{1,2} The aim of this study was to determine the effectiveness of extract of gambier (*Uncaria gambier* [Roxb.]) as an anti-inflammatory agent in male wistar rats.

Samples and materials

Samples used in this studied were white *Rattus norvegicus* L. wistar rats. The inclusion criteria of white rat *Rattus norvegicus* were male, aged 10-12 weeks, weight 150-250 grams, and good health without disability. The studied was an experimental study using simple random sampling method. The sample size was calculated by using the formula of Federer and amount of samples were 30 samples. It was divided in to 5 groups. The materials of study were gambier (*Uncaria gambier* [Roxb.]) extract as treatment group,

potassium diclofenac as positive control group, and distilled water as a negative control group. Using Carrageenan is to induce inflammation.

Preparation

Gambier was extracted by soxhletation methods and divided into 3 doses, 6 mg / 200 g, 12 mg / 200 g, and 24 mg / 200 g weight of rat. The doses were selected based on studied by Hasti *et al.* (2012), which indicated that gambier extract consisted of 6 mg / 200 g weight of rats had hepatoprotective activity in rats. Then, 6 mg dose increased to 12 mg and 24 mg.¹⁴ The doses of potassium diclofenac for humans usually are 150 mg / day. Human dose conversion factor weighing 70 kg to 200 g rat body weight is 0,018, and then the dose of diclofenac potassium for rats (200 g) is $0,018 \times 150 \text{ mg} = 2.7 \text{ mg} / 200 \text{ g}$ weigh daily.²⁰ Gambier extract and potassium diclofenac made in oral preparations dissolved in 2 ml CMC solution 1%. Maximum volume of liquid administered orally in rats was 5 ml / 200 g of weight.²¹ Carrageenan was induced to rats in suspension form. The process of Carrageenan suspension had been made by 0.05 grams carrageenan to be suspended 5 ml of 0.9% of NaCl solution (Otsuka®, Indonesia) in the flask.

Treatment to rats

This studied had finished in 4 days. All samples were induced with 1% carrageenan 0.1 ml in gingiva mandibular at 8 am on the first day, then after 5 hours, blood samples were taken to count the number of segmented neutrophil cells before being treated. After that, each group was given treatment. Group I (negative control) was treated with distilled water, group II (positive control) were given oral potassium diclofenac of 2.7 mg / 200 g BB rat / day, and group III (group treat I extract gambir) extract gambir oral dose of 6 mg / 200 g BB rats, group IV (treatment group II extract gambir) extract gambir oral dose of 12 mg / 200 g BB rats, and group V (treatment group III extract gambir) extract gambir oral dose of 24 mg / 200 g BB rats. The treatment of group II, III, IV, and V was done from the first day, by provided half the dose at night at 7 pm. For the next day rats were given treatment twice a day, a half dose in the morning at 07:00 and half-dose at night at 7 pm. The provision of treatment on day 4 conducted in the morning at 07:00 as much as half the dose.

Counting the number of neutrofil segmented cell

Blood samples were taken on the fourth day by taking from the orbital sinus rats. Then orbital sinus rat placed in tubes which had contained anti-coagulant ethylene diamine tetra-acetic acid (EDTA). Counting the number of neutrophil cells was done by using a segment of hematology analyzer.²²

RESULTS

The data was tested with Shapiro Wilk normality test to determine whether the data normally distributed or not and Levene's test. The test results showed that $p > 0,050$. It means that the

data are normally distributed and homogen. Data analysis was continued by paired T test to compare the average number of segments neutrophil cells before and after treatment. Data paired T test results could be seen in Table 1.

The average number of segmented neutrophil cells in each groups could be seen in Table 1. It showed of decrease in segmented neutrophil cell in all groups after being treated with a significance of $p < 0.050$. It means that there were differences in the average number of neutrophil cells in each segment of the groups before and after treatment. Unpaired T test was conducted to determine an average ratio of the number of neutrophil cells post-treatment between groups. Data unpaired t test results are shown in Table 2.

Tabel 1. Effectivity of declining the number of segmented neutrophil cells before and after treatment

Group	Mean Pre-test (%)	Mean Post-test (%)	P Value*
Group I	52,5±0,85	32,5±0,30	0,002
Group II	47,3±0,40	3,6±0,14	0,000
Group III	40,5±0,65	28,2±0,21	0,014
Group IV	46,6±0,76	25,3±0,18	0,001
Group V	44,2±0,75	20,8±0,12	0,001

Paired t-test, $p=0,050$

Tabel 2. Effectivity of declining the number of neutphil segmented cells between groups after treatment

Group		P Value*
Group I	Group II	0,000
	Group III	0,017
	Group IV	0,001
	Group V	0,000
Group II	Group III	0,000
	Group IV	0,000
Group III	Group V	0,000
	Group IV	0,031
Group IV	Group V	0,000
	Group V	0,000

Independent t-test, $p=0,050$

Tabel 3. Compatibility dose among the groups

Variabel	GI	GII	GIII	GIV	GV
GI		0,000*	0,001	0,000	0,000
GII	0,000		0,000	0,000	0,000
GIII	0,001	0,000		0,021	0,000
GIV	0,000	0,000	0,021		0,001
GV	0,000	0,000	0,000	0,001	

Post Hoc Least Significance Difference, $p=0,050$

Comparison of the average number of neutrophil cells between groups after treatment in table 2 showed $p < 0.050$. It means there were significant differences among those groups. ANOVA test was done to know the significance of all groups, and the result was $p < 0.050$. It meant that all groups had significantly different.

After that, it continued to post hoc test in order to know how much conformity doses among the gambier extract groups with a positive control group. Post hoc test used in this study was least Significance Difference test. Post hoc test results could be seen in Table 3. Table 3 showed that there were significant effect among the groups with positive control, it meant that no groups had the same effect as the positive control group.

DISCUSSION

Based on the study, the average number of segmented neutrophil cells of all groups was 46.2% after being induced by carrageenan. Carrageenan is an inflammatory inducer that is commonly used in the formation of edema, because it can stimulate the release of inflammatory mediators, especially prostaglandin. Edema was formed and grew fast at maximum volume for about 5 hours after induced.²³ This study was counting segmented neutrophil cells, because the cells could be found in periphery blood.²⁴ The reduction of segmented neutrophil cells was significantly different in all groups, because of the content of catechins in gambier extract. This study showed that gambier extract with 24 mg / 200 g dose could reduce the number of neutrophil cells more than 6 mg and 12 mg. It is due to catechins more contained in the gambier extract in 24 mg dose than 6 mg and 12 mg.

Gambir has many chemicals contained such as, catechins, tannins, catechu acid, pyrocatechol, florosence gambier, red catechu, quercetin, fixed oil, and wax.¹⁶ The content of Gambir which has anti-inflammatory properties is catechins, which is the main compound of gambir.²⁶ Catechins are polyphenolic compounds into the flavonoid group.⁹ Studied was conducted by Putri et al. (2012) showed that Gambir extract containing flavonoids could be inhibit inflammatory reactions.⁸

This study was appropriate with that theory that catechins had anti-inflammatory role through several mechanisms, which inhibits the action of the enzyme cyclooxygenase such as lipooxygenase, the enzyme phospholipase, and inhibits the action of transcription factors such as pro-inflammatory cytokines Nuclear Factor Kappa Beta (NF-Kb).^{7,18,19} If the enzymes and NF-Kb was prevented, pro-inflammatory cytokines may also be disrupted so that catechins could suppress the inflammatory process.

Other studies about anti-inflammatory effect of catechin had been conducted by Mota et al. (2015). Their study was examined the anti-inflammatory effects of green tea plants which also contains catechins. It showed anti-inflammatory of green tea extract was effects from flavonoids. It could be inhibit the action of enzymes and transcription factors pro-inflammatory cytokines.⁷

Based on tested Post Hoc test, gambier extract groups showed decrease of the number of segmented neutrophil cells was significantly in negative than positive control groups. The

decrease of segmented neutrophil cell with potassium diclofenac was more significantly compared than all group of gambier extract. It means that the doses of gambier extract used in this study should be added in order to provide the same effect as the medicine potassium diclofenac.

CONCLUSION

Gambier extract dose of 24 mg/200 g BW rats is more effective as an anti-inflammatory in male wistar rats than dose of 6 mg (difference of 7.4%) and 12 mg (difference of 4.5%), but less effective when be compared by potassium diclofenac.

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Antibacterial Activity Of Hibiscus Rosa-Sinensis Flower Extract Against *Fusobacterium nucleatum*

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ABSTRACT

INTRODUCTION: One of the major diseases affecting the oral and dental health is periodontal disease, which has a high prevalence in society. *Fusobacterium nucleatum* has been associated with the pathogenesis of periodontal disease and its prevalence around 95%. Hibiscus rosa-sinensis flower extract have been reported to have antibacterial activity against gram negative bacterias, such as *Escherichia coli* and *Pseudomonas aeruginosa*.

Objective: This study aimed to determine the antibacterial effect of *Hibiscus rosa-sinensis* flower extract against *F. nucleatum*. **Materials and methods:** This study was an in vitro laboratory experimental with post test control group design. Ethanol extract of Hibiscus rosa-sinensis flower was prepared to concentrations of 2%, 4%, 6%, 8%, and 10%. Metronidazole was used as positive control. Antibacterial activity against *F. nucleatum* was carried out by agar diffusion method. Data were analyzed using Oneway ANOVA followed by Post Hoc test. **Result:** The result showed that the inhibition zone diameters ranged from 5,10 to 17,75 mm for *Hibiscus rosa-sinensis* flower extract and 16,18 mm for metronidazole. The diameter of inhibition zone was wider with the increasing of concentration of *Hibiscus rosa-sinensis* flower extract. **Conclusion:** There were significant differences in the inhibition zones between all groups ($P < 0,05$). It can be concluded that *Hibiscus rosa-sinensis* flower extract has antibacterial effect against *F. nucleatum*. Higher concentration of *Hibiscus rosa-sinensis* flower extract provides stronger antibacterial effect.

Keywords: *F.nucleatum*, *Hibiscus rosa-sinensis*, antibacterial, inhibition zone

INTRODUCTION

Periodontal disease is a common disease which has pretty high prevalence in society.¹ Depkes RI stated that the total amount of periodontal treatments in Indonesian

hospitals in 2010 reached 92,979 cases.² Periodontal disease is a polymicrobial infection involving numerous anaerobe Gram-negative pathogen embedded in a complex biofilm called dental plaque, which results in the destruction of the periodontal connective tissue and resorption of the alveolar bone.³

Anaerobe bacteria were found 83% in periodontitis case and 62% in healthy subjects. *Fusobacterium nucleatum* is one of those bacteria that commonly found in periodontitis patients, which its prevalence around 95%.⁴ *F. nucleatum* is an obligate anaerobe Gram negative bacteria, that has ability to adapt very well in oxygen-rich environment, because it has peroxide enzymes which could diminish the reduct-oxidation response.^{4,5} Besides, *F. nucleatum* can invade oral epithelial cells, and may facilitate the entry of noninvasive bacteria by coaggregating with them.^{6,7}

Many antibiotics including amoxicillin, penicillin, clindamycin, metronidazole, and tetracycline are widely known to be administered to suppress the periodontal pathogens.⁸ Metronidazole is an effective drug of choice for anaerobic bacteria, including *Fusobacterium* spp.⁹ However, the systemic administration of metronidazole has been reported to cause serious side effects, like encephalopathy and peripheral neuropathy.^{10,11} Therefore, to reduce those side effects, the development of alternative antimicrobial approaches for the treatment of periodontal diseases is of great relevance.

The use of plant extracts with medicinal properties represents an essence alternative for the treatment of periodontal disease, because they tend to have a low side effect.¹² *Hibiscus rosa sinensis* L., known as shoeblackplant, is an ornamental plant throughout the tropics and subtropics areas, which traditionally has a number of medical uses.^{13,14} Parts of this flower, including leaves, flowers, and roots have been used for the treatment of a variety of diseases. Traditionally, hot aqueous extract of *Hibiscus rosa sinensis* flower and root can be used for treated gonorrhea, the disease induced by infection from Gram-negative bacteria, *Neisseria gonorrhoeae*.^{14,15}

Ruban *et al*¹⁶ reported that *Hibiscus rosa sinensis* flower could inhibit the growth of Gram-positive bacteria, such as *Staphylococcus aureus*, or Gram-negative bacteria, such as *Escherichia coli* and *Pseudomonas aeruginosa*.¹⁶ The inhibition of bacterial growth in vitro by the extract of the flower could be due to the presence of some active compounds in the extract, like flavonoids, alkaloids, tannin, and saponin.¹⁷ These active compounds have their different ways to inhibit the growth of the bacteria which make the bacteria lysis.¹⁸ ¹⁹ This study aimed to determine the antibacterial effect of *Hibiscus rosa-sinensis* flower extract against *F. nucleatum*.

MATERIALS AND METHODS

This research was in vitro experimental study with post-test control group design.

Preparation of *Hibiscus rosa-sinensis* flower Extract

The freshly *Hibiscus rosa-sinensis* flower with red colour was obtained from flower

cultivation garden in Jambi. *Hibiscus rosa-sinensis* flower was collected and cleaned, then dried over a period of 48 hours at 40°C in an oven and ground into powder using a blender. *Hibiscus rosa-sinensis* flower was extracted by maseration method using 70% ethanol. The extracts were filtered by using Buchner funnel and deposited for 48 hours. Filtrates were then concentrated using a rotary evaporator until all solvents evaporated, to obtain 100% crude extract. 100% crude extract was diluted with 1%Na-CMC to obtain five different concentration of *Hibiscus rosa-sinensis* extract (2%, 4%, 6%, 8%, and 10%).

Culture preparation for antibacterial assay

The periodontopathic bacterial strain *F. nucleatum* ATCC 25586 was used in this study. Inoculum of *F.nucleatum* was suspended in saline (0.9% NaCl) and its turbidity was adjusted to 0.5 Mac Farland standards (10^8 CFU/mL). This saline culture preparation was used to inoculate the plates. Bacteria from the saline solution was swabbed using sterile cotton swab into Mueller Hinton Agar plates, then the plates were incubated in anaerobic jar at 37°C for 24 hours.

Anti bacterial assay

Antibacterial activity of extracts was evaluated by disc diffusion method(Cakram Kirby-Bauer method) The sterile cylinder disc 6 mm (*Whatman Schleicher andSchuell*) containing 2%, 4%, 6%, 8%, and 10% of the *Hibiscus rosa-sinensis* extract was placed onto the surface of agar plate. For positive control, metronidazole discs (Oxoid) were used in this study. The plates were incubated at 37 °C for 24 h. At the end of the incubation, the inhibition zones formed around the disc were measured with a transparent ruler in millimeter units.

Statistical Analysis

All the data were expressed as the mean value \pm standard deviation (SD). SSPS software, version 20.0 was used for statistical analysis. One-way ANOVA test followed by Post Hoc Tukey HSD was used for statistical comparison of susceptibility assays results, among the tested substances. Difference was considered statistically significant at $\alpha < 0.05$.

RESULT

All tested substances showed inhibition activity against *F. nucleatum*, as shown in figure 1.

All data were distributed normally and homogen ($p>0,05$) so next analysis by using one-way ANOVA test followed by Post Hoc can be done. The antibacterial activity of *Hibiscus rosa-sinensis* extracts against *F. nucleatum* was shown in table 1.

The result showed that the smallest zone of inhibition was found in 2% *Hibiscus rosa sinensis* flower extract (5.10 ± 0.35 mm), while the largest was found in 10% *Hibiscus rosa sinensis* flower extract (17.75 ± 0.59 mm). The diameter of inhibition zone was wider with the increasing of concentration of *Hibiscus rosa-sinensis* flower extract. Metronidazole as

positive control showed the zone of inhibition slightly smaller than 10% *Hibiscus rosa sinensis* flower extract (16.18 ± 0.27 mm). There was a statistically significant difference between groups as determined by one-way ANOVA ($p < 0.05$). Analysis by *Post Hoc Tukey* HSD showed that there was a significant difference of zone of inhibition between all concentration groups of *Hibiscus rosa sinensis* flower extract and metronidazole group ($P < 0.05$), except between 8% *Hibiscus rosa sinensis* flower extract and metronidazole ($P > 0.05$)

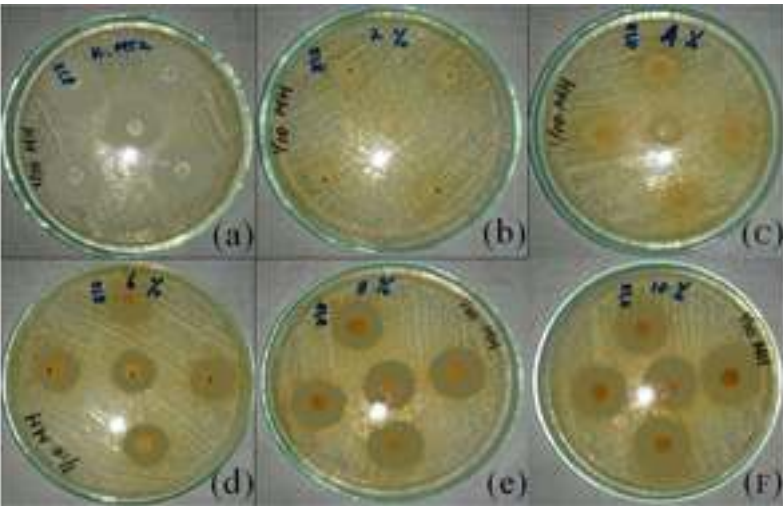


Figure 1.Inhibition zone of tested substances against *F. nucleatum* (a) positive control (metronidazole); (b) 2% *Hibiscus rosa-sinensis* extract; (c) 4% *Hibiscus rosa-sinensis* extract; (d) 6% *Hibiscus rosa-sinensis* extract; (e) 8% *Hibiscus rosa-sinensis* extract; (f)10% *Hibiscus rosa-sinensis* extract

Table 1. Antibacterial activity of *Hibiscus rosa-sinensis* extracts against *F. nucleatum*

Groups	Zone of Inhibition in diameter (mm) (Mean ± SD)
2% <i>Hibiscus rosa-sinensis</i> flower extract	5.10±0.35
4% <i>Hibiscus rosa-sinensis</i> flower extract	8.28±0.50
6% <i>Hibiscus rosa-sinensis</i> flower extract	12.30±0.51
8% <i>Hibiscus rosa-sinensis</i> flower extract	15.36±0.52
10% <i>Hibiscus rosa-sinensis</i> flower extract	17.75±0.59
Metronidazole (positive control)	16.18±0.27

DISCUSSION

All concentrations of *Hibiscus rosa sinensis* flower extract and metronidazole have antibacterial effect against *F. nucleatum*. Metronidazole used as positive control because it is *drug of choice* against *F. nucleatum*. Mean of inhibition zone diameter in metronidazole group was 16,18 mm, larger than inhibiton zone of 2%, 4%, 6%, and 8% *Hibiscus rosa sinensis* flower extract, but smaller than 10% *Hibiscus rosa sinensis* flower extract. Result of *Post Hoc Tukey* HSD indicated that there was equality of antibacterial activity between

metronidazole and 8% *Hibiscus rosa sinensis* flower extract ($P>0,05$). Metronidazole has antibacterial effect because it can covalently binds to DNA, disrupt its helical structure, inhibiting bacterial nucleic acid synthesis and resulting in bacterial cell death.⁸

This study showed that all concentrations of *Hibiscus rosa sinensis* flower extract have antibacterial effect against *F. nucleatum*, which is Gram-negative bacteria. These finding was supported by the study from Ruban *et al*¹⁶, which revealed that *Hibiscus rosa sinensis* flower extract can inhibit other Gram-negative bacteria, like *E. coli*, *Salmonella sp*, and *P. aeruginosa*.¹⁶ *Hibiscus rosa-sinensis* possess good antibacterial activity, because its structure contains some active compounds, including alkaloids, flavanoids, and tannin. These active compounds may act alone or in combination to inhibit bacterial growth. Alkaloids and flavonoids have been found in vitro to be effective and had antimicrobial activity against a wide array of microorganisms. Their activity is due to their ability to complex with the extracellular and proteins and make a complex with the bacterial cell walls, flavonoids may also disrupt microbial membranes.¹⁸ Some earlier investigations had reported that the tannins isolated from the flower possess remarkable toxic activity against bacteria and may assume pharmacological importance.¹⁹

The concentration of *Hibiscus rosa sinensis* flower used in this study were relatively low, range from 2-10%. Based on classification of bacterial inhibition response by Greenwood, antibacterial effect of *Hibiscus rosa sinensis* flower at concentration 2%-4% can be classified as very low with inhibition zone diameter around 5,10-8,28 mm, concentration 6%-8% classified as low with inhibition zone diameter ranged from 12,30-15,36 mm, and concentration 10% classified as moderate with inhibition zone diameter 17,75 mm.²⁰ This finding indicated that the higher concentration of the extract will exhibit the greater antibacterial effect. This result are in close agreement with previously reported by Pelzcar *et al* that concentration of antibacterial agents influence its activity. In this study, 10% *Hibiscus rosa sinensis* flower extract showed moderate antibacterial activity, so further studies are needed by using higher concentration, to observe the optimal concentration of *Hibiscus rosa sinensis* flower which exhibit the strongest antibacterial activity. According to study from Meena *et al*²¹, lethal dose (LD_{50}) of *Hibiscus rosa sinensis* flower is 1600 mg/Kg body wt.²¹ It means the dosage given in this study can consider as low, so the higher dosage can be give and still safe to be used.

Other factors that might contribute on the antimicrobial activity of *Hibiscus rosa sinensis* flower extract are the solvent and extraction method used in this study. Ethanol solvent and maseration method that used in this study could be influenced the amount of the extracted active compounds from this extract, so it would affect its antibacterial activity. The previous study by Rao *et al*²² reported that some active compounds like saponin was not detected in *Hibiscus rosa sinensis* flower extract which used ethanol solvent with maseration method, while it was detected when used ethanol with soxhlet method.²² Sowmya *et al*²³ compared between ethanol, aquous, ethyl acetate, acetone, eter, chloroform in several medicinal plants, and reported that ethanol solvent can dissolve a large number of the active agents.²³ Ruban *et al*¹⁷ stated that different solvents using for making *Hibiscus*

rosa sinensis flower extract had different inhibition activity against Gram-positive and Gram-negative.¹⁷ Therefore, other studies should be conducted to evaluate the potential antibacterial effect of *Hibiscus rosa sinensis* flower using other solvents or other extraction methods. This study showed that *Hibiscus rosa sinensis* flower has antibacterial activity, but further studies are needed to be carried out to isolate and identify the active compounds of *Hibiscus rosa sinensis* flower and their influence in disruption of biofilm formation for prevention and control of periodontal diseases.

CONCLUSION

Based on the current findings, it was proved that ethanol extracts from *Hibiscus rosa sinensis* flower exhibited good potential against oral pathogens. The concentration of *Hibiscus rosa sinensis* flower extract has an impact on antibacterial activity; the higher the concentration of *Hibiscus rosa sinensis* flower the greater its usefulness as an antibacterial agent. Thus, *Hibiscus rosa sinensis* flower should be considered having beneficially potential in dentistry field as oral care products such as toothpaste and mouthwash.

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The Difference In Anti-Bacterial Activity Between Basil Leaf (*Occinum Sanctum*) Essential Oil And Chlorhexidine Gluconate Towards *Enterococcus Faecalis*

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Abstract

INTRODUCTION: Chlorhexidine gluconate is a commonly used irrigation agent for root canal treatments. However, it is ineffective towards *Enterococcus faecalis* because these bacteria possess the ability to enter deeper layer of tissue beyond dentinal tubules. The increase of bacterial resistancy towards synthetic agents has encouraged a few researches to investigate the anti-bacterial properties of herbs as irrigation agents for root canal, one of which is basil. Basil (*Occinum sanctum*), is a herbal plant with a characteristic aroma that is commonly used as an appetizer. It possesses anti-bacterial, anti-fungal and anti-viral properties. Essential oil obtained from basil possesses high levels of eugenol, which plays a major role in its anti-bacterial property. Basil essential oil is effective towards gram-positive and gram-negative bacteria. **Objective:** This research was carried out to investigate the presence anti-bacterial property in basil leaf essential oil compared to chlorhexidine gluconate towards the growth of *Enterococcus faecalis* ATCC 29212. **Materials and methods:** Initial procedures were to extract the essential oil from basil leaves through distillation. Results from phytochemical tests show that basil contains phenol, flavonoid, triterpenoid saponin, tannin with negative results on steroids. Bacterial tests in this research adapted the microdilution method by measuring Minimum Inhibitory Concentration (MIC) basil leaf essential oil towards *Enterococcus faecalis* ATCC 29212 compared to chlorhexidine gluconate. **Result:** Results from this research showed that the MIC value for basil leaf essential oil was 31,25 ppm while the value for chlorhexidine gluconate was 0,49 ppm. **Discussion:** Therefore, it can be concluded that essential oil from basil leaves posses anti-bacterial effects but are lower than that of chlorhexidine gluconate towards *Enterococcus faecalis* ATCC 29212.

Keywords : *Occinum sanctum*, Anti-bacterial activity, *Enterococcus faecalis*

INTRODUCTION

The success of endodontic therapies highly depend on the eradication of infection-

causing microorganisms from the root canal.¹¹ *Enterococcus faecalis* is one such gram-positive coccal bacteria that is present in the root canal due to failures in endodontic therapies. They are also present in necrotic pulp tissue.²

Ideal root canal medications should possess properties such as bio-compatibility, easy to clean, does not cause tooth discolouration nor interfere with the process of obturation.³ The increase of bacterial resistancy towards synthetic agents have encouraged a few researches to investigate the anti-bacterial properties of herbs as irrigation agents for root canal. Over time, there has been an increase in usage of medicine from natural sources. According to World Health Organization, plants are potential sources to the discovery of new medicine.⁴ Medicine obtained from plants are also safer compared to medicine synthesized synthetically. An example of such products is basil essential oil, as it posses high anti-microbial ability, bio-compatible, anti-inflammatory, and anti-oxidant.

Basil posses anti-bacterial, anti-fungal and anti-viral effects.⁵ This said anti-bacterial effect is from the eugenol which is the main component in essential oils found in basil leaves.^{5,6} The content eugenol plays a big role in anti-bacterial properties of basil. Mann *et al* (2000) stated that essential oils found in basil leaves are effective towards both gram-positive and gram-negative bacteria.⁵

Groups of active compounds found in basil leaves were obtained through distillation to form essential oils. Phytochemical tests were carried out on basil leaf essential oil to ascertain contents of compounds. Phytochemicals in plants, among others, contain alkaloid, saponin, flavonoid and terpenoid.⁴

This research was carried out to investigate the presence anti-bacterial property in basil leaf essential oil towards the growth of *Enterecoccus faecalis* ATCC 29212.

RESEARCH METHODOLOGY

The research object was anti-bacterial activity towards the growth of *Enterecoccus faecalis* in liquid media. The sample used is essential oil from basil leaves. *Enterecoccus faecalis* ATCC 29212 was used as bacteria in this research.

The variable of this research is the anti-bacterial activity of basil leaf essential oil towards the growth of *Enterecoccus faecalis* ATCC 29212. The data collection method adapted was the true experiment method. Forms of data used were quantitative and were collected by measuring or calculating with an Elisa Reader to measure the Minimum Inhibitory Concentration (MIC) of basil leaf essential oil towards *Enterecoccus faecalis* ATCC 29212.

MATERIALS AND METHODS

Materials and tools that were used in this experiment were essential oil obtained from basil leaves, *Enterecoccus faecalis* ATCC 29212 bacteria, liquid agar media, microplate and an Elisa reader. The method used to extract essential oil from basil leaves was distillation.

Phytochemical tests were carried out to investigate the various groups of compounds found in basil leaf essential oil. The phytochemical tests carried out encompassed alkaloid, saponin, polyphenol, flavonoid, tannin and terpenoid tests. the anti-bacterial activity (MIC) test was carried out using the micro-dilution method, in which its optical density was measure with an Elisa reader. The results were rated by concentration ppm.

RESULTS AND DISCUSSION

Phytochemical tests carried out on the basil leaf essential oils produced positive results to the presence of phenolic, flavonoid, saponin, triterpenoid and tannin (Table 1). Results from the MIC test for basil leaf essential oil was 31,25 ppm while the value for chlorhexidine gluconate was 0,49 ppm (Table 2). The mechanism of flavonoid causes damage to the permeability of bacterial cell wall so that the cell membrane is undermined, followed by the discharge of intracellular substance and hamper bacterial motility.^{7,8,9}

A few researches have shown that terpenoid is able to hamper bacteria growth by interfering with the formation of cell wall or cell membrane, causing them to not form completely or not being formed altogether.¹⁰ Saponin on the other hand, works to damage cell cytoplasm by decreasing surface tension to increase permeability or leakage and causes intracellular substance to leak out.¹¹ The anti-bacterial mechanism of phenol stems from its ability to poison protoplasm, damage and puncture cell walls and coagulate bacterial cell proteins. Large molecules of phenols are able to deactivate essential enzymes in bacterial cells even in low concentrations. All in all, it causes damage to bacterial cells, denatures proteins, deactivates enzymes and causes cell leakage. Tannin works as in anti-bacterial agent by obstructing reverse transcriptase enzyme and DNA topoisomerase and ultimately causes bacterial cells to not form.¹¹

Table 1. Phytochemical Tests on Basil Leaf Essential Oil

	Phenol	Flavonoid	Steroid	Saponin	Triterpenoid	Tanin
Basil leaf essential oil	+	+	-	+	+	+

Legend : (-) : Not Contained, (+) : Contained

Table 2. MIC Value of Basil Leaf Essential Oil and Chlorhexidine Gluconate Towards *Enterococcus faecalis* ATCC 29212

No	Sample	MIC value (Concentration ppm)
1	Basil Leaf Essential Oil	31,25
2	Chlorhexidine Gluconate	0,49

CONCLUSION

Based on the results of the research and discussion, it can be concluded that basil leaf essential oil possesses anti-bacterial activity towards the growth of *Enterococcus faecalis* ATCC 29212. However, the MIC value of 31,25 ppm obtained from basil leaf essential oil was lower than that of chlorhexidine gluconate which has a MIC value of 0,49 ppm.

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Evaluation Of Antifungal Activity Of Stichopus Hermaniiethanol Extract As Oral Candidiasis Treatment

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ABSTRACT

INTRODUCTION : The presence of Candida species as a human commensal, alarming rates of oral infections have been observed, including oral candidiasis. Currently available antifungal drugs have progressively lost their effectiveness. Stichopus hermanii has been used traditionally as food preservatives and disease remedie, it's antifungal potency need to be explored. **Objective**: to evaluate the antifungal activity of Stichopus hermanii ethanol extract against oral candidiasis. **Material and Method** : Twenty four wistar rats were randomly divided into four groups, i.e. 1st group (normal rats as control group), 2nd group (oral candida infection group), 3rd group (treatment group received nystatin), 4th group (treatment group received Stichopus hermanii ethanol extract 0.09 mg/gBW). The antifungal activities of Stichopus hermanii ethanol extract were examined by estimating the fungal burden in rat dorsal tongue. The in vitro antifungal activities were assessed by tongue swab sample examined by broth micro-dilution method. The in vivo activity was evaluated by histology assay of tongue biopsy. **Result** : Microbiologically, Stichopus hermanii ethanol extract reduced the number of colony forming units (CFU) sampled from treated rat's oral cavity similar to nystatin, compared to untreated control rats ($p<0.05$). Histologically, Stichopus hermanii ethanol extract and nystatin reduced the biofilm formation on the dorsal tongue epithelium from the oral cavity of rats treated, compared to untreated control rats ($p<0.05$). The histological data were confirmed by the microbiological result, pointing that Stichopus hermanii extract could be considered as antifungal agents. **Conclusion** : Stichopus hermanii extract could be considered as antifungal agents for oral candidiasis.

Keywords: *Stichopus hermanii, experimental oral candidiasis, antifungal activity*

INTRODUCTION

Oral candidiasis has emerged and are being increasingly recognized as important public health problems expanding population of immuno-compromised patients¹. Oral candidiasis are usually associated with *Candida* species represent the main opportunistic fungal infections, leading to high morbidity and mortality in the population^{2,3}. The antifungal agents are numerous, but antifungal agents are currently due to the high toxicity^{4,5}. This is indicating that current antifungal therapy to treat oral candidiasis is still ineffective. Therefore, the discovery of new antifungal agents is still needed. Among the potential sources of new agents, marine biotas have long been investigated because they contain many bioactive compounds that can be used in therapy, because of their low toxicity^{6,7}. Sea cucumbers, also known as *Stichopus hermanii*, are marine biotas, is widely used orally and topically to treat various disease such as wound healing, antibacteria, antifungal, antitumour, antianaphylactic, anti-inflammatory, antinociceptive and antioxidant agent⁸. Thus, the objectives of this study were to evaluate the antifungal activity of *Stichopus hermanii* ethanol extract against oral candidiasis.

METHOD

Strains and media

The microorganisms used in this study were *Candida albicans* ATCC (American Type Culture Collection) 9002. Sabouraud dextrose agar (SDA) was used for the maintenance and culture of fungal strains while Sabouraud dextrose broth (SDB) was used for the determination of the minimum inhibitory concentrations (MICs). A single colony from SDA was grown in yeast extract-peptone glucose medium (YPG : yeast extract, 2%; bacto peptone, 1%; glucose, 2%) for 18 hours at 30°C in a shaker. The culture was harvested by centrifugation at 2500 g, and then cells were washed three times in Phosphate Buffer Saline (PBS) and adjusted to 3×10^8 CFU/mL (using a hemocytometer chamber for counting cells). The viability of the inoculum was confirmed by quantitative cultures of serial 10 fold dilutions on SDA plates. The number of viable cells was determined using the drop count method⁹.

Antifungal agents

Stichopus hermanii was collected from Karimun Jawa coastal region. Adult sea cucumber was selected to get the best extract result considering to its maximum secondary metabolite contents. The collected samples were cleaned, immersed in water for one night to get rid of salt and parasite then dried in dryer machine. *Stichopus hermanii* then splitted, the inner abdomen were removed then cleaned and washed, so only the flesh of the body proceed to next process. Each sample were cut in small piece of 3-10 cm, the wet weight then measured then dried up in solar dryer for 3-4 days to reduce the water content. The dried sea cucumber then cut into smaller pieces of 1 cm, mashed by blender the the weight were measured and ready for the maceration process. Two hundred and fifty (250) gram mashed dry sea cucumber sample immersed until soaked in 500 mL methanol solvent for

24 hours at room temperature, then filtered with filter paper to separate filtrate and residue. Residue then reimmersed in 500 mL methanol solvent for 24 hours, again filtered with filter paper to separate filtrate and residue, resulted in maceration filtrate with the ratio of 250 gram sample / 1000 mL solvent (1:4 w/v). Ethanol (polar) filtrate got homogenized with 1000 mL hexane solvent (non polar) then performed partition with separatory funnel the each of the filtrate layer of ethanol and hexane solvent were separated. Ethanol (polar) filtrate then got re-homogenized with 1000 mL chloroform solvent (semi polar), performed partition with separatory funnel the each of the filtrate layer of methanol and chloroform solvent were separated. Each filtrate were separated by its solvent with rotary evaporator until extract produced. The evaporated extract then placed in the vial and stored in -30°C until the next analysis¹⁰. Nystatin was purchased from Bristol-Myers Squibb.

Animals

The animals used for the in vivo experiments were 150-170 g male Wistar rats. Infected rats distributed into four groups of 6 animals each were housed in cages and had access to food and water *ad libitum*. Rats were randomly divided into four groups, i.e. 1st group (normal rats as control group), 2nd group (oral candida infection group), 3rd group (treatment group received nystatin), 4th group (treatment group received *Stichopus hermanii* ethanol extract 0.09 mg/gBW). All animal experiments were maintained in laboratory animals and were approved by the animal ethical committee of the Hang Tuah University.

Induction of oral infection with Candida albicans in rat

Our experiments were repeated three times, to enhance the infection rate; rats were immunosuppressed with dexamethasone and treated with tetracycline. One week before infection, rats received drinking water with 0.5 mg/L of dexamethasone with tetracycline (0.1%). On the day of infection, dexamethasone was raised to 1 mg/L, while tetracycline was reduced to 0.01% and maintained throughout the experiment. The rats were orally infected three times at 48 h intervals (days-7, -5 and -3) with 0.1mL of saline suspension containing 3.10^8 viable cells of *Candida albicans*. Oral infection was achieved by means of a cotton swab rolled twice over dorsal tongue. Just before inoculation, the animals were sampled to confirm the absence of *Candida albicans* in the oral cavity, and 72 h after the last inoculation all groups were sampled in the same manner to check for the presence of the fungi and to quantify the number of CFU in the oral cavity before the beginning of the treatment. Before the start of the treatment, all groups of infected animals were sampled. The oral swabs were all positive for the presence of *Candida albicans*^{11,12}.

Antifungal treatment

Stichopus hermanii ethanol extract at the doses of 0.09 mg/gBW were administered orally over 7 days, starting 24 h after infection. Two control groups were used; untreated control received distilled water and a positive control group treated with reference antifungal drug nystatin at 10 mg/kgBW.

Quantification of viable yeasts in vitro and in vivo

The quantification of the infection was assessed by microbiological (in vitro) and histopathological techniques (in vivo).

In vitro

Seven days after the treatment, oral samples were collected and cultured to quantify the CFU in the dorsal tongue of the animals of each group. Fungal were collected by rolling a sterile cotton swab over the dorsal tongue, which was then suspended in 1 mL of sterile saline. 25µl samples from this suspension were dropped in duplicate, after serial ten fold dilution on SDA plates containing 0.05% chloramphenicol. All plates were incubated at 30°C for 24 h, and the colonies were counted. The number of viable cells was determined using the drop count method to calculate the log of the CFU/mL¹³. At day 8, i.e. 24 h after the administration of the last dose of antifungal agent or saline, All animals in each group were sacrificed by cervical dislocation and tonge were collected from each rat. The tongues were removed, fixed *in toto* by immersion in Bouin solution for at least 48h. Tongue sections were embedded in paraffin and 5µm thick serial transverse sections were stained with both hematoxylin-eosin stain and Periodic Acid Schiff (PAS), to assess the fungal infection by the thickness of fungal biofilm^{11,12}.

Statistical analysis

One way analysis of variance was used to analyze the fungal load in all animals between each treatment group and the control group. When there were differences between groups, the means were compared using the Least Significant Difference test at a 5%. Results are expressed as mean ± standard deviation. All data were analyzed using SPSS Statistics 17.0.2.

RESULT

Stichopus hermanii ethanol extract have been used traditionally for generations by humans as food and to treat illness. Many studies have confirmed their role in health maintenance and promotion, but the major challenge is to provide scientific evidence. Therefore, the *in vitro* and *in vivo* antifungal potentials of Stichopus hermanii ethanol extract were investigated. The results of *in vitro* antifungal assay are presented in Table 1 and 2.

Table 1. Antifungal activity of Stichopus hermanii ethanol extract against Candida albicans in vitro

Group	Zone of Inhibition (mm)		
	Mean	Standart Deviation	ANOVA test
Control group	0.00	0.0000	p = 0.000*
Infection group	6.00	0.0050	
Nystatin treatment group	2.00	0.0012	
Stichopus hermanii treatment group	3.00	0.0015	

The results indicated that the extracts can inhibit fungal growth but the greatest inhibition zone found in Nystatin treatment group.

Table 2. Antifungal activity of *Stichopus hermanii* ethanol extract against *Candida albicans* in vitro

Group	Biofilm thickness (µm)		ANOVA test
	Mean	Standart Deviation	
Control group	0.00	0.00	
Infection group	146.50	20.05	
Nystatin treatment group	12.68	0.12	
<i>Stichopus hermanii</i> treatment group	30.10	0.15	
			p = 0.000*

Based on the thickness of the biofilm formed by *Candida albicans*, the data showed that a decline in the thickness of the biofilm in the group treated with nystatin and ethanol extract *Stichopus hermanii*, but the thickness of the biofilm group treated with ethanol extract *Stichopus hermanii* still larger than the group treated with nystatin.

DISCUSSION

Oral candidiasis is a common infection both in oral and perioral which usually result from excessive development of endogenous *Candida albicans*. Oral candidiasis may not appear immediately because the *Candida albicans* is less pathogenic fungi that are predisposing factors that lead to oral candidiasis. Clinical experience indicates that an increase in the biofilm layer related to the severity of an infection disease¹⁴.

Therefore, this study aimed to analyze the effectiveness of the golden sea cucumber (*Stichopus Hermanni*) in preventing the formation of biofilm on Wistar rats with oral candidiasis. Observation of biofilm formation in Wistar rats that experienced oral candidiasis can be indicated on the tongue. This is because the tongue is one organ in the oral cavity is the most sensitive to changes that occur in the body¹⁵. The result of this study proves that the ethanol extract of *Stichopus hermanii* 0.09mg / gBW can prevent biofilm formation of *Candida albicans* significantly. This proves that *Stichopus hermanii* has potential as an antifungal. Flavonoids and tannins belonged to phenolic compounds. Phenolic compounds interact with the cell membrane proteins that cause precipitation and terdenaturasinya cell membrane proteins¹⁶. Damage to the cell membrane causes changes in membrane permeability, resulting in fungal cell membrane lysis¹⁷. Phenol can damage proteins in the cell membrane so that the membrane of *Candida albicans* cells into lysis, phenol is able to penetrate the cell nucleus and the fungus *Candida albicans* fungus can not multiply. Tannins are compounds that are lipophilic so easily bound to the cell wall and cause damage to the cell wall. In addition, the tannins can inhibit the synthesis of chitin which is an essential component of fungal cell walls¹⁸.

Saponins are surfactants which form polar so that it breaks down the fat cell membranes, which in turn cause the permeability of the cell membrane, it resulted in the diffusion process materials or substances needed by the fungus can be disrupted, eventually the cells swell and rupture¹⁹. Terpenoids, including triterpenoids and steroids are bioactive compounds that function as an antifungal. The compound can inhibit fungal growth, either through the cytoplasmic membrane and interferes with the growth and development of fungal spores²⁰.

In general, sea cucumbers have compounds that can serve as an antifungal. Based on prior research it demonstrated that the compound triterpene glycosides in n-butanol fraction of trepang (*Actinopyga lecanora*) showed antifungal activity against 20 fungal isolates tested²¹. The crude extract and the purified fraction isolated from *Holothuria Polii* (Mediterranean Sea cucumbers) showed antifungal activity against *Aspergillus fumigatus* and *Trichophyton rubrum*²². In addition, it was reported that the sea cucumber patagonicoside type A has a good antifungal activity against pathogenic fungi (*Cladosporium cucumerinum*)²³. Compounds triterpene glycosides from sea cucumber (*Psolus patagonicus*) also have potential as a potent antifungal compared to synthetic effective antifungal product²⁴. Based on the potential antifungal as expressed by some research on it is interesting to explore the sea cucumber as a natural source of new antifungal agents to be developed as drugs against infectious diseases.

CONCLUSION

Stichopus hermanii extract could be considered as antifungal agents for oral candidiasis.

ACKNOWLEDGEMENT

This research was supported by a grant from Fundamental Research Program, funded by Ministry of Education and Culture Indonesia.

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The Effect Of Combination *Sticopus Hermanii* and Hyperbaric Oxygen On Osteoblast And Osteoclast In Periodontal Tissue Diabetic Rat

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ABSTRACT

Objective : To examine the effect Combination *Sticopus hermanii* and Hyperbaric Oxygen Therapy 2,4 ATA on osteoblast and osteoclast in periodontal tissues diabetic rats. **Materials and methods** : A total of 45 male Wistar rats were equally divided in healthy controls (group-1), diabetic + periodontitis (group-2), diabetic -periodontitis + SH (group-3), diabetic-periodontitis + HBOT (group-4), and diabetic -periodontitis+SH+HBOT (group-5). Experimental diabetic was induced by single dose 65 mg/kg of BW intraperitoneal. The SH gel 3% by topical application gave in sulcus gingiva for 7 days. HBOT 2,4 ATA 3x30 minutes interval 5 minute for 7 days and the animals were decapitated. The measurement osteoblast, osteoclast after 50 days was examined using histopathology method. **Results** : It was found that combination SH and HBOT in osteoblast can increased significantly $p=0,003$ (28.47 ± 3.20) after 7 sessions HBOT than DM-periodontitis ($9.22 \pm 4,95$) and osteoclast ($3,50 \pm ,957$) decreased significantly $p=0,000$ than without DM-periodontitis ($5,00 \pm 0,816$) can increased. **Conclusions** : The combination of *Sticopus hermanii* and HBOT can increase osteoblast, reduces osteoclast in hyperglycemia periodontal tissue diabetic rat.

Keywords : *osteoblast, osteoclast, diabetic, hyperbaric oxygen*

INTRODUCTION

Periodontal disease is second most common oral disease after dental caries in Indonesia with the prevalence of 96.58% in all stage of ages. In hyperglycemia condition, the susceptibility of periodontitis increased three times. Diabetes is the sixth complication disease and the most common in oral cavity.¹ The severity and prevalence of periodontal disease in diabetic patient related to the increasing of blood glucose level and cause *advanced glycation end products* (AGEs), lead to the increase of IL-1 β and TNF- α .^{2,3} The increasing level of lypopolysaccaride and TNF- α also lead to insulin resistance and the development of diabetes.^{3,4} Management of periodontitis with diabetes could be pointed at

local factors but systemic factor should be considered as the control of blood glucose level. Proper treatment of periodontitis potentially raised the general condition of the patient.⁵ Local periodontal therapy as scaling and root planning histologically do not showed the attachment of new connective tissue⁶ thus adjuvant therapy should be considered in management of periodontitis with diabetes .

Sea cucumber is marine biota with medical benefit bioactive compound and has been used as traditional food and folk medicine since ancient time. Golden sea cucumber (*Stichopus hermanii*) has been consumed as food rich with content of *polyanion* related to compound of sulfated glycosaminoglycans (GAGs) which affect physiologic activity function including wound healing.⁷ Several studies stated that sulfated GAGs i.e chondroitinsulphate and heparin sulphate has the important role in wound healing.⁸ *Stichopus hermanii* also contain protein, vitamin C, flavonoid, Superoxide Dismutase(SOD), and kolagen which have the influence in inflammation phase of healing.

Hyperbaric oxygen therapy (HBOT) is a breath therapy using 100% pure oxygen in a igh pressure chamber more than 1 ATA (Atmosphere Absolute).⁹ Our previous study stated that HBOT in periodontal disease resulted in healing effect by the decreasing level of malondialdehyde (MDA) in periodontitis with diabetes mellitus.¹⁰ Another research in human osteoblast culture were compared the control group without therapy with the group received HBOT. Result showed the number of osteoblast in group received HBOT 2,4 ATA for 30 minute on the sixth day after exposure (2000-2500 cells) were higher than control group without therapy (1500-2000 cells).¹¹

Osteoblast are fibroblast undergo modification and same as fibroblast originated from mesenchymal cells.¹² Alveolar bone loss in periodontitis caused by the increasing of bone resorption by osteoclast or the decreasing bone formation by osteoblast or both of those. Osteoblast has the role on collagen synthesis to form osteoid as basic bone material.¹²

Osteoclast is big motile branch cells with multiple nucleus.¹³ In the area of bone resorption osteoclast reside in the crypt formed by enzyme on the matrix known as lakuna howship. Osteoclast caused the excessive resorption on the bone.^{1,5,13}

This study aimed to examine the effect of combination of *Sticophus hermanii* and HBOT to osteoblast and osteoclast of alveolar periodontitis rat induced by *Porphyromonas gingivalis* with diabetes mellitus with the dose of 2,4 ATA 100% O₂ 3x30 minute and 5 minute interval for 7 days. The dose was refered by the previous research of the same treatment resulted in the decreasing of blood glucose level effectively compared to 10 days of treatment.¹⁵

MATERIAL AND METHOD

This study is true experimental with post test only control group design. Thirty male wistar rats age 8 weeks were randomly arrange into 5 groups. K0 were normal control group while K1-K4 was periodontitis and diabetes rats.

Diabetes condition was induced by streptozotocin 50 mg/ kg BB single dose

intraperitoneally. Rats stated to be diabetes when hyperglycemia was measured 4 days after induction with the level above 250 mg/dL.¹⁶ Periodontitis condition were induced by innoculated bacterial suspension of *P. gingivalis* ATCC 33277 containing 10⁹ CFU/ml in 2 ml PBS by peroral administration with nasogastric tube, swabbed in buccal/labial-palatal gingiva along molar to molar regio and anal regio. The administration of *P. gingivalis* were done 3 times in 4 days.¹⁷ After 2 weeks periodontitis condition was achieved and were started to get the treatment.

K1 group received no treatment as positive control, K2 were given HBOT 2,4 ATA 3x30 minute and 5 minute interval for 7 days, K3 were given *Sticophus hermanii* gel on gingival sulcus for 5 days, K4 were given combination of HBOT and *Sticophus hermanii*. After treatment done, rat was sacrificed and mandibular section was performed hematoxylin eosin staining. Data were analyzed by Anova and LSD.

RESULT

Result on osteoblast examination showed the decreasing amount in K1 group compare to normal. All treatment in group K2-K4 raised the number of osteoblast significantly but the highest number was on group K4 (p<0.05) which receive the combination of *Sticophus hermanii* and HBO. Result on osteoclast examination showed the increasing amount in K1 group compare to normal. All treatment in group K2-K4 decreased the number of osteoclast significantly but the lowest number was on group K4 (p<0.05) which receive the combination of *Sticophus hermanii* and HBOT.

Table 1. Mean of osteoblast number

Group	Mean of Osteoblast
K0	14.12 ± 7.54
K1	9.22 ± 4.95
K2	24.97 ± 4.99
K3	22.80 ± 6.45
K4	28.47 ± 3.20

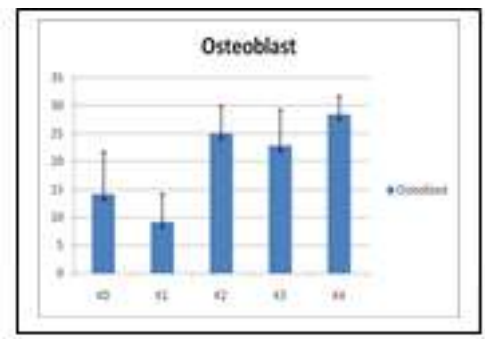


Fig 1. Number of osteoclast on alveolar mandible of all groups

Table 2. Mean of osteoclast number

Group	Mean of Osteoblast
K0	1.50 ± 1.291
K1	$5.00 \pm .816$
K2	4.00 ± 2.062
K3	4.50 ± 2.449
K4	$3.50 \pm .957$

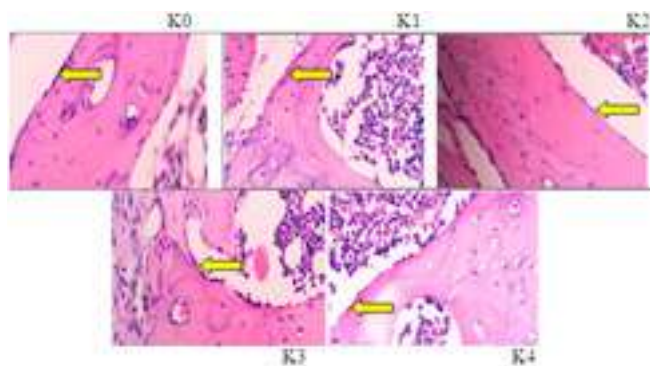


Fig 2. Number of osteoclast on alveolar mandible of all groups

DISCUSSION

Standard treatment of periodontitis are performed by nonsurgical therapy as scaling and root planning and supportive periodontal recall to remove plaque bacterial as main etiologic factor of periodontitis⁶. Concerning to the condition of periodontitis with diabetes mellitus (DM), adjunctive therapy should be considered to control blood glucose level and improve wound healing. HBOT posses' physiologic and pharmacologic therapeutic effects.¹⁸

Physiologically, oxygen transport in plasma is the key role of HBOT effect in the tissue. When air pressure in the chamber increased, the oxygen partial pressure in alveolar will be enhance proportionally and increase the dissolved partial oxygen pressure in plasma. Inhalation of 100% pure oxygen in pressure 2-3 ATA in HBOT resulted in arterial partial oxygen pressure of sekitar 1200-2000 mmHg, lead to the increasing of subcutaneous oxygen diffusion between 30-50 mmHg compare to regular breathing in pressure of 1 ATA. HBOT increase blood oxygen concentration to regulate various enzymatic reaction and cell respiration in normal tissue.¹⁹

Therapeutic effect of HBOT affected the modulation of NO production, modify the growth factor and cytokine effect by regulating the level or its receptors, stimulate protein membrane which influence ion formation, enhancing cell proliferation, rapid collagen depositioin, stimulate capillary building and arboriation, antimicrobial effect, immune response modulation, provide oxygen supply to the tissue, rapid wound healing, eliminate toxic substance and reduce its effect, swelling reduction in healing^{11,19,20}.

Result showed the higher increasing amount of osteoblast in K4 group treated by the combination of *Sticophus hermanii* gel and HBOT compare to K2 group treated only with HBOT or K3 group treated by *Sticophus hermanii* gel. Induction with streptozotocin (STZ) lead to accumulation of AGEs resulted in alteration of cell and extracellular matrix component as abnormal function of endothelial cells, capillary formation and vascular proliferation then disturb the vascularization and bone healing resulted in decreasing number of osteoblast^{2,4}. AGEs also cause the increasing of inflammatory immune response to periodontal pathogens by the increasing production of proinflammatory cytokine such as IL-1 β and TNF- α , showed in gingival crevicular fluid of DM patients^{3,4}. TNF- α elicit bone destruction marked by the increasing of osteoclast number. In the other hand, *Porphyromonas gingivalis* trigger the elevation of lipopolysaccharide serum level and TNF- α cause the insulin resistance and development of Diabetes Mellitus. Periodontitis and DM have bidirectional relationship which affect the severity each other. The reduced number of osteoblast and high number of osteoclast in group K1 might be the result of the TNF- α and worsen by the accumulation of AGEs.

HBOT also has its role on antimicrobial effect against periodontal pathogen such as *Porphyromonas gingivalis*. Once main bacterial pathogen eliminated, the progression of disease could be terminated.²¹ HBOT enhance the oxygen pressure in the tissue in deep level that prevent the growth of microbe by inhibit its metabolic reactions. HBOT have the bacteriostatic and bactericidal effect to certain microorganism²². While the direct effect of HBOT in bacterial killing is by the enhancement of leucocyte function which won't be happen when tissue oxygen pressure is below 30 mmHg as in infected tissue, the neutrophil activity will be impaired.^{21,22}

Collagen matrix formation, angiogenesis and wound healing process depend on the sufficient amount of oxygen supply, in this case HBOT enhance tissue oxygenation. Hypoxia wound healing on HBOT are stronger and faster and resulted in optimum stimulation of fibroblast proliferation and angiogenesis^{11,19}. Sufficient amount of oxygen stimulate cartilage formation, on the contrary, insufficient oxygen supply lead to failed formation of fibrous tissue by osteoblast²¹

Bioactive compound of *Sticophus hermanii* such as saponin posses the anti-inflammatory property, inhibit the bacterial growth by interaction with bacterial cells lead to bacterial destruction and lysis.^{8,18} It also contain the compound of PUFA (*Polyunsaturated fatty acid*) saturated fatty acid with have the role as source of energy, antioxidant, membrane production, and mediators of cell signal transmission³¹ EPA (*Eicosapentaenoate*) dan DHA (*Docosahexanoate*) are PUFA which stimulate PMN, macrophage, produce ROS, enhance antimicrobial activity and has its main role in immune system to prevent prostaglandin formation and inhibit inflammatory cytokine (IL-6, IL-1 α dan TNF- α). Prostaglandin has its role in osteoclast formation and bone resorption.^{8,18}

Treatment with 2,4 ATA HBOT in 3x 30 minute, each 5 minute break proved to press down the osteoclast differentiation by reducing the number of RANKL induced by positive TRAP mononuclear and multilocular osteoclast formed in human monocyte and blood perifer

cells so that excessive formation of osteoclast could be prevented.³⁶ The increasing number of osteoblast and decreasing number of osteoclast by combination therapy of *Sticophus hermanii* gel and HBOT are related with our previous research of the effect HBOT on the reducing of periodontal ligament fibroblast MMP-8 expression in hyperglycemic rats ¹⁰

The decreasing osteoclast number were appeared highest in K4 group treated by the combination of *Sticophus hermanii* gel and HBOT compare to K2 group treated only with HBOT or K3 group treated by *Sticophus hermanii* gel. Statistical analysis result showed that the number of both osteoblast and osteoclast in K0 group as normal control and K4 group which given combination therapy have no significant different ($p>0.05$) it means that the number of osteoclast in both groups are not different. The treatment resulted in the same osteoblast and osteoclast number as in normal periodontal tissue, thus potentially developed as significant adjunctive therapy of periodontitis with diabetes.

CONCLUSION

Combination *Sticopus hermanii* and Hyperbaric Oxygen 2,4 ATA 100% O₂ 3x30 minute, 5 minute break interval for 7 consecutive days could increase the number of osteoblast and decreased the number of osteoclast of diabetic rat periodontal tissue

ACKNOWLEDGEMENT

This research was supported by a grant from Fundamental Research Program, funded by Ministry of Education and Culture Indonesia.

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Distalization Of Upper Molar With Removable Appliance

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ABSTRACT

Distalization of the upper first molar is one of the methods used to gain space for correcting malocclusion. The upper first molar distalization is performed especially in non-extraction orthodontic treatments, borderline cases, and in cases involving children who are still in their growth and development phase. The appliance used for upper first molar distalization may include extraoral or intraoral appliances. The extraoral or intraoral appliances used in upper first molar distalization have their own strengths and weaknesses. The appliance of choice for treatment will depend on each individual case. The extraoral appliance that is often used for upper first molar distalization is the headgear. There are a lot of intraoral appliances used for this purpose, including the expansion screw.

Keywords:*distal, molar, expansion*

INTRODUCTION

Orthodontic treatments aim to correct malocclusions that may take the form of crowding, spacing, protrusion, and anterior or posterior crossbites.¹² The most frequently found malocclusion cases in Indonesia are crowding and protrusion, class II division 1 cases, or mild class I type 1 and 2 cases.

Orthodontists or dentists, when treating crowding or protrusion due to the lack of space, may use various techniques in the treatment. One of the techniques used in orthodontic treatment for crowding is selection to gain space. The space might be gain through extraction of one to several teeth, distal dental arch expansion through molar distalization, and slicing or flaring.¹²³

Orthodontic treatment to correct crowding or protrusion will need space as the two conditions are compensations of lack of space. One of the treatments of choice to gain space is molar distalization. Molar distalization can be performed using extraoral or intraoral appliances⁴ The selection of molar distalization as the treatment of choice is very much affected by the case to be treated.⁵

LITERATURE REVIEW

Indications

Most orthodontic treatments to treat malocclusion include first premolar extraction and canine retraction.³ The upper first molar distalization can be used to correct malocclusion under some considerations. The case selection should be based on patient's age, which should still be in growth and development phase; wide or long distal basal part; small anterior crowding or diastema; relatively neat lower dental arch; normal overjet or no indication to reduce overjet; relatively normal overbite; and mesially drifted upper first molar (mesial drifting).³⁶ The level of success of the treatment will depend on the above factors. In the case where second molar has erupted, the treatment will take longer time.³⁷

Type of Appliance

Extraoral Appliance

The appliance used for upper first molar distalization may include extraoral or intraoral appliances. Extraoral appliances have been used for a long time for upper molar distalization with headgear as the most frequently used appliance.

*Intraoral Appliance*⁵⁴

The development of science and knowledge in orthodontics has been very rapid that the intraoral appliances for upper first molar distalization have been progressing rapidly.⁸ Some intraoral appliances that can be used for upper first molar distalization are jig, magnet, and expansion screw.⁵

Expansion Screw

Expansion screw can be used for orthodontic expansion (dental arch) or orthognathic expansion (basal arch). Upper first molar distalization using expansion screw is an orthodontic expansion, which is moving the teeth instead of the basal arch or jaw.⁵ Parts of orthodontic plate using expansion screw:

Base Plate

This is the removable part, made of acrylic, of a removable appliance.⁹ The base plate should adapt well to the mucosa and should be polished until it is smooth to prevent mucosal injury and food retention as well as facilitating easy cleaning. Base plate functions as the support and active and passive appliance attachment as well as protecting palatal spring from damage. It also distributes forces created by active components to the anchor when teeth are moved and to prevent unwanted dental movement.⁹ Base plate also strengthens anchoring by contacting the teeth that are not moved by attaching the plate wedge into the lingual/palatinal surface. This can also be an active component if it is equipped with an expansion screw. Base plate can also be expanded using anterior or posterior bite riser and it can also maintain shifted teeth position by adding self-curing acrylic.

The acrylic plate should have adequate thickness for spring and retention wire attachment. The recommended thickness of an acrylic plate is around one sheet of wax or about 1-2 mm.⁹ The base plate for expansion screw is usually thicker than the ordinary plate and the acrylic surface is usually expanded to cover $\frac{1}{3}$ to $\frac{1}{2}$ of dental cervical part. There are two types of resin acrylic: heat acrylic resin and cold curing acrylic resin. ⁹ The heat acrylic resin requires several processes, including making the wax model of the removable appliance (waxing), flasing and packing, wax removal, resin mixture filing, cooking, and polishing. Meanwhile, the cold curing acrylic resin does not need those processes. This type of resin uses brush technique that involves applying cold mold seal and wire in its respective position on the working model and attaches the occlusal part using wax. After that, a thin layer of acrylic powder (powder resin) is applied and several drops of monomer are applied. This is performed repeatedly until the desired thickness. Model is then soaked in water (cold or warm) for more or less half an hour before it is polished.

Expansion Screw

Orthodontic treatment using expansion screw can be applied through skeletal or dental expansion. Dental expansion is a useful approach to move one or a group of teeth through buccal, labial, mesial, or distal tipping, depending on the position of the expansion screw. Expansion screw can be used for normal dental inclination, palatoversion, linguoversion, and mesioversion.¹⁰ Examples of these are Fan type expansion screw, Glennross expansion screw, and Schwarz expansion screw. There are also screws that move in three sides, right, left, and anterior, such as Bertoni expansion screw. Expansion screws are activated by turning the screw clockwise with $\frac{1}{4}$ turn (90°). ⁹¹⁰ The advantages of this screw is that it is inexpensive, easy to clean, and can add dental arch length; however, it is difficult to define the amount of pressure applied.¹⁰ An expansion plate that is used for molar distalization can also be used as space regainer. Skeletal expansion is used to expand the arch by opening the median palatine suture and is a fixed appliance. There are two types of this appliance: Rapid Palatal Expansion (Rapid Maxillary Expansion) in which activation is performed with $\frac{1}{4}$ turn/day for 2 weeks and Slow Palatal Expansion (Slow Maxillary Expansion) in which activation is performed with $\frac{1}{4}$ turn/week for 2.5 months. The examples of this appliance are Haas type expansion and Hyrax type expansion.

Clasp

Clasp is a retention component that prevents forces from removing the plate, maintain mechanic forces that will guarantee springs to be in their appropriate position, prevents plate moving habit, reduces difficulties faced during talking and eating, enables additional extraoral pull if needed without moving the position, and accelerates patient's adaptation to the appliance because it is appropriately held. ¹⁰ An example of these clasps is Adams clasp. Adams clasp is made of 0.7 mm wire on molars and 0.6 mm wire on primary teeth. It is a modification of arrow head clasp and introduced by Adams. The retention function of this clasp is very good through the utilization of the cervical undercuts.⁹ This clasp is small

and simple, only involves one or several teeth, both fully erupted teeth and partially erupted teeth, in permanent and primary dentitions.¹⁰¹¹

Labial Bow

Labial bow in expansion screw plate functions to maintain the arch and to add retention. The labial bow is made of 0.8 mm wire.⁹¹⁰

CONCLUSION

Upper first molar distalization can be performed intraorally using the expansion screw. The success in upper first molar distalization is very much influenced by a very selective case selection.

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Adjunctive Orthodontic Treatment Of Patient With Periodontal Disease (Case Report)

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ABSTRACT

Orthodontic treatment is ideally performed on healthy hard and soft tissue supporting the teeth. Patients with severe periodontal disease do orthodontic treatment if the health of the periodontal tissues are well controlled before beginning orthodontic treatment. Case report describe two cases of malocclusion orthodontic treatment in patients with severe periodontal disease. Orthodontic treatment using fixed appliance in patients with severe periodontal disease, related to the initial examination, biomechanics, effect of orthodontic treatment to the periodontal support and the treatment sequence. Orthodontic treatment in malocclusion patients with severe periodontal disease could be corrected properly so that the patients allows for better in cleaning their teeth. Orthodontic treatment in patient with severe periodontal disease could be successfull if the treatment done with adequate procedures and good patient cooperation.

Keywords: *Orthodontic treatment, periodontal disease*

INTRODUCTION

Adjunctive orthodontic treatment is orthodontic treatment which the tooth movement is carried out to correct malocclusion and restore function and aesthetic especially for anterior teeth. The goals of adjunctive orthodontic treatment in the patient who just had treatment for severe periodontal disease is to make it easier for patient to control periodontal problem by eliminating plaque accumulation, improve periodontal health, improve contour of alveolar ridge adjacent to the teeth, establish favorable crown to root ratio, position and transmit occlusal forces along axes of the teeth, and replace missing teeth or damage teeth. There are two steps of procedures in adjunctive orthodontic treatment for patients who just had treatment of severe periodontal diseases: the first is adequate diagnosis data base, and the second is list of the patient problems¹

In adjunctive orthodontic treatment of patient who just had treatment for severe periodontal disease, the diagnosis and treatment need special attention. The interview and clinical examination are the same with other orthodontic treatments without periodontal

problems, but the diagnosis records for patients who just had treatment for severe periodontal disease are different compared to orthodontic treatment of patients without periodontal disease.

For adjunctive orthodontic treatment of patient who just had treatment for severe periodontal disease, the evaluation of patients' oral health status should be followed by oral hygiene levels, periodontal probing, bleeding on probing, and proper radiographs because panoramic radiographs do not give sufficient details.¹ Biomechanical of adjunctive orthodontic treatment in patient after treatment of severe orthodontic disease using fixed orthodontic appliance is different with orthodontic treatment in healthy periodontal condition. In adjunctive orthodontic treatment of patient after treatment of severe periodontal disease, the forces must be minimum and periodontal condition should be well under controlled.¹

CASE REPORT

A 36 years old male patient was referred from periodontist to have an orthodontic treatment in anterior teeth after periodontal treatment of severe periodontal disease. Chief complains from patient werespacing and longer upper anterior teeth and crowding at the lower incisor teeth.



Figure 1: Smile of patient after treatment of severe periodontal disease and before orthodontic treatment

Aim of Treatment

The aim of orthodontic treatment in this case was to correct the extrusion and protrusion of upper anterior central incisors, the diastema between upper central and lateral incisor, and the crowding of lower anterior teeth.

Treatment Procedures

Orthodontic treatment was done using fixed appliance MBT prescription slot .022. The priority of the treatment was on the maxillary anterior teeth, and in the lower anterior teeth to eliminate of mild crowding. Bracket placement on the posterior teeth was placed at normal position, while at the anterior teeth, was place 1 mm lower from the normal. The treatment objectives were to level and align of central incisor the teeth, close the upper anterior diastema, correct the extrusion of upper central incisors.



Figure 2: Extrusion of upper central incisors, upper central and lateral incisors diastema, gingival recession of upper central incisors and black triangle between central incisors



Figure 3: Panorex Before Orthodontic Treatment

Panorex before orthodontic treatment shows there was vertical resorption of alveolar bone of upper anterior teeth. This panorex was taken after finished of severe periodontal treatment and before orthodontic treatment, which is four anterior teeth was fixed using ligature, supporting bone especially of central upper incisor only one quarter apically, and also one quarter at the mesial of lateral incisors.

Treatment progress

The occlusion of posterior teeth was not changed too much, but the malocclusion at the upper anterior teeth was corrected and black triangle between central incisors teeth was not yet corrected. During orthodontic treatment, patient must be controlled to periodontist in 3 or 4 months interval.

Treatment Result

Treatment result shows that crowding and extruded of upper central incisors anterior teeth was corrected, diastema of upper central and lateral incisors was corrected and the relations of upper canine right and left were class II, the relations of upper first molar left and right were class II. The black triangle between upper central incisors was corrected by stripping at the mesial contact point of central incisors, and the black triangle still showed because of gingival recession.

Before treatment

During Treatment

After treatment

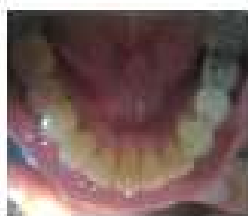
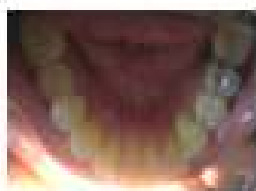
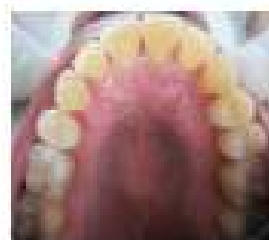
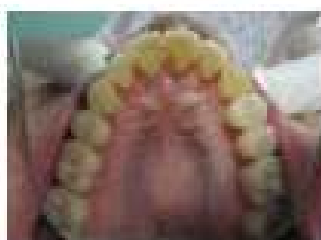
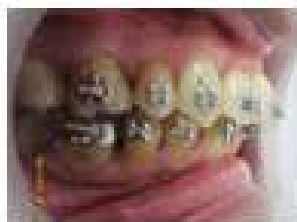
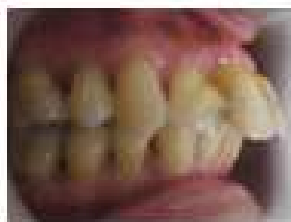
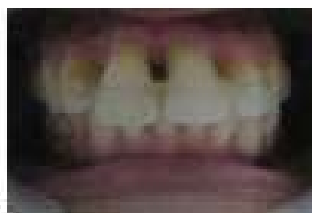


Figure 4: A.Before orthodontic treatment, B. Progress of the treatment, C. After treatment



Figure 5: After Orthodontic Treatment Before Debonding



Figure 6: Radiograph from panorex, especially four anterior teeth shows osteogenic formation of alveolar bone (red and yellow arrows) Before Treatment. B. After Treatment before debonding

In this case the goal of the treatment was to correct anterior teeth that suffer of periodontal disease. Esthetically of upper anterior teeth was corrected and patient was satisfied with the result. The mobility of upper anterior teeth was reduced in less of grade one.

DISCUSSION

Severe periodontal disease is characterized by severe breakdown of the periodontal attachment leading to teeth loss unless treated. Symptoms of malocclusion in patients with severe periodontal disease may result increase of overjet and deep bite, flaring of upper incisors, or extrusion of the teeth.² Before starting orthodontic treatment in the patients who just had treatment for severe periodontal disease, periodontal disease should be well controlled, the forces must be keep in minimum, good oral hygiene must be maintained.³ The amount of bone supports on each tooth must have special consideration before orthodontic treatment, when the periodontal support has been reduced, the magnitude of forces to move the teeth must be reduced.

Bracket placements in ideal position are only on the teeth to be moved and for other tooth which is not to be moved, the bracket was put in the position where the arch wire is straight, so the tooth will not move. In this case, because posterior teeth were not involved in periodontal disease, the bracket was placed on normal position and in the intruded upper anterior teeth, the bracket was put 1mm to the incisal edge.⁵

In this case, patient has suffered from periodontal disease since 4 years ago, starting with mobility of anterior teeth, the disease keeps getting worst and after completing the periodontal treatment, patient wanted to correct his anterior teeth. Orthodontic treatment was undertaken for nearly one year, followed by orthodontic retention.

CONCLUSION

Adjunctive orthodontic treatment is an orthodontic treatment which the tooth movement is carried out only in the involved part of dentition, with the goal is to restore the function, enhance the appearance, make it easier to eliminate plaque accumulation and orthodontic forces depend on the resorption of alveolar bone.

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Orthodontic Patient Examination And Analysis In Order To Establish The Correct Diagnosis

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ABSTRACT

The goal of orthodontic treatment is to create better occlusal relationship in terms of facial aesthetics frame¹. The success of orthodontic treatment is greatly influenced by the skills of the operator to perform the examination, analyze, diagnose and determine treatment plans. Diagnosis can be defined as a systematic flow in order to determine abnormalities, to find irregularities, to construct therapy planning as well as elaboration of indications, which would guide doctors to take necessary acts. Orthodontic diagnoses associated with abnormalities in terms of teeth, jaws and face (dentofacial), particularly in relation to dental abnormalities of the maxilla and mandible (malocclusion). Establishing an orthodontic analysis requires a careful examination of a patient as well as the selection of cases thoroughly in order to obtain a list of orthodontic problems. Necessary inspections include anamnesis, clinical examination extra-oral and intra-oral, radiographic examination and analysis of study models. The correct examination to establish diagnosis will assist operators in developing treatments that will be given to the patients.

Keywords: *Clinical examination, Orthodontic Diagnosis, treatment plan*

INTRODUCTION

The success of an orthodontic treatment is based on the ability of the operator to diagnose and the proper treatment plan.¹ Diagnosis are stipulated based on the results of systematic examination. The examinations which are needed include the patient's anamnesis, extra and intra oral clinical examinations, radiographic examinations, and model study analysis. At the end of this process, an orthodontist should play a role in a comprehensive data collection for each patient in order to formulate the appropriate treatment plan².

The Patient's Anamnesis

Anamnesis is the debriefing between the dentist and the patient or the patient's parents about anything that is related to the growth, development, habits, and others which

are related to abnormalities in patient's mouth and face. Important issues that should be asked by the operator to the patient in the patient's anamnesis are the main complaints, the patient's disease history, the teeth treatment history, and also the growth and development of the patient³.

Since the beginning, the operator should identify the main reason of why the patient wants an orthodontic treatment, the needs, and the expectation from the treatment. The question that can lead to the main complaint is "Why do you think you need to use a bracket?", or "What don't you like about your smile, or teeth, or your face?". From these questions we can acknowledge the patient's motivations and expectations from the orthodontic treatment. For the under age patients, the consultation can be done with the parents or the patient's guardian.³ The patient's disease and teeth treatment history is needed to know the background of the health status and also the dental hygiene which will affect the orthodontic treatment. It is needed to discuss whether the patient is consuming drugs or have consumed drugs because several conditions can influence the orthodontic treatment. For example, a patient with an uncontrolled diabetes can give power in the orthodontic treatment that can give bad effect on the periodontal tissues¹.

Bad oral habits such as biting or sucking objects (a finger or a pen), tongue thrusting, breathing from the mouth, etc. should be evaluated as these will be related to malocclusion etiology or direct effects on the prognosis of orthodontic treatments¹.

Orthodontic treatments with growth modification will gain benefit from the peak of growth in puberty period, this means the operator needs to enquire facts which are related to the patient's growth and development, such as the age of sexual maturity or *menarche* in women, and the change of voices in men. Based on these, the operator can predict whether the patient has passed the growth peak or not. Cervical vertebral assessment can be made from the patient's cephalometric X-ray. It is important to note that one's chronological age does not always coincide with skeletal or dental age. Serial cephalometric X-rays are the best way to determine whether growth has stopped or is still ongoing^{1,4}.

Extra oral examination

The extra oral examination include the facial examination, the facial median line examination, the profile, also the lip and TMJ.

Facial examination

The facial examination is started with the checking of proportions between the facial height and width. The types of face characteristics are divided into three categories which are *dolichofacial* (Facial height > facial width, long face), *mesofacial* (facial height is proportional with the facial width), and *brachyfacial* (Facial width > facial height, square face). The face proportion is obtained from dividing the face into three parts based on the space between the border of the hair (*trichion*) and the ridge prominent between eyebrows (*glabella*), *glabella* to *subnasal*, and *subnasal* to *menton*. The space should be the same in order to have the proportional face¹.



Fig 1. Facial thirds of The Face³.

Face Profile Examination

The face profile analysis is intended to determine the relation of the jaw in anteroposterior direction. In this stage the patient sits perpendicularly or stand with the straight ahead view. This also include the relation of 2 lines from the (*nasa*) to the bottom of upper lip and from the bottom point of upper lip to the chin. Normally, this line forms a straight line with a bit of inclination angle. Big angles ($> 10^0$) are indications of a convex profile (Upper jaw is in front of the chin), and a concave profile (upper jaw is behind the chin)⁵. Esthetic line (E-Line) from the ricketts can also help in analysing the patient's face profile. E line is obtained from drawing a line from the end of nose to the chin. Normally the upper lip is 4mm behind the E-line and the lower lip is 2mm behind the E-Line. The protrusive incisive can affect the patient's face profile³.

Median Line Examination

The shifting of upper jaw median line and lower jaw median line to the facial median line should be noted (in millimeters) with the information of the shifting direction of each jaw⁶. The facial median line is obtained by making an imaginer line from the sof tissue glabella by using a thread through the philtrum of the upper lip to the chin soft tissue. This line can also show that the face is asymmetric. Then, the facial median line becomes the benchmark to see whether there is a shifting of teeth median line or not.⁷.

Lips Examination

Ideally the upper and lower lips are touching or open for 3-4mm when the patient is in the relax position where there is not a coercion from the lips to close the mouth. The patients with short upper lip (*short philtrum*) will *strain* when they try to close the mouths and will open for 4mm when resting³. The opened lips relation can be caused by short upper lip (*short philtrum*), protrusive incisive teeth (upper and lower lips positions are in normal relations), normal teeth inclination with mandibular retrognati, normal teeth inclination with maksila prognati, combination of mandibular retrognati and maksila prognati, or one third of lower face that is longer than normal with or without *open bite*. The clinical description of tighten lips is deep *mentolabial sulcus* and hyperactive mentalist. The patient with hyperactive mentalist shows the image of orange skin on the soft tissue around the chin^{1,4}.

TMJ Examination

The TMJ examination is an important part of a diagnosis. If the mandibular is moving normal, the function is not disturbed, while limited movements indicate problems in functions. Thus, the important indicator from the TMJ function is the ability to open maximum. The palpation of mastication muscular and TMJ are routine parts in the teeth examination to record signs of problems in TMJ. For example pain in TMJ, the existence of sound, or the limitation of opening the mouth¹.

Intra Oral Examination

Oral Hygienes

A good oral hygiene is an important factor throughout the orthodontics treatment. Education and motivations should be given to patients before the treatment is started. The mouth hygiene evaluation needs to be done in the beginning of the examination, and the orthodontics treatment should be delayed until the patient can achieve a good mouth hygiene. All diseases (caries, periodontal diseases, pulp and soft tissues abnormalities) should be controlled before the orthodontics treatment begin¹.

Occlusion (Overjet, overbite, crossbite, openbite)

The deep occlusion examination in patients indicating orthodontics treatment includes overbite, overjet, crossbite or openbite examinations. Overbite is the vertical space from the *incisal edge* of lower jaw incisive teeth to the *incisal edge* of upper jaw incisive teeth. This can be measured by using a probe or a ruler. In *openbite* case the result is zero or negative in anterior *crossbite*. Overjet is the horizontal space from the facial surface of lower jaw anterior teeth to the lingual surface of upper jaw anterior teeth.

The image of *crossbite* can be evaluated by teeth occlusion. *Crossbite posterioris* when the position of upper molars is closer to the palatal than to the lower molars. *Crossbite* can be caused by dental or skeletal abnormalities. Crossbite skeletal happens because the width of the mandibular is less than the maxilla. Crossbite dental upper molars are tipping to palatal. When the teeth is occluded, the vertical problems such as *openbite* or *deepbite* can be evaluated³. *Deep bite* can also be evaluated by using the measurement of Spee Curve. The Spee Curve is a curvature formed by an imaginary line which is drawn from the incisal edge of anterior teeth and the peak of buccal mandibular posterior teeth, viewed from the sagittal plane¹³.

The depth of Spee Curve is measured as the perpendicular distance between the lowest peak and the flat plane through the upper end of mandibular teeth (touching the incisal end of incisive central teeth and the distal cusp tip of the most posterior teeth). The depth of the spee curve is usually followed by *deep bite*.

Frenulum labii, Tongue, and Palatum

Frenulum is the folds of mucous membrane that connects the lips and cheeks in alveolar mucous, gingiva, and periosteum underneath. The examination of the frenulum is

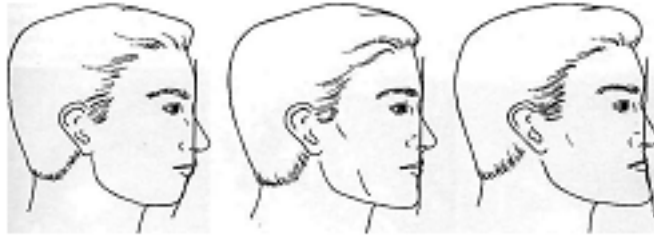


Fig 2.Convex and concave profiles obtained from disproportion of the jaw. (A) the indication of the Class II relationship is convex facial profile, where the upper jaw is too far forward or the lower jaw is too backward. (C) an indication of the Class III jaw relationship is concave profile in which the upper jaw is too backward or mandibularis forward¹.



Fig 3. Examination of midline shifting



Fig 4. overbite



Fig 5. Overje

needed to see the attachment or insertio. The Frenulum can endanger the gingiva hygiene when the attachment is too close with the edge of gingiva, this can disturb the plaque control and is caused by the muscle pull on gingiva. Frenulum labii superior can also cause aesthetic disruption or disrupt the stability of the orthodontics treatment in the case of *midline* diastema¹¹. To determine the role of frenulum as the cause of *midline* diastema, a *blanch test* is needed. This test can be conducted by pulling the lips up and front. The discoloration on region of interdental indicates the fibers of frenulum muscles has reached the peak of alveolar bones¹².

The tongue examination is conducted to know the existence of pathological lesions, the shape and size, and the relation to the curvature of mandibular teeth. The siting on the lateral edge of the toungue, with *general* diastema on teeth, indicates makroglossia. The tongue is composed of strong muscles that constantly gives pressures on the lingual surface of the teeth to compensate pressure from lips on the labial surface of the teeth. The tongue functional evaluation during talking and swallowing can help in determining the malocclusion etiology^{1,3}.

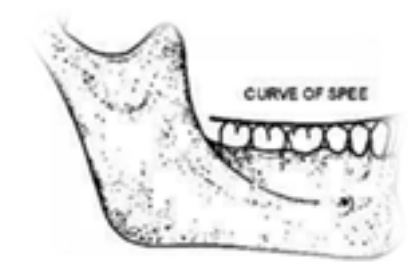


Fig 6. Curve of Spee

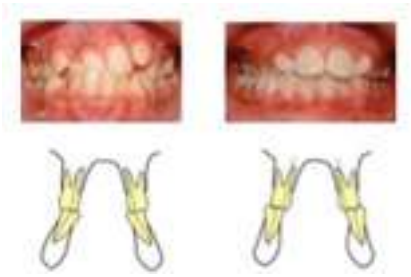


Fig 7. Anterior Crossbite and Posterior Crossbite³



Fig 8. Examination of Labii Frenulum with Blanch test¹.

The palate examination is conducted to see the depth. Of the palate can indicate habits such as *mouth breathing* or finger sucking. The depth measurement and the constriction of palate can be done on a study model^{1,3}.

Model Analysis

Important data obtained through the teeth and mouth direct examination are of course can produce accurate data. However, practitioners are not able to analyse the teeth directly inside the patient's mouth. Thus extra examinations are conducted indirectly on a study model. A study model analysis is an assessment of three dimensions on maxilla and mandibular teeth, and also the assessment on the occlusal relation. The position of the teeth on the jaw and the relation with teeth on the opponent jaw are assessed in sagittal, transversal, and vertical directions⁸. There are several analysis that can be used, but which analysis that will be used very much depends on the case. Various analysis on permanent teeth are to see the relation of upper and lower teeth, and the curvature symmetry of teeth viewed from sagittal and transversal directions. The analysis to see the different size between the teeth curvature and the jaw are Nance, Lundstrom, Bolton, Howes, Pont, and *diagnostic setup*. The analysis for mixed dentition are radiographic image analysis, Moyers, and Tanaka-Johnston. Several results of analysis can be made and used simultaneously as considerations in compiling the treatment plans.

Radiographic Analysis

Cephalometric Analysis

Model analysis cannot give information to clinicians about the skeletal relation from the patient, thus radiographic cephalometric examinations are needed to help analysing the relation of jaw bones (between maxilla and mandible), the relation of jaw (basis cranii), and the relation of teeth and jaws. One of the analysis that is often used is Steiner analysis because it is quite easy and fast. This analysis is one of the most popular analysis to plan an orthodontics treatment and this method is a combination of Down's method, Wendell Wyllie, Brodie, Rickett's, Thomson, Riedel and Holdaway¹⁴.

Panoramic Radiograph X-ray Analysis

Panoramic photos are common radiograph which can produce comprehensive images of the teeth, and bone structures that are adjacent to both jaws. Many information can be obtained from panoramic x-ray such as several dental abnormalities (cysts, fractures), abnormal numbers of teeth (supernumerer, *missing teeth*), impacted teeth location, and the condition of periodontal tissue. On a patient with mixed dentition, the panoramic x-ray can see the order of eruption of canine teeth, the first and second premolar of maxilla and mandible which are going to affect the structure of teeth in the jaw. The room differences can also be seen between the width of mesiodistal canine teeth, first molar, and the second primary teeth with canine, first premolar, and both permanent that are usually called *Lee Way Space*^{1,4}.

CONCLUSION

There are several examinations stages for orthodontics patients to have diagnosis such as anamnesa, extra and intra oral clinical examinations, model analysis, and radiographic examination. The whole examinations are used to formulate problem to help the operator in making treatment plans. A proper examination can produce accurate diagnosis that support the success of a treatment.

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Management of Class III Skeletal Deformity with Le fort I Osteotomy and Bisagital Split Ramus Osteotomy (Case Report)

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ABSTRACT

INTRODUCTION Class III skeletal deformity is the result of mandibular prognathism or maxillary deficiency.^{1,2} Class III malocclusion is more common in Asia than in Caucasian. The class III malocclusion affects around 22.4% of Asia population.³ Accordingly, class III malocclusions is one of the main cause of seeking orthodontic treatment Some severe class III skeletal deformity cases can't be managed with single orthodontic treatment, sometimes we should combine with surgical treatment or we can call it orthognatic surgery. The orthognathic surgeries commonly used to treat the deformity are mandibular setback osteotomy and Lefort I maxillary advancement osteotomy.^{1,2,3} The purpose of this case report is that orthognatic surgery should be considered in the treatment plan of class III skeletal deformity with a collaboration of orthodontist and oral maxillofacial surgeon. **Case report** In this case report 22 years old male patient referred from orthodontist with chief complaint extreme protruded lower jaw. He has been receiving orthodontic treatment for almost two years. Because of his extreme skeletal class III deformity a single orthodontic treatment can't solve the problem, the patient agreed to take the surgery. **Case Management:** We managed this patient with mandibular setback osteotomy with counter clockwise rotation and Le Fort I maxillary advancement osteotomy with impaction. **Discussion:** Discussion of this case report is that orthognatic surgery should be considered in the treatment plan of class III skeletal deformity, especially in severe class III deformity with extreme maxillomandibular discrepancy. The collaboration between orthodontist and oral maxillofacial surgeon will produce a great result in both function and esthetic of stomatognathic system.

Key words : class III skeletal deformities, orthognatic surgery, orthodontist, oral & maxillofacial surgeon

INTRODUCTION

Facial deformity caused by asymmetry has long been of great mutual interest to the orthodontist and the oral surgeon. The deformity of maxillofacial region is readily expressed as a profile disfigurement, since the soft tissues of the face depend on the jaws for much of their contour. The selection of the proper type and site of osteotomies in orthognathic surgery is based on the extent of the dentofacial deformity, the degree of the desirable jaw movement and the anticipated soft tissue changes following surgical intervention.^{1,2,3,4}

Improvement of the stomatognathic function is a major reason for seeking combined orthodontic surgical therapy, but the consequences of surgery on facial appearance are of great importance, even for the patient whose chief complain is not dominated by the cosmetic rationale. A study conducted by the National Research Council of USA reveals that dentofacial deformities affect 20% of the population, out of which 5% of the population have major severe skeletal deformities.^{4,5} Class III malocclusion is more common in Asia than in Caucasian. The class III malocclusion affects around 22.4% of Asia population.¹ Accordingly, class III malocclusions is one of the main cause of seeking orthodontic treatment.^{1,4}

Abnormal skeletal anatomy can be classified into any different ways. The abnormalities may affect the jaws, namely the maxilla and the mandible, or may be complicated by associated abnormalities in other parts of the face and skull. The following classification of jaw deformities is proposed by Henderson. It is found to be adequate for clinical purposes.^{2,4}

Symmetrical Disproportion Of Jaws

Mandibular enlargement

Mandibular deficiency

Maxillary enlargement

Maxillary deficiency

Bimaxillary disproportion

Asymmetrical Disproportion Of Jaws

Unilateral mandibular enlargement

Unilateral mandibular deficiency

Unilateral maxillary abnormalities

Cleft lip and Cleft Palate

The treatment plan is formulated and tailored specifically for each individual patient. Thorough evaluation and diagnosis are among most important aspects of overall patient's management. The evaluation and treatment plan is based on the outcome of analysis of the patient's medical history, social history, motivation, objective facial aesthetic profile (frontal, lateral) cephalometric measurement of soft and hard tissues of the facial skeleton, dental relations, and the degree of fractional, social and psychological disturbances. Patient evaluation for orthognathic surgery may be divided into four main areas-^{1,2,3,4}

Patient concerns or chief complaints,

Clinical examination,

Radiographic and imaging analysis

Dental model analysis.

A patient's ultimate satisfaction with treatment outcome often depends upon attention to the patient's chief concerns. Patients with unrealistic expectations must be counselled, so that they understand treatment limitations and likely outcomes before initiating orthodontic or surgical therapy. Co-operative studies between surgeons and psychiatrists have provided some valuable guidelines in the evaluation and selection of patients for corrective surgery.³ All major anomalies should be corrected at the initial operation, within the limits of good surgical practice. The orthodontist is usually consulted prior to the formulation of a definitive surgical plan. A stable occlusal relationship of the jaws is critical for the stability of the fragments post operatively. Speech therapy may also be integrated into treatment plan in selected cases.

Mandibular ramus osteotomy^{1,2,3,4}

Bilateral Sagittal split osteotomy is probably one of the most popular osteotomy performed today to correct mandibular deformity. The technique was initiated by Trauner & Obwegeser with later modifications by DalPont, Hunsuck & Epker. The natural plane of cleavage between the lingual and buccal cortical plates of the ramus is used to develop a sagittal split separating the proximal (condylar) fragment from the distal (dento alveolar) segment. This allows forward, backward or rotational repositioning of the constituent parts relative to one another. This is highly cosmetic procedure, as it is done intra orally (no extra oral scar) plus there is broader bony contact of the osteotomy segments ensuring good healing. Other ramus osteotomies of the mandible have been described, depending on the design of bone cut, e.g. - inverted L, vertical sub sigmoid etc. Each of these variations has its own advantages & disadvantages.

Le Fort I osteotomy (Low level)^{1,2,3,4}

Le fort I osteotomy is a versatile procedure which is done intraorally to resolve many functional and aesthetic problems. A horizontal osteotomy is made from the lateral part of the pyriform rim posteriorly across the canine fossa and through the base of zygomatic buttress to the pterygomaxillary fissure. The posterior aspect of the lateral maxilla, the pterygomaxillary suture, the lateral nasal wall and the nasal septum are sectioned with osteotomy. Then the whole maxilla is down fractured and mobilized. In this position simultaneous advancement, vertical or horizontal movements of the maxilla are possible. The operative results and the precision of the operative technique as reported by Obwegesser have proven the versatility of this technique.

Outcomes after correction of maxillofacial deformities^{2,3,4,5}

Psychological aspect

A person's physical appearance is the characteristic which is most obvious in social interactions. It is not only the individuals own perception of his or her appearance which not only contributes to these psychosocial effects but also the reaction of others. To improve facial aesthetic is the most powerful motivating factor leading people for surgical correction.

High degree of satisfaction has been reported following orthognathic surgery is in contrast to several studies involving corrective surgery.

Speech

The study by Dalstom and Vig's shows that nasal acoustic coupling and nasal resistance are the only speech parameters significantly affected by orthognathic surgery. Maxillary repositioning doesn't significantly affect velopharyngeal function and it would seem that the type of orthognathic surgery performed has no long term, perceptually discernable effects upon speech.

Masticatory Function

The alignment of maxillo - mandibular relationships often results in improved masticatory function.

Soft Tissues

The survey done by Quest et al suggested that soft tissues undergo spatial changes immediately after surgery and other changes after a prolonged period. The latter may be due to functional remodeling which is not clearly understood. The used of prognostic tracings and photographs will also allow the patient to understand the procedure more readily and provide an idea of changes following corrective orthognathic surgery.

Temporo mandibular joints

Temporomandibular joint dysfunction (TMD) is one of the most common causes of facial pain seen in a study of 280 patients with different types of mandibular deformities. After surgery the incidence of such symptoms in the same patient group was only 11.1%. Hence orthognathic surgery should always be considered in patients with chronic facial pain resulting form TMJ dysfunction in association with dentofacial deformities.

Stability

It is mandatory to organize a complete treatment plan including all the morphological and functional abnormalities which are present and arrive at a corrected position of facial skeleton which not only satisfy aesthetic and functional criteria but will also be stable. The improvement in different surgical technique and methods of fixation, and a better understanding of the effects of growth and soft tissue environment on the facial skeleton have succeeded in achieving more predictable results. The stability of the re positioned bone fragments depends on the types of skeleton pattern and the type of surgery performed.

Many intra operative and post operative complications has been noticed, like oedema, hemorrhage, pain, fragmentation of the bone segments, relapse, bone necrosis, infection, delayed or malunion, disturbance of the inferior alveolar nerve or infraorbital nerves and other unexplained nerve injuries, and Oro antral fistula is rarely seen. Other serious complications are although rare but some are reported.^{1,2}

Class III skeletal deformity is the result of mandibular prognathism or maxillary deficiency.¹ Class III malocclusion is more common in Asia than in Caucasian.² The class III malocclusion affects around 22.4% of Asia population.³ Accordingly, class III malocclusions is one of the main cause of seeking orthodontic treatment⁴ Some severe class III skeletal deformity cases can't be managed with single orthodontic treatment, sometimes we should combine with surgical treatment or we can call it orthognatic surgery. The orthognathic surgeries commonly used to treat the deformity are mandibular setback osteotomy and Lefort I maxillary advancement osteotomy.⁵ The purpose of this case report is that orthognatic surgery should be considered in the treatment plan of class III skeletal deformity with a collaboration of orthodontist and oral maxillofacial surgeon.

CASE REPORT

In this case report 22 years old male patient refered from orthodontist with chief compalaint extreme protruded lower jaw. He has been receiving orthodontic treatment for almost two years. The orthodontist offered the patient to do orthognhatic surgery to get better result. The patien agreed and he came to Hasan Sadikin General Hospital Bandung to undergo orthognatic surgery.

Case Management

As usual we did hard tissue and soft tissue analysis.to get good surgical planning. From the cephalometric analysis we got $SNA = 84,5^\circ$ $SNB = 107^\circ$ ANB , and overbite = -10 mm, length of the mandible (Go-Gn) = 81,5 mm, length of maxilla (PNS-ANS) = 50 mm. The treatment planning for this patient is mandibular setback osteotomy with counter clockwise

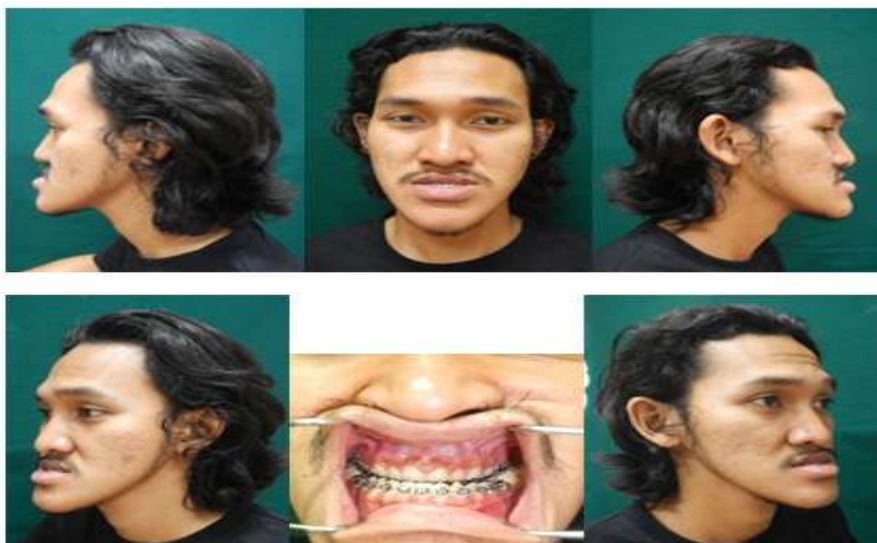


Figure 1. Preoperative profile pictures



Figure 2. Preoperative radiographs



Figure 3. Durante Operation



Figure 4. Postoperative profile

rotation and Le Fort I maxillary advancement osteotomy with impaction. For the mandible we planned to setback $\pm 7\text{mm}$ with counter clockwise rotation, and for the maxilla we did 5 mm advancement with 2 mm posterior impaction. We did over correction to anticipate the relapse after the surgery.

The patient was hospitalized until 3rd day postoperative day. The patient feels numbness on left mandible and resolve within 3 months postoperative. One month after operation the patient went back to the orthodontist to continue the post operative orthodontic treatment, in order to get optimal result. Approximately 18 months after surgery we did radiographic examination to evaluate condition.



Figure 5. Postoperative Occlusion

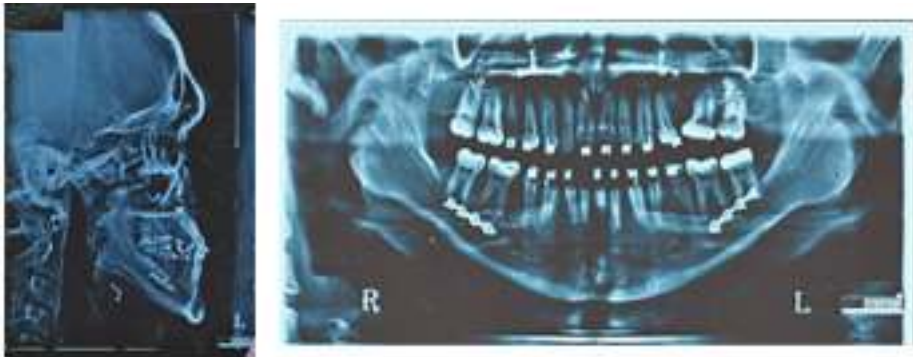


Figure 6. 18 months postoperative radiographs



Figure 7. Pre operative and post operative cephalometric analysis

As we did in preoperative procedure, we also did cephalometric analysis. From the analysis we got $SNA = 84^\circ$, $SNB = 83^\circ$, Overjet = + 2mm, length of the mandible (Go-Gn) = 75 mm, length of maxilla (PNS-ANS) = 53 mm. From the post operative analysis we can see there is slight relapse after 18 months, but the relapse still acceptable; because we



Figure 8. 18 months postoperative profile picture



Figure 9. 18 months postoperative occlusion

were already anticipated it in the preoperative treatment planning. According to the family the patient doesn't have any sleeping problem like snoring or even OSAS. The patient is very satisfied with the result whether esthetically or functionally.

DISCUSSION

The discussion of this case report is that orthognathic surgery should be considered in the treatment plan of class III skeletal deformity, especially in severe class III deformity with extreme maxillomandibular discrepancy. Orthognathic surgery has become an acceptable treatment plan for patients with various maxillofacial deformities with pleasing results. During the last few decades the profession has witnessed intense interest in the treatment of facial deformities and has been widely practiced throughout world. The collaboration between orthodontist and oral maxillofacial surgeon will produce a great result in both function and esthetic of stomatognathic system.

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Management Of Impacted Maxillary Central Incisor With Surgical Transplantation (Case Report)

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ABSTRACT

Patients with impacted maxillary central incisor is a rare case presented in Oral and Maxillofacial Surgery Departement Dr. Hasan Sadikin General Hospital. This case can have a major impact on dental and facial aesthetics. The purpose of this paper was to present successfully the surgical exposure treatment of impacted permanent maxillary on left central incisor with retained of left central and lateral of deciduous incisors. A case of 23 years old female patient with chief complaint unerupted upper left front tooth. Panoramic and upper occlusal radiographs showed horizontally impacted of left central incisor tooth. The treatment plan includes the extraction of retained deciduous teeth, surgical extraction of the impacted tooth and transplantation of left central incisor into former socket revocation, continue with interdental wiring with arch bar from left first premolar to right first premolar, and alignment to achieve normal occlusion. Final outcome showed complete healing of bone socket. After seven days of operation, the intra oral suture removal was performed, there was no wound dehiscence, and interdental wiring was well fixed with arch bar. After four weeks, there was no sensitivity found on the left maxillary central incisor, there was no mobility of tooth and occlusion was intact. The tooth was stable and the alignment was proper. Successful prognosis of surgical transplantation of impacted maxillary central incisor in this case depends on the following factors: the condition of the remaining periodontal ligament attached to the extracted donor tooth, the adaptation of the donor tooth to the socket, the duration and the method of splinting after transplantation, and the timing of endodontic treatment.

Keywords : Impacted maxillary central incisor, Transplantation, Interdental wiring

INTRODUCTION

Impaction of maxillary permanent incisor is not a frequent case in dental practice, but its treatment is challenging because of its importance to major impact on dental and facial aesthetics. Various treatment modalities are available for the management of impacted maxillary central incisors, surgical transplantation are one of treatment options. Several studies have shown that impacted teeth can be properly positioned with using surgical repositioning. This case report demonstrates a successful treatment outcome with surgical transplantation.

CASE REPORT

A 23 years old female came to Oral and Maxillofacial Surgery Department Dr. Hasan Sadikin Hospital reported with chief complaint unerupted upper left front tooth. Patient had no significant medical history and dental history. Clinical examination showed that the patient was retained of left central and lateral of deciduous incisors. Upper occlusal and panoramic radiographs showed horizontally impacted of left central incisor tooth.



Fig. 1. A. Frontal view, B. Occlusal view, showed unerupted of left permanent central incisor, with retained of left central and lateral of deciduous incisors.



Fig. 2. Intra oral occlusal radiograph showed horizontally impacted of left central incisor tooth.

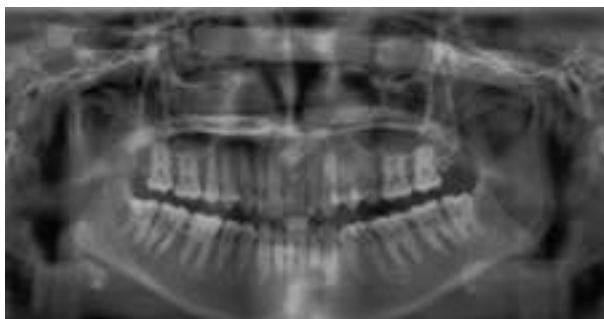


Fig. 3. Intra oral panoramic radiograph showed horizontally impacted of left central incisor tooth.



Fig. 4. A. Clinical picture intra operation showed after transplatation of tooth left maxillary central incisor and interdental wiring with arch bar from left first premolar to right first premolar. **B.** Post operation after 4 weeks removed arch bar interdental wiring.

The patient was performed extraction of left maxillary deciduous central and lateral incisors and odontectomy of left maxillary central incisor under general anesthesia. Left maxillary central incisor was then transplatated. Transplantation was chosen due to wide of post extraction socket of left maxillary deciduous central and lateral incisors that was available for mesiodistal of left maxillary central incisor. After transplantation of left maxillary central incisor, the treatment was continued with interdental wiring application from left first premolar to right first premolar and maintained for four weeks. On the first control after seven days of operation, the intra oral suture removal was performed, there was no wound dehiscence, and interdental wiring was well fixed with arch bar. On the second control after four weeks, there was no sensitivity found on the left maxillary central incisor, there was no mobility of tooth and occlusion was intact. Furthermore, the patient was contented.

DISCUSSION

Impaction of maxillary incisors requires monitoring or intervention when there is eruption of central lateral teeth that occurred greater than six months previously, both central incisors remain unerupted and the lower incisors have erupted greater than one year previously and there is deviation from the normal sequence of eruption.¹

The incidence of unerupted maxillary central incisor in the 5-12 year old age group has been reported as 0.13%. In a referred population to regional hospitals the prevalence has been estimated as 2.6%. Literature reveals several causes of failure or delayed eruption of maxillary incisors. Eruption failure may occur if pathological obstructions, such as supernumerary teeth, odontomas, cysts, develop in the eruptive path of the incisor. Supernumerary teeth and odontomas are the most common cause : 56-60% of supernumerary teeth cause impaction of permanent incisors due to a direct obstruction for the eruption.¹

Eruption failure can also be caused by tooth malformation or dilacerations. Dilacerations occur after trauma to a primary tooth, where the developing permanent tooth bud is damaged due to close proximity to the primary tooth. The degree of damage of the permanent tooth depends on the developmental stage of the tooth in question, as well as the type and direction of the trauma inflicted. Other possible causes of lack of eruption of maxillary incisors are: ectopic position of the tooth bud, non-vital or ankylosed primary teeth, early extraction or loss of deciduous teeth, mucosal barriers in the path of eruption that acts as a physical barrier to eruption, endocrine abnormalities, and bone disease.¹

An intra oral examination should be undertaken to identify the presence of deciduous teeth retained beyond their normal exfoliation dates. Buccal or palatal swellings should be noted as well as the availability of suitable space for the eruption of the incisors 9 mm for a central and 7 mm for a lateral incisor. Radiographs should be taken. A dental panoramic tomography and anterior occlusal radiograph can be taken for general assessment purposes. For detailed assessment of position it has been shown that the use of a horizontal parallax technique is better than vertical. For more accurate assessment of root and crown morphology, periapical radiographs should be taken using the long cone technique. More recently, cone beam computed tomography technology has become available for imaging the maxillofacial region and this can be used for the localisation of impacted teeth, including incisors. This technique allows accurate localisation of the impacted tooth and visualisation of associated structures.²

Although several different approaches to treatment of unerupted maxillary incisors have been proposed in the literature, a common feature among them is that early diagnosis is critical to the success of the treatment. It is thought that the less time the normal eruption is delayed, the better the outcome. If there has been a loss of space, it is necessary to create space prior to treatment and maintain that space throughout the treatment phase. The treatment possibilities vary from conservative to more aggressive approaches. The most conservative management would be the extraction of any obstruction, the creation of space, and the observation for spontaneous eruption. 70% of teeth have been reported to erupt spontaneously after removal of obstruction, without any further treatment. Surgical transplantation are one of treatment options.¹

Indication of surgical transplantation on this case is adequate space is available for the impacted maxillary central incisor. The tooth is carefully extracted and placed in a surgically prepared socket. It is immobilised with a splint for about 4 weeks, when it is usually

firm. Good results are obtained with young patients, but resorption of roots is a complication after 2-5 years and occasionally leads to loss of the tooth. Early endodontic treatment may help to prevent this.³

CONCLUSION

Management impacted of maxillary incisor treatment may have a good result if early diagnosis of the presence and removal of impacted teeth is essential. Maxillary permanent incisor was successfully positioned in the maxillary arch by surgical exposure with transplantation and fixation with interdental wiring which showed good stability. Successful prognosis of surgical transplantation depends on the following factors, the condition of the remaining periodontal ligament attached to the extracted donor tooth, the adaptation of the donor tooth to the socket, the duration and the method of splinting after transplantation, and the timing of endodontic treatment.

ACKNOWLEDGMENT

The authors would like to acknowledge Melita Sylvana and Endang Syamsudin for their participation in taking of the case.

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A Rare Case Of autotransplantation Of Impacted Teeth In Post Odontoma Sites (A Case Report With 4 Years Follow-Up)

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ABSTRACT

Odontomas represent the most common type of benign jaws tumors. Two distinct types of odontomas are acknowledged: complex and compound odontoma. Compound odontomas are often associated with impacted adjacent permanent teeth and their surgical removal represents the best therapeutic option. Auto-transplantation has recently become more popular because of a better understanding of its science, but our case which involved transplanting at a site previously occupied by an odontoma is new. This paper aimed to present a single surgical procedure to remove compound odontoma and auto-transplanted the teeth involved in order to improve prognosis, and shorten the treatment time. A case of a 12-year-old boy patient with compound odontoma associated of impacted maxillary central incisor and mandibular canine is presented. A minimally invasive surgical technique is adopted to remove the least amount of bone tissue, followed by extirpation of the odontomas and auto-transplantation of the permanent teeth involved.. Final outcome shows complete healing of the bone socket. No recurrence was detected at radiographic follow up at 1 year, thus confirming the success of this therapeutic approach. After a 4-year follow-up period the teeth responded positively to vitality test. In selected cases surgical extirpation of the lesion with auto-transplantation of the tooth involved might be considered as a viable treatment to obtain healing of the lesion and physiological restoration of bone. The success of auto-transplantation depends on several factors: such as patient age, surgical technique employed, and duration of time that the tooth being out of its socket.

Keywords: Autotransplantation; Impacted teeth; Odontoma

INTRODUCTION

Odontomas are considered odontogenic hamartomas constituted by tooth-forming tissues laid down with variable degrees of organization and mineralization. Histologically, odontoma is a mixed odontogenic tumor consists of epithelial and mesenchymal cells that present as complete dental tissue differentiation (enamel, dentin, cementum and pulpal tissue). It is considered as the most common odontogenic tumors of the jaws, and constitute 22% of all odontogenic tumors^{1,2}. They are characterized by their slow growth and nonaggressive behavior and are usually detected incidentally in the second or third decade of life during routine radiographic examinations^{1,3}.

The etiology of odontoma is unknown, but local trauma, infection or mutant gene has been suggested as possible cause. The pathogenesis of odontoma is associated with trauma during primary dentition, hereditary anomalies (Gardner's syndrome and basal cell nevus syndrome), odontoblastic hyperactivity or alterations of genetics components responsible for controlling dental development such as small formation, impaction, delayed eruption, bad positioning, cyst formation or displacement and resorption of adjacent teeth, but only rarely they are seen to be associated with the absence of one or more contiguous teeth⁴.

According to the latest classification of the World Health Organization, two types of odontomas can be found: Complex odontoma and compound odontoma, the latter being twice as common as the former. Compound odontomas appear as numerous miniature or rudimentary teeth and complex as conglomerates of hard tissue with no similarity even to rudimentary teeth⁵. Odontoma is a symptomless lesion unless it erupts. It is usually detected by routine radiograph with frequent associating with unerupted teeth, mainly mandibular third molar followed by upper canine and upper central incisor. Treatment options for cases of impacted teeth usually involve surgically aided orthodontic treatment, surgical uprighting, auto-transplantation, and surgical removal⁵.

Autotransplantation is another treatment option of impacted teeth. It means a traumatic surgical removal of the tooth from its impacted site to be re-implanted in its correct position. This case report presents the autotransplantation of impacted teeth associated with odontoma, The success of autotransplantation process depends on several factors: like patient age, developmental stage of the transplanted tooth, type of transplanted tooth, surgical technique employed, and duration of time that the tooth being out of its socket⁵.

CASE REPORT

A patient attended the department of Oral and Maxillofacial Surgery, Hasan Sadikin Hospital with complains of a missing upper front tooth and a hard swelling above the gum in that region. The patient was a healthy boy with no other systemic or oral health issues. On careful examination, a tip of enamel-like hard tissue slightly protruding at the edentulous gum was visible. Two firm protuberances were felt in the labial sulcus beside the labial frenulum of upper and lower jaw. In orthopantomograph, radiopaque masses were visible in

the alveolar region between 12-21, and 34-32 the missing 11, 33, 34 being impacted apical to the pathology as a separate entity (Fig.1). We decided to excise the radiopaque masses and transplant the impacted 11, 33 and 34 to its proper position in one stage surgery.

CASE MANAGEMENT

One hour prior to surgery patient was given intravenous prophylactic antibiotic. Extraoral and intraoral antiseptis was performed with povidone iodine 10%. The surgery was performed under general anesthesia. The surgical procedure was initiated with an triangular incision, from the maxillary central incisive to right primary canine. A relaxing incision was performed to allow a mucoperiosteal flap raise to expose the very superficially located mass (Fig. 2a).



Figure 1.Impacted 11, 13, 23, 33, 34 with radiopaque masses between 12-21 and 35-32



Figure 2. a. Surgically exposed of odontoma and impacted tooth; b. Several blocks of lesion were removed.



Figure 3.Transplants in position.



Figure 4. Clinical and radiographic at 4 years follow up.

Surgical approach was performed using a spherical drill and after removal of bone, the calcified masses were exposed. Small tooth like masses were removed and submitted for histopathological examination (Fig. 2b). Surgical cavity was totally smoothed and small adjustments of the socket dimension were done by a round tungsten carbide surgical bur. The impacted tooth was then exposed and extracted after removing the covering bone. It was loosely fitted immediately into the socket with several blocks of alveolar bone as grafts. The flap was repositioned and sutured with interrupted stitches (Fig. 3). A periodontal pack was given.

Those sequences were done to teeth 11, 33 and 34. The transplants were kept out of incisal contact and splinted with a flexible wire bonded labially by composite. We kept the splint for 2 months. The teeth were exposed to normal function 2 weeks after the removal of splint. Follow up was done weekly for 2 months, then 6 months, and hereafter, every 6 months till date. Follow up visits showed acceptable clinical healing with no signs of tooth mobility, ankylosis or gingival recession. There were no sign of infection at any stage. There were no radiological signs of root resorption or bone loss at 4 years follow up (Fig. 4).

Histopathological examination of the excised mass showed irregularly arranged dental hard tissues with areas of cell rich pulpal tissue. Clear spaces and clefts representing the mature enamel that is lost in the process of decalcification are often seen confirming the diagnosis of a complex odontoma.

DISCUSSION

Many indications of autotransplantation have been identified, but our case which involved transplanting at a site previously occupied by a tumor is new. We were presented a case report with an odontoma occupying the space of missing teeth, with a fully formed impacted teeth located superiorly to the pathology. Treatment of choice for the odontoma is complete surgical removal with perfect curettage to the area in order to prevent complication like cystic changes. The challenge in our treatment plan was in replacing the missing tooth in the post-odontoma site by auto-transplantation, within a single stage surgery.

The procedure of transplantation in this case includes preparation of the recipient site which previously occupied by an odontoma and placement of the transplanted teeth slightly below occlusal plane with fine adjustment and splinting the tooth with adjacent teeth by wire and composite adhesive for 2 months. Splinting periods ranging from 2 weeks to 2 months have been reported by various authors^{6,7,8}. Maximum duration of fixation was used to this case to insure maximum stabilization, as there was no bone support the transplanted teeth. This period of fixation requires cooperation from the patient, because the fixation wire may cause discomfort to the patient and the possibility of mucous ulceration, food impaction in addition to its effect on patient's appearance.

The success of autotransplantation can be assessed using clinical and radiographic parameters during follow up time. The follow up period may range from 1 year to 14,5 years⁹. In the presented case follow up was done weekly for 2 months, then 6 months, and hereafter, every 6 months till date. The clinical examination during the follow up period showed reasonable outcome. This was manifested through healthy gingival and periodontal tissue and normal tooth appearance with no sign of mobility. After 6 months assessment showed no sign of internal or external resorption with new bone formation around the tooth. We followed up this patient until 4 years and the radiographic assessment showed normal periodontal ligament and normal bone formation.

Autotransplantation has advantages as it induces bone formation, maintain proprioceptive function and a normal periodontal ligament and serve as shock absorber⁵. Successful outcome of autotransplantation requires due regard to factors like minimizing periodontal ligament and cemental damage, surgical technique, splinting, antibiotic prophylaxis, approximation of bone and tooth at cervical region, gingival sealing of the tooth against microbial contamination, and a proper case-selection. Replacement resorption and inflammatory resorption of the root can be avoided by preventing procedural damage to the cementum and pulpal infection respectively⁶. Amongst the parameters of success, the most important is the absence of chronic root resorption⁸. We are presenting this case because of the absence of infection, a normal pocket depth, the lack of pathological tooth mobility, and the radiographic absence of periodontal bone loss at 6 months until 4 years follow-up.

The success of autotransplantation in a site that previously occupied of an odontoma has recently become more consistent compared to that of earlier studies owing to a better knowledge of healing mechanisms of the periodontal tissues. During a short treatment duration, autotransplantation gives the option of replacing the missing tooth with a natural tooth complete with a periodontal ligament and, sometimes, a vital pulp. However, the procedure is technique sensitive and strict regard to certain factors is critical for its success.

CONCLUSION

This case report presented the successful outcome for surgical management of compound odontoma with autotransplantation of associated impacted tooth. Replacing the missing tooth in post-odontoma site by autotransplantation, within a single stage surgery is a big

challenge. Preventing procedural damage and maximum stabilization are important factors to determine the success of autotransplantation in additions of patient age and surgical technique employed.

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Oroantral Fistula Closure Using Buccal Flap : A Case Report

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ABSTRACT

The oroantral Fistula (OAF) is a pathological communication between the oral cavity and the maxillary sinus. These condition arise commonly after extraction of posterior maxillary teeth due to the close anatomical relationship between the root of the molar and premolar teeth and the sinus floor or pneumatization of maxillary sinus. OAF is characterized by the presence of epithelium arising from the oral mucosa and/or from the maxillary sinus mucosa that, if not removed, could disturb healing process. Closing the OAF is important to avoid bacterial infection, and chronic sinusitis. Radiographic shows a discontinuity at sinus floor and radiopacity in a part of sinus. We present Indonesian Female, 41 years old with chief complaint constant headache after first upper left molar extraction and follow with liquid came out through his nose and food inflow through the socket. Clinical examination revealed an approximately 10-mm non healing socket in first upper left molar with pus discharge and nose blowing test was positive (+). We decided to do debridement, removing all epitelial lining on fustula and closing the OAF by using buccal flap. All procedure under local anesthesia. 3 weeks after procedure, the OAF heals completely and there was no other specific complaint from the patient.

Keywords : Oroantral Fistula , Debridement, Buccal Flap

INTRODUCTION

The oroantral Fistula (OAF) is a pathological communication between the oral cavity and the maxillary sinus. These conditions arise commonly after extraction of posterior maxillary teeth due to the close anatomical relationship between the root of the molar and premolar teeth and the sinus floor or pneumatization of maxillary sinus^{1,2,3}. OAF is characterized by the presence of epithelium arising from the oral mucosa and/or from the antral sinus mucosa that, if not removed, could inhibit healing process^{4,5}.

Most of the minor communications, having a diameter of 1-2 mm, heal spontaneously in the absence of infection. When chronic oroantral fistula defects are wider than 5 mm and

persist for more than 3 weeks, a secondary surgical intervention is required. Closing the OAF is important to avoid bacterial infection, and chronic sinusitis. Radiographic shows a discontinuity at sinus floor and radiopacity in a part of the sinus.

Different flap designs for OAF's closures have been described in the literature, each of which presents both advantages and disadvantages. Buccal flap, described by Rehrmann⁶, palatal rotation- advancement flap⁷ and use of buccal fat pad⁸ could be successful techniques to close OAF, although the choice of the adequate technique is still debatable.

CASE REPORT

Indonesian Female, 41 years old came to our clinic with chief complain of constant headache after first upper left molar extraction and followed by liquid came out through his nose and food inflow through the socket. This condition persists since 1 month before admission. There was dull pain on her left cheek and a lot of pus came out from her nose especially when prostration. Patient sought for medical treatment but the condition was not getting better. Clinical examination revealed an approximately 10-mm non healing socket in first upper left molar with pus discharge about 5 cc. Nose blowing test was positive (+). We put dental tissue forcep on the socket and easily came in about 15 mm.

OPG shows upper left first molar socket connected with inferior wall of left maxillary sinus. Working diagnosis was Oroantral Fistula caused by non healing upper left first molar socket. We decided to do debridement, removing all epitelial lining on fistula and closing the OAF by using buccal flap. All procedure was performed under local anesthesia. 3 weeks after procedure, the OAF healed completely and there was no others specific complain from the patient.



Figure 1. OPG shows discontinuity at inferior wall of left maxillary sinus



Figure 2. Non-healing socket



Figure 3a, 3b. Dental tissue forcep came in the socket

CASE MANAGEMENT

Asepsis and antisepsis of the operation area were done by using povidon iodine and nearing with the sterile *doek*. Local anesthesia pehacaine ® 2 ml injected to vestibulum upper left molar and palatal. We made vertical incision on mesial and distal aspect of vestibulum 45° to alveolar crest about 1 cm from to socket side. The incision was elevated mucoperiosteal as trapezoidal flap and then we remove all necrotic tissue on the socket until we had healthy tissue and good vascularization.

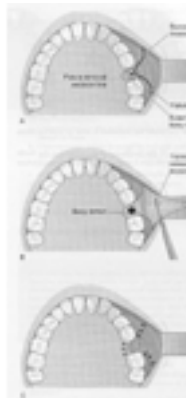


Figure 4. Buccal flap closure procedure ⁹



Figure 5. Incision, flap elevation and debridement of the OAF



Figure 6. Suturing the defect with 2 layers by using vicryl ® 5-0



Figuree 7. Three weeks after the surgery

The flap was sutured in place in two layer which are sinus mucosal and oral mucosa with vicryl ® 5-0. The patient was warned against blowing the nose for 3 weeks. We prescribe antibiotic clanekeksi ® 500 mg three times daily, decongestan and analgesic for 5 days. The patient was followed up three weeks later for any post operative complications and any other subjective complains.

DISCUSSION

Oro Antral Fistula should be surgically closed in order to avoid sinusitis and any other infection. There were many surgical approaches to treat oro antral fistula, such as buccal flap, rotational palatal flap, buccal fat flap. Many parameters must be considered when we choose the technique for OAF closure including size of defect, height of the alveolar ridge, sinus inflammation and past medications¹⁰.

In this case we choose to use buccal flap for OAF closure. It starts with an incision around the socket as the opening of the soft tissue is always smaller than the opening of the sinus itself. Two vertical incisions are made from each side toward the buccal vestibulum which base of the flap is always wider to make a better blood supply to the flap. If the flap

can not be brought over socket, dissection of periosteum should be performed to release the tension and the flap edge could be united.

The buccal flap technique can be satisfactorily employed in the treatment of small and medium-sized communications, but its use is restricted to conditions when the defect has been dislocated to the palatine area due to a greater buccal loss, which requires a greater flap sliding.

Medications include antibiotic, decongestant and analgesic. The use of decongestant to avoid cough and sneezing which made high pressure on antrum and break the flap. Evaluation need to evaluate for post operative complications like wound dehiscence, necrosis of the flap, infection or any other subjective complaints.

CONCLUSION

OAF requires surgical treatment to avoid sinusitis and any infection correlated. The treatment should be carefully planned to avoid failures. History taking, diagnosis, debridement, surgical technique and medications are the keys for good closure of OAF. Buccal flap has good result in OAF closure. It need post operative follow up to make sure there is no complication after the operation.

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TRANSMUCOSAL ATTACHMENT IN DENTAL IMPLANT (LITERATURE STUDY)

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ABSTRACT

In dental implants surgery, there are two biological considerations that must be considered, namely; Relations the soft tissue-implant interface (Transmucosal Region), as well as the relationship of bone-implant interface (Jaw-Bone Region). Healing of the mucosa results in the establishment of a soft tissue attachment (transmucosal attachment) to the implant. Transmucosal attachment serves as a seal that prevents products from the oral cavity reaching the bone tissue, and thus ensures the osseointegration and the rigid fixation of the implant. The peri-implant mucosa and the gingiva have several clinical and histological characteristics in common. Some important differences, however, also exist between the gingiva and the peri-implant mucosa. The mucosal tissues around intraosseous implants form a tightly-adherent attachment known as transmucosal attachment consisting of a dense collagenous lamina propria covered by keratinized stratified squamous epithelia. The implant barrier epithelium is analogous to the junctional epithelium around natural teeth; in that, the epithelial cells attach to the titanium implant by means of hemidesmosomes and basal lamina. This evidence supports the concept that a viable biologic seal can exist between the epithelial cells and the implants. Since endosseous implants are permucosal, the soft tissue-implant interface should be considered in their placement and maintenance

Key Word: Dental Implant, Transmucosal Attachment, Biological Seal

INTRODUCTION

The concept of replacing missing teeth for esthetics and function has been an elusive goal for more than 1500 years. This has led to the evolution of many materials and techniques including complete dentures, removable and fixed partial dentures. To overcome the limitations of these materials and techniques, dentistry has long sought a superior method of artificial tooth replacement through dental implants with a goal of restoring the normal contour, comfort, esthetics, health and the most traditional dental disciplines, which

include the bone and soft tissue reconstruction.¹ In dental implants surgery, there are two biological considerations that must be considered, namely; Relations the soft tissue-implant interface (Transmucosal Region) , as well as the relationship of bone-implant interface (Jaw-Bone Region) .^{1,4}

The mucosal tissues around intraosseous implants form a tightly-adherent attachment known as transmucosal attachment consisting of a dense collagenous lamina propria covered by keratinized stratified squamous epithelia. The implant barrier epithelium is analogous to the junctional epithelium around natural teeth; in that, the epithelial cells attach to the titanium implant by means of hemidesmosomes and basal lamina.¹

This evidence supports the concept that a viable biologic seal can exist between the epithelial cells and the implants. Since endosseous implants are permucosal, the soft tissue-implant interface should be considered in their placement and maintenance.

LITERATURE REVIEW

Periimplant Mucosa

The soft tissue that surrounds dental implants is termed periimplant mucosa. Features of the periimplant mucosa are established during the process of wound healing that occurs subsequent to the closure of mucoperiosteal flaps following implant installation (one-stage procedure) or following abutment connection (two-stage procedure) surgery. Healing of the mucosa results in the establishment of a soft tissue attachment (transmucosal attachment) to the implant. Transmucosal attachment serves as a seal that prevents products from the oral cavity reaching the bone tissue, and thus ensures osseointegration and the rigid fixation of the implant. The peri-implant mucosa and the gingiva have several clinical and histological characteristics in common. Some important differences, however, also exist between the gingiva and the peri-implant mucosa. ³



Fig. 1. Schema of biological region around dental implants The surrounding tissue of dental implants is biologically divided into two regions; jaw-bone and transmucosal regions. A variety of oral pathogens (red arrows), likely bacteria and their products, are able to penetrate into the submucosal tissue around dental implants through the transmucosal region around dental implants, followed by causing the destruction of peri-implant tissue, similar to the destruction of periodontal tissue around tooth ⁴

Dimension

The structure of the mucosa that surrounds implants made of titanium has been examined in man and several animal models (for review see Berglundh 1999). In an early study in the dog, Berglundh et al. (1991) compared some anatomic features of the gingiva (at teeth) and the mucosa at implants.

The clinically healthy gingiva and peri-implant mucosa had a pink color and a firm consistency. In radiographs obtained from the tooth sites it was observed that the alveolar bone crest was located about 1 mm apical of a line connecting the cemento-enamel junction of neighboring premolars. The radiographs from the implant sites disclosed that the bone crest was close to the junction between the abutment and the fixture part of the implant. (Figure 3).³



Figure 2. After 4 months of careful plaque control the gingiva (a) and the peri-implant mucosa (b) are clinically healthy.³

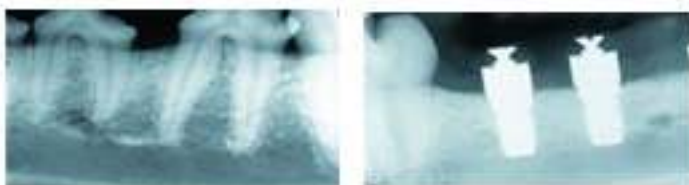


Figure 3 (Left) Radiograph obtained from the premolars in the left side of the mandible.³ (Right) Radiograph obtained from the implants in the right side of the mandible.³

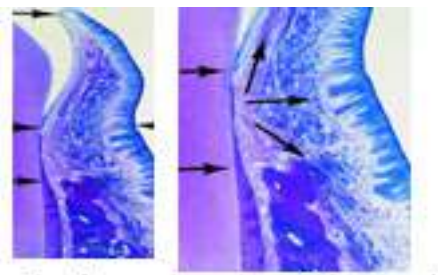


Figure 4 (Left). Microphotograph of a cross section of the buccal and coronal part of the periodontium of a mandibular premolar. Note the position of the soft tissue margin (top arrow), the apical cells of the junctional epithelium (center arrow) and the crest of the alveolar bone (bottom arrow). The junctional epithelium is about 2 mm long and the supracrestal connective tissue portion about 1 mm high. Figure 4 (right). the direction of the principal fibers (arrows).³

Histological examination of the sections revealed that the two soft tissue units, the gingiva and the peri-implant mucosa, had several features in common. The oral epithelium of the gingiva was well keratinized and continuous with the thin junctional epithelium that faced the enamel and that ended at the cemento-enamel junction (Fig. 4). The supraalveolar connective tissue was about 1 mm high and the periodontal ligament about 0.2–0.3 mm wide. The principal fibers were observed to extend from the root cementum in a fan-shaped pattern into the soft and hard tissues of the marginal periodontium.³

The outer surface of the peri-implant mucosa was also covered by a keratinized oral epithelium, which in the marginal border connected with a thin barrier epithelium (similar to the junctional epithelium at the teeth) that faced the abutment part of the implant. It was observed that the barrier epithelium was only a few cell layers thick and that the epithelial structure terminated about 2 mm apical of the soft tissue margin and 1–1.5 mm from the bone crest. The connective tissue in the compartment above the bone appeared to be in direct contact with the surface (TiO₂) of the implant. The collagen fibers in this connective tissue apparently originated from the periosteum of the bone crest and extend towards the margin of the soft tissue in directions parallel to the surface of the abutment.³

In another study (Abrahamsson et al. 1998), it was demonstrated that the material used in the abutment part of the implant was of decisive importance for the location of the connective tissue portion of the transmucosal attachment. Abutments made of aluminum based sintered ceramic (Al₂O₃) allowed for the establishment of a mucosal attachment similar to that which occurred at titanium abutments. Abutments made of a gold alloy or dental porcelain, however, provided conditions for inferior mucosal healing. When such materials were used, the connective tissue attachment failed to develop at the abutment level. Instead, the connective tissue attachment occurred in a more apical location. Thus, during healing following the abutment connection surgery, some resorption of the marginal peri-implant bone took place to expose the titanium portion of the fixture to which the connective tissue attachment was eventually formed.³

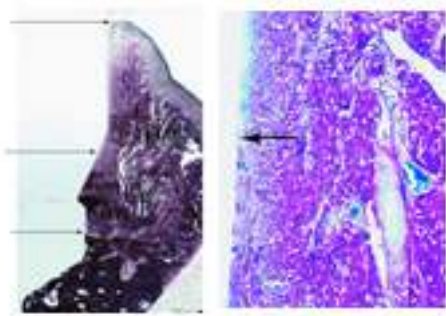


Figure 5. (Left) Microphotograph of a buccal–lingual section of the peri-implant mucosa. Note the position of the soft tissue margin (top arrow), the apical cells of the junctional epithelium (center arrow), and the crest of the marginal bone (bottom arrow). The junctional epithelium is about 2 mm long and the implant–connective tissue interface about 1.5 mm high.³ Figure 5 (Right). Higher magnification of the apical portion of the barrier epithelium (arrow).³

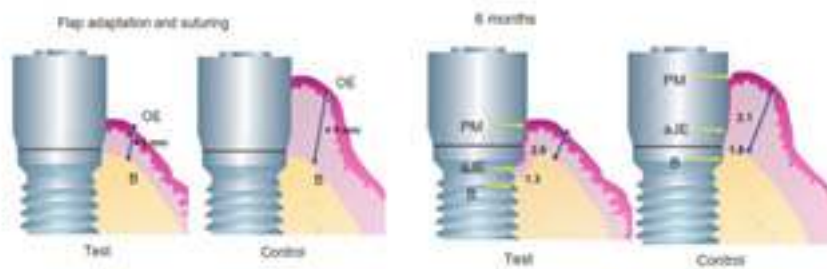
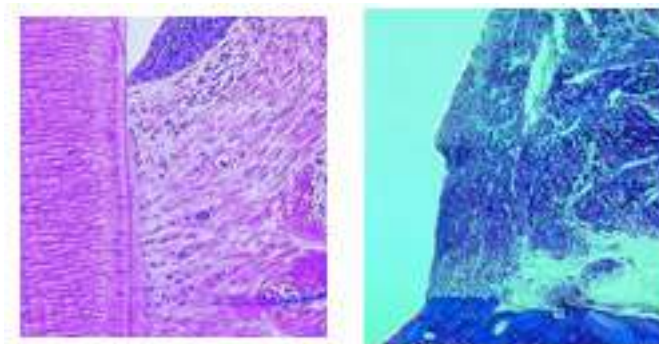


Figure 6 (Left). Schematic drawing illustrating that the mucosa at the test site was reduced to about 2 mm. From Berglundh & Lindhe (1996) **(Right)** Schematic drawing illustrating that the peri implant mucosa at both control and test sites contained a 2 mm long barrier epithelium and a zone of connective tissue that was about 1.3–1.8 mm high. Bone resorption occurred in order to accommodate the soft tissue attachment at sites with a thin mucosa. From Berglundh & Lindhe (1996).³



Gambar 7 (Left). Note on the tooth side the presence of an acellular root cementum with inserting collagen fi bers. The fibers are orientated more or less perpendicular to the root surface. **Microphotograph of the peri-implant mucosa and the bone at the tissue/titanium interface.** Note that the orientation of the collagen fi bers is more or less parallel (not perpendicular) to the titanium surface.³

The location and dimensions of the transmucosal attachment were examined in a dog experiment by Berglundh and Lindhe (1996). Implants (fixtures) of the Brånemark System® were installed in edentulous premolar sites and submerged. After 3 months of healing, abutment connection was performed. In the left side of the mandible the volume of the ridge mucosa was maintained while in the right side the vertical dimension of the mucosa was reduced to ≤ 2 mm (Fig. 3.19) before the flaps were replaced and sutured. In biopsy specimens obtained after another 6 months, it was observed that the transmucosal attachment at all implants included one barrier epithelium that was about 2 mm long and one zone of connective tissue attachment that was about 1.3–1.8 mm high. A further examination disclosed that at sites with a thin mucosa, wound healing consistently had included marginal bone resorption to establish space for a mucosa that eventually could harbor both the epithelial and the connective tissue components of the transmucosal attachment.³

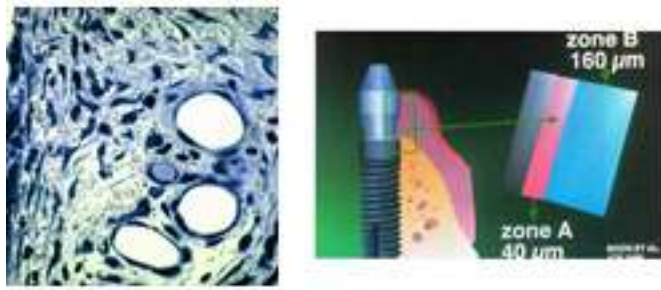


Figure 8 (Left). Microphotograph of the implant/connective tissue interface of the peri-implant mucosa. A large number of fibroblasts reside in the tissue next to the implant..³ **Figure 8 (Right).** Schematic zone A and B



Figure 9. A buccal–lingual section of a beagle dog gingiva. Cleared section. The vessels have been filled with carbon. Note the presence of a suprapariosteal vessel on the outside of the alveolar bone, the presence of a plexus of vessels within the periodontal ligament, as well as vascular structures in the very marginal portion of the gingiva.³

Quality

The quality of the connective tissue in the supraalveolar compartments at teeth and implants was examined by Berglundh et al. (1991). The authors observed that the main difference between the mesenchymal tissue present at a tooth and at an implant site was the occurrence of a cementum on the root surface. From this cementum (Fig. 3-22), coarse dento-gingival and dento-alveolar collagen fiber bundles projected in lateral, coronal, and apical direction. At the implant site, the collagen fiber bundles were orientated in an entirely different manner. Thus, the fibers invested in the periosteum at the bone crest and projected in directions parallel with the implant surface (Fig. 3-23). (Buser et al. 1992). ³

The connective tissue in the supra-crestal area at implants was found to contain more collagen fibers, but fewer fibroblasts and vascular structures, than the tissue in the corresponding location at teeth. Moon et al. (1999), in a dog experiment, reported that the attachment tissue close to the implant (Zone A) contained only few blood vessels but a large number of fibroblasts (Collagen 67%, Fibroblast 32% dan Blood vessel 0,3%)

that were orientated with their long axes parallel with the implant surface. In more lateral compartments (Zone B), there were fewer fibroblasts but more collagen fibers and more vascular structures (Collagen 85%, Fibroblast 11%, Vascular 3%). From these and other similar findings it may be concluded that the connective tissue attachment between the titanium surface and the connective tissue is established and maintained by fibroblasts³

Blood Supply

The vascular supply to the gingiva comes from two different sources (Fig. 3-26). The first source is represented by the large suprapariosteal blood vessels, that put forth branches to form (1) the capillaries of the connective tissue papillae under the oral epithelium and (2) the vascular plexus lateral to the junctional epithelium. The second source is the vascular plexus of the periodontal ligament, from which branches run in a coronal direction and terminate in the supraalveolar portion of the free gingiva. Thus, the blood supply to the zone of supra-alveolar connective tissue attachment in the periodontium is derived from two apparently independent sources .³

Berglundh et al. (1994) observed that the vascular system of the peri-implant mucosa of dogs (Fig. 3-27) originated solely from the large supra-periosteal blood vessel on the outside of the alveolar ridge. This vessel that gave off branches to the supra-alveolar mucosa and formed (1) the capillaries beneath the oral epithelium and (2) the vascular plexus located immediately lateral to the barrier epithelium. The connective tissue part of the transmucosal attachment to titanium implants contained only few vessels, all of which could be identified as terminal branches of the supra-periosteal blood vessels.³

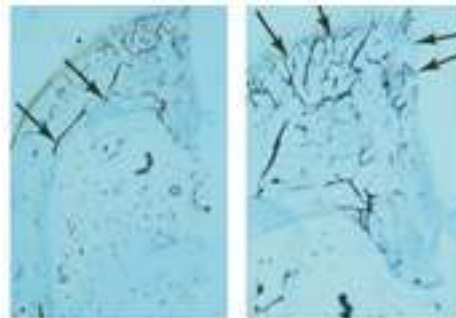


Figure 10. A buccal–lingual cleared section of a beagle dog mucosa facing an implant (the implant was positioned to the right). Note the presence of a suprapariosteal vessel on the outside of the alveolar bone, but also that there is no vasculature that corresponds to the periodontal ligament plexus. (b) Higher magnification Note the presence of a vascular plexus lateral to the junctional epithelium, but the absence of vessels in the more apical portions of the soft tissue facing the implant and the bone³

DISCUSSION

In dental implants surgery, there are two biological considerations that must be considered, namely; Relations the soft tissue-implant interface (Transmucosal Region) , as well as the relationship of bone-implant interface (Jaw-Bone Region) .1,4

The mucosal tissues around intraosseous implants form a tightly-adherent attachment known as transmucosal attachment consisting of a dense collagenous lamina propria covered by keratinized stratified squamous epithelia. The implant barrier epithelium is analogous to the junctional epithelium around natural teeth; in that, the epithelial cells attach to the titanium implant by means of hemidesmosomes and basal lamina.¹

. This evidence supports the concept that a viable biologic seal can exist between the epithelial cells and the implants. Since endosseous implants are permucosal, the soft tissue-implant interface should be considered in their placement and maintenance.¹

Transmucosal Attachment can be said to have a resemblance with a slight difference to the relationship with the soft tissue and the teeth, so that the relationship must be considered during installation and maintenance of the implants, This attachment aims to prevent foreign bodies from the oral cavity reaches the bone tissue, and with thus it can be ascertained occurrence of osseointegration and strong fixation of the implant.³

In another study (Abrahamsson et al. 1998), it was demonstrated that the material used in the abutment part of the implant was of decisive importance for the location of the connective tissue portion of the transmucosal attachment. Abutments made of aluminum based sintered ceramic (Al₂O₃) allowed for the establishment of a mucosal attachment similar to that which occurred at titanium abutments.³

CONCLUSION

Transmucosal attachment is composed of two parts, the barrier epithelium that is similar to the junctional epithelium with a length of 2 mm. Then proceed with the connective tissue zones with a thickness of 1 - 1.5 mm which is composed of collagen fibers running in parallel with the surface of the implant, the fibers originating from the periosteum of the alveolar bone crest.

The connective tissue in the area supracrestal implants was found to contain more collagen fibers, but fewer fibroblasts and vascular structures.

The vascular system of the mucous periimplant come only from large supra-periosteal blood vessels, which provide blood supply to the connective tissue under the oral epithelium and the connective tissue in the lateral barrier epithelium. This happens due to lack of vascular source derived from the periodontal ligament around Implant.

The implant barrier epithelium is analogous to the junctional epithelium around natural teeth; this evidence supports the concept that a viable biologic seal can exist between the epithelial cells and the implants.

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Semilunar Flap For Treatment Miller's Class I Gingival Recession (A Case Report)

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ABSTRACT

Gingiva recession is a common finding in many patients. A variety of periodontal plastic surgery procedures have been attempted in the past to treat the gingival recession deformities with varying degrees of success. This case report describes semilunar flap for the treatment of recession defect on maxillary anterior region. Treatment of gingival recession aims to improve esthetic, reduce of gingiva recession and hipersensitive. A 51 year female patient came to department of periodontics, UNPAD Stomatological hospital with a chief complaint on maxillary anterior. Patient felt a gingival recession, and hypersensitive to cold water and tooth brushing. Clinical examination reveal the recession in 12 (2 mm) which categorized as class I Miller. The case of gingival recession in maxillary anterior can be corrected using a semilunar flap technique. The treatment of gingival recession using a semilunar flap technique in this case. Evaluation was performed at the 1st, 2nd, and 4th week. Miller's Class I gingival recession in maxillary anterior can be treated with seminular flap in maxillary anterior as therapy to cover the denuded root and reduce the hypersensitive.

Keywords: Gingival recession, root coverage, semilunar flap

INTRODUCTION

Gingival recession is a common problem in the dental patients. It is defined as the apical migration of the gingival soft tissue margin to the cemento-enamel junction with exposure of the root surface.¹ A gingival recession frequently results from a combination of predisposing and aggravating factors. Predisposing factors for gingival recession include tooth malposition, high frenal attachment, and insufficiency of width or thickness of keratinized gingiva. Aggravating factors include inflammation, trauma mechanical (vigorous tooth brushing in horizontal direction or by brushing with a hard bristle toothbrush), abfraction,

and iatrogenic factors (traumatic occlusion, restorative inadequate, partial dentures with poor designed, orthodontic treatment or periodontal treatment). It may also be caused due to bad habits resulting in gingival laceration including traumatic tooth picking and eating hard foods and smoking.^{2,3,4,5}

Sullivan and Atkins (1968) classified gingival recession into four categories: deep-wide, shallow-wide, deep-narrow, and shallow-narrow. Miller (1985) divide gingival recession into 4 categories:^{5,6,7} Class I : marginal tissue recession does not extend to the mucogingival junction. There is no loss of bone or soft tissue in the interdental area. This type of recession can be narrow or wide, class II: marginal tissue recession extend to or beyond the mucogingival junction. Ther is no loss of bone or soft tissue in the interdental area. This type of recession can be sub classified into narrow or wide, class III: marginal tissue recession extend to or beyond the mucogingival junction. There is bone and soft tissue lost in the interdental area or malpositioning of the tooth, class IV: marginal tissue recession extend to or beyond the mucogingival junction. There is severe bone and soft tissue lost in the interdental area or severe malpositioning of the tooth.

It has been observed that Class I ad II gingival recession shows 100% to root coverage procedures (prognosis good to excellent), Clas III shows 50 to 70% success (only partial coverage can be expected), and Class III shows only 0 to 10% success (a very poor prognosis).^{5,8} There are many procedures that have been used for treatment of gingival recession among of them using lateral pedicle graft technique, coronal positioned flap, free gingival graft, subepithelial connective tissue auto graft, guide tissue regeneration, as well as semilunar coronally repositioned flap. Semilunar flap was initially described by Tarnow (1986) as a semilunar incision made parallel to the gingival margin of the facial tissue and coronally positioning this tissue over the denuded root. Tarnow reported the semilunar flap indicated for treatment of gingival recession in areas with minimal labial probing depth (PD) and adequate band of keratinized gingiva.^{3,5,6}

CASE REPORT

A 51 year old female came to came to department of periodontics, UNPAD Stomatological hospital with chief complaint on maxillary anterior. Patient felt a gingival recession, and hypersensitive to cold water and tooth brushing. The result of clinical examination reveal a gingival recession in 15,14,13,12,23,24,25,32,32,41,42. The recession defect in 12 as diagnosed as Miller's Class I, papilla interdental not involved and radiographic imaging reveal no any bone loss (Fig.1). No relevant medical and dental history was reported. Patient's brushing technique was also analyzed by asking her to demonstrate the technique on the dental chair. There was minimum amount of plaque seen and the gingiva was free of inflammation. This case can be corrected by seminular flap.

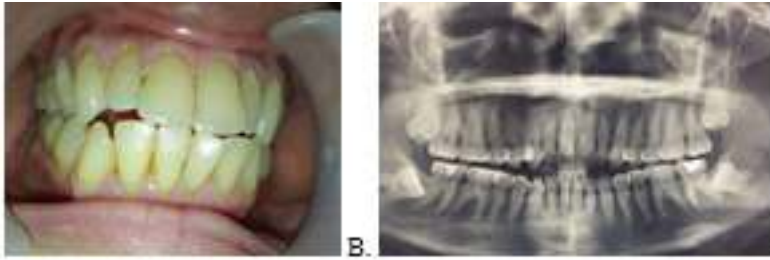


Figure 1. (A) Clinical before surgery. (B) Radiographic imaging

CASE MANAGEMENT

Surgical Pcedures

In this case semilunar flap technique was chosen to gain an optimal root coverage and favourable esthetics result. Initial treatment was done by scalling and root planing and patient was given an oral hygiene instruction. Patients were educated to use a toothbrush with soft brush and correction of brushing technique.

Prior to surgical treatment, the surgical procedure was explained to the patient and patient was given an informed consent. Surgical treatment was initiated with prophylactic and extraoral-intraoral antiseptics using betadine solution 10% (Fig.2), then local anesthesia using infiltration technique in 12 was performed (Fig.3).



Figure 2. Extra and intraoral antiseptic with solution betadine 10%.



Figure 3. Infiltration of local anesthesia in 12

The incision was marked on the tissues and semilunar incision was performed using #15 surgical blade at mucogingival junction. A semilunar incision was given following the outline of the gingival margin. The incision is ended at least 3 mm from the tip of the papilla, this is the area of which is rich in vascular supply (Fig.4).

Second incision (intrasulcular incision) was performed, then partial thickness flap from intrasulcular incision to semilunar incision. The incision need to be performed carefully to prevent gingival breakage (Fig.5). The facial tissues was completely released, then placed the flap to coronally cover the denuded root, then fixated for 5 minutes with a moist gauze. No suture were placed (Fig.6). Perform cleaning over surgical area with NaCl then being closure with periodontal dressing (Fig.7).



Figure 4. Semilunar incision with surgical blade #15.

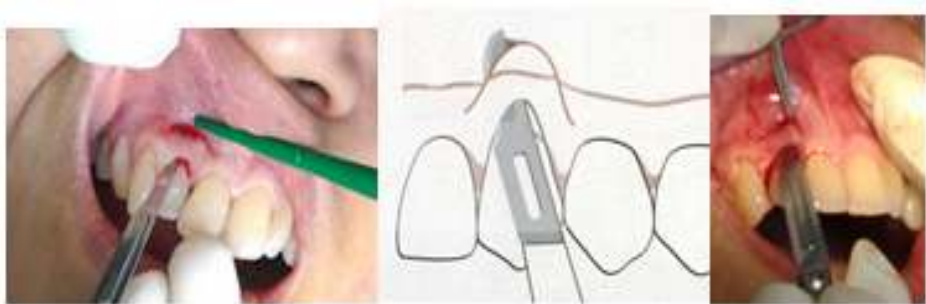


Figure 5. Incision in sulcus with partial thickness flap to semilunar incision.



Figure 6. Fixation the incision to coronal for 5 minutes.



Figure 7. Application periodontaldressing at surgical site.



Figure 8. Post surgery (A)1st week. (B) 2nd weeks. (C) 4th weeks.

Post-operative care: The patient was prescribed 500 mg amoxicillin capsules tid for 7 days and instructed to take an analgesic (500 mg mefenamic acid, tid.) as necessary and rinse with 0,2% chlorhexidine twice daily for 1 weeks. Patient was advised to take soft diet and not to brush at the surgical site for at least 2 weeks after the day of surgery. Patient was given instruction to report to the clinicians if they had any discomfort following surgery. The dressing was removed after 2nd weeks and the area was irrigated with chlorhexidine. Patient was instructed for 1 week, 2 weeks, and 4 weeks recall. Evaluation was performed in 1st week, 2nd week, and 4th week which clinically show a good wound healing. Patient had no complaint after surgical intervention. At the 1st week irrigation was done using NaCl. Two weeks post-operatively periodontal pack was removed and saline irrigation was done, wound area showed reddish, edematous had still persistent, recession had decreased. The patient was monitored at regular intervals and was kept under maintenance therapy. At the end of 1 month, clinical examination was done. The recession defects showed signs of satisfactory healing and root coverage was accomplished without any post-operative complication and hypersensitivity was decrease.

DISCUSSION

Gingival recession is a major aesthetic concern in dentistry. It is a common condition and its extent and prevalence increase with age. In adult, the prevalence of gingival recession

range from 20% to 100%. It may cause dental hypersensitivity, root caries, unaesthetic gingival appearance and periodontal attachment. Gingival recession can occur locally or generally at all teeth depend of the etiology. A number of periodontal plastic surgeries have been used to treat gingival recession each demonstrating different level of succes.⁵

Treatment planning of gingival recession was based on its etiological factor and severity of recession. Prior to the treatment, etiological factors of the recession need to be corrected. The treatment of gingival recession could be treated with surgical and non-surgical. The purpose of recession with surgical intervention was to cover recession area and to decrease the hypersensitivity, prevent recession to be more severe and for esthetics correction essentially in anterior. The successful of the treatment was linked with surgical technique, suturing technique, and post-operative treatment.^{4,9,10}

This technique is a simple procedure, minimally invasive, one-stage periodontal plastic surgical procedure. It generally requires no sutures, no shortening of the vestibule, the existing papillae are not interfered, no tension on flap, and can be successfully to treat Miller's Class I gingival recession. Semilunar flap technique can be used as a treatment procedure in patients who complain of having sensitive teeth from exposed of root the teeth and in isolated gingival recession in maxillary teeth.^{3,10}

CONCLUSION

Semilunar flap procedure is a simple technique for treating Miller's Class I gingival recession which has high patient acceptance and satisfactory results, especially in the anterior esthetic zone.

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The Role Of Inflammatory Mediators in Periodontal Disease

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ABSTRACT

Periodontal disease is a pathological condition that involves inflammation of the tooth supporting structure. Periodontitis, so it called, is characterized by periodontal pocket formation, clinical attachment loss, and alveolar bone resorption. It is initiated by microbial biofilms formed on the teeth and involving interactions between bacterial products, numerous cell populations and inflammatory mediators. The host defense system, including the innate and adaptive immunity is responsible for eliminating bacteria invading the periodontal tissue. Failure to eliminate the bacteria will result in a continuous state of inflammation where the inflammatory cells will continue to produce inflammatory mediators in order to eradicate the bacterial invaders. These inflammatory mediators have the capability to alter the connective tissue and alveolar bone metabolism resulting in tissue and bone destruction. The characteristic of tissue and bone destruction is a result of inflammatory mediators such as cytokines, chemokines, arachidonic acid metabolites, and proteolytic enzymes. This review summarizes the pathogenesis of periodontitis with the main focus on inflammatory mediators and their role in periodontal disease.

Key words: periodontitis, inflammatory mediator

INTRODUCTION

Periodontitis is defined as an inflammatory disease of supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with increased probing depth formation, recession, or both¹. It is one of the most common chronic inflammatory diseases in aged populations². It has been generally accepted that periodontitis is initiated by microbial biofilms in dental plaque³. The invading bacteria and their endotoxins will trigger

host response and inflammation process occurs. Inflammation process is a necessary component for the host defense against pathogens and contributes in wound healing³. When inflammation remains unresolved, it evolves into a chronic state because host immune and inflammatory responses are insufficient to remove the bacteria. In chronic inflammation, the balance between tissue destruction and healing is maintained, but it can tilt towards destruction³.

Destruction of periodontium is the characteristic of periodontitis, is generally accepted to be a result of the host-immune inflammatory response caused by bacteria. Traditionally, host response has been thought to be triggered by immune cells such as T and B lymphocytes, neutrophils, and macrophages, but it has been revealed that resident cells in gingival connective tissue also play as important contributors in mediating inflammation. These cells are triggered to release inflammatory mediators including cytokines, chemokines, prostaglandines, and proteolytic enzymes, which could cause tissue degradation and bone resorption by activating osteoclast and several distinct host degradative pathways³.

PATHOGENESIS OF PERIODONTITIS

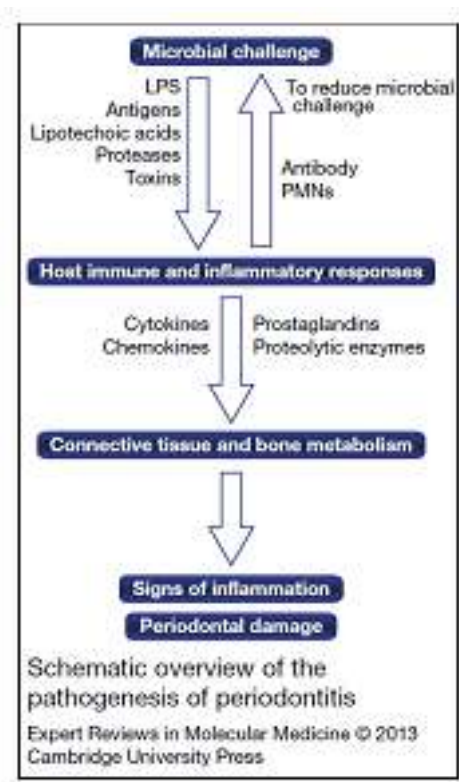


Figure 1. Schematic overview of the pathogenesis of periodontitis³

Inflammatory periodontal disease is a consequence of the interaction of environmental, genetic, host, and microbial factors⁴. Periodontitis is initiated by dental plaque bacteria. The bacterial infection begins in the gingival epithelium leading to gingivitis, and will progress into the underlying connective tissue leading to periodontitis⁵. Bacterial components such as Lypopolisaccharide (LPS), antigens, and toxins will induce host response which activates immune cells and triggers an antibody response directed towards reducing the magnitude of the microbial challenge. It will result in the production of inflammatory mediators such as cytokines, chemokines, prostaglandins, and proteolytic enzymes i.e. matrix metalloproteinases (MMP)(Figure 1.)³. When the host's immune system cannot resolve the infection, a chronic inflammatory response develops leading to periodontal inflammation and periodontal damage, i.e. loss of attachment and alveolar bone^{3,6}.

Host Response

Bacterial components, such as lypopolischarides, peptidoglycans, lipoteichoic acids, proteases, and toxins, could instigate host response by stimulating various inflammatory cell types as well as of resident cells of the tissue. Periodontal epithelium provides a physical barrier to infection and has an active role in the innate host defense, because it is in constant contact with bacterial products. It can participate in the infection by signaling further innate and acquired immune responses. It can also respond to bacteria by increasing their proliferation, by altering their cell signaling events, and by changing the cell differentiation and cell death and altering tissue homeostasis. The integrity of the epithelial barrier is specifically disrupted by different microbial pathogens that attack cell-cell junctions and thereby dissociate cells from each other. Families of natural antibiotic peptides or proteins are expressed in epithelium and by neutrophil⁶.

Antigens and products, such as LPS and peptidoglycans, released by bacteria are recognized by toll-like receptors (TLRs) on the surface of host cells, which initiates an inflammatory response³. TLRs family is the best characterized class of pattern recognition receptor (PRRs) on immune cell surfaces and detects multiple PAMPs in the bacterial wall⁶. Examples of PAMPs that are recognized by TLRs include peptidoglycan bacterial lipoproteins, and *Pg* LPS⁷. TLRs are expressed on a variety of cells, including both lymphoid and nonlymphoid cells, and on various epithelial surfaces, including dendritic cells. Pathogen recognition by TLRs expressed from epithelial cells leads to the production of cytokines, chemokines and antimicrobial peptides that induce the recruitment of more inflammatory cells to the infected sites⁶.

Through a cascade of events, mast cells are stimulated to release vasoactive amines and preformed tumor necrosis factor α (TNF- α), which increases vascular permeability and the expression of adhesion molecules such as intercellular adhesion molecule-1 (ICAM-1), endothelial adhesion molecule-1 (ELAM-1), and P-selectin on endothelial cell surfaces^{3,5}. This process recruits PMNs into the tissue, where they release lysosomal enzymes, which contribute to tissue degradation. These cells are present in the junctional epithelium in large numbers and appear to wall off the underlying tissues from the bacterial biofilm. The

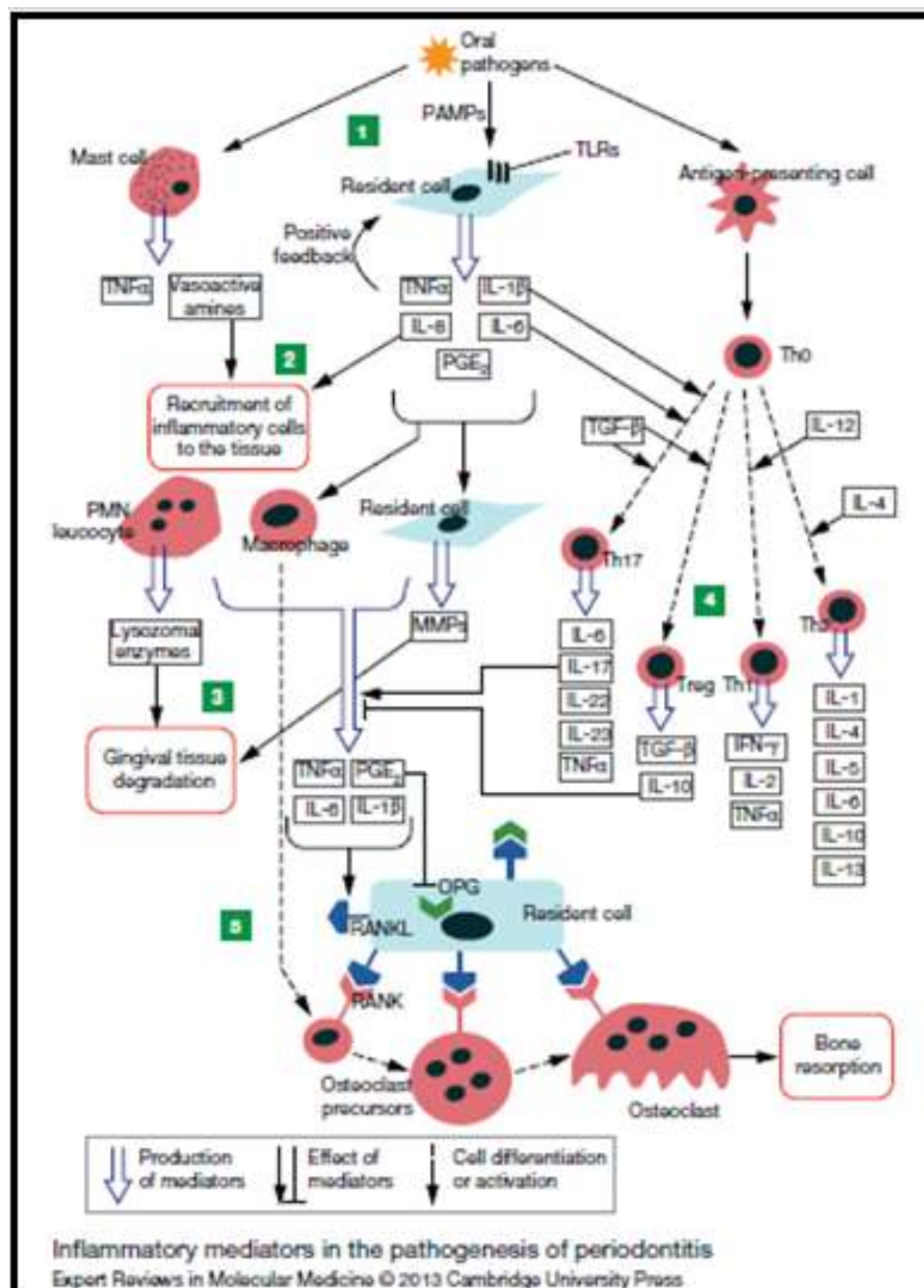


Figure 2. Inflammatory mediators in the pathogenesis of periodontitis³

presents of these cells is the result of the existence of generation of chemotactic factors in the gingival sulcus and underlying tissues⁶.

Macrophages and lymphocytes further invade the tissue in response of vasoactive amines and (TNF- α)³. Macrophages also produce several cytokines and present antigens to T cells. It also capable of differentiating osteoclasts in response to TNF- α in the presents of receptor activator of NF- κ B ligand (RANKL). Periodontal pathogens, such as *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis*, have been shown to activate macrophages and stimulate the secretion of proinflammatory and tissue destructive mediators such as IL-1, TNF- α , IL-6, and PGE-2⁵.

When the epithelial barrier, with its antimicrobial peptides and other components of innate systems are breached, the adaptive immune response is activated. Cytokines or interleukins are integral with this response and represent intercellular messengers. The cells responsible in adaptive immune response are the lymphocyte (T-cell and B-cell)³. Lymphocytes are important immune cells that can produce IL-1, IL-6, IL-17, RANKL, and TNF- α cytokines. It is also secrete a number of inhibitory molecules that directly inhibit osteoclast formation, including osteoprotegerin (OPG), IL-4, IL-10, IL-13, and interferon- γ (IFN γ)⁵. As the active resolution of inflammation continues, bacterial antigens eventually encounter antigen presenting cells such as dendritic cells, macrophages and B cells.

When naive CD4 T helper cell (Th0) interact with antigen presenting cells, naive T cells differentiate into various subsets of cells including Th1, Th2, Th17, and regulatory T cells (Treg), depending on the cytokines which they produce³. Th17 cells has been hypothesized to be involved in Th1 modulation and enhanced inflammatory mediators production by gingival fibroblast, and maybe the primary source of RANKL production by osteoblasts in periodontal disease. *Porphyromonas gingivalis* outer membrane protein induced a significant increase in the production of IL-17, and this type of cytokine has been shown to stimulate epithelial, endothelial, and fibroblastic cells to produce IL-6, IL-8, TNF- α , and PGE₂^{3,8}.

Bone resorption, in periodontitis, is a shifted balance towards bone destruction through mechanisms including increased osteoclast activation. The activation of osteoclasts is stimulated by cytokines, such as IL-1 β , TNF- α , IL-6, macrophage colony-stimulating factor (M-CSF), IL-17, and PGE₂ (Figure 2). The TNF family RANKL induces the differentiation of osteoclasts in the presence of M-CSF³. RANKL is a polypeptide of 314 amino acids, and is identified in lymphocytes, stromal cells, and many other cell types in periodontal tissues². RANK is a receptor found on the surface of osteoclast precursors. When RANK binds to its ligand RANKL, it stimulates the proliferation and differentiation of these precursor cells into mature osteoclasts^{5,7}. OPG (Osteoprotegerin) competes with RANKL by binding to RANK without stimulating any osteoclasts differentiation⁵. OPG is a decoy receptor of RANKL, produced by a variety of cell types including osteoblasts and marrow stromal cells. RANKL/OPG ratio was higher in individuals with periodontitis than in healthy individuals⁵.

Cytokines and chemokines

Cytokines are small secreted proteins released by cells, have a specific effect on the

interactions and communications between cells. Cytokine is a general name; other names include lymphokine (cytokines made by lymphocytes), monokine (cytokines made by monocytes), chemokine (cytokines with chemotactic activities), and interleukin (cytokines made by one leukocyte and acting on other leukocytes). Cytokines may act on the cells that secrete them (autocrine action), on nearby cells (paracrine action), or in some instances on distant cells (endocrine action). There are both pro-inflammatory cytokines and anti-inflammatory cytokines⁹.

Pro-inflammatory cytokines including IL-1, IL-6, IL-12, IL-17, IL-18, IL-21, TNF- α , and IFN- γ have been demonstrated to be involved in the pathogenesis of periodontitis³. These cytokines, predominantly IL-1, IL-6, and TNF- α are produced by resident cells (epithelial cells and fibroblasts) and also phagocytes (neutrophils and macrophages) in periodontal environment. IL-12 and IL-18 is known as a cytokine that is able to enhance the maturation of naive T cells to Th1 cells⁶.

IL-1 is a multifactorial cytokine which is able to activate many cell types with potent inflammatory features⁴. There are two forms of IL-1 that have agonist activity, IL-1 α and IL-1 β ⁵. It is produced by several type of innate immune cells such as PMNs, monocytes, and macrophages after recognition and presentation of microbes to these cells^{5,10}. IL-1 β and IL-6 are signature innate cytokines and have been characteristically associated with inflammatory cell migration and osteoclastogenesis¹⁰. IL-1 β expression was elevated in gingival crevicular fluid at sites of recent bone and attachment loss in patients with periodontal disease¹¹. IL-17, which is the specific cytokine of Th17 cell, is involved in osteoclastogenesis by inducing RANKL expression on osteoblastic cells. The main function is to mediate inflammation by stimulating resident cells to secrete potent pro-inflammatory cytokines like IL-1, IL-6, IL-8, and PGE₂ that exacerbate the inflammatory reaction and tissue destruction⁴.

TNF- α is a multi-effect cytokine that has many functions, from cell migration to tissue destruction. It impacts cell migration by inducing the up-regulation of adhesion molecules to promote rolling and adhesion of neutrophils to the vessel wall, leading to extravasation. It also stimulates the production of chemokines involved in cell migration to infected and inflamed sites¹⁰. Tumor necrosis factor "family" includes two structurally and functionally related proteins, TNF- α or cachectin mainly produced by monocytes / macrophages and TNF- β or lymphotoxin, a product of lymphoid cells. TNF- α , once produced and secreted, will bind to TNF receptor present in all plasma membrane of most of the cells throughout the body¹². TNF- α induces the synthesis of IL-1, IL-6, IL-8, PGE₂, and ICAM-1, also MMPs and RANKL which contributes to extracellular matrix degradation and bone resorption^{3,4,10,12}.

Chemokines are a large family of chemotactic cytokines that stimulate the recruitment of inflammatory cells. They are produced by a number of cell types in the periodontium, such as fibroblasts, endothelial cells, macrophages, osteoclasts, epithelial cells, polymorphonuclear leukocytes, monocytes, lymphocytes, and mast cells¹¹. They are divided into two major families based on their structure, CC and CXC chemokines. They act through receptors referred to as CC chemokine receptor (CCR) and CXC chemokine receptor (CXCR). IL-8/CXCL-8, chemoattractant of PMNs, is found drastically increased

and have been correlated with disease severity. Another chemokine that contribute to the enhanced severity of periodontal disease is macrophage chemoattractant protein-1 (MCP-1/CCL2), which is supposed to be the major chemoattractant of macrophages⁵.

Prostaglandin E-2

Prostaglandins are a group of potent arachidonic acid-derived inflammatory mediators with the capacity to induce a wide variety of biological responses, including vasodilatation, vascular permeability; oedema, pain and fever, and the mediator also play an immunoregulatory role in neutrophil and monocyte chemotaxis. They function in both an autocrine and a paracrine fashion and modulate the responses of other hormones. PGE₂ is the most prominent in the pathogenesis of periodontitis³. PGE₂ is produced by immune cells, osteoblasts, periodontal ligament cells, fibroblasts, and other resident gingival cells and has a wide range of biological effect on the cells of the diseased gingiva^{3,5}. The actions of PGE₂ include the stimulation of inflammatory mediators and MMPs, as well as osteoclast formation via RANKL³. Recently, macrophages were shown to secrete more PGE₂ when stimulated with *P. gingivalis* LPS⁵

Matrix Metalloproteinases

Maintenance of the extracellular matrix is important for normal development and function of gingival tissue. Proteolytic MMP enzymes and their endogenous inhibitors of metalloproteinases (TIMPs), are involved in the homeostasis of the extracellular matrix in healthy tissue, but they are also key players in the process of tissue destruction in inflammatory diseases. MMPs are also involved in regulating the activities of cytokines and cytokine receptors³. MMPs degrade extracellular matrix and basement membrane components. This group of 23 human enzymes is classified into collagenases, gelatinases, stromelysins, membrane-type matrix metalloproteinases, and other matrix metalloproteinases, mainly based on the substrate specificity and the molecular structure¹⁰.

The expression and pathologic release of matrix metalloproteinases was originally thought to be limited to neutrophils, but it is now clear that a broad range of human periodontium cell types including gingival epithelial cells, fibroblasts, endothelial cells, monocytes / macrophages, and plasma cell¹⁰. The main stimulatory cytokines for matrix metalloproteinases are IL-1 β , IL-6, TNF- α , and also bacterial LPS^{3,10}. It upregulates MMP-1, -3, -8, and -9 expression in gingival fibroblasts³.

MMP-1 or collagenase-1 from mononuclear phagocytes, fibroblasts and epithelial cells have a wide range of substrates. It digests interstitial collagen, extracellular matrix components and soluble nonmatrix mediators. MMP-9 degrades several types of extracellular matrix, including basement membrane type IV collagen. It is expressed by neutrophils and epithelial cells, and stimulated by several cytokines such as TNF- α , and also bacterial LPS. MMP-13 (collagenase-3) is expressed by the basal cells of the gingival pocket epithelium, it degrades type I, type III, and type IV collagens, as well as fibronectin, tenascin, and some proteoglycans¹⁰.

DISCUSSION

Periodontitis is a consequence of the interaction of environmental, genetic, host, and microbial factors. It is a chronic inflammatory disease in which microbial etiologic factors induce a series of host responses that mediate inflammatory events. The cells contribute to this inflammation including immune cells, and also resident periodontal cells such as gingival and periodontal ligament fibroblasts. They produce several inflammatory mediators in focus of eliminating bacteria and promote healing. These inflammatory mediators are capable to alter connective tissue and bone metabolism, resulting in destruction of tissue and alveolar bone. Cytokines, chemokines, prostaglandins, and matrix metalloproteinases are inflammatory mediators responsible for inflammatory process. Among these groups, cytokines and chemokines such as IL-1, IL-6, IL-8, IL-17, and TNF- α are the major inflammatory mediators responsible for bone destruction in periodontitis by promoting osteoclastogenesis. They could induce another inflammatory mediators such as PGE₂ and MMP which causing tissue destruction by degrading extracellular matrix.

Several alterations found on periodontal disease can be associated with PGE₂, especially when IL-1 and TNF- α is present. Higher levels of PGE₂ have been found in human inflamed gingival tissue, especially from periodontal sites exhibiting recent attachment loss. MMPs are key players in the process of collagen destruction and further tissue destruction in periodontal inflammatory disease. It is also involved in the regulation of cytokines and its receptors. The MMPs levels are found to be higher in inflamed periodontal tissue, where increased levels of inflammatory mediators upregulate MMP expression^{3,10}.

Cytokines such as IL-1 and TNF- α can stimulate osteoclastogenesis by enhancing expression of RANKL and differentiation of osteoclast precursors. It also induces RANKL and OPG expression in several cells, such as osteoblast and fibroblast. PGE₂ also stimulates bone resorption by upregulating RANKL expression and inhibition of OPG expression in osteoblastic cells³.

Traditional treatment of periodontitis mainly focuses on decreasing and eliminating microorganism by mechanically removing bacterial biofilm on tooth surfaces and adjacent soft tissue. The development of studies about periodontitis and the role of inflammatory mediators have indicated strong potential for adjunctive host-modulating therapy as new therapeutic strategies in the management of periodontal disease. This host-modulating therapy includes the inhibition of inflammatory mediators such as PGE₂ and cytokines³.

CONCLUSION

Periodontitis is an inflammatory disease caused by bacterial challenge, resulting in tissue destruction and bone resorption. During the activity of inflammation, resident cells and immune cells express or produce inflammatory mediators including cytokines, chemokines, PGE₂, MMPs that collectively contributing to the destruction of connective tissue and bone resorption.

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Alveolar Ridge Augmentation

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ABSTRACT

Alveolar bone resorption is a common clinical problem that can occur physiologically and pathologically. Defects that occur due to loss of teeth due to extraction, advanced periodontal disease, trauma, long term use removable prosthesis, dehiscence and fenestration defects, developmental abnormalities of teeth, odontogenic cysts and tumors. Post extraction socket resorption can occur horizontally, vertically, buccal and lingual direction. Success of a dental implant can be affected by the width of the alveolar ridge, an indication of the amount of bone available to hold the implant. The objective of the study was to describe the hard tissue augmentation for treatment of alveolar ridge defect and the choice of material. Surgical reconstruction procedures for the preparation and placement of dental implants have been more numerous and complex. Various augmentation procedure can be used, the procedure has been categorized by defect dimensions: horizontally or vertically. Horizontal ridge augmentation can be performed using particulate or block grafts with or without barrier membranes. From the review evaluated the outcomes of horizontal and vertical augmentation procedures, that no specific technique was superior. The choice of materials should be based on the clinical indication.

Keyword : Alveolar ridge defect, augmentation, barrier membranes, bone graft, dental implant.

INTRODUCTION

Alveolar bone resorption is a common clinical problem that can occur physiologically and pathologically. Defects that occur due to loss of teeth due to extraction, advanced periodontal disease, trauma, long term use removable prosthesis, dehiscence and fenestration defects, developmental abnormalities of teeth, odontogenic cysts and tumors. Post extraction socket resorption can occur horizontally, vertically, buccal and lingual direction.¹ A classification of alveolar ridge defects has been proposed (Seibert 1983, Allen et al. 1985, Wang & Al-Shammari 2002):²

These resorption patterns form the alveolar ridge was not appropriate for optimal prosthodontic rehabilitation.¹ Success of a dental implant can be affected by the width of the alveolar ridge, an indication of the amount of bone available to hold the implant. The objective of the study was to describe the hard tissue augmentation for treatment of alveolar ridge defect and the choice of material.

DISCUSSION

Surgical reconstruction procedures for the preparation and placement of dental implants have been more numerous and complex, on the size and morphology of alveolar bone defect. Various augmentation procedure can be used, the procedure has been categorized by defect dimensions: horizontally or vertically. The method used to increase bone width horizontal and vertical bone deficiencies including bone grafts and monocortical particulate block grafts. Barrier membrane can be used with bone graft to reconstruct all types of alveolar ridge defect. Repair alveolar ridge defect to the normal position, in terms of altitude and thickness, it is very important to achieve a harmonious balance between the biological condition of the tissue, function and aesthetic appearance.^{3,4}

Barrier membranes.

Different types of barrier membranes have been tested for GBR. These membranes must fulfil specific criteria for promoting bone regeneration of the edentulous ridge, such as biocompatibility, cell occlusion properties, integration by the host tissue, and space making capacity. Their specific composition falls into two broad categories: non-resorbable and resorbable. ePTFE has been the most frequently used material for non-resorbable membranes in both periodontal and bone regeneration clinical applications. ePTFE membranes are flexible with an external porous structure allowing for tissue integration and an internal occlusive layer providing the barrier mechanism. They are composed of a chemically stable and biologically inert polymer that resists microbiologic and enzymatic degradation and does not elicit any immunologic reactions. To enhance the space making capacity of these devices, a titanium scaffold is applied between the two ePTFE layers, adding stiffness and reinforcing the membrane structure. These non-degradable barrier membranes require a second surgical intervention to remove them. This disadvantage, together with the high occurrence of postoperative complications, mainly from early membrane exposure, has limited their clinical use and has led to the development and broader use of resorbable membranes.⁵

Bioresorbable membranes must ensure that the tissue reactions during the process of membrane resorption or biodegradation are minimal and do not affect the outcome of bone regeneration (Hardwick et al. 1995). Several bioresorbable materials have been tested with varying success in bone regeneration applications. Bioresorbable membranes are either natural (xenogeneic collagen type I or III) or made of synthetic polymers, including polyurethane, polyglactin 910, polylactic acid, polyglycolic acid, polyorthoester,

polyethylene glycol, and different combinations of polylactic and polyglycolic acid (Sandberg et al. 1993; Zellin et al. 1995; Brunel et al. 1998; Jung et al. 2006). When inserted into an aqueous environment, such as a biologic system, the biodegradable polymers undergo enzymatic degradation by hydrolysis. The natural collagen membranes undergo resorption by enzymatic degradation.⁵

Several experimental studies have compared the potential of these barrier membranes for promoting bone regeneration. When non-resorbable ePTFE membranes were compared with synthetic bioresorbable membranes made of poly d,l-lactide-co-trimethylen-carbonate, significantly more bone was formed around implants covered with ePTFE membranes, although both test and control implants exhibited new direct bone-to-implant contact (Hurzel et al. 1997). These differences are mainly due to the lack of stiffness and space-making capacity of bioresorbable membranes, which when placed directly over the implant threads, tend to collapse and occlude the space available for bone regeneration. This problem is usually overcome by using a scaffold or graft material under the membrane that provides the space for tissue ingrowth and subsequent bone formation. Experimental studies comparing non-resorbable and collagen resorbable membranes, with and without the use of a scaffold, have shown similar bone regenerative outcomes for the non-resorbable membranes and the collagen resorbable membranes used with a scaffold (Hurzel et al. 1998).⁵

The choice of membrane material usually depends on the amount of bone regeneration needed, mainly in the vertical dimension. ePTFE barrier membranes have demonstrated more favorable results when compared with resorbable devices, mainly due to their better space-making capacity, longer barrier function, and lack of a resorption process that may negatively affect bone formation (Hämmerle & Jung 2003). Nevertheless, a high rate of soft tissue dehiscence was observed with the use of ePTFE membranes. When this complication occurs, early contamination of the exposed membrane usually jeopardizes the regenerative outcome. A metaanalysis evaluating the influence of membrane exposure on the outcomes of regenerative procedures reported that new bone formation was six-fold greater when no soft tissue dehiscence occurred (Machtei 2001).

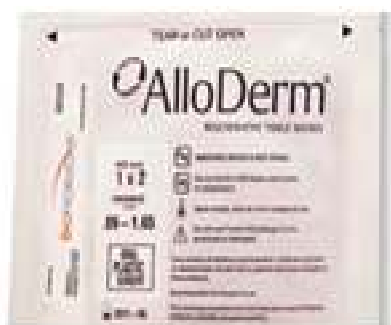


Figure 1a Barrier membran⁶

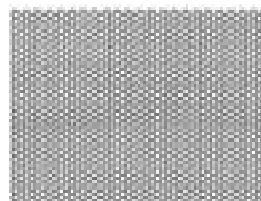


Figure 1b titanium mesh⁷

As already mentioned, these frequent complications and the need for a second surgery to remove the membrane with non-resorbable membranes make resorbable membranes the current gold standard, provided they are used with an adequate space-making graft material.⁵

Bone grafts.

Autogenous bone grafts (autografts) have historically been the gold standard in bone regeneration therapies since they have well-documented osteoconductive, osteoinductive, and osteogenic properties (Yukna 1993). In alveolar bone augmentation surgeries, autogenous bone is used either as a particulate or a block graft. Particulate bone grafts are normally harvested from intraoral sites and used in combination with barrier membranes following the principles of GBR. These bone chips have the disadvantages that their availability is limited within the oral cavity and, as they lack a rigid and supportive structure, they do not provide the space making capacity necessary for the treatment of class II and III defects. In these cases, rigid titanium-reinforced ePTFE barrier membranes or other space maintenance strategies, such as tenting screws or microimplants, have been used in conjunction with particulate bone autografts. Another drawback with the use of autografts is their fast resorption rate, which requires early implant placement to assure functional loading to the regenerated bone, thus preventing its resorption.⁵

Monocortical block autografts may be harvested from intra- or extra-oral sites. Common intraoral donor sites are the mandibular chin or the ascending ramus area, whereas common extraoral donor sites are the iliac crest or the calota. They may be used



Figure 2. (a, b) Use of an allograft block in the posterior maxilla. (c) Re-entry after 6 months. (d) Histologic evaluation of the regenerated bone shows significant osteoconductivity and incorporation of the allograft block particles with new/vital bone. Use of block grafts to overcome severe horizontal ridge deficiencies have proven very predictable.⁵

in combination with barrier membranes or alone, and they require fixation to the recipient crestal site with mini-screws to avoid micro-movements during healing. These grafts, due to their excellent space maintenance capacity, are indicated in large crestal defects in which there is a need for vertical bone augmentation. Their main disadvantage is the morbidity associated with their harvesting, mainly from the chin area. As with particulate autografts, their resorption rate is high, although when combined with a barrier membrane or with bone particulate xenografts, resorption is slowed.⁵

Bone substitutes.

In order to avoid the morbidity associated with the harvesting of autogenous bone grafts, allografts, xenografts, and alloplasts have been indicated and tested.⁵

Allografts are bone grafts harvested from cadaver donors and processed by freezing or demineralization and freezing. These grafts are then sterilized and supplied by specially licensed tissue banks as bone particles or large blocks. Demineralized freeze-dried bone allografts (DFDBAs) have shown osteoconductive as well as osteoinductive properties due to the release of bone morphogenetic proteins (BMPs) during the demineralization process. There is some concern, however, regarding their absolute non infectivity, although there have been no reported cases of disease transmission from DFDBAs used for dental purposes among over 1 million cases over 25 years (Yukna 1993). These allografts are usually used in combination with barrier membranes following the principles of GBR.⁵

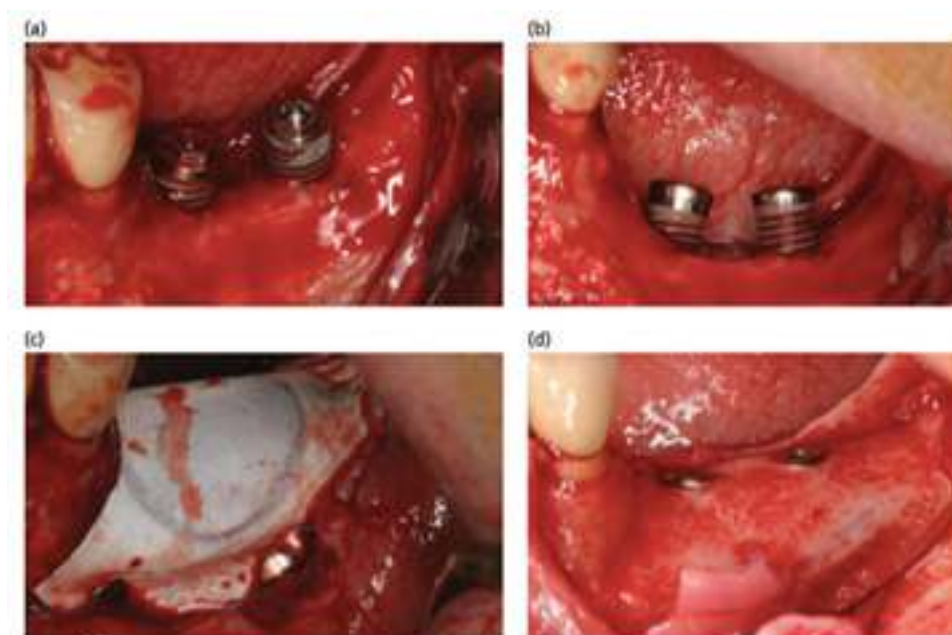


Figure 3 (a, b) Class 2 defect (Seibert). (c–e) Implant placement and horizontal guided bone regeneration procedure with deproteinized bovine bone mineral + non-cross-linked collagen membrane. (g) Implant-supported prosthesis.⁵

Xenografts are graft biomaterials of animal origin, mainly bovine and equine. These graft materials are deproteinized in order to completely remove the organic component and thus avoid any immunogenic reaction. This chemical or low heat process preserves the original bone architecture and the inorganic mineral composition, which assures the osteoconductive properties of the biomaterial. Inorganic bovine bone grafts are usually particulate and utilized according to the principles of GBR in combination with resorbable collagen membranes. Different preclinical and clinical studies have demonstrated their safety and efficacy as bone substitutes for both periodontal and peri-implant augmentation procedures (Baldini et al. 2011). Recently, highly purified porcine collagen type I has been added to xenografts to enhance their clinical handling by improving the cohesion between the mineral granules.⁵

Alloplasts are synthetic bone substitutes that include different combinations of calcium phosphates fabricated under different sintering conditions, which yields different physical properties and resorption rates. The combination of hydroxyapatite and beta-tricalcium phosphate (β -TCP) provides a scaffolding function (hydroxyapatite) as well as osteoconductive properties (β -TCP). These biomaterials are usually resorbable and delivered as granules. They should be always used in combination with barrier membranes.⁵

Horizontal ridge augmentation,

Horizontal ridge augmentation can be performed using particulate or block grafts with or without barrier membranes (Fig. 50-7). The use of particulate grafts together with barrier membranes (GBR) is especially indicated in conjunction with the placement of an implant in class I defects, when there is enough bone width to allow good implant primary stability. In severe class I defects, a delayed bone regeneration approach (staged) is indicated and a block graft is often advocated to assure enough space maintenance to allow significant horizontal augmentation. Both GBR and block grafts have been demonstrated to be a successful and predictable treatment modality to augment a horizontally deficient ridge (Fiorellini & Nevins 2003; Schwartz & Arad & Levin 2005; Schwartz & Arad et al. 2005). According to Donos et al. (2008), the implant survival rate for staged GBR was 99–100%, while that for one-stage ridge augmentation was 87–95%, but this systematic review was hindered by a lack of randomized clinical controlled trials and heterogeneity of the available studies, thus restricting the number of studies included in the systematic review.⁵

The use of autografts is currently somewhat limited due to the morbidity associated with their harvesting and their high resorption rate (mainly when used as bone chips). The use of bone substitutes, mainly of xenogeneic origin, together with resorbable membranes (collagen), has demonstrated good results in one-stage or delayed horizontal bone augmentation techniques with minimal patient morbidity and few postoperative complications. Moreover, these xenogeneic grafts have a very slow resorption rate, which assures their long-term stability.⁵

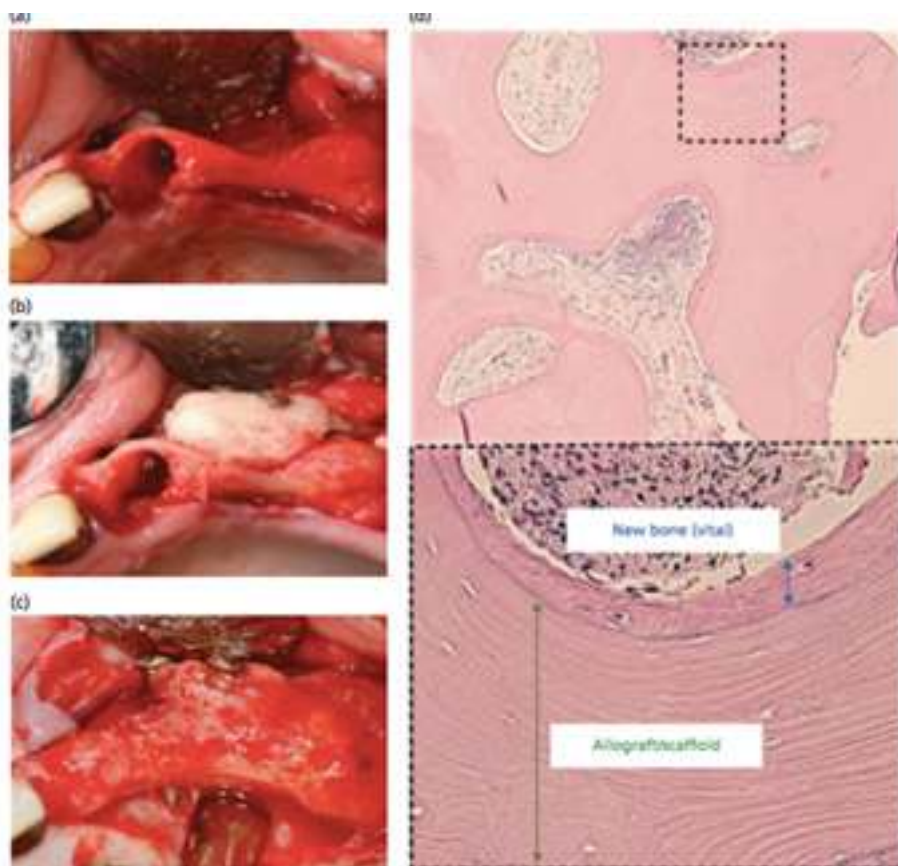


Figure 4 (a–c) Class 3 defect (Seibert). Implant placement and vertical guided bone regeneration with an ePTFE membrane and autologous bone. (d) Re-entry surgery at 12 months. (Courtesy of S. Morante.)⁵

Vertical ridge augmentation.

Moreover, the available studies are very heterogeneous and with relatively small sample sizes, which limits the ability to draw valid conclusions. From the limited information available, it appears that vertical augmentation is a highly technique-sensitive procedure which may give successful treatment outcomes, like adequate gain in vertical bone height and successful implant placement (Fig. 4).⁵

A recent systematic review evaluated clinical outcomes of vertical bone augmentation to enable dental implant placement (Rocchietta et al. 2008). The review evaluated clinical, histologic, and long-term outcomes of implants placed in vertically regenerated bone and identified three main groups of vertical bone augmentation techniques: (1) GBR (seven studies), (2) onlay bone-block grafting (five studies), and (3) distraction osteogenesis (13 studies). The lack of clinical trials, the heterogeneity of the studies, and the small sample sizes limited the ability to perform any metaanalysis, although the authors reported that there was clinical and histologic evidence corroborating that vertical ridge augmentation may be achieved successfully. Nevertheless, a broad range of technique-related complications

were highlighted. For GBR, the reported complication rates were 0–45.5% and complications were mainly related to membrane exposure. For distraction osteogenesis, complication rates were higher (10–75.7%), and complications included fractures or infection of the distractor, neurologic alterations, fractures of the distracted or basal bone, and lingual or palatal inclination of the distracted bone. Minor complications were reported after onlay block bone grafting and these were related to the morbidity from harvesting the block and graft shrinkage. These results are consistent with data from an earlier systematic review that evaluated the outcomes of horizontal and vertical augmentation procedures (Esposito et al. 2009). From this review it was concluded that no specific technique was superior and the complexity of these techniques and the high frequency of complications was highlighted.⁵

There are several published case series demonstrating the possibility of attaining a significant vertical bone augmentation, but also highlighting the technical difficulties and the high number of postoperative complications of this technique. In a small clinical study, six partially edentulous patients were recruited and 14 implants were placed leaving the coronal third exposed circumferentially. Autogenous bone grafts covered with titanium-reinforced ePTFE membranes were used to cover the implants and the flaps were raised to allow for a submerged healing. An average of 4.95 mm of bone height was gained after 12 months in areas where the membranes were not exposed (Tinti et al. 1996). In a similar study, Simion et al. (1994) placed implants protruding 4–7 mm above the bone crest in five patients. ePTFE membranes were used to cover the exposed implant threads. At 9 months, the histologic assessment showed bone formation up to 3–4 mm above the previous bone crest and the implant fixture was osseointegrated with the new bone. In a multicenter long-term study, Simion et al. (2001) evaluated the survival rate of implants placed at the time of the vertical ridge augmentation. The 123 implants with 2–7 mm of exposed implant thread were assigned to three groups: titanium-reinforced ePTFE, allograft, and autograft. The overall implant success rate was 97.5% in the group with ePTFE membranes, and this was the group demonstrating the least amount of bone loss.⁵

Choice of material.

This choice should be based on the clinical indication. For small bone defects requiring mainly horizontal bone augmentation, the use of xenografts and alloplasts has demonstrated excellent results. The use of xenografts with a much slower resorption rate demonstrated significantly better preservation of the socket walls than the non-grafted sites. Histologically, these xenograft granules were integrated and fully surrounded by newly formed bone (Araújo & Lindhe 2009). In a similar experimental model, a β -TCP alloplast demonstrated limited bone promotion properties, with the graft particles being encapsulated with connective tissue (Araújo et al. 2010).⁵

In crestal defects requiring horizontal augmentation, particulate bone grafts should be utilized in combination with barrier membranes. Experimental studies testing different graft materials [biphasic hydroxyapatite + β -TCP (BCG)] or collagen-coated deproteinized bovine bone mineral (DBBM) (BOC) showed that both biomaterials increased bone fill and

the percentage of osseointegrated bone graft particles, and it was concluded that both BCG and BOC provide an osteoconductive scaffold to support GBR procedures at dehiscence□ type defects (Schwarz et al. 2007).⁵

In large crestal defects for which the aim is both horizontal and vertical bone augmentation, the use of monocortical autogenous corticocancellous block grafts is recommended.

CONCLUSION

From the review evaluated the outcomes of horizontal and vertical augmentation procedures, that no specific technique was superior. The approach is largely dependent on the extent of the defect and specific procedures to be performed for the implant reconstruction. The choice of materials should be based on the clinical indication.

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ONE VISIT FRENECTOMY AND GINGIVECTOMY

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ABSTRACT

Aesthetic dentistry including removal of fibrous gingival growth especially in upper maxillary anterior to reveal natural contour of tooth is vital. It may requires minor surgical treatment such as gingivectomy, gingivoplasty or frenectomy. It is a case report of surgical removal high frenum attachment followed by gingivectomy of anterior maxillary section in one visit. A 27-years old male patient with chief complaint of gum bleeding, halitosis and unpleasant look of upper anterior gum. Intra oral examination showed poor oral hygiene, high frenum attachment, palatoversion of element 11,21 with class 2 gingival enlargement of anterior maxillary region element 11,12,21. No history of medication or significant systemic condition observed. Patient was cooperative and wanted time effective treatment. We first performed scaling and root planning treatment, followed by evaluation. Since the enlargement did not subside, patient was informed and agreed about gingivectomy and frenectomy as advanced treatment plan. On the next appointment, conventional frenectomy was conducted, followed by gingivectomy on element 11,12,21 with local anesthesia. We used periodontal pack and asked patient to come back next day for evaluation. Follow up continued at day 7 post-op to remove suturing silk. There was neither major complaint nor complication following the treatment. Patient was satisfied with the aesthetic result. Relapse was not noticeable. One visit surgical therapy of gingivectomy and frenectomy is a viable treatment option for patient with fibrous enlargement and high frenum attachment. This combination procedure will improve aesthetic as well as lowering gingival growth on adjacent area.

Keyword: frenectomy, gingivectomy, one visit treatment

INTRODUCTION

Fibrous gingival growth or hyperplasia or enlargement may be caused by chronic inflammation, after therapy with drugs like phenytoin, cyclosporine, nifedipine, and nitrendipine. Long-term use of these drugs has to be ruled out¹. Gingival hyperplasia may

be associated with physical development, retardation, and hypertrichosis. It has been suggested that gingival enlargement may be due to nutritional and hormonal factors; however, these have not been completely substantiated. The constant increase in the tissue mass can result in delayed eruption and displacement of teeth, arch deformity, spacing, and migration of teeth². Abnormal attachment of frenulum mostly occurred without pain complaints. There are several frena present in oral cavity, started from the most noticeable maxillary labial frenum, mandibular labial frenum and lingual frenum³. In most cases, high labial frenum is found with persistent central diastema showing unaesthetic appearance⁴.

Gingivectomy is a periodontal surgical treatment to remove fibrous gingiva. It is a treatment option for fibrous enlargement which will completely improve gingival appearance. Frenectomy is a surgical procedure to remove high attachment of frenum. There are several technique based on the incision procedure classified as conventional/classic, Millers, V-Y plasty, Z-plasty and electrocautery⁵. Vestibuloplasty is performed on the shallow vestibule caused by flat alveolar ridge. It is aimed to remove unwanted muscle insertions into alveolar ridge by surgery. The procedure is done by exposing bone at the place where these muscles formerly attached. Some techniques proposed are mucosal advancement/submucosal vestibuloplasty, secondary epithelialization and grafting vestibuloplasty⁶.

Aesthetic dentistry including removal of fibrous gingival growth especially in upper maxillary anterior to reveal natural contour of tooth is vital. It may requires minor surgical treatment such as gingivectomy, gingivoplasty or frenectomy. In our patient, both high frenum attachment and fibrous gingival growth were observed. So in this article we aimed to report a procedure of surgical removal high frenum attachment followed by gingivectomy of anterior maxillary section in one visit.

CASE REPORT

A 27-years old male patient came with chief complaint of gum bleeding, halitosis and unpleasant look of upper anterior gum. Intra oral examination showed poor oral hygiene (OHI-s index : 3.1), high frenum attachment, palatoversion of element 11,21 with class 2 gingival enlargement of anterior maxillary region element 11,12,21. No periodontal pocket, no tooth mobility in general. Currently patient is not under any drug treatments, no history



Figure 1. Clinical Presentation of Fibrous Enlargement and Frenum Attachment

of medication nor significant systemic condition observed. Patient was cooperative and wanted time effective treatment.

CASE MANAGEMENT

Patient was examined intraoral and extra orally in our department and signed informed consent to perform vestibuloplasty on the left and right lower buccal frenum.

We first performed scaling and root planning treatment, followed by control and evaluation. Since the enlargement did not subside, patient was informed and agreed to perform gingivectomy and frenectomy as advanced treatment plan.

On the next appointment, conventional frenectomy was conducted. Patient was injected with local anesthesia in submucous area around frenum. Then frenectomy was performed using V- shaped incision technique then the new frenum insertion was sutured. After the procedure finished, then followed by gingivectomy on element 11,12,21 at the same day. The treatment was initiated with local anesthesia then determining bleeding point and



Figure 2. Surgical procedure sequelae a. High labial frenum b. V-incision frenectomy c. Suturing d. Gingivectomy e. Follow up day 7



Figure 3. a. Before surgical treatment b. After surgical treatment

then external bevel incision 2 mm below bleeding points was started. Once gingival removal was finished, gingivoplasty was performed to reach physiologic contour of gingiva. Then we used periodontal pack dressing and asked patient to come back next day for evaluation. Follow up continued at day 7 post-op to remove suturing silk. On the follow up, surgical area appeared to be in normal gingival contour, enlarged tissue was eliminated and no pain complaint from patient.

DISCUSSION

It is a unique case where the fibrous enlargement of upper anterior gingiva and high labial frenum attachment was observed in one case. High frenum attachment is usually followed by central diastema, but in this case, there was overgrowth of the gingiva on the central incisor region instead. This is caused by malpositioned anterior incisor and high labial frenum attachment since patient has no history of drug treatment which may induce enlargement such as anti convulsants, immunosuppressants or calcium channel blockers⁷.

Etiology for gingival enlargement also from inflammation process which is caused by prolonged exposure to dental plaque. Factors that favor plaque accumulation and retention include poor oral hygiene with OHI-s score >3, irritation by anatomic abnormalities and improper restorative and orthodontic appliance. Some systemic condition associated with enlargement such as hormonal (pregnancy, puberty), nutritional and allergic⁸. If the etiology is unknown it is termed as idiopathic enlargement⁹.

Gingivectomy is treatment of choice for fibrous gingival enlargement removal. It can be done using surgical technique (scalpel), electrodes, laser or chemical. But first, scaling and root planning have to be performed to distinct fibrous enlargement from edema. In this case we performed gingivectomy by surgical technique which is recommended for the condition. As the affected area is in anterior region, so gingivoplasty was also performed to reshape physiologic gingival contours.

Frenectomy is a surgical procedure to remove unwanted muscle insertion of frenum. There are several technique used in frenectomy such as V, Z, miller and Y plasty. We used V insicion because it is practical yet suitable in this case. Combined with gingivectomy it will produce a better aesthetic appearance. Although reports about recurrence rates after gingivectomy are conflicting (4), we hope as the high frenum attachment was removed, so

it will decrease recurrence rate since no more muscle insertion which promotes growth and food retention.

Healing after surgical procedure is initiated by protective surface formation and inflammation. In 24 hours, there is increase in new connective tissue cell, mainly angioblast. Accordingly, epithelial cells will arise and migrate over the wound. Surface epithelialization will be generally complete about one month⁸.

We found there are some advantages of doing one visit frenectomy and gingivectomy, such as less chair side time, less appointments and cost effective. On contrast, we observed also some disadvantages of this method, such as surgical wound healing may takes more time, more local complication since there are two sites of surgery.

This case required multidisciplinary care, periodontist, orthodontist and general dental practitioner to obtain best treatment outcome. Orthodontic treatments, as part of periodontal rehabilitation programs, may bring benefits, such as the improvement of access for dental hygiene and reestablishment of occlusal balance. It is a good practice to maintain the plaque control following gingivectomy procedure.

CONCLUSION

Patient is satisfied with the result, especially in aesthetic aspect of the gingival appearance. After 1 month of control and follow up post gingivectomy there was no complain. Gingival size, shape and contour are in normal range. No fibrous enlargement noticeable. In this case we are concern about recurrent fibrous tendency as the position of element 11 and 21 in palatoversion. So patient was advised to consult with orthodontist and to maintain a proper oral hygiene routine.

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Coronally Advanced Flap For The Treatment Of A Singlerecession: A Two-Year Follow Up

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ABSTRACT

Gingival recession defects associated with cervical abrasions are usually treated by periodontal plastic surgery to correct the deformities of the gingiva. Numerous surgical procedures have been implicated for root coverage. Coronally advanced flap (CAF) is a simple pedicle flap that can be utilized for root coverage and aim to restore gingival esthetic and resolve hypersensitivity of teeth. A case report is presented dealing with the treatment of a Miller Class I recession and cervical abrasion on the lower right region of a 36-year-old male patient. A CAF procedure was chosen to treat the single defect regarding the adequate thickness of keratinized gingiva. Horizontal interdental incisions were made to preserve the adjacent papillae. Two years after surgery showed favorable root coverage although the result was not significant. The treatment helped to resolve hypersensitivity and achieved patient's satisfaction.

Key words: coronally advanced flap, esthetic, gingival recession, root coverage

INTRODUCTION

Gingival recessions associated with cervical abrasions may cause negative impacts on both esthetic appearance and dentine hypersensitivity.¹ Numerous surgical procedures have been implicated for root coverage. Coronally advanced flap (CAF) as a periodontal plastic surgery aim to restore gingival esthetic and resolve hypersensitivity of teeth by root coverage.^{2,3} Restrepo introduced the original procedure in 1973; it was designed to cover isolated gingival recessions.⁴ The procedure included vertical incisions mesial/distal to the recessed area, a partial-thickness flap elevation, and removal of epithelium from the papillae adjacent to the recession to coronally position the flap.^{1,4} Considering that the design of the flap and the papilla involvement during surgical procedures are important factors that may interfere with clinical outcomes, the present case was performed with horizontal interdental incisions.¹ The CAF technique with horizontal interdental incisions as an attempt to preserve

interdental papillae aimed to resolve tooth hypersensitivity by root coverage and achieve satisfaction of the patient's esthetic.

CASE REPORT

A 36 year-old male patient reported to the Department of Periodontology, Universitas Padjadjaran, Bandung, Indonesia, with a chief complaint of tooth hypersensitivity on the lower right region [Fig. 1a]. Clinical examination revealed 2 mm gingival recession of Miller Class I was present in mandibular buccal region of 44 accompanied with tooth abrasion. Presence of more than 3 mm width of attached gingiva was noted. There was minimum amount of plaque seen and the gingiva was free of inflammation. The patient was first submitted to initial preparation comprising scaling, root planing, restoration on 44, and oral hygiene instructions before scheduled for surgery.

CASE MANAGEMENT

The CAF was made with horizontal interdental incisions to preserve the interdental papillae and followed by two oblique vertical incisions. One was made on the distal aspect of tooth 44, and the other was on the mesial [Fig. 1b]. They were extended beyond the mucogingival junction to relieve muscle tension [Fig. 1c]. The epithelium on the adjacent papillae was de-epithelized. The root surface was instrumented with curettes and conditioned with tetracycline HCl 100mg/mL for 3 minutes, then irrigated with sterile saline solution for 5 minutes. The tissue flap is coronally advanced, adjusted and secured at the level of 1 mm above the CEJ by suturing the flap with continuous sling sutures (Ailee, Co., Ltd., non-resorbable nylon 5.0 suture material) and interrupted sutures on the vertical incisions [Fig. 1d]. Noneugenol periodontal dressing (Coe-Pak[®]) was placed over the surgical site for a week.

Patient was instructed to discontinue tooth brushing around the surgical site for the first three weeks after the surgery. During this period, patient was advised to use 0.2% chlorhexidine gluconate solution twice daily for two weeks. Systemic antibiotics and analgesics were prescribed for seven days post surgery (Amoxicillin 500mg t.i.d., Mefenamic acid 500 mg t.i.d when needed). The sutures were removed after 14 days [Fig 1e and f].

RESULT

Recession defect was resolved and root coverage was seen in 44 in terms of recession height. Even though the esthetic result was not significant, the patient reported to be completely satisfied with the outcome and tooth hypersensitivity was also totally abolished. The follow up examination of 1 and 3 months post operation showed an uneventful healing and the periodontal tissues presented normal colour, texture and contour [Fig. 2a]. However, the follow up of 2 years post operation showed a slight shrinkage [Fig. 2b].



Fig. 1. a) Pre-operative view; b) Oblique vertical incisions and horizontal interdental incisions; c) Flap was elevated; d) Flap was coronally advanced and secured with a continuous sling and interrupted sutures; e) One week post operative view; f) Two weeks post operative view, after sutures removal

DISCUSSION

One of the most common esthetic concerns associated with the periodontal tissue is gingival recession. It is the displacement of the gingival margin apical to cemento-enamel junction (CEJ), resulting in higher incidence of attachment loss, root caries, and root hypersensitivity. Its development has been frequently associated with periodontal disease, traumatic tooth brushing, frenal pull, and tooth malposition.^{3,2,5–9}

Surgical treatments like free graft and pedicle flap are indicated when the gingival recession causes functional or esthetic problems. Coronally advanced flap technique have shown more predictable recession coverage with apparently satisfactory esthetic results.^{5,10,11} This technique was chosen as the patient demonstrated more than 3 mm of attached gingiva and thick gingival biotype. Additions of horizontal interdental incisions were made to preserve the adjacent papillae to maintain the esthetic outcome, although after two years the gingiva shrunk. Recent study demonstrated a shrinkage post CAF procedure from 89% in 1 month postoperatively to 58.8% after 6 months.¹²

Root planing was performed after the flap was elevated, then conditioned with tetracycline HCl 100 mg/mL. Root surface conditioning by topical application of acidic solutions have been demonstrated to remove not only root instrumentation smear layer, but also any remaining root surface contaminants. Demineralization of the root



Fig. 2. a) Follow up examination after 3 months and b) two years.

surface with root conditioning agents have been associated with uncovering and widening of the dentinal tubules with exposure of dentin collagen, thereby providing a matrix which supports migration and proliferation of cells involved in periodontal wound healing resulting in enhanced connective tissue cell attachment to the root surfaces.^{13–15}.

In this case report, improvements in clinical parameters such as recession height and clinical attachment level was achieved.

CONCLUSIONS

Coronally positioned flap procedure is a simple technique that provides satisfactory results for treating a single class I recession defect associated with shallow abrasion. This technique also resolves hypersensitivity though the esthetic aspect was not significant.

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Correlation Between Patients With Partial Tooth Loss Characteristics And patients' Motivation To Use Dentures At Rsgm Of Jember University

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ABSTRACT

Objective: The impact of losing teeth can disturb the intake of nutrition because of the decreasing of the mastication, dysfunction of phonetic functions so we can't spell some alphabet and uncomfortable feeling. Many people think that losing teeth is not a big problem that can run your life so the small percentage of the usage of denture. Patients' characteristics, socio-demography knowledge and level can affect someone's motivation to take a decision to get a prosthetic care. The characteristics of the patients that take treatment from RSGM Universitas Jember are about gender (male/female), age and education level. **Objective:** The purpose of this study is to know the correlation between patients' with partial tooth loss characters and patients' motivation to use denture at RSGM of Jember University. **Materials and methods:** An observational analytical research with cross sectional approach. All patients who attended the oral diagnostic department at RSGM of Jember University on January-Maret 2016 were chosen as samples with total number of 106 patients. The study used intraoral examination and questionnaires. The data were analyzed using Chi-Square and Rank Spearman test. **Results and Discussion:** The result of statistical analysis is there are correlation between patients' characteristics (education) with the motivation to use denture $p < 0,05$, but there's no correlation between gender, age of the patients with their motivation to use denture ($p > 0,05$)).

Keywords: Motivation, patients' characteristics, to use dentures

INTRODUCTION

Teeth are the main functional component of the oral cavity. Teeth provide variety of function includes mastication, speech and esthetics. Absence of teeth in the oral cavity resulting in difficulty in chewing food, alteration of speech and poor esthetics, greatly affect the quality-of-life.^{1,2} The other effects are psychological and emotional impact that relate with someone's appearance. Someone that loose his teeth will keep of from social activities

because of he is unconfident, this can reduce his productivity at work and also his life quality. Therefore, there is interaction among edentualism, physical condition, social, and mental of somebody.³Edentulism can lead directly to impairment, functional limitation, physical, psychological, and social disability, and handicap .⁴

Periodontal, caries disease and trauma may cause the edentualism. Tooth loss is a general indicator of the severity of oral diseases experienced by an individual or a population, as tooth loss may be the result of caries, periodontal disease and trauma. Tooth loss also reflects the non-disease related aspects of the dental delivery system including attitudes, belief, behavior, treatment cost, access to and utilization of dental services, limitation of dental services and variation among treatment options.⁵Tooth loss also has relation with age and education level. The increasing of age often get related to the increasing number of the teeth that loose.⁶Tooth loss also related with the education level. With high education level, someone will periodically get dental care.⁷

In Indonesia, the mean ofDMF-T tend to be increasing. In 1970 DMF-T = 0,70, in 1980 DMF-T = 2,30 and in 1990 DMF-T = 2,70, SKRT 2001 DMF-T = 5,30. The result of Riset Kesehatan Dasar (RISKESDAS) 2013 that the amount ofDMF-T on ≥ 12 aged category in Indonesia is 4,6with each amount of D-T=1,6 M-T=2,9 F-T=0,08. M-T= 2,9shows thatthe amount of tooth loss reach 290 teeth every 100 people.⁸RISKESDAS 2007 said that the utilization of dental care services for teeth extraction reach 79,6% and the utilization of denture only reach.⁹This shows that the low motivation of Indonesian, especially in Jember, to change their teeth that lost with denture. Moreover, there are lot of people that think that tooth loose is not a big problem that can affect their life, it causes the low percentage of denture used. Furthermore, social-demographic factors, knowledge, and economy also affect the motivation of someone to takes decision to get prosthetic care. The clinical situation as the region and the amount of tooth that loosedisturbs the mastication, phonetics, and also the aesthetic. The disruption also affect someone's motivation to get prosthetic care.¹⁰Motivation is a set or a group of behaviors that give base of someone to act in way to a specific purpose.Motivation shows up in two ways, there are extrinsic motivation that comes from other people influence, and intrinsic motivation that comes from our selves.¹¹. Someone's decision that lost his tooth to wear denture can be affected of motivational factors.

From that INTRODUCTION, writers want to know correlation between the patients' characteristics (gender, age, education) with partial edentolous ridgesand their motivation to use denture at RSGM, University of Jember.

MATERIALS AND METHODS

This research is analytical observation that use cross sectional approach. The subject of this research was determined by purposive sampling of the taking sample method. The amounts of sample are 106 patients from RSGM University of Jember with oral diagnose, on January until March 2016, with partial edentulous and the tooth root that left has indication of extraction on maxilla or mandible, gents or ladies, and state the agreement to take part of

this research and agree the inform consent. This research is done by the intra oral check and the questionnaire about motivation fulfilled. The patients' characteristics are about gender, age and education. Patients' motivation is patients' booster factor who lose their teeth to use denture. Their motivation divided into intrinsic and extrinsic motivation. Questions about intrinsic motivation consist of knowledge level and attitude of patients to use dentures, while the questions extrinsic motivation consist of economy, social class, and family support. Motivation divided into three classes, there are low motivated with 1-5 as the score, average motivated with 6-10 as the score, and high motivated with 11-15 as the score. This data will be analyzed with non-parametric statistic test with *Chi-Square Test* and *Rank Spearman*.

RESULT

This research is held in Oral Diagnose section at RSGM University of Jember, subjects of this research are new patients that get checked on Oral Diagnose section with *partial edountulus ridge* on January-March 2016 with the amount of subjects were 106 people. The result is right down below

Tabel 1. Subjects distribution based on gender

Gender	Frequency	Percent
Laki laki	55	51.9
Perempuan	51	48.1
Total	106	100.0

Tabel 2 .Subjects distribution based on age

Age	Frequency	Percent
15-24	32	30.6
25-34	11	10.4
35-44	21	19.8
45-54	31	29.2
55-64	11	10.4
Total	106	100.0

Tabel 3 . Subjects distribution based on education.

Education	Frequency	Percent
SD	27	25.5
SMP	11	10.4
SMA	48	45.3
Sarjana	20	18.9
Total	106	100.0

Motivation Description Use of Denture

Patient's motivation with partial missing teeth (partial edentulous ridge) to use denture to be measured using a questionnaire stating right or wrong in a sentence. In this study, the motivation was measured using a questionnaire with questions about the intrinsic motivation that statement the level of knowledge and attitude of patients to use dentures and extrinsic motivation namely from economic factors, social class, and environment push to use denture.

Table 4. Patient motivate distribution to use denture based on gender

Gender	Motivationcategory						Total		p value
	Low Count	%	Moderate Count	%	High Count	%	Count	%	
Man	15	14.2%	15	14.2%	25	23.6%	55	51.9%	.673
Woman	15	14.2%	17	16.0%	19	17.9%	51	48.1%	

Table 5. Patient motivate distribution to use denture based on education.

Education	Motivation category						Total		p value
	Low Count	%	Moderate Count	%	High Count	%	Count	%	
SD	12	11.3%	11	10.4%	4	3.8%	27	25.5%	.001
SMP	3	2.8%	3	2.8%	5	4.7%	11	10.4%	
SMA	11	10.4%	17	16.0%	20	18.9%	48	45.3%	
Bachelor	4	3.8%	1	.9%	15	14.2%	20	18.9%	

Table 6. Patient motivate distribution to use denture based on age.

Age	Motivationcategory						Total		p value
	Low Count	%	Moderate Count	%	High Count	%	Count	%	
15-24	10	9.4%	13	12.3%	9	8.5%	32	30.2%	.304
25-34	3	2.8%	7	6.6%	4	3.8%	14	13.2%	
35-44	2	1.9%	4	3.8%	10	9.4%	16	15.1%	
45-54	9	8.5%	5	4.7%	17	16.0%	31	29.2%	
55-64	4	3.8%	3	2.8%	4	3.8%	11	10.4%	

The gender table shows the distribution of low motivation to use dentures are 15 people that equal between man and woman (14.2%), while main motivation to use denture was the highest (25 people /23.6%). The education table shows that the secondary school education had the lowest motivation to use denture (3 people/2.8%), While the senior high school education motivation using denture was the highest (20 people /18.9%).

The age table shows that the 25-34 age had the lowest motivation to use denture (3 people/2.8%), while the 45-54age motivation using denture was the highest (17people/16.0%).

Analysis of the patients characteristic (gender) with partial tooth loss with motivation using a denture tested using Chi-Squaretestwith the result of $p = .673(p > 0.05)$. This did not show a significant correlation with patients' motivation to wear. Analysis of the patients characteristic (age) with partial edentulous ridge with motivation using a denture using Rank Spearman with the result of $p = .304(p > 0.05)$. This did not show a significant correlation with patients' motivation to use denture. Analysis of the patients characteristic (education) with partial tooth loss with motivation using a denture using Rank Spearman with the result of $p = 0.001(p < 0.05)$. This show a significant correlation with patients' motivation to wear..

DISCUSSION

According to Haggard in Bastable motivation was a psychological boost that drives someone to the various actions.¹² Someone would take action if he/she wanted to achieve his/her goals or needs. Motivation was a force that encourages a person to behave and active to achieve goals.¹³ Patients characteristics was a feature that's on the patient and owned by every patient that's different from other patients.

Data from patients with partial missing teeth were 106 people who check their teeth at the Oral Diagnosis in the RSGM Universitas Jember shows that the man had more motivation using denture than women (25 people/23.6%). The statistic test results shows there's no significant correlation between gender and motivation from using denture. The number of male patients with partial tooth loss was 55 people from 106 respondents. Lukacs, 2006 stated that the percentage of tooth loss is more common in women than men.¹⁴ The percentage of tooth loss was higher in women because women experienced a period of puberty, menstruation, and pregnancy resulted hormonal fluctuations, this resulted in the decreased salivary flow caused more cariogenic oral conditions. High caries incidence also increases the risk of tooth loss. Females in this study had higher number of tooth loss and earlier tooth loss compared to males.¹⁵ This shows that the percentage of tooth loss is more common in women than men, but in this study males had higher motivation to make dentures, however the analysis results of the relationship between gender and patients motivation using a denture with a statistical test Chi-Square tests had value of 0,521 which means greater than value of $p > 0.05$. This showed no relationship between gender and patients' motivation using denture. The need of denture is influenced by several factors such as health status, gender, social structure, the capability, the individual perception of the price of making the denture, the distance from home to the place of service and patient attitude towards the denture care.¹⁶

The patient motivate distribution based on education to use denture, undergraduate education had a high motivation to use denture (20 people/18.9%). On the analysis results of the relationship between education level and patients motivation using a denture with a statistical test of Rank Spearman correlation with the result of $p = 0.001$ which means smaller than the value of α ($p < 0.05$) showed a correlation between education level and patients motivation using dentures. Highly-educated respondents are more obedient to undergo treatment than less educated respondents.¹⁷ It's due to the highly educated respondents had higher knowledge of how to maintain their dental health than low-educated. A person's education level affects the health level of knowledge. The level of denture function knowledge will affect a person's attitude to use denture after the extraction.¹⁸ This attitude affects the motivation of the patient to determine the decision to use dentures. According to Muneeb, the lack of awareness due to poor educational level leads to poor level of motivation therefore resulting in bad oral hygiene and multiple saddle areas. The majority of our study population belonged to the primary education status, and most subjects in this group required more complete dentures. This is also the case for subjects with no education

or with secondary educational status. Subjects with higher educational status (university) needed more of partial dentures. Our study showed that the need for complete dentures decreased with increasing level of education ($p < 0.05$), hence the likelihood of retaining teeth in the mouth becomes higher as the educational level increases. This might be due to the fact that those with higher level of education are more informed about their health needs and may seek dental treatment earlier and more often than those of lower educational status who may only seek dental treatment when there is apparent morbidity.¹⁹

Patients motivate distribution to use dentures by age, 45-54 years of age had the highest motivation to use denture (17 people/16.2%). On the analysis results of the relationship between age and patients motivation to use dentures with statistical Rank Spearman had significance value of 0.46 which means greater than the value of α ($p > 0.05$) showed there is no relationship between age and patients motivation to use denture. In the range age 45-54 years old had higher motivation to use denture that possible because young age are more concerned in masticatory function or aesthetic function. According to World Health Organization, adult should have a minimum of 21 functional teeth to provide good dietary intake.²⁰ According to Dwairi the older age groups required more of removable complete dentures than the younger age groups who needed more of removable partial dentures.¹⁹ Tooth loss is a major clinical dental problem and it is considered an inevitable outcome of old age. It has been documented in the literature that age and missing teeth show a direct relationship.^{21,22}

CONCLUSION

From the results of research conducted at the Hospital Dental Jember University from January to March 2016, it can be concluded that there's no correlation between characteristics gender and age with patient motivation to use denture and there's a correlation between education level and patients motivation to use denture.

Description Of The Maxillary Residual Ridge Morphology Based On Classification For Complete Edentulism

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ABSTRACT

INTRODUCTION: Each edentulous patient has characteristics of oral tissues with different complexity degree. The complexity of treatment can be categorized using the classification of the complete edentulism with maxillary residual ridge morphology as the diagnostic criteria. **Objective:** The purpose of this research aimed to obtain a description of the maxillary residual ridge morphology based on classification for complete edentulism on edentulous patients visiting Dental Hospital, Padjadjaran University. **Materials and methods:** This research was a descriptive study with survey technique. The sample size was 35 people that collected using consecutive sampling. Morphological description of the patient's maxillary residual ridge was obtained by performing intra oral examination, and then be categorized using the classification for complete edentulism, Prosthodontic Diagnostic Index. **Result:** The result showed that edentulous patients visiting Dental Hospital, Padjadjaran University had the morphology of the maxillary residual ridge as much as 28,57% of type A, 34,29% of type B, 22,86% of type C, and 14,28% of type D. **Conclusion:** According to the result of the study, type B was the most common maxillary residual ridge morphology and be able to be treated by clerkship program students under the supervision of general dentists with experience in the field of Prosthodontics.

Key words: Maxillary Residual Ridge Morphology, Classification for Complete Edentulism, Prosthodontic Diagnostic Index

INTRODUCTION

The success of denture treatment is influenced by the support, stability, and retention of the denture.¹ A complete denture highly depends on the underlying tissues that support it. Soft tissue and hard tissue of mouth can help the denture to get support, retention, and

stability. Anatomy and quality of the underlying tissues are important factors in determining the success of denture treatment.²

After the tooth removed, alveolar bone will undergo a process of atrophy. Although there is a process of healing, the alveolar bone will not return to normal. Along with the growth of bone filling the empty socket, there is also a resorption process of the alveolar ridge both horizontally and vertically. This resorption process results in a narrower and shorter ridge.³ The smaller residual ridge reduces the denture supporting tissues, so that the denture becomes less stable and retentive. Along with the resorption of alveolar ridge, the stability of the denture will be more difficult to obtain. Residual ridge resorption after tooth loss complicates the denture treatment so the success is difficult to achieve.⁴⁻⁵

Edentulous patients cannot be classified as a single diagnostic group because of the significant variations among them.⁶ Clinicians should be able to determine the difficulty of every complete denture cases so that the success of treatment can be achieved.⁷ The American College of Prosthodontists (ACP) has developed a classification system for complete edentulism based on specific diagnostic criteria. The classification system, known as Prosthodontic Diagnostic Index (PDI), divides complete edentulism into four levels of difficulty or complexity: class I, II, III, and IV. Class IV designates patients who require the most difficult degree or complexity of treatment. PDI classification system is based on specific diagnostic variables: mandibular bone height, maxillary residual ridge morphology, mandibular muscle attachments, and maxillomandibular relationship. Residual ridge morphology is the most objective criterion for maxilla because measurement of the maxillary residual bone height by radiography is not reliable.⁷⁻⁹

Maxillary residual ridge morphology is divided into four types, namely type A, B, C, and D. Type A is more favorable than type B, both are residual ridge morphology that resists vertical or horizontal movement of the denture base. Type C offers minimal resistance to vertical or horizontal movement of the denture base. Type D does not resist vertical or horizontal movement of the denture base. Maxillary residual ridge morphology type A is the criterion of class I PDI, type B for class II PDI, type C for class III PDI, and type D for class IV PDI.⁸ The purpose of this research aimed to obtain a description of the maxillary residual ridge morphology based on classification for complete edentulism on edentulous patients visiting Dental Hospital, Padjadjaran University.

MATERIALS AND METHODS

This research was a descriptive study with survey technique. The population of this research was all edentulous patients visiting Prosthodontic Department of Dental Hospital, Padjadjaran University. The samples were all edentulous patients visiting Prosthodontic Department of Dental Hospital, Padjadjaran University within March to April 2015 who meet the criteria of samples taken by consecutive sampling. The samples were selected according to the following criteria: a man or woman who had lost their entire upper and lower teeth and were or would do a complete denture treatment; willing to follow the research procedures

and signed an informed consent. The variable of this research was the residual ridge morphology of edentulous maxilla.

After asking ethics requirements to the Ethics Committee at Hasan Sadikin Hospital Bandung, the edentulous patients visiting Prosthodontic Department of Dental Hospital, Padjadjaran University who fulfilled the criteria were selected as research respondents. The selected respondents were explained about the procedure and purpose of the research and asked to sign the informed consent. The respondents were invited to sit and relax in dental chair and asked about their identity, main complaint, dental care experience, and denture-wearing history, as listed in medical records. Mucosa of the maxilla was dried with cotton roll and the maxillary residual ridge morphology was observed and recorded. The results of this research were then evaluated by classifying the maxillary residual ridge morphology into the Prosthodontic Diagnostic Index with measurement as follows:⁸

Type A: (1) Anterior labial and posterior buccal vestibular depth that resists vertical and horizontal movement of the denture base; (2) Palatal morphology resists vertical and horizontal movement of the denture base. U-shaped palatal vault gives best retention and stability of the denture¹⁰; (3) Sufficient tuberosity definition to resist vertical and horizontal movement of the denture base; (4) Hamular notch is well defined to establish the posterior extension of the denture base; (5) Absence of tori or exostoses.

Type B: (1) Loss of posterior buccal vestibule; (2) Palatal vault morphology resists vertical and horizontal movement of the denture base; (3) Tuberosity and hamular notch are poorly defined, compromising delineation of the posterior extension of the denture base; (4) Maxillary palatal tori and/or lateral exostoses are rounded and do not affect the posterior extension of the denture base.

Type C: (1) Loss of anterior labial vestibule; (2) Palatal vault morphology offers minimal resistance to vertical and horizontal movement of the denture base. V-shaped palatal vault gives less retention of the denture¹⁰; (3) Maxillary palatal tori and/or lateral exostoses with bony undercuts that do not affect the posterior extension of the denture base; (4) Hyperplastic, mobile anterior ridge offers minimum support and stability of the denture base; (5) Reduction of the post malar space by the coronoid process during mandibular opening and/or excursive movements.

Type D: (1) Loss of anterior labial and posterior buccal vestibules; (2) Palatal vault morphology does not resist vertical or horizontal movement of the denture base. Flat shaped palatal vault gives no retention or stability of the denture.¹⁰; (3) Maxillary palatal tori and/or lateral exostoses (rounded or undercut) that interfere with the posterior border of the denture. Tori that extend the vibrating line interfere with the posterior border of the denture¹¹; (4) Hyperplastic, redundant anterior ridge; (5) Prominent anterior nasal spine.

The obtained data was then collected, processed, and presented in tabular form.

RESULTS

The research to 35 edentulous patients visiting Dental Hospital, Padjadjaran University showed results as follows:

Table 1. Description of the Maxillary Residual Ridge Morphology

Residual Ridge Morphology	Characteristic	Total
Buccal Vestibule	Present	33
	Lost	2
Labial Vestibule	Present	35
	Lost	0
Palatal Vault	U-Shaped	30
	V-Shaped	0
	Flat-Shaped	5
Tuberosity	Defined	16
	Poorly Defined	19
Hamular Notch	Defined	18
	Poorly Defined	17
Tori	Absent	30
	Present, No Undercuts, Not Affecting the Posterior Extension of the Denture Base	5
	Present, With Undercuts, Not Affecting the Posterior Extension of the Denture Base	0
	Present, With Undercuts, Affecting the Posterior Extension of the Denture Base	0
	Absent	26
	Present, No Undercuts, Not Affecting the Posterior Extension of the Denture Base	4
Eksostosis	Present, With Undercuts, Not Affecting the Posterior Extension of the Denture Base	5
	Present, With Undercuts, Affecting the Posterior Extension of the Denture Base	0
	Not Hyperplastic	29
Anterior Ridge	Hyperplastic and Mobile	2
	Hyperplastic and Redundant	4
Post Malar Space	No Reduction	33
	Reduction	2
Anterior Nasal Spine	Not Prominent	35
	Prominent	0

Table 2. Description of the Maxillary Residual Ridge Based on Classification for Complete Edentulism

Morphology	Male	Female	Total
Type A	3	7	10
Type B	8	3	12
Type C	4	4	8
Type D	4	1	5
Total	20	15	35

Table 3. Description of the Maxillary Residual Ridge by Age Group

Morphology	Age Group (Year)				Total
	35-44	45-54	55-64	≥ 65	
Type A	3	1	4	2	10
Type B	1	6	3	2	12
Type C	1	2	2	1	6
Type D	0	2	2	1	5
Total	5	10	12	8	35

Table 4. Description of the Maxillary Residual Ridge by Period of Edentulism

Morphology	Period of Edentulism				Total
	< 1 Year	1-5 Year	6-10 Year	> 10 Year	
Type A	4	3	2	1	10
Type B	3	7	2	0	12
Type C	3	3	1	1	8
Type D	2	2	1	1	6
Total	11	15	6	3	35

Table 5. Description of the Maxillary Residual Ridge by Denture-wearing History

Morphology	Denture-wearing History		Total
	Yes	No	
Type A	8	2	10
Type B	5	7	12
Type C	5	3	8
Type D	4	1	5
Total	22	13	35

DISCUSSION

The maxillary residual ridge morphology is influenced by several components. One of them is the vestibule. The depth of the vestibule is important for the extension of denture base, stability, and retention of a denture.¹² After the tooth extracted, there is resorption of alveolar bone so that the depth of the vestibule decreases and complicates the manufacture of denture. Loss of vestibule usually needs a surgery procedure to increase the depth of the vestibule before denture treatment. Loss of buccal vestibule is more common than loss of labial vestibule because posterior teeth are usually removed earlier than anterior teeth so that the posterior part undergoes process of resorption more than the anterior part.¹³

On examination of the palate, the majority of patients had U-shaped palatal vault which is ideal for denture retention and stability. This research found no V-shaped palatal vault, but found some of flat-shaped. Flat palate complicates the manufacture of denture because the stability, support, and retention are difficult to obtain.¹⁰ Patients with flat palate are classified as maxillary residual ridge morphology type D, which is the most difficult in denture treatment. This condition will get worse with the loss of vestibule.

The research found some patients having poorly defined tuberosity and / or hamular notch. It was usually found in patients with low depth of the vestibule. Tuberosity tends to be more resistant to the resorption compared to alveolar ridge, but tuberosity still experiences resorption and may results in reduced of ability to resist the movement of the denture. Poorly defined hamular notch complicates the determination of the posterior border of the denture. Excessive alveolar bone resorption causes changes of hamular notch.²

Some patients had poor quality of tuberosity due to loss of bone after tooth was extracted. Periodontal tissue infections cause sclerosis of the bone so tuberosity can easily fracture when extracting the tooth. Therefore the tuberosity could not resist the movement of the denture so the stability is difficult to obtain.¹⁴

Most of the respondents had neither maxillary tori nor exostosis. Some of respondents had tori or exostosis which location did not affect the denture, but some of them had undercut area on the eksostoses. Undercut area on tori and exostoses can interfere in insertion of the denture so the surgery procedure is needed.⁷

Hyperplastic and mobile ridge are commonly caused by irritation of ill-fitted denture.^{7,12} Denture supporting mucosa inflames and fibrous tissues proliferate, in severe condition, the tissues would seem redundant.¹² If possible, surgery was usually performed to obtain the stability of the denture, but could also be managed by proper impression technique.¹⁵

Impression technique for anterior portion of the hyperplastic tissues is done by mucostatic non pressure impression followed by selective pressure impression for other

stable portion of the mucosa.¹⁵ This impression technique requires skilful operator so not everyone can handle cases with hyperplastic tissues. Cases with hyperplastic tissues are the criteria for maxillary residual ridge type C and D, and the cases should be handled by prosthodontists.⁷ In this research, 6 patients had mobile or redundant hyperplastic tissues. These patients were found in cases handled by residents of prosthodontic program.

On inspection of post malar space, there were 2 people whose space were reduced when opening mouth. Examination of post malar space should be done at the initial examination of denture treatment. In patients with no reduction of post malar space, the denture base must be extended to this area for the best retention. However, in patients with post malar space reduction, border molding procedures should be done by moving the mandible forward and laterally.¹⁶ The denture treatment for patients with reduction of post malar space is more difficult and should be handled by prosthodontists.

Maxillary residual ridge undergoes the resorption with upwards and backwards direction. However, the ridge area of anterior nasal spine tend to not experience resorption process.¹⁷ Therefore, in patients with severe alveolar ridge resorption, the anterior nasal spine tends to be more prominent. In this research, no patient was found with prominent anterior nasal spine.

According to the result of the study, type B was the most common maxillary residual ridge morphology, followed by type A, C, and D. Maxillary residual ridge morphology type A and B had adequate and favorable anatomy structure so the treatment could be done by clerkship program students in Dental Hospital, Padjadjaran University. Maxillary residual ridge morphology type C and D were more difficult to handle, therefore the denture treatment should be done by prosthodontic residents in Dental Hospital, Padjadjaran University.

Maxillary residual ridge morphology type B had less favourable anatomy structure compared to type A so the denture treatment of this type was more difficult than type A. According to Morris⁷, type A can be treated by almost all dentists, while type B should be treated by general dentists who have experience in treating cases of complete dentures. Therefore, edentulous patients with maxillary residual ridge morphology type B in Dental Hospital, Padjadjaran University might be treated by clerkship program students under the supervision of general dentists with experience in the field of Prosthodontics.

Difficulty of denture treatment in patients with maxillary residual ridge morphology type B is caused by the loss of buccal vestibule, the presence of tori or exostoses without undercut and does not interfere in insertion of the denture, and poorly defined tuberosity or hamular notch.⁸ This research found that a lot of patients had shallow buccal vestibule depth due to resorption, and many poorly defined tuberosity and hamular notch. Poorly defined tuberosity and hamular notch add the difficulty of denture treatment because those two are important in determining extension of denture base so the stability and retention of the denture were difficult to obtain.^{2,8}

Tori or exostoses was found in some patients with maxillary residual ridge morphology type B. Fortunately, the tori or exostoses had no undercut and did not interfere in extension or insertion of the denture so the surgery procedure was not needed. The denture treatment

is not too difficult compared to cases when tori or exostoses found to have some undercut areas or interfere in insertion of the denture, which is the criterion of maxillary residual ridge morphology type C or D.⁸

Difficulty of denture treatment is determined by quality of underlying tissues that was affected by resorption process.¹⁸ PDI Classification in determining the difficulty of denture treatment is related to the severity of ridge resorption.¹⁹ Alveolar ridge resorption is affected by multi factors, such as sex (gender), age, period of edentulism, and history of denture wearing.²⁰

Residual ridge resorption occurs faster in women. This is possibly due to the size of jaw which is smaller in women than in men. Women who are in post menopause period experience deficiency of estrogen, so that loss of bone and alveolar ridge resorption occurs faster.²¹ However, this research had different results. Most of male patients had maxillary residual ridge morphology type B, whereas the majority of female patients had morphology type A. This deviation might be caused by lack of respondents so the research had not obtained the description that fitted the theory.

Alveolar ridge resorption is affected by age. Older edentulous patients tend to have more severe resorption than younger edentulous patients so the treatment needed is more difficult.²⁰ However, other study²¹ had shown that there were no relation between alveolar ridge resorption and age of the patient. This research showed that every age group had various type of maxillary residual ridge morphology. Most patients aged 35-44 years, 45-54 years, and 55-64 years had fair maxillary ridge morphology, while the majority of patients aged over 65 years had poor morphology.

The severity of residual ridge resorption is affected by period of edentulism. Several studies found that patients who were edentulous longer had more severe bone loss than those who were just edentulous. Denture wearing affects resorption process. Studies had shown that patients who wearing denture more often or longer had more severe bone loss. History of denture wearing and oral hygiene has some impact to the severity of alveolar ridge resorption.²²

However, several studies had shown that there were no correlation between period of edentulism and alveolar ridge resorption. Severe alveolar ridge resorption was only experienced by patients with ill-fitting denture.²² This research found that the description of maxillary residual ridge morphology by period of edentulism and denture wearing history showed some variation. The variation might occur because the alveolar ridge resorption process was a complex process, which was affected by multi factors, such as nutrition, hormone, medicine intake, age, gender, size of ridge after tooth extraction, use and quality of denture.²²

PDI classification system for complete edentulism can be served as a guide in choosing edentulous cases which are appropriate and in accordance with the competence of the operator. In dentistry school, this classification system can be used as a guide selecting the proper cases to be done by clerkship program student and residents of Prosthodontic.⁹ However, some of the criteria listed in this system are subjective, so standardization is needed. Each listed criterion should be explained and detailed.

The authors found difficulty in determining the type of maxillary residual ridge morphology in patients with characteristics that meet the criteria of some types of morphology. McGarry⁸ has stated that in those instances when a patient's diagnostic criteria are mixed between two or more classes, any single criterion of a more complex class places the patient into the more complex class. Therefore, the authors decided to classify the patients according to the finding of anatomical characteristics of a more complex group.

CONCLUSION

Based on the results of this research and the discussion about the description of maxillary residual ridge morphology based on classification for complete edentulism, it could be concluded that: type B was the most common maxillary residual ridge morphology found in edentulous patients visiting Dental Hospital, Padjadjaran University, and be able to be treated by clerkship program students under the supervision of general dentists with experience in the field of Prosthodontics.

ACKNOWLEDGEMENT

The authors wish to thank all staff and residents of Prosthodontics, students of Faculty of Dentistry, Padjadjaran University for their contributions to this research.

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One Piece Dental Implants Treatment For Narrow Edentulous Space Rehabilitation

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ABSTRACT

Advanced technology in implantology provides convenience in implant placement, variety of prosthetic options and cost effective. A form of dental implant option which abutment and implant tooth served as one entity is called one piece implant. Advantages of one piece implant are less surgical discomfort and efficient for narrow edentulous space. It is a case report of surgical treatment using one piece dental implant performed in patient with narrow edentulous space. a 22-years old female patient came with chief complaint of upper right canine positioned out of the dental arch causing space between lateral incisor and first premolar. She wanted aesthetic rehabilitation in a short period of time. No significant systemic condition observed. At the first appointment we assessed OPG view of patient and set treatment plan such as extraction of element 13, preliminary treatment, informed consent and finally decided to use one piece implant form as space measurement between element 12 and 14 is as narrow as 6 mm. Next appointment we performed implant operative surgery. Following 5 days of antibiotic, analgesic and mouth wash. After one month healing PFM crown was cemented as the final restoration. There was no complaint and no complication following the implant treatment. Patient was satisfied with the result. One piece implant and PFM crown provides optimum aesthetic and functional rehabilitation for patient with narrow edentulous space.

Keyword: one piece implant, narrow edentulous, surgical treatment

INTRODUCTION

Tooth loss not only causes difficulties in mastication and oral hygiene maintenance, but also psychologically discomfort in some patients, especially those who often speak in public, considering aesthetic factor is important. For this reason, most patients want to replace the missing tooth even if it is only one tooth.¹

Nowadays, dental implant technology is growing so implant placement procedure

is getting more simple, option for prosthetics be more various, and cost relatively more affordable. Those are the main reasons for dentists to recommend dental implant as the best treatment for replacing the missing tooth. Dental implant provides various advantages regarding to stability and convenience compared to dentures.²

Dental implants available in market are one piece (the abutment and the implant are fused) and two pieces (the implant and the abutment are separate). Two pieces dental implant placement procedure is usually more complicated than one piece, and requires twice surgical procedure. Two pieces dental implant always has microgap at the abutment – implant junction that potentially leads to complication. In this case, one piece dental implant design considered as superior over the two pieces design.³ One piece dental implant design be popular in recent years. In one piece dental implant, the abutment and the implant are fused as an integrated piece. In this type, implant is inserted into the bone, and the abutment is placed on gingival (non submerged). While in two pieces dental implant system, implant is inserted into the bone and placed under gingival (submerged), this system requires second surgical procedure to place the abutment.⁴ It is a case report of surgical treatment using one piece dental implant performed in patient with narrow edentulous space.

CASE REPORT

Female patient aged 22 years, came to Dental Clinic Malang with chief complaint of ectopically erupting upper left canine tooth, so there was space between the lateral incisor and the right maxillary first premolar. Patient aimed to do aesthetic incisor improvement in short time due to admission test requirement in an institution.

Intraoral examination found that condition of tooth #13 was malpositioned and erupted on buccal side of tooth #14, #15. There was edentulous ridge between tooth #12 and #14 with width of edentulous space as 6 mm. General condition of patient was good and no medical history of any case management.



Figure 1. Patient's initial condition



Figure 2. Patient's panoramic radiographic image



Figure 3. Condition of extracted tooth #13

Panoramic radiographic examination findings were curved root tooth #13 and impacted tooth #38, #48. No abnormalities have been found in examination of soft tissues, texture, consistency and depth of gingiva, with Angle's class I malocclusion. On the first visit, initial treatment was carried out i.e scaling, and followed by explanation to the patient regarding to alternative of treatment. In order to fill space between teeth #12 and #14, dental implant treatment was chosen to replace tooth #13. The distance between distal side of tooth #12 and mesial side of tooth #14 measured as 5 mm. considering the narrow size of edentulous space, the type of implant to be used was one piece dental implant with its small diameter thus suitable to the condition of available edentulous space.

CASE MANAGEMENT

On the second visit, we performed continued initial treatment before implant placement, i.e extraction of malpositioned tooth #13 and creation of flap to cover defect that appeared after extraction, started with aseptic procedure on extra oral work space using cotton and povidone iodine 70%, and intraoral work space using cotton and povidone iodine 10%. After that, topical anesthesia was applied on mucogingival junction space followed by local anesthesia with syringe. After anesthesia effect was achieved, flap was

then performed using scalpel no.15, so buccal bone was opened above tooth #14 and #15. After malpositioned tooth #13 successfully extracted, in order to prevent post-extraction defect, so 2 grams of bone graft was added into the socket and covered again with flap that had been created, then it was sutured for flap fixation.

Next step was operative treatment of implant placement. The diameter was 3 mm, and length was 10 mm. Positioning of implant was carried out with local anesthesia. Surgical template as a guidance was positioned and drilling was performed until the required size was achieved. After that, surgical template was detached and one piece implant was inserted into the intended depth. Torque value used in this case was 30-35 N.cm. Then flap was stitched up with interrupted suture around the neck of implant.

During five days after surgery, patient was given antibiotic and analgesic, and instructed to gargle the mouthwash containing chlorhexidine 0.12%. After seven days of implant placement, up hecting was carried out followed by abutment preparation to create temporary crown made of acrylic. Impression was carried out using elastomeric material. After 1 month healing period of soft tissue, temporary crown was detached and abutment preparation was done to create permanent crown, and final impression was made using silicon (polysiloxane)-based impression material. After the creation process of porcelain-fused-to-metal permanent crown was done, glass ionomer cement was inserted.



Figure 4. Condition after placement of one piece dental implants



Figure 5. Condition of one piece dental implant after up hecting



Figure 6. Condition after placement of artificial crown #13

DISCUSSION

Conventional theory stated that using standard size or wide-diameter implant is important to ascertain adequate contact between bone and implant. It has been reported that space between implant and adjacent tooth is at least 1.25 mm, which space of 0.25 mm is used for periodontal ligament while 1 mm is used for bone in order to ascertain appropriate amount of blood supply required in osseointegrated implant. One piece dental implant is alternative treatment of choice in limited anatomy case which mesiodistal space between two adjacent teeth is inadequate (< 6 mm) to place conventional implant with the smallest diameter (3.75 mm). Particularly, one piece implants are indicated in replacement of teeth with small cervical diameter and for the case which there is reduced interradicular bone.⁵

Surgical protocol in implant placement process includes surgery with or without flap. Flapless surgery will prevent detachment of periosteum from soft tissue, thus blood supply on marginal bone could be maintained. This could decrease the risk of bone resorption. Flapless surgical procedure has advantages such as decreased risk of post-operative haemorrhage, increased patient's comfort, short duration of surgery, and shorter duration of wound healing compared to flap surgical technique. In case of implant, flapless surgical technique could be performed if bone morphology is in good condition, and no need of correction of hard and soft tissues.⁶

Unlike standard / conventional implant, one piece implant has smaller diameter and allows direct placement of temporary crown. This type of implant only requires bone drilling by one-third to one-half of the total length of implant, and will be tightly bound to the bone, thus integration could be formed quickly. Some advantages of one piece dental implant include less of hemorrhage, reduced post-operative discomfort, shortened healing time, placement to narrow edentulous space, and direct placement of temporary crown.⁷

Option of management in this case had been informed to patient regarding to alternative treatment for her condition, such as option to perform orthodontia treatment in order to replace the malpositioned tooth #13 to the right position, or tooth replacement with dental bridge, but due to consideration about limitation of time and expectation related to a better aesthetic appearance, so treatment using dental implant was a choice to replace the tooth #13.

Dental implant itself nowadays is a popular choice to replace the missing teeth, and in this case we found a narrow edentulous space that not allowed to use conventional dental implant with large diameter and structure. Based on this condition, one piece dental implant was chosen which suitable for situation mentioned earlier.

The advantages of using one piece dental implants are aesthetic and functional rehabilitation, shorter time of work procedure, minimum armamentarium, minimum damage in adjacent tissues, a preferred option to use in narrow space for conventional implant could not be used, and more affordable cost.^{8,9} Since technique of small drill is used, prevention of adjacent tissue damage and immediately aesthetic rehabilitation are possible to achieve. One piece dental implants obviously have better advantages over conventional dental treatment protocol to place the minimum space.

Management of edentulous space in patient with missed tooth requires a thorough planning and should be in accordance with multidisciplinary approaches. A successful implant depends on the availability of adequate tissue dimension and primary stability that securely achieved.¹⁰ In such situation that aesthetic and functional need are required and challenging as on missed anterior teeth and smaller diameter, the availability of edentulous space from orthodontic treatment result or remaining space of conventional implant replacement, so dentists need to plan the most appropriate procedure of alternative treatment regarding to the situation. In this case, one piece dental implants could provide satisfied result.

One piece dental implants are more limited and could not change the type of abutment, thus for anterior area with thin gingival may lead to aesthetic complications. Unlike the two pieces that could use zirconia for abutment. Moreover, in one piece dental implants, it is difficult to do adjustment of abutment angle as we could do in two pieces, consequently sometimes we need surgical approaches such as bone graft, alveolar ridge expansion and/or alveoplasty to improve the width of alveolar ridge.^{10,11}

Mucogingiva correction in one piece dental implant is directly carried out at the time of implant placement, e.g with apically-repositioned flap. In two pieces, the second surgery is actually needed to place the prosthetic, but it provides a special advantage that at the time of the second surgery is carried out, several of soft tissue manipulations to improve aesthetic could be done such as rolled flap.¹² In terms of prosthetic placement, one piece dental implants are simpler. There is no need healing abutment and creation period of emergence profile as in two pieces. In one piece dental implants, after 3 months it could directly impressed and crown could be made in laboratory. In terms of impression, one piece implants could only be carried out using closed tray method with simple copings. It is contrast to two pieces implant. Even though it requires some additional accessories and seems more complex, but two pieces implant could be impressed well using open and closed tray method.^{13,14}

Patient's acceptance of treatment and solution of rehabilitation using one piece dental implants with thorough treatment plan and minimum invasive surgical technique was very good. A good clinical result was obtained with no signs of bone resorption or infection or rejection of implant due to other causes. The good stability level of dental implant and bone

together with good aesthetic result and soft tissue showed that one pieces dental implant is appropriate treatment of choice.

CONCLUSION

Most of one piece dental implants have small diameter, thus very suitable to replace the narrow edentulous space. It is particularly recommended in placement on anterior region with minimum masticatory forces and maximum aesthetic need. Placement procedure of one piece dental implant is more simple due to requires only one surgical process and its restoration could utilize immediate loading technique.

ACKNOWLEDGMENT

We would like to thank Bobby Ardhya Susetyo, drg. for his assistance during operation procedure.

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The Radiograph Fourth Molars Mandibular Impaction (Case Report Patients in The City of Tasikmalaya)

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ABSTRACT

Supernumerary teeth of fourth molars can be found in the region of the maxillary or mandibular posterior. They are classified according to their shape and location. Further clinical problem can occur when it is found on both jaw the right and left. Detection of Supernumerary fourth molars is difficult because rare, found by chance when there are complaints in patients in private clinic in city of Tasikmalaya on one women with bad Oral Hygiene and several caries at first molars. Patients present with symptoms of TMD. The purpose of this paper is to analyze of root defect between fourth molars and third molars to detect the risk factors occurrence of the resorbtion, cyst and pericoronitis. Thorough clinical and radiographic examination of the patient is required for comprehensive treatment plan. This article presents an overview of the clinical problems associated with supernumerary fourth molars, also on the classification, diagnosis and management.

Keywords: Fourth molars, risk factor, diagnosis, management

INTRODUCTION

Supernumerary structures occurring in molar region can be divided into paramolars and distomolars.¹ Fourth molars or distomolars are situated distal to the third molars, they have a rudimentary shape and are usually seen as impacted teeth.² Supernumerary molars occur more frequently in the maxilla i.e., 79.7% and often were impacted (88.7%) and found bilaterally (23.9%)³⁻⁴ The etiology of supernumerary teeth has not been yet completely clarified and various theories have been suggested relating this anomaly such as hereditary disorders, horizontal proliferation of the dental lamina, and abnormal embryological formation. Environmental factors may also have a role.⁴ Paramolar is usually small and dysmorphic supernumerary tooth located buccally or palatally/lingually to one of the molar series. Distomolars are located distal or distolingual to third molars.¹ Paramolars are relatively uncommon supernumerary anomalies occurring in molars series with prevalence of 0.09–0.29%.⁵ Exact mechanism of their development is still unclear but various factors such as genetic and environmental factors have been proposed. According to dichotomy theory supernumerary teeth such as paramolar arise from third tooth bud arising from dental lamina near permanent tooth bud or possibly by splitting of permanent bud itself. According to theory of phylogenetic reversion, paramolars may be an atavistic appearance of fourth molar of primitive dentition. Hyperactivity theory is the most acceptable one. It states that supernumerary teeth such as paramolars are result of local, independent conditional hyperactivity of dental lamina. According to this lingual extension of additional tooth, bud gives supplemental or eumorphic tooth. Rudimentary form arises from proliferation of epithelial remnants of dental lamina induced by presence of complete dentition.⁵⁻⁶ In the literature, one can find various theories of A rare case of retained fourth molar teeth in maxilla and mandible. hyperdontia, namely atavistic, vascular, genetic (hereditary) and hyperdontia of dental lamina hyperfunction. An atavistic theory holds that the occurrence of supernumerary teeth is the return to the teeth pattern of primitive higher mammals/eutheria with dental formula 3143 and having 44 teeth. It should be noticed though that the primitive dental formula includes neither supernumerary canine nor distomolars – retromolars. A vascular theory explains the occurrence of supernumerary teeth in the front part of the maxilla. The authors of this theory assume that such a location is related to the survival of a sphenopalatine artery that should have disappeared along with embryonic development of a specimen. According to a genetic theory, supernumerary teeth result from activation of genetic information that was deactivated in the process of evolution. The occurrence of atavistic forms in humans indicates that genetic information, contained in DNA, may be latent across many generations and is activated by the organism in specific and favourable circumstances. An inheritance theory says about familial occurrence of hyperdontia. Such a thesis is a subject of many suggestions that assume autosomal dominant inheritance and autosomal recessive inheritance either X-linked or polygenic. A view on inheritance connected with sex was proved by observations of many authors who noticed more frequent occurrence of hyperdontia in boys. The concept of hyperfunction of dental lamina assumes

that after a normal number of teeth buds supernumerary teeth appear. Dental lamina that did not undergo the process. The local factors such as inflammatory processes, scarring, pressure and injuries may be the causes of dental lamina hyperfunction.⁷⁻¹⁰

CASE REPORT

Patient female, age 22, attended clinical practice with feel pain in the lower right tooth region, the patient did not report any systemic alteration. The panoramic radiograph (figure 1) showed the teeth #18, #28, #8 and #48 retained, and the presence of the fourth molars retained distally to the teeth #18 and #28 (figure 2). The radiographic picture looks a resorption on the roots of molar teeth 18 and 38. The radiographic picture looks a resorption on the roots of molar teeth 18 and 38. The resulting of considerable pressure towards mesial.

DISCUSSION

Supernumerary structures occurring in molar region can be divided into paramolars and distomolars.¹ Fourth molars or distomolars are situated distal to the third molars, they have a rudimentary shape and are usually seen as impacted teeth.² Supernumerary molars occur more frequently in the maxilla i.e., 79.7% and often were impacted (88.7%) and found bilaterally (23.9%).³⁻⁴ The etiology of supernumerary teeth has not been yet completely clarified and various theories have been suggested relating this anomaly such as hereditary disorders, horizontal proliferation of the dental lamina, and abnormal embryological formation. Environmental factors may also have a role.¹¹ Paramolar is usually small and dysmorphic supernumerary tooth located buccally or palatally/lingually to one of the molar series. Distomolars are located distal or distolingual to third molars.¹ Paramolars are relatively uncommon supernumerary anomalies occurring in molars series with prevalence of 0.09–0.29%.⁵ Exact mechanism of their development is still unclear but various factors such as genetic and environmental factors have been proposed. According to dichotomy theory supernumerary teeth such as paramolar arise from third tooth bud arising from dental lamina near permanent tooth bud or possibly by splitting of permanent bud itself. According to theory of phylogenetic reversion, paramolars may be an atavistic appearance of fourth molar of primitive dentition. Hyperactivity theory is the most acceptable one. It states that supernumerary teeth such as paramolars are result of local, independent conditional hyperactivity of dental lamina. According to this lingual extension of additional tooth, bud gives supplemental or eumorphic tooth. Rudimentary form arises from proliferation of epithelial remnants of dental lamina induced by presence of complete dentition.⁵⁻⁶ In the literature, one can find various theories of A rare case of retained fourth molar teeth in maxilla and mandible. hyperdontia, namely atavistic, vascular, genetic (hereditary) and hyperdontia of dental lamina hyperfunction. An atavistic theory holds that the occurrence of supernumerary teeth is the return to the teeth pattern of primitive higher mammals/eutheria with dental formula 3143 and having 44 teeth. It should be noticed though that the primitive

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CASE INTERPRETATION

Detection of Supernumerary fourth molars found by chance when there are complaints in patients in private clinic in city of Tasikmalaya on one women, age 20 years old. In this case, for interpretation we were helped by Drg. Fahmi Oscandar, M.Kes. SpRKG from Departement of Oral Maxillofacial Radiology, Faculty of Dentistry, Padjadjaran University, Bandung, Indonesia.



Fourth Molars in Right Maxillary and Mandible

PANORAMIC RADIOGRAPHS INTERPRETATION	
Data Interpretation	
Area 1 (Dental Teeth)	
Missing teeth / Agenesis	-
impaction	18 position vertical, 38 horizontal, 48 vertical position, supernumerary teeth in the distal 18 vertical position, supernumerary teeth in the distal 48 horizontal positions, 25 labioversion position in region 24.
Crown condition	Radiolucent of enamel until pulp chamber 16, radiolucent of enamel until near the pulp chamber 36;
conditions roots	18 have 3 root , dilaseration toward the distal at half root, 2 root in 38, straight, apical part superimposed with the mandibular canal; 2 root of 48, straight, root superimposed with mandibular canal; supernumerary teeth 18 distal roots not fully formed; single root in 25, straight.
Alveolar condition Crest-furcation	3 mm horizontal decline in the region 15-17, 34-37, 46-47
Periapical conditions	Diffuse radiolucent 16
Area 2 (maxillary)	
Area 3 (mandible)	
Area 4	
Shape: Condyle-Fossa	condyle head shape, right and left is ovoid
Eminence	
Located of Condyle	on the glenoid fossa
Area 5 (Ramus)	
within normal limits	
Impression	
Abnormalities in the region of 1 and 4	
Suspect radiodiagnosis	16 Periapical abscess 36 reversible pulpitis Impaction type B is characterized by a vertical 18 toward the mesial root dilaseration Class IIA impaction horizontal 38 Class IIIC impaction vertical 48 Fourth molar vertical impaction in the distal part 18 Fourth molar horizontal impaction in the distal part 48 25 labioversi in region 24

CONCLUSION

From the results of the above interpretation we had some data to create narrative and conclusions as below. The conclusion that we made just concentrated discusses fourth molar only. Most of supernumerary cases are retained, so that the diagnosis is through routine radiographs. The early diagnosis and treatment are important to prevent problems, such as crowding, eruption failure, tooth displacement, damaging to alveolar bone grafts and implants, associated pathologies, gingivitis, abscesses, and odontogenic cysts and tumors. Treatment should be tailored according to each case. For the patient of this case report, surgical treatment was referred to the surgical surgery , so that both the third and fourth molars did not interfere in tooth movement. All characteristics were favorable for surgical intervention because patient did not exhibit contributory diseases.

The authors recommend: The presence of fourth molars as well as the risks and benefits of extraction versus observation should be discussed with the patients and an individualized treatment plan should be fabricated.

The authors comment that the fourth molars have a possibility of being displaced in

the infratemporal fossa or the maxillary sinus during surgery and note that this is more likely to occur if the bone distal to the fourth molars is thin. (Note these are known complications of wisdom teeth removal as discussed on the complications page (<http://www.teethremoval.com/complications.html>) The authors of course recommend that each patient should have a panoramic x-ray and/or computerized tomography performed.

The authors also say it is even possible to remove a third molar (wisdom tooth) and leave the fourth molar in place which may allow the fourth molar to migrate down and after some time (a few years) a safer extraction can be performed.

Of course the risks of leaving a fourth molar are similar as leaving a third molar (wisdom tooth) for observation (http://www.teethremoval.com/risks_of_keeping_wisdom_teeth.html) Below I have added the panoramic radiographs that are in the journal article and I have added some labels for the fourth molars. Looking at these x-rays removing a fourth molar appears to be even more risky than removing a third molar (wisdom tooth), so hopefully you are fortunate enough to not have a fourth molar.

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Description of Mandible Density in Patients with Type 2 Diabetes Mellitus using Panoramic Radiograph

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ABSTRACT

Introduction: Type 2 diabetes mellitus is the systemic disease that can cause the decrease of bone density. Bone density can be seen with the trabecular form which composed by bone and marrow. Some equipment to assess is panoramic radiograph. The aim of this study was to describe the mandibular bone density in patients with type II Diabetes Mellitus using panoramic radiographs. **Material and Method:** The descriptive research design was done. The population of this study is all panoramic radiographs of patients with type 2 diabetes mellitus at Dental Hospital. The samples consisted of 20 women and 20 men, aged 25-55 years. The examination was conducted by calculating the percentage between bone and marrow in two areas, the head of condyles and the angulus of mandible. **Result:** The results showed that percentage of bone in the head of condyles both in man and women has same value is 23%, but in the angulus area, men has lower value at 22.82%, while women 23.2%. **Conclusion:** The density of the mandible in patients with type 2 Diabetes Mellitus in the head of condyle both men and women have the same value, while at the angle, the man lower than women.

Keyword: Density of mandible, Tipe II Diabetes Mellitus, Percentage of bone and marrow

INTRODUCTION

Diabetes mellitus is a metabolic disease which can cause metabolic disturbances and cause damage the body tissues.¹ Diabetes mellitus type-2 or type-2 diabetes previously known as adult-onset diabetes in the form of a metabolic disorder characterized by high blood glucose in the context of their resistance insulin and relative insulin deficiency. In the United States found 23.6 million people with diabetes mellitus and it turned out 17.9 million or approximately 7.8% of all diabetics are type 2. It also happened in Indonesia, since the beginning of this century, Indonesia has become the country with the number of patients with diabetes mellitus type 2. Based on WHO epidemiological study was conducted at 1999 in Indonesia, in the case of diabetes mellitus ranging from 1, 5% - 2.3%, and 90% are type 2 diabetes mellitus.^{4,5,6}

Determination of the jaw bone density is very important, especially for the diagnosis, treatment planning, treatment progress as viewed on implant osseous integration, or the success of periodontal treatment. Assessment of the decline in the quality of bone can be affected by systemic conditions^{7,8,9,10,11}. There are number systemic diseases that lead to decreased bone density, as well as diabetes mellitus (DM). Diabetes mellitus can affect bone mineral formation due to obesity and hyperglycemia¹². Albright and Reifstein in 1948 first reported that, there has been a decrease in bone density in people with diabetes. The same thing has been said by other researchers, who expressed the same^{13,14,15, 16, 17,18, 19}. Value of bone mineral density (BMD) in patients with type 2 diabetes, according to a recent study showed a decrease in bone density the radius bone and mandible earlier this does not occur in the spine and femur²⁰. The relationship between bone mineral density (BMD) and type 2 diabetes mellitus has been controversial. In same study, The patients with type 2 diabetes no significant different from non-diabetic patient, while the outhter study said, at mellitus type 2 patient had lower density between non diabetic.^{1,22,23,24}. Same study have been reports that the hyperglycaemic medications on diabetic patients can cause increasing the bone density and make the risk of fractures.^{25,26,27}.

Bone density can be defined a number of bone tissue in a unit volume and length. Volume jaw bone mostly composed of trabecular. The density of the trabecular density can be regarded as a whole and bone²⁸. Panoramic radiograph is a radiograph of the most commonly use in the dentist's. This is used by the researchers to determine the level of bone density, especially in the mandible. Many studies using panoramic radiographs especially to assessing same thing. This can be done to assess bone density and microstructure macrostructure. Macrostructure can be assessed by looking at the cortical bone and alveolar bone, while the microstructures that can be evaluated through the trabecular²⁹. Research on trabecular pattern has been done on patients with a history of systemic disease, trabecular density seen by the presence and thickness of hard tissue such as bone nets which restrict the marrow cavity or often called trabecular nets³⁰. Shimamoto in 2007, said that the trabecular bone have relatively higher metabolic rates up to 5-8 times compared with cortical bone, so the bone in case of a decrease in bone density, the bones become

fragile and break easily. However, trabecular bone to support a minimum amount of material though 31. Each of systemic diseases have different characters, such as osteoporosis, diabetes mellitus, steroid users, people with tuberculosis and other diseases can be seen a decrease in bone quality when we review of trabecular pattern ³².

MATERIAL AND METHOD

The descriptive research design was done. ^{28,29}. Population and sample in this research is all data panoramic radiographs of patients with Type 2 diabetes mellitus during 2016. The criteria are set are: 1) all radiographs should be of good quality with brightness, sharpness and density are well evidenced by the anatomical details were clearly visible 2) aged 25-55 years, 3) mandibular evident where there is no history of mandibular fractures. From the data, collected obtained a sample of 40 pieces of panoramic radiographs consisting of 20 women and 20 men. Assessment carried out by assessing bone density using Image-J software. The area chosen was the head of condyle and the angle of the mandible. Region of interest (ROI) used in this study was 5x5 mm. The final results are expected by looking at the value of bone density area ratio bone / particles and marrow.

RESULT

This research has shown that for the assessment in mandible bone in the head of condyle and angle of mandible in male in female, with age group 25 to 55 year old.

This study shows that based on the assessed area, the value of bone / particles at two areas there is no difference in value between the head of condyle bone and angle of the mandible both in men valued 76.78 at the head of condyle and a little higher on the angle of the mandible value of 77.18. While in women, seen similar density values ranged from 76.79 to 76.80 both on the head of condyle and the angle of the mandible. A similar trend can be seen in the value of marrow / hole in two areas both on IFI men and women have a value ranging 22.82 to 23.22.



Figure 1. Panoramic radiograph, seen areal of ROI 5x5 mm, in the head of condyle and angle of the mandibular condyle (Research property)

Tabel 1. Density of Head Candyle

	Right		Left		Averange	
	Bone	Marrow	Bone	Marrow	Bone	Marrow
Women	23,53	72,47	22,88	72,12	23,21	76,79
Man	23,13	71,88	23,32	71,68	23,22	76,78

Tabel 2. Density of Mandible Angle

	Right		Left		Averange	
	Bone	Marrow	Bone	Marrow	Bone	Marrow
Women	23,24	71,76	23,16	71,84	23,20	76,80
Man	23,01	71,99	22,62	72,38	22,82	77,18

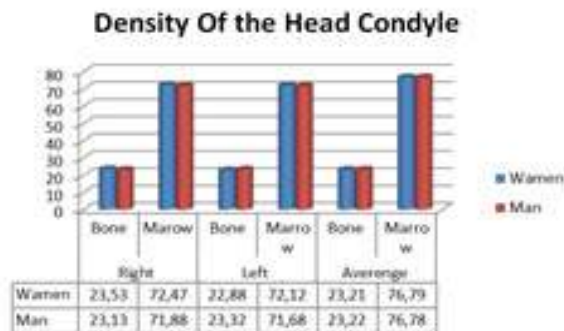


Diagram 1. Shown the value between man and women there's no difference, the score average in 76,79-76

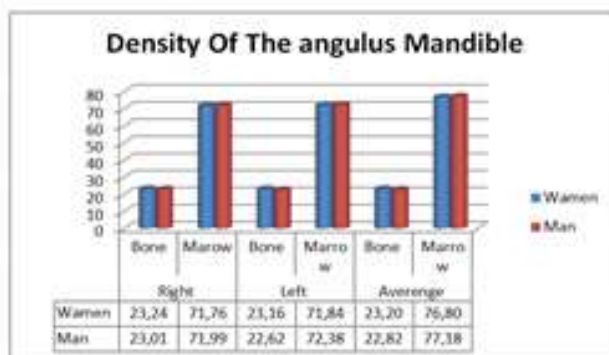


Diagram 2. Shown that the less differences above man and women density in angulus of mandible

The results also showed that the bone /particles in patients with diabetes mellitus type 2 is lower than the value of marrow/hole. It gives meaning of that, in the description of the bones in the head area of the angle of the mandible condyle and dominated by the hole/ marrow as compared with the number of particles /bone either in man or women.

DISCUSSION

Diabetes mellitus is a metabolic disorder that is caused by many factors, of which the primary symptom are visible in the form of chronic hyperglycemia as well as several disturbances in the metabolism of carbohydrates, fats and proteins. This condition is caused by a deficiency of the hormone insulin secretion, disorders of insulin activity, or it can occur both ^{30,31}Diabetes mellitus can cause many complications caused by high blood glucose levels (hyperglycemia). Some of the proteins in the body, in these conditions will be become glycolysis and its cause of growing number of IgG. ³²

The World Health Organization (WHO) classifies diabetes mellitus in multiple categories based on the treatment and symptoms are: ³³Diabetes mellitus type 1, include ketoacidosis syndrome until the destruction of beta cells in the pancreas, which caused or cause autoimmunity are idiopathic; Diabetes mellitus type 2, caused by a deficiency of insulin secretion, is often accompanied by insulin resistance syndrome Gestational diabetes mellitus, including gestational impaired glucose tolerance (IGT) and gestational diabetes mellitus (GDM); Diabetes mellitus type 2 (adult-onset diabetes, obesity-related diabetes, non-insulin-dependent diabetes mellitus, NIDDM) is a type of diabetes mellitus was not due mindless levels of insulin in the blood circulation is low, but because of metabolic disorders, which caused by mutations in many genes in the pancreas. ^{34,35} There are several theories about the cause for certain states and mechanisms of this resistance, but obesity is a predisposing factor most suspected occurrence of resistance to insulin, this is related to how many of adipokine hormone is give the tolerance in the body. Obesity is with diabetes mellitus type 2, found in about 90% of patients the world. ^{34,35}

Diabetic mellitus condition can cause the decrease of the bone density. Things to keep in mind that the insulin and mechanism of diabetic mellitus can effect bone metabolism. ³⁶ This is because the function of insulin in increasing the uptake of amino acids and collagen synthesis in bone cells, which is crucial to bone formation by osteoblasts. Bad body condition cause hypo calcemia resulting in provokes an increase of parathyroid hormone, which can improve the process of bone resorption. Bad body condition also interfere with the metabolism of vitamin D, resulting in decreased absorption of calcium in the intestines and stimulates macrophages to synthesize cytokine hormone functioning bone resorption. ^{34,35}

This condition causes a decrease in bone density in the condition of diabetes mellitus. A decrease in bone density can occur in almost all parts of the skeleton including the mandible bone. A decrease in density in this study can be represented by the number of particles / bone was lower when compared to the number of holes / marrow on an area of research and more than 50%. Seen from the research, that the values of the particle / bone 75% lower

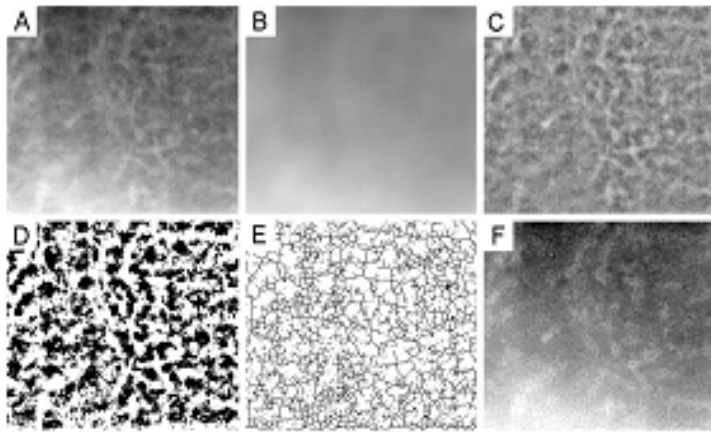


Fig. 1. Trabecula pattern during the digitalisation proces ³⁷

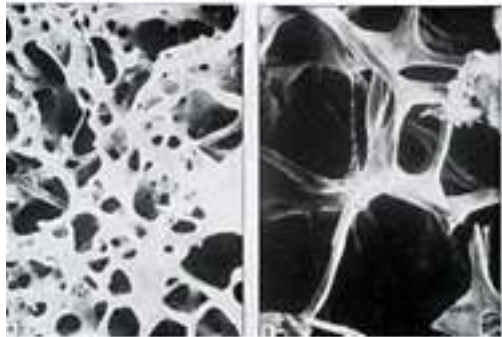


Figure 1. Differences between bone microstuctur by the bone/particel and (figure.right) dominated by hole/marrow (right) ³⁷

than the number of holes / marrow in this area. Another suggestion said that the reduction in bone density caused by interference with the process of the formation of calcium on bone formation so that the rate of resorption greater than reposisi.³⁴ bone mass in patients with type 2 diabetes mellitus controlled by consuming oral insulin regularly recorded fewer fractures than those who did not consume insulin. Resorption may caused the increse of bone quality, the resorption process actually mush be stop in normal remodeling proseces, but in people with diabetes mellitus, resorption process faster than with the healing process (apopsis). According to several literature, the condition of diabetes mellitus with high blood glucose levels (hyperglycemia) will cause the body to become glycosylation, caused by rising amount of IgG glication.³⁴ On the glycosylation state of hyperglycemia and affinity IgG antibody to an antigen, so that people with diabetes mellitus vulnerable to infection, thereby reducing the ability of fibroblast multiplication which resulted in delays and regeneration ability granulizes. ^{32,33}

CONCLUSION

The density of the mandible in patients with type 2 Diabetes Mellitus in the head of condyle both men and women have the same value, while at the angle, the man lower than women.

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Compatibility Mandible Gonial Angle Measurement On Digital Lateral Cephalometric And Panoramic Radiographs

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ABSTRACT

INTRODUCTION: The gonial angle is one of the most important anatomical shapes required for orthodontic treatment, prosthodontic and also as a data in forensic dentistry. Gonial angle measurement technique between panoramic and lateral cephalometric radiographs with the accurate results was still been controversion. **Objective:** The purpose of this study was to determine the compatibility of the gonial angle on lateral cephalometric and panoramic radiographs. **Materials and methods** This study was using a correlative descriptive method with purposive sampling technique. A total of 122 lateral cephalograms and 122 panoramic radiographs were obtained from 35 males and 87 females. Gonial angle on lateral cephalometric radiographs were determined by the tangent of the ramal plane and mandibular plane, while in the panoramic radiographs gonial angle determined from two imaginary line inferior border of the mandible and the most posterior aspect of the ramus on left and right. This study was used Pearson's correlation coefficient and Bland-Altman plot for statistically analysis. **Results:** The mean gonial angle was 121.08 and 124.20 degrees on panoramic and lateral cephalometric radiograph. There no significant differences between the right and left gonial angle and gonial angle measurement using panoramic and lateral cephalometric radiographs ($r=0,95$). Bland-Altman plot showed mostly subject point is between the limit of agreement, so that the agreement between the two methods is acceptable. **Conclusion:** The conclusion of this study showed that the gonial angle measured on panoramic radiographs have the same accuracy with the lateral cephalograms.

Keyword: gonial angle, panoramic radiography, cephalometric radiography

INTRODUCTION

The gonial angle is formed by the line tangent to the lower border of the mandible and the line tangent to the distal border of the ascending ramus.¹ The gonial angle size is influenced age, sex and status of the dentition. The gonial angle is used as a inclination guidance of the mandible on orthodontic treatment. This angle can also be used as a data forensic,² and is an important parameter in predicting the eruption of third molar.³ Research conducted by William and Rogers (2006) managed to determine the sex of using anatomical skull and mandible including gonial angle of the mandible.⁴

Lateral cephalometric radiograph is a technique often used to measure this angle. An image of superimposition of the gonial angle on the right and left lateral cephalogram difficult to get an accurate measure of the gonial angle.⁵ The existing shortcomings in lateral cephalometric radiographs were not found on panoramic radiographs, so lately panoramic radiographs are also used to measure the gonial angle.⁶

Until now, methods to measure accurately and reliably are still a debate for researchers previously⁶. Some researchers such as Akcam et al. (2003) found the image generated from panoramic radiographs affected by error magnification and displacement, causing distortion⁷. This leads to the lack of credibility of the resulting size of panoramic radiographs⁸. There are also researchers like Singh and Kenneth (2010) who found it difficult to get accurate results from lateral cephalometric radiographs for their image of superimposition of anatomical structures⁹. Therefore, this study was conducted to look at the suitability and see is there any significant difference in the size of gonial angle between panoramic and cephalometric radiographs.

Research on the use of panoramic and cephalometric radiographs in the lateral angle measurements gonial had previously been done by Booshehri et al. in 2012. The study was conducted in Yazd, Iran, where the indigenous population of the area is the Caucasoid race. The results of the study with a sample size of 80 panoramic radiographs and lateral cephalometric radiographs of 80 pieces was found that the concordance between the angular size gonial panoramic and cephalometric lateral radiographs of about 95%. In Indonesia, especially in Bandung with the majority of the population is Mongoloid race, there has been no report that examines the suitability of the angular size gonial as measured by radiographic cephalometric lateral and panoramic, so that those reasons make researchers are interested in doing research on the corner gonial in Dental Hospital mouth Dentistry, Padjadjaran University in Bandung. The purpose of this study was to measure and to determine the compatibility of the gonial angle on lateral cephalometric and panoramic radiographs.

MATERIALS AND METHODS

The descriptive correlative research design was done in Dentomaxillofacial Radiology

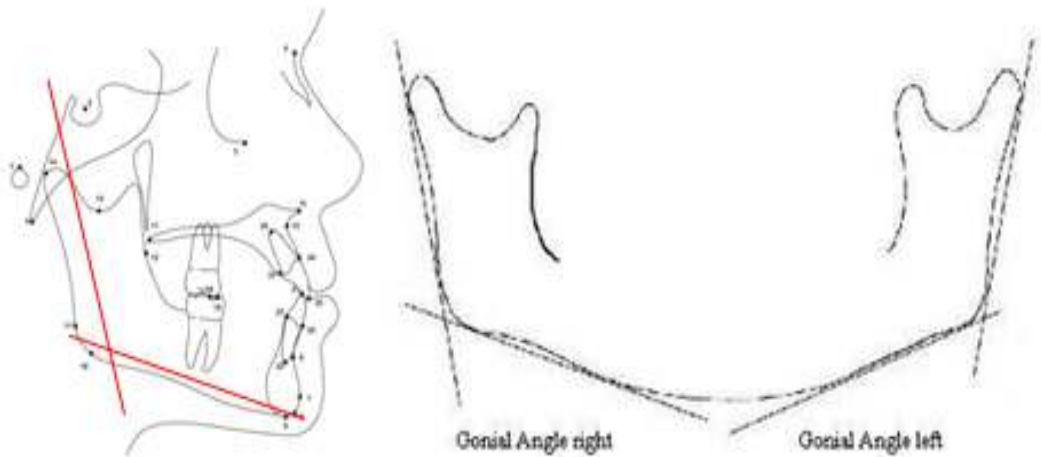


Figure 1. gonial angle measurements using panoramic radiographs and lateral cephalometric^{6, 10}

Departement of Dental Hospital, Padjadjaran University, Bandung. The study involved panoramic and lateral cephalometric radiographs of 35 male and 87 female were taken from the radiographic data archive of radiology department throughout 2014. All samples have relationships with Class I occlusion with the gonial angle that can be measured.

Gonial angle on lateral cephalometric radiographs were determined by the intersection of the ramal plane and mandibular plane, while in the panoramic radiographs gonial angle determined from two imaginary line inferior border of the mandible and posterior rami on the left and right (figure 1). Angle measurements on both radiograph is performed using a computer with software EzImplant and EazyDent. The data obtained are presented in tables and diagrams are then analyzed by Bland-Altman plots and Pearson correlation test using the following formula¹¹:

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \cdot \sqrt{n \sum y^2 - (\sum y)^2}}$$

Where: r= Pearson correlation coefficient
n= number of samples
x= lateral cephalometric radiographs
y= panoramic radiographs

This study was conducted to look at the suitability of gonial angle measured by lateral cephalometric and panoramic radiographs. Statistical analysis was used to look at the suitability is the Pearson correlation analysis. Pearson correlation coefficient r value is -1 to +1. Sign (+) or (-) shows only the direction of the relationship, where the (+) indicates a unidirectional relationship (positive) while the (-) indicates a relationship in the opposite direction (negative). The correlation coefficient r can be interpreted as follows:

0.00 - 0.19: very low
0.20 - 0.39: Low
0.40 - 0.59: medium
0.60 - 0.79: High
0.80 - 1.0: very high

This study also uses statistical analysis of Bland-Altman plots were used to identify the consistency between the two methods of measurement on one subject. Bland-Altman graph have been selected for this study was conducted to test two different methods of measurement of one sample.^{11, 12}

Pearson correlation analysis was made with the formulation of hypotheses as follows:

- H0: $\rho = 0$; There is no size suitability gonial angle on lateral cephalometric radiographs and panoramic Dental Hospital Padjadjaran University.
- H1: $\rho \neq 0$; There is a significant conformity between the angular size gonial on lateral cephalometric and panoramic radiographs in Dental Hospital Padjadjaran University.

Criteria: Hypothesis (H1) is accepted if $t_{\text{count}} > t_{\text{table}}$, and vice versa if $t_{\text{count}} \leq t_{\text{table}}$ then the hypothesis is rejected.

RESULTS

Table 1 shows the average size of gonial angle using a different measurement technique. From the table it can be seen no significant differences between the right and left gonial angle and gonial angle measurement using panoramic and lateral cephalometric radiographs.

Table 1. Average size gonial angle measurement using panoramic and lateral cephalometric radiographs

Variable	average size (Degree)
Right panoramic radiographs	120,80
Left panoramic radiographs	121,37
Panoramic radiographs	121,08
Lateral cephalometric radiographs	124,20

Table 2 below shows the correlation gonial angle measurements using panoramic radiographs and lateral cephalometric statistically. Pearson correlation value generated from these data is between 0.90 to 0.95 which means that these variables have a very strong relationship.

Table 2. Correlation Between Panoramic Radiography and lateral cephalometric radiographs in Gonial

Variable	Angle Measurement				
	Pearson's correlation coefficient (r)	P value	t-count	t-table	Information
Right panoramic radiographs and Lateral cephalometric radiographs	0.93	0.00	11.978	1.979	Significant
Left panoramic radiographs and Lateral cephalometric radiographs	0.90	0.00	8.859	1.979	Significant
Panoramic radiographs and Lateral cephalometric radiographs	0.95	0.00	13.416	1.979	Significant

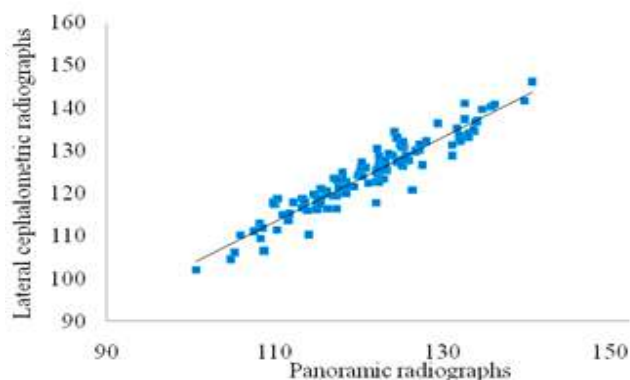


Figure 2. Correlation of Gonial Angle Size on Lateral Cephalometric radiographs and Panoramic

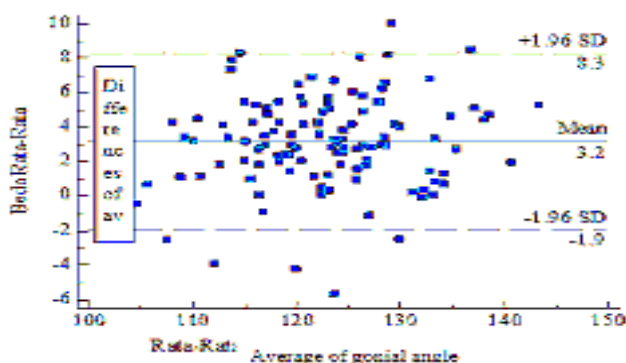


Figure 3. Bland-Altman graph for Assessing Suitability Gonial Angle Between Panoramic Radiography And Lateral Cephalometric

In figure 2 below shows the Pearson correlation coefficient values generated positive sign that indicates correlation gonial angle size as measured by radiographic panoramic and cephalometric lateral unidirectional. In this study it means the greater the size of the resulting gonial angle on lateral cephalometric radiographs, the higher the gonial angle size on panoramic radiographs.

Compatibility of the gonial angle sizedetermined based on the Bland-Altman graph above (figure 3). Correspondence between the two methods is determined based on the number of dots that are in the area limit of agreement (the area between the dotted lines). The graph shows the most points in between the limits of agreement, so that the agreement between the two methods is acceptable.

Judging from the results of hypothesis testing based on the value of t obtained by value $t_{count} > t_{table}$. In accordance with the criteria of testing the hypothesis, then H_0 and H_1 (hypotheses) received, which means that there is a high suitability between gonial angle measurement using lateral cephalometric and panoramic radiographs.

From Table 3 it can be seen that the age group under 15 years had an average size of 126.18 degrees gonial angle on panoramic radiographs and 128.73 degrees on lateral cephalometric radiographs. From these data the Pearson correlation values of 0.935 and p-value of 0.00. The age group 15-29 years has an average size of 120.00 degrees gonial angle on panoramic radiographs and 123.50 degrees on lateral cephalometric radiographs. In this age group Pearson correlation values of 0.95 and a p-value of 0.00. While in the age group over 29 years gained an average size gonial angle of 117.84 degrees and 120.05 degrees on panoramic radiographs and lateral cephalometric with Pearson correlation value was about 0.947 and p value of 0.00. Thus, it is known that the measurement of gonial angles by age group using lateral cephalometric radiographs and panoramic radiographs have high suitability.

Table 4 below shows the gonial angle size in men and women. The males are known gonial angle size of 124.43 degrees on lateral cephalometric radiographs, while in the panoramic radiographs obtained an average size of gonial angle 121.44 degrees. Pearson correlation value of these data is 0.944 and p-value is 0.00. The average size gonial angle in women is equal to 124.17 degrees and 120.94 degrees on lateral cephalometric and panoramic radiographs. Pearson correlation value of these data is 0.952 and p-value is 0.00. It shows a high suitability gonial angle size as measured by lateral cephalometric radiographic techniques and panoramic radiographs by sex.

Table 3. Compatibility of Gonial Angle Size On Lateral cephalometric radiographs and Panoramic Based on Age Group

Age Group (Years)	Average Size Gonial Angle		Differences Average cephalometric radiographs and Panoramic (degrees)	Pearson Correlation Coefficient (r)	p-Value
	Panoramic Radiograph (degrees)	Lateral Cephalometric Radiograph (degrees)			
< 15	126.18	128.73	2.55	0.935	0.00
15-29	120.00	123.50	3.50	0.95	0.00
>29	117.84	120.05	2.21	0.947	0.00

Table 4. Compatibility of Gonial Angle Size On Lateral cephalometric radiographs and Panoramic Based on Sex

Gender	Average Size Gonial Angle		Differences Average cephalometric radiographs and Panoramic (degrees)	Pearson Correlation Coefficient (r)	p-Value
	Panoramic Radiograph (degrees)	Lateral Cephalometric Radiograph (degrees)			
Male	124.43	121.44	2.99	0.944	0.00
Female	124.17	120.94	3.23	0.952	0.00

DISCUSSION

Table 1 shows the gonial angle size on panoramic radiographs is 121.08 degrees which is smaller than the size of the angle of lateral cephalometric radiographs reviewed by 124.20 degrees. Statistically, this difference was not significant ($r = 0.95$; $p = 0.00$; $t_{\text{count}} > t_{\text{table}}$). This difference could be due to the possibility of error when the position of radiation exposure is not known by the authors, because this study used secondary data. Figure 3 shows that the majority of the sample point lies between the lines limits of agreement, so there is conformity gonial angle measurement between lateral cephalometric and panoramic radiographs.

Zangouei-Booshehri et al. get the same results on the research in 2012 in Iran.⁵ They stated that the panoramic radiography can be used as a method of measuring the gonial angle with the same degree of accuracy with lateral cephalometric radiographs in the research. Several previous studies said that the panoramic radiography can not be trusted in the measurement of parameters of vertical face, but the angle measurements, this method is unreliable because the angle measurement is not affected by the distortion of radiographs, especially on the back and lateral mandible.⁷ By maximizing the accuracy of the position of the head using light indicators, bite block in the right position as well as the selection of the right mandible, panoramic radiography can be used in measurement gonial angle. Based on the results of data processing research in Tables 2, 3 and 4 Pearson correlation values of all categories is almost close to 1, where it shows the relationship very high among gonial angle measurement using lateral cephalometric and panoramic radiographs are. Results of the study also note that the Pearson correlation value obtained is positive, so it can be said that gonial angle measurement using lateral cephalometric and panoramic radiographs have a direct relationship. Intention of the sentence is that the bigger the gonial angle produced on lateral cephalometric radiographs, the greater the size of the resulting gonial angle on lateral cephalometric radiographs. It is also supported by Booshehri seen from the research that has been done in 2012.

Gonial angle can be measured by both the lateral cephalometric and panoramic radiographs.^{13,14} Panoramic radiography can produce the gonial angle almost as accurate as gonial angle measured using lateral cephalometric radiographs.⁵

Initially, gonial angle measured by lateral cephalometric radiographs, but after doing some research before, it is known that panoramic radiographs can also be used in measurement gonial angle. Measurements using panoramic radiographs have the advantage that it allows the measurement of the left and right gonial angle without superimposition that can affect the accuracy of measurement of the gonial angle.

Nohadani and Ruf (2008) said that the panoramic radiography cannot be used because the vertical size of panoramic radiographs are untrustworthy.¹⁵ According Booshehri et al. (2012) angle measurements using panoramic radiographs can be trusted because the measurement is not affected by the distortion of the image, especially the posterior and lateral aspects of the mandible. Therefore panoramic radiographs can be used in the angle

measurement with good preparation of exposure.

This research also viewed gonial angle by age group. Researchers divided the sample into three age groups, namely under 15 years of age who represent a group of children, aged 15 to 29 years represents a group of teenagers and young adults as well as the age group above 29 years who represent groups of older adults.^{16, 17} The division is based on age group by age group Wein et al. (2010) and Ferrari et al. (2010) which adopted of division organization age according to the World Health Organization (WHO). The purpose of this age grouping is to see change in angular size gonial with age.

Gonial angle is one of the important factors in assessing the morphology of basal bone and connecting the visible aging process of remodeling changes in the mandible.¹⁸ Table 3 shows the difference in gonial angle size in the age group under 15 years (children), ages 15 to 29 (teens and young adults) years and above the age of 29 years (older adults) where the gonial angle size greater in children who will shrink by age teens and young adults and will grow smaller in the age group of older adults. This is according to research conducted by Upadhyay et al. in 2012 ago.

Gonial angle size varies in different age where gonial angle will decrease with age.² It is related to the growth of the mandible with age which at children the condyloid process almost be a straight line with the body of the mandible so that the gonial angle at this stage is still very blunt. As people age, the condyloid and coronoid process develop so that the gonial angle also shrinking.¹⁹ Gonial angle will shrink until the age of about 25 to 35 years, and after that the gonial angle size will remain².

Booshehri et al., (2012) found gonial angle size between males and females are alike, but Gungor et al. (2007) pointed out that the gonial angle may differ between men and women.²⁰ It may be based on the genetic differences in growth patterns. The gonial angle generally larger in men about 3 to 5 degrees compared to women.⁵ The gonial angle size is greater in males than in females can be attributed to the morphology of the mandible larger in males than in females. Men also have mastication force larger than females.²

This study results obtained that gonial angle difference based on gender is not meaningful. The average size of gonial angle in men is equal to 121.44 degrees slightly larger than in women that is equal to 120.94 degrees on panoramic radiographs, whereas in cephalometric radiographs of 124.43 degrees and 124.17 degrees in men and women. According Shahabi (2009), gender did not affect the size of gonial angle.⁶ This is supported by research conducted by Chole et al. (2013) who found that the size gonial angle of 123.68 degrees in males and 124.39 degrees in women, with no significant differences between the two sexes.²¹ The other study was conducted by Upadhyay et al. (2012) said that there is no difference in the size of gonial significant angle between men and women.²

The results of this study indicate that gonial angle measurements can be performed using lateral cephalometric and panoramic radiographs. The gonial angle measurement can be done using one of these techniques. Panoramic radiographs can be used as a comparison measure gonial angle on lateral cephalometric radiographs were too superimposition so difficult to determine the points determinants gonial angle.

This research was conducted using secondary data of Dentomaxillofacial Radiology Departement's archives of Dental Hospital, Padjadjaran University, Bandung, Indonesia by paying attention to the time limit and sampling technique that have been described previously. Researchers did not participate directly determine the position of the patient prior to radiation exposure so that there is the possibility of error to prepare the patient. Thus one of the weaknesses of this study is the distortion of radiographic results due to improper positioning of the patient is unknown to investigators.

CONCLUSION

The conclusion of this study showed that the gonial angle measured on panoramic radiographs has the same accuracy with the lateral cephalograms.

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Description The Form Of Head Condyle In Temporomandibular Joint Based On Gender And Age On Panoramic Radiograph

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ABSTRACT

INTRODUCTION: The appearance of the mandibular condyle varies greatly among different age groups and individuals. Morphologic changes may occur on the basis of simple developmental variability as well as remodelling of the condyle, malocclusion, trauma, disease, and other developmental abnormalities. The purpose of this study was to find the description of condyle head form in temporomandibular joint based on gender and age using panoramic radiograph. **Materials and methods:** The descriptive research design was done with purposive sampling using secondary data, so that we can obtain 169 samples of panoramic radiographs from the Installation of Oralmaxillofacial Radiology Dental Hospital Padjadjaran University. The data were recorded, collected, and presented in table form. **Result:** The result of this study shows that in growth spurt, the highest occurrence of condylar head form on female's right side are round and pointed on the left side, while in male's right side are angled and pointed on the left side. In addition, it is also noted that 37.87% of the samples have an asymmetry condyle shape. **Conclusion:** The conclusion of this study is that the most occurring condylar head form on temporomandibular joint on panoramic radiograph taken from the Installation of Oralmaxillofacial Radiology Dental Hospital Padjadjaran University were round on the right side and pointed on the left side. The highest occurrence of condylar head form in growth spurt on female are round, while in growth spurt on male are angled.

Keywords: Panoramic radiograph, Condyle head form, gender and age

INTRODUCTION

The appearance of the mandibular condyle varies greatly among different age groups and individuals. Morphologic changes may occur on the basis of simple developmental variability as well as remodeling of the condyle, malocclusion, trauma, disease, and

other developmental abnormalities.¹ The adaptive or degenerative changes in the temporomandibular joints appear over a long period of time, it is understandable that the condylar changes increase with advancing ages.² Hedge in his article was said that a study in 1980's on mandibular condyle morphology in relation to malocclusion in children revealed that the condylar size in males was greater than in females. Facial type, occlusal force, and functional load also affect condylar shape in normal variation.³

Oliveira in 2009 has done the research at Bauru School of Dentistry – University of Sao Paulo using panoramic radiographs of 283 subjects with asymptomatic TMJ. The research concluded that condylar shape can be divided in flat, pointed, angled, and round shapes. The research also concluded that round shape was the most frequent among the total number of condyles studied.⁴ Other studies who has done by Sato, shows that flattening, erosion, osteophyte, and sclerosis shapes were the most frequent among the total number of condyles studied with TMD patients as a subjects.² Condylar shape variation can be seen using panoramic radiograph.

Panoramic radiograph is the most popular radiological exam used routinely in dental and oral maxillofacial practice, because it is simple, economic, and relatively low patient radiation dose imaging modality.⁵ Panoramic radiograph can give images of all structure of the teeth as well as jaw and condyle. Several other studies have used panoramic radiograph to evaluate the purpose of condylar symmetry.⁶ The purpose of this study was to find the description of condyle head form in temporomandibular joint based on gender and age on panoramic radiograph.

MATERIALS AND METHODS

The descriptive research design was done with purposive sampling using secondary data, so that we can obtain 169 samples of panoramic radiographs from the Installation of Oralmaxillofacial Radiology Dental Hospital Padjadjaran University on June 2015. Samples in this study were panoramic radiographs which have met the criteria that fit for this research. The criteria of purposive sampling used in this research were aiming to get the image of head condyle on the right and left sides either on TMD or non-TMD patients. The criteria mentioned below are the inclusion and exclusion criteria that used to determine the sample and population.

Inclusion criteria: 1. Digital panoramic radiographs of patients from the Installation of Oralmaxillofacial Radiology Dental Hospital Padjadjaran University on June 2015; 2. Mandibular condyle can be seen clearly.

Exclusion criteria: 1. Congenital disorders on condyle such as bifid condyle exist in panoramic radiograph.; 2. Fracture on head of condyle exists in panoramic radiograph; 3. Post-surgery on condyle exist in panoramic radiograph.

The tools and materials used in this study is: 1. Computer unit (Toshiba NB520); 2. EasyDent and EzImplant applications; 3. Digital panoramic radiographs of patients from RSGM Unpad on June 2015 radiographs which have met the criteria that fit for this research. Panoramic radiographs was taken using CBCT-3D Picasso Trio.

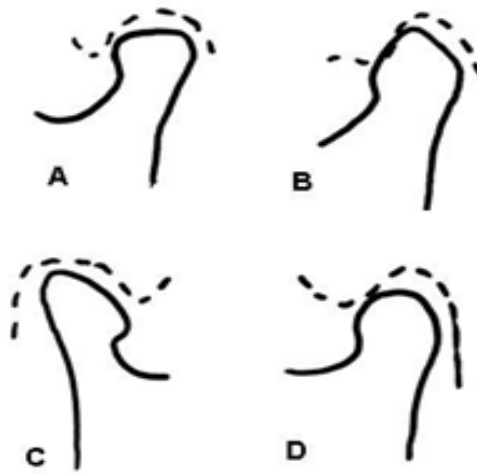


Figure 1 Condylar shape variation (A) flat, (B) pointed, (C) angled, (D) round⁴

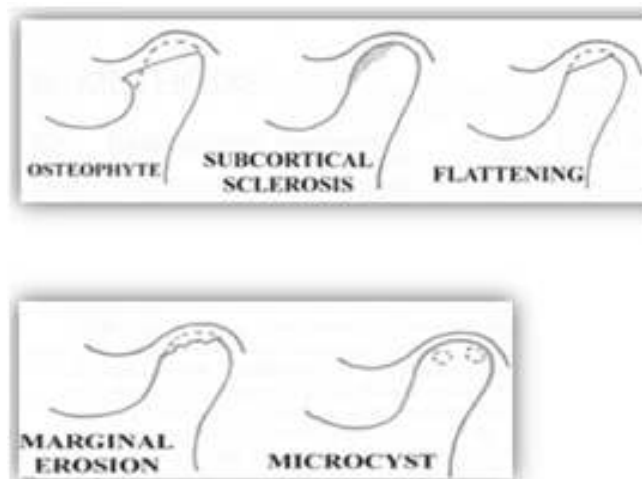


Figure 1 Condylar shape variation in TMD subjects⁴

Determining the shape was done by comparing condylar shape on panoramic radiographs with existing condyles form shown in the image above. Results then recorded and the average was calculated for each gender and age group.

RESULTS

From the 169 data that has been collected, respondent from the age as early as 5 to the maximum age of 66 could be found. The age ranges are then divided into 8 ranges based on growth spurt so that in accordance with purpose of this research which is to observe

growth and development of mandibular condyle. The result data based on aged ranges then separated from male and female due to differences in the onset of growth spurt, which is in female range between the ages of 10 and 15, while in male range between the ages of 12 and 17.⁷ Distribution of age ranges after growth spurt is then adjusted. Furthermore, based on collecting data, showed that most respondents are of aged 16-33 years.

Table 1. Overall average of condylar shapes

Shape	Side	Female	Male	Total
Angled	Right	3	1	4 (4.73%)
	Left	3	1	4 (4.14%)
Flat	Right	3	1	4 (0.89%)
	Left	3	1	4 (1.48%)
Pointed	Right	6	2	8 (1.57%)
	Left	4	1	5 (1.23%)
Round	Right	40	19	59 (19.57%)
	Left	45	20	65 (19.23%)
Erosion	Right	3	1	4 (1.48%)
	Left	3	3	6 (3.25%)
Flattening	Right	1	2	3 (0.5%)
	Left	1	2	3 (1.1%)
Microcyst	Right	-	-	-
	Left	-	-	-
Osteophyte	Right	-	1	1 (0.29%)
	Left	2	4	6 (1.77%)
Sclerosis	Right	1	-	1 (0.29%)
	Left	2	-	2 (0.59%)
Total		208	130	338

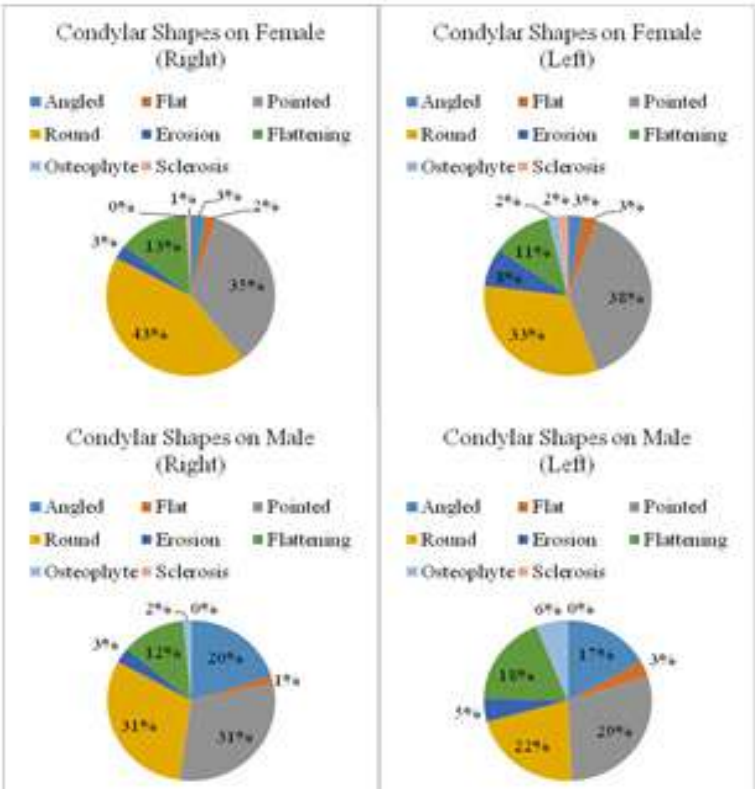


Diagram 1 Overall average of condylar shapes

Table 2 Average of condylar shapes based on age ranges in female

Shapes	Side	Before growth spurt	Growth spurt	After growth spurt	Total
Angled	Right	-	-	2	2 (0.96%)
	Left	-	-	2	2 (0.96%)
Flat	Right	-	2	1	3 (1.44%)
	Left	-	2	1	3 (1.44%)
Pointed	Right	-	3	35	38 (17.79%)
	Left	1	3	37	41 (19.71%)
Round	Right	2	4	39	45 (21.63%)
	Left	1	3	30	34 (16.35%)
Erosion	Right	-	-	3	3 (1.44%)
	Left	-	-	8	8 (3.83%)
Flattening	Right	-	1	3	4 (1.90%)
	Left	-	1	11	12 (5.77%)
Microcyst	Right	-	-	-	-
	Left	-	-	-	-
Osteophyte	Right	-	-	2	2 (0.96%)
	Left	-	-	1	1 (0.48%)
Sclerosis	Right	-	-	2	2 (0.96%)
	Left	-	-	1	1 (0.48%)
Total		4	18	186	208

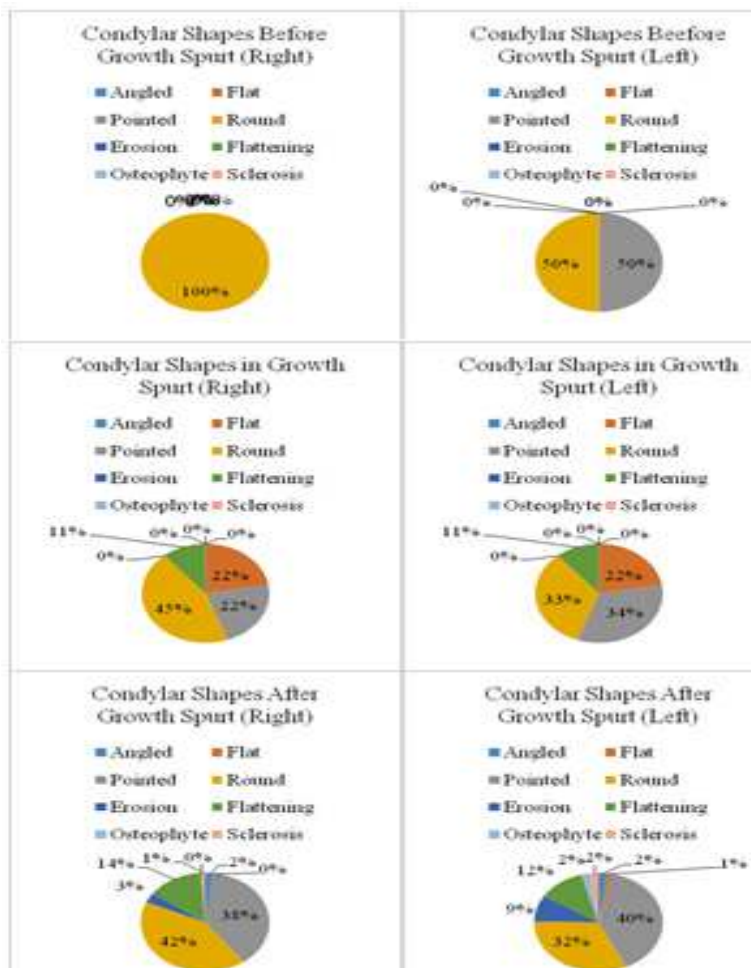


Diagram 2 Average of condylar shapes based on age ranges in female

Based on the table above, it showed that round shape was the most frequent on the right side, followed by pointed, flattening, angled, erosion, and flat shapes. Sclerosis and osteophyte shapes come in last place. While in the left side, pointed shape was the most frequent, followed by round, flattening, angled, erosion, osteophyte, flat, and sclerosis shapes. Microcyst shape is absence on this research.

Age ranges on female respondents divided based on growth spurt, which is the onset start at the age of 10 and end at the age of 15.⁷ Age under 10 years then classified as ages before growth spurt, while age over 15 years classified as ages after growth spurt.

Based on the table below, it showed that round shape was the most frequent on the right side, followed by pointed, flattening, and erosion shapes. Angled and flat shapes placed on fifth place, and then followed by sclerosis shape. Osteophyte shape is absence on the right side. While in the left side, pointed shape was the most frequent, followed by round, flattening, erosion and flat shapes. Angled, osteophyte, and sclerosis shapes comes in last place.

Age ranges on female respondents divided based on growth spurt, which is the onset start at the age of 12 and end at the age of 17.⁷ Age under 12 years then classified as ages before growth spurt, while age over 17 years classified as ages after growth spurt.

Based on the table above, it showed that round and pointed shapes was the most frequent on the right side, followed by angled, flattening, and erosion shapes. Flat and osteophyte shapes come in last place. Top four on the right side was the same with the left side. Flat, erosion, and flattening shapes comes after those. Sclerosis shape is absence on both sides.

Tabel 3 Average of condylar shapes based on age ranges in male

Shapes	Side	Before growth spurt	Growth spurt	After growth spurt	Total
Angled	Right	1	2	10	13 (10%)
	Left	-	1	0	1 (0.77%)
Flat	Right	-	-	1	1 (0.77%)
	Left	1	-	1	2 (1.54%)
Pointed	Right	-	-	20	20 (15.38%)
	Left	-	2	17	19 (14.61%)
Round	Right	3	1	16	20 (15.38%)
	Left	2	-	12	14 (10.77%)
Erosion	Right	-	-	2	2 (1.54%)
	Left	-	-	3	3 (2.31%)
Flattening	Right	-	-	8	8 (6.15%)
	Left	1	-	11	12 (9.23%)
Microcyst	Right	-	-	-	-
	Left	-	-	-	-
Osteophyte	Right	-	-	1	1 (0.77%)
	Left	-	-	4	4 (3.08%)
Sclerosis	Right	-	-	-	-
	Left	-	-	-	-
Total		8	6	116	130

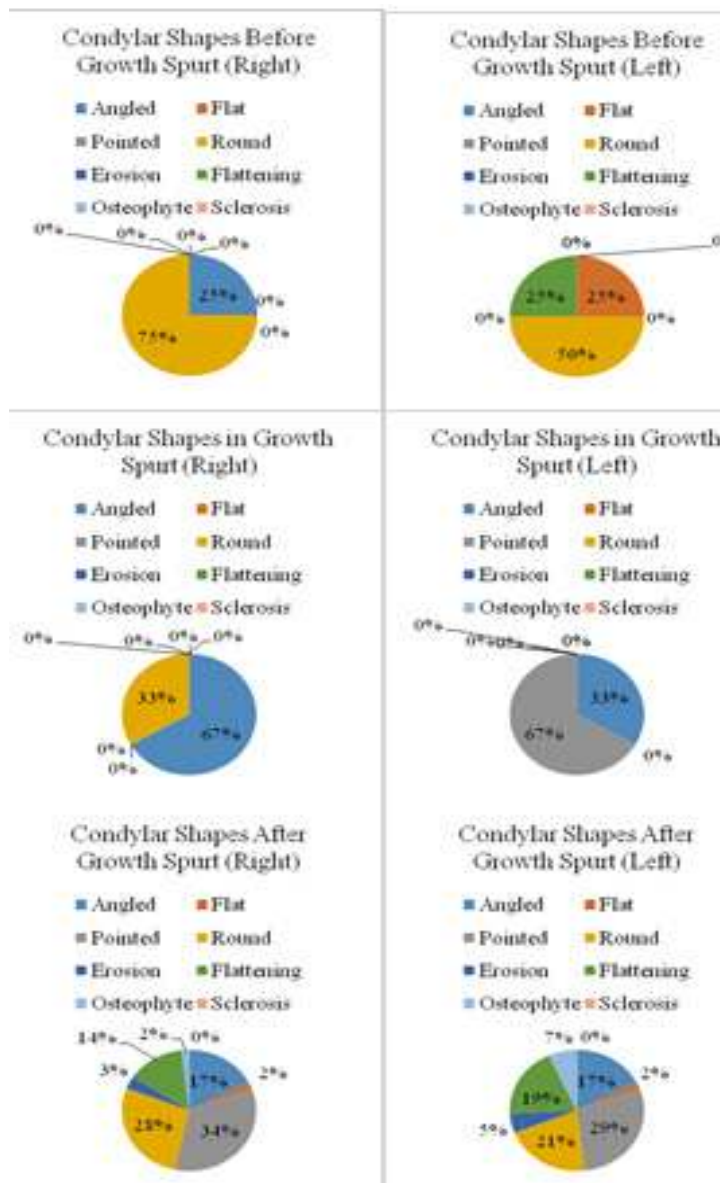


Diagram 3 Average of condylar shapes based on age ranges in male

DISCUSSION

This research shows that 21.3% respondents had an erosion, flattening, osteophyte, and sclerosis condylar shapes, so it can be estimated that 21.3% of respondents has suffered from TMD. Gross in his study said that condylar changes in TMD can be caused due to excess load on the TMJ that affects the functional relationship between the condyle,

disc, and eminence which will affect the shape of condyle. This excess load can be caused by malocclusion, parafunctional habits such as bruxism, or an orthodontic treatment.⁸ An initial adaptative response, triggered by overloading, induces structural changes in the TMJ. This is a slow but continuous process of modelling that involves all the elements of the TMJ, within tissue-specific limits. When the reserve of adaptative and compensatory responses is exhausted, the changes taking place in TMJ are known as regressive modelling.⁹ At this stage, decompensated and destructive morphologic changes are usually revealed with pain and other clinically evident signs and symptoms.⁹ However, additional factors like hormonal influences, hypervascularity, heredity, infection or trauma, may stimulate excess growth of condyle.¹⁰

Condylar shapes that most commonly found in the period before growth spurt of female on the right side is round shape and on the left side is round and pointed shapes, while in male round shape are most found on both side. Shape differences in female and male can be due to differences in value of surface area as well as volume of the condyle, which is male has a higher value¹¹, so that pointed shape which are most found in female in age before growth spurt, most likely to be due to the lower surface area and volume of the condyle.

Condylar shapes that most commonly found in the period of growth spurt of female on the right side is round shape and on the left side is pointed shape, while in male angled shape are most found on the right side and pointed shape on the left side. Wadhwa said on his research that both estrogen and progesterone receptors have been localized in the TMJ.¹² Orajarvi said on his research that estrogen is an important hormone in the development of human bones, which is acts as an inhibitor of bone resorption and as a regulator of bone formation¹³, furthermore lack of estrogen in body can cause a decrease in the thickness of the cartilage of the condyle.¹³ Lack of estrogen also increases the width of mandibular condylar head, which includes both the condylar cartilage and subchondral bone¹⁴, so that the average head of condyle in male is wider than in female, and perhaps this is also the reason why angled shape is most common in male than in female.

Sex hormones are known to influence the differentiation, growth and development, and metabolism of connective tissue.¹⁵ Nishioka said in his research that sex hormones may contribute to dysfunctional remodelling of the TMJ.¹⁶ Abubaker et al suggest that sex hormones can affect the extracellular matrix of the TMJ disc in female.¹⁷

Majority of condylar shape in the period after growth spurt is dominated by pointed shape both in male and female. Round shape mostly found on the right side in female. This is can be caused by the degree of remodeling were determined by age. Adaptative or degenerative changes on condyle in a long period of time allow condylar changes increase with advancing ages. Karlo indicated that condylar morphology was associated with the subject's age, where subjects under 7 may exhibit rounder condyles and older subjects more oval-shaped condyles¹⁸, so it can be understood why the shape of the condyle in this age group are mostly has a pointed shape. The prevalence of changes in the condylar morphology was found to be relatively lower in subjects who were between 20-40 years old as compared to those above 40 years old.¹¹

Differences of condylar shapes on the right and left sides can be caused by differences in occlusal force that received by the right and left side. Durgha on his research has said that occlusal force is one of the important factors influencing maxillofacial development, and the high occlusal force group tended to have condyles with larger, more rounded form at the lateral and posterior side than the low occlusal force group.¹¹ These difference also can be caused by difference of disc position. Hasegawa reported that changes in the shape and size of the mandibular condyle vary according to the previous position of the articular disc.¹⁹

Differences of condylar shapes on the right and left sides indicate that there are subjects who have asymmetric condylar shape. This study get result that 64 of the 169 subjects had an asymmetric condyle, ie 39.42% in female and 35.38% in male. Condylar shape asymmetry can occur in male and female with different variations shape on the right and left sides. This may be due to anatomic variations and technique limitations.⁴ This also can be caused by TMD. Buranastidporn et al found a significant association between the presence of the vertical asymmetry of the condyle and the presence of internal TMD.²⁰ Furthermore, condylar shape asymmetry can be caused by trauma and parafunctional habits that will lead to TMD.²¹

Condylar shape asymmetry can also be found in non-TMD subjects. This study showed that by the age before the growth spurt, 1 of 2 female subjects and 3 of 4 male subjects has an asymmetric condylar shape, while by the age of growth spurt 11.11% of female subjects and 2 of 3 male subjects also has an asymmetric condylar shape. Growth factors also influence this phenomenon. Fluctuation during growth may indicate that functional forces to the TMJ and mandibular gonial regions are not necessarily in balance, which may lead to unequal growth of the condyle and ramus heights on the right and left sides.²² Saglam and Sanli on their research found that 6.27-8.36% non-TMD subjects has an asymmetric condyle.²³

Level of condylar asymmetries at the age after growth spurt in this study shows those 41.94% female subjects and 31.03% male subjects has an asymmetry condylar shape. Condylar shape asymmetry also can be caused by dental occlusion relationship, so even though the growth has been completed condyle will still adapt to dental occlusion relationship by remodeling. Iturriaga on his research found that subjects with malocclusion class II have a higher prevalence of condylar asymmetry compared with subjects with malocclusion class I and III.²⁴ Other than that, posterior crossbite also can influence in the development of the condylar shape asymmetry. Prolongation of posterior crossbite can cause permanent changes in tooth position, in the bony support, and possibly in the growth center at the temporomandibular joint.²⁵

CONCLUSION

The conclusion of this study is that the most occurring condylar head form on temporomandibular joint on panoramic radiograph taken from the Installation of Oralmaxillofacial Radiology Dental Hospital Padjadjaran University were round on the right

side and pointed on the left side. The highest occurrence of condylar head form in growth spurt on female are round, while in growth spurt on male are angled.

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Description of Microstructure in Trabecular Jaw Quality for Patient with Smoking Habits Using Panoramic Radiograph

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ABSTRACT

INTRODUCTION: According to WHO, Indonesia country profile age-standardized estimated prevalence of smoking among those aged 15 years or more in year 2013 shows that there are currently 73.3% male adults who smoke any tobacco and 63.9% of them smoke daily. Many studies have found that smoking will be a risk factor for osteoporosis and incur only negative effects on bone, however it is unsure for young to adult active smokers will have negative effects on their microstructure of trabecular jaw quality and the rate of bone turnover **Objective:** The purpose of this research is to describe the microstructure in trabecular jaw quality for patient with smoking habits using panoramic radiograph. **Material and Method:** This research is done by using *image j* software with 50x50 pixels intensity (PI) in digital panoramic radiographs. The samples of 30 smokers and 12 non-smokers of secondary data are collected to be analysed. Analysis performed in mental foramen area in both side of the jaw. **Result:** The mean for trabecular percentage of male smokers is 21.119%; of female smokers is 21.456; male non-smokers is 29.522% and female non-smokers is 30.444%. **Conclusion:** The conclusion of this reasearch, that there is lowering of trabecular percentage for regions of interest (ROI) in mandible of male and female smokers and they are indicated for osteoporosis. All dentists can be at a very important role in preventing osteoporosis by conveying this message.

Keywords: Smoking, Osteoporosis, Panoramic Radiograph, Trabecular Percentage, Image j Software

INTRODUCTION

Recently there has been some researches done that have proven that smoking seems to incur only negative effects on bone health. According to WHO, Indonesia country profile age-standardized estimated prevalence of smoking among those aged 15 years or more in year 2013 shows that there are currently 73.3% male adults who smoke any tobacco and

63.9% of them smoke daily. There are 63.0% male cigarette smokers and 59.4% of them smoke daily. Besides, there are currently 3.8% female adults who smoke any tobacco and 2.4% of them smoke daily. There are 3.5% female cigarette smokers and 2.3% of them smoke daily¹. This is a very important issue for Indonesia because this will have great impacts on their health conditions. If the heavier a person smoke and the earlier smoking is started, it will increase the risk of fractures and osteoporosis². This often causes heavy smokers in having lesser amount of teeth in their oral cavity³. Because there will be a drastic reduction in the mineralization process of bones in hip, hand, bone formation^{4,5}. However moderate or light smokers seem that do not suffer from this harm⁶. Researchers also show that for post-menopausal woman who smoke tend to lose cortical bone like tubular and mid shaft bone 50% faster than nonsmokers⁷. Besides, the life time risk of having hip fracture if compared to non-smoker woman, smoking woman increases nearly by double; 12.5% of the hip fractures cases are estimated due to the smoking habits. Smoking not only brings disadvantages for females, however for male who smoke will also be facing bigger chance for getting the risk for fractures if compared to non-smokers⁸.

Panoramic radiograph is a common imaging technique in dentistry that gives a unique image of maxillary and mandibular jaws. The advantages of this radiographic technique are it has relatively small radiation, require lesser time and it is cheap and affordable. However the main disadvantages might be due to the wrong head adjustment which will cause magnification, high distortion and possible some mistakes. Besides, parameters including imaging device, equipment and the patient's position could change the quality of image and lead to false clinical judgement. In this study, we used digital panoramic radiography and 5x5 pixel matlab software to determine the bone density of the mandibular jaw⁹.

Researchers have studied more than 4,000 different components in cigarette and more than 60 of these components have been proven as potent toxins and 45 of them are chemical carcinogens. Tobacco will directly interfere with osteoblast functioning and two candidates such as benzo[a]pyrene (BaP) and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) will stimulate bone resorption by osteoclasts^{10,11}. Researchers have proposed a few mechanisms by which smoking might reduce bone mineral density and induce osteoporosis risk. The action of smoking can change the micro architecture of trabecular bone and it will induce cortical bone becoming thinner and also the bone mineral density will be reduced¹². Smoking is likely to enhance the stress hormone cortisol which will have the action in lowering bone mineral density. In post-menopausal woman, the action of smoking can stimulate the increased activity of liver enzymes hence enhance the speed for the breaking down of estrogen thus this will induce the increased of bone loss. Because female tend to have smaller, thinner bones than men, they will lead to the higher possibility of having osteoporosis fracture¹³. Furthermore, calcium absorptions will likely be hampered in those smokers. Besides, the action of smoking also blocks the hormonal function such as calcitonin. Calcitonin is a type of thyroid hormone that forces calcium from the blood into the bones. It also blocks the breakdown of bones. If calcitonin is reduced, tobacco use encourages the breakdown of bone while preventing its mineralization¹⁴.

MATERIALS AND METHODS

The study design used for this research is descriptive study. The population of this research is the patients who come to Sekeloa Dental Hospital. The sample collecting of this research is by consecutive method, they are the patients who smoke and came to sekeloa Dental Hospital in one month duration time.

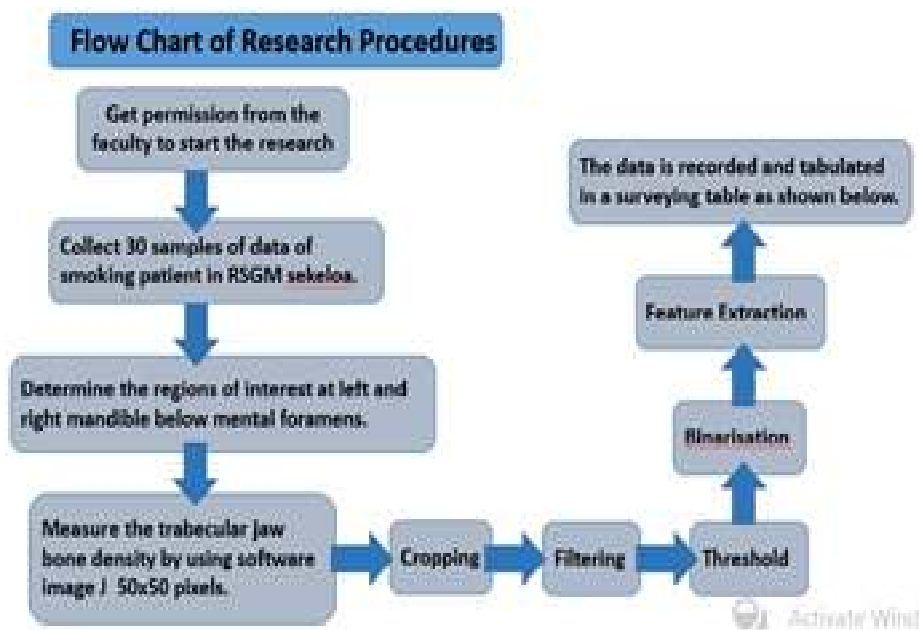


Figure 1. Chat lines of inquiry



Figure 2: Panoramic Radiograph with Regions of Interest (Red Colour Boxes) with 50x50 Pixels Located Below Mental Foramen at Left and Right Mandible.

This research will only be conducted in subjects age 20-49 years who have a panoramic radiograph with good quality where sharpness, brightness and opacity clearly visible. Based on the rules above, 30 samples of radiograf panoramic data were collected. Assessment is done on the left and right mandible area with ROI 5x5mm, with position, under the mental foramen. Jaw bone density measurements carried out by assessing the trabecular using software image J. The process begins with cropping, filtering, threshold, binarisation and lasty feature extraction. The collected data will then be averaged in the form of tables and

RESULT

This research was conducted from January to April 2016 at Sekeloa Dental Hospital. A total of 30 secondary samples of panoramic radiograph for smoking patients are collected and 12 secondary samples of panoramic radiograph for normal healthy patients are collected as well. All data were then categorized based on age groups, genders and smokers or non-smokers patients.

Table 1. Characteristic Samples

Age	Male Smokers	Female Smokers	Total	Male Non-smokers	Female Non-smokers	Total
20-29	8	2	10	2	2	4
30-39	8	3	11	3	2	5
40-49	7	2	9	1	2	3
Total	23	7	30	6	6	12

Table 2. Percentage of Trabecular and Marrow in Male and Female Smokers to Male and Female Non-Smokers in Region 3 and 4.

Age	Mean for Male and Female Smokers		Mean for Male and Female Non-Smokers	
	Trabecular (%)	Marrow (%)	Trabecular (%)	Marrow (%)
20-29	19.916	80.084	29.321	70.679
30-39	25.652	74.348	30.625	69.375
40-49	18.322	81.678	30.003	69.997
Mean	21.297	78.703	29.983	70.017

Table 3. Percentage of Trabecular and Marrow in Male Smokers to Male Non- Smokers in Region 3 and 4.

Age	Male Smokers		Male Non-Smokers	
	Trabecular (%)	Marrow (%)	Trabecular (%)	Marrow (%)
20-29	19.435	80.565	27.692	72.308
30-39	25.656	74.344	30.694	69.306
40-49	18.265	81.735	30.181	69.819
Mean	21.119	78.881	29.522	70.478

Table 4. Percentage of Trabecular and Marrow in Female Smokers to Female Non-Smokers in Region 3 and 4.

Age	Female Smokers		Female Non-Smokers	
	Trabecular (%)	Marrow (%)	Trabecular (%)	Marrow (%)
20-29	20.396	79.604	30.950	69.050
30-39	25.593	74.407	30.556	69.444
40-49	18.378	81.622	29.826	70.174
Mean	21.456	78.544	30.444	69.556

Table 5. Percentage of Trabecular and Marrow in Male Smokers to Female Smokers in Region 3 and 4.

Age	Male Smokers		Female Smokers	
	Trabecular (%)	Marrow (%)	Trabecular (%)	Marrow (%)
20-29	19.435	80.565	20.396	79.604
30-39	25.656	74.344	25.593	74.407
40-49	18.265	81.735	18.378	81.622
Mean	21.119	78.881	21.456	78.544

Table 4.6. Percentage of Trabecular and Marrow in Non-Smokers Male to Female Non-Smokers in Region 3 and 4.

Age categories	Male Non-Smokers		Female Non-Smokers	
	Trabecular (%)	Marrow (%)	Trabecular (%)	Marrow (%)
20-29	27.692	72.308	30.950	69.050
30-39	30.694	69.306	30.556	69.444
40-49	30.181	69.819	29.826	70.174
Mean	29.522	70.478	30.444	69.556

Table 7. Percentage of Trabecular for Male and Female Smokers to Male and Female Non-Smokers according to Age Categories at Region 3 and 4.

Age	Male Smokers	Female Smokers	Mean	Male Non-smokers	Female Non-smokers	Mean
20-29	19.435	20.396	18.498	27.692	30.950	28.605
30-39	25.656	25.593	25.398	30.694	30.556	30.533
40-49	18.265	18.378	17.797	30.181	29.826	28.451
Mean	21.119	21.456	20.564	29.522	30.444	29.196

Table 1. shows the characteristics of total sample collected for this research. There are total 30 smokers and 12 non-smokers who are according to age group 20- 29, 30-39 and 40-49. There are 23 male smokers and 7 female smokers, whereas there are 6 male and 6 female non-smokers. If according to age 20-29, there are 8 male smokers, 2 female smokers, 2 male non-smokers and 2 female non-smokers. For age 30-39, there are 8 male smokers, 3 female smokers, 3 male non-smokers and 2 female non-smokers. For age 40-49, there are 7 male smokers, 2 female smokers, 1 male non-smoker and 2 female non-smokers.

DISCUSSION

For female, a previous study done by Australian cross-sectional study in pre-menopausal women (118 current smokers, 158 non-smokers; mean age 33 years) found a 4–5% deficit in BMD at the femoral neck, lumbar spine and total body in smokers. This association was more pronounced in women with a BMI (body mass index) <25 kg/m² and who had breastfed at least one child ¹⁵. Sporting activity appeared protective against bone loss. Another study of healthy community dwelling young women found that, at 2 years of follow-up, smokers aged 20–39 years had a lower spinal BMD than non-smokers. This can be shown in table 7, in which the mean for trabecular percentage of the female smokers is 21.456%, whereas the mean for trabecular percentage of the female non-smokers is 30.444%. This shows about 8-9 % deficit in trabecular percentatge in ROI for our mandibular jaws.

For male, a previous cross-sectional data collected as part of the Framingham Study, a population-based cohort study with over 40 years of follow-up, found a 4–15.3% lower BMD in male smokers at all skeletal sites ¹⁶. Further analysis of longitudinal data over 4 years from this cohort found that men (but not women) who smoked lost more BMD at the hip than men who had never smoked ¹⁷. A French study of 719 men aged 51–85 years reported that former smokers had a higher BMD at the forearm than current smokers ¹⁸. However, following adjustment for age, body mass, alcohol intake and caffeine intake, the two groups

had a similar BMD at the lumbar spine, hip and whole body. This also can be shown in table 7, in which the mean for trabecular percentage of the male smokers is 21.119%, whereas the mean for trabecular percentage of the male non-smokers is 29.522%. This shows about 8-9% deficit in trabecular percentage in ROI for mandibular jaws.

The mean percentage of trabecular in male and female smokers in table 2, is 21.297% which is lower than the mean percentage of trabecular in male and female non-smokers which is 29.983. A 2003 study also found that smoking can significantly reduce the protective effect of calcium on the bones. The inhibition of calcium may be an offshoot of the effect of tobacco use on vitamin D levels. But this observation also indicates that smoking may affect the body's ability to properly utilize calcium. This is not surprising considering the fact that the hormones and vitamins needed to mineralize the bone with calcium are all inhibited by tobacco use.

Traditionally, vitamin D has been considered almost exclusively in the context of its role in calcium homeostasis. Whether ingested or synthesized, vitamin D is transported to the liver, which is then transported to target tissues, where it functions like a steroid, binding to the vitamin D receptor (VDR). When there is a need to increase blood calcium levels (e.g., during growth or pregnancy), 1,25 (OH)2D3 acts in the intestine to increase calcium absorption. If this increased intestinal absorption is insufficient to restore normal calcium levels, 1,25 (OH)2D3 works in concert with the parathyroid hormone (PTH) in the kidney to promote calcium reabsorption from the distal tube, and in the skeletal system to release calcium from bones.

As a result the results in table 3 between male smokers and male non-smokers, table 4 between female smokers and female non-smokers as well as table 7 between male and female smokers and male and female non-smokers shows significant different in their trabecular percentage as well. For table 3, the mean percentage of trabecular for male smokers is 21.119 % and 29.522 % in male non-smokers. The different is 8.403 % between these values and the result is significant. One of the reasons behind this value is that smoking will increase the nicotine level in human blood circulatory system. Nicotine is one of the addictive components of tobacco, is a highly toxic alkaloid and has been the focus of several studies evaluating the relationship between specific cigarette components and bone. The effect of nicotine on bone remains controversial, with some studies finding adverse effects by found an important effect of tobacco smoking on BMD of lumbar spine and femur in rat which is compatible with the results from previous studies by ^{19, 20}. The experiment is about the rat being exposed to smoke and the BMD of lumbar spine and femur was lower in 4-month in controls. This is not seen in the 2-month and 3-month. This might be due to differences in time of passive smoking^{19,20}. Proved that the 5-month cigarette smoke inhalation induced the decrease in BMD, demonstrated that 4 months of nicotine treatment was detrimental to bone by causing an increase in the bone resorbing cytokines and cotinine levels and nicotine also exerted negative effects on the dynamic trabecular histomorphometric parameters. In a rabbit model of bone graft revascularization, elevated systemic levels of nicotine impaired vascularization of a cancellous bone graft implanted

into the distal femur^{21,22}. Others have reported direct toxic effects of smoking on bone mass in rodents *in vivo* (Broulik P. D. and Jarab J., 1993) (Epping-Jordan et al.) reported the mean blood nicotine concentration for smokers who smoked 30 cigarettes daily was 40-42 ng/ml. The blood nicotine concentrations in the 4-month smoke-exposed rats were 40.6 ng/ml, indicating that the average blood nicotine concentration was similar to the average for heavy smokers. The blood nicotine concentration did not differ among 2, 3 and 4 months, but there may be a harmful effect of longer smoke exposure for 4 months. Thus, we

considered that the timing of BMD decrease may be associated with the dose level and the duration of smoke exposure.

Besides, this can be seen in table 2 between male and female smokers to male and female non-smokers, table 4 between female smokers to female non-smokers as well as table 4.7 between male and female smokers and male and female nonsmokers. The different in percentage of trabecular shows significant results. For table 7, we know that the mean of percentage of trabecular is 30.444% but the mean for the female smokers is 21.456% only. Tobacco smoke affects the metabolism of sex hormones and its most profound effect is on the level and activity of estrogen. By stimulating increased activity of liver enzymes, tobacco smoke promotes the destruction of estrogen. Decreased estrogen levels due to natural or smoking habits might induced menopause lower bone mineral density in humans. (Eastell, 2006). Because of the nature of its association with various hormonally related diseases, smoking has been considered potentially anti-estrogenic. There was a small (8%) reduction in oestriol excretion in smokers among premenopausal woman. MacMahon et al. (1982) reported similar excretion rates of oestrone, oestradiol and oestriol in smokers and non-smokers in the follicular phase, but about 30% lower excretion of all three oestrogens in smokers in the luteal phase, whereas Michnovicz et al. (1988) reported 31% lower excretion of oestriol in the follicular phase. Estrogen plays a role in bone metabolism. Low circulating estrogen is an important risk factor for post-menopausal osteoporosis (Sambrook and Cooper, 2006). Estrogen has been shown to induce apoptosis in bone-resorbing osteoclasts (Kameda *et al*, 1997; Kousteni *et al*, 2002). Estrogen is anti-apoptotic in osteoblasts, leading to an overall building of bone (Kousteni *et al*, 2002). Besides, another hormone affected by smoking is cortisol. Cortisol is known as the stress hormone and smokers have higher levels of this hormone than nonsmokers.

High levels of cortisol is also directly responsible for higher stress levels among smokers. Cortisol promotes the breakdown of bones. Therefore, when tobacco use increases its level and its duration of usage, this will cause the percentage of bone to be reduced. Furthermore, smoking blocks the actions of the calcitonin hormone. Calcitonin is a thyroid hormone that drives calcium from the blood into the bones. It also blocks the breakdown of bones. By reducing its level, tobacco use encourages the breakdown of bone while preventing its mineralization. Therefore, this will cause the percentage of bone to be reduced. In addition, smokers had lower levels of the hormone, DHEAS (dehydroepiandrosterone sulfate), a testosterone metabolite which later causes the testosterone level to be lower as well. The androgen found in blood is testosterone (Williams et al., 2013). Androgens

protect men from the onset osteoporosis through the maintenance of cancellous bone and expansion of cortical bone (Kini & Nandeesh, 2012). Androgens have multiple effects on the skeleton. It affects bone size, bone mass and bone remodeling. In adolescence, it promotes skeletal growth by stimulating osteoblast and suppressing osteoclast function, activity and lifespan. It also increases periosteal apposition, providing men with a bigger and thicker cortical bone (Kung, n.d.).

As a result for the female smokers, they tend to have lower in percentage of trabecular due to the reduction in estrogen, testosterone and calcitonin as well as increase in cortisol. The different in percentage of bone can be seen also in table 2, 3, 5 and 7. This is most obvious to be seen in table 4 which is comparing the female smokers and the female non-smokers, having the different of 8.988% of trabecular.

For table 7, the mean for percentage of trabecular for male and female smokers, increases from 18.498% at age 20-29 to 25.398% at 30-39 and decrease again to 18.378% at age 40-49; the mean for percentage of trabecular for male and female non-smokers increases from 28.605% at age 20-29 to 30.533% at age 30-39 and decreases to 28.451% at age 40-49.

From the age of a newborn, the bone is undergoing growing phase until approximately age 35-39, these ages are the ages people will reach their peak bone mass. Peak bone mass is the time at which their bones are highest in density and strongest moment in this current life. (Edelson and Kleerekoper 1995). However after the age of 35-39, the average bone mass will start declining and women tend to lose 0.5 percent to 1 percent of their bone mass every year. During menopause, when the ovaries cease creating estrogen, the rate of bone loss increases. Without the use of estrogen replacement therapy, most women tend to lose 3-7 percent in BMD per year. This will result in the loss of BMD up to 15-35 percent of loss in bone mass in the first 5 years after menopause (Bonnick 1994). This osteoporosis process will further increase when they going older. This will normally starts from 6% at the age of 50 year and will up to 50% after the age of 80 (Prevalence of low femoral bone density in older U.S. adults from NHANES III. By Looker AC, 1997).

A gross prediction states that 10% female who are older than the age of 50 will suffer from osteoporosis. However, only 2% of men older than the age of 50 will suffer from osteoporosis, according to the U.S. Centers for Disease Control and Prevention. An estimation of 50% of women and 20% of men if they are more than the age of 50 will tend to suffer from osteoporosis-related fracture (Osteoporosis, by Sambrook P, 2006). Besides, the different in percentage of bone between male and female smokers and male and female non-smokers which shown by table 2, 3, 4 and 7 might be due to tobacco smoking which contain toxic compounds. Toxins in smoke will have negative influence on bone remodelling process. Previous study had investigated into two likely candidates which are benzo[a]pyrene (BaP) and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). These two components will stimulates bone resorption by osteoclasts. When used at low doses BaP and TCDD were able to stimulate osteoclast formation *in vitro* and *in vivo*, an effect that was due to interaction with Ahr. Cyp1 inhibitors reduced osteoclastogenesis in cells treated with RANKL, TCDD or

BaP. Furthermore, cells lacking Cyp1a1/1a2 or Cyp1a1/1a2/1b1 treated with TCDD showed lower levels of osteoclast differentiation than cells in which the genes encoding these proteins were functional, demonstrating that the Cyp enzymes are downstream of Ahr.

Furthermore, cigarette smoking can also be directly toxic to the bone. Besides nicotine, the primary addictive compound in tobacco, the other known and suspected toxic compounds can directly kill off osteoblasts. Osteoblasts are the cells that give rise to the bone. They produce the protein known as osteocalcin which is absolutely essential for the proper mineralization of the bones. With the reduction of osteoblasts, the percentage of bone will be reduced as well. Smoking also damages blood vessels and nerves. This means that tobacco use can reduce blood flow and sensations in the limbs. This damage to the surrounding muscles and nerves increases the risks of injuries and bone fractures. In addition, the damage to the blood vessels means that repair to the bones take much longer.

For table 6, when comparing the trabecular percentage of male non-smokers and female non-smokers, the data shows that in age 20-29, female non-smokers has higher percentage of mean value of trabecular, but male non-smokers has higher percentage of mean value of trabecular in age 30-39 and 40-49. Male non-smokers should have greater trabecular percentage, but the difference was dependent on skeletal site for example higher 9% than women in lumbar spine (1.05 ± 0.25 g/cm² for man and 0.96 ± 0.11 g/cm²); femoral neck in men (0.85 ± 0.13 g/cm²) was 6% higher than in women (0.80 ± 0.11 g/cm²). The age achieving pBMD was reached in women was younger than in men. For example, at the femoral neck, age of pBMD in women was 22.4 years (95% CI: 19 - 24) which was earlier than in men (26; 95% CI: 24 - 29). This trend was also observed at the lumbar spine (25 in women and 27 years in men).

Smoking is associated with increased concentrations of free radicals, which may contribute to bone resorption. (Duthie G. G., 1991) A prospective cohort study involving 66651 women, aged 40–76 years of age, found that current smokers with a low vitamin E and C intake had an increased risk of hip fracture. (Melhus H., et al 1999).

CONCLUSION

It can be concluded, based on the panoramic radiograph using image j software at ROI below mental foramen at region 3 and 4, it was found that the trabecular percentage decreases. Based on three age groups; gender as well as between smokers and non-smokers.

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Discription of The Normal Mandibular Alveolar Resorption Pattern Based on Gander Using Panoramic Radiograph

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ABSTRACT

INTRODUCTION: Alveolar bone resorption occurs physiologically. The process of bone resorption and remodeling happens continually throughout our lives. **Objective:** The aim of this research is to describe the normal resorption pattern of alveolar bone based on gender in 30-60 year old people using panoramic radiograph . **Material and Method:** This research is using descriptive method. The Population is all of panoramic radiographs obtained using quota sampling technique from Padjadjaran University Dental Hospital. The sample of this study is the radiograph of 30 males and 30 female aged 30-60 year old. The radiographs measures using Ex-Paz Plus soft ware at four locations: canine, first premolar, second premolar and first molar both of side left and right jaw. **Results:** The study were found that female's resorption mean values of 1.944 and 2.073 in the 30-45 and 46-60 age range, while males were 1.813 and 1.888 respectively. Resorptions, moving from canine to the first molar, when compared between genders were: (males: 1.664, 1.737, 1.987, 2.034; females: 1.642, 1.800, 2.288, 2.304). When compared between the age groups, the resorptions from canine to the first molar were: (30-45 age range: 1.613, 1.717, 2.100, 2.083; 46-60 age range: 1.671, 1.817, 2.204, 2.229). The resorption values in region 3 and region 4 were: (males: 1.900, 1.810; females: 2.052, 1.965). **Conclusion:** bone resorption increases with age, particularly in females. Females experience more bone resorption more than males. Bone resorption tends to increases moving posteriorly, regardless of whether it was based on gender or age. Region 3 experiences more bone resorption than region 4 in both genders.

Keywords: Mandibular, Resorption, Gender, Panoramic

INTRODUCTION

Alveolar bone resorption is one of the most commonly faced dental problems by people encompassing a wide range of ages ¹. However, many studies suggest that it is more prevalent in aging adults (30-60 years). This is because alveolar bone resorption is directly affected by hormonal changes that occur during aging, marked by andropause in men, and menopause in women ^{2,3}. Andropause is the syndrome where the aging male experiences partial androgen deficiency characterized symptoms such as decreased sexuality, erectile dysfunction, alterations in libido. The development of this typical climacterium syndrome is believed to be at about the age of 50 ⁴. On the other hand, menopause is defined as at least 12 consecutive months of amenorrhea not due to surgery or other obvious cause ⁵. Internationally, the median age at which women experience natural menopause is 50 years (range, 49–52 years) ⁶. Andropause and menopause has been known to cause bone loss ^{7,8}.

In a recent research, post-menopausal women was found to consist of more than 15% of the population in developed countries and 5-8% in less developed regions of the world. By 2030, the menopausal and post-menopausal population is expected to increase to 1.2 billion, with 47 million more women added each year ³. Life expectancy in men is also increasing, therefore making bone loss in men has also becoming more and more recognized as an important health issue ². With the increasing population of aging adults (30-60) and its concomitant bone resorption problem, dental health professionals would agree that the resorption pattern occurring in the alveolar bone within this population is a topic of current interest and that studying it would be beneficial to the advancement of dental health.

A study on age related changes in trabecular and cortical bone microstructure revealed that age related bone loss is a result of the interplay of genetic, hormonal and biochemical factors. The loss of quantity and quality of bone is caused by thinning of trabeculae, decrease in cortical bone, and continual resorption at the endocortical surface. These ages related processes are experienced by both males and females, but are especially prominent in postmenopausal women ⁹. Bone remodeling occurs throughout life, with the achievement of maximum bone mass at the third decade of life. This is maintained in small variations until age 50, where thereafter, resorption predominates and bone mass decreases. Bone remodeling increases in premenopausal and early postmenopausal women and then slows with further aging but continues to be faster than in premenopausal women. As for men in their fifties, they do not experience the rapid loss of bone mass like women in the years following menopause. However, by 65 or 70, both men and women experience bone loss at the same rate ¹⁰.

The alveolar bone, despite being unique in location and function, is still part of the skeletal system. It is regulated metabolically along with other bones in the body, and has therefore been positively associated along with overall body bone loss ⁸. There are three main co-factors influencing alveolar bone resorption. The first is the anatomical structure of the jaw such as the bone quantity, bone quality and shape. The second factor is mechanical,

in the form of the frequency and intensity, duration and trajectory of the forces applied on the alveolar bone. The third is metabolic factors consisting of age, female gender, and hormone balance such as estrogen deficiency or menopause. Menopause due to aging is the most common cause of bone loss ¹¹.

The alveolar bone, or "The alveolar process is the part of the maxilla and the mandible that house and supports the alveoli of the teeth. It develops in conjunction with the development and eruption of the teeth, over the basal bone and coronal to it. Physiologically, the alveolar bone is the area where forces are transmitted to during mastication ^{12,13}. The alveolar bone quality is determined by a process called remodeling. *Bone remodeling* is the lifelong process wherein old bone is removed from the skeleton, and new bone is added ¹⁰. This process is governed by osteoclasts, which resorb bone cells, and osteoblasts, which synthesize and mineralize the osteoid, and also produces factors that regulate osteoclast function ¹⁴.

In healthy and young people, there is a good balance between bone resorption and deposition, this prevents bone loss from occurring. However, as we age, the proliferation of osteoclasts causes resorption processes to dominate. This bone loss process begins at 35-40 years, and carries on with different intensities, with perimenopausal women experiencing more accelerated effects as compared to men ¹³. This is because there are many local and systemic factors that affect bone remodeling. The local factors include post extraction conditions, bite stress, while systemic factors are hormones such as estrogen and androgens ^{10,15}. The normal development of bones is determined by correct functioning of the endocrine system. The hormones that play an important role in bone formation include estrogen in females, testosterone and androgen in males, and others ¹⁰.

In post-menopausal women, there is a drop of estrogen levels in the body. This drop in estrogen levels is associated with an increase in the loss of teeth and resorption of alveolar bone ⁸. On the other hand, men are at peak bone mass level in their thirties. At this point men typically have more accumulated bone mass than women. However, after this point, men also experience a decline in amount of bone because of age related decrease in androgen concentration ². It is the loss of androgens or estrogens that increases the rate of bone remodeling and causes an imbalance by prolonging the lifespan of osteoclasts, while shortening the lifespan of osteoblasts, causing bone resorption ¹⁰.

To observe alveolar bone resorption, panoramic radiographs has been extensively utilized by researchers, because they have greater area of hard and soft tissue and the ability to visualize adjacent areas ¹⁶. It is a radiographic procedure that produces single image of facial structures including maxillary, mandibular arches and their supporting structures, utilizes intensifying screens, requires less radiation and saves time ¹⁷. Through panoramic radiographs, we can also determine the quality and quantity of the bone ¹⁸. These factors enable the resorption pattern occurring at different locations in the jaw to be observed, therefore becoming the choice method of normal alveolar bone resorption analysis in this research.

MATERIAL AND METHOD

The methodology of this research is descriptive method ¹⁹. The population in this study is the panoramic radiographs of all patients who come to Sekeloa Dental Hospital with the criteria: 1) Patients Men and women, 2) aged 30-60, 3) good quality radiographs especially the alveolar bone clearly visible, 4) have teeth complete in the mandible, ranging from 2 lateral incisors, molars and 4) there was no fracture of the alveolar bone. Based on this it obtained a total sample of 60 patients (30 male, 30 female). Pasient data subdivided into two age groups: Group A. 30-45 years, group B 46-60 years, both men and women. Assessment conducted on alveolar bone by measuring the height of the alveolar bone in the proximal area of the teeth on both sides of the mesial and distal.

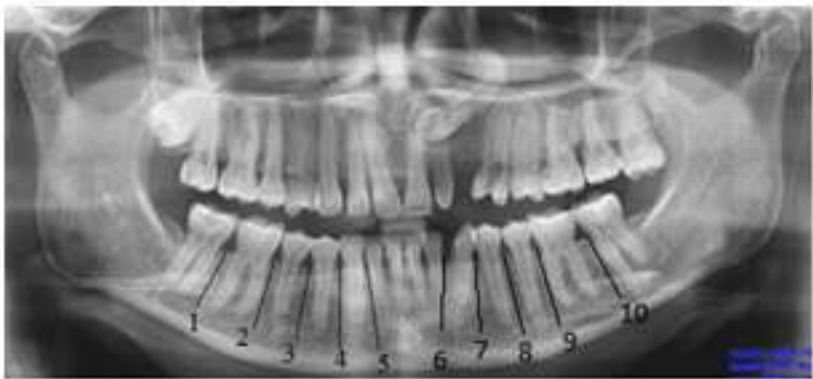


Figure 1. Points where resorption of alveolar bone loss will be measured

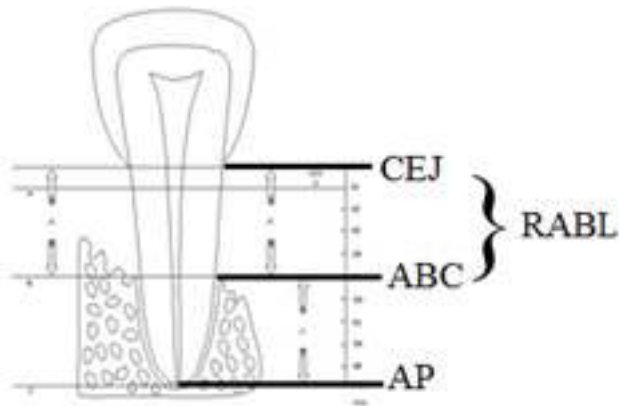


Figure 2: Anatomical location of Cementoenamel Junction (CEJ), Alveolar Bone Crest (ABC), Root Apex (AP) and Resorption of Alveolar Bone Loss (RABL)²⁰

Assessment is done by resorption of Alveolar Bone Loss (Rabl) with the formula ²⁰ :

$$[(CEJ-AP) - 2mm] - [ABC-AP] = RABL.$$

The assessment was performed on alveolar bone by measuring the height of the alveolar bone in the proximal area of the teeth on both sides of the mesial and distal. The measurement technique is illustrated as follows:

The measurement technique is illustrated as below:

RESULTS

Panoramic radiographs were assessed from 30 the males and 30 females respectively. Each gender was further divided by age into two groups- 30-45 years and 46-60 years. Each group contains 15 samples. The normal resorption pattern of the mandibular canines, premolars and first molars were measured. The results are presented in the form of mean resorption values respectively for the results of this research, canine, first premolar, second

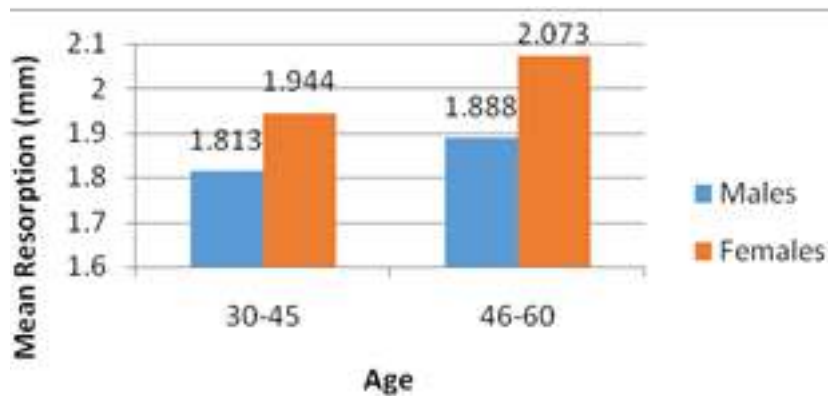


Chart1. Mean Resorption Based on Gender

Table 1. Resorption Pattern of Gender based on Location

Gender	Mean resorption (mm)			
	C	P1	P2	M1
Males	1.664	1.737	1.987	2.034
Females	1.642	1.800	2.304	2.288

Table 2. Resorption Pattern of age based on Location

Gender	Resorption (mm)	
	Region 3	Region 4
Males	1.900	1.810
Females	2.052	1.965

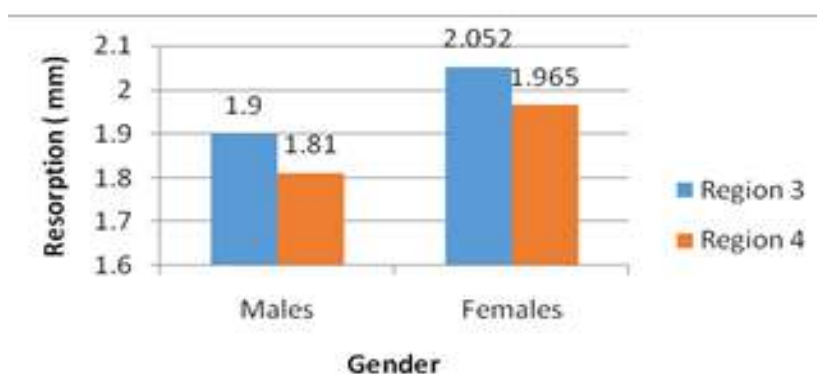


Chart 2. Resorption Pattern on Mandibular Region 3 and 4 based on Gender

premolar, and first molar. Chart 2 shows that females experience more resorption than males in both regions. However, both males and females have more resorption in region 3 than region 4 (males: 1.900, 1.810; females 2.052, 1.965).

DISCUSSION

Based on chart 1, males and females both experience bone resorption as they age ¹³. This is also supported by N. Kaka et al, found that resorption progresses in direct proportion to age, due to the cumulative effects that affect bone resorption such as calculus and caries. After age of 30, men and women experience bone loss at about 1% yearly ^{1,21}. In the 30-45 age range men and women have similar resorption numbers because hormone production for both genders is still normal. However, women still experience more resorption because of their bones are less solid than males, putting women at higher risk of bone loss ²¹. This fact is supported by a statement from the Bilezikian which states that where the amount of bone at any age depends on the peak bone mass of an individual ²².

The 46-60 age range marks the onset of andropause for males and menopause for females, explaining the categorically larger resorption in women. The larger increase from resorption in age 30-45 to 46-60 in women than men also marks the time of hormonal changes of both genders ^{6,23}. Men are less affected by age related bone resorption because their andropause does not bring testosterone production to a complete stop, but rather just diminishes. Women however experience menopause, and there is a complete cessation of estrogen production by the ovaries, which are the main source of estrogen ²⁴.

According to Table 2, resorption generally increases moving posteriorly because, the maximum biting force of the teeth in the molar region is greater, while anteriorly the biting force is lesser. The maximum bite force in the anterior incisor region range from 35-50 psi, in the canine region 47-100 psi and in the molar area 127 to 250 psi. In regions where bite forces are higher, bone resorption rates are also greater ²⁵. In women, the bite force in the second premolars appears slightly higher than the first molar. This is unexpected

because the bite force of the first molar is higher than that of the second premolar. However, the difference is not significant because the second premolar the biting forces of the second premolar are still similar to that of the first molar ²⁶. Also, in implant dentistry, it is generally considered that the anterior mandible consist of a denser and thicker cortical bone with course trabecular bone, while bone in the posterior mandible has thinner cortical bone with fine trabecular bone ²⁵. The deficit in cortical bone results in larger trabecular spaces, and thinning of the trabecular in the cancellous bone ²⁷. In addition to that the trabecular bone is more active in bone remodeling and this makes the posterior mandible more susceptible to bone resorption ²⁸. The course cancellous bone is a characteristic of a healthy skeleton, while the fine cancellous bone is associated with early fracture callus ²⁹.

As expected, females experience more resorption in all locations except the canine region, where males have a higher resorption values. The study by N. Kaka *et al*, provides a possible explanation of this phenomenon- the bone resorption in the lower anterior teeth could be due to the thinner interseptal anterior bone and the opening of the submandibular salivary gland orifice being located lingual to the lower incisors, thus increasing plaque and calculus incidence from saliva formation. Also, most people may meet with difficulty in cleaning the lower anterior region due the curvature of the teeth. This fact could be more prevalent in males who are more careless in brushing ¹.

As depicted on Table 2, shows that bone resorption increases moving from anterior to posterior mandible at age 30-45 and age 46-60. This shows that this resorption pattern of increasing resorption in posterior teeth is independent of age. The only difference between the two age groups is that the resorption values in 46-60 age group is higher. Lastly, based on chart 4.2, it can be observed that region 3, also the left mandible quadrant has more resorption in both genders because most people are right handed ²⁷.

Right handed subjects had higher average plaque index scores in the right quadrant (region 4) compared to the lower left quadrants (region 3). This is because right handed subjects have better access to the left quadrants (region 3) of the mouth for oral hygiene procedures, thus resulting in more successful plaque removal. However, defects such as tooth abrasion were also more commonly found on the left side of the mouth (region 4) than the right side (region 4), which is associated with tooth brushing, also known as the removal of plaque mechanically. Mechanical trauma has been associated with alveolar bone loss ^{31,32}.

This research has a couple of shortcomings. One of the few being that it was unable to be fully determined that the samples were free from systemic diseases or had factors that could affect alveolar bone height. However, each sample chosen had overall good alveolar bone health, with no obvious generalized bone resorption, so it was assumed that the samples were healthy individuals.

CONCLUSION

Based on the panoramic radiographs, it can be concluded that females experience more bone resorption more than males. Bone resorption tends to increases moving posteriorly, regardless of whether it was based on gender or age.

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Description of Panoramic Radiograph Failure at RSGM UNPAD

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ABSTRACT

INTRODUCTION:The panoramic radiograph is a single and a large X-ray film that shows the entire face and the bony structure of the teeth. There are few errors in performing panoramic radiographs such as positioning errors and technical errors. **Objective:** The purpose of this research is to identify the failure of panoramic radiograph at RSGM UNPAD. **Materials and methods** The method of this research was a descriptive research with secondary data collected by a cross-sectional technique from February until March 2016. There were 418 total sample of failed panoramic radiograph taken in the Radiology Installation of RSGM UNPAD. **Result:** From the result, the largest proportion of the sample is from criteria 9, contact between tongue and palate, which accounts for (46.41%). This is followed by criteria 3, chin pointing upward (23.44%), criteria 10, open lips (20.81%), criteria 2, head behind of the plane focus (17.46%), criteria 7, head turned to the right (14.35%), criteria 11, incorrect position of the spine (13.39%), and criteria 6, head tilted to the left (11.24%). Meanwhile, there are five criteria reported the least number of sample firms, which account for less than 10 percent, namely criteria 1, head forward of the plane focus (9.33%), criteria 4, chin pointing down (8.61%), criteria 8, head turned to the left (8.37%), criteria 5, tilted to the right (7.65%), and criteria 12, movement during exposure. **Conclusion:** As a conclusion, the error that occurs most often is the patient does not put their tongue on the palate accounts for, while fewest error of the criteria applicable is as much as movement during exposure.

Keyword: Panoramic radiograph, Failure, RSGM UNPAD

INTRODUCTION

A panoramic radiograph is considered useful and practical to complement the clinical examination in the diagnosis of diseases of the teeth, such as endodontic disease, and disease of the bones of the face¹. One of the complementary exams more often performed

by the dentist has been the radiographic examination, which is important in the auxiliary diagnostic in oral problems.²

The main indications of panoramic radiography are the general survey and oral health; provide best subsidies for surgical procedures; initial and progressive evaluation for orthodontic treatment; information on growth and development in children. Moreover, the review about chronological dental eruptions and axes of eruptions of permanent teeth; cystic lesions or neoplastic views; dimensional measurement for implantology; historical documentation of the patients; evaluation of the temporomandibular joint and to detect the existence of foreign bodies are also the indication of panoramic radiography.³

In some cases that the image quality is not satisfactory, the value of the radiographic images decreases and they should be repeated. It will also result in increased exposure to radiation, more cost, and waste of time (Kaviani et al., 2008) Such compromised quality is not the result of the existing limitedness of radiographic equipment; rather, they usually result from errors committed by the operators during patient adjustment. Therefore, knowledge about common errors during preparation for panoramic radiographs might be effective in preventing unnecessary exposure of the patients to radiation, wasting their time, imposing extra costs on them, and finally resulting in high-quality images.⁴

In a study by Rushton, the most common technical errors were the patient anteroposterior position, and low radiographic contrast and density.⁵ In another study, 35% of the images were free of errors and in 20% of them the patients' head were in a more anterior position than the standard. In 15.5% of the images, the patients had not placed their tongues on the palate.⁶ In general, the least frequent error was related to patient movement.⁷

In a study by Al-Fateh, the most common positional error was a superimposition of the palatoglossus air space on the roots of maxillary incisors (81.8%), followed by a half slumped position of the patients (17.2%).⁸ In a study by Glass et al., the most common errors in panoramic radiographs of 75 edentulous patients were evaluated; in 67 radiographs (89.3%) there were one or more errors regarding the correct positioning of the patients.⁹

In a study by S.Pandey, all radiographs taken for a 3 months period were 1010. All panoramic radiographs examined for various errors. Data were analyzed for the frequency of some faults, both technical and processing errors, which directly contributed to the failure of the radiographs. Total 1010 radiographs were analyzed for errors. 27.5% (n=278) were showing errors which ranged from technical errors 11.3% (n=14) to positional errors 16.2% (n=164) and 72.5% of radiographs were error free. The most common technical error was density/dark radiographs which were 45% (n=51) and the most common positional error found was tongue not resting against the palate, 20% (n=32).⁷ A perfect X-rays cannot be done immediately but takes time to get it.¹⁰

Concerning the importance of panoramic radiography in the field of dentistry, a study will reveal the failure of panoramic that usually occurred in performing this radiograph for the operator's reference and guidance in order to minimize the errors that usually happened. Based on the information above, the author is interested in conducting a research that

investigates the positioning errors of panoramic radiograph at the Radiology Installation of RSGM UNPAD will be conducted. The aim of this study is to identify the failure of panoramic radiograph at the Radiology Installation of RSGM UNPAD.

The purpose of this research is to determine the common factors that are affecting the failure of panoramic radiograph at the Radiology Installation of RSGM UNPAD.

MATERIALS AND METHODS

The design of this research will be descriptive study. It will be carried out by making overviews of common failures in performing panoramic radiograph at the Radiology Installation of RSGM UNPAD. The population of this would be all the panoramic radiographs at RSGM UNPAD. The samples used in this research will be the failed panoramic radiographs taken in the Radiology Installation of RSGM UNPAD that meet the positioning error criteria. The sample size will be determined by purposive sampling technique. The total sample size calculation would be estimated from 450 samples to 500 samples.

This research would only enroll, the failed panoramic radiographs due to incorrect position that was taken at RSGM UNPAD:- ¹¹

- Head positioned forward the plane of focus
- Head positioned behind the plane of focus
- Chin pointing upward
- Chin pointing down
- Patient's head tilted to the right
- Patient's head tilted to the left
- Patient's turned to the right
- Patient's turned to the left
- Absence of contact between tongue and palate
- Open lips
- Incorrect positioning of the patient's spine
- Patient movement during exposure

RESULT

Table 1 Distribution of Subject According to Gender

Gender	Total Radiograph	Percentage (%)
Male	185	44.26 %
Female	233	55.74 %

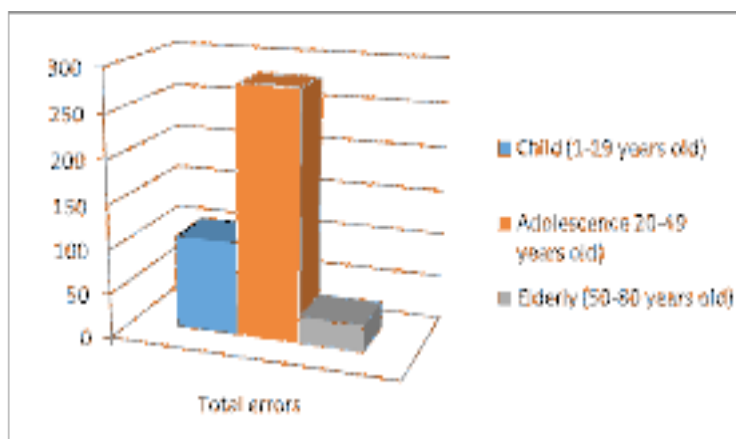


Diagram 1 Distribution of subject according to gender

Table 2 Total Errors Based on the Age Group

Age Group	Total errors	Percentage (%)
1-19 years old	106	25.36 %
20-49 years old	281	67.22 %
50-80 years old	31	7.41 %

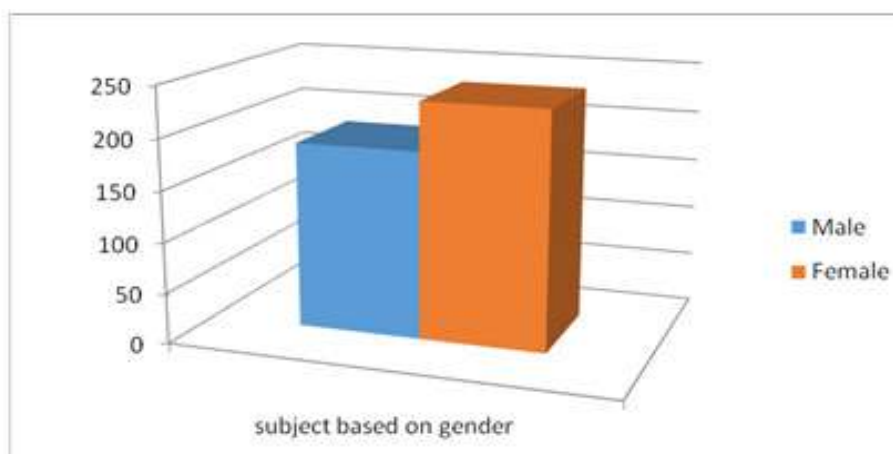


Diagram 2 Total Errors Based on the Age Group

Table 3 The Result of Positioning Errors Observed in RSGM UNPAD

Panoramic Radiograph Failure at RSGM UNPAD		
Criteria	Total errors	Percentage (%)
Head forward of the plane focus	39	9.33 %
Head behind of the plane focus	73	17.46 %
Chin pointing upward	98	23.44 %
Chin pointing down	36	8.61 %
Head tilted to the right	32	7.65 %
Head tilted to the left	47	11.24 %
Head turned to the right	60	14.35 %
Head turned to the left	35	8.37 %
No contact between tongue and palate	194	46.41 %
Open lips	87	20.81 %
Incorrect position of spine	56	13.39 %
Movement during exposure	29	6.93 %

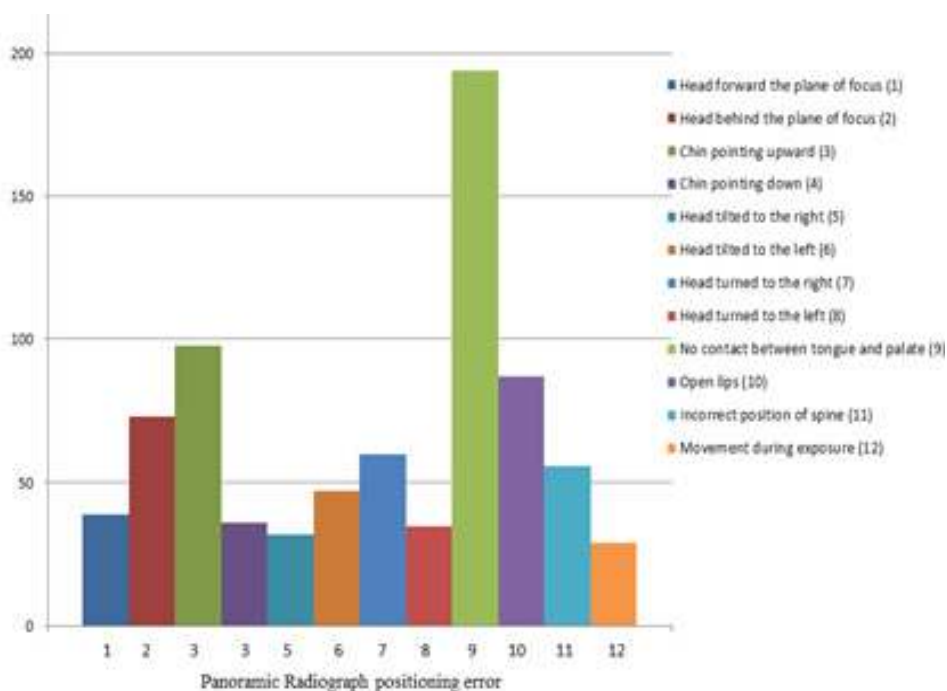


Diagram 4.3 The Result of Positioning Errors Observed in RSGM UNPAD

DISCUSSION

Table 1 and diagram 1 shows the female is the majority subject to the percentage of 55.74% with a total of 233 panoramic radiographs while male subject is 44.26% with a total of 185 radiographs. This result is aligning with a previous researcher Benjamin et al (2011) with results, 47.3% males and 52.7% females where the female subject is higher than the male subject.

It can be further seen in Table 2 and Diagram 2, the result of total errors is classified into three stages of age group. Stage one, child from the age of 1 to 19 years old, stage two, adolescence from the age 20 to 49 years old and stage three, elderly from the age 50 to 80 years old. With regards to the classification of total errors into a respective age group, the largest proportion of the total errors is from the adolescence group (20-49 years old), which accounts for 67.22% of the total errors. This is followed by child group (1-19 years old) 25.36% and elderly (50-80 years old) 7.41%. This result is not in any agreement of researchers because many of the studies excluded the child subject from their sample of the study. This is proved by the study done by Dhillon, 2012 and Al-Faleh where they excluded child as their sample of the study. In brief, these results indicate that the majority of the age group that usually makes positioning errors are from the age group of 20 to 49 years old (adolescence).^{8,17}

Table 3 and diagram 3 provide the descriptive statistics of the sample across 12 specified criteria of positioning errors that have been employed in this research. With regards to the identified criteria, the largest proportion of the sample is from criteria 9, contact between tongue and palate, which accounts for (46.41%). This is followed by criteria 3, chin pointing upward (23.44%), criteria 10, open lips (20.81%), criteria 2, head behind of the plane focus (17.46%), criteria 7, head turned to the right (14.35%), criteria 11, incorrect position of the spine (13.39%), and criteria 6, head tilted to the left (11.24%). Meanwhile, there are five criteria reported the least number of sample firms, which account for less than 10 percent, namely criteria 1, head forward of the plane focus (9.33%), criteria 4, chin pointing down (8.61%), criteria 8, head turned to the left (8.37%) criteria 5, titled to the right (7.65%), and criteria 12, movement during exposure (6.93%).

The results from the survey report 39 errors (9.33%) is grouped under criteria 1, the patient's head forward of the plane focus. This result is in agreement with results obtained in the studies done by Shakeel Khan (2015) where the result of patient's head forward the plane of focus error percentage is 20.8% that examined 480 samples which is higher than recent study. They differ in result because a study by Shakeel Khan, 2015 examined all pretreatment digital panoramic radiographs of patients with permanent dentition, presenting to the Orthodontic Department where recent study the sample is taken from a various department. According to Choi (2012), the images in a radiograph will appear shortened and narrowed due to the front teeth located out of focus with a blurred aspect.¹² In addition, the premolars will overlap the column on the ramus of the mandible.

Table 4.3 also indicates that 73 errors which represent 17.46% is grouped under

criteria 2, the patient's head behind of the plane focus. This result is in agreement with results obtained in the studies done by Dhillon (2012) that the result shows 30.0% of percentage for patient's head positioned behind the plane of focus based on 1,782 samples which is higher than recent study. The explanation to the differ in result compare to recent research is that the period of sample from the study of Dhillon is taken for 38 months while recent study is taken for 2 months. This occurs when the patient's head positioned behind the plane of focus, the dental arches, especially the anterior teeth are located outside of focus with a blurred aspect as seen on the forward head positioned in expanding along a horizontal direction. This is supported by Passler and Vesser 2006; Langland and Langlais, 2002, who stated that the condyles can be designed to the side edges of the image receptor.^{13,14}

The other explanation for forward and backward position of the teeth on the notched bite block may be attributed either to a misunderstanding of the patients or even to underestimate the importance of proper positioning in performing the panoramic radiograph. In this study backward positioning (17.46%) was more prevalent than forward positioning (9.33%). This is with agreement by Dhillon et al that reported in their study that backward positioning of the patient (30%) was more prevalent than forward positioning (18.3%)

Meanwhile, there are 98 errors (23.44%) is grouped under criteria 3, chin pointing upward. This result is in agreement with results obtained in the studies done by Al Faleh (2002) that the result recorded for the percentage of chin pointing upward account for 11.6% that examined 500 samples which is lower than recent study. The result differs as seen that the studies done by Al Faleh is only focused on six positioning errors compared to recent studies that focus on twelve criteria of positioning errors. Under those circumstances, if the chin is elevated, the occlusal plane on the radiograph appears flattened or inverted, and it creates a distorted image of the jaw. Hence, the shadow radiopaque palate bone overlaps the roots of the maxillary teeth. Accordingly, Ezoddini Ardakani (2011) argued the chin of the patient and the occlusal plane must be positioned correctly so that distortions are avoided.¹⁵ In contrast, if the chin pointing down, the teeth are too overlapping region and the symphysis may be out of the jaw radiography. In addition, both mandibular condyles can be projected out of the upper edge of the image.¹⁶ As shown in table 4.3 the results indicate there are 36 errors is grouped under criteria 4, chin pointing down (8.61%). In another research stated that the percentage for chin pointing down is (12.5%) by Shakeel Khan (2015) based on 480 samples which is higher than recent study. The differ in the result is because of the amount of sample conducted by Shakeel Khan et al higher.

Furthermore, the results of the research pointed out that there are only 32 errors (7.65%) is fall down under criteria 5, titled to the right, while 47 errors (11.24%) fall down under criteria 6, titled to the left. In fact, Dhillon (2012) states that it is very common for the patient to incline or turn the head to the right or left. Therefore, it is possible to observe the radiographic image in an asymmetric structure to the side to which has the slope seemed to have reduced in size compared to the opposite side and occurs marked overlapping in the proximal surfaces.¹⁷ This result is also supported in the research by Dhillon that the percentage of patient's head tilted to left or right is 12.7% that examined 1,782 samples.

The explanation to the difference in results compared to this research is that the amount of sample from the study of Dhillon is taken for 38 months while this study is taken for 2 months with a large sample size.

In addition, criteria 7, head turned to the right and criteria 8, head turned to the left report the total error as 14.35% and 8.37%, respectively. For this reason, the film shows that the teeth on one side of the midline appear to have extended and to overlap the sharp proximal surfaces, whereas, the teeth on the opposite side are shown shortened. As a result, the branch from one side of the mandible appears much larger than the other one, and the condyles differ in size. This result is in agreement with the result obtained in the studies done by Kaviani (2008) reported that the percentage of patient head rotation to left or right occurred accounts for 39.5% based on 250 samples. They differ in a result seen in the study of Kaviani higher than recent study because the amount of sample is lower than a recent study that only emphasizes in positioning error compared to the previous study by Kaviani that conducted darkroom errors, failure to remove metallic accessories, and equipment setup error.

On the other hand, Table 4.5 highlighted that 194 errors are grouped under criteria 9, no contact between tongue and palate meanwhile 87 errors are grouped under criteria 10, open lips. Under that situation, the absence of tongue contact with the palate is identified by the visualization of a radiolucent band designed at the height of the apex of the upper teeth in a panoramic radiograph. Moreover, if the tongue is not on the palate or the lips are open, the air between the parted lips obscures the crown of the upper and lower teeth. The apical region of the maxillary teeth is obscured by the dark air space between the dorsum of the tongue and the hard and soft palates (palatoglossal air spaces). This is supported by Akarslan et al., (2003) who provided that the position of the tongue also has a great influence on the quality of the radiographic image.¹⁸

The possible explanation for this error may be a lack of communication between the operator and the patient because of different languages. The technician may find difficulty in instructing the patient to swallow and to keep the tongue on the roof of the mouth. Another explanation is that the patient sometimes may misunderstand the instruction, putting only the tip of the tongue on the palate, or the patient does not pay much attention to the instruction given by the operator. Finally, criteria 11, incorrect positioning of spine and 12, patient movement during exposure show a result of 56 errors and 29 errors, respectively. This result is in agreement with the result obtained in the studies done by Al Faleh (2002) research that the incorrect patient's spine occurred accounts for 17.2% that examined 500 samples. With respect to posture of the patient, the incorrect column positioned and movement during radiography can produce a "ghost image" in radiopaque area in the center of radiography, in the region of the incisors, as well as blurred portions in radiography and large site defects in the inferior border of mandible.¹⁷ The explanation for the incorrect spine is there is a natural inherent tendency for patients when holding the handles of the machine to slump. The dental technician needs to make sure before taking the radiograph that, the patient's back and spine are erect with the neck extended.

Based on table 4.3 the result shows the largest percentage is absence contact of the tongue on palate criteria account for 46.41%. This is supported by S. Pandey in 2014 that also result in the highest amount of percentage is 71.6% that examined 1010 of radiographs.⁷ The least numbers of percentages based on the research result are patient movement during exposure, which is accounted for 6.93%. This is confirmed by the study of Dhillon in 2012 that examined 1,782 radiographs of panoramic with a percentage of 1.6%.¹⁷

CONCLUSION

The most frequent type of mistake in panoramic radiograph is patient positioning errors. Based on current research that has been conducted, the most common of positioning error is the patient does not put their tongue on the palate. Meanwhile the least common of positioning error is patient movement during the exposure of panoramic radiograph.

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim. In the name of Allah SWT, the Most Gracious and Most Merciful for His blessings and His will to grant me strength, willpower and determination to complete my thesis as one of the requirements to graduate as Sarjana Kedokteran Gigi at Faculty of Dentistry, Universitas Padjadjaran. I would express my deepest and sincere gratitude to all these individuals who helped me directly and indirectly throughout the process of completing this minor thesis. Dr. Nina Djustiana, drg., M.Kes as the Dean of Faculty of Dentistry, University of Padjadjaran. Drg, Ria N Firman, M.Hkes., Sp.RKG (K), as my first supervisor for her full guidance, valuable time, immense patience, constructive suggestions and advice in the study deserve my warmest gratitude. Drg, Farina Pramanik. MM., Sp.RKG, as my second supervisor for her valuable ideas, inspiring discussions, endless encouragement, guidance and time are much appreciated. Dr. Drg. Avi Laviana, Sp. Ort as my dosen wali for her advice and guidance, endless encouragement, and time are much appreciated. The lecturers and staffs of Radiology, Department of Faculty of Dentistry, Universitas Padjadjaran for their overwhelming cooperation. My beloved parents, Mohd Shuhaimi Bin Yunus and Nik Samihah Binti Maidin. My siblings; Muhammad Nubli, Ahmad Faizal, Nik Rozlin Elini, Nik Hanis Nujhan, Nik Suriani, Ahmad Syafiq and Muhammad Wafiy for their prayers, endless encouragement, and love in making this thesis possible. All KPBI staffs and lecturers for their cooperation and assistance in the process to complete this study. My fellow classmates who helped me and guided me in completing this minor thesis. Thank you for those who have involved directly and indirectly for their constant support, help and advice. May Allah SWT bless all of them, for all the contribution they have made for this thesis to be completed. I hope this research would be meaningful and can be referred as a guidance for education purpose in the future.

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Description of Corpus Length and Ramus Height of Mandible in Patients with Panoramic Radiograph

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ABSTRACT

INTRODUCTION: Mandible consist soft womain parts which are the ramus and the corpus. Corpus leng than dramus height grow differently according to age and gender.

Objective: The purpose of this study is to determine the growth of corpus length and ramus height of mandible.

Materials and methods The method of this research was a descriptive research with secondary data collected by cross-sectional technique from June until December 2014. There were 157 panoramic radiograph taken from Radiology Installation at RSGM UNPAD, 88 were females and 69 were males, measurements had been done using EzImplant software. Corpus length was measured from gonion to median line of mandible whereas ramus height was measured from highest point of condyle to gonion.

Result: From the result, average of corpus length in males was 79.98 mm (6-13 years), 90.89 mm (14-16) and 93.22 mm (17-30). Average of ramus height in males was 45.90 mm (6-13), 56.69 mm (14-16) and 59.62 (17-30). Average of corpus length in females was 75.49 mm (6-11 years), 85.85 mm (12-14) and 87.50 mm (15-30), while the average of ramus height in females was 42.92 mm (6-11), 51.11 mm (12-14) and 54.03 (15-30). **Conclusion:** As a conclusion, corpus length and ramus height increase along with age. The mean of corpus length and ramus height are higher in males than in females. The largest growth occurred during 14-16 years in males and 12-14 years in females, corpus length and ramus height showed the same growth pattern.

Keywords : corpus length, ramus height, mandible, panoramic radiograph

INTRODUCTION

Mandible is the bone of the lower jaw, which is known as one of the most important bones in the craniofacial complex. The pattern of mandibular growth coincides with body height growth during adolescence.¹ Thus, it can be represented the same as the growth in

height velocity curve. Although growth seems to cease after pubertal growth spurt, growth changes still occurred between late adolescence to mid-adulthood.² However, Behrents concluded that craniofacial skeletal changes continue to occur at least until the third decade.³ Mandible grows differently according to age and gender. The growth increases as the age increases. For example, in females, the mandibular length relatively increased from ages 6 to 14 per year, respectively.⁴ In adulthood, the corpus length are also increasing according to ages, from 6 to 18 years old.⁵ As stated before, gender also influenced the mandible's growth. Apparently, males have higher values of ramus height when compared to female and it is statistically significant.⁶ On the other hand, corpus length also is recorded higher in males.⁵

According to Enlow and Moyer's Classification, controlling factors that can influence craniofacial growth generally is divided into two categories which are the natural factors and disruptive factors.⁷ Examples of natural factors are genetic, function, general body growth and neutrophism while disruptive factors such as orthodontic forces, surgery, malnutrition, malfunction and gross craniofacial anomalies are the factors that can also influence the growth process.⁸

In this study, panoramic radiograph is used to describe the corpus length and ramus height that have been portrayed in the images. Panoramic radiography has contributed as the imaging procedure which is very useful for diagnostic problems as it gives broad coverage of maxilla and mandible.⁹ However, the main reason of using panoramic radiograph in this research is because it shows bilateral view of both jaws, therefore allow us to see any differences between two sides and also provide us with vertical measurements of the mandible adequately.⁶

This study is important in orthodontics for diagnosis, prevention, interception, and correction of malocclusions. This will help to will improve treatment planning as most orthodontic treatments take place during growth.¹⁰ Besides that, it also give contribution in dental implants as implant placement is recommended only after growth has ceased or clinically insignificant, the understanding of mandible growth and the changes that took place is.² However, the main contribution of this study is that it can be very useful for medico legal and anthropological work to identify human skeletal remains.¹¹ Mandible becomes the definite source for gender confirmation when there is absence of complete pelvis.¹²

Without the information of mandible's measurements which varies from different age and gender, treatment may be complicated and need further observation. Understanding the growth of craniofacial is one of the key points for successful orthodontic treatment. Orthodontic and dental implant treatment would not be successful without correlating treatment plan with craniofacial growth pattern in patient properly. Whereas in the scope of forensic, human identification process would take more time to be accomplished thus delay the data processing. The objective of this research is to know the average of corpus length and ramus height in patients with panoramic radiograph.

MATERIALS AND METHODS

This research is a simple descriptive research. The populations were the secondary data of panoramic radiograph in RSGM UNPAD. The samples are taken from June until December of 2014 from RSGM UNPAD based on the criteria below using purposive (non-random) sampling technique.

Samples taken must have the following criteria:

1. Age: From 6 to 30 years old
2. Presence of mandibular anterior teeth
3. Clear and sharp images of panoramic radiograph with good quality

Samples will be excluded according to these following criteria:

4. Presence of jaw fractures at growth center of mandible (condyle and angle)
5. Presence of wire and plates
6. Median line of the jaw portrayed on the panoramic radiograph images cannot be determined: when there are superimposed images and the position of roots are slanted.
7. Mandible is not rotated

The operational definition in measuring corpus length and ramus height are as followed:

1. Corpus length is a distance between gonion and the median line of mandible. Gonion is the bisecting point of intersection between posterior border of ramus and the body of mandible. Median line is the vertical line portrayed from a point in between of mandibular central incisors to the lowest point of chin.
2. Ramus height is a distance between condylion to gonion in which condylion is the highest point on the mandibular condyle whereas the definition of gonion is the same as stated before.



Figure3.1Diagramshowonhowtomeasureramus height(1)andcorpus length (2)of themandible.¹³

RESULT

Each of the corpus length and ramus height is recorded and the result will be the mean of corpus length and ramus height based on gender and phase. Result is presented in the form of diagram as followed:

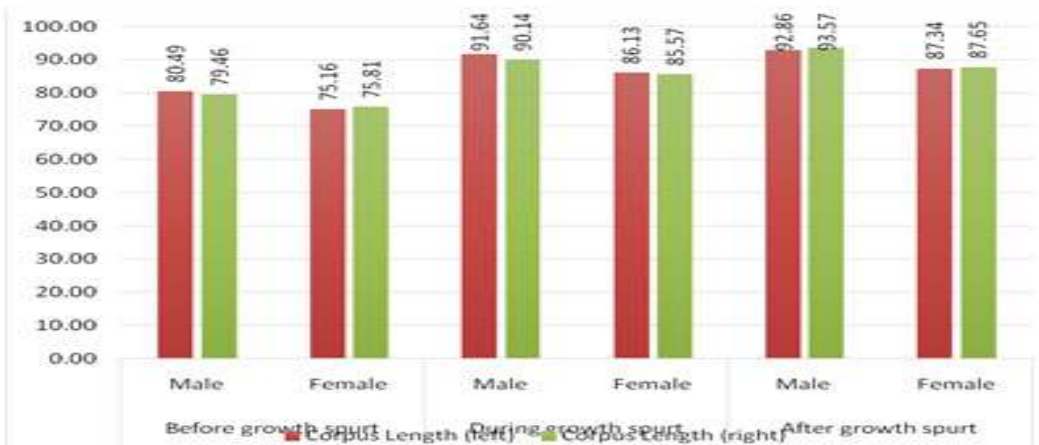


Diagram 4.1 Comparison of corpus length according to gender

Note:Before growth spurt (male) = 6-13 years old; Before growth spurt (female) = 6-11 years old; During growth spurt (male) = 14-16 years old; During growth spurt (female) = 12-14 years old; After growth spurt (male) = 17-30 years old; After growth spurt (female) = 15-30 years old

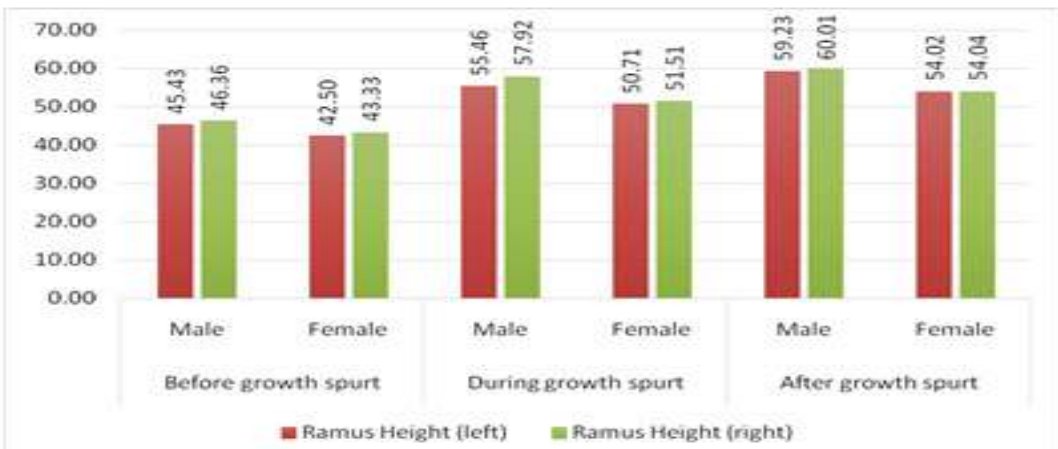


Diagram 4.2 Comparison of ramus height according to gender

Note:Before growth spurt (male) = 6-13 years old; Before growth spurt (female) = 6-11 years old; During growth spurt (male) = 14-16 years old; During growth spurt (female) = 12-14 years old; After growth spurt (male) = 17-30 years old; After growth spurt (female) = 15-30 years old

Based on the diagram above, there is a difference between male and female in which both sides of corpus length in male subjects are higher than female subjects from before growth spurt phase until after growth spurt phase. The graph also has shown that there is a slight difference between left and right side of corpus length in both genders although the value is very small. There is no determined result on which side of corpus length is longer.

Based on the diagram above, the difference of ramus height between male and female is quite obvious. Both sides of ramus height in male subjects are seen higher than female subjects in every phase. Similar to the comparison of corpus length, there is a slight difference between left and right side of ramus height seen in both genders.

To show the comparison of increment of corpus length and ramus height in each gender, the mean of measurements of left and right side are combined to find an average, as showed in table 4.1 above.

Based on the results from table 4.1, a diagram is illustrated as above to show the comparison of increment of corpus length and ramus height in male and female. According

Table 4.1 Average of corpus length and ramus height based on gender

Gender	Male			Female		
Age (years)	6-13	14-16	17-30	6-11	12-14	15-30
Corpus length (mm)	79.98	90.89	93.22	75.49	85.85	87.50
Ramus height (mm)	45.90	56.69	59.62	42.92	51.11	54.03

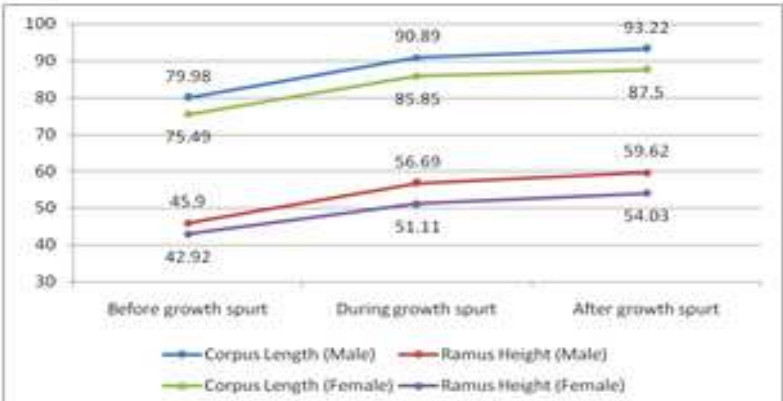


Diagram 4.3 Increment of corpus length and ramus height in both genders

to diagram 4.3, corpus length shows the same pattern and almost the same amount of increment as ramus height in male subjects. In female subjects, corpus length and ramus height display the same pattern of increment however, it can be seen in diagram 4.3 that corpus length shows a slightly higher increment than ramus height from before growth spurt until during growth spurt.

DISCUSSION

This research is carried out to study the growth and development of mandible. Hence, the subjects chosen in this research still undergo growth and development. Subjects beyond age of 30 years old are excluded since growth started to cease after that. In this research, it is found that corpus length and ramus height continuously increases with age. Corpus length increases from 79.98 mm to 90.89 mm until 93.22 mm recorded in the oldest age group in males. While in females, it increases from 75.49 mm to 85.85 mm and to 87.50 mm in the oldest age group. This confirms with the finding by Kostelac⁵ in 2004 that a gradual increase was noticed with age for both male and female subjects from age group of 6 to 12 years amounted to 74.73 mm, in the age group of 13 to 15 years it was 77.95 mm and in the oldest age group, from 16 to 18 years, 81.12 mm. A study about changes in the craniofacial complex from adolescence to mid-adulthood also reported that corpus length increases with age in both genders.²

Ramus height also showed the same pattern of growth when it increases from 45.90 mm to 56.69 mm until 59.62 mm in males. Whereas in females, it increases from 42.92 mm to 51.11 mm until 54.03 mm recorded in the oldest age group. The same result recorded by Kostelac⁵ in 2004 that ramus height increased gradually from 6 to 12, 13 to 15 and 16 to 18 years whereby the value measured was 43.38 mm, increasing to 46.81 mm and 49.66 mm respectively. This also confirms with the result found by Al-Habab⁶ in 2012 that the mean of ramus height in age group of 11 to 19 years was 46.116 increasing to 53.874 mm in age group of 20 to 29 in males while in females, it increased from 45.837 mm to 53.123 mm.

These results can be explained by the growth and development that occur in mandible in which remodeling and displacement take place. As a result, changes occur in growth of mandible with a basic concept known as the V principle.¹⁴ Bone deposition occurs on the inner side while resorption occurs on the outside surface. The "V" moves away from the tip and enlarges simultaneously. Thus, mandible increases in size and growth movement are in unified process.¹⁵ This explained the result of increasing corpus length and ramus height found in this research earlier.

Based on this study, the highest increments of both measurements are recorded from before growth spurt phase until during growth spurt phase. This is due to the pubertal growth spurt that took place during adolescence. According to a research conducted by Gomes¹⁰ in 2006, the highest mandibular growth rates of corpus length and ramus height were recorded during peak of growth velocity phase in which the pubertal growth spurt take place. This also confirms with the result in a research of growth of mandible during pubescence in which

the increments are recorded annually and the highest mean of increment of corpus length and ramus height were during pubertal spurts.¹⁶ According to Proffit¹⁷, greatest craniofacial change occurs during growth spurt takes place thus, supporting the result of this research.

This research's result also suggested that there is a slight difference between increment of corpus length and ramus height. This result contradicts with the theory and other previous studies. Theoretically, vertical aspects of craniofacial growth have greater growth potential than the anteroposterior aspects.¹⁸ According to Enlow and Hans⁷, the ramus normally becomes more vertically aligned during its development due to "remodeling" rotation of ramus alignment that causes condylar growth becomes directed in a more vertical course along with the rest of the ramus.

Thus, ramus height should display greater growth changes than corpus length as what has been proved in a study of maxillary and mandibular growth increments, showing a result of increment in ramus height by 30.6 % higher than in corpus length by 21.4 %. Hence, concluded that ramus exhibited the largest percentage increase.¹⁹ However, the increment of ramus height does not show much difference than corpus length in this result. This might be due to the differential rates and amounts of deposition and resorption throughout each field in every individual. Therefore, overall mandibular growth is not uniform and steady, because corpus length and ramus height grow in an irregular pattern.²⁰

In this research, it is concluded that male has longer corpus length and higher ramus height compared to female. This finding is in accordance with previous studies by Kostelac⁵ in 2004, Al-habab⁶ in 2012, Yassir²¹ in 2013 and West and Mcnamara² in 1999 suggesting that corpus length and ramus height were higher in males than in females. This could be due to the hormone factor. Gonadotrophic hormone of the pituitary gland stimulates the production of testosterone in males. This testosterone stimulate growth of muscle and bone in male in a way that it caused different changes in craniofacial skeleton between two sexes.²² Bite force also affected the growth of mandible where maximum bite force in male can increase the thickness of the masseter muscle thus, seem to develop a greater ramus height.²³ Another reason is because of the two extra years of childhood growth that males have since the pubertal growth spurt is delayed two years after females. Therefore, males tend to grow more and they become larger than females.¹⁸

The left and right side of corpus length and ramus height recorded in this research are approximately the same. Hence, this proves that there are no asymmetries in subjects studied in this research. Anatomically, the left and right side of mandible are equally the same except when there are conditions such as TMJ disorders, chewing habit and other factors that can affect the symmetry of jaw.

This research provides general information about growth and development of mandible that is easy to be comprehended. Grouping of ages in this study allows differentiating the rate of growth that takes place in every phase thus, concluding which phase display the highest growth. The mean and increment of corpus length and ramus height according to age could be determined and this information could be used mainly in the identification of individuals in forensic. However, the range of ages used in this study is quite large; therefore

it does not allow the author to elaborate more on the growth and development in every age of years hence, smaller range of ages would give a more accurate and detailed result.

CONCLUSION

Based on this research result, it can be concluded that the corpus length and ramus height increase along with age in subjects aged from 6 to 30 years old due to the growth and development process. Corpus length and ramus height are recorded higher in males than in females for both left and right side. The highest increments of both measurements are found before growth spurt phase until during growth spurt phase. Corpus length and ramus height showed the same growth pattern. The measurements of both left and right side are almost the same even though there is only a slight difference between both sides, thus it does not affect the result.

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Analysis of The Mandible Cortical Bone Height in Amlodipine user Patient Using Panoramic Radiograph

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ABSTRACT

INTRODUCTION: Hypertension is a systemic disease that is associated with blood vessels. One consequence of this disease is the sufferer must take anti-hypertensive drugs for a lifetime. There is a miraculous kind of anti-hypertensive drug classes include channel blocker, which is able to block the absorption of calcium into the body, and consequently decreased bone density and quality. Measurement of bone density can be performed using a digital panoramic radiograph. **Objective :** To analysis the height of the cortical mandibula bone in amlodinine user patient using panoramic radiograph. **Material and Method:** This study using descriptive research design. Analysis was performed on 30 patients using panoramic radiographs amlodipine, where measurements were taken at the mandibular cortical bone. Assessment is done by three index measurement: Antegonion Index (AI), Gonion Index (GI) and Mental Index (MI). **Result :** based on research results, the value of GI and AI had a similar range between 1.75 to 1.76 mm, while MI ranges from 1.8 to 1.9 mm. When Viewed with the normal value indicates it turns out the only difference seen in MI.. **Conclusion:** The conclusion that can be drawn from this study, the height of the mandibular cortical bone in patients taking amlodipine, index AI andgh GI not seen any difference, whereas in MI seen there is a decreasevisible compare than normal patient, but the three of them is quite normal its mean that there is no osteoporosis or osteopenia.

Keyword: Cortical Mandibula Height, Mental Index, Gonion Index, Antegonion Index, Amlodipine

INTRODUCTION

Hypertension or high blood pressure is a vascular disorder that cause in the supply of oxygen and nutrients carried by the blood to the tissues of the body is inhibited.¹ Prevalence of hypertension according to the American Heart Association (AHA) in American in patients aged over 20 years reached numbers 74.5 million people, while in Indonesia in 2007 was 31.7% are cases.²

To treat a hypertension commonly doctor using oral medication. Hypertension drug, such as amlodipine, is a Calcium Channel Blocker class. Amlodipine as peripheral arterial vasodilator, and causes a decrease in vascular resistance, which in turn lowers blood pressure. Several studies have described about the effects of drug use Calcium Channel Blockers, suspected that these drugs can affect the quality of the calcium in the bones, This is evidenced by Rejnmark et al in 2006 which found that the risk of fracture increased by 6% in the Calcium channel blocker or amlodipine, while Takaoka et al in 2013 reported the same about Calcium channel blockers, but until now research will be it is still very rare.^{2,3} Panoramic radiography is one of the conventional radiographs of the most common and frequently used in dentistry. A panoramic radiograph provides thorough information we can continuously. Many examinations can be made include bone density measurement. Sign of the reduction in density can be seen with some indicators on panoramic radiographs, one technique to assess is the height of the cortical bone of the mandible with five index measurements, namely Panoramic Mandibular Index (PMI), Mandibular Cortical Index (MCI), Mental Index (MI), Gonion Index (GI) and Antegonion Index (AI).⁴ Hypertension patients who consume amlodipine is suspected decreased in bone density. which can use panoramic radiographs, through multiple indices of measurement, this is the basic of this research.

MATERIAL AND METHOD

This research is descriptive research design, which will see a comparison of mandibular bone height in patients in amlodipine user and non-amlodipine user patients used three different measurement index. Population and sample in this research is all panoramic radiography data of hypertension patient users amlodipine totaled 30 panoramic radiographs were in accordance with the criteria of the study, namely: taking amlodipine for 1- 3 years, aged 26-55 years, patients do not have a history of fracture of the condyle and systemic disease bone metabolism such as hyperparathyroidism, hypoparathyroidism, pagets disease, osteomalaysia, renal osteodystrophy, osteoporosis and osteogenesis

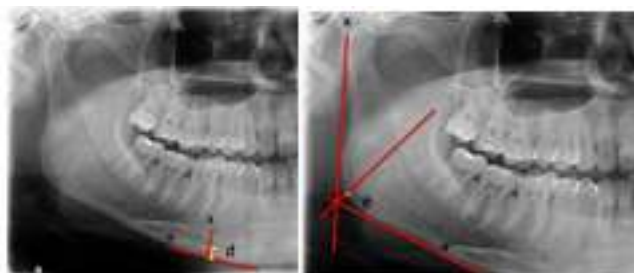


Figure 1. A. Measurement of height of mandibular cortex on the mental foramen. Line: (A) the outer line of mandibular cortex, (B) Outline of the mental foramen drawn perpendicular to A and (d) The mandibular cortex height by the mental foramen / Mental Index.(B) Measurement Index Gonion altitude. Line: (A) a line that of mandibular rami to point gonion, (B) line of mandibular outer cortex (e) The height of the mandibular cortex by Gonion / Gonion Index.⁶

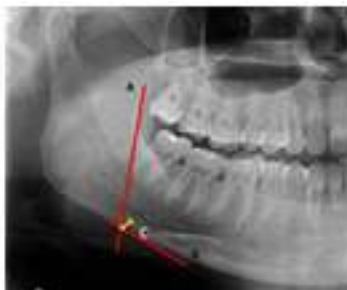


Figure 2. The measurement technique Antegonion Index (AI) (A) Outline the outer cortex of the mandible (B) of antegonion straight line, perpendicular from the cortex of the mandible (c) The line perpendicular intersection between the lines A and B / Altitude mandibular cortex by Antegonion. ⁶

imperfecta, better quality which is clearly visible mandibular cortex, whereas for patients with non amlodipine obtained from the value of previous researchers. It studied were mandibular cortex bone measurement techniques performed on three kinds of scale in millimeters (mm). The selected index for the measurement is Mental Index (MI), Gonion Index (GI) and Antegonion Index (AI). ^{1,5,6}

RESULT

Results of the research that has been done in this study showed:

1. Assessment of the height of the mandibular cortex is:

Table 1. The height of the mandible bone cortex in amlodipine user pasien using panoramic radiographs in Gonion Index

No	Assessment	Hight Rate	Low Rate	Average
1	GI Right	1.80	0.15	0.836
2	GI Left	1.90	0.18	0.841

Table 2. The height of the mandible bone cortex in amlodipine user pasien using panoramic radiographs in Antegonion Index

No	Assessment	Hight Rate	Low Rate	Average
1	AI Right	2.49	0.39	1.754
2	AI Left	2.40	0.40	1.762

Table 3. The height of the mandible bone cortex in amlodipine user pasien using panoramic radiographs in Mental Index

No	Assessment	Hight Rate	Low Rate	Average
1	MI Right	2.98	1.03	1.926
2	MI Left	2.98	1.10	1.863

2. Comparison of Mandible cortex bone between Users and non user amlodipine Patient is:

Table 4. Description of mandible cortical bone hight in user and non user amlodipine pasien with Gonion Indeks

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	GI Normal Right	1.3927	30	.14295	.02610
	GI measured Right	.8360	30	.53240	.09720
Pair 2	GI Normal Right	1.4757	30	.11389	.02079
	GI measured Right	.8417	30	.55340	.10104

Tabel 5. Description of mandible cortical bone hight in user and non user amlodipine patient with Antegonion Indeks

		Mean	N	Std. Deviation	Std. Error Mean
Pair 3	AI Normal Right	2.5540	30	.17053	.03113
	AI measured Right	1.7543	30	.51497	.09402
Pair 4	AI Normal Left	2.5257	30	.18317	.03344
	AI measured Left	1.7627	30	.50062	.09140

Table 6. Description of mandible cortical bone hight in user and non user amlodipine pasien with Mental Indeks

		Mean	N	Std. Deviation	Std. Error Mean
Pair 5	MI Normal Right	2.8783	30	.26519	.04842
	MI measured Right	1.9263	30	.59901	.10936
Pair 6	MI Normal Left	2.9577	30	.26697	.04874
	MI measured Left	1.8630	30	.55121	.10064

DISCUSSION

Based on the Anova analysis that has been done shows that the ratio of height of mandibular cortex in normal patients with patients on amlodipine using methods Gonion index (GI), the Antegonion index (AI) and the Mental Index (MI) there is a difference. The value used has significance level $\alpha = 0.05$ and nilai $t_{table} > t_{measure}$.

If the comparison between the value of GI with AI in patients with amlodipine not seen a significant difference, as well as on the GI and MI. Things are different, if done at AI value calculation shows that the value AI against GI significantly, while the MI is no difference. In the assessment of the value of MI compared to the value of GI and AI also has a value that is not meaningful.

This value shows that, mandibular cortex bone height in patients with amlodipine on three indexes, have different values. The third value of the index figures show almost identical, but the value of cortex elevation on users and non-users amlodipine patient, show there was in users' amlodipine has lower value.

According Gungor et al, that the normal value of mandibular cortical bone height ≥ 0.32 mm, 0.25 to 0.32 mm at risk of osteopenia and osteoporosis ≤ 0.25 mm. Mandibular cortical bone height values in the amlodipine has a value of 0.32 and they can be quite good, although the value is lower than the average value of non-users amlodipine.

Osteocytes are adult cells that are involved in the maintenance of bone function, located in the osteon (bone matrix unit) while osteoclasts are multinuclear cells (multinucleated) that have a role in the destruction, resorption and bone remodeling. Osteoblasts found the surface and inner the bone. Osteoblasts respond to any variety of chemical signals to produce bone matrix. In the first, the bone matrix called osteoid. Within a few days, calcium in the osteoid began to settle and harden for a few weeks or months later. Part of the osteoblast become apart of osteoid and called true bond. Along with the formation of bone, osteocytes in matrix form protrusions that connect one osteocytes to another osteocyte, to made a form of microscopic channels system in the bone.⁷

The Calcium is one of the components that contribute to bone, mostly of calcium ions in the bone which is not crystallized. non-crystalline calcium is calcium ions are capable of move from one matrix to another matrix within the bone through the interstitial fluid, and blood. Bone formation continues over both the direction of the length or thickness. Rate of bone formation is always changing throughout life. Bone formation is determined by hormones, food, and stress on a bone. Amlodipine induced suppression of bone repair by decreasing bone formation and increase bone resorpsi. The latest research shows that the renin-angiotensin system (RAS), which is the main substance in the amlodipine, a role in controlling blood pressure and effect on bone density. Asaba J. et al. RAS conduct research on transgenic mice and the results showed that angiotensin II has the role of causing a decline in bone density. Angiotensin II on cytokines RANKL and vascular endothelial growth factor (VEGF), which is capable of inducing the formation of osteoclasts, and also decrease in bone density.⁸

The whole system of renin to angiotensin II, known as Renin Angiotensin Aldosterone System (RAAS), which is one of the causes of hypertension, for RAAS is a hormonal system that plays a role in controlling the cardiovascular system, kidneys, glands and renal and blood pressure regulation.⁹ There are 10 residues known as angiotensin I. Angiotensin I is then converted into angiotensin II by the angiotensin converting enzyme (ACE), the residue is then will be found in the pulmonary circulation and the vascular endothelium darah.¹⁰

Angiotensin II serves to enhance the effect of sympathetic nerves including vasoconstriction (narrowing of blood vessels), which can cause increased blood pressure (hypertension), renal efferent arteriolar vasoconstriction leading to an increasing perfusion pressure in the glomeruli. The adrenal cortex function releases the hormone aldosterone, a hormone that works on the renal tubules to retain sodium and excrete potassium and chloride. If sodium reabsorption it will be followed by the entry of water into the blood vessels, which causes an increase in blood volume, and increase the blood pressure.¹⁰

The use of ACE inhibitors, work by suppressing angiotensin II, thereby causing a decrease in cytokines and vascular endothelial growth factor (VEGF), which is able to inhibit osteoclast, so it does not lower the bone density. In contrast to amlodipine, lowering the influx of calcium ions into myocardial cells and blood vessels, but not to angiotensin II, so as not to inhibit the increase in cytokines and vascular endothelial factor (VEGF), whose effects cannot inhibit the increase osteoclast, so the decline in bone density occur. This is what causes the difference in height of the alveolar bone, the user amlodipine with non-amlodipine patient.^{11,12,13,14}

CONCLUSION

The conclusion that can be drawn from this study, the height of the mandibular cortical bone in patients taking amlodipine, index AI and gh GI not seen any difference, whereas in MI seen there is a decrease visible compare than normal patient, but the three of them is quite normal its mean that there is no osteoporosis or osteopenia

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Caries Description in Permanent Teeth Based on Mount and Hume Classification

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ABSTRACT

INTRODUCTION: A method of grouping caries lesions based on Mount and Hume classification, with the principle of minimal intervention, is expected to identify white spot lesions that cannot otherwise be identified using the G. V. Black classification system. The specific treatment plan for each caries lesions is also provided by Mount and Hume classification. **Objective:** This study aims to determine the caries prevalence in permanent teeth based on Mount and Hume classification. **Materials and methods** This research was conducted by collecting descriptive data from patient observation. Data collection took place at Instalasi Rawat Jalan Integrasi Rumah Sakit Gigi dan Mulut Universitas Padjadjaran, between April 14th and May 14th 2015. All patients who fulfilled the inclusion criteria had given their informed consent prior to examination. Qualified patients underwent a visual and tactile clinical examination using the WHO probe. Carious lesions found during the examination were put into fifteen groups based on Mount and Hume classification, recorded, and processed in the form of a table. The prevalence of each group was then calculated by dividing the number of caries-affected teeth by the total number of teeth examined. **Result:** The results show that of 104 patients with 2990 teeth, prevalence of caries 1.0 is 11.71%; caries 1.1 is 18.13%; caries 1.2 is 4.88%; caries 1.3 is 0.54%; caries 1.4 is 0.97%; caries 2.0 is 2.58%; caries 2.1 is 1.00%; caries 2.2 is 1.04%; caries 2.3 is 0.27%; caries 2.4 is 0.07%; caries 3.0 is 1.97%; caries 3.1 is 0.64%; caries 3.2 is 0.17%; caries 3.3 and 3.4 is 0.00%. **Conclusion:** Caries prevalence found in this research is 43.95% and the highest rate of prevalence is found in caries 1.1 based on Mount and Hume classification (18.13%).

Keywords— dental caries; minimal intervention; mount and hume classification; white spot lesions

INTRODUCTION

Dental caries is the most common teeth and mouth disease in Indonesia [1], [2]. Based on the 2013 Riset Kesehatan Dasar (Riskesdas) report, Indonesia scores 4.6 on the DMF-T index. This score indicates high severity in dental caries, according to the categorization recognized by the World Health Organization (WHO). The prevalence of active caries in Indonesia based on the Riskesdas report in 2007 reached 43.4% [3], [4], [5].

Restoration approach in handling cases of dental caries is one of the causes of the current high prevalence of dental caries. G. V. Black classified carious lesions into six classes based on the location in 1908. The basic principle of “extension for prevention” in this classification requires extensive structural removal in order to form an ideal cavity, so the remaining tooth structure becomes brittle and causes “replacement dentistry”. Non-cavitated lesions (white spots and brown spots), which are the earliest signs of dental caries, also cannot be identified by this classification [6], [7], [8].

Minimal intervention is a concept that aims to improve the treatment of promotive and preventive efforts, noting the symptoms and causes of a disease. Caries risk assessment and early detection of carious lesions are attempts at implementing the principle of minimal intervention in the handling of cases of dental caries. Early detection of carious lesions is expected to identify non-cavitated lesions so demineralization of tooth structure can be stopped and the teeth can be treated without surgical intervention [9], [10], [11].

Mount and Hume developed a new caries classification with the principle of “minimal intervention” in 1997. Carious lesions are classified more specifically based on their positions (site) and extensions (size). There are three site-based groups and five size-based groups. Thus, this system allows non-cavitated lesions to be identified prior to the formation of cavities [6], [7]. The specific treatment plan for each caries lesions is also provided by Mount and Hume classification [7], [12].

Rumah Sakit Gigi dan Mulut Universitas Padjadjaran (RSGM Unpad) is a hospital that provides general and specialized dental services located in Jalan Sekeloa Selatan I, Bandung. Instalasi Rawat Jalan Integrasi RSGM Unpad is a combined installation that consists of Operative Dentistry, Orthodontics, Prosthodontics, Periodontics, and Oral Medicine. Research on the prevalence of caries in permanent teeth based on Mount and Hume classification has never been done in this place so that relevant prior on-site data is unavailable.

The authors of this paper were interested in researching the prevalence of caries in permanent teeth based on Mount and Hume classification in RSGM Unpad based on the aforementioned issue. This research was conducted on patients at the Instalasi Rawat Jalan Integrasi RSGM Unpad. This study aims to determine the caries prevalence in permanent teeth based on Mount and Hume classification in Instalasi Rawat Jalan Integrasi RSGM Unpad.

MATERIALS AND METHODS

This is a descriptive observation-based research. Data collection took place at Instalasi Rawat Jalan Integrasi RSGM Unpad, between April 14th and May 14th 2015. The population included all patients in Instalasi Rawat Jalan Integrasi RSGM Unpad and samples were selected based on purposive sampling. The inclusion criteria for this research were new patients in Instalasi Rawat Jalan Integrasi Angkatan 2011 RSGM Unpad between April 14th and May 14th 2015; free from supra gingiva calculus; aged 13 years and over; and with a period of permanent teeth. The exclusion criteria for this research were patients who have been doing maintenance in the Instalasi Rawat Jalan Integrasi RSGM Unpad before April 14th 2015; patients with mixed dentition period, edentulous patients; patients using fixed orthodontics appliance; the caries which is located beneath or on the edge of existing restorations; and patients who are not willing to the subject of research. All patients who fulfilled the inclusion criteria had given their informed consent prior to examination. Qualified patients underwent a visual and tactile clinical examination using the WHO probe. Carious lesions found during the examination were put into fifteen groups based on Mount and Hume classification, recorded, and processed in the form of a table. The prevalence of each group was then calculated by dividing the number of caries-affected teeth by the total number of teeth examined.

Mount and Hume classification is a system that identifies carious lesions based on the site and size. Carious lesions were grouped into three based on location, site 1 (pits and fissures, occlusal surface), site 2 (interproximal), and site 3 (cervical third of the crown, root surface caries). Carious lesions were grouped into five based on size, size 0 (non-cavitated lesions, such as white spots or brown spots), size 1 (minimal lesions, limited to enamel, ball on the WHO probe drops into the surface of the enamel cavity/discontinuity), size 2 (moderate dentin involvement, ball on the WHO probe enters the opening of the cavity and in the opinion of the examiner the base is in dentin), size 3 (enlarge lesions, remaining tooth structure is weakened to the extent that cusp of the posterior teeth or incisal edges of the anterior teeth are split, or are likely to fail if left exposed to occlusal load), and size 4 (extensive lesions, bulk loss of tooth structure, loss of a complete cusp of the posterior teeth or incisal edges of anterior teeth) [12], [13], [7], [14].



Fig. 1. Three sites based on Mount and Hume classification: 1. occlusal fissures, 2. proximal contacts areas, 3. cervical regions around the full circumference of the tooth [12]



Fig. 2. Five sizes based on Mount and Hume classification: size 0 (no cavity), size 1 (minimal), size 2 (moderate), size 3 (enlarged), size 4 (extensive) [21]

Table 1. Mount and hume classification.¹²

Site	Size				
	No Cavity (0)	Minimal (1)	Moderate (2)	Enlarged (3)	Extensive (4)
Pit/ Fissure (1)	1.0	1.1	1.2	1.3	1.4
Contact Area (2)	2.0	2.1	2.2	2.3	2.4
Cervical (3)	3.0	3.1	3.2	3.3	3.4

RESULT

The result of research conducted on 104 patients with 2990 among them teeth shows that the prevalence of caries is 43.95%, as shown in Table II below:

Table 2. Caries prevalence based on Mount and Hume classification

Mount and Hume Classification	Caries Prevalence
Caries 1.0	11.71%
Caries 1.1	18.13%
Caries 1.2	4.88%
Caries 1.3	0.54%
Caries 1.4	0.97%
Caries 2.0	2.58%
Caries 2.1	1.00%
Caries 2.2	1.04%
Caries 2.3	0.27%
Caries 2.4	0.07%
Caries 3.0	1.97%
Caries 3.1	0.64%
Caries 3.2	0.17%
Caries 3.3	0.00%
Caries 3.4	0.00%
Total	43.95%

Table II shows that caries 1.1 is the type of caries with the highest prevalence with percentage 18.13%. Caries 3.3 and 3.4 are not found in this research.

DISCUSSION

The result shows that based on its location (site), carious lesions occur most commonly on site 1. This is consistent with the Mount and Hume theory that caries most often occurs in the pits and fissures of teeth (site 1). This is due to the anatomical shape of pits and fissures, causing cariogenic bacteria to often be trapped in this area and cannot be cleaned effectively with a tooth brush [12], [15]. The next discussion is based on the highest carious lesions at each classification site.

Site 1 includes the pits and fissures and occlusal surfaces of posterior teeth [12]. Order of prevalence of caries lesions at site 1 is as follows: 18.13% for caries 1.1; 11.71% for caries 1.0; 4.88% for caries 1.2; 0.97% for caries 1.4; and 0.54% for caries 1.3.

Caries 1.1 is superficial caries occurring in pits and fissures [12], the result shows that caries 1.1 is the most common lesion. The high prevalence of this type of lesions is due to its confinement to the enamel, so it is often asymptomatic and the patient does not realize that his teeth have cavities [15]. The possibility of the presence of hidden caries also increases the prevalence of this lesion clinically. Hidden caries is an occlusal caries with dentin involvement and can be detected with radiographs (bitewing), but clinically this caries looks like a superficial caries [16], [17].

Caries 1.0, non-cavitated lesions (white spots or brown spots) on pits and fissures [12], is the second type of lesions more frequently found during this research. White spot lesions are asymptomatic and patients are often unaware of the existence of these lesions [15].

Caries 1.4 is caries in pits and fissures and occlusal surfaces of posterior teeth that have involved the pulp, usually there has been a loss of cusps of the posterior teeth or incisal edges of anterior teeth [12]. Caries 1.3 is caries in pits and fissures and occlusal surfaces of posterior teeth with large cavities which involve enamel and dentin [12]. Patients who have these carious lesions are usually already aware of them and feel a cavity in the tooth interfering with its functions, prompting them to get fillings. This leads to the infrequent findings of both lesions in this research, because restoration has usually been done on affected teeth.

Site 2 includes the interproximal surfaces below the contact point on the anterior and posterior teeth [12]. Order of prevalence on site 2 is as follows: 2.58% for caries 2.0; 1.04% for caries 2.2; 1.00% for caries 2.1; 0.27% for caries 2.3; and 0.07% for caries 2.4.

Caries 2.0 is a white spot lesions or brown spots on the interproximal surfaces of anterior and posterior teeth [12]. These lesions usually take the form of brown spots which extend to the facial and lingual. Therefore, they are easily identifiable and many were found in this research.

Caries 2.2 is caries with moderate cavities on the interproximal surfaces of anterior and posterior teeth involving enamel and dentin [12]. Interproximal caries are large on the outside (enamel) and form a cone towards DEJ so, clinically, the cavity will look spacious and easily identified [15], [18]. Consequentially, caries 2.2 was quite commonly found in this research.

Caries 2.3 and 2.4 have enlarged and extensive cavities [12]. As is the case in caries 1.3 and 1.4, these lesions are rarely found in this research because affected patients had undergone teeth restoration.

Site 3 is carious lesions that occur in the cervical one third of the crown or, following gingival recession, the exposed root [12]. Order of prevalence in site 3 is: 1.79% for caries 3.0; 0.64% for caries 3.1; 0.17% for caries 3.2; and 0.00% for caries 3.3 and 3.4.

Caries 3.0 is non-cavitated lesions (white spots or brown spots) in the cervical region [12]. Lesions found in this research were usually white spots in the cervical area forming a line parallel to the margin of the gingiva, easily identified when the tooth is dried. Many were found in this research.

Caries 3.3 and 3.4 are lesions with enlarged and extensive cavities on root surfaces. These lesions are very rarely found in this research because most of research subjects were about twenty years of age, while the root surface caries usually occurs in the elderly due to decreased protective factors, for example xerostomia [15], [19], [18].

Most lesions found on site 3 were non-carious lesions (e.g. abrasions and abfractions) that were not included in the results. Caries at site 3 are caused by various factors, such as the use of fixed orthodontic appliance, high sugar consumption, poor oral hygiene, and

xerostomia [20]. The carious lesions on site 3 were very infrequent in this research due to the good oral hygiene of most subjects.

CONCLUSION

Caries prevalence found in this research is 43.95% and the highest rate of prevalence is found in caries 1.1 based on Mount and Hume classification (18.13%). Mount and Hume classification should be used in clinical practice attempts at implementing the principle of minimal intervention in the handling of cases of dental caries, due to its early detection of caries lesions and specific treatment plan to each lesion.

ACKNOWLEDGMENT

We are very thankful to Faculty of Dentistry Padjadjaran University, Rumah Sakit Gigi dan Mulut Universitas Padjadjaran, collabolators and colleagues for providing all the support and cooperation in writing this paper.

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Direct Composite Restoration With Stamp Technique

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ABSTRACT

Creating functional and esthetic form on posterior teeth is very challenging. Efficiency and effectiveness are important to achieve a good restoration. There are many ways and techniques to restore posterior teeth, one of them is stamp technique. Typical indication of stamp technique are large single-tooth restoration, occlusal rehabilitation and direct fibre reinforced fixed partial denture. Describe a step by step of stamp technique to restore posterior teeth. A 21-year old female referred from the Department of Orthodontics, Faculty of Dentistry, Padjadjaran University for reshaping lower left tooth due to a dental anomaly. The clinical examination showed a free caries at mandibullary left second premolar (tooth 35) and diastema 2 mm at mesial region. The vitality test was positive. The radiographic examination showed that root of 35 shorter than other. The treatment plan is reshaping and recounturing with direct composite restoration using stamp technique. The stamp technique can be an alternative technique to restore posterior teeth with direct composite in an effective and efficiency way.

Keywords : Stamp technique, restoration, reshaping, composite.

INTRODUCTION

Direct composite restoration is currently the standard technique for direct restoration.¹ Direct composite restoration use to restore defects, repair tooth structure invisibly and change tooth shape and alignment.² Dental composite has advantages as a restorative material due to esthetics, conservation of tooth structure, adhesion to tooth structure, and low thermal conductivity.³ The conservative treatment approach is best collaborated with the use of composite due to their ability of bonding to many surfaces including natural teeth.² With good case selection, proper adhesion and placement, posterior composite can provide successful and predictable restorations that may match the appearance of natural teeth.⁴

Nevertheless, resin composite still has minor weakness. Placing successful posterior composites is difficult, tedious, and time consuming. The procedures includes achieving

the proper isolation, precise execution of the adhesive steps, incremental placement, adaptation, adjusting the occlusion, and finishing and polishing. For this reason, an alternative placement technique of composite restoration was introduced. The stamp technique is presented by three typical indications: large single-tooth restoration, occlusal rehabilitation of a compromised occlusal surface due to erosions and direct fibre-reinforced fixed partial denture.⁵

The stamp technique consists of fabricating an occlusal matrix to impress the occlusal anatomy of posterior teeth. The advantages of using an occlusal matrix are the reproduction of the original occlusal anatomy and occlusion, minimal requirement of finishing and polishing, minimal voids at the occlusal anatomy, and reproduction of optimally polymerized occlusal surface due to the exclusion of air during curing.⁶

CASE REPORT

A 21-year old female referred from the Department of Orthodontics, Faculty of Dentistry, Padjadjaran University for reshaping of the lower left tooth because of anomaly. Clinical examination showed that tooth #35 no caries and intact occlusal surface. The vitality test using electric pulp test was positive. There is 2 mm diastema with tooth #34 (Fig. 1).



Fig. 1. Clinical feature of the tooth 35 before treatment



Fig. 2. Radiographic before treatment



Fig. 3. A. Mock Up of tooth 35, B. Clear matrix template tooth 35.

Radiographic examination showed 18, 28, and 38 are missing. Root of 35 shorter than other teeth (Fig. 2). The diagnosis of tooth 35 is vital tooth with microdontia. The treatment plan is direct composite restoration with stamp technique.

Subjective, objective, and radiographic examination was done on the first visit, then the patient signed the informed consent. Local scaling was done around tooth 35. Impression was made with double impression technique using materials polyvinylsiloxane (Exaflex, GC) followed by taking bite registration. The diagnostic mock up was made from working model to establish the shape of restoration using resin composite. A clear matrix was used to duplicate the mock up and used as template (Fig. 3).

. CASE MANAGEMENT

On the second visit, bracket on teeth 34 and 36 was removed. A2 shade was determined using shade guide (Fig. 4).

Rubber dam was placed. Intra enamel preparation was done on surface of tooth 35 using aluminum oxide disc (Sof-Lex XT coarse, 3M). The surfaces of teeth 34 and 36 covered by *Plumber's teflon tape* (PTFE) and then the surface of tooth 35 was treated with 37% phosphoric acid and adhesive (Fig. 5).



Fig. 4. A2 Color Shade Determination



Fig. 5. a. Rubber Dam placement, b. Intra enamel Preparation Tooth 35, c. Etched Application, d. Adhesive Application.

An enamel shade (A2) composite was placed in template matrix and then thin layer of flowable composite was applied on enamel shade. After that template matrix with the composite material was placed on tooth 35 from occlusal aspect and checked for correct fit (Fig. 6).

Rubber dam was removed, a #12 blade used to remove any excess material. Finishing and polishing were accomplished with finishing and polishing system (Fig. 7).

Postoperative evaluation was done one week later. There are no contact premature and any symptoms (Fig. 8).

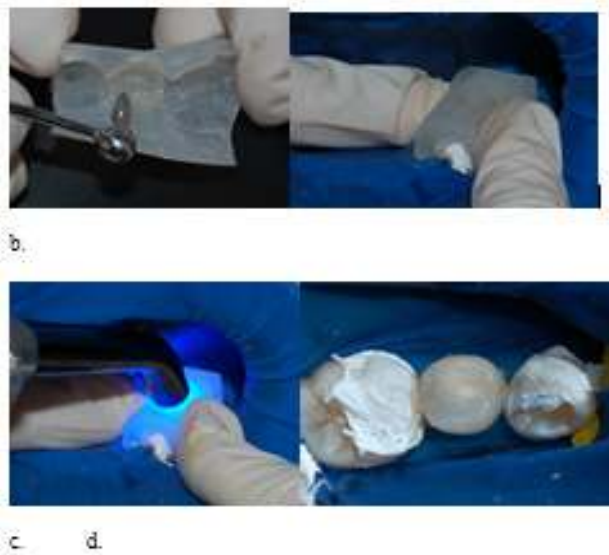


Fig. 6. a. Resin Composite Application on Template Matrix. b. Insertion of template matrix, c. Light Cure Application, d. Post-Curing Composite.

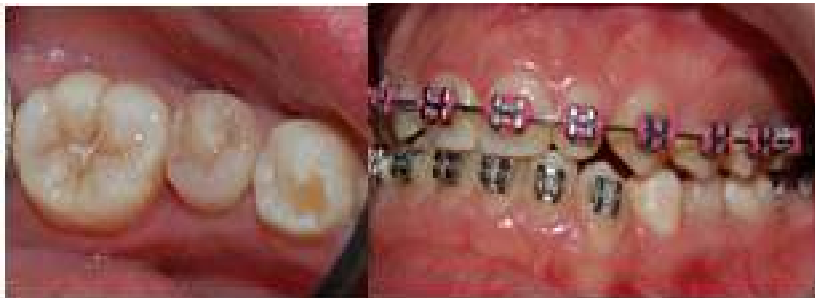


Fig. 7. Postoperative view of tooth 35.



Fig. 8. One week evaluation direct composite restoration using stamp technique tooth 35.

DISCUSSION

The restoration of actual shape and topography of tooth surfaces very challenging. In this case, tooth 35 diagnosed with microdontia resulting diastema between tooth 34 and spaces between opposing teeth. When the shape and size of teeth do not require prosthetic reconstruction, and the occlusal ratio of the molars is normal, esthetic and functional teeth reconstruction with composite can be done.⁷

Resin composites have been used increasingly as posterior restoratives. Nowadays, patients are attracted to a restoration that matches the color of natural teeth. In this case, resin composite used as a material for reshaping posterior tooth due to avoid the concerns over the use of mercury containing materials, thermally non-conductive, and bond to tooth structure with the use of adhesives. The advantages of resin composite as a posterior restorative material are esthetics, conservation of tooth structure, adhesion to tooth structure, low thermal conductivity, elimination of galvanic currents, and radiopacity.⁸

Above all, reshaping posterior tooth can be a very time consuming. The stamp technique chosen in this case because it was minimal invasive, requires less time, and lowest cost solution. The diagnostic mock up has an important role in this case to achieve the best shape and occlusal topography of tooth. The clear matrix was used in this case because it allows the polymerisation of light-curing. Slight infra-occlusion was made to prevent excessive occlusal load due to root length is shorter than the other teeth.⁹

CONCLUSION

The stamp technique provides a simple and easy approach to reshape posterior tooth with accurate shape and occlusal topography, and less time consuming in finishing and polishing. The stamp technique can be an alternative technique to restore posterior teeth with direct composite in an effective and efficiency way.

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Intentional Endodontic In Left Maxillary Central Insisivus

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ABSTRACT

Intentional endodontic is a procedure that involves the purposeful extirpation of healthy (non inflamed, non infected) pulpal tissue as an aid to provision of a restoration. Intentional endodontic can be performed to provide post, doubtful pulp health prior to restorative procedures, pulpal exposure when restoring a tooth. In this case coronal dentin remains insufficient to provide retention and resistance for making a restoration, to achive that, restoration with post and core will be needed. A 41 years old female complaint about her restoration in the left upper anterior tooth was loosed and hypersensitivity to cold. Clinical examination showed that caries reaches the dentin at the distal and large composite fillings in the mesial side. There is positive reaction in a vitality test, percussion, palpation showed negative reaction and no mobility. Examination radiographic revealed radiolucent approaching the pulp in the distal part of the tooth, one and straight root, membrane periodontal, lamina dura, alveolar crest, periapical showed no abnormality. Diagnosis of these case is pulpitis reversible. All caries at distal side and composite restoration at mesial side had to be removed, making the labial wall so thin and it will be difficult to obtain a good and long term restoration. And then one visit endodontic were performed, the tooth restored with resin fiber post and all porcelain crown. intentional endodontic can become one of consideration treatment when retention, resistance, support of the coronal and radicular dentin are needed.

Keyword : intentional endodontic, one visit endodontic

INTRODUCTION

Intentional endodontic is a procedure that involves the purposeful extirpation of healthy (non inflamed, non infected) pulpal tissue as an aid to provision of a restoration. Intentional endodontic can be performed to provide post, doubtful pulp health prior to

restorative procedures, pulpal exposure when restoring a tooth. In this case coronal dentin remains insufficient to provide retention and resistance for making a restoration, to achieve that, restoration with post and core will be needed.

CASE REPORT

A 41 years old female came to Postgraduate Clinic Dental Faculty and complaint her four anterior maxillary teeth, she wanted to restored them all and the restoration in the left upper anterior tooth was loosed since 2 weeks ago and hypersensitivity to cold. This loosed restoration restored with tooth coloured filling 3 months ago. Patient's general condition is in a good term and did not have a history of allergies and systemic diseases. Extra oral examination seemed symmetrical facial appearance, there were no abnormality at TMJ, left and right submandibular gland were not palpable and painless. Intra oral examination showed moderate oral hygiene, stains on the anterior maxillary teeth, and no abnormalities in the surrounding tissue. Clinical examination at tooth 21 showed that caries reaches the dentin at the distal and large composite fillings in the mesial side. There is positive reaction in a vitality test, percussion, palpation showed negative reaction and no mobility.

Examination radiographic revealed radiolucent approaching the pulp in the distal part of the tooth, radiopaque from enamel to dentin in the mesial side, one and straight root, membrane periodontal, lamina dura, alveolar crest, periapical showed no abnormality.

Diagnosis of this tooth was pulpitis reversible. The treatment plan for 21 was intentional endodontic with one visit endodontic procedure and will be restored using crown all porcelain. Three other teeth restored using all porcelain crown on 12 and porcelain veneers on 11 and 22. The prognosis for this case was good because no periapical lesion, single root canal and an easy access, and the restoration will be last longer because the additional from post and core.

CASE MANAGEMENT

On the first visit after the examination, establish the diagnosis and settle the treatment plan, patient will be informed and signed the informed consent. Then removed all the caries and the old restoration.



Fig. 1. Clinical feature of tooth 21 before treatment



Fig. 2. Radiographic tooth 21 before treatment



Fig. 3. Removal of the caries and old restoration



Fig. 4. Extirpation of the pulp tissue was accomplished with barbed broache file



Fig. 5. Trial obturation and after obturation

Built the artificial wall to obtain a sterile area for endodontic treatment, wiped labial and palatal mucosa using 10% povidone iodine then performed infiltration, isolated the working area using rubber dam, opened pulp chamber access with Endo Access Bur (Dentsply, Maillefer) until the orifice clearly visible then extirpate pulp tissue using Barbed Broache File.

Prepared straight line access to canal orifice using Protaper XS (Dentsply) and then exploration of the root canal with K File number 10, then measuring the length of root canal by apex locator (Propex Pixi, Dentsply) and the result was 26 mm. Glide path was created by ProGlider (Dentsply) and root canal preparation was accomplished by rotary file Protaper Next (Dentsply), master apical file was X2 and irrigated with NaOCl 2,5% after each file usage. Final irrigation with NaOCl 2,5%, EDTA 18% and chlorhexidine 2% agitated by EndoActivator (Dentsply). Protaper Next Gutta Percha X2 measured in accordance to working length and inserted into root canal and took a radiographic examination. The master cone radiograph showed gutta percha well fitted in root canal. Root canals then obturated using cold lateral condensation gutta percha with Endomethason sealer and then took radiographic examination.

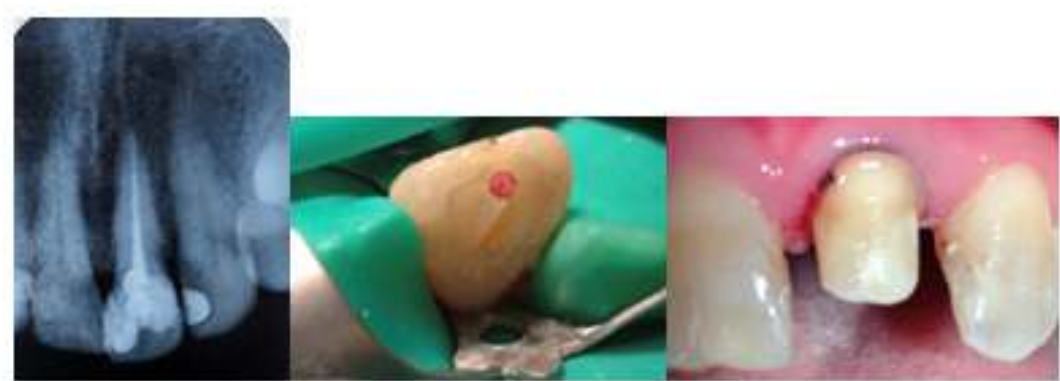


Fig. 6. Control post obturation, fiber post cementation, and prepared tooth for crown porcelain



Fig. 7. Final restoration at tooth 21

On the next visit the tooth was found asymptomatic. Percussion, bite and palpation test were resulting in negative responses. The radiographic examination showed obturation sealed the canal and no apical lesion. The canal then prepared for fiber post and cemented with resin cementation (DMG), after that the tooth prepared for crown porcelain. The third appointment, patient had no complaint, percussion and bite test were resulted as negative. All porcelain crown cemented with resin cementation.

DISCUSSION

In this case the patient wants to rehabilitate the fourth of the maxillary anterior teeth. There was deep caries approaching the pulp at the distal of tooth 21 and a large composite restoration at mesial side so the first procedure is to remove all the caries and old restoration leaving only thin labial wall. Intentional endodontic to the remaining healthy pulp to gain retention and resistance of the restoration using post core and crown all porcelain at 21 must be considered for this case. And with all porcelain, colour of the fourth of the maxillary anterior teeth can be adjust.

Intentional endodontic is a procedure that involves the removal of a healthy pulp tissue intentionally as reinforcement of the restoration¹. Intentional endodontic can be considered as one of the treatments on the vital teeth that require restoration with retention and support from the pulp chamber and root canal². According to Whitworth et al, 2002, intentional endodontic can be considered treatment on teeth with prosthodontic or dental restoration procedure that endanger the healthy pulp³. In this case intentional endodontic was performed due to the remaining teeth did not provide adequate restoration without the retention and support from the pulp chamber and root canal.

Consideration for intentional endodontic is divided into biological and mechanical consideration. Biological consideration is when the pulp getting persistent traumatic from restoration or occlusion (stress pulp syndrome). Mechanical consideration is when the remaining coronal dentin part were not sufficient to obtain retention and resistance for the restoration and required a post core that will increase the retention and resistance of the radicular dentin¹. Mechanical consideration is the basic consideration of the intentional endodontic for this case.

The patient should be informed about the procedure, risk and the prognosis of intentional endodontic⁴. Intentional endodontic usually done with one visit endodontic because of the pulp is not infected and does not require medicament between visits⁵. In this case, one visit endodontic were done due to the vitality of the pulp that is not infected, easier access of the pulp chamber, single root canal. The advantages of the one visit endodontic are more comfortable for the patient, reducing appointments, getting the working length of the canal constantly⁶

CONCLUSION

Intentional endodontic can be considered as a treatment for a vital tooth when required a retention, resistance and support of the coronal dentin and radicular dentin and provided an adequate restoration.

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Direct Pulp Capping With Mineral Trioxideaggregate (A Case Report)

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ABSTRACT

Applying pulp capping in an iatrogenic open pulp case with MTA resists bacterial leakage and may provide protection for the pulp. MTA could allowed repair and continued pulp vitality in teeth when used in combination with a sealed restoration..A woman aged 45 years came to Unpad Conservation Clinic with chief complaints feeling discomfort and sensitive on the upper left regio since two months ago. Approximately two years ago, the tooth had been filled by a dentist. The patient never had any throbbing pain on the spesific tooth. The radiographic examination shows radiopaque appearance with slight radiolucent underneath it. Laminadura is still intact, there is no widening of the periodontal membrane, and no periapical abnormalities.The old filling was removed. Caries were removed by a low speed round carbide bur. Following the cleanse of the cavity, one spot of pulp area is exposed. MTA was applied on the perforated spot as a direct pulp capping procedure along with a humid cotton pellet and GIC as a temporary filling. After 8 weeks, GIC were removed, followed with preparation for onlay composite as the final restoration.MTA can be a pulp-capping material on a direct pulp exposure in permanent teeth with with a good predictable result.

Key words: Mineral Trioxide Aggregate, Direct Pulp Capping, Reversible Pulpitis.

INTRODUCTION

Preservation and maintenance of pulpal vitality is one objective in endodontics. Historically, the placement of a medicament or material against a direct pulpal exposure during caries excavation has been considered controversial, and instead conventional endodontic therapy has been recommended. The reluctance to place a direct pulp cap on an exposure in a carious field is based on unpredictable outcomes using traditional materials and treatment protocols.¹

A variety of materials have been proposed as candidates for direct pulp capping during recent years, one of the material beside the conservative calcium hydroxide is mineral trioxide aggregate (MTA). Initially, MTA was used in endodontics to seal off all pathways communication between the root canal system and the external surface of the tooth.² Pitt Ford et al. were the first to evaluate the performance of MTA for pulp capping in monkey's teeth, and they demonstrated superior performance of MTA compared with calcium hydroxide. After testing both materials in dog's pulp, Faraco and Holland showed that MTA achieved the most favorable results.^{3,4}

Current results suggest better post-operative outcomes when applied by an experienced clinician. One factor contributing to more favorable results with both calcium hydroxide and MTA may be an antibacterial effect directed against microorganisms, and specifically their toxins.⁵

MTA has proven to be one of a very few exogenous materials that is not only well tolerated by connective tissues, but also contributes to a bacteria-tight seal. Both properties suggest that an application of MTA as pulp capping material may be clinically successful under the conditions of minimal bacterial exposure.⁶

Indeed, several studies document that MTA is an effective material for direct pulp capping and pulpotomies. Excellent tissue healing has been observed over the useful life of the primary teeth and permanent teth.⁵

In this case report, treatment of pulp capping is done with the use of MTA and continued with composite onlay restorations.

CASE REPORT

Patient female 45 years old came and complaints that her right upper back teeth feels uncomfortable since \pm 1 week before. The complained teeth was filled a year ago by another dentist, and since the patient never felt any throbbing pain. The patient wanted to relieve her teeth discomfort, and also repaired the filling. Patient's General health condition was good with no history of systemic disease.



Figure 1. Initial condition and clinical aspects of 24

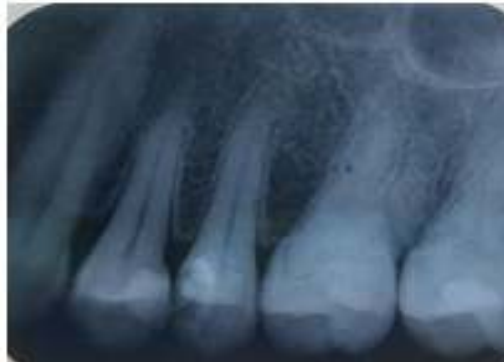


Figure 2. Initial dental radiographic photos of 24 (diagnosis)

At extra-oral examination, the patient's face looked symmetrical, left and right submandibular gland was not palpable and there wasn't pain at all. At intraoral examination, dental fillings was found on 24, 25. The filling looked unified and it was not in good form, EPT test and cold tests showed a positive response. Percussion, bite and palpation test showed a negative response, and there is no tooth mobility. A state of good oral hygiene.

At radiological examination, the teeth 24 showed a radiopaque formed on occlusal to dentin, with a radiolucent stripe below the radiopaque near the pulp chamber. There are approximately 2 roots showing within normal limits. Periodontal membrane, laminadura, alveolar bone crest, furcation and periapical tissue were in normal limits.

Diagnosis is Reversible pulpitis 24 (AAE 2013). Treatment plan is pulp capping treatment followed by onlay composite restoration. Prognosis is good, patient is cooperative and no systemic disorders.

CASE MANAGEMENT

At the first visit several test were done to get the proper diagnosis, followed with the disposal of old fillings. Rubber dam is placed, caries excavation was done with excavator (Medesy) and stainless steel bur (Mani) (Figure 3). While removing the caries some of pulp tissue were exposed, leaving a small entrance to the pulp. The cavity were flushed using a sterile distilled water and dried with a cotton pellet. Soon after that pulp capping material (MTA, Angelus) were applied on the cavity by mixing the powder and liquid on the ratio 3:1, followed by application of moist cotton pellet then the cavity was sealed with GIC (Figures 4 and 5).

On the second visit, patient came 8 weeks later. There are no complaints found, percussion and bite test gave negative responses. There were no abnormalities found on the surrounding tissues, and the mobility of the tooth is negative.

GIC filling were opened, MTA found beneath GIC was checked followed by preparation of indirect onlay composite restoration. Periapical photo was taken before the preparation.



Figure 3. Previously cleaned cavity



Figure 4. MTA Material (Angelus)



Figure 5. Applications of MTA.

Radiographically we can find radiopaque image extending from occlusal to the distal pulp horn (in the form of material restoration). Periodontal membrane, laminadura, alveolar bone crest, furcation and periapical found still within normal limits, and there was secondary dentine formed on the base of the cavity (figure 7).



Figure 6. Two months control post application of MTA



Figure 7. Periapical radiograph taken 8 weeks post pulp capping



Figure 8. Insertion composite onlay

Subjective and objective examination were done. There were no complaints, percussion and bite test gave negative responses. There were no abnormalities in the surrounding tissues, and there was no tooth mobility found. After full examination, try in of the onlays is done followed by cementation of composite onlays (Figure 8).

Onlay restorations were observed within a week period on fourth visit, then subjective and objective examination were done, with the absence of complaints. There is no abnormalities found during the test. (Figure 8).



Figure 8. Controls week post insertion onlay

DISCUSSION

Maintaining an intact healthy pulp is preferable to root canal treatment or other endodontic procedures that are complex, expensive, and time consuming. When dealing with a deep carious lesion, indirect pulp capping, a procedure that avoids accidental pulp exposure during the removal of carious dentin, may be attempted. Another approach is to remove all carious dentin. If there is a carious exposure, the exposed pulp tissue is covered with a biocompatible liner (direct pulp capping). Others advocate a procedure involving surgical removal of inflamed pulp tissue (pulpotomy or pulpectomy); the remaining tissue is then covered with dressing that hopefully allows healing. The success rate of these procedures is variable and depends on proper diagnosis and clinical judgment but primarily on the status of the pulp before the procedure.⁷

Direct pulp capping means that a minimal pulp exposure is just cleaned and covered with a wound dressing. Except for one study comparing MTA with calcium hydroxide, reported clinical success rates after direct pulp capping in primary teeth are low and the procedure should therefore be restricted to accidental or pinpoint carious exposures. In an RCT on hard-tissue formation after direct pulp capping in healthy young permanent teeth, a calcium hydroxide cement was compared clinically and histologically with a dentin bonding material as wound dressing material.⁸

Mineral Trioxide Aggregate (MTA) is a material that has been developed and reported by Lee et. al. in 1993, for the endodontic use. MTA is a modification of portland cement that is used in the production of concrete.⁹

MTA is a powder composed of tricalcium silicate, bismuth oxide, dicalcium silicate, tricalcium aluminate, tetracalcium aluminoferrite and dicalcium sulfate dihydrate. It sets via hydration to become a colloidal gel with a pH of 12.5, similar to that of calcium hydroxide. The setting time is 3–4 hours, and has compressive strength of 70 MPa. MTA in a set state is biocompatible, has good sealing properties, promotes hard-tissue formation and has very low solubility. Overall, high success rates (>95%) have been achieved with MTA as dressing material for treating cariously exposed pulps in permanent teeth.⁸

Despite its many advantages, MTA has some drawbacks such as a long setting time and discoloration of teeth. Efforts have been made to overcome these shortcomings. Other major drawbacks with MTA seem to be its cost and perceived problem with storage. Commercially available MTA is expensive and once the package is opened, the material should be sealed in an airtight and waterproof container.¹⁰

CONCLUSION

MTA can be a pulp-capping material on a direct pulp exposure in permanent teeth with with a good predictable result when the pulpal diagnosis is no more severe than irreversible pulpitis. Clinicians should be aware that the treatment described was performed by one operator; we cannot claim that every clinician will obtain similar results. Careful attention to diagnostic criteria and treatment procedures, however, should result in many successful outcomes.

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One Visit Endodontic Treatment Of Maxillary Central Incisors (Case Report)

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ABSTRACT

Endodontic treatment should be simple, predictable and time saving. One visit endodontic treatment is a root canal treatment process is completed in one visit. This gives the advantage to minimize the risk of microorganisms in root canals, as well as saving time for the treatment more tolerable by the patients. A 22 years old female patient complain about pain in maxillary central incisors since 2 week ago. There was a history that teeth have been restored one month ago. Clinical examination teeth 11 and 21 with Electric Pulp Test was positive, percussion, palpation, mobility was negative. Radiographic examination showed no periapical lesion. Diagnosis was pulpitis irreversible. One visit endodontic treatment has been done in maxillary incisors central. Final restoration was done by placing a fiber post and all crown porcelain. One visit endodontic treatment can be successfull if it was suitable with the case selection

Key words : pupitis irreversible, case selection, one visit endodontic

INTRODUCTION

Irreversible pulpitis is classified into two categories, asymptomatic and symptomatic. In asymptomatic irreversible pulpitis, the teeth do not show any pain or symptom, but the clinical findings show deep caries lesion or significant tooth structure loss which if left untreated, it would arise the symptom or even worse, become non vital. Meanwhile, the pain which develop in symptomatic irreversible pulpitis sometimes shows a form of emergency therefore needs to be treated immediately. The teeth manifest an intermittent or spontaneous pain and the episode could be worsen if the teeth are stimulated by cold stimuli, although the stimuli have been removed¹

The aim of root canal treatment is to eliminate the bacteria within the root canal so that healing process can be achieved. Many researches show it is impossible for operator to create a definite sterile environment in the root canal, even though the processes of

cleaning, shaping also irrigation using disinfectant and antiseptic agent have been done. The microorganisms within the root canal are able to multiply rapidly if the canal being left empty during 2-4 days.²⁻⁴

Many operators eliminate or prevent the reinfection and contamination of the bacteria within the root canal using calcium hydroxide as intervisit sterilization agent. However, many studies show that calcium hydroxide is failed to create a sterile environment in root canal or to promote the healing process. It is still debatable what caused the failure to be happened, because neither the intervisit dressing nor the negative culture test result did not guarantee the healing process to be successfully achieved.²

The other approach which often used to eliminate the possibility of microorganism recontamination in root canal is by doing the canal obturation compactly right after the canal preparation and irrigation in the same visit³. Moreover, the compact obturation establishes a certain environment where the microorganisms lacking of nutrition and space to grow^{4,5,6}. The advantage of one visit root canal treatment is the time efficiency, patient convenience, and the capability of avoiding the possibility of bacterial recontamination during the each visit⁷.

CASE REPORT

A 22-years-old female attended Conservative Dentistry Postgraduate Clinic, Dental Hospital, Faculty of Dentistry, Universitas Padjadjaran (RSGM) ,complain about throbbing pain in maxillary central incisors since 2 week ago. There was a history that teeth have been restored one month ago. Without any remarkable medical history.

The physical and vital sign examination shows blood pressure 106/74 mmHg, pulses 76x/min, and respiration 18x/min. Extraoral examination revealed symmetric face, normal lip tonus, normal TMJ, and normal submandibular left and right lymph nodes. Clinical examination of the teeth 11 and 21, showed old composite restoration in mesial and distal side, respectively. The Electric pulp test exhibited positive result for both of the teeth while in percussion, palpation, and mobility tests are negative.

The diagnosis of both teeth 11 and 21 are irreversible pulpitis (AAE, 2013). The prognosis of the teeth are good, because there are single roots, with straight canal, the teeth position do not complicate the treatment, patient's mouth opening is normal, and the



Figure 1. Initial clinical



Figure 2. Preoperative diagnostic radiograph

	Gigi 11	Gigi 21
Crown	Radioopaque from email to pulp in mesial and distal	Radioopaque from email to pulp in mesial and distal
Root	Straight	Straight
Periodontal membrane	Normal	Normal
Lamina dura	Normal	Normal
Periapical	Normal	Normal

patient is cooperative. The treatment plan for 11 and 21 consists of root canal treatment, one visit pulp extirpation, fiber post, and all porcelain crown restoration.

CASE MANAGEMENT

On the first visit, following the subjective, objective, radiograph examination, diagnosis process, and treatment planning had been thoroughly done, patient signed the informed consent and filled the anesthesia pre-evaluation form. Aseptic measure was done using 10% povidone iodine swabbed on buccal mucosa surface of 11 and 21, then the xylestein anesthetic agent was infiltrated on mucobuccal fold of 11 and 21, 1 ml per tooth.

The operation area was isolated using rubber dam, followed by the access opening using round bur and endoaccess bur (Endostrip Jet, Dentsply) from the coronal through the pulp chamber. After that, the pulp was extirpated using the extirpation file #10 (barbed boarch). The extirpation needle was inserted into the canal and rotated clockwise, then the needle was slowly withdrawn until all the pulp was removed.

When all the pulp tissue was completely removed the root canal was irrigated with 2.5% NaoCl without any pressure until no debris was left, then continued with drying the canal using sterile paper point. Canal exploration was done using k-file #10 and #15 on both teeth. The canal was prepared with crown down techniques, using *Protaper Universal Rotary* (Protaper Universal, Dentsply), initiated file with protraper S and then SX which had been lubricated with lubricating gel (Glyde, Dentsply Maileffer), inserted along 2/3 working length to enlarge the canal. Working length was established with initial file #10 using apex locator (ProPex, Pixie, Dentsply Maileffer). Working length for 11 and 21 were 21mm and 22 mm, respectively (Figure. 6).



Figure 3. Local anesthetic.



Figure 4. Access cavity.



Figure 5. Pulp tissue removed.

After the working length was obtained, the canal was prepared using file S1, followed by S2, F1, F2, F3 consecutively on both teeth (figure.7)

Canals were irrigated between every file change activated by Endoactivator (Endoactivator, Dentsply) (Figure 8). On the last irrigation, 2,5% NaOCl was used, followed by aquadest, and 2% chlorhexidine. Canal was redried using suction tip and sterile paper point, and the obturation trial was done using 21mm Master Apical Cone F3 for the teeth 11 and 22 mm Master Apical Cone F3 for the teeth 21, confirmed by radiograph photo.



Figure 6. Determine working length.



Figure 7. Preparation with F3 file.



Figure 8. Activated with Endoactivator.

The radiograph showed that the Master Apical Cone was already adequately adapted. The canal then obturation using lateral condensation technique, and sealed using Endomethasone sealer. Following the Master Apical Cone F3 insertion into the canal, spreader was used to condense the guttapercha laterally to give more space for guttapercha accessories. Procedure was repeated until spreader could no longer be inserted into the canal. Guttapercha was cut right below the orifice, then the cavity was cleaned from



Figure 9. Trial foto with guttapercha.



Figure 10. Obturation of the canal with gutta-percha.



Figure 11. Radiography control.

the excess sealer and guttapercha, then sealed with Glass Ionomer Cement (GC, Gold Label). The obturation was evaluated using radiograph, the radiograph showed a hermetic obturation (Figure 10). After that, the patient was instructed to visit the clinic in 7 days later for control.



Figure 12. Try in fiber post.



Figure 13. All porcelain crown.



Figure 14. Before treatment (left) and after treatment (right).

On the second visit, post root canal treatment control was elaborated. Patient had no complaint, the percussion, pressure, palpation, and mobility test showed negative results. The adjacent tissue was normal and radiograph imaging showed hermetic obturation with no periapical abnormalities) (Figure 11).

The root canal treatment was followed by fiber post restoration and all porcelain crown (Figure. 12, 13, 14)

DISCUSSION

On this particular case, one visit endodontics was chosen to manage the pulpitis irreversible teeth with consideration of single canal tooth with no periapical lesion from the radiographic image.

One visit endodontics was indicated for cases of pulpitis irreversible, necrotic pulp with no periapical lesion, tooth with less difficulty for cleaning and shaping, patient who want the treatment to be finished immediately^{8,9}

The advantages of one visit endodontics are (1) Lessen the amount of treatment visits thus increase patient convenience, (2) The ability to avoid possibility of bacterial recontamination caused by temporary restoration leakage between visits (3) Decrease patient anxiety and fear (4) More efficient for operator and (5) Less cost for patient.⁸⁻¹⁰

Rotary instrument shorten the operator working time compared to the manual instrument. ProTaperUniversal is a rotary instrument used for canal preparation with crown down technique. Root canal preparation using crown down techniques has many advantages such as ease of debris and microorganisms removal toward coronal area, ability to maintain the canal shape, and prevent the fracture of root canal.^{1,10,11}

Canal irrigation using combination of 2.5% NaOCl and 17% EDTA has antimicrobial property and the ability to dissolve organic and inorganic debris. The combination of 2.5% NaOCl and 17% EDTA are ideal to remove the remnants of pulp tissue, debris, and smear layer within the root canal. The other irrigation agent, 2% Chlorhexidine, which has wide spectrum antimicrobial property, was used as final rinse right before the canal obturation^{10,12}.

Obturation was done using guttapercha Master Apical F3 file and sealed with Endomethasone sealer. The treatment was followed by control 7 days later after the obturation. Patient had no complaint, the percussion, pressure, palpation, and mobility test showed negative results. The adjacent tissue was normal and radiograph imaging showed hermetic obturation with no periapical abnormalities. The root canal treatment was followed by fiber post restoration and all porcelain crown.

CONCLUSION

One visit root canal treatment can be chosen as management for case of pulpitis irreversible with no periapical abnormalities.

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Non-Surgery Treatment For Periapical Lesion On Tooth 21 And 22 With Conventional Endodontic Technique

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ABSTRACT

Pulp defense system towards prolonged bacterial infection can cause pulp necrosis and periapical lesion. Periapical lesion often occur without acute pain and can be detected on radiographic examination. Incidence of periapical lesion showed 6-55% are cysts, 9.3-87.1% are periapical granulomas, and 28.7-70.07% are abscesses. Research reported success rate up to 85% conventional endodontic treatment of teeth with periapical lesion, therefore conventional treatment is most preferred on periapical lesion cases. Calcium hydroxide is common used as intra-canal medicament owing to its effective antimicrobial formulations. A 22 year old female patient came with chief complaint was unaesthetic composite restoration on maxillary anterior left tooth. The patient felt swelling on palate and upper gingiva. Clinical examination showed discolored composite restoration on distal tooth 21 and mesial tooth 22. Radiographic examination showed radiolucent involving tooth 21 and 22. Treatment done first with access opening and working length determination. Tooth 21 was prepared by crown down technique using ProTaper handuse, while tooth 22 was prepared by conventional technique using K-file. Intra-canal medicament used was calcium hydroxide. The post-operative radiographic examination showed good progression of periapical lesion, hard-tissue healing, and decreased radiolucency on radiographic examination. Conventional treatment for periapical lesion showed high success rate. Conventional treatment should be the first consideration prior to surgery approach. Calcium hydroxide was used as intra-canal medicaments and showed a significant result because of its antimicrobial formulation.

Keywords : periapical lesion, conventional endodontic, calcium hydroxide

INTRODUCTION

Periapical lesion is a sequence of healthy pulp changes due to failure of pulpal defense system towards bacterial invasion. A prolonged and untreated pulp inflammation will easily lead to pulp necrosis. Pulp defense system has a several ways to withstand the bacterial infection and periapical lesion is an outcome of the process. Incidence of periapical lesion showed 6-55% are cysts, 9.3-87.1% are periapical granulomas, and 28.7-70.07% are abscesses. Treatment for periapical lesion may vary from non-surgery to surgery approach. Non-surgery treatment for periapical lesion reach survival rate 85%. This high survival rate makes non-surgery approach should be considered prior to surgery approach. The purpose of this case report is to report the periapical lesion significant progression treated with conventional endodontic approach.

CASE REPORT

A 23 year-old male came to Conservative Department Faculty Dentistry of Universitas Padjadjaran with her chief complaints were her old composite restoration on upper left anterior teeth and she felt a swelling on her palate. On November 2015, the patient felt severe pain accompanied by fever. She sensed the swelling on the palate was more firm after she ate or drink cold food or beverages. Patient recalled no trauma history. And she undergone orthodontic treatment from 2011 until 2013. Patient came to our department demanding a treatment.

Extraoral examination showed facial symmetry. There is no abnormalities found on lips and temporomandibular joint. Lymph nodes examination showed no swelling or pain. Clinical examination showed an average oral hygiene. A swelling reddish lump found on the anterior palate which approximately sized 4 mm. The consistency was soft and immobile. There was an old and discolored composite restoration on distal tooth 21 and mesial tooth 22 which suspected expand onto palatal area. Objective examination on tooth 21 showed



Figure 1. Pre-operative clinical situation of the patient.



Figure 2. Radiographic examination showed periapical lesion on tooth 21 and 22.

positive vitality tests, tender to percussion, negative pressure test, positive palpation test around palatal area, and negative mobility test. Examination on tooth 22 showed negative vitality test, no response to percussion, negative pressure test, negative palpation test, and negative mobility test.

CASE MANAGEMENT

The diagnosis determined for tooth 21 and 22 were chronic apical abscess. The treatment plan was conventional endodontic treatment for both of the tooth. On the first visit (April 1st 2016), patient was notified about the treatment and the outcome desired. After the patient agreed and understood about all the consequences of the treatment, patient signed informed consent. The treatment began by isolating oral cavity with rubber dam. The access opening were done by #2 round diamond bur and the cavity wall were smoothed with Endo-Z bur.

Root canal preparation of tooth 21 was done by ProTaper Universal Handuse. First step done was using Sx file to enlarge two-third coronal part. Then glide path was negotiated using small sized K-file #15 to #20. Working length determination was done with electronic apex locator and the result was 25 mm. Crown down preparation was continued with shaping file S1 then S2. A copious 2.5% sodium hypochlorite was delivered combined by repeated recapitulation to maintain working length. After using of shaping file, the preparation was continued with finishing file F1 and ended with F4. Preparation completed by last recapitulation and irrigation combination (2.5% sodium hypochlorite, distilled water, and 2% chlorhexidine).

Root canal preparation of tooth 22 was done by standard technique. First step performed was working length determination which was done by electronic apex locator and K-file #10. Straight line access was acquired but the working length remained vague. K-file then pre-bended and the glide path obtained was curved to palatal on apical third. The preparation was continued with standard technique until K-file #45. Between file exchanged, a copious 2.5% sodium hypochlorite was delivered. Watch-winding movement was used to



Figure 3. Access opening on tooth 21.



Figure 4. Pre-curved K-file to maintain the natural shape of root canal 22 which is curved to palatal on apical third.



Figure 5. (a) and (b). Caries removal. (c) old composite replacement.

prepare the curved canal. Last was recapitulation using K-file #10 and rinsed with distilled water combined with 2% chlorhexidine. Intracanal medicament used in this case was calcium hydroxide. The cavity was blocked with cotton pellet and temporary restoration material Cavit.

Second visit was conducted on April 2016, the patient came with no complaints but the tooth still tender to percussion. Rubber dam was applied and Cavit was opened. Root canal still filled with calcium hydroxide and the consistency were watery at two-third coronal also at one-third apical. The root canal then rinsed with irrigation combination and then dried

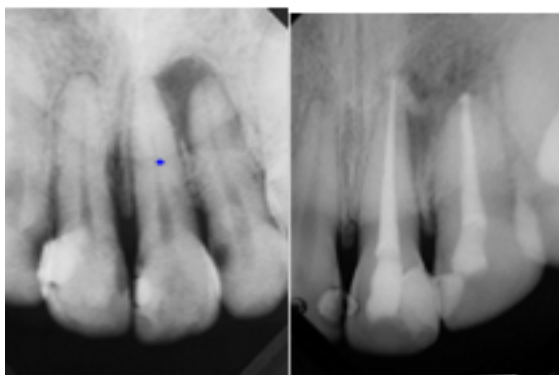


Figure 6. A pre-operative and post-operative radiograph of the patient.

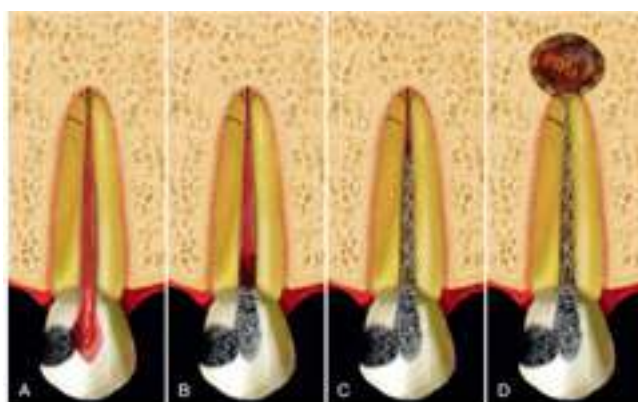


Figure 7. A dynamic process from healthy pulp defense system to a forming of periapical lesion.

with paper point. Calcium hydroxide again used as an intracanal medicament. The cavity then blocked with cotton pellet and Cavit.

Third visit, tooth 21 and 22 still tender to percussion and the consistency of calcium hydroxide still watery. The old composite showed darken color and worsen condition on proximal and marginal area. Secondary caries was discovered underneath the composite restoration. The caries was removed and the old composite was replaced at that time. Another intracanal medicament replacement procedure was done and the cavity again blocked with cotton pellet and Cavit.

Forth visit, patient showed no more sensitivity to percussion and there is no complaint. Rubber dam was applied and root canal was cleansed. Calcium hydroxide found inside the root canal was dry in the coronal part and even in the apical. Root canal then rinsed, dried, and trial radiography was taken. The result showed significant progression of the lesion. The patient has to leave at that time so the obturation was canceled. Root canal was filled with calcium hydroxide and compacted with cotton pellet and Cavit.

Fifth visit the patient came and the root canal was prepared for obturation. Rubber dam was applied and the root canal was irrigated with abundant 2.5% sodium hypochlorite, distilled water, and 2% chlorhexidine. Master gutta percha prepared for tooth 21 was ProTaper gutta percha size F4 and for tooth 22 was ISO size #45. Endomethasone was manipulated for the sealer and lateral condensation technique was used for both of these teeth. An unfilled space detected which was finger spreader then loaded with accessory gutta percha #15. Orifice then packed with glass ionomer cement and Cavit. Patient then instructed to have radiography examination. The final radiograph showed a compact obturation and a significant progression of the lesion.

DISCUSSION

Pulp necrosis is a sequence occurred from pulpal defense system toward bacterial invasion. In this patient, the etiology of pulp necrosis can be vary. Initial clinical examination that showed fail composite restoration which is discolored on distal tooth 21 and mesial tooth 22. When the old composite removed, secondary caries can be observed underneath and around cervical areas. Bacteria penetration can enter pulp chamber through many routes. Pulp exposure toward bacteria may happen when the restoration procedure is done such as bacteria from biofilm, calculus, caries, rubber dam leakage, and from contaminated instruments. And bacteria penetration after the restoration performed may happen from the infamous composite weakness shrinkage, overhang contour in proximal area, and bad oral hygiene. Patient complained a swelling on anterior part of palatal. Swelling has to be palpated to distinguish the consistency whether solid or fluctuant. This patient has a reddish and soft swelling that indicate an abscess. With that diagnosis, the treatment plan was conventional endodontic treatment which is a non-surgery approach.

Root canal preparation for tooth 21 was done by crown down technique with ProTaper handuse instruments while for tooth 22 was done by standard technique using K-file. Tooth 22 root canal discovered had a curve at apical third to palatal direction. A natural shape of curved canal should be preserved and it can never be straightened. Straightening root canal can lead to an apical foramen transportation which cause failure of root canal preparation such as ledge. A way to conserve natural shape of curved root canal is to use small K-file size #10 to maintain a reproducible glide path and canal has to be filled with irrigant. In this patient, the preparation was done by maintaining curved shape canal by pre-bending each K-file and using watch-winding movement. Watch-winding movement is done by moving the file 30°-90° clockwise to penetrate the file apically. Then the file moved reciprocally to put the file more apically and counterclockwise to cut the wedged dentinal wall. A 3 to 5 stroke will loosen the file and permit the file prepare more apically. This movement is done with gentle pressure and it is suitable for negotiating glide path or conserving curved canal.

Mechanical instrumentation and chemical irrigation reported only remove 50% to 80% of all bacteria amount inside root canal. One of the way to advance bacterial removal is intracanal medicament between dental scheduled time. Calcium hydroxide is already an

accepted medicament due to its advantages in releasing calcium and hydroxyl ion which lead to superb antimicrobial properties. Calcium hydroxide has a consistency that can be intact inside root canal for weeks or months and it can survive the dissolution caused by dentinal fluid. Moreover, calcium hydroxide is a high alkaline substances that exterminate bacteria through protein membrane denaturation and DNA breakage. For the obturation, endomethasone was chosen as a sealer material. Endomethasone is a zinc-oxide eugenol based which has antimicrobial properties, in particular studies reported it is effective towards *Enterococcus faecalis* even 7 days after mixing. It is reported that endomethasone can penetrate into dentine tubulus 250µm deep.

Surgery approach is indicative for treating periapical lesion. Among periapical cases, there were found 6-55% cases were cyst, 9.3%-87.1% were periapical granulomas, and 28.7%-70.07% were abscess. The success rate of non-surgical treatment for periapical lesion is 85%. This high number demand clinician to perform conventional technique prior to considering endodontic surgery.

CONCLUSION

Non-surgery approach has to be considered and attempt prior to surgery decision. This case showed a successful periapical lesion with conventional endodontic which can be seen radiographically that the healing process was occurred.

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Conventional Endodontic Treatment Of Chronic Periapical Lesion Associated With Traumatized Left Maxillary Incisors

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ABSTRACT

Untreated traumatize tooth in long term may cause tooth lose its vitality, become discolored and progresses to a chronic periapical lesion. All inflammatory periapical lesion should be initially treated with conservative non surgical procedures. A 19 years old male came with complaint about fractured and discolouration on his anterior upper teeth with no pain and evidence of recurrence swelling on buccal surface of gingival. Clinical examination revealed the teeth had no response to vitality test, tender to percussion, no mobility and abnormalities observed on the surrounding tissues. Radiographic examination showed large periapical radiolucent with loss of periodontal ligament (PDL) and interrupted lamina dura. A diagnose of pulp necrosis with chronic periapical lesion determined. Root canal treatment performed using crown down technique using Mtwo system rotary file instrument. Root canal was irrigated using NaOCl 5.25% alternately with EDTA 17%, and chlorhexidine 2% as final irrigant. Calcium hydroxide paste used as inter-appointment medicament. Obturation was done Once the radiographic image shows healing progression of the lesion, using lateral compaction of gutta-percha point. The tooth was internally bleached to restore its color. A long term composite restoration with fiber post reinforce was done following the endodontic treatment. Conventional root canal treatment showed favorable clinical and radiographic result. Clinically the tooth is symptom free where as radiographic examination showed healing of the lesion and significant bone apposition. For that reasons, the necessity of additional surgical of periapical lesion may be postponed after being evaluated in 1 year-recall:-

Keywords: Traumatize, discoloration, chronic periapical lesion, conventional, non surgical.

INTRODUCTION

Most dental trauma occurs in the 7- to 12-year-old age group and is mainly due to falls and accidents in neighborhoods. It occurs primarily in the anterior region of the mouth, affecting the maxillary teeth more than the mandibular teeth. Serious accidents like automobile crashes can affect any tooth and occur in all age ranges.

Complicated crown fractures involving enamel, dentin, and pulp occur in 0.9 to 13% of all dental injuries. A crown fracture involving the pulp, if left untreated in pulp necrosis. However, the manner and time sequence in which the pulp becomes necrotic allow a great deal of potential for successful intervention in maintaining pulp vitality. The first reaction after an injury is depends on the stage of development of the tooth, time between the accident and treatment, concomitant periodontal injury, and the restorative treatment plan.

Maxillary anterior teeth are in high incidence of dental trauma. This is caused by the location of the tooth in the arch. Location of anterior teeth affected the esthetic, psychological and emotional of patients. The incidence of trauma to maxillary incisor is approximately 77%. Crown fracture can damage periapical tissue that begins with the inflammatory process and continue with necrotic condition. Necrotic tissue then seeps out of the root canal and into the supporting tissue and cause lesions that are from endodontic. The pulp will survive depends on the severity of the trauma and the type of inflammation reaction with in.

CASE REPORT

A 19 years old male came to the Conservative Dentistry Postgraduate Clinic, Dental Hospital, Faculty of Dentistry, Universitas Padjadjaran with chief about fractured and discolouration on his anterior upper teeth with no pain and evidence of recurrence swelling on buccal surface of gingival, revealed the teeth had no response to vitality test, tender to percussion, no mobility and abnormalities observed on the surrounding tissues. Previously, patient had history of tooth fracture caused by falling down from bike when he was in 6th grade. Patients had recurrence swelling at buccal 21 and 22.

Objective examination on tooth 21 showed visible fracture involving $\frac{1}{2}$ distoincisal, vitality test using cold and Electric Pulp The tooth gave a weak response to vitality test, tender to percussion, and without mobility or abnormalities in the surrounding tissues. Tooth



Figure 1. Clinical condition before root canal treatment



Figure 2. Pre-operative radiograph

22 showed intact tooth structure, but no response vitality test, tender to percussion, and without mobility or abnormalities in the surrounding tissues. (Figure 1).

On radiograph examination tooth 21 showed a straight single root with appearance of crown fracture at the $\frac{1}{2}$ distoincisor, PDL was slightly widened at apical one third with an interrupted lamina dura at the apex. Radiolucency seen at the periapical 22 with a 12 mm in diameter. On radiograph examination tooth (Figure 2).

Diagnosis of teeth 21 and 22 were necrotic pulp with periapical lesion. The established treatment plan for teeth 21 and 22 non surgery root canal treatment followed by fiber post and long temporary restoration.

CASE MANAGEMENT

On the first visit, informed consent was conveyed to the patient. The operation area of 21 and 22 was isolated using rubber dam, followed by the access opening from palatal side using round bur (ISO Ø 016). The orifice was enlarged using endo Z bur (Dentsply). The exposed pulp chamber was cleaned with disinfectant agent, NaOCl 2.5% (Bayclin). The working length determination was done using K-file #15 (SS, Dentsply) and apex locator of tooth (VDW Gold). The working length obtained were 21 was 24 mm, while for tooth 22 = 23 mm. Cleaning and shaping of the canal was done with crown down technique using file rotary system (VDW) and file M-two. The initial file both for teeth 21 dan 22, was #15 M-two VDW and the MAF was #30 M-two VDW. Following the cleaning and shaping, teeth were irrigated using 5.25%NaOCl, 17% EDTA, and 2% Chlorhexidine. Aquadest was used between every disinfectant agent change. The canal was filled by Ca(OH)_2 and restored using cotton pellet and temporary restoration.

On the second visit, the canal was evaluated. Patient had no complaint, the percussion, pressure, palpation, and mobility test showed negative results. Rubber dam was set, followed by temporary restoration removal. The calcium hydroxide wetness was evaluated and the paste was still wet. Irrigation was redone on each canal using 5.25%NaOCl, 17% EDTA,

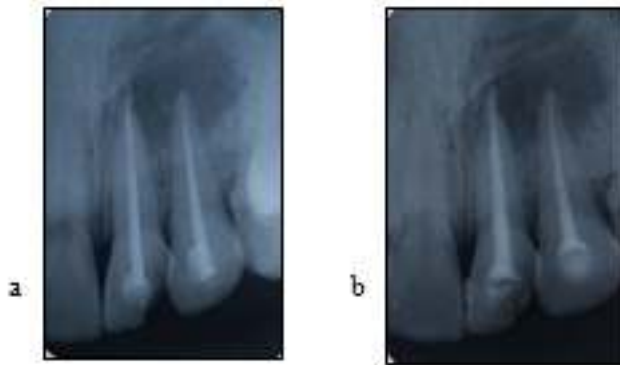


Figure 3. (a).Master cone 21,22 radiograph. (b). Obturation 21,22 radiograph



Figure 5. Recall 3 month after obturation radiograph

and 2% Chlorheksidine. Aquadest was used between every disinfectant agent change and followed by the reapplication of calcium hydroxide paste into the canal, then sealed again with temporary restoration.

On the third visit, patient had no complaint, the percussion, pressure, palpation, and mobility test showed negative results, but the calcium hydroxide paste was still wet, thus the reapplication of medicament was needed. Rubber dam was set, followed by temporary restoration removal, Irrigation was redone on each canal using 5.25%NaOCl, 17% EDTA, and 2% Chlorheksidine. Aquadest was used between every disinfectant agent change and followed by the reapplication of calcium hydroxide paste into the canal, then restored again with temporary restoration.

On the fourth visit, patient had no pain nor complaint, the percussion, pressure, palpation, and mobility test showed negative results, and the calcium hydroxide paste was already dried. The obturation trial was done using Master Apical Cone 21 and 22, confirmed by radiograph photo. Radiograph photo showed that the previous periapical lesion was decreased in size (Figure 3a). The canal then obturated using lateral condensation technique, and sealed using Endomethasone sealer. Guttapercha was cut right below the



Figure 6. Radiograph after 5 month obturation



Figure 7. Long temporary crown restoration

orifice, then the cavity was cleaned from the excess sealer and guttapercha, then sealed with 2mm Glass Ionomer Cement and temporary restoration. The obturation was evaluated using radiograph, the radiograph showed a hermetic obturation with adequate working length (Figure 3b).

On the fifth visit, post root canal treatment control was elaborated. Patient had no complaint, the percussion, pressure, palpation, and mobility test showed negative results. The adjacent tissue was normal and radiograph imaging showed hermetic obturation with significant change on periapical radiolucent appearance. The lesion appeared more radiopaque similar to surrounding bone. The root canal treatment was followed by fiber post restoration and long temporary restoration on the next visit. Patient was observed and instructed to visit the clinic in 5 months for control.

On the sixth visit, patient still had no complaint, the percussion, pressure, palpation, and mobility test showed negative results. The adjacent tissue was normal and radiograph imaging showed hermetic obturation with significant change on periapical lesion.

DISCUSSION

Regeneration is a process by which altered periapical tissues are completely replaced by tissues native to their original architecture and function. Repair is a process

by which altered tissues are not completely restored to their original structures. Histologic examination of most tissue sections in experimental animals and humans shows that healing of periradicular lesions after root canal therapy is by repair rather than regeneration of the periradicular tissues. Inflammation and healing are not two separate entities; in fact, they constitute part of one process in response to tissue injury. On the molecular and cellular levels, it is impossible to separate the two phenomena. Inflammation dominates the early events after tissue injury, shifting toward healing after the early responses have subsided. However, for convenience and to simplify the complex inflammatory-resorptive process, they are studied as two separate entities.^{1,2}

The level of healing is proportional to the degree and extent of tissue injury and the nature of tissue destruction. When injury to periradicular tissues is slight, little repair or regeneration is required. However, extensive damage requires substantial healing. In other words, periradicular repair ranges from a relatively simple resolution of an inflammatory infiltrate in the PDL to considerable reorganization and repair of a variety of tissues.²

The sequence of events leading to resolution of periapical lesions has not been studied extensively. Based on the processes involved in the repair of extraction sites, after removal of irritants, inflammatory responses decrease and tissue-forming cells (fibroblasts and endothelial cells) increase; and finally, tissue organization and maturation ensue. Bone that has resorbed is replaced by new bone; resorbed cementum and dentin are repaired by cellular cementum. The PDL, which is the first tissue affected, is the last to be restored to normal architecture. Histologic examination of healing of periapical lesions shows evidence of healing in the form of cementum deposition, increased vascularity, and increased fibroblastic and osteoblastic activities. Studies have shown that some cytokines play an important role during healing of periapical lesions. Some lesions do not completely regain all of the original structures. Variations are seen in different fiber or bone patterns. These may be obvious radiographically with a widened lamina dura or altered bony configuration. Certain factors, such as the size of the defect or the extent of injury to the underlying stroma, may impact complete regeneration of the original tissue architecture. Boyne has shown that these critical-sized defects do not heal unless stimulated by inductive factors such as bone morphogenetic proteins.^{3,4}

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Management Pulp Necrosis With Open Apex Using Apical Plug mineral Trioxide Aggregate

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ABSTRACT

Endodontic treatment of non-vital immature teeth with open apex can be done by apexification. Apex closing can be done by single-visit apexification known as apical plug. Apical plug is done to form artificial barrier in the apex using Mineral Trioxide Aggregate (MTA). MTA is a biocompatible material with good sealing ability and marginal adaptation. Apical plug using MTA will form immediate apex-closing. A 12 years old male patient complained about pain and swelling in maxillary right incisor since 2 weeks before visiting. There was a history of trauma around 3 years ago. Clinical examination tooth 11 with vitality test, palpation, mobility was showed negative and percussion test positive. Radiographic examination showed periapical lesions and open apex. Diagnosis was Pulp Necrosis with Asymptomatic Apical Periodontitis and Open Apex. Treatment using MTA apical plug after the root canal had been debrided with 1% NaOCl, Calcium Hydroxide was then placed in the canal, before the apical was filled with the MTA plug. Apical plug has been done with MTA (6 mm) in apical tooth 11. There are significant reduction on the periapical lesion without any clinical symptoms Final restoration was done by placing crown. Apex-closing using MTA as apical plug can be done successfully and time efficiency.

Key words : Open Apex, Apical Plug, Mineral Trioxide Aggregate

INTRODUCTION

Apexification is a procedure to form apical calcific barrier to close opened apices in non-vital teeth with immature roots. Apical closing with apexification can be done by one visit, also known as apical plug, or apexification using calcium hydroxide (conventional). The disadvantage of using calcium hydroxide in apexification is its long time span, frequent visits, and risk of tooth fracture. Apical plug is done to form artificial barrier in apex using Mineral Trioxide Aggregate (MTA). The benefits of MTA are its sealing ability as biocompatible material and good marginal adaptation. MTA can perform immediate apical closing.

CASE REPORT

A 12 years old male patient came to clinic PPDGS Konservasi Gigi RSGM FKG UNPAD With a chief complaint of fractured upper anterior teeth due to a playground accident that took place 3 years previously, and the teeth have been left untreated.–Patient has not complaint of any discomfort until 1 year ago when pain and swelling were experienced and went to see a local dentist for treatment. Patient left the treatment unfinished as no pain nor swelling existed, and at the moment he insist to continue the treatment. No pain or swollen in the troubled tooth now, patient wanted the tooth to be treated. General examination : no hypertension, diabetes mellitus, and hepatitis.

Extra oral examination : symmetrical face, no abnormality in the lips. Intraoral examination of tooth 11 : fracture Ellis type III involving email, dentin, and exposed pulp. Vitality, palpation and mobility tests showed negative results, percussion and pressure tests showed positive results,no swollen in the gingival. Oral hygiene was good.

Radiographic examination Showed an oblique fracture that runs from 1/3 mesiocervical to 2/3 distoincisal invoving the pulp. The root canal is considered large with a blunderbuss opened apex. Thickening periodontal ligament was inspected with an interrupted lamina dura at the 1/3 apical, and radiolucency shown at the periapical.

Diagnosis for tooth 11 is necrosis of pulp with asymptomatic apical periodontitis (AAE 2013) and open apex. Treatment plan for this case was apical closing with MTA following cleaning of the canal. Post endodontic restoration chosen was a custom fiber post with a built-up core and finalized with a porcelain fused to metal crown.

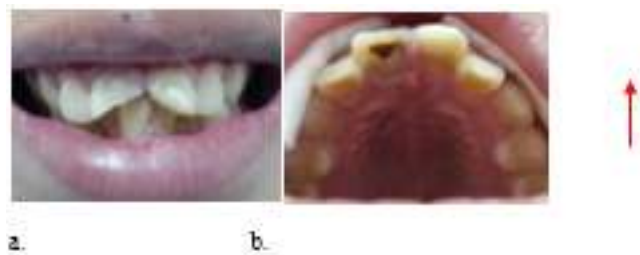


Figure 1. (a). Tooth 11 from bucal, (b). From palatal



Figure 2. Periapical Radiograph 11 with open apex

CASE MANAGEMENT

On first visit, subjective, objective, and radiographic examinations on tooth 11 was done and informed consent was completed. Rubber dam was placed, access preparation, root canal irrigation using NaOCl 1% and aquadest were done after that, continued by drying the root canal with paper point. Apex locator was used to determine the working length and radiographic photo was done to confirm working length by using file no. 90 and the result was 19 mm.

After obtaining working length, instrumentation was done by decreasing 2 mm of working length. Biomechanical preparation was done using K-FileDentsply number 120 with circumferential technique because the root canal was wide. File was moved slowly against the root canal wall to clean the root canal, necrotic debris, and microorganism in root canal. During root canal cleaning 1% NaOCl was delivered with light pressure and disposed directly using small tip air suction. Following biomechanical preparation, root canal was dried using paper point, filled with calcium hydroxide, and sealed with sterile cotton pellet and temporary filling. Patient was instructed for a 2 weeks recall.

Second visit, patient did not show any discomfort, tissues abnormalities were not found, palpation test was negative, percussion test was positive, and pressure test was negative. Temporary filling was opened, calcium hydroxide still looked wet, then cleaned by using file and irrigation. Root canal then was dried using paperpoint, filled with calcium hydroxide and temporary filling.

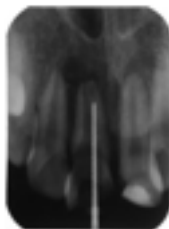


Figure 3. Working length confirm 11

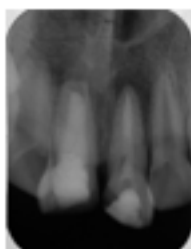


Figure 4. Periapical Radiograph following calcium hydroxide application

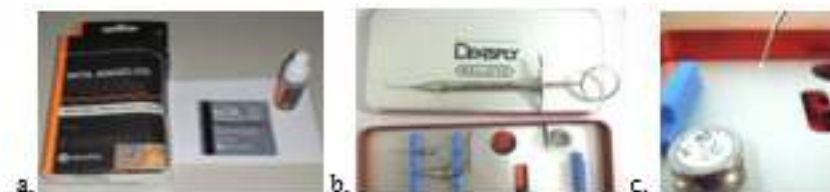


Figure 5. (a). MTA Angelus. (b). Messing Gun. (c). MTA container

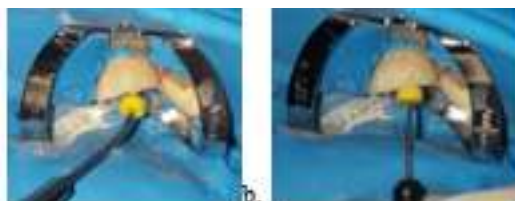


Figure 6.(a). Application of MTA using Messing Gun. (b).Finger plugger to compact MTA



Figure 7. Periapical Radiograph following apical plug with MTA



Figure 8. Periapical Radiograph of 1 week post treatment

Third visit, patient did not show any discomfort. Radiographic examination showed healing progression, lesion become small.

Rubber dam was used for isolation, temporary filling was opened, root canal was irrigated using NaOCl 1% and aquadest, then root canal was dried with sterile paper point. MTA (Angelus, Brasil) was prepared in stainless steel container. Powder and liquid MTA were mixed based on manufacturer's instructions (Mix for 30 seconds the content of 1



Figure 9. Before Treatment



Figure 10. After Treatment

sachet of MTA Angelus with 1 drop of distilled water. The mixture should be homogeneous and with a consistency similar to wet sand) then put inside the root canal using messing gun (Dentsply, jerman) for 6 mm and condensed with finger plugger.

Periapical radiographic was taken following MTA application applying MTA into root canal. A moist cotton pellet was placed into the root canal. Cavity was then sealed with temporary filling. Forth visit, patient did not show any discomfort. Custom made fiber post was constructed with its core and PFM crown was seated and cemented on tooth 11 at the following appointment

DISCUSSION

Trauma was one of many factors of tooth fracture that can cause defect of pulp in anterior and posterior tooth. Coronal fracture with exposed pulp incidence 2-13% from all trauma involving teeth. Most of the case happens in newly erupted tooth with immature root and can cause inflammation of pulp and necrosis.^{1,2}

In this case, the apex of the tooth was still open with periapical lesion. Trauma that happened during the root formation as the most probable cause. Trauma in tooth with immature root can cause the root formation to stop, so that wide and vast root canal will form and apex will be open divergent or convergent.³ Periapical lesion may appeared due to bacterial invasion into the exposed pulp, started from the crown and fracture line to the pulp, further progressed to necrosis of the pulp and forming of the periapical lesion.

Treatment of opened apex can be done with conventional apexification using calcium hydroxide, aimed to induce calcific bridge formation in apex. Apexification takes a long time, about 3-21 months. Long time span of treatment can weaken hard tissue structures of the root. Porous and small amount of soft tissues are sometimes found in the calcification.⁵

Another apexification method is by forming apical plug or often called single visit apexification. Single visit apexification is a non-surgery technique that place biocompatible material in the apical of the root. It aims to form artificial apical stop so that root canal filling can be done immediately.³ Biocompatible material used in this technique is Mineral Trioxide Aggregate (MTA). MTA has good sealing ability and can induce good bone formation. Setting time of MTA is 4-6 hours.

Treatment in this case was pulp necrosis treatment by fixing periapical lesion, apical plug using MTA, and crown restoration. Treatment was initiated by determining working length. Working length that had been determined was decreased by 2 mm from apical. This was done to avoid damaging Hertwig's Epithelial Root Sheath (HERS). HERS can continue the root formation normally.³ Root canal cleansing was done in circumferential motion to clean dentinal wall of infected root canal. The main aim of instrumentation was debridement, not root canal shaping.³ Root canal irrigation using NaOCl with low concentration which was 1%. High concentration of NaOCl used in an opened apex will cause inflammation if NaOCl gets into periodontal tissues.¹

Periapical lesion was treated by using calcium hydroxide. Based on study by Pari Ghaziani et al, when pulp necrosis involving periapical lesion occurs, calcium hydroxide must be applied into the root canal to disinfect and treat periapical lesion before using MTA.^{5,6}

In this case, apex closure was done using MTA. MTA as the apical plug. According to Hence, formation of apical artificial barrier using MTA is recommended to replace conventional apexification. MTA has good biocompatibility, sealing ability, and marginal adaptation.⁵ the use of MTA as an artificial barrier has some advantages, such as less patient visits, immediate apex closing with optimum setting time of 48-72 hours, and has potential to decrease weakening of root.^{4,8,9}

Initial pH of MTA is 10,2 and increases to 12,5 after 3 hours. MTA stimulates osteoblast formation by giving active biological substrates for bone cells.³ MTA also stimulates production of interleukin because of its alkaline nature and ability to release calcium.⁸

CONCLUSION

This case showed that apex closing with MTA as apical plug was a success and time-efficient because less visitations were needed.

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Healing Of Periapical Lesion Using Calcium Hydroxide In Nonsurgical Endodontic Treatment

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ABSTRACT

The periapical lesions are primarily caused by root canal infection. Therefore the treatment procedure should eliminate the etiological factors in the root canal system. Many of periapical lesions healed after this root canal treatment. A 21 years old female patient referred to Conservative Dentistry Clinic, Padjadjaran University Dental Hospital, with the chief complaint of pain on left mandibulary premolar. There was a history of trauma around 7 years ago. Intra oral examination shows that the premolar tooth has no caries and restoration. Vitality test of 35 was negative, and positive on percussion. Periapical radiograph represent a radiolucence periapical lesion of 35 along one third of the root with undefined radiopaque border line. Nonsurgical endodontic treatment was performed by using Calcium hydroxide intra canal medicament. After 2,5 months treatment, there are significant reduction on the periapical lesion shown by periapical radiograph, without any clinical symptoms. Follow-up radiographic examination 3 months later shows that the healing still in process and there are no clinical symptoms. Nonsurgical endodontic treatment can be successful if the diagnosis and technical procedures are carefully performed.

Keywords. Healing; Periapical lesion; Nonsurgical endodontic treatment

INTRODUCTION

The diagnostic of periapical lesions is based on clinical and radiographic findings. Periapical lesions resulting from necrotic dental pulp are among the most frequently occurring pathologies found in alveolar bone. Exposure of the dental pulp to bacteria and their by-products, may elicit nonspecific inflammatory response as well as specific immunological reactions in the periradicular tissues, and cause the periapical lesion.¹⁻³

The treatment of these infection consist of the elimination of the infectious agents by root canal treatment, allowing healing of the lesion. However, when the infection is not completely eliminated, the periapical lesion still remains. Periapical lesions of endodontic origin may develop asymptotically and become large. Proper biomechanical preparation followed by calcium hydroxide medication renewed periodically represents a nonsurgical approach to resolve extensive inflammatory periapical lesions.⁴⁻⁶

Necrotic pulps harbors pathogenic bacteria, necrotic pulp provide nutritional supply for these bacteria which leads to the development of periapical lesion. Conventional root canal treatment is primarily based on the removal of this microbial infection from the root canal system. Irrigants and intra-canal medicaments aid in reducing the microbial flora of infected root canals. In the present case reports, calcium hydroxide was used as the intra-canal medicament.⁵

CASE REPORT

A 21 years old female patient referred to Conservative Dentistry Clinic,University Dental Hospital, with the chief complaint of pain on left mandibulary premolar. There was a history of trauma around 7 years ago. Physical examination shows his blood pressure was 120 / 80 mmHg, with pulse 76 times per minute. The extra oral examination shows there are no abnormalities for his face symmetry, lips and temporomandibular joint. Intra oral examination shows that the oral hygiene was in good condition and the premolar tooth has no caries and restoration (Figure 1). Vitality test of 35 was negative and positive on percussion test. There are no mobility and no abnormality from the surrounding tissue. Periapical radiograph represent a radiolucence periapical lesion of 35 along one third of the root with undefined radiopaque border line (Figure 2). The diagnose of this case was pulp necrose with apical periodontitis (AAE 2013). Root canal treatment was decided as a treatment plan of these case.



Figure 1. Clinical condition teeth of 35



Figure 2. Periapical Radiographic of 35

CASE MANAGEMENT

After the patient signed the informed consent, the endodontic treatment started with isolating teeth by using rubber dam. Access opening was done by using open access bur. After the orifice was found, the pulp extirpated by using barbed broached needle, and then exploring the root canal by using K-File #8 and #10. The working length of the root canal determined by using apex locator and the result is 20 mm. The glide path was formed by using Path File #13, #16 and #19. The biomechanical preparation was done by using Protaper Next (Dentsply) with crown down technique until file X3, based on working length. The root canal was irrigated with combination of sodium hypochlorite 2.5% , root canal lubricant EDTA 15% (Glyde, Dentsply) and sterile saline solution. Irrigation also combined with agitation technique by using sonic instrument (Endoactivator, Dentsply). The canal was dried with sterile paper points. Calcium hydroxide paste was placed in canal until the paste seen at the canal orifice and after that the acces cavity was sealed with intermediary restorative material. The patient instructed to get another visit on 2 weeks. On second visit, the objective examination shows negative on result, but the calcium hydroxide was still wet. So, the medicament was refreshed and after that the medicament was changed every 1 month. On 4th visit, the radiographic periapical photo was taken to see the lesion and the calcium hydroxide was refreshed and the patient was informed to get another visit 2 months later (Figure 3).

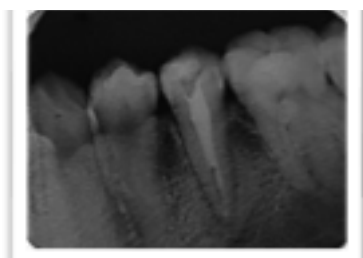


Figure 3. Periapical photo shows the lesion healing process of 35 after 2.5 months calcium hydroxide application

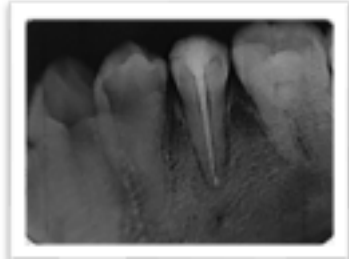


Figure 4. Trial Periapical photo of 35



Figure 5. Obturation periapical photo of 35

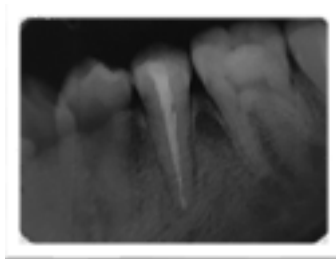


Figure 6. One week after obturated of 35

The next visit, subjective and objective examination still shows negative result and clinically there were no surrounding tissue abnormalities. The calcium hydroxide removed by using sodium hypochlorite 2.5% and saline, with final rinse using chlorhexidine 2% (Odontohex, AM Australia). The trial radiographic photo was done after placing guttaperca point X3 size with 20 mm length in the root canal (figure 4). Obturation was done by using the same guttaperca, with single cone technique, using endomethasone sealer. The periapical radiograph was taken after that (figure 5). The patient asked to have another visit 1 week later.

The subjective and clinical examination was done one week later and there are no abnormalities and still shows negative results. After having another periapical photo as control photo (Figure 6), the treatment followed by endodontically treated teeth restoration

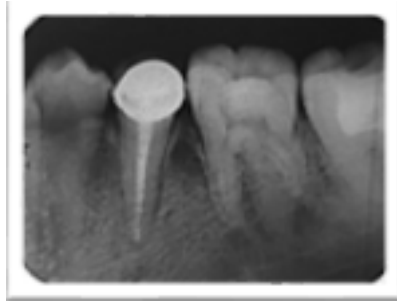


Figure 7a. One month after obturated of 35



Figure 7b. Intra oral photo of 35 after restored

(porcelain fused to metal restoration with fiber post). The result after restored, shows that there are no clinical symptoms, no tissue abnormalities and the radiographic photo shows that the size of the lesion was getting smaller (Figure 7a & b).

DISCUSSION

Necrosis, death of the pulp, may occur immediately after a traumatic injury that disrupt the blood supply to the pulp. Within hours an inflamed pulp may degenerate to a necrotic state. Periapical lesions are classified according to the clinical picture and histologic appearance. The teeth with periapical lesions on this case are called apical periodontitis. The etiology of the case is the discharge of bacterial toxins from the necrotic pulp due to trauma. In this condition, the symptoms that often appear were the presence of pain and discomfort from being up to the perceived weight when conducted tests on percussion. There were no response to the test of vitality due to the occurrence of pulp necrosis. Pulpal necrosis is usually asymptomatic but may be associated with spontaneous pain and discomfort or pain (from the periradicular tissues) on pressure. Tooth with necrotic pulp should be nonresponsive to vitality testing, because of the spread of inflammatory reactions to periradicular tissues, often sensitive to percussion.¹⁻³

Necrotic pulps harbor pathogenic bacteria, necrotic pulp provides nutritional supply for these bacteria which leads to the development of periapical lesion. Conventional root canal treatment is primarily based on the removal of this microbial infection from the root canal system. Irrigants and intra-canal medicaments aid in reducing the microbial flora of infected root canals.⁵ Endodontic infection control is another crucial point to be addressed while planning the intervention. For elimination or maximum reduction of microorganisms in the root canal system, the professional should associate debridement using endodontic files with efficient irrigating solution and intracanal medication. Moreover, patency and enlargement of the canals in case of necrotic teeth with periapical lesions will help eliminating microorganisms from the apical foramen, thus preventing the inflammatory process to perpetuate. Root canals are performed in the setting of periapical lucency due to apical periodontitis. If treatment is successful, bone regeneration and healing of the periapical lesion will ensure and manifest as a gradual reduction in lesion size. Irrigation with sodium hypochlorite and adequate biomechanical preparation is recommended for effective neutralization and removal of infection from the root canal system, followed by calcium hydroxide intracanal medication.⁷⁻⁹

Calcium hydroxide dressings were selected because they reportedly provide excellent clinical and laboratorial results. A success rate of 80.8 and 73.8% has been reported with calcium hydroxide, when used for endodontic treatment of teeth with periapical lesions. A high degree of success has been reported by using calcium hydroxide beyond the apex in cases with large periapical lesions. Calcium hydroxide was associated to an aqueous vehicle to allow rapid release of Ca^{++} and OH^- . Zinc oxide was added to the paste to allow better visualization of the medication within the canal. Calcium hydroxide is a widely used material in endodontic treatment because of its bactericidal effects. It is thought to create favorable conditions for periapical repair and stimulate hard tissue formation. The action of calcium hydroxide beyond the apex may be four-fold: (a) anti-inflammatory activity, (b) neutralization of acid products, (c) activation of the alkaline phosphatase, and (d) antibacterial action. High frequency of periapical healing showing completed resorption of the periapical defect is observed with the treatment of calcium hydroxide. The exact mechanism of action of calcium hydroxide is still speculative. The efficacy of calcium hydroxide, owing to its antiseptic, anti-exudative, and mineralization inducing properties depends on the sustained release of calcium and hydroxyl ions to the root canal and periapical region. Regular renewal of the root canal dressing is fundamental in reducing the intensity of the periapical inflammatory process as they are progressively resorbed by the periapical fluids.^{5,7,10,11}

$\text{Ca}(\text{OH})_2$ is often used to effect periapical healing by combination of its antimicrobial activity and its ability to promote hard tissue formation and periodontal healing. In this particular non-surgical technique, calcium hydroxide paste was considered and used as the intracanal dressing material of choice because of its reputed healing of periapical inflammation and formation of an apical hard tissue barrier. The influence of calcium hydroxide on periapical healing could be attributed to both its antibacterial effects and mineralising effects. Microorganisms coming in direct contact with calcium hydroxide are possibly destroyed by its

Table 1. Periapical Index

PAI Score	Description of Radiographic findings
1	Normal Periapical Structures
2	Small changes in Bone Structures
3	Change in Bone Structure with Mineral Loss
4	Periodontitis with well — defined radiolucent area
5	Severe periodontitis with exacerbating features

high alkalinity (usually pH 12 to 13). Once the bacteria are destroyed and their substrate neutralised, the calcium hydroxide in contact with vital connective tissue in the apical area exerts basically the same effect as when it is placed on the coronal pulp. Tissue layers similar to those formed after pulpotomy and pulp capping with calcium hydroxide have been noted in the apical barrier. But instead of reparative dentine, a collagenous cementum-like tissue is formed, probably because different cells are involved.^{12,13}

Radiographic evaluation was done using the PAI scoring system given by Ørstavik in 1986. This is a 5-point scale radiographic interpretation designed to determine the absence, presence, or transformation of a diseased state. The reference is made up of a set of five radiographs with corresponding line drawings and their associated score on a photographic print (Table 1). Healing of the periapical lesion usually occurs with hard tissue regeneration that is characterised by reduction of the radiolucency on follow-up radiographs. This case shows that the healing still on process, and there are small changes in bone structures that define the PAI score is 2 whilst the initial condition of PAI score was 4.^{14,15}

CONCLUSION

Nonsurgical endodontic treatment of periapical lesions have shown a high success rate. This treatment with calcium hydroxide is an initial treatment option of choice in patients with large periapical lesions, affording complete periapical healing. Periodic follow-up examinations are essential and various assessment tools can be used to monitor the healing of periapical lesions.

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Nonsurgical Endodontic Retreatment On Left Maxillary Second Premolar With Underfilled Obturation.

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ABSTRACT

Endodontic re-treatment commonly correlated with the failure in endodontic therapy. Generally, the most important factors that related with this condition were the qualities of the root canal obturation and the coronal restorations. The purpose of endodontic retreatment is to restore the tooth condition and to eliminate the infection. This article discuss about nonsurgical endodontic retreatment on left maxillary second premolar with underfilled obturation. A 27 years old male patient came with discomfort on tooth 25. He also reported a history of previously endodontic treatment approximately two years ago. The clinical examination showed no adequate restoration on tooth 25. Percussion test showed a sensitive response, but negative response to palpation and mobility. Radiographic examination showed an endodontic treated teeth with underfilled obturation. Nonsurgical endodontic retreatment followed porcelain fused to metal crown with fiber post as the final restoration. Nonsurgical endodontic retreatment can be used as an excellent alternative therapy for failure endodontic with underfilled obturation.

Keywords: Nonsurgical Endodontic Retreatment, underfilled obturation

INTRODUCTION

Endodontic re-treatment commonly correlated with the failure in endodontic therapy. There are many causes for failure of initial endodontic therapy include iatrogenic procedural errors such as poor access cavity design, untreated canals (both major and accessory), canals that are poorly cleaned and obturated, complications of instrumentation (ledge, perforation, or separated instrument), and overextensions of root-filling materials. Coronal leakage has also been blamed for posttreatment disease, as has persistent intracanal and extracanal infection and radicular cysts.¹

Indications nonsurgical endodontic retreatment are tooth with underfilled obturation with patient complain, canal obturation is not perfect with coronal restoration that needs to

be replaced and the tooth with root canal system that can be accessed easily from coronal. The contraindications nonsurgical endodontic retreatment are root canal walls were thin so increase the risk of perforation, their broken instruments in the root canal can not be removed by conventional root canal was bent with curvature that is difficult in the apical portion, and a tooth with root fracture horizontal and vertikal.¹⁻³

CASE REPORT

A 27 years old male patient was refered to Conservative Departement Faculty of Dentistry Padjadjaran University complaining about discomfort feeling on left maxillary teeth. The patient did not report the presence of spontaneous pain. Periapical pathology could be observed in the preoperative radiograph. The dental history indicated that the upper left second premolar had previously received canal treatment two years ago, but the definitive restoration loosed three months later. The patient's medical hystory was noncontributory. There was no history of drug allergies.

Extra oral examination showed no facial asymmetry, swelling or lymphadenopathy present. Clinical examination showed a positive response to percussion test and negative response to the electric pulp test, palpation and mobility, no swelling on gingival, erythema or sinus tract present, has existing temporary filling material, discoloration on the tooth and good oral hygiene (Figure 1).



Figure 1. Initial clinical situation Teeth 25



Figure 2. Pre-op Radiographic

Radiographic examination showed radiolucent on the occlusal and distal continued until pulp chamber and radiopaque in the root canal look like obturation material. The quality of the root canal filling was inadequate because the limit of the filling was below the standard required with deviation in the apical third of the buccal and palatal canals (Figure 2).

Based on the history, clinical test, and radiograph, a diagnosis of the tooth 25 was previously treated tooth with symptomatic apical periodontitis. Treatment plan for this case was nonsurgical endodontic retreatment and the follow-up was restoration porcelain fused to metal crown and fibre post on palatal canal. The prognosis was good because the patients cooperative, good oral hygiene, dental tissue is still quite extensive and there was no radiolucent on periapical.

CASE MANAGEMENT

The first visit, after subjective, objective, radiographic examinations, diagnosis and treatment plans determination, the patient signed the informed consent. Rubber dam was placed and continued with the opening of the pulp chamber, tooth irrigated with 2.5% NaOCl and cleaned up visible root canal orifices with gutta-percha that filled the canal (Figure 3). Cotton pellet soaked in xylene was applied to the root canal orifices to soften gutta-percha. Gutta-percha removed using Gutta Percha Remover (GPR) bur and Hedstrom files. After the gutta-percha removal completed, the canals irrigated with 2.5% NaOCl and x-rays to confirm whether there gutta-percha are still lagging behind (Figure 4).



Figure 3.Clinical Photo



Figure 4. Dental Radiographic Confirmation

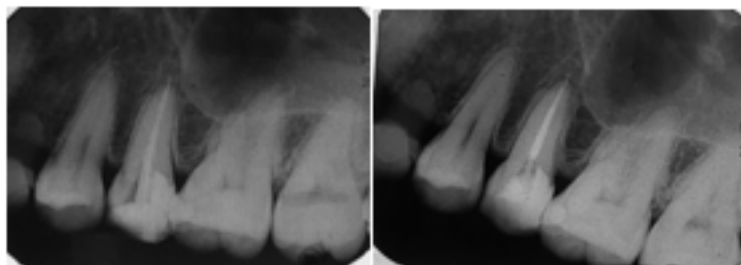


Figure 5 Trial Radiographic Photo and After Obturation Radiographic Photo



Figure 6. Control Radiographic Photo

Coronal flaring was performed using Protaper SX file. All canals were negotiated to length, according to the electronic apex locator (Propex, Dentsply). Working length measurement were buccal 15.5mm and palatal 16.5 mm. Chemomechanical instrumentation using crown-down technique was performed in all canals using ProTaper Rotary Instrument (Protaper, Denstply). 2.5% NaOCl was used after every instrument and canal patency was maintained with a #10 C file. Master apical file size were F2. 2.5% NaOCl was used as final irrigation solution, followed by 15% EDTA, and a final rinse with 2% Chlorhexidine. The canals were dried with sterile paper points and then filled with calcium hydroxide paste and closed temporary fillings. Treatment was continued two weeks later.

The second and third visits, clinical examination showed positive response to percussion, negative response to palpation and mobility. The root canal cleaned and irrigated with 2.5% NaOCl and 2% CHX and then the canals dried with paper points. Application of calcium hydroxide paste and closed temporary fillings, treatment was continued two weeks later. On the fourth visit clinical examinations showed negative response to percussion, palpation and mobility. The root canal cleaned and irrigated with 2.5% NaOCl and dried with paper points. Gutta-percha master cones F2 placed on buccal and palatal root canal to trial radiographic photo. Obturation of the root canal with lateral compaction using gutta-percha master cone and endometason sealer, and the orifice of root canals covered with glass ionomer cement (Figure 5).



Figure 7. a) Try in Fiber Post; b) Preparation Core; c) PFM Crown Teeth 25



Figure 8. Control PFM Crown Teeth 25

Next visit for control of post-obturation the root canal. Patients reported there was no complaints and clinical examination showed negative response to percussion, palpation and mobility. The radiographic examination showed periapical with normal limit (Figure 6).

After endodontic nonsurgical retreatment, the tooth was restored with porcelain fused to metal crown with fiber post in palatal canal (Figure 7).

The last visit, patient reported there was no complaints and clinical examination showed negative response to percussion, palpation and mobility. The radiographic examination showed definitive restoration in good condition (Figure 8).

DISCUSSION

There are many causes for the endodontic failure such as, include iatrogenic procedural errors such as poor access cavity design, untreated canals (both major and accessory), canals that are poorly cleaned and obturated, complications of instrumentation (ledge, perforation, or separated instrument), and overextensions of root-filling materials. Basic treatment option for failure of initial endodontic therapy are as follows do nothing, extract the tooth, nonsurgical retreatment and surgical retreatment.¹

Indications of nonsurgical endodontic retreatment are tooth with underfilled obturation with patient complain, canal obturation is not perfect with coronal restoration that needs to be replaced and the tooth with root canal system that can be accessed easily from coronal. The contraindications of nonsurgical endodontic retreatment are root canal walls were thin so increase the risk of perforation, broken instruments in the root canal that can not be removed by conventional root canal was bent with curvature in the apical and tooth with horizontal and vertikal root fracture.¹⁻³

In this case, the failure of root canal treatment earlier can be caused by the result of underfilled obturation. It can provide an empty space which allows the re-colonization of bacteria in the root canal and the release of the restoration few months after the inserted causing diffusion of saliva/oral fluid into the root canal facilitate the re-invasion of bacteria into the root canal and the periapical region.^{2,3}

Nonsurgical endodontic retreatment can be an option in this case because it is a non-invasive treatment, easily access to the root canal obtained from the coronal and root canal straight through to apikal.² This option was also taken in consideration of the overall good prognosis looks of patient motivation, and good oral hygiene.

The treatment starts with taking gutta-percha from the root canal, there are a variety of techniques to take gutaperca out by using a solvent (citrus oil, eucalyptus oil, chloroform, xylene, endosolve), hedstrom file (hand instruments), ultrasonic scaler and laser.^{2,4} In this cases using the solvent selected was xylene and removal gutta-percha done using a combination of Gutta-Percha Remover (GPR) bur and hedstrom file because the technique were simple and effective.

Root canal preparation was done using crowdown technique. This technique used to minimize extrusion of debris/irritant to periapical tissues. Irigans solution used in this case were sodium hypochlorite (NaOCl) 2.5% and 2% chlorhexidine. Sodium hypochlorite used because it has the ability to remove debris from the root canal, dissolve vital and necrotic tissue, has potential broad-spectrum antimicrobial activity, especially with high concentrations, the action of lubrication. Chlorhexidine as irigan used because it has a broad-spectrum antimicrobial effect, very low toxicity and effective against *Enterococcus faecalis* in the dentinal tubules. In this case chlorhexidine used as the final irigan caused chlorhexidine has substantivity (residual effect) on dentin and capable maintance antimicrobial effects up to 48-72 jam.^{1,2}

In conclusion, nonsurgical endodontic retreatment can be used as an excellent alternative therapy for failure endodontic with underfilled obturation case. In conducting the nonsurgical endodontic retreatment required careful consideration and a good understanding of the causes of failure of treatment, the condition of the teeth and periapical tissues so that the success of treatment can be achieved.

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Management Of Separated Endodontic Instrument During Root Canal Treatment With Bypass Technique

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ABSTRACT

The iatrogenic failure can occurred during root canal treatment procedure. That will affect the success of the treatment. Improper use of the instrument can cause this failure. Limited flexibility and strength of intracanal instruments combined with improper use may result in an intracanal instrument separation. A common cause for instrument separation is improper use. Typical examples of improper use include inadequate access, overuse of the instrument, too much radicular pressure during instrumentation and the continues of a large instrumen in curved canal. There are basically three strategies to manage separated instrumen which are attempt to remove the instrument, attempt to bypass it or prepare and obturate to the segment. A 32th years old male patient with a large cavity of first upper right premolar tooth had been restored but the filling was failed. Patient had history of spontaneous pain and wanted the filling to be replaced. At the time of preparation biomechanical was occurred iatrogenic failure in the form of fractured instrumen file protaper universal rotary S1 in the apical third of root canal. The treatment decided to bypass separated instrument in the palatal root and root canal treatment performed on both canalss. The obturation was done and the post-obturation was done with fiber post and composite crown as longterm temporary restoration. The management of a separated instrument with bypass technique can be successfully carried out.

Key words : fractured endodontic instrument, bypass technique, root canal treatment

INTRODUCTION

File separates during endodontic treatment is complications most frequently associated with aberrant root canal anatomy and severe root curvatures. Teeth with fractured files may sometimes be treated by an orthograde approach from within the root

canal system. Bypassing separated files has been more successful when the instrument was lodged in the coronal or middle part of the root. However, a perforated tooth with a curved root canal which cannot be negotiated, or one associated with an apical lesion, often requires a retrograde approach in order to create successful obturation.¹

CASE REPORT

A male patient 32 years old came with a large cavity of first upper right premolar tooth had been restored but the filling was failed. Patient had history of spontaneous pain and he wanted the filling to be replaced. Extra oral examination showed that the face was symmetrical, both submandibular nodes were painless and impalpable. Intraoral examination showed deep caries in 14, the tooth had no response to vitality test, tender to percussion and without mobility and abnormalities of surrounding tissue. Patient had a poor oral hygiene.

Radiographic examination showed radiopaque in coronal from occlusal to pulp chamber. There were divergent roots. Periodontal membrane was widen alongside the root, uncontinuity of lamina dura, alveolar crest normal and periapical tissues were radiolusen.



Figure 1. Earlier Image of Tooth14

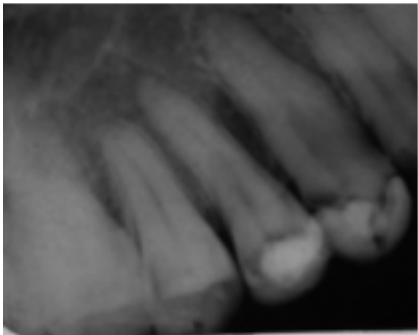


Figure 2. Earlier Radiographic Image (Diagnosis) tooth14

The diagnosis was pulp necrosis with asymptomatic apical periodontitis tooth 14. The treatment plan were access preparation, bypassing the separated instrument, cleaning and shaping the root cana, intracanal medicament with calcium hydroxide and long term temporary restoration. Prognosis was questioned because the separated instrument in the third apically root canal and the tooth with apical periodontitis.

CASE MANAGEMENT

First visit after diagnosis was established, access preparation was done on occlusal of tooth 14, opened with sterile round bur and endo access bur. Pulp chamber was cleaned and orifices were found. The coronal thirds are enlarged with Gates Gliddenburs. Hand files then are used to determine the working length and to secure a glide path. Cleaning and shaping were performed in all canals using ProtaperRotary System (Dentsply). Master apical file in buccal canal was F3 file. During preparation, S1 file was separated in the palatal canal. Irrigation was done using NaOCl 2.5%, EDTA 17%, and chlorhexidine 2%. Treatment was postponed and radiographix examination was taken tto confirm separated file inside palatal canal. Radiographic imaging showed separated file inside palatal canal, at the 1/3 apical curvature canal. Calcium hydroxide was applied as intracanal medicament inside buccal root and temporary filling was applied.

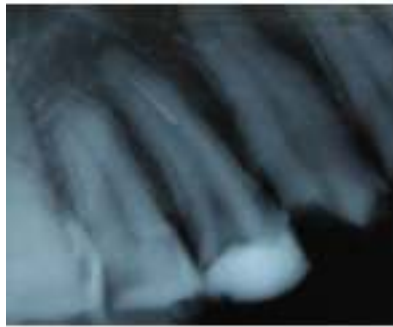


Figure 3. Radiographic confirmation of the fractured



Figure 4. Radiographic confirmation of bypass

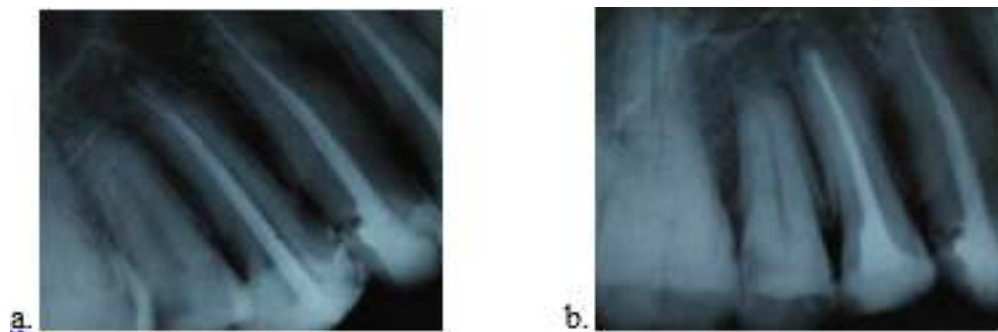


Figure 5 (a).Master cone radiograph of tooth #14. (b). Obturation radiograph of tooth #14



Figure 6. 1 week control after root canal obturation

Patient came back for the next appointment. Tooth was asymptomatic, not sensitive to percussion, and without tooth mobility. Rubber dam was placed, temporary filling was detached. Root canal then was irrigated using NaOCl 2.5%, EDTA 17% , and chlorhexidine 2%. The attempt to removal of a separated instrument was failed. Bypass then was done, began with a precurved 0.8 K-file was inserted into the root canal until it lodged aside the separated file segment; then it was rotated 15° to 30° and pulled out. This was patiently repeated until the file was incrementally bypassed. Radiographs were taken during the procedure to confirm that the 0.8 K-file was following the correct path. Once the separated file segment was bypassed, larger files were used in succession and root canal therapy was continued. Palatal root preparation was done with stepback technique incorporating a stepwise reduction of the working length for larger file. Master apical file in palatal canal was 25 K- file. Irrigation was done with NaOCl 2.5%, EDTA 17% and chlorhexidine 2%. Calcium hydroxide was applied inside the root canal and sealed with temporary filling.

Patient came back with tooth was asymptomatic, not sensitive to percussion, neither tooth mobility nor periodontal abnormalities were found. Rubber dam was placed, temporary filling was removed, calcium hydroxide was cleaned, master cone was selected, and master cone radiograph was taken. The master cone radiograph showed gutta-percha well fitted in all canal. (Image 5a).

Root canal obturated by gutta-percha with Guttaflow as sealer. Gutta percha was cut on the orifices and 2 mm GIC base was applied and closed with temporary filling. Radiographic image was done to confirm that the root canal obturation was covering the entire root canal and hermetic. (Image 5b).

Patient came back after 7 days for the next appointment. Tooth was asymptomatic, not sensitive to percussion, neither tooth mobility nor periodontal abnormalities were found. A radiograph showed no periapical abnormalities. Then the tooth was restored with post fiber and composite crown as longterm temporary restoration.

DISCUSSION

Separated instruments while doing endodontic treatment is a complication that often relates with curved root canals, anomaly and extreme curvature of roots, improper access into the root canals, repetition of instruments, and operator's skill.^{2,3} Common causes of fractured instruments are improper use of file, limitation of file's ability, inadequate access, root canal anatomy, and possibility of faulty from the manufacturer.²

Intracanal separated instrument creates obstruction of the root canal by metallic fragments, which can jeopardise thorough chemomechanical debridement and compromise the outcome of root canal treatment. When such an accident is verified clinically, the fragment can be removed or bypassed and sealed within the root canal space, or true blockage can be performed the choice being based on an assessment of the potential benefit of removal compared with the risk of complication. In most cases, removal of the separated instrument segment is the best alternative. However, practitioners often find orthograde fragment removal to be difficult and time consuming.^{3,4}

Extraction of separated instruments is based on the location of the separated instruments. If the separate occurs in coronal of root canal, extraction can be done. But if the separated instruments are deep inside the canal or inside the curved apex, extraction is difficult and another complication may result.²

Material of separated instruments affects opportunity of extraction. Nickel-titanium file is easily separated and more difficult to be extracted compared to stainless-steel file when ultrasonic extraction is done.^{2,3} Extraction of separated instruments located in 1/3 apical is very difficult and increase the risk of ledge, root perforation, and root fracture. Root canal diameter and curvature, material of separated instruments, and potential of destruction of remaining tooth are considerations in extracting the fragment in that location.³

Several approaches that can be done when separated of rotary NiTi occurs are extracting the separated instrument, bypass, leaving the separated instrument inside the root canal (Leaving it in situ), or surgery.⁵

The aim of the treatment is the same, which is root canal disinfection. Extracting separated instrument is an ideal solution.⁵ However, nickel-titanium tends to separate and extracting it with ultrasonic instrument is difficult. If the ultrasonic tip touches the tip of separated instrument, the file will move further inside the root canal. The use of excessive

ultrasonic vibration can cause the file to fracture and more difficult to extract.⁶

There are four steps of extracting separated NiTi : access modification , attempt to extract the separated nstrument inside the curved root canal, root curvature is to be straightened for better access.⁶ This will make direct access to the separated instrument, so that it can be easily extracted. Another way is to make exit pathway directly from coronal of root canal into the separated instrument location so the fractured instrument can be extracted. In this case, this attempt had not been done because the possibility of perforation because root curvature that complicates direct access. If previous attempts fail to be done, instrument can be extracted with ultrasonic instrument with light tip such as CPR 6,7, or 8. Light pressure is applied on the lateral of separated instrument. Retrieval is done by continuous irrigation using EDTA to clean debris.

Prognosis of separated instrument depends on how much debris and unfilled space, including the separated instrument, in the root canal. Bypassing the instrument and incorporating it into the obturation should also have no effect on the prognosis. However, if the instrument cannot be removed or bypassed in a tooth with a necrotic, infected pulp and apical periodontitis, the prognosis will be uncertain. This case should be followed closely and, if symptoms persist, apical surgery or extraction should be considered.^{2,7}

CONCLUSION

Success rate of endodontic treatment relates with root canal disinfection, even when separated instrument occurs. When disinfection is obtained, bypassing separated instrument can be a success.

SUGGESTIONS

To avoid separate of instruments, signs of deformities in the instruments must be observed, single use of instruments is one way to minimize the risk of fracture and analysis of position of the separated instrument and root canal anatomy are important in determining the strategy of separated instrument management.

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Management Of Maxillary First Premolar With Three Root Canals: A Case Report

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ABSTRACT

Endodontic management of root canals with anatomic variation of root canal configuration may be challenging. Treatment failure may occur due to procedural errors such as over extension of pulp chamber and perforation of pulp chamber floor and orifice canal wall as a result of misaligned preparation while exploring canal orifice, and also undetected canal. Proper knowledge of dental anatomy and its variations is essential for the success of endodontic treatment. A 22 years old male came with large decay and had history of spontaneous pain on his maxillary posterior tooth. Clinical examination showed the tooth had weak response to vitality test, tender to percussion with no mobility and abnormalities in the surrounding tissues. Radiographic examination showed three separated roots with two buccal roots and one palatal root. The mesiobuccal root showed curvature at middle third with widening periodontal membrane at periapical tissues. A diagnosis of pulp necrosis associated with chronic periapical periodontitis was determined. Root canal treatment was performed with modified access cavity preparation. The obturation was done with warm vertical compaction using Genesis system. The post-obturation restoration was done with fiber post and zirconia crown. Anatomic variation of root canal configuration associated with additional root canals may cause difficulties in cleaning, shaping, and obturation. A thorough knowledge in internal anatomy of the tooth, appropriate instrumentation techniques, and customized treatment planning depending upon the anatomic variation will help in managing root canal treatment, prevent complications, and enhance the quality of the treatment.

Keywords: Three roots, maxillary premolar, anatomic variation.

INTRODUCTION

One of the determining factors for the success of endodontic treatment is understanding the morphological anatomy of the tooth structure and its variants in relation to its anatomy.¹ The internal anatomy of maxillary first premolars is particularly complex due to their variation in number of roots and canal configuration.² Three rooted maxillary premolars were reported to be a rare variation in Asian population (0.6%) as compared to non-Asian population,³ but possibility of extra roots or canals should always be in operator mind to ensure successful endodontic treatment.⁴ Unidentified root canals represent a major cause of endodontic treatment failure.⁵

The anatomical and structural complexities of the root canal should be effectively assessed and efficiently approached. Treatment challenge begins at case assessment and all operative stages, including cavity design, canal access, orifice localization, cleaning and shaping of the root canal system, and proper obturation when a tooth found to have an extra root.⁶

Preoperative radiographs should be carefully examined to facilitate successful endodontic treatment in maxillary premolars in order to make a diagnosis of additional roots or canals.⁴ Careful interpretation of a radiograph may reveal anatomical details of a root canal system.⁷ The canal may diverge into two parts that either remain separate or merge before reaching the apex if a radiograph shows a sudden narrowing or even a disappearing pulp space.¹ An abrupt straightening or loss of a radiolucent canal in pulp cavity should be suspected as an extra canal.⁶ Equal or greater size of mesio-distal width of mid root than crown mostly shown the tooth has three roots.⁴

Enhanced illumination and magnification may help to locate root canal orifices and visualize the treatment site. The higher magnification and illumination can be useful for access cavity preparation, instrumentation and obturation.⁸ More than one root canal should be suspected when the pulp chamber appears to deviate from normal configurations, either triangular in shape or too large on a mesio-distal plane.⁹

CASE REPORT

A 22-years old male patient was referred from local public health center to the Conservative Dentistry Postgraduate Clinic, Dental Hospital, Faculty of Dentistry, Universitas Padjadjaran for a root canal treatment on his maxillary right first premolar. His chief complaint was the tooth has a large decay, food impacted while chewing food at that region, and produce prolonged pain. He had history of spontaneous pain. Clinical examination showed his maxillary right first premolar has been restored with a temporary restoration at distal, buccal, and occlusal surface of the tooth (Figure. 1). The tooth gave a weak response to vitality test, tender to percussion, and without mobility or abnormalities in the surrounding tissues.

Preoperative radiographic examination confirmed the carious lesion was extended into the pulp chamber from the distal surface of the tooth, the mesiodistal root diameter was



Figure 1. Clinical appearance of tooth #14 before root canal treatment



Figure 2. Pretreatment radiograph of tooth #14

greater than the mesiodistal width of the crown, straightening of radiolucent canal was abrupt or loss in pulp cavity, may showed the canal may diverges into two parts. There was three separated roots with two buccal roots and one palatal root. The mesiobuccal root showed widening periodontal membrane at periapical tissues (Figure. 2). Diagnosis was concluded, based on clinical and radiographic findings, as pulp necrosis of tooth #14 associated with chronic periapical periodontitis. The tooth suspected to have three independent roots and root canals.

CASE MANAGEMENT

Prior to the treatment, information was given to the patient on the futured treatment plan of root canal treatment and a zirconia crown with fiber post following RCT on tooth # 14. Patient was obliged to sign the informed consent should he agree with the procedures proposed.

Following anesthesia and rubber dam isolation, temporary restoration was removed with round diamond bur. Then the access cavity was prepared. In the floor of pulp chamber only two orifices were detectable (Fig.1b), even with extention of the access cavity, no other orifices were found. The size of buccal orifice was larger than usual, extension of this orifice was carried out using Endo-Z bur (Dentsply). The floor of pulp chamber was examined with a 3.5x magnification loupe, the white line test revealed an extra orifice at distal site of buccal



Figure 3. T-shape outline access



Figure 4. Distal artificial wall create with resin composite

orifice, the white dentinal dust was explore using DG16 explorer, and clarified the location of distobuccal and mesiobuccal canals. Then access opening was modified resulting a cavity with T-shaped out line, the prepared was cut at the buccoproximal angle from the entrance of the buccal canals to the cavosurface angle. (Figure 3). The mesiobuccal and distobuccal canals were explored with K-file #10 and the palatal with K-file #15 with estimated working length, resulting in clinical and radiographic confirmation of three canals.

Coronal flaring was carried out with Gates Glidden burs. The distal surface was restored with resin composite to create an artificial wall (Figure 4). Cleaning and shaping were performed in all canals using Protaper Rotary System (Dentsply). The pulp chamber was filled with sodium hypochloride 5.25%. Sequential rotary files (Protaper Rotary System,



Figure 5. Irrigant agitation with ultrasonic



Figure 6. Master cone radiograph of tooth #14



Figure 7. Obturation radiograph of tooth #14

Dentsply) was begun by using K-file #10 in watch-winding motion to explore canals to $\frac{2}{3}$ of the estimated working length that were determined from pre-op radiograph. Then S1 file followed by SX file were used to the same length of K-file #10 in brushing motion. EDTA

Then, canals were negotiated with K-file #10 to full working length that were determined using apex locator to establish apical patency. After working length of all canals were determined using apex locator, all files were used to full working length. K-file #15 was used and continued with Proglider file (Dentsply) to confirm glide path.¹¹ Then, S1 followed by S2 files were used to shape canals. Canals were irrigated between each file.



Figure 8.Post fiber insertion and crown build up for zirconia crown tooth preparation of tooth #14

Then F1 file as finishing file was used in a straight in and out motion. After that, K-file #20 was used in mesiobuccal and distobuccal canals to gauge apical foramen and found fit closely to canals, so F1 file was determined as master apical file (MAF). In palatal canal K-file #20 was loose, so F2 file was used followed by F3 file and with the same manner K-file #25 and K-file #30 were used to confirm the foramen apical fit closely, and then F3 file was determined as MAF. Finally all canals were irrigated and K-file #10 was used to working length to remove debris and ensure patency.

Final irrigation was done with the use of NaOCl 5.25%, EDTA 17%, chlorhexidine 2% solution , and agitated with ultrasonic (Figure 5). Canals were dried with absorbent paper points, filled with calcium hydroxide paste, and the cavity sealed by temporary filling.

Patient came back after 14 days for the next appointment. Tooth was asymptomatic, not sensitive to percussion, neither tooth mobility nor periodontal abnormalities were found. Calcium hydroxide was cleaned, master cone was selected, and master cone radiograph was taken. The master cone radiograph showed gutta-percha well fitted in all canal and confirmed a type VIII Vertucci root canal morphology (Figure 6).

Root canal obturated by gutta-percha with Warm Vertical Compaction System (Genesis) and AH Plus Sealer (Dentsply). The mesiobuccal and distobuccal canals were obturated with down pack and backfill obturation technique until gutta-percha was reach 1 mm under orifice, while the palatal canal was obturated only with down pack technique leaving gutta-percha from apical constriction 5 mm in length. Then an obturation radiograph was taken (Figure 7).

Patient came back after 7 days for the next appointment. Tooth was asymptomatic, not sensitive to percussion, neither tooth mobility nor periodontal abnormalities were found. A radiograph showed no periapical abnormalities. Then the tooth was restored with post fiber and a zirconia crown (Figure 8).

DISCUSSION

The anatomical abnormalities of the root canal systems are a challenge for a successful endodontic therapy. Thorough knowledge of the internal anatomy of teeth is essential before an operator can rationally approach any endodontic procedure. Treatment failure may occur due to procedural errors such as undetected extra roots and canals. Three rooted maxillary premolars were reported to be a rare variation in Asian population (0.6%) as compared to non-Asian population.³

In the case report discussed, the right maxillary first premolars have type VIII root canal morphology according to Vertucci classification (Fig. 11).¹ An abrupt straightening or loss of a radiolucent canal in the pulp cavity and an equal to or greater width of the mid-root region that is than the mesiodistal width of the crown should be suspected as an extra canal in the same root or in the other independent roots.^{4,6}



Figure 9. Cementing zirconia crown of tooth #14

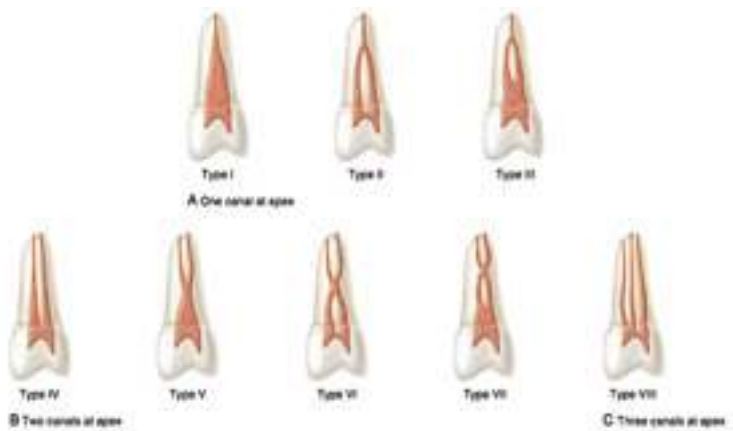


Figure. 11. Vertuci's classification.²



Figure 12. T-shaped outline access.2



Figure 13. Restoration of the endodontically treated tooth.2

Extra root may detectable by palpation of buccal cervical area of the tooth with exploring the mesiodistal reveal a buccal furcation and the presence of an eccentric orifice other than in its normal location in premolars buccopalatally leads to the suspicion of the presence of an extra canal.¹⁰ Good illumination and magnification make the root canal treatment easier to locate all the root canal orifices with the aid of an operating microscope or loupe. This improve the clinician's view of the complexity of the root canal anatomy and aid in the location of additional canals.⁸

Diagnostic measures such as preoperative radiographs, examination of the pulp chamber floor with a sharp endodontic explorer, touching of grooves with ultrasonic tips, performing the sodium hypochlorite champagne bubble test, visualizing canal bleeding points, white line test, and red line test are important aid in locating root canal orifices.¹⁰

Modifying the access had to be done as the first step to successfully accomplish the root canal treatment. In this case, access opening was resulting a cavity with T-shaped outline in order to retain the base of pulp chamber, localized the buccal orifice, and directing a straight access to root canals. The prepared was cut at the buccoproximal angle from the entrance of the buccal canals to the cavosurface angle (Figure 12). This T-shaped access outline is helpful for correctly reaching all of the root canals.⁸

Coronal flaring and straightening the access may reduce interference of instrument in root canals. Gates Glidden drills was used in order to allow unrestricted placement and to improve the tactile sensation of the instrument in the canal.⁷

Glide path was created by Proglider (Dentsply).¹¹ Glide path is necessary for creation of a radicular path that can be cleaned then shaped to a continuously tapering funnel that can be predictably and easily obturated.¹²

A progressive taper allows instrument and irrigation solution contact with the surfaces of the canal walls, thereby enhancing the effectiveness of cleaning.¹³ The sequence of rotary files (Protaper Universal Rotary, Dentsply) was used in accordance with the manufacturer's instructions to obtain a continuous tapering of the canals. The apex locator was used to ensure the full working length. EDTA gel was used as a lubricating agent to allow the smooth movement of instruments in the canals. Ultrasonic agitation was used to produce vigorous intracanal fluid agitation through acoustic streaming and cavitation. This hydrodynamic activation serves to improve the penetration, circulation and flow of irrigant into the more inaccessible regions of the root canal system.

The intracanal medication has the function of eliminating remaining microorganisms and preventing recontamination, preventing or reducing periapical inflammation, solubilize organic matter, neutralize toxins, control persistent exudation, control external inflammatory resorption and stimulate repair.¹⁴ Calcium hydroxide is the most appropriate medication for endodontic purposes, being a substance with antimicrobial activity, inhibiting root resorption, and inducing formation of hard tissue. However, it is necessary to have longer contact time with the tissue for its action.¹⁵ The calcium hydroxide inside the canals was change every 14 days for 3 times in this case. Warm vertical compaction obturation is a technique used for anatomically complex canals obturation. This obturation system was chosen in this case, to ensure inclusion of the ramifications of the main canal, such as the lateral canals, apical delta system and anastomoses between canals.^{13,16}

A post and a crown was the chosen restoration following root canal treatment. This restorations associated with the excessive hard tissues removal on the root and tooth (Figure 13). It is considered that durability of non-vital tooth decreases along with the loss of hard tissue and the tooth was susceptible to fracture.^{2,17}

CONCLUSION

Root canal treatment of maxillary first premolar with extra root canals may cause failure if there is undetected extra roots and canals. Thorough knowledge of the root canal anatomy, careful interpretation of the preoperative radiographs, proper modified endodontic access cavity preparation, orifice localization and exploration of the root canal, and the use of operating microscope or loop are the prerequisites for endodontic success in maxillary premolar with three roots.

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Non-Surgical Root Canal Retreatment On The Maxillary Left Second Premolar

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ABSTRACT

Root canal treatment failure is usually caused by recurrent infection in the root canal. The case of teeth requiring root canal treatment is generally caused by the presence of persistent infection in the root canal. The microorganisms that are in recurrent infections of the root canal originate from microorganisms capable of surviving the previous treatment or microorganism entering into a root canal after the treatment is completed as a result of leakage or loss of restorations (crowns). This case report will discuss the non surgical root canal retreatment on the maxillary left second premolar. Female patients aged 26 years old came to UNPAD Dental and Oral Hospital complaining the lost of the filling on the upper left tooth, and food often got trapped in the tooth. Approximately 3 months earlier, the patient had been treated with root canal treatment at the dentist before. The patient wanted the tooth to be refilled due to appearance disturbance. Intra oral examination test resulted: vitality (-), percussion (+), palpation (-), and tooth mobility (-). Management of root canal treatment failure cases is the non-surgical treatment. The main purpose of non-surgical root canal treatment is to regain access to the apical foramen, by disposing of root canal filling completely, resulting in good cleaning and shaping therefor filling can be done perfectly. Treatment in this case is managed well by showing absence of patient complaints, no swelling, no pain, widening and thinning of periodontal membrane radiographically, lamina dura resumed to normal.

Key words: non-surgical root canal retreatment.

INTRODUCTION

The potential for an optimal outcome of endodontic treatment reaches up to 90%-95% of the cases when teeth are treated under controlled clinical condition. ¹ After a root canal procedure, a tooth may require re-treatment because of a persistent infection or reinfection of the root canal. Re-treatment requires complete removal of the root canal filling material, followed by further shaping, cleaning and reobturation.^{2,4}

However cross sectional studies have demonstrated that the reality for the overall population might be somewhat different with only 35%-60% of the root canal treated exhibiting no disease.⁵⁻⁸ The great majority of these studies revealed a strong correlation between the quality of endodontic treatment and periradicular status.⁹ Root canal treatment failure is usually caused by recurrent infection of the root canal. The microorganisms that are in the root canal that causes recurrent infection can be derived from microorganisms that can survive on previous treatment or microorganisms that enter into a root canal after the treatment is completed as a result of leakage or loss of restorations (crowns).¹⁰⁻¹¹

CASE REPORT

Female patients aged 26 years old came to UNPAD Dental and Oral Hospital complaining the lost of the filling on the upper left tooth, and food often got trapped in the tooth. Approximately 3 months earlier, the patient had been treated with root canal treatment at the dentist before. The patient wanted the tooth to be refilled due to appearance disturbance. Intra oral examination test resulted: vitality (-), percussion (+), palpation (-), and tooth mobility (-).

Radiographic examination resulted in radiopaque image in the half of root canal. Widening of the periodontal membrane and discontinued lamina dura are seen in the apical portion. The walls of root canal diminish in the coronal third (Figure 1).

The clinical diagnosis is previously treated (AAE) of maxillary left second premolar with chronic apical periodontitis. The prognosis is good since the re-treatment can be performed through coronal, oral hygiene is good, the patient is cooperative and no systemic disorders are found. Non-surgical root canal re-treatment is chosen for treatment planning. Final restoration is designed as fiber post and porcelain zirconia crowns.



Figure 1.Initial Diagnosis Photo

CASE MANAGEMENT

On the first visit, the patient's root canal is cleaned to dispose leftover food and debris, followed by improving the access. Working length measurement is done by the radiographic method, obtaining temporary working length of 11.5 mm. Gutta percha removal

is performed by softening the gutta percha with xylene liquid dripped on cotton and placed in the root canal for a few seconds. After gutta percha becomes soft, removal is done using a needle file retrieval headstrom # 20, # 25 (Figure 2).

After gutta percha is removed, it is confirmed by takinroot canal using a file-K # 10.

Cleaning and smoothing of the root canal walls is performed with circumferential movement with K-file # 15, # 20, # 25, # 30, # 35, # 40, # 45. After each turn of the needle, irrigation is done using 2.5% NaOCl and 17% EDTA. Root canals are dried with paper points, and given medicaments, in this case calcium hydroxide, and filled with temporary restoration. On the second visit, the patient has no complaints, examinations result in: percussion +, pressure +, mobility -, and calcium hydroxide is dry but still dirty. Calcium hydroxide is the removed with file. The canal is irrigated with 2.5% sodium hypochlorite and 17% EDTA. Calcium hydroxide is reapplied and the tooth is filled with temporary filling.



Figure 2.Gutta percha removal with needle (File Headstrom #20,#25)

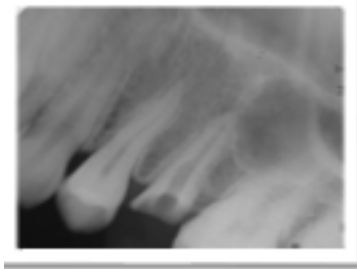


Figure 3. The root canal is free from gutta percha

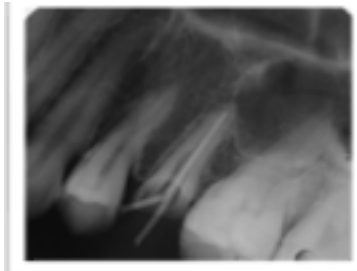


Figure 4. Filling trial radiograph.



Figure 5. Root canal obturation radiograph.



Figure 6. Control after treatment

On the third visit, it reveals complaints (-), percussion (-), palpation (-) and calcium hydroxide looks clean and dry. Calcium hydroxide is cleaned by irrigating the canal with NaOCl 2.5% solution and EDTA 17%, then dried with paper points. Prior to root canal filling, gutta percha trial radiograph is taken according to the appropriate MAF No. 35 (Figure 4).

Root canal is filled with gutta percha and sealed with endometason by performing lateral condensation technique. Radiograph picture is then taken and it reveals the filling is in accordance with working length. Gutta percha is cut with a heated excavator, 1 mm phosphate cement is applied to the orifice area and then covered with glass ionomer (Figure 5).

On control visit the following week, the patient has no complain about pain, shows negative results on palpation, percussion, and pressure tests and radiographic picture reveals reduction in radiolucency at the apical portion (Figure 6). The follow upon this case is fiber post and porcelain zirconia crown.

DISCUSSION

Root canal treatment failure is clinically characterized by swelling, pain, sinus track, while radiographically characterized by decreased radiographic density due to the occurrence of bone loss, the radiolucent lesions in the periapical, widening of periodontal membrane, and discontinuing of lamina dura. The causes of root canal treatment failure are fault diagnosis or errors in planning a treatment.¹¹⁻¹²

Other causes are errors during treatment procedure, inappropriate restoration, improper root canal cleaning, coronal restoration leakage, non-hermetic root canal filling, and vertical root fracture which can cause unsuccessful root canal treatment due to reinfection in the root canal.¹¹⁻¹² Root canal re-treatment in this case is due to the detached crown restoration, therefore causing radiolucent lesion at the periapical, widening of periodontal membrane and discontinuing of lamina dura. Thus re-treatment is required to eliminate reinfection.¹²

The root canal treatment can be done in two ways, which are non-surgical (conventional) and surgical treatment. Non-surgical root canal re-treatment is root canal re-treatment by entering through the crown, aiming to clean the root canal from irritants which largely consist of microorganisms remaining from previous treatment or the ones which entered the canal after completion of treatment. Surgery is the second choice if the non-surgical treatment cannot be done.¹³⁻¹⁴

In this case report, the non-surgical root canal re-treatment on the maxillary left second premolar is performed since the access preparation to the canal can be gained through coronal. The canal entrance can be reached without obstruction. This tooth has undergone root canal treatment and restored with post and crown made of porcelain fused to metal a few years ago, but got detached since five months ago. Root canal treatment failure is caused by the detached post and porcelain fused to metal crown which leave the canal open and contaminated. Thus the root canal treatment results in failure. The treatment failure requires non-surgical endodontic re-treatment.

The main purpose of non-surgical root canal re-treatment is to re-gain access to the apical foramen, by disposing the root canal filling completely, resulting in good cleaning and shaping therefor filling can be done perfectly. The root canal treatment will be successful if the disposal of the filler can be done perfectly to allow cleaning of the root canal up to apical foramen.¹⁵

The root canal treatment may be less successful in difficult cases, such as root canal treatment on the tooth with curved root.³ Surgical root canal treatment is performed on the canals which cannot receive re-treatment through root canal system because the bacteria and other irritants cannot be removed coronally and apical portion cannot be cleaned.^{4,5}

Indications of endodontic surgical re-treatments are repeated failure with non-surgical treatment, in cases of non-surgical re-treatment that can not be done, and is not expected to provide a better result.^{13,15} General contraindications of endodontic surgical re-treatment are influenced by several things, such as anatomical factor of close approximation to maxillary sinus which can risk maxillary sinus perforation that leads to sinusitis.^{13,15-16}

This non-surgical root canal re-treatment applies calcium hydroxide medicament, and after 1 month, abnormalities in the periapical region is reduced. Periapical lesion healing abilities depend on many factors, such as diagnosis, good access, and identification of all the orifices of the root canal system.^{17,18}

Treatment in this case is managed well by showing absence of patient complaints, no swelling, no pain, widening and thinning of periodontal membrane radiographically, lamina dura resumed to normal. The existed complaints have been eliminated during the fourth

visit. The final restoration in the form of fiber post and porcelain crowns zirconia performed 2 weeks after charging for setting time sealer endometason 72 hours. Final restoration of fiber post and porcelain zirconia crown will be inserted 2 weeks after root canal filling since the setting time of endomatason takes up to 72 hours.

Non-surgical root canal re-treatment in this case gives good results due to proper cleaning and access preparation to the root canal can be gained directly without obstructions. Root canal re-treatment on the maxillary left second premolar resulted well by using non-surgical techniques. It can be concluded that the proper case and selection should be considered in non-surgical root canal re-treatment.

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Intra Coronal Bleaching On Upper Left Central Incisor Tooth (Case Report)

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ABSTRACT

Aesthetics of the teeth is of great importance to patients, including tooth colour. Bleaching is a treatment to remove discoloration of the teeth, make the teeth more brighter with chemicals procedure. In the case of dental trauma, vascular supply termination occurs and the influx of blood products into the dentin tubules can cause intrinsic discoloration in the teeth so that the teeth discolored. A male 18-year-old complained of left upper front teeth discolored. Anamnesis the patients had a trauma, causing his tooth broken 10 years ago. Examination of intra-oral, fractures of the upper two thirds incisal and the crown shows discoloration with the grey colour. The diagnosis was pulp necrosis with discoloration. Endodontic treatment begun in advance and the procedure completed by bleaching intrakoronal and composite resin restorations for temporary restorations. At the time of control, had no complaints from patients, percussion and palpation insensitive, there is no tooth mobility, and radiographically no abnormalities in periapical and dental aesthetics quite well. The intrinsic discoloration of case management in patients with post traumatic show good successful.

Keywords: Bleaching, Intra Korona, aesthetic

INTRODUCTION

Aesthetics of the teeth is of great importance to patients, including tooth colour. The colour of the teeth is influenced by a combination of their intrinsic colour and the presence of any extrinsic stains that may form on the tooth surface intrinsic tooth colour is associated with the light scattering and adsorption properties of the enamel and dentine, with the properties of dentine playing a major role in determining the overall tooth colour.¹

Extrinsic stains tend to form in areas of the teeth that are less accessible to tooth brushing and the abrasive action of a toothpaste and is often promoted by smoking, dietary intake of tannin-rich foods (e.g. red wine) and the use of certain cationic agents such as chlorhexidine, or metal salts such as tin and iron.¹

CASE REPORT

Male patient, 18 years old, came with a complaint of his upper left anterior tooth color turning blackish. From anamnesis, history of collision 10 years ago was found which fracture the two third incisal crown. Upon falling, throbbing pain was felt for a few days, but the pain then disappeared.



Figure1. Intra oral image on initial visit. Teeth 11 and 21 are fractured on the two third incisal and discolored.



Figure 2. Initial radiograph, teeth 11 and 21 have undergone root canal treatment with hermetic fillings.

Generally, patient is in good condition. All systemic disorders are denied. There are no abnormalities found on extra oral examination. Intra oral examination revealed moderate oral hygiene; protrusion on maxillary anterior teeth with open bite. Both maxillary central incisors are malpositioned (mesiolabio-torsoversion and labioversion) with diastema. The right central incisor (tooth 11) has no caries, is fractured on the two third incisal, grayish discolored, not sensitive to percussion and palpation, has glass ionomer filling, whereas left central incisor (tooth 21) has no caries, is grayish discolored, grade 2 mobile, sensitive to percussion and palpation, and fistula on the tooth 21 gingival regio. From radiographic image, teeth 11 and 21 have undergone root canal treatment and have hermetic fillings. Teeth 11 and 21 are diagnosed as non vital teeth post root canal filling with discoloration. Treatment plans for teeth 11 and 21 are intra coronal bleaching and composite resin restoration. The prognosis is good for this patient.

CASE MANAGEMENT

Case management for this case on the initial visit is explaining to the patient the probable causes of tooth discoloration, the procedures to be followed, expected results and possibility of rediscoloration. Once the patient approves, informed consent is taken. The next step is to take radiograph image to evaluate the periapical tissue condition (radiograph shows no abnormalities on the periapical area and fillings are hermetic). After tht, teeth color evaluation is done prior to the treatment and rubber dam is installed.

All restoration material is removed, gutta percha or endodontic sealer from access on cavities (2 mm from CEJ), dentin is exposed, cement layer (Glass Ionomer Cement), approximately 2 mm, is applied to protect the obturated root canals (barrier material).

The next step is application of intra coronal bleaching material (*Opalendo*) to the inside part of labial side and to put temporary filling approximately 3 mm until covering the whole access. Temporary filling sealing evaluation is performed and waited for 5 minutes. Patient is instructed to come for evaluation 2 weeks to place composite resin restoration.

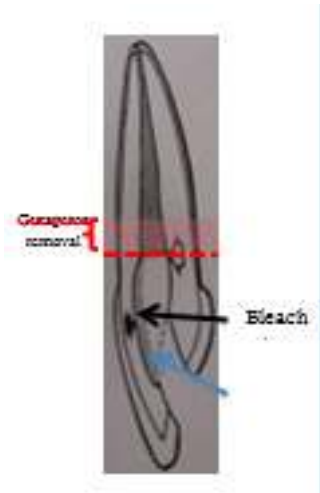


Figure 3. Dentin, gutta percha, sealer, and pulp horn material removal limit



Figure 4. Insertion Glass Ionomer Cement as Barrier

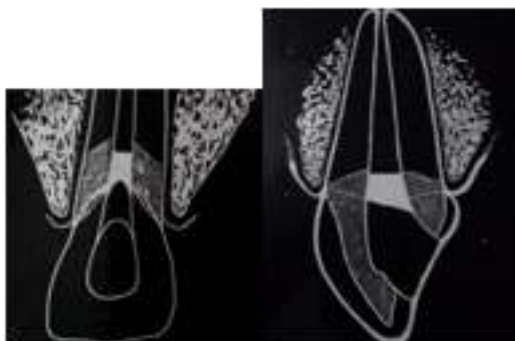


Figure 5. Facial and lateral views reveal Glass Ionomer filling as Barrier.²



Figure 6. intra coronal bleaching and composite resin restoration.

DISCUSSION

The color change or discoloration may occur due to age, genetics, smoking, chromogenic material, as well as trauma. The etiology can be classified as follows^{2,3} Systemic are medications (tetracycline), metabolic distrophic calcification, fluorosis and genetic like hyperbilirubinemia, amelogenesis imperfecta and dentinogenesis imperfecta. The local factors are pulp necrosis, intrapulpal hemorrhage, endodontic materials, root resorption, aging and pulp tissue residue after endodontic treatment.

On this case, the patient experiences trauma that causes pulp necrosis, bacterial, mechanical, and chemical irritations of pulp that will cause pulp death, therefore releasing bacterial products that are able to penetrate to dentin tubules and cause discoloration around the dentin. Discoloration degrees are directly correlated with time duration when the pulp undergoes necrosis. Compound discoloration is seen on the pulp chamber, and this coloration usually can be addressed by intra coronal bleaching.

Extirpation of the pulp in traumatized teeth can cause bleeding in the pulp chamber and cause a rupture of the blood vessel walls. Components of the blood flow in the dentin tubules and cause staining around the dentin. Initially, the temporary color change from brown to pink can be observed. This is followed by haemolysis of red blood cells. The released heme is mixed with rotting pulp tissue to form iron. Then iron can be changed by

hydrogen sulphate produced bacteria and become dark iron sulfate, which will change the color of the tooth to be gray. This product can penetrate deeply into the dentin tubules and cause staining to the teeth as in this case.³

Cleaning the endodontic materials and residual sealer or medicaments containing tetracycline from the pulp chamber can cause staining of teeth. Root canal filling and intracanal medicaments trapped in the pulp chamber will be directly in contact with dentin, and sometimes in the long term will penetrate the dentin tubules. Although intra coronal bleaching treatment is an option, nevertheless the prognosis depends on the type of sealer and the duration of the coloring. For example, staining caused by metallic ions is difficult to be removed by bleaching treatments.⁴

Radiograph result of the patient reveals hermetic filling, no abnormalities in the periapical area, no complaint during percussion and palpation tests with intact coronal structure, therefore internal bleaching is performed on this case prior to final restoration. Intracoronar Bleaching is the use of chemical bleaching agent in the coronal section of endodontic treated teeth to tackle tooth discoloration.⁵ The indications are discoloration that comes from pulp chamber, discoloration caused by tetracycline in moderate until severe degree, dentin discoloration, discoloration in which extra coronal bleaching cannot be done and non vital teeth after hermetically endodontic treatment. The contra indications are teeth that have lost a lot of email, extensive restoration (become rough), pregnant and nursing women, peroxide allergy, superficial email discoloration, defective email formation, non hermetic filling, and dubious prognosis

Intra coronal bleaching techniques consist of:²⁻⁴ Walking Bleach technique, using sodium perborate and hydrogen peroxide (3-30%), thermocatalytic (heat application) technique, using hydrogen peroxide (30-35%)/ superoxol and ultraviolet photo-oxidation (light) technique, using hydrogen peroxide (30-35%)/ superoxol.

Walking bleach technique is performed in this case for patient esthetic purposes that aim on addressing discoloration on the teeth and making the color to be brighter by using 35% hydrogen peroxide which is strong oxidator. The used material is available in syringe from the factory (gel formed) so it is easier to be applied and safer than the other techniques. In general, the mechanism of bleaching by hydrogen peroxide is not well understood and it can form a number of different active oxygen species depending on reaction conditions, including temperature, pH, light and presence of transition metals. Under give rise to free radical formation, for example, by homolytic cleavage of either an O–H bond or the O–O bond in hydrogen peroxide to give photochemically initiated reactions using light lasers, the formation of hydroxyl radicals from hydrogen peroxide has been shown to increase. As peroxide diffuses into the tooth, it can react with organic coloured materials found within the tooth structures leading to a reduction in colour.¹

Complications that can occur in intra coronal bleaching are: can cause external root resorption, a burning sensation when using hydrogen peroxide 30-35% and can reduce the adhesion strength of the composite.⁵

CONCLUSION

Intra coronal bleaching on the upper left central incisor shows excellent success with the changing of tooth color into the appropriate color of original tooth.

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Effect Of Fluoride Application Before Or After Bleaching of Carbamid Peroxide 35 % On Bleached Guide Scores, Hardness, And Enamel Brightness

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ABSTRACT

Introduction: The purpose of bleaching treatment is to increase whiteness and brightness of teeth. However, bleaching can cause reduction of enamel hardness due to demineralisation. Addition of fluoride can induce remineralisation which is able to maintain enamel hardness. **Objectives:** The purpose of this study is to obtain the most optimal effect of applying fluoride between before or after bleaching with 35% carbamide peroxide on discoloured tooth samples. **Materials and methods:** This is a pure experimental research with a pre-post test design and the results were analysed with paired T test ($p=0.05$). Samples used were 20 maxillary first premolars which were divided into two groups: group 1 {fluoride (PDS PTY LTD; 15 ppm) applied before bleaching (Denjoy)} and group 2 {(fluoride (PDS PTY LTD; 15 ppm) applied after bleaching (Denjoy))}, with three times repetition ranges one week. Tooth shades were measured with VITA Bleachedguide 3D-Master, brightness values (L^*) measured with Chroma meter and enamel hardness (HV) with Vickers Hardness Tester. **Results:** (1). Whiteness scores (bleachedguide) obtained with fluoride application before bleaching shows the most significant changes after the third repetition of bleaching which is $3,60 \pm 1,27$. (2). Hardness values of tooth with fluoride application after bleaching shows a decrease of $39,20 \pm 35,81$ HV after third bleaching which is most significant. (3). Brightness values of tooth with fluoride application before bleaching shows the most significant increase after third repetition which is $1,12 \pm 1,20$. **In Conclusion:** The application of fluoride is best done before bleaching with 35% carbamide peroxide in three repetitions.

Keywords: Bleaching, Fluoride, Tooth shade scores, Brightness values of tooth (L^*), Hardness values of tooth (HV)

INTRODUCTION

Pearly white teeth is one of the important aspects of facial appearance besides playing an important role in human social interactions, self confidence and psychosocial aspect. Discoloured tooth which are brownish and black were normally greyish white or yellowish white in colour. Tooth colour can be influenced by enamel translucency and thickness and also the thickness of underlying dentine colour. Teeth colour can change due to intrinsic factors (endogenous colouration within the tooth structure) or extrinsic factors (colour changes on the surface of tooth).¹

Recent studies showed that most people were not satisfied with their teeth colour. A study conducted by Tin-Oo et al. (2011) reported that 56.2% among 235 subjects were not satisfied with their tooth colour, and Al-Zarea (2013) reported that 65.9% among 220 subjects were dissatisfied with their tooth colour and 80.9% needed tooth bleaching treatments. These days, the demand for tooth bleaching is constantly increasing.^{2,3}

Generally, there are two bleaching techniques that are frequently used which are in-office or power bleaching, and home bleaching. In-office bleaching is usually done with high concentration bleaching agents such as 35%-38% hydrogen peroxide or 35%-40% carbamide peroxide.⁴ In-office bleaching procedures are done by dentists and it produces a more satisfying result, however it may cause reduction in enamel hardness. Whereas home bleaching procedures are done by patients at home using low concentration bleaching agents such as 10% carbamide peroxide which produces less optimal colour changes.⁵ As a minimally invasive procedure, bleaching is a more popular choice of tooth discoloration treatment among dentist because it is done locally on the enamel and is highly effective and conservative when correctly done.⁶ Hydrogen peroxide and carbamide peroxide are the most frequently used bleach (strong oxidator). According to the American Dental Association (ADA), carbamide peroxide is more frequently used for tooth whitening due to better effectivity and safety when compared to hydrogen peroxide.^{5,6} Evaluation of tooth whitening can be done with the following methods which are shade guide, spectrophotometer, chromameter and digital camera.⁷

Although bleaching can whiten and brighten teeth, the commonly reported side effects were reduction of enamel hardness and weakening of enamel structure. Oxidation process of peroxide agents can dissolve enamel matrix and release calcium and phosphate ions. When hydroxyapatite loses these ions, the hydroxyapatite molecule becomes distorted and unstable which causes the enamel structure to become porous, hence reducing its hardness.⁸ Loss of enamel structure eases the formation of tooth attrition, abrasion, and erosion which will eventually lead to tooth hypersensitivity due to the opening of dentinal tubulus.⁹

Remineralisation process needs to be done during bleaching treatment to replace lost tooth mineral structure due to demineralisation and tooth hypersensitivity treatment. Common remineralising agents used contains fluoride or fluoride compounds.¹⁰ Bleachedguide scores are tooth shades based on its arrangement in the shade guide (1-15). Decrease in tooth

shade score is the difference between scores before and after bleaching treatment, the higher the decrease in scores, the whiter the teeth.

Enamel hardness is the enamel resistance towards penetration from a given load where a certain load is asserted on a small area of the material for a certain period of time. According to Joiner (2007), hardness measurement is the most common technique used to evaluate the effects of peroxide and other bleaching agents on enamel. Enamel hardness were measured with Micro Vickers Hardness Tester.¹¹

Enamel brightness is a parameter that determines the brightness level of teeth by obtaining L* values based on the CIELAB system. L* values can be obtained by using a colour spectrophotometer or chromameter type 400/410. The results obtained by chromameter shows that the higher the L* values, the brighter the tooth specimen, whereas lower L* values shows darker tooth colour.

Based on the above statements, this experiment is carried out to determine the effects of fluoride application before or after bleaching with 35% carbamide peroxide on tooth shade scores based on VITA Bleachedguire 3D-Master, brightness values and enamel hardness.

METHODS

Samples used in this experiment were 20 permanent maxillary first premolar which were extracted for orthodontic purposes. Samples were selected through purposive sampling base on the inclusion criteria which were teeth with shades 1M2, 1.5M2, 2M2, 2.5M2, 3M2, 3.5M2, 4M2, 4.5M2, 5M2, 5M2.5, and 5M3 on the VITA Bleached guide 3D Master, and came from male and female patients aged 20 to 30 years old, whereas the exclusion criterias were filled tooth, carious tooth, crowned tooth, endodontically treated, bleached tooth, orthodontically treated tooth, tooth with pathologies such as fractures, abrasion, attrition, and tooth anomalies such as amelogenesis imperfecta and dentinogenesis imperfecta. Tooth samples were stored in 0.9% NaCl solution to maintain the teeth under physiologic conditions after extraction and also to prevent dehydration. Tooth specimens with dimension 5x5x4 mm were taken from the buccal surface and cut on it mesial, distal, occlusal, and cervical sides with a bur disc. The specimens were then polished with 600 and 1200 grit abrasive paper to obtain a smooth and flat surface for colour measurement with chromameter type 400/410 and hardness testing with Vickers Hardness Tester. Specimens were divided into two groups where before bleaching treatment, measurements of tooth shade scores, brightness and enamel hardness values were taken on specimens of both groups as baseline data.

Group 1. Bleaching treatment with 35% carbamide peroxide after topical application of fluoride

Ten specimens were applied with a drop of fluoride topically (PDS PTY LTD; 15 ppm) for 15 minutes, which were then rinsed under running water and dried with tissue. Specimens were then subjected to application a drop of of 35% carbamide peroxide

(DENJOY, China) for 15 minutes which were then rinsed under running water and dried with tissue. Specimens were stored in 5cc of artificial saliva for 7 days where the artificial saliva were renewed daily. After 7 days, measurements of tooth shade scores of all specimens were taken with VITA Bleachedguide 3D-Master, hardness values (HV) were measured with Vickers Hardness Tester (Future-tech FM-800) on the 8th day and brightness values (L*) of samples were measured with chromameter CR-400/410 on the 9th day (1st repetition). The second treatment (2nd repetition) and third treatment (3rd repetition) were done one week apart each treatment according to the bleaching procedure and measurements of tooth shade scores, brightness and enamel hardness values were taken after each treatment.

Group 2. Bleaching treatment with 35% carbamide peroxide before topical application of fluoride

Ten specimens were applied with a drop of 35% carbamide peroxide (DENJOY, China) for 15 minutes which were then rinsed under running water and dried with tissue. Specimens were then subjected to application a drop of fluoride topically (PDS PTY LTD; 15 ppm) for 15 minutes, which were then rinsed under running water and dried with tissue. Specimens were stored in 5cc of artificial saliva for 7 days where the artificial saliva were renewed daily. After 7 days, measurements of tooth shade scores of all specimens were taken with VITA Bleachedguide 3D-Master, hardness values (HV) were measured with Vickers Hardness Tester (Future-tech FM-800) on the 8th day and brightness values (L*) of samples were measured with chromameter CR-400/410 on the 9th day (1st repetition). The second treatment (2nd repetition) and third treatment (3rd repetition) were done one week apart each treatment according to the bleaching procedure and measurements of tooth shade scores, brightness and enamel hardness values were taken after each treatment.

RESULTS

Table 1. Group 1 shows a decrease in tooth shade scores before and after the first, second, and third repetition with p value of 0.000 based on paired T test ($p < 0.05$). This means that tooth samples became whiter after the first, second, and third repetition. Results of group 1 showed that increased repetitions causes a decrease in tooth shade scores, where sample showed the highest decrease in tooth shade score of 3.60 ± 1.27 after the third repetition.

Table 1. Group 2 shows a decrease in tooth shade scores before and after the first, second, and third repetition based on paired T test at $p < 0.05$ which were 0.000 and 0.001 in this study. This means that tooth shades of samples became whiter after the first, second, and third repetition. Results of group 2 showed that application of fluoride after bleaching treatment causes a decrease in tooth shade scores after the first treatment which were 1.20 ± 0.29 and after the second repetition tooth shade scores reduced to an average of 2.40 ± 1.35 , which increased again after the third repetition to 1.60 ± 0.97 . Based on the data obtained, application of fluoride after bleaching shows the highest average tooth shade

scores after the second repetition which were 2.40 ± 1.35 . It can be concluded that between group 1 (with fluoride application before bleaching) and group 2 (fluoride application after bleaching) showed that the effect of fluoride application before bleaching on tooth shade scores were greater than fluoride application after bleaching.

Table 1. Average decrease in tooth shade scores based on shade guide before and after fluoride application for bleaching treatment with 35% carbamide peroxide

Group		Baseline (score)	Repetition I (score)	P	Repetition II (Score)	P	Repetition III (Score)	P
1	$\bar{x} \pm SD$	9.80 ± 1.99	7.70 ± 2.63	0.000*	7.00 ± 1.83	0.000*	6.20 ± 1.23	0.000*
	Decrease from baseline		2.10 ± 0.88		2.80 ± 1.14		3.60 ± 1.27	
2	$\bar{x} \pm SD$	8.90 ± 1.66	7.70 ± 1.77	0.001*	6.50 ± 1.18	0.000*	7.30 ± 1.70	0.001*
	Decrease from baseline		1.20 ± 0.79		2.40 ± 1.35		1.60 ± 0.97	

Paired T Test, *significant $p < 0.05$

Group 1: topical application of fluoride - bleaching with 35% carbamide peroxide

Group 2: bleaching with 35% carbamide peroxide - topical application of fluoride

Table 2, Group 1 shows a significant difference of enamel hardness before and after the first, second, and third repetition based on paired T test analysis ($p=0.000$) and ($p=0.001$). This means that there is a decrease in enamel hardness after the first, second, and third repetition. Decrease in enamel hardness after the first repetition was 16.71 ± 21.09 , and became 35.52 ± 21.02 after the second repetition and after the third repetition reduced to 26.91 ± 16.15 , which means that increased repetitions causes a decrease in enamel hardness. Although the average enamel hardness were between the range of 324.29 ± 29.14 to 300.77 ± 17.30 .

Table 2, Group 2 shows a significant difference in enamel hardness values before and after the second and third repetition based on paired T test analysis ($p=0.001$) and ($p=0.007$). This means that there is a decrease in enamel hardness after the second and third repetition. Decrease in enamel hardness after the first repetition was 5.27 ± 9.14 , and increased to 28.84 ± 17.89 after the second repetition and after the third repetition became 39.20 ± 15.81 , which means that increased repetitions causes a decrease in enamel hardness. Although the average enamel hardness were between the range of 328.56 ± 40.01 to 294.63 ± 49.16 . Between group 1 and group 2, the least decrease in enamel hardness was in group 2 repetition I which was 5.27 ± 9.14 , and the largest decrease were in group 2 repetition III which was 39.20 ± 15.81 .

Table 3, Group 1 shows a significant difference of brightness values before and after the second, and third repetition based on paired T test analysis where $p=0.023$ and $p=0.017$. In this study brightness values after the second repetition decreases by -1.26 ± 1.45 whereas after the third repetition brightness values increased by 1.12 ± 1.20 .

Table 3, Group 2 shows the difference in enamel brightness values before and after the first, second and third repetition based on paired T test analysis which were no significant where $p > 0.05$. It can be concluded that significant increase in brightness values before

and after the first, second, and third repetition based on paired T test analysis ($p < 0.05$) were only on group 1 repetition III.

Table 2. Average decrease in hardness values (HV) before and after fluoride application for bleaching treatment with 35% carbamide peroxide

Group		Baseline (score)	Repetition I (score)	P	Repetition II (Score)	P	Repetition III (Score)	P
1	$\bar{x} \pm SD$	341.00 \pm 26.67	324.29 \pm 29.14	0.000*	305.74 \pm 30.33	0.001*	300.77 \pm 17.30	0.001*
	Decrease from baseline		16.71 \pm 21.09		35.52 \pm 21.02		26.91 \pm 16.15	
2	$\bar{x} \pm SD$	333.83 \pm 42.21	328.56 \pm 40.01	0.102	304.99 \pm 53.09	0.001*	294.63 \pm 49.16	0.007*
	Decrease from baseline		5.27 \pm 9.14		28.84 \pm 17.89		39.20 \pm 35.81	

Paired T Test, *significant $p < 0.05$: Group 1: topical application of fluoride - bleaching with 35% carbamide peroxide; Group 2: bleaching with 35% carbamide peroxide - topical application of fluoride

Table 3. Average increase in brightness values (L*) before and after fluoride application for bleaching treatment with 35% carbamide peroxide

Group		Baseline (score)	Repetition I (score)	P	Repetition II (Score)	P	Repetition III (Score)	P
1	$\bar{x} \pm SD$	84.58 \pm 3.50	83.89 \pm 3.37	0.136	83.32 \pm 2.79	0.023*	85.69 \pm 3.13	0.017*
	Decrease from baseline		-0.69 \pm 1.34		-1.26 \pm 1.45		1.12 \pm 1.20	
2	$\bar{x} \pm SD$	84.59 \pm 2.04	84.95 \pm 1.49	0.378	85.05 \pm 1.84	0.180	85.24 \pm 1.98	0.218
	Decrease from baseline		0.35 \pm 1.20		0.45 \pm 0.98		0.65 \pm 1.55	

DISCUSSION

Bleaching is currently one of the popular esthetic treatments among society beacuse of the perception that bleaching is a painless tooth esthetic restorative procedure.¹² The effectiveness of bleaching treatment can be measured with several methods such as shade guide, spectrophotometer, chromameter, and digital photography.⁷ In this study, whiteness of teeth are measured with VITA Bleachedguide 3D-Master as this shade guide is specifically designed to evaluate tooth colour before and after bleaching, where it has a better coverage of tooth shades and focuses mainly on brightness or value compared to VITA Classical shade guide which is commonly used by dentists.¹³ Lower tooth shade scores indicates whiter teeth whereas higher scores indicates darker teeth.

Decrease in tooth shade scores after bleaching treatment can be influenced by several factors, which are type of bleaching agents, concentration and duration of bleaching, severity of tooth discolouration, and the usage of additional catalysts such as LED light.¹⁴ The highest decrease of tooth shade scores in this study was 3.60 \pm 1.27 whereas Ontiveros et al. (2009) reported a decrease of tooth shade scores of 2.80 \pm 1.50 after bleaching with 25% hydrogen peroxide 45 minutes for two bleaching sessions. This difference may be due to the usage of different bleaching agent for this research which was 35% carbamide peroxide with fluoride application before or after bleaching, applications were done once a week for 15 minutes and is repeated three times. Whereas Da Costa et al (2012) reported

a decrease shade scores by 3.00 ± 1.50 after bleaching with 35% carbamide peroxide where the same bleaching agent is used in different frequency of application. Da Costa et al (2012) study carbamide peroxide was applied an hour a week for two weeks, while in this study carbamide peroxide was applied once a week for 15 minutes and done in three repetitions, and also applied fluoride before or after bleaching.

Brightness value is a parameter to determine the lightness of teeth which is indicated by L^* values based on the CIELAB colour system which is ranged from 0 to 100. In this study, L^* values were obtained by using a chromameter CR-400/410 which shows the wavelength of light reflected from the surface of teeth where the higher the L^* values, the brighter the tooth specimen, whereas lower L^* values shows darker tooth specimen. According to Dietschi et al (2006), L^* values is a colour measuring parameter which is most suitable for testing changes in brightness of teeth after bleaching in experimental conditions.¹⁴ In this study, the average brightness values of samples increased significantly only in group 1 repetition III by 1.12 ± 1.20 which was applied fluoride before bleaching with 35% carbamide peroxide, whereas for group 2, the increment was not significant after repetition I, II, and III (Table 3).

Although bleaching treatments are able to whiten teeth and increase its brightness effectively, it can also reduce enamel hardness due to the oxidation process of peroxide agents that releases calcium and phosphate ions. Loss of these minerals causes enamel prism to be porous or has a honey-comb like structure microscopically which reduces its hardness.⁸ Methods usually used for hardness testing are Knoop (KHN) and Vickers (HV). According to Hora et al (2012), the average hardness value for enamel is in the range from 250 to 360 VHN.¹⁴ In this study the average microhardness values of samples from groups 1 and 2 after repetition I, II, and III decreased after treatment, however the hardness values were still within the normal range where the average hardness values of group 1 after repetition III was 300.77 ± 17.30 with a total decrease of 26.91 ± 16.15 and group 2 after repetition III was 294.63 ± 49.16 with a total decrease of 39.20 ± 35.81 . A study by Hora et al. (2012) shows lesser decrease of enamel hardness compared to our results, where they obtained a decrease of 24.27 ± 7.28 VHN. This difference may be due to the difference of bleaching agents used where in this study 35% carbamide peroxide was used whereas Hora et al. (2012) used 25% carbamide peroxide in two applications for five minutes. Besides that, the frequency and duration of application of bleaching agents in Hora's study was lesser compared to this study.¹⁴

The mechanism of tooth whitening is still unknown, but it is believed to be caused by free radicals that are released during oxidation process. When hydrogen peroxide diffuses into tooth structure, it will be broken down into water (H_2O), oxygen (O_2) and free radicals. Bleaching causes free radicals produced during oxidation process to break down molecules of chromophore pigments into smaller molecules which reduces its ability to reflect light, hence making the tooth appear brighter and whiter.¹⁷ Chen et al (2008) reported that bleaching procedures which includes fluoride application can reduce the demineralisation effects without affecting the efficiency of tooth whitening. The use of 0.05% fluoride after

bleaching is able to regain enamel hardness. Fluoride forms a layer of calcium fluoride on the surface of enamel which will stop further demineralisation. Frequency of the use of low concentration fluoride during tooth whitening treatment can be advantageous for patients with a high risk of demineralisation. A study evaluated the effects of fluoride after bleaching with 10% carbamide peroxide reported that the resistancy of enamel did not increase.¹⁸ According to Chuang et al (2009), 0.37% of fluoride in 10% of carbamide peroxide can reduce demineralising effects on enamel and retain the microtensile bond strength, and in another study, 0.11% of fluoride in 10% carbamide peroxide can reduce microtensile bond strength and regain it after 7 days.¹⁹ Borges et al (2012) stated that addition of fluoride and calcium into 35% hydrogen peroxide can increase enamel hardness. Fluoride gel combined with calcium can significantly increase enamel hardness after bleaching with 35% hydrogen peroxide. In another further study using extracted molars and bleached with 10% carbamide peroxide, the enamel hardness decreased and two weeks after fluoride treatment all samples showed a significant increase in enamel hardness.²⁰ Generally, fluoride works topically by obstructing the demineralisation of crystal surface in teeth, increase the speed of remineralisation of crystal surfaces (creates new crystal surface which is more resistant towards acid), and in higher concentrations can stop bacterial enzymes. Application of fluoride containing products about 1ppm on tooth enamel is known to be able to reduce solubility of enamel and forms a layer of fluorapatite crystals which replaces hydroxyapatite. Change of hydroxyapatite to fluorapatite has a positive effect of mineral ion resistancy towards acid, the critical pH of fluorapatite (4.5) is lower than hydroxyapatite (5.5), which makes fluorapatite more resistant towards acid compared to hydroxyapatite.^{21,22}

CONCLUSIONS

In this study, it can be concluded that application of fluoride before bleaching produces better tooth shade whitening and brightness values, and also lesser decrease in enamel hardness compared to the group with fluoride applied after bleaching.

ACKNOWLEDGEMENTS

This research was supported by DRPM Kemristekdikti Tahun 2016 as Hibah Bersaing Reasearch.(No 176/UN5.2.3.1/PPM/2016 on Februari 2016)

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The Effectiveness Of Parachlorophenol Camphor Menthol Against Oral Candida Albicans

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ABSTRACT

Introduction: Parachlorophenol campher menthol is an antiseptic that usually is utilized for endodontic treatment. Nowadays, this antiseptic is still beneficial although there are some new products are used as root canal antiseptic. The study was conducted to asses the inhibition zone and exposure time of this antiseptics. Method: A diffusion disk test and drug dilution test was applied to examine its activity against *Candida albicans* isolated from oral cavity. Zones of inhibitions were measured in mm after 48 hours of incubation at room temperature and exposures times could be determined by subculturing 0,1 ml Mc Farland standard of *Candida albicans* suspension in 1 ml antiseptic everyday until the *Candida albicans* was not growing any longer. Result: The avarage of parachlorophenol campher menthol's inhibition zone is 11 mm and its exposure time is 1,5 days. Conclusion: The data demonstrate that antiseptic of parachlorophenol campher menthol have antifungal effect against *Candida albicans* as weel as generally synthetic antifungal.

Keywords: Parachlorophenol camphor menthol, *Candida albicans*

INTRODUCTION

At present, parachlorophenol camphor menthol (ChKM) is an antiseptic that is still very common used by the dentists in hospitals, health centres (puskesmas), clinics, and privates practices. By this reason, this antiseptics significantly remains to be a beneficial until nowadays. Beside their use mentioned this antiseptic is prooved of having a great antimicroorganisms effect and there were many researches about inhibition zone of ChKM against some bacteria and their exposure time as well. In the year of 1973, Spangberg conducted a research to determine the effectiveness of the amount of antiseptics against several microorganisms and his research gave the result that ChKM has evaporation effect against *Streptococcus faecalis*. Other research was carried out by West Chemical Product, Inc. America to figure out the inhibition zone of ChKM against *Streptococcus faecalis* by

using disc test showing the significant result of ChKM's inhibition zone. From this research it could be concluded that antiseptics of Chkm provide an excellent antimicroorganisms.

On the other hand, antiseptics of ChKM has other pharmacologically advantages as Weine (1985) stated that this antiseptics had a great antifungal effect. There were many researches was conducted to study the effectiveness of ChKM against some fungi, one of them was carried out to examine its effect against *Candida albicans* through dilution system. The study exhibited antifungal effect of ChKM was great that showed it's activity is 3 to 5 days in inhibiting almost all of any species of fungi (Ingle, 1985). So, it was proved that ChKM has a significant effect against fungi, presumptively it would affect *Candida albicans* as well. However, at present there has no a test to determine inhibition zone and exposure time of ChKM against *Candida albicans* which is determined by using disc test.

Talking about the effectiveness ChKM against various microorganism, this antiseptics is utilized for endodontic treatment as an antimicroorganism possessing a potentiality to inhibit all types of micoorganisms found in the cavity and the root canal. ChKM that is used for endodontic treatment has 35% of parachlorophenol concentration containing chlor ion which is more potential and more toxic than a phenol itself whereas (Mutschler, 1991, Reynold, 1982 and Ingle, 1985). Beside that, antifungal effect of ChKM against *Candida albicans* had qualitatively been compared by Larz Spangberg as he did a research about a numerous kind of endodontic antiseptics toward the various root canal microorganisms. This study showed that *Candida albicans* growth could be inhibited by ChKM through 0,01 of dilution meanwhile Harrison and Madonia (Grossman, 1974) found that 1% of ChKM is in vitro potential to combat the various microorganisms. Thus, it could definitely conclude that ChKM is very effective against *Candida albicans* through dilution method. The present study was carried out to examine the efficacy of antiseptic of ChKM against *Candida albicans* through determination their inhibiton zone and exposure time.

METHODS

The study used oral isolates of *Candida albicans* as a sample and its number was 30 samples. The specimen was taken from oral cavity by swabbing oral mucosa with sterile cotton that was subsequently cultured in Saburoud Glucose Agar (SGA) and incubated for 48 hours at room temperature. As the colonis appeared, it was examined by gram and biochemistry testing and *Candida albicans* might give the results to sugar test as glucose positive, sacharose positive, maltose negative, and lactose negative. *Candida albicans* used as acontrol was *Candida albican* of ATCC 10.231. A suspension from strain of *Candida albicans* was prepared in a sterile physiological solution of 0.5 Mc Farland density. The minimum inhibitory concentration (MIC) used a dilution technique was that a serial dilution with polyethylene glycol.

The technique to measure the zone of inhibition used was Shadomiy's technique by utilizing paper disc of 6 mm in diameter and 1 mm in width. The petri dishes were inoculated with a suspension of *Candida albicans*, the papers discs sprinkled with ChKM of 0,003 ml

(Grossman, 1974) was put on the *Candida albicans* cultures and then the petri dishes were preincubated for 30 minutes at room temperature and eventually incubated it at 37°C for 48 hours. The treatment carried out was conducted in 30 of replication. The results were read at 48 hours and determined the efficacy of studied antiseptic by measuring the zone of inhibition around the papers discs in mm.

The exposure time was obtained by adding 0,1 ml of *Candida albicans* suspension to 1 ml of the studied antiseptic in their MIC inside the tests tubes. The mixture was incubated at room temperature for 1, 2, 3, 4, 5 days and were inoculated in SGA respectively every 24 hours. The treatments were conducted in 30 of replication, and the datas collected were tabulated.

RESULT

Table 1 shows that teh greatest number of ChKM having a largest inhibition zone of 10 mm and 11 mm for 6 samples.

Table 1. The Data's Distribution of Inhibition Zone around ChKM Paper's Disc against Candida albicans

Inhibition Zone	Number of Datas (mm)
8,5	1
9,5	1
10	6
10,5	6
11	6
11,5	1
12,5	1
13	1
24	1

The avarage of inhibition zone around ChKM paper's disc can be seen in table 2 below exhibiting that the avarage of ChKM's inhibition zone is 11 mm with 10,8 mm of median.

Table 2. The Avarage of Inhibition Zone Around ChKM Paper's disc against Candida albicans

Treatment	Median	The avarage of inhibition zone
ChKM	10,8	11

The result of exposure times determination of ChKM against *Candida albican* are able to be seen in table 3 and 4. Table 3 shows the distribution of their data's exposure times for ChKM's samples and the shortest in time is belong to ChKM are those 4 samples for 2 days of exposure time. Table 4 consist of ChKM's avarage time needed to combat *Candida albicans*. The time gained by ChKM to inhibit *Candida albicans* has an avarage of 1,5 days.

Table 3. The Data's distribution of Exposure Time and ChKM against *Candida albicans*

Exposure Time Days	Number of Datas
1	21
2	4
3	4
4	1
5	0

Table 4. The Avarage of Exposure Time of ChKM against *Candida albicans*

Treatment	Median	The avarage of exposure time
ChKm	1,0	1,5

CONCLUSION

Based on the result above, it is concluded that antiseptic of ChKM has a great antifungal towards *Candida albicans* with inhibition zone of 11 mm in avarage and time taken by ChKM in this study to combat the *Candida albicans* is 1,5 days in avarage.

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Dental Management In Children With Low Birth Weight

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ABSTRACT

Teeth development in children is correlated with the whole body growth and development. This might be influenced by the interaction of genetical and environmental factors. Bad environmental interaction might result in Low Birth Weight (LBW) neonates that would affect their dental growth and development. A Low Birth Weight neonate is a neonate born with birth weight less than 2500 grams, or less than the 10th percentile of Lubchenco growth curve. About 70% of the LBW are Small for Gestational Age (SGA).LBW might be caused by characteristic maternal factors: infectious disease during pregnancy, alcoholic, smoking habit; and the child's factors: twins, chromosomal anomaly, and placental anomaly. The oral symptoms in LBW children are, enamel defect of deciduous teeth in the form of hypoplasia or hypocalcification, dilaceration, and delayed teeth eruption . The aim of this study was to decide comprehensive dental management in children with LBW. Dental management started with prenatal counseling, oral health management during pregnancy, infant oral health by using prediction score of severity Enamel defect of deciduous teeth based on birth weight, type of LBW, maternal illness during pregnancy and, socio-economic status family. Prenatal counseling includes general health in pregnancy by an obstetrician, dental management during pregnancy, and postnatal oral health in child at the time of the first eruption of teeth, at age one year, and periodically oral examinations ,every three months based. Prenatal counseling ,good oral health in pregnant mothers and child need to be done to prevent the incidence of LBW and, as an early intervention against the child's teeth eruption.

Keywords: Low Birth Weight, Small for Gestational Age, Enamel Hypoplasia, Enamel Hypoplasia, Enamel Hypocalcification, Prenatal Counseling.

INTRODUCTION

Teeth is a multifunctional and very important organ in human, to chew the food before swallowing, esthetical performance, and speaking. Pediatric orthodontic health is a part of the whole body health, reflecting the body health, and has an important part in a child's quality of life.

Dental enamel is the outer part of the tooth, it has calcification and is the hardest part in human body. Enamel consists of hydroxyapatite crystals with 96% anorganic elements, 4% water and organic elements. In spite of the bone, cartilage or dentin, enamel has no remodelling and resorption that means if a decay occurs, the decay will remain unrepairable.¹⁻⁸

Deciduous or permanent dental growth and development are influenced by genetical and environmental factors. A worse prenatal environment of a pregnant mother such as infectious disease, smoking habit, alcoholic, trauma, drug consumption, might result in LBW neonate that might affect the dental growth and development, because the critical growth of deciduous teeth occurs during prenatal period. Enamel hypoplasia and hypocalcification are the most often anomaly occur that makes the caries easy to grow, besides delayed eruption of deciduous teeth and *dilacerasi*.

Caries is caused by several anatomic condition of the teeth: opaque, reducing of hardness, pit, groove, substrate, microorganisms, and time. The defect of dental enamel is generally occur in LBW infants that makes the caries easier to occur. The opacity of the teeth, pit / groove make the food overload to occur that might cause caries, then the teeth become useless and get abscess, pain and difficulty in eating. Premature loss of deciduous teeth may cause *reducing arch length*. Besides, it might also cause esthetical defect, especially of the anterior teeth that makes the child psychologically uncomfortable and worsen the child's quality of life.

Severe caries disease causes the child difficult to eat, sleep difficulty because of pain that affect the daily activities and worsen the child life quality. So it is important to conduct the oral health since neonatal period. Good dental and oral health of a child means an image of a good dental and oral health in adult life as an integral part of the whole health.

The aim of the study was to decide the comprehensively right dental management in children with LBW.

LITERATURE REVIEW

Teeth development or odontogenesis begins at 6-7-week age of the embryo as a complex and continuous state as a results of an interaction between oral epithelial and mesenchymal cells, beginning with the thickening of oral epithel called dental lamina. The forming cells of the tooth came from the first branchial arch ectoderm and mesenchymal neural crest.^{1,2}

The development of human teeth: 22 deciduous and 32 permanent teeth, starts from

the interaction of oral epithel and mesenchymal cells. The process is similar in all teeth – decidual and permanent teeth. The growth and development of decidual teeth are: initiation, proliferation, histodifferentiation, morphodifferentiation, aposition, calcification, maturation, and exfoliation. Calcification phase of decidual teeth has the longest period of development until several months or years after birth. At the time of birth, decidual teeth are in calcification phase, except the anterior teeth that have the last calcification phase, generally have the eruption phase at age 4-9 months after birth.¹⁻⁶

During the developmental period the teeth become susceptible against any kinds of anomalies that might result according to the onset of the anomaly.⁶⁻⁹ The aposition phase consists of matrix and calcification that are susceptible to any gangguan. Calcification is a continuous dynamic process,; it is a matrix hardener process as a result of calcium extraction or other mineral salt such as magnesium, carbon, phosphate and result as anorganic matrix.

Dental growth and development need a gen expression control to amelogenesis process, consists of the forming of enamel matrix followed by calcification. Gens which take part in enamel matrix are AMELX, ENAM, MMP20, KLK-4. The mutation of these gens might result in mild to severe of enamel defect.⁷

As in other tissues/parts of the body, the dental growth and development is influenced by the interaction of genetical and environmental factors. Genetical factors determine the quality and quantity of the growth; and environmental factors are infection, trauma stress, drugs consumption, diseases, nutritional input, geographical position, smoking habit, alcoholic, and social economic status.³⁻⁸

During the fetal period (>12 weeks pregnancy) proliferation moves fast, and this condition needs nutrition and oxygen for every growing organ, so the fetus becomes sensitive to every change in oxygen or nutrition input. Malnutrition during pregnancy, infectious disease during pregnancy, endocrine or placental factor might result in Intra Uterine Growth Restriction (IUGR), and cause low birth weight neonate. Malnutrition during pregnancy, trauma on pregnant mother, contra indicative drugs during pregnancy, severe smoking habit, alcoholic, hypertension, twins, and infection, may cause the birth of Low Birth Weight neonate, that might affect dental development, because the critical period and development of decidual teeth is in prenatal period. The defect may be in the form and measurement, enamel defect and late eruption of decidual teeth. Therefore, adequate nutritional input is strongly needed in forming dental enamel and its calcification. Enamel defect might cause the change of tooth colour easier, change the form, minimize the hardness of the tooth.¹⁻⁹ During the critical phase, environmental disturbance might cause unpreventable defect of the developing organ system including on the teeth. Klaus and Fanaroff (2003) found that many pregnant women who were poor (from low socio economic family) and had malnutrition, gave birth to neonates with birth weight less than 2500 grams (LBW), 70% of which were Small for Gestational Age (SGA).¹⁰⁻¹² A study by Riskesdas (Basic Health Research) found the national percentage of LBW was 10.3%; 10.8% were in West Java.¹³ LBW/SGA is a neonate born with birth weight less than the 10th percentile of Lubchenco

growth curve. LBW is a result of prenatal growth defect (intra Uterine Growth Restriction – IUGR), caused by factors such as maternal, child, and placental factors.

Maternal factors are among others: age >35 years, or young mother, short stature, thin, malnutrition in mother that cause no increase of mother's weight during the third trimester of pregnancy. Other factors are smoking habit, alcoholic, cocaine, anemia, antiphospholipid syndrome, vascular disease during pregnancy, severe infectious disease, lupus erythematosus, malignancy, nulliparity, and low socio economic condition. The child factors are single or multiple pregnancy, congenital, genetical, and chromosomal anomalies, and placental factors such as tumor and placental defect.¹⁰⁻¹²

Intra Uterine Growth Restriction may cause defects on the development of the organs such as dental, because pregnancy is the critical period in forming the teeth, especially deciduous teeth. Factors that result in birth of LBW-SGA neonate might also cause defect to the development of deciduous teeth. Previous studies found out that the incidence of enamel defect of primary teeth in children with body weight less than 2500 grams were 20-100%. A study in 2009 found the incidence of enamel defect in LBW neonates were 87.58%, while in normal body weight neonates was 23%.¹⁴⁻¹⁹

Oral Manifestation in Low Birth Weight children. Several studies found out that prematurely born neonates (less than 27 weeks gestation) and LBW (< 2500 grams) were highly risky for oral problems such as delayed eruption, abnormal form of the crown root, dilaceration and enamel defect.¹⁵⁻²²

Complications might occur in LBW neonates such as asphyxia, hyperbilirubinemia, high fever during neonatal, anomalies of the teeth structure in the form of hypocalcification, enamel anomaly during calcification, and maturation of the formed matrix, and hypoplasia caused by disturbances at the time of matrix forming during protein secretion phase by ameloblast (enamel forming cells). Hypoplasia might be also caused by decreased amount of ameloblast. The manifestation of hypocalcification in the form of opacity, while in hypoplasia we may find pit / fissure, incomplete form of tooth surface". The growth and development of the enamel of deciduous teeth occurred in two phases during prenatal period, i.e. matrix forming within less than 16 week gestation, and calcification phase (mineralization) within 16-32 weeks pregnancy. When anomaly occur within the last period of the enamel matrix forming, and in the beginning period of calcification, then hypoplasia and hypocalcification might occur.^{4-6,14-19} Enamel defect as a result of developmental anomaly during pregnancy, is bilateral on the teeth with the majority of structural anomaly on the anterior teeth, upper jaw as well as lower jaw.

DISCUSSION

Dental Management in Low Birth Weight Neonates. So far, every step we did in the management of caries is focused on the defect and lesion, followed by the prevention against the severity. The prevention against dental health is early intervention through the risk factors of oral health. Generally, enamel defect can be prevented as early as possible

since the odontogenesis of decidual teeth that means during pregnancy through prenatal counseling.

1. Prenatal Counseling.¹⁷ LBW can be prevented through pregnancy examination by a gynecologist, because LBW neonate has the risk to have enamel defect. American Association of Pediatric Dentistry (AAPD) announced that oral health of pregnant mothers and their babies is the basic thing in educating/informing about the management of dental health in children. A pregnant mother had to look after her dental and oral health, because unhealthy dental and oral will result bad effects for her baby in the future life. Some studies revealed a correlation between periodontal infection in pregnant mother and LBW incidence. Pregnant mother with periodontal disease has 7.7 times probability to give b premature LBW. Controlled of oral infection may increase the life quality of pregnant mother, and decrease the transmission of mother’s oral bacteria to the fetus.²³⁻²⁵
2. Prediction on Severity of Enamel Defect of Decidual Teeth. There are several methods in preventing dental caries when the teeth are in the mouth. But now we are going to speak about the earliest intervention using/through the oral health risk factors to prevent worsening dental defect in LBW children . Based on the Developmental Defect of Enamel from Federation Dentaire Internationale (DDE) scoring there are 4 factors in determining severity of enamel defect they are; Type of LBW (Symetrically,asymmetrically), Birth weight, Mother’s disease during pregnancy, and social economic status of the family with less than Minimal Income Rate /UMR Income. Mild abnormality may be in the form of dental hypocalcification, one or more opacity, while several abnormalities are hypoplasia, and the combination of hypoplasia and hypocalcification of more decidual teeth: the teeth are looked opacity the colour changed and thrre are more pit,groove-fissur and easy breaking.

Predictive scoring of the severity. Through the scoring there were normal condition, mild and severe structural abnormalities. By scoring the prediction severity of dental anomalies at the time of birth, the health personnel could help the early intervention in preventing more severe dental defect. The percentage of the probability of enamel defect can be seen in the following table.

Table Scoring prediction of LBW type are shows on table 1 ²⁶:

Table 1. Four Factor Determined Severity Of Enamel Defect

LBW TYPE	
Asimetry	0
Simetry	33
Birth Weight	
> 2500g	0
< 2500g	47
Mother's Diseases During Pregnancy	
Non	0
Yes	35
Social Economy	
> 1.300.000,	0
< 1.300.000,	30
Total Score	

Tabel 2 Possible percentage of enamel defect

Normal	0,
Mild defect (hypocalcification)	30--77,
Severe (hypoplasia, and combined with hypocalcification).	>77

For example, a neonate with a history of LBW asymmetric, birth weight less than 2500 grams, maternal disease during pregnancy, and family income less than 1 million, then the scoring is:

For example there is a baby with asymetry LBW, Birth Weight 2000gr Mother diseases yes and Income Rate One Million : The Prediction Should be as followed

Asymmetric	0
Birth weight < 2500 grams	47
Mother disease during pregnancy	35
Social economic	20
Total	102

Total score 102 is between 78 – 122, this means the neonate had the possible risk to have 30% mild defect and 63% severe defect. According to this predicted condition, early intervention might be done as follows.

3. Dental Management Based on the Severity of Enamel Defect Score

Score	Enamel defect of deciduous dentition	Treatment suggestion
0	Normal	Careful cleansing of the child's teeth at home by the parents since deciduous teeth grow in the mouth
	No defects on the surface (Enamel surface is smooth)	Consultation to a pediatric orthodontist since the first decidual tooth, at least at one year old.
1-77	Mild Enamel Defect	Careful cleansing of the child's teeth at home by the parents every day since deciduous tooth grow in the mouth.
	Opaque white stain on the enamel surface when the tooth grows	Consultation to a pediatric orthodontist since the first decidual tooth, at the latest at age 1 year to be protected with varnish fluor application Protect the enamel surface by applying tooth paste with CPR-ACP.
>78	Severe Enamel Defect	Careful cleansing the child's teeth at home by the psrents every day since deciduous tooth grow in the mouth.
	The enamel surface is Not soft, looked harsh or Brownish plaque when the Tooth grows	Consultation to a pediatric orthodontist since the first decidual tooth grows. At the latest at age 1 year, protected with sealen on the harsh enamel surface. Routine and periodically examination within 3 months Interval to protect the newly grown tooth from caries and hole.

CONCLUSION

Enamel defect may occur in every child, that makes it easier to grow a hole on the teeth. If unattended, it may cause defects of biting function, psychological appearance, and the child health. As the forming of the teeth began in the fetus at 6-weeks pregnancy, and the calcification begins at 4-5 months pregnancy, prevention need to be started against the defect of the enamel structure. This should be done as a prevention against the risk factors and also structural defect of the teeth, that might result/occur in low birth weight neonates by routine examination of the pregnancy by a gynecologist, sufficient nutrition intake, vitamins (A,C,D) and mineral, calcium, phosphorus, magnesium, and fluor, prevent bored condition, and smoking. These could be done by preventing the risk factors said to be the cause of low birth weight neonates and also cause enamel defect of the teeth.

Furtherly, the pregnant mother should be advised to do dental and oral health examination before and during pregnancy to gain the best/primary oral health for the mother and her child.

Earliest intervention as possible on the teeth predicted to have enamel defect by consultation to a pedodontist soon after the eruption of the first deciduous tooth, or at least at age 12 months, followed by routine examination every three months.

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The Progression Research Of Allium Sativum In Dentistry

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ABSTRACT

Allium Sativum Is Traditional Plant Which Grow In Many Places In Indonesia. Some Research Showed That Allium Sativum Has Medicament Potentiality Especially For Antibacterial. Recently Allium Sativum Will Be Used In Dentistry Too Based On Result Of Research That Was Conducted In Many Country. The Aim Of This Study Was To Explain An Update Research Related To Allium Sativum That Consist Of Composition And Medicament Potentiality. In Indonesia There Are Many Types Of Allium Sativum That Can Be Found For Example Multi Layer And Single Layer. Antibacterial Potentially Also That Allium Sativum Is Used For Dentistry Material. Streptococcus Mutans As One Of Normal Oral Microflora Will Be Decresed In Blood Fusion. The Next Research Will Be Focused On Used Of Allium Sativum For Mouthwash Or Caries Prevention. Many Expert Will Make Research Based On Potentially And Antibacterial, Not Only In Laboratory Buat In Clinical That Will Be Prepare In Packaging.

Keywords: Allium Sativum, Antibacterial, Medical Potentiality, Oral Microflora

INTRODUCTION

Garlic (Allum sativum) has a wide range of therapeutic effects on the cardiovascular system, antibacterial, anti-fungal, anti viral, antibiotics, anticancer, antioxidant, immunomodulator, antiinflammatory, and hypoglycemic effects. The main content of Allium sativum is allicin which produced by enzyme allinase garlic when crushed. Garlic can be extracted to obtain the active ingredients contained there include allicin, ajoene diallusulfide, S-allylcysteine, enzymes, saponins, and flavonoid. ¹

Result of some research showed that garlic can be used for infectious diseases. Garlic is available in capsules and powder, as additives or supplements. Allium sativum showed effect of broad spectrum antibiotics against Gram positive and Gram negative. ¹⁻²

Sulfur compounds in garlic extract is known to inhibit the growth of Streptococcus mutans in dental plaque so that the acid product of these bacteria can be inhibited. Acid as

a result of bacterial metabolism is the cause demineralization of the teeth which initial stage of the chemical composition of garlic quite complex and pharmacological capacity has been investigated. The entire section of garlic contains a substance that is odorless, amino acid derivatives containing sulfur. The main component of the overall sulfur in garlic is glutamyl cysteine and S-allyl cysteine sulfoxides including alliin. ¹⁻³

The aim of this study was to explain an update research related to *Allium sativum* that consist of composition and medicament potentiality also some dental medicament according to dental caries for future research.

LITERATURE REVIEW

Garlic is a bulbous plant cloves layered or tiered, has a pseudo-stem is formed from the leaf midrib and included of *Allium* genys. According to Ross et al, in the centuries garlic has been known to have an effect as an alternative medicine. ^{1,4}

Garlic has a specific taste and smell, while garlic crushed or cut, alinase converted by enzymes into allicin. Allicin (C₆H₁₀S₂) is the womb of an oily, yellow liquid that gives a characteristic smell of garlic. Cavallito and Bailey research showed that allicin is responsible for the antimicrobial effects. It works by blocking the core of enzyme that containing thiol, including cysteine proteases and alcohol dehydrogenase. Cysteine protease enzyme is a prime suspect in the infection process, have a destructive and infectious organisms invade the tissues. The enzyme alcohol dehydrogenase plays an important role in the metabolism and life of these harmful microorganisms. ^{1,5}

The active component of garlic extract, the allicin partially inhibit protein synthesis inhibiting of DNA and RNA. Garlic extract has demonstrated broad spectrum antibacterial effect, the effect of which on the *Staphylococcus*, *Streptococcus*, *Klebsiella*, *Escherichia*, *Salmonella*, *Proteus*, *Clostridium*, *Mycobacterium* and *Helicobacter*. ⁵⁻⁶

Grosso et al showed that mouthwash containing garlic extract is more effective in reducing the number and total salivary bacteria especially for *Streptococcus mutans*. Bakri showed that the activity of garlic extract smaller than the activity of garlic extract smaller and slower in Gram positive bacteria compared to Gram negative bacteria. This difference is due to the inability of garlic extract in invading thick peptidoglycan layer in the cell envelope of Gram positive bacteria. ^{1,7}

DISCUSSION

Many research has been done for explore garlic for inhibited the activity of bacteria. The result has been showed that garlic have many potentially and it can be used for *Streptococcus mutans* activity. According to research conducted by Heon-Jin et al garlic extract can increase biofilm formation by *Streptococcus mutans* on the use of fixed orthodontic appliance, which is the way it works thought to increase the expression of glucosyltransferase. Function in the formation of glucan as a medium of *Streptococcus*

mutans adherence to surfaces existence. Ethanol extract of garlic which is applied to the tooth surface believed to increase of biofilm formation by *Streptococcus mutans* that caries process continues.⁸

Some comparison research between garlic and another natural medicine can be shown from many research. Jain et al showed that the antimicrobial effectiveness of six plant extracts of Indian origin (aloe vera, amla, garlic, ginger, neem, and tulsi) is often used as a traditional medicine against *Streptococcus mutans*. Aloe vera has anti inflammatory and antioxidant properties. Amla is a rich source of vitamin C. The fruit has antiviral, antibacterial, and anti cancer. Ginger has been used in herbal medicines worldwide, ginger is useful for the prevention and treatment of various diseases including dental infections. Neem has allergenic activity, antifungal and anti inflammatory. Tulsi is used to treat various diseases. Eugenol, ursolic acid, and carvactol are the active component of tulsi is responsible for antimicrobial activity. All the extracts were found to have antimicrobial activity against oral pathogens. Garlic extract most effective against *Streptococcus mutans*.⁸⁻⁹

Maryati research showed comparison of inhibition and killing power of garlic extract against *Streptococcus mutans* in planktonic form and in the form of biofilms. The ethanol extract of garlic have inhibitory effect especially for *Streptococcus mutans* ATCC 25175. Based on the research results of Prasanto three varieties of garlic extract (local garlic varieties Ciwidey single local garlic cloves and imports garlic) contains of antioxidant, garlic varieties that have the most excellent antioxidant power that a single clove.¹⁰⁻¹¹

Garlic contains phenolic that has an antibacterial and phenol also has broad spectrum antibacterial activity that can against Gram negative bacteria. Phenol group has capability for damaging the cell membrane, enzymes activated and proteins denaturation. The effect of this situation is cell wall will be damaged due to decreasing in permeability. Cytoplasmic membrane permeability will be changed and allowing the disruption of transport organic ions are essential to the cell resulting in growth inhibition. This process will be caused of cell death.¹²

Research that related to dentistry showed that garlic will be used for prevent caries. *Streptococcus mutans* is a commonly bacteria that caused of caries. Two species that play a role in the initiation of dental caries is *Streptococcus mutans* and *Streptococcus sobrinus*. *Streptococcus mutans* has a relationship with caries in many cross sectional epidemiological study and also assumed to have a major role in the initiation process of the formation of caries lesions, even if the bacteria are not the first bacterium that colonizes the tooth surface. Cariogenic bacteria has three properties that make function in the caries process, the ability of bacteria on the teeth the ability to produce acid and can live in acidic conditions. *Streptococcus mutans* will be able to synthesize extracellular polysaccharides glucans, can produce lactic acid through fermentation, forming colonies that are firmly attached to the tooth surface, has the ability to form a polysaccharide extracellular (dextran) resulting properties of the adhesive and cohesive plaque on the tooth surfaces and is more acidogenic than other *Streptococcus* species. Therefore *Streptococcus mutans* has been a major target in an effort to prevent dental caries. These bacteria can produces extracellular

glucosyltransferase and fructosyltransferases. The enzyme specific for the substrate sucrose is used to synthesize glucan and fructan. Although inert glucan is not undermined by plaque microorganisms, such glucans provide energy for the bacteria and other oral currently without exogenous carbon. ¹³⁻¹⁶

CONCLUSION

Garlic has a broad spectrum activity for antibacterial and it can be used for prevent caries in laboratory research. Related to *Streptococcus mutans* that garlic have a inhibition and bactericidal ability. Next research with garlic should be developed especially for dentistry.

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The Relation Between Frequency Of Toothbrush Replacement In A Year And Dental Caries Prevalence Of Grade Iv And V Students Of Jember Kidul 04 Elementary School

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ABSTRACT

Introduction: The most common dental and oral disease of human is caries. It is suffered by adults as well as children. Toothbrush is mechanical tool that is considered to be the most effective way to clean the plaque. However, the effectiveness of brushing teeth depends on the shape of toothbrush as well as its methods, regularity, and duration. One of the most important things in brushing teeth of children is replacing the toothbrush regularly every three months in order to maintain its ability to clean the teeth. Frequency and regularity of toothbrush replacement is a behavior affecting the condition of oral hygiene, the quantity of caries, and periodontal disease. **Objective:** This research was conducted to observe the relation between the frequency of toothbrush replacement in a year and the caries prevalence of students of grade IV and V SDN at Jember Kidul 04 Elementary School. **Methods:** The method used in this research was Observational Research Analysis with cross-sectional approach. The sample of this research was the students of grade IV and V SDN Jember Kidul 04, Kaliwates Jember. Caries examination was conducted on deciduous as well as permanent teeth by using def-t and DMF-T index, and OHI-S index for oral hygiene examination. Data of frequency of the student's toothbrush replacement in a year was collected by filling in questionnaire. **Result and Conclusion:** There is a relation between toothbrush replacement frequency and oral hygiene and caries of deciduous teeth, but there is no relation between toothbrush replacement frequency and caries of permanent teeth.

Keywords: Caries, def-t, DMF-T, OHI-S, Toothbrush

INTRODUCTION

Health is a very important factor in human life including oral and dental health. It indirectly becomes an important part that can not be separated from general health, thus it

is a lifetime investment. Dental and oral disease mostly found in community is dental caries. Caries occurs not only in adults but also in children.¹

The results of basic health research conducted by the Ministry of Health in 2007 stated that in Indonesia 75 % of population suffer from caries, but only 1.6 % were motivated to have dental treatment and medication e.g. filling the cavities, and 43 % had no treatment. This condition shows the low awareness of the people to maintain oral health because 43 % of Indonesian population has untreated cavities. Data from the Executive Board of Indonesian Dentists Association (IDA) state that 89 % of caries sufferers are children under 12 years i.e. the age of preschool to elementary school.²

A survey conducted by the Family Health Department in 2001 exhibited that the prevalence of active caries was child population aged 10 to 12 years, and 52 % out of 71.2 % of the population suffered from dental caries had not obtained proper treatment.² Children aged 10 to 12 years are generally in the grade IV to VI of elementary school.

Dental caries is caused by several factors, micro organisms, substrate, dental and time. Caries occurs when those four factors are present.³ Other factors that may favor to the incidence of caries are age, snacks and drinks consumption, gender, lifestyle, and oral hygiene.⁴ Oral hygiene can be improved by maintaining regular tooth cleaning.

Brushing teeth is a routine procedure carried out to maintain oral health and hygiene, especially the teeth and gingival providing freshness in the mouth by adding toothpaste, to prevent caries and periodontal disease, to prevent the accumulation of food remains on the teeth, and to perform massage on the gingival.⁵ A toothbrush is a mechanical device that is considered most effective for removing plaque on the teeth. The effectiveness of tooth brushing mainly depends on the shape of a toothbrush, method, frequency and duration of tooth brushing.⁶ One of the important things in tooth brushing is regular replacement of toothbrush conducted every three months in order maintain its ability to clean the teeth well.¹

In connection with the above opinion, the frequency of toothbrush replacement in cleaning teeth and mouth is a behavior that will affect the condition of oral hygiene, which will also affect the number of caries and periodontal disease. Every individual is necessary to know the importance of dental and oral hygiene as it plays a role in efforts to prevent the incidence of caries.⁷ Many researchers prove that tooth brushing effectiveness mostly depends on the shape of a toothbrush, as a result, new forms of toothbrush created to be more effective in the removal of plaque.⁸

Research on the frequency of replacing toothbrush is rarely conducted, thus the researchers are interested to observe the relation between the frequency of toothbrush replacement in a year on oral hygiene and dental caries prevalence of children. Jember Kidul 04 State Elementary School is chosen as research site by reason that the school has never been addressed as location to study on caries status, oral hygiene, and has no School Dental Health Program. Jember Kidul 04 Elementary School is located in the downtown area nearby the Public Health Center, but it has not been covered by an adequate health care. The research was conducted on the students aged 10-12 years grades IV and V of Academic Year of 2015-2016.

METHODS

The research was an analytic observational with cross - sectional approach. The research was conducted at Jember Kidul 04 State Elementary School of Kaliwates District of Jember Regency during November 2015 up to January 2016. Total sampling or saturated sampling technique was used in the research. The total sample of the research was 99 students i.e. the students of grade IV and V of Jember Kidul 04 State Elementary School.

The tools used in the study were mouth mirror number 3 and 4, tweezers, bent explorers, tampons, bins, trays, Deppen glass, head lamp, stationery and white cloth. Materials used in the study were alcohol (70%), masks, handscoon, tampons, tissue, hand sanitizer or soap, water, card status and informed consent.

The research was initiated with a permission letter of research from the Faculty of Dentistry, University of Jember, the Board of National and Political Unity of Jember Regency, the Education Department of Jember Regency, and the Education Office of Kaliwates District for Jember Kidul 04 State Elementary School. Furthermore, informed consent was distributed to students of grade IV and V of Jember Kidul 04 State Elementary School to be approved by their parents. The implementation stage of this research was conducted by examination of dental caries, oral hygiene, and the distribution of questionnaires.

Examination of dental caries was carried out by having the students sit on the chairs provided. The operator filled in proofing sheet by the identity of students. A student being examined was asked to gargle using plain water and to open their mouths. The operator positioned the student as comfortable as possible in order to get adequate lighting of the head lamp. The operator examined the students to see decays on the permanent and deciduous teeth, missing or indications of extraction, and fillings using a mouth mirrors number 3 and 4. Mouth mirror number 3 was used to retract the cheek of the student allowing the operator to see clearly, while the mouth mirror number 4 was used to observe the condition of teeth with caries, or formed cavities. The teeth suspected to have caries lesion but cavities not yet clearly visible were examined using a bent explorer for example in the pits, fissures, approximal, buccal, and cervical marked by the explorer catching them.

The examinations were performed on all teeth, starting from the region of the right and left maxillas, and then continued to the region of left and right mandibles. The results of the observations were noted on the sheet provided (status cards). Calculation was conducted using the index of DMF-T and def-t. The results obtained were subsequently put into categories according to WHO i.e. 0.0 to 1.1 are very low score; 1.2 to 2.6 are low score, 2.7 to 4.4 are moderate scores; 4.5-6.5 are high score, and > 6.6 is very high score [8].

Dental and oral hygiene examination was carried out by using OHI-S index in students consisting of the examination of *Debris Index-Simplified* (DI-S) and *Calculus Index-Simplified* (CI-S). Examination was carried out on 6 permanent teeth, i.e. the tooth 16 on the buccal surface, tooth 11 on the labial surface, tooth 26 on the buccal surface, the tooth 36 on the lingual surface, the tooth 31 on the surface of labial, and tooth 46 on the lingual surfaces. The results obtained were then put into categories according to WHO's i.e.

clinical criteria of score from 0.0 to 1.2 is good, and 1.3 to 3.0 is moderate, 3.1 to 6.0 is poor [9]. The last stage was to distribute the questionnaires to every student and instructed to bring them home to be filled out by parents of students at home.

The data were analyzed using the *Kolmogorov -Smirnov* test for normality, and Levene's test for homogeneity. The result showed that data were not normally distributed and the variance of the data was not homogeneous. Subsequently, the non-parametric *Spearman* correlation test was performed.

RESULTS

The research data obtained from the examination results of deciduous and permanent teeth were calculated using an index DMF-T and def-t.

The students with caries in permanent teeth with very low criteria were 49.49 %, low criteria were 20.20 %, moderate criteria were 23.23 %, high and very high criteria were 3.03% 4.04 %. Students who caries in deciduous teeth with very low criteria of 44.44 %, 13.13 % lower, were 21.21 %, 11.11 % high and very high 10.10% .

The research data obtained from the examination of debris and calculus at 6 permanent teeth calculated using *Debris Index- Siplified* (DI-S) and *Calculus Index-Simplified* (CI-S). The data were subsequently calculated and recalculated using the *Oral Hygiene Index-Simplified* (OHI-S). Students with good criteria of dental and oral hygiene were 8.08%, moderate were 65.65 %, and poor were 26.26 %. The research data were obtained from the questionnaires completed by parents of the students at home.

Table 1. Cross distribution of dental caries based on DMF-T and def-t indices to the number of students

Criteria	DMF-T	%	def-t	%
Very Low	49	49,49	44	44,44
Low	20	20,20	13	13,13
Moderate	23	23,23	21	21,21
High	3	3,03	11	11,11
Very High	4	4,04	10	10,10
Total	99	100	99	100

Source : Primary data processed by the researchers in 2016

Table 2. The distribution of oral and dental hygiene based on OHI-S index

Criteria	OHI-S	%
Good	8	8,08
Fair	65	65,65
Poor	26	26,26
Total	99	100

Table 3. Distribution of toothbrush replacement in a year of the students

Frequency	Number of Student	%
2 times	14	14,14
3 times	35	35,35
4 times	50	50,50
Total	99	100

The students replacing toothbrush 2 times in a year were 14.14 % , 3 times a year were 35.35 % , and 4 times a year were 50 % , 50 % . The data were subsequently analyzed using *Spearman* correlation test using SPSS version 16.0 for Windows to determine the relationship between two variables. The results showed significant value of 0.042 ($p < 0.05$) indicating that there was a relationship between the frequency of toothbrush replacement to deciduous tooth caries, the significant value was 0.153 ($p > 0.05$) demonstrating no relationship between the frequency of toothbrush of replacement to the permanent tooth caries, and a significance value of 0.036 ($p < 0.05$) showing a relationship between the frequency of replacing the toothbrush toward oral and dental hygiene.

DISCUSSION

The results show that the prevalence of caries in permanent teeth is lower than deciduous tooth caries, distribution of toothbrush replacement frequency of children in a year at most four times a year, and the most dental and oral hygiene are at the moderate criteria. A proper replacement frequency of toothbrush is every 3 months, or 4 times a year in order that a toothbrush can work effectively in cleaning the teeth and mouth.² The statement does not correspond with the results of the research because there are 50.50 % replacing toothbrushes four times a year but the most of dental and oral hygiene are at the moderate criteria i.e. 65.65%.

Spearman correlation test results show a significant relationship between the frequency of toothbrush replacement toward deciduous tooth caries of the children, but no relationship in the permanent tooth caries. *Spearman* correlation test of the resulted data also shows a significant correlation between the frequency of toothbrush replacement on oral hygiene. The results of data analysis using *Spearman* correlation test demonstrate a significant relationship between oral and dental hygiene and deciduous tooth caries, but not related to permanent tooth caries.

The more hygiene a person is, the more that person will be avoided from dental caries.¹⁰ Differences in oral and dental hygiene of person may be influenced by many factors including the frequency of brushing teeth, the selection of appropriate toothbrush, oral hygiene behavior and the role of parents, thus it will also affect the prevalence of dental caries.⁸

Differences in the prevalence of dental caries of permanent and deciduous teeth are caused by that a child at the age of 10-12 years is an age group of mixed dentition

period that is susceptible to dental caries.¹¹ The study shows many common deciduous teeth do not come out, thus the deciduous teeth remain in the oral cavity for longer time, and are more susceptible to caries than permanent teeth. The period of mixed dentition has permanent teeth and deciduous teeth in the oral cavity in almost the same number i.e. 14 permanent teeth and 10 deciduous teeth.¹² Morphology of deciduous teeth is characterized with thinner enamel compared to permanent teeth consequently they are more prone to dental caries than permanent teeth.

The high prevalence of dental caries is also caused by the poor eating habits of children aged 10-12 years that frequently consume foods containing high sugar e.g. chocolates, sweets and biscuits. In addition, this condition is worsened by a lack of awareness of children to clean their teeth after eating high sugar foods.¹³

Jember Kidul 04 State Elementary School is one of the primary schools in Jember Regency that does not have a School Dental Health Program and never holds oral health promotion, as a result the student's low knowledge about oral health affects their behavior in maintaining oral health, therefore the School Dental Health Program and counseling should be provided for the students. As consequent, selection of the elementary students as the object of School Dental Health Program is very important considering to the lack attention of students on dental health. This age period is considered very sensitive to the education of both behavioral and habitual models that can still be improved.⁴

CONCLUSION AND SUGGESTION

Based on result of the research, it is concluded that there is a relationship between the frequency of toothbrush replacement of children in a year and dental hygiene as well as deciduous tooth caries. The results show no relationship between the frequency of toothbrush replacement of children in a year and permanent tooth caries. The researchers suggest the necessity of toothbrush replacement every three months in order to maintain the toothbrush ability to clean teeth properly to enhance the status of oral hygiene, and to reduce the incidence of caries. The results of the research can also be used as supporting information to the Health Authority in Jember Regency. Thus, we recommend that Jember Kidul 04 State Elementary School to establish School Dental Health Program and to provide oral and dental health in order to achieve optimum health degree through oral and dental health service in educational environment especially primary schools.

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The Relationship Between Dental Caries And Oral Hygiene On Patients Of The Pediatric Dental Clinic At Dental Hospital Of Jember University

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ABSTRACT

Introduction: The most prevalent dental and oral diseases in Indonesian society are dental caries and periodontal disease. Children become the most vulnerable group to these problems due to their eating habits to high cariogenic foods as well as less awareness and knowledge about oral health care. Objective: The purpose of this study was to determine the relation and the value of caries index and oral hygiene on patients of Pediatric Dental Clinic at Dental Hospital Jember University. Materials and Methods: The type of this research was analytic survey with cross sectional approach. The samples were 98 people selected by purposive method sampling. The study was conducted on the samples by oral examination to observe dental caries and oral hygiene. The measurement method of dental caries was carried out using def-t index and DMF-T index while for oral hygiene using OHI-S index. Result and Conclusion: The average of def-t index on patients of Pediatric Dental Clinic at Dental Hospital Jember University was 10.7 (very high) while the average of DMF-T index was equal to 1 (very low) and the average value of OHI-S index was 1,37 (moderate). The result of Correlation Test did not show any significant relation ($p > 0.05$) between dental caries and oral hygiene on patients of Pediatric Dental Clinic at Dental Hospital of Jember University. It is concluded that there is no significant correlation between dental caries and oral hygiene on patients of Pediatric Dental Clinic at Dental Hospital of Jember University.

Keywords : def-t index, dental caries, DMF-T index, OHI-S index, oral hygiene.

INTRODUCTION

Oral health is an integral part of general health that may affect a person's quality of life. In Indonesia oral health problems still remain as a major constraint to both adults and children. The most oral and dental diseases suffered by Indonesian people are caries and periodontal disease ¹

Children are the most susceptible groups to oral health problems. It is caused by their bad eating habits especially on snacking cariogenic foods as well as lack awareness

and knowledge about appropriate oral health care. These habits will bring bad impacts on children's oral cavity, the food remains, the kind sucrose, is retained on the surface of teeth. Without proper cleanup efforts, it will be fermented by microorganisms in the plaque into acid that can dissolve the enamel and accelerate the process of caries development ²

Oral health status in general is expressed in the prevalence of dental caries and periodontal disease. Observation of oral health status, in the case of dental caries, is conducted using Index Decay Missing Filled Teeth (DMF-T) ³ According to WHO the rate of dental and oral hygiene is carried out using the Simplified Oral Hygiene Index (OHI-S) ⁴

Sufiawati *et al.* (2002) stated that elementary school students of class I, II and III treated in the students' clinic of Dentistry Faculty of Padjajaran University had poor dental and oral health with the average def-t index score of 10.2. In his research on elementary students, Manurung (2014) stated that there was no student with good oral hygiene, 60% of elementary school students had poor oral hygiene with an average score of OHI-S of 3.89, while the 40% of primary school students had moderate oral hygiene with an average score of OHI-S 2.58. Based on this condition the author intends to conduct an epidemiological study to determine the value of the index of dental caries and oral hygiene in patients at the Pediatric Dental Clinic of Dental Hospital of Jember University and their mutual relationship.

METHODS

Type of the study was analytic survey with cross sectional approach. The study population was the patients of Pediatric Dental Clinic of Dental Hospital of Jember University in 2014. The sample selection was done by purposive sampling and sample number was calculated using the formula of Slovin and obtained 98 samples. This research was conducted October to December 2015 at Pediatric Clinic of Dental Hospital of Jember University.

The first phase of this research is the preparation of tools and materials. The oral examination of samples was subsequently conducted to observe caries and oral hygiene samples. The measurement method used for dental caries was an index of def-t and DMF-T while oral hygiene using the OHI-S index.

Caries scoring was carried out by observing the components of caries decay visually using mouth mirror and straight explorer to observe whether there were dental cavities in the samples. Exfoliated components were observed visually using mouth mirror in primary teeth of patients to determine whether there were missing teeth due to caries. Missing components was observed visually using mouth mirror in the permanent dentition of the patients to determine whether there were missing teeth due to caries or for other reasons. Filling components was observed visually using mouth mirror to determine whether there were teeth been that had been filled due to caries which were still in good condition. Subsequently the data resulted were calculated based on the formula as below.

Score of def-t index/ individual = d+e+f
Score of DMF-T index/ individual = D+M+F
Mean of def-t/DMF-T indices = $\frac{\text{total def/DMF}}{\text{Number of samples examined}}$

In this study, the oral hygiene was measured by OHI-S index according to Green and Vermilion [5]. The examination was carried out on six tooth surfaces i.e. buccal surface of the first molars of right maxilla (tooth 16), the labial surfaces of the first incisor teeth of right maxilla (tooth 11), the labial surfaces of left molars of maxilla (tooth 26), the lingual surfaces of the left molars of mandible (tooth 36), labial surface of first left incisor tooth of mandible (tooth 31) and the lingual surface of right molars of the mandible (tooth 46).

In each of the surface, the measurement was performed on *debris score simplified index* (DI-S) score and *simplified calculus index* (CI-S) score, while the OHI-S score is obtained by summing the scores of DI-S and CI-S.

The data obtained were subsequently tested for normality and homogeneity using *Kolmogorov-Smirnov Test* and *Levene Test*. If the data obtained were normal and homogeneous distribution, they were subsequently assessed using *Pearson correlation test-Correlation Test*. If the data obtained were not normally and homogeneously distributed, they were assessed using *Spearman-Correlation Test*.

RESULTS

Results of the study associated with dental caries and oral hygiene in patients at the Pediatric Dental Clinic of Dental Hospital of Jember University is presented as below.

Table 1 shows that the average score of OHI-S in female patients is 1.27 (good) and male patients is 1.46 (medium), it can descriptively be concluded that female patients have better oral hygiene than male patients.

Table 2 shows that the patients possessing the finest oral hygiene were those aged 12 years with an average score of OHI - S of 0.67 (good).

Table 3 shows that the average score of def-t index of the patients at the Pediatric Dental Clinic of Jember University is 10.7 (very high). The male patients possess higher scores i.e. 11.5 (very high) compared to female patients with a score of 9.8 (very high).

Table 4 shows a decline of index scores of def - t in line with the age of the patient.

Table 5 shows that the average DMF - T index score of the patients of the Pediatric Dental Clinic of Jember University is 1 (very low). It is also found that the female patients also have higher DMF-T index score of 1.1 (very low) as compared to male patients with a score of 0.8 (very low).

Table 1 Results of oral hygiene the examination using OHI - S index based on gender

Gender	n	OHI-S Score	Mean of OHI-S Score	OHI-S Criteria					
				Good		Moderate		Poor	
				n	%	n	%	n	%
Male	53	77.41	1.46	23	43	29	55	1	2
Female	45	57.12	1.27	23	51	21	47	1	2
Total	98	134.53	1.37	46	47	50	51	2	2

Table 2. Results of the oral hygiene examination using OHI - S index based on age

Age	n	OHI-S Score	Mean of OHI-S Score	OHI-S Criteria					
				Good		Moderate		Poor	
				n	%	n	%	n	%
6	11	12.67	1.15	6	55	5	45	0	0
7	47	65.34	1.39	24	51	22	47	1	2
8	31	43.38	1.40	12	39	19	61	0	0
9	7	10.64	1.52	3	43	3	43	1	14
10	1	1.83	1.83	0	0	1	100	0	0
12	1	0.67	0.67	1	100	0	0	0	0
Total	98	134.53	1.37	46	47	50	51	2	2

Table 3 Results of the dental caries and def - t index examination based on gender

Gender	Dental Examination						
	n	d	e	f	Σ def-t	Mean	Criteria
Male	53	453	152	2	607	11.5	Very High
Female	45	294	146	1	441	9.8	Very High
Total	98	747	298	3	1048	10,7	Very High

Table 4 Results of dental caries - def t index examination by age group

Age	n	Dental Examination					Criteria
		d	e	f	Σ def-t	Mean	
6	11	95	43	0	138	12.54	Very Low
7	47	424	155	2	581	12.36	Very Low
8	31	181	81	1	263	8.5	Low
9	7	38	19	0	57	8.14	Low
10	1	6	00	0	6	6	Very Low
12	1	3	0	0	3	3	Very Low
Total	98	747	298	3	1048	10.69	Very Low

Table 5 Results of the dental caries examination and DMF - T index based on gender

Gender	n	Dental Examination					
		D	M	F	Σ DMF-T	Mean	Criteria
Male	53	53	44	1	45	0.8	Very low
Female	45	45	46	0	50	1.1	Very low
Total	98	98	90	1	95	1	Very low

Table 6 Results of the dental caries examination and DMF - T index based on age group

Age	n	Dental Examination				Σ DMF-T	Mean	Criteria
		D	M	F				
6	11	2	0	0	2	0.2	Very Low	
7	47	30	0	0	30	0.6	Very Low	
8	31	46	4	1	51	1.7	Low	
9	7	11	0	0	11	1.6	Low	
10	1	1	0	0	1	1	Very Low	
12	1	0	0	0	0	0	Very Low	
Total	98	90	4	1	95	1	Very Low	

Table 6 shows that the patients with lowest average score of DMF - T index is group age of 12 years with average score of 0 (very low)

The data obtained were further assessed using correlation test. It is known that the data of def-t and OHI-S index are normally distributed and homogeneous while the data of DMF- T index is not normally distributed and homogeneous. The results of correlation tests show no significant relationship between the def - t index and OHI-S index $p = 0.664$ ($p >$

0.05), and there is also no significant relationship between the DMF-T index and OHI-S index $p = 0.173$ ($p > 0.05$) in the patients of Pediatric Dental Clinic of Dental Hospital of Jember University.

DISCUSSION

Oral hygiene plays an important role in the occurrence of oral disease. If oral hygiene is not maintained properly, it will cause various diseases in the oral cavity. Both good and bad indicators of oral hygiene can be measured using OHI-S index. The goal of OHI-S index is to observe the condition of a person's oral cavity. In addition, it is also used to assess the effectiveness of tooth brushing. Thus, the poor oral hygiene does not only occur to those with poor behavior of oral and dental treatment but also to those with good behavior of dental and oral treatment, but the time and frequency of tooth brushing are still mistaken. Oral hygiene in this study was assessed using OHI-S index.

The test results of OHI-S index in the patients of Pediatric Dental Clinic of Dental Hospital of Jember University are in a category of average score 1.37 (moderate). The results also show differences of OHI-S scores between male and female patients. Oral hygiene of female patients' is better than that of male patients'. Table 1 shows female patients' average score is 1.27 (good) whereas the male patients' average score is 1.46 (moderate). These results are supported by Worang *et al.* (2014) in his research stating that girls did better in maintaining oral health than boys.

The above OHI-S score difference is allegedly influenced by the children's psychological condition. Boys tend to neglect the condition on their own, including oral health. In addition, the above difference may also be influenced by age factor because it is related to the level of maturity. Girls get mature faster than do boys. Maturity is also alleged to trigger girls to maintain dental and oral health. The results are consistent with the research conducted by Zetu in Ningsih (2015) stating that girls have more positive attitude towards oral hygiene and have high confidence to improve their oral hygiene ⁶

The patients with the best oral hygiene are those aged 12 years with an average score of 0.67 (good) (Table 2). These results are consistent with the research conducted by Mawuntu *et al.* (2015) stating that the age of the sample (> 10-12 years) have a percentage of the most excellent oral hygiene i.e. 68.42 % compared with the other two age groups of samples. It is due to children at this age are able to maintain the cleanliness of their own including their dental and oral hygiene ⁷

Caries is a disease of dental hard tissue like enamel, dentin and cementum caused by the activity of microorganisms in carbohydrate that can be fermented. Caries is marked by the demineralization of dental hard tissue which is further followed by a breakdown of the organic material, which causes bacterial invasion and death of the pulp as well as the spread of the infection to the periapical tissue leading to pain ⁸ In this study caries was measured using def-t and DMF-T indices.

Examination of caries based on the def-t index shows that the patients of Pediatric Dental Clinic of Dental Hospital of Jember University have an average score of def-t of 10.7 (very high). These results are consistent with the research carried out by Sufiawati *et al.* (2002) in which the study showed an average score of def-t of 10.2 (very high). The high rate of caries in children can be caused by the habits of consuming cariogenic food. The habit of consuming cariogenic food leads to increased production of acid in the mouth leading to reduced pH of saliva to 5.5 or less started in 5-15 minutes after consuming the food and stimulating the process of caries ⁹

Deciduous teeth are more susceptible to dental caries than permanent teeth. The enamel of permanent teeth contains more minerals and is more dense than enamel in primary teeth. It becomes one of the reasons for the high prevalence of caries in children ¹⁰

The results of the research also show that male patients have higher score of def-t than female patients. Male patients have average score of def-t of 11.5 (very high) while female patients have 9.8 (very high) (Table 3). These results are consistent with the research carried out by Worotitjan *et al.* (2013) showing that the male students have higher score of DMF-T (3.86) than female students (3.47). It occurs because girls are more willing to keep it clean ¹¹

The score of def-t is decreased in line with more age of the patients examined at Pediatric Dental Clinic of Dental Hospital of Jember University (Table 4). It is associated with the patient's dentition phase change. The age of patients in this study ranged from 6-12 years. The age of 6 years is the early phase of the permanent teeth starting to grow in the oral cavity of patients initiated by one permanent molar tooth eruption and then in line with the age of the patient, the eldest of the teeth will be replaced by permanent teeth ¹² It makes the assessment component of the def - t index decreased, and declines the scores of def-patients. There is a relationship between caries prevalence and age. It is associated with a time of tooth eruption, which early erupted tooth will tend to have a higher index of dental caries compared to the last erupted tooth thus it will be exposed to dental caries risk factors for quite long time ¹³

Caries examination based on the DMF-T index shows that female patients have a higher score of DMF-T than male patients (Table 5). The prevalence of dental caries in women which is higher than in men is caused by tooth eruption of girls that is faster than that of boys, thus the teeth of girls are longer in the oral cavity and have more time to be exposed to risk factors causing caries ¹³

The results of caries examination based on age group shows that patients with the best average score of DMF-T are the patients aged 12 years. Table 6 shows that patients aged 12 possess average DMF-T score of 0 (very low) indicating that patients age 12 possess good oral hygiene without caries in their oral cavities since a child aged 12 years has started to realize the importance of maintaining dental and oral health ¹⁴. The older children are the broader cognitive development they have. They have wider experience and are able to process information well because of their biological development and adaptation development of cognitive structures ¹⁵

Correlation test conducted shows no significant relationship between the def - t index and OHI- S index ($p > 0.05$) and also no significant relationship between the DMF-T index and OHI-S index ($p > 0.05$). These results indicate that caries is not influenced by the cleanliness of the oral cavity. Rehman *et al.* (2008) states that there is no significant relationship between the DMF-T index and OHI-S index. In his study he concludes that the frequency of sugar intake, frequency of eating snacks between meals, and socio-economic status play an important role in the DMF-T index in school children aged 11-14 years ¹⁶

Dental and oral hygiene in this study is measured using OHI-S index. OHI-S index measurement is based on the calculation of the debris index and calculus index. Debris is a soft material that is attached to the tooth surface to form plaque, material alba, and food debris while calculus is a hard deposit caused by the deposition of inorganic salts of which main composition are calcium carbonate and calcium phosphate mixed with debris, microorganisms and cells epithelial-cell desquamation ⁵

Oral hygiene assessment carried out by several stages; first applying disclosing solution on the surface of the tooth to be examined, instructing the children to gargle and finally performing assessment of oral hygiene by calculating score of the dental plaque ¹⁷ In the study, researchers do not use the disclosing solution for measuring dental plaque, the researchers only use explorer after the instructing the patients to gargle thus it may affect the results.

Plaque plays an important role in the occurrence of oral disease. The bacteria present in plaque are responsible for the occurrence of tooth decay, the bacteria will metabolize the food remains left in the oral cavity. Plaque attached to the tooth surface contains a lot of bacteria, especially *Streptococcus* and *Lactobacillus*. The bacteria will metabolize the cariogenic food remains, particularly fermentable carbohydrates (sucrose, glucose, fructose and maltose). The carbohydrate possesses tiny and low weight molecules thus they are easily absorbed and metabolized by bacteria. The metabolism results can produce not only acids but also extracellular polysaccharides, polysaccharide intracellular, alcohol and carbon dioxide (CO_2) ⁵

Lactic acid is the most widely produced by the bacteria, besides there are also pyruvic acid , acetic acid, propionate acid, and formic acid. These acids will be preserved by plaque on the tooth surface resulting in a reduction in plaque pH below normal. If a person frequently and constantly consumes carbohydrates that can be fermented (sugar), the plaque pH will remain below normal leading to tooth surface demineralization i.e. the solubility of calcium phosphate in tooth enamel triggering tooth decay that causes caries ⁵

The decrease in plaque pH is not always followed by the process of caries, low plaque pH may return to a normal pH caused by other metabolism of foods consumed e.g. metabolic substrates containing nitrogen will produce bases, it also contains a base compound (NH_3) as a result of metabolism of urea in saliva. The results of base metabolism can also cause insoluble calcium phosphate replenished (remineralization). This supports the findings that the presence of a substrate (debris) which can be metabolized by bacteria that create acidic conditions (decline of plaque pH) is not always followed by the caries

process, it depends on the individual's ability to restore the plaque pH turn to normal ⁵ .

Some foods have protective factors to inhibit the demineralization of the tooth surface. Foods requiring more mastication that may stimulate the flow of saliva and increase the capacity of the buffer can neutralize the acid environment in the oral cavity assisting to restore the normal pH of the plaque pH within a fairly short time ¹⁸

CONCLUSIONS AND SUGGESTIONS

The patients at the Pediatric Dental Clinic of Dental Hospital of Jember University have an average score of def - t index with very high criteria. The average score of the index of DMF-T criteria is very low and the average index score of OHI-S with the moderate criteria. Results also revealed that there is no association between caries and oral hygiene thus it can be concluded that dental caries is not affected by the cleanliness of the oral cavity.

Researchers hope the research can be used as a foundation to carry out the efforts to improve oral health education both at the Dental Hospital of Jember University and at schools around Jember Regency to realized optimum oral health in society.

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Hall Technique As A Dental-Treatment Option, Start With Minimal Then End Up Maximal

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ABSTRACT

The Hall technique is a novel method of managing carious primary molars by cementing preformed metal crowns, also known as stainless steel crowns (SSCs), over them without local anaesthesia, caries removal or tooth preparation of any kind. Hall technique still has a lot of controversy, so it has not been widely applied in dental practice, especially in Indonesia. This article literature study will compare the strengths and weaknesses of the hall technique from various sides, based on reviews from various sources of research, journals, and textbooks related to the implementation guidelines of hall technique. The advantages of hall technique has been widely recognized by research in developed countries, among others in terms of ease of application, a short processing time, reduce the anxiety level of the patient, and long-term durability when compared with conventional restoration. However, some studies have also found the constraints that can be a debilitating factor of this technique, such as the selection of cases that are less precise and skilled clinicians. However, having the theoretical basis of the application of hall technique is the key to get a successful treatment and minimize the failures that may occur. In conclusion, the development of treatment options for caries in primary teeth, in this case was hall technique, can be considered a treatment option for dental caries performed especially in pediatric dentistry.

Key words: Hall Technique, stainless steel crown, carious primary molar, dental treatment

INTRODUCTION

Percentage of people in Indonesia who have oral and dental problems, according Riskesdas (Riset Kesehatan Dasar), in 2007 to 2013 increased from 23.2% to 35.9%. The latest data in 2013, by age group, the highest proportion of oral and dental problems that are in the productive age range 35-44 years, and is high in children aged 5-9 years in the

amount of 28.9%, followed by the age range of 1-4 years in the proportion of 10.4%¹. Oral and dental problems by the age of children was very varied, one of which is the carious primary molar that need early intervention for prevention as a treatment.

Proper treatment of carious primary molars is particular important because of the need to prevent oral infections, as well as because of the role primary molars play in proper mastication and in maintaining proper space in the arch for the permanent premolars. Stainless steel crowns (SSCs), also known as “preformed metal crowns,” have shown significant clinical success and are considered a favorable restoration for two-surface and larger carious lesions on primary molars.²

In conventional approach, application of SSC consist of administration of local anesthetic; adequate removal of tooth structure from the mesial, distal, and occlusal surfaces; and complete removal of caries, which comes at an increased expense and risk to the patient’s behaviour during treatment. This statement leads us to realize that dental treatment for children is not the same as dental treatment for adults, because different types of treatment might influence children’s behaviour and perceptions.^{3,4}

In the future, pediatric dentist must continue to explore alternative strategies for “painless”, “more biological”, and “non-surgical” caries management and restorative treatment for primary dentition. On progress, the hall technique combined with SSC was introduced as a dental treatment option that more suitable for primary dentition. The Hall technique is a novel method of managing carious primary molars by cementing preformed metal crowns, also known as stainless steel crowns (SSC), over them without local anaesthesia, caries removal or tooth preparation of any kind.⁴

Hall technique still has a lot of controversy, so it has not been widely applied in dental practice, especially in Indonesia. In developed countries, various studies have been conducted to see the resilience of the restoration, patient satisfaction, clinician’s satisfaction, as well as the stress level of children during treatment using hall technique⁴⁻⁷. The results of various studies on the comparison of hall technique with other techniques from various studies will be shown in this paper. This article literature study will compare the strengths and weaknesses of the hall technique from various sides, based on review from various sources of research, journals, and textbooks related to the implementation guidelines of hall technique. The definition of hall technique, indications and contraindications, the procedure, clinical appearances before and after treatment also can be seen in this paper.

LITERATURE REVIEW

Many children in a pediatric practice are there because they’ve been management problems in general practice. They arrive with memories of a bad experience, reluctant, obstinate, frightened, or even terrified. These new options for treatment will give offices the ability to treat children without anesthesia, rubber dams, or drilling, and that makes the child, the parent, and the staff much calmer, and much, much happier. The one of dental treatment option is hall technique.

The Hall Technique is a method for managing carious primary molars where decay is sealed under preformed metal crowns (PMCs) without local anaesthesia, tooth preparation or any caries removal. The technique is named after Dr Norna Hall, a general dental practitioner from Scotland, who developed and used the technique for over 15 years until she retired in 2006.⁶

The initial process of any carious is biofilm's formation that seen as plaque. The point was in the community of micro-organisms within plaque being extremely sensitive and responsive to changes in its environment. For cariogenic plaque, if the environment can be altered to be unfavourable for cariogenic bacteria in the community, plaque can lose its cariogenic potential. The Hall Technique adapting this theory by manipulates the plaque's environment, sealing it into the tooth, separating it from the substrates (essentially, nutrition) that would normally receive from the oral environment.⁶

Any primary teeth have an important role, not excluding primary molars. Not only as main construction for mastication system, primary molars also have significant contribution in jaw's development and malocclusion problems. Premature loss of the second deciduous molars had a greater effect on the dental arches compared with the first deciduous molars. These findings indicate a need for a judicious indication for space maintainers. It is suggested that such appliances should only be indicated in cases of premature loss of the second deciduous molars and should be fitted within the first 3 months after the extractions.^{7,8}

Hall technique is a management option for active, early to moderate proximal lesions involving the dentine in primary molars with no signs or symptoms of pulpal involvement. A visible band of 'normal' appearing of dentine, between the carious lesion and the dental pulp on a bitewing radiograph is the key radiographic sign used to indicate that there is no irreversible damage to the dental pulp. The presence of this band of dentine has been shown to be a good predictor of success when a Hall crown is placed.⁶

Indications and Contraindications

Hall crowns are not a universal answer to managing all carious primary molars. Instead, with proper case selection, the Hall Technique can be an effective management option for primary molar teeth affected by dental caries. Having the theoretical basis of the application of hall technique is the key to get a successful treatment and minimize the failures that may occur. To do the right case selection, clinician needs to know indications and contraindications for using the hall technique in practice.⁶

Indications for hall technique, include teeth with non-cavitated occlusal lesion. Tooth with light or dark brown discoloration at the base of the pit or fissure with or without white demineralization at the sides of the pit or fissure, that could be detected visually after cleaning and drying the teeth, no breakdown in enamel (no cavity) but the area is soft (sticky) upon gentle exploring, was suitable for hall crown application. In addition, if the patient was unable to accept fissure sealant or any conventional restoration, the hall technique was able to be applied.^{6,9,10} Not only the non-cavitated one, the tooth with cavitated occlusal lesion also can be treated by hall technique, but of course with some considerations. Patient who

has the cavitated occlusal lesion, but refuse the caries removal technique, was one who indicated for hall technique treatment.⁶

Caries development also occur in proximal area, which can appear as a cavitated or non-cavitated lesions. This condition become another indication for hall technique application because at the end, the hall crown will cover up the whole proximal surfaces. Beside the lesion, another condition that may corrected by the hall crown was decrease of occlusal vertical dimension (OVD) in primary dentition. In children, the occlusal-dimension changes occur as a result of early childhood caries that broke down the anterior teeth and decrease the overbite distance. To regain the normal OVD position, the hall crown can be applied on the posterior teeth in order to make an openbite position and reach the optimal OVD at the end.⁶

There are so many dental problems that can be found in children, but not all of them can be treated by hall technique. There were some dental's condition that become contraindications for hall technique, such as teeth with signs or symptoms of irreversible pulpitis or dental sepsis, the clinical or radiographic signs of pulpal exposure, or periradicular pathology, and crowns that was so broken down so they would normally be considered as unrestorable with conventional techniques.⁶

Hall Technique Procedure

The prevention of pulp exposure is one of the main benefits from avoiding complete caries removal in caries management options such as the Hall Technique¹². The procedure is not an easy way, but with a good understanding about the step, the hall technique will become proper treatment for some cases. So that, the clinicians should understand about every steps of hall technique's procedure start from the begining examination to the end of treatment.

In the first visit, the clinicians should take any informations that may helpful during the treatment, such as patient's behavior, habit, and dental condition clinically. A full history and clinical examination, including bitewing radiography, should be carried out. From the bitewing radiography, the clinicians will see the outline of lesion, so that it can be categorized as an indication or contraindication for the hall technique treatment. If the diagnose was an indication for hall technique, informed consent to parents and behavior management for children should be given. The child and parent should be briefed on the procedure. Children should be shown a crown, and allowed to handle a spare one if felt beneficial. Young children sometimes respond to the idea of the crown being "a shiny helmet", just like soldiers wear to protect their heads", or "a precious-shiny princess crown" or it being a "twinkle tooth".^{6,9} If the child show the cooperative respond and seems to accept the hall technique treatment, try to assess the shape of the tooth and its contacts. Placing orthodontic separators through the mesial and distal contacts can be very useful when fitting crowns with the Hall technique. The clinicians can postpone this step into the next visit if the patient's respond was negative.⁶

For the second visit, try to make a condusive athmosphere and explain the next step to the child with the psychological approaches. If the respond was good, sit the child



Figure 1. Decrease of occlusal dimension in primary dentition 11

upright, then specify the fittest crown, the smallest size of crown which will seat. A gauze swab square can be used to protect the airway in addition. In some case, crown's position or transposition can be present to find the fit size.⁶

After the fittest crown already picked, prepare for cementing step. Dry the crown at first, and fill with glass-ionomer luting cement or any kind of different luting cement, ensuring the crown is well filled, with no air inclusions. If possible, the tooth should be dried prior to cementation, but otherwise there is no caries removal or tooth preparation of any kind, and also no local anaesthetic injection is given. If the cavity is large, some cement may be placed within it, just before placing the crown. Then, place the crown over the tooth. Once excess cement has been removed, the child should be asked to bite firmly on the crown for 2-3 minutes, or the crown should be held down with firm finger pressure as an alternative. Finally, remove excess cement, floss between the contacts, and do not forget to check the occlusal-dimension.⁶

In some cases, there are some potential complication that may occur when hall crowns are placed. **Increased of occlusal-dimension** was the first and the most frequently problem that may occur. Concerns about the increase in the occlusal-vertical dimension (OVD) following placement of Hall Technique crowns have been alleviated. As the Hall technique does not involve any occlusal reduction of the tooth, it is inevitable that placing the crown will result in a premature contact and an increase in the OVD. In the experience, the occlusion reestablishes within a few weeks. A number of studies have found that the occlusion re-establishes itself within 15 to 30 days following placement of the HT crown.^{9,13}

Another complication that have been investigate by the research was about the microleakage from the hall and conventional technique. In his research, Yalcinkaya compare about this complication, and make a result that the scores in the Hall group were significantly worse than those in the conventional technique group. Three kind of luting cement were used in their research. Resin cement displayed the lowest extent of microleakage, followed by glass ionomer and polycarboxylate cements.¹⁴ Other complication that may occur were sepsis, impacted of the permanent molar, occlusal wear, and poorly fitted crown.

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Figure 2. Placing orthodontic separator to make a space in proximal 6



Figure 3. A small lower second primary molar crown may fit an upper first primary molar 6

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RESEARCH COMPARISON

The hall technique has been widely recognized by research in developed countries, among others in terms of ease of application, a short processing time, reduce the anxiety level of the patient, and long-term durability when compared with conventional restoration. Preformed metal crowns offer physical protection to teeth affected by caries, through complete tooth coverage, as well as arresting caries progression. In direct comparisons, their longevity has been found to be equal to or superior to restorations. A less invasive alternative method for using preformed metal crowns is the hall technique, where crowns are pushed over teeth with no tooth preparation or caries removal. The hall technique has also been shown to have good longevity.¹⁵

The Hall technique promises to alleviate the suffering and anxiety that many young children feel in the dental chair. The placement of a HT Crown is a very simple procedure and is a lot faster and more comfortable, with less anxiety for the patient. It has the added bonus of

preventing the progression of the carious lesion that is being treated and the development of new carious lesions on other surfaces of the tooth that is being managed.^{6,9} Looking in other aspect, from cost-effectiveness evaluation, the initial costs of ART treatment (the costs to produce one unit) calculate cheaper to provide. But after 3 years, for the survival rates, ART restoration need maintenance cost for long time after.¹⁶

Table 1. Result mean overbite from research about OVD pre-post treatment using the Hall technique ¹³

	N	Mean (mm)	SD
Pre-treatment visit	56	2.45	1.03
Treatment visit	56	0.54	1.79
Evaluation visit (15 days)	48	1.96	1.15
Evaluation visit (30 days)	8	2.75	1.49

Table 2. Research comparison about the Hall Technique from different aspects

Author	Title	Study Objective	Result
Innes N, Stewart M, et al, 2015 ¹⁵	The Hall Technique; retrospective case-note follow-up of 5-year RCT	to establish the Hall Technique's (HT) success over the lifetime of primary teeth compared to conventional restorations (CR)	The HT continued to outperform the standard restorations in primary molar teeth with significant caries involvement over the lifetime of the teeth. (Fig.4)
Santamaria RM, Innes NPT, et al, 2015 ⁴	Acceptability of different caries management methods for primary molars in a RCT	compare children's behaviour and pain perception, also technique acceptability (parents and dentists)	Children showed more negative behaviour in the CR group; There were no statistically significant differences in parents' rating of their child's level of comfort; Dentists reported more negative behaviour in CR group
Daniela Hesse, and Mariana Pinheiro, et al, 2016 ¹⁶	Atraumatic Restorative Treatment compared to the Hall Technique for occluso-proximal cavities in primary molars: study protocol for a randomized controlled trial	cost-effectiveness OVD changes	for initial cost, ART give more effective cost than the HT treatment the OVD tends to be increased after placement of a crown using the HT
Zeynep Yalçinkaya Erdemci, S. Burçak Çehreli, et al, 2014 ¹⁴	Hall Versus Conventional Stainless Steel Crown Techniques: In Vitro Investigation of Marginal Fit and Microleakage Using Three Different Luting Agents	to evaluate and compare microleakage and marginal discrepancies in SSCs placed by either the conventional technique (CT) or Hall technique	Stainless steel crowns applied using both the conventional technique and the Hall technique demonstrated microleakage, with the latter displaying significantly higher scores
V. van der Zee, W.E. van Amerongen, 2010 ¹³	Short Communication: Influence of preformed metal crowns (Hall technique) on the occlusal vertical dimension in the primary dentition	Influence of Hall PMCS on occlusal vertical dimension	After placement of preformed metal crowns using the Hall technique, the occlusion returns back to the pre-treatment situation within 15-30 days

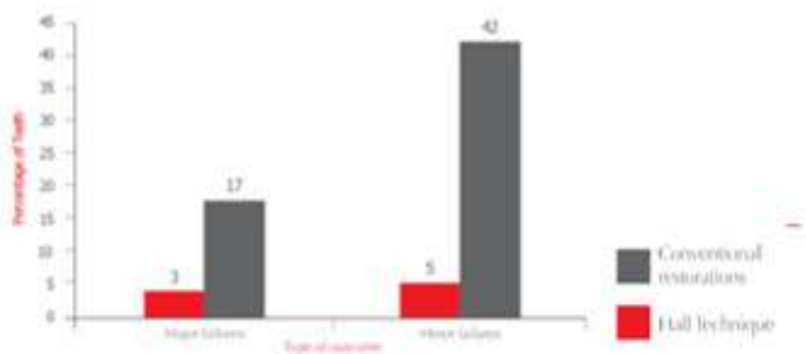


Figure 4. Major and Minor Failures over 5 years 40 for 91 of 132 pairs of teeth (69%) 35 treated with the Hall Technique compared 30 to conventional restorations 15

CONCLUSION

Beside of all weaknesses that may occur in the using of Hall Technique, this technique technique seems to offer an effective, noninvasive treatment option for carious primary molar teeth involving two or more surfaces. Sealing in caries in deciduous molars using Hall PMC seems to improve pulpal health and patients benefit from the smaller cavity size, no need for local anaesthesia and a less traumatic procedure from the point of view of child behaviour management.

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Dental And Oral Health Problems In Children As A Passive Smoker (Literature Study Article)

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ABSTRACT

Based on Basic Health Research (Riskesdas) in 2013, as many as 85% of households in Indonesia were exposed to cigarette smoke. Global youth tobacco survey 2009 data (GYTS 2009) mentioned 68.8% of school children aged 13-15 years exposed to environmental tobacco smoke in homes, and according to Riskesdas 2007, 59.1% of children under five years old were passive smokers. This literature review aims to explain dental and oral health problems occurring in children as a passive smoker. Passive smoking, also known as exposure to environmental tobacco smoke (ETS), is defined as inhalation of the cigarette smoke of another individual or the exhale of a smoker. Passive smokers absorb nicotine and other compounds just as smokers do, and as the exposure to ETS increases, the level of these harmful compounds in the body also increases. Children exposed to tobacco smoke are at increased risk of asthma, ear and respiratory infections, and sudden infant death syndrome. Passive smoking in children can also cause disturbances in dental and oral health. Environmental tobacco smoke contains over 4000 chemical agents adversely affecting the oral health of passive smokers and changes the normal oral and nasopharyngeal flora. Children as a passive smoker, can be affected by exposure to environmental tobacco smoke, including disruption of dental and oral health, such as melanin pigmentation of the gingiva, increased incidence of caries, affected of periodontal health and delayed in dental development.

Keywords: dental and oral health problems, children, passive smoking, tobacco smoke, nicotine.

INTRODUCTION

Passive smoking, also known as involuntary smoking, second hand smoking (SHS) or exposure to environmental tobacco smoke (ETS), is defined as inhalation of the cigarette smoke of another individual or the exhale of a smoker. Passive smoking can adversely affect the health of non-smokers of all age groups ^{1,2}.

Non-smokers exposed to environmental tobacco smoke (ETS) absorb nicotine and other compounds just as smokers do, and as the exposure to ETS increases, the level of these harmful compounds in the body also increases. Chronic nicotine exposure from smoking is associated with numerous adverse health consequences. Most parents were moderate to heavy smokers, with a majority of them smoking 6 to 10 cigarettes per day, their children may have been exposed to passive smoke³.

ETS contains over 4000 chemical agents adversely affecting the oral health of passive smokers^{1,4-7}. Cotinine is a nicotine biomarker with a half-life longer than that of nicotine^{1,5-7}. Cotinine is a major metabolite of nicotine, which is specific to tobacco smoke. It is sensitive enough to distinguish between people not exposed to secondhand smoke and those exposed to low, moderate and high levels of secondhand smoke^{2,5}. Measurement of cotinine level is a suitable and reliable objective and quantitative screening tool for determination of exposure to ETS as it is for active smoking. A dose-dependent correlation exists between the number of cigarettes smoked by a smoker and the plasma and saliva cotinine levels of his/her non-smoker companion¹.

Based on Basic Health Research (Riskesdas) in 2013, as many as 85% of households in Indonesia were exposed to cigarette smoke⁸. Global youth tobacco survey WHO 2009 data (GYTS 2009) mentioned 68.8% of school children aged 13-15 years exposed to secondhand smoke in homes, and according Riskesdas 2007, 59.1% of children under five years old were passive smokers⁹.

Passive smoking exposure may start in utero and may continue after birth throughout the childhood. The relationship between both pre-natal and post-natal passive smoking exposure and the health status of children has been reported in many investigations¹⁰. Children exposed to secondhand smoke (SHS) are at increased risk of asthma, ear and respiratory infections, and sudden infant death syndrome^{1,4-6,11}. Children are more vulnerable than adults to the adverse health effects of SHS exposure⁶. In addition, there are a number of studies on oral health in relation to passive smoking in young children¹⁰.

Passive smoking changes the normal oral and nasopharyngeal flora and may cause upper airway infection. It may decrease alveolar bone density or cause severe periodontitis, gingival pigmentation in children and adults, primary and permanent tooth decay. It may also delay tooth development¹.

This literature review aims to explain the passive smoker effect to dental and oral health in children, so it can be concern for health practitioners, especially dentists and increase parental awareness of the impact of exposure to environmental tobacco smoke.

LITERATURE REVIEW

The following are some of the dental and oral health problems in children as a passive smoker such as melanin pigmentation of the gingiva, increased incidence of caries, affected periodontal health and delayed in the development of teeth.

Melanin pigmentation of the gingiva

Hyperpigmentation of the gingiva is caused by excessive melanin deposition by the melanocytes mainly located in the basal and supra basal cell layers of the epithelium¹². It has been observed that there is positive correlation between gingival pigmentation in children and parental smoking, this pigmentation may be induced by the stimulation of melanocytes by stimuli present in tobacco smoke such as nicotine and benzopyrene^{12,13}.

The exposure to ETS is difficult to quantitatively measure and has been approximated by self-reported estimates, primarily of the smoking history of spouses. However, the documentation of gingival pigmentation in non-smokers is meager and has remained contentious. According to study of Sidharan et al. in 2010, the prevalence of gingival pigmentation in passive smokers was statistically significant in children and young adult³.

Smoking was found to cause diffuse oral melanin pigmentation in European and Asian populations. Increased pigmentation was reported in 21.5% of smokers, and the intensity of the pigmentation was related to the number of cigarettes consumed. One study noticed a significant increase in the gingival melanosis of children with parents who smoke. The prevalence of gingival pigmentation increased and reached maximum levels in $\approx 60\%$ of children aged 1 to 6 years; moreover, another study reported the prevalence continued at this level for nearly 7 years and was followed by a gradual decrease to $\approx 40\%$ in children 17 years of age³.

The potential accumulation in melanin-containing tissues of nicotine and tobacco-specific compounds may be a concern for any individual who is chronically exposed to tobacco smoke. However, individuals who have higher concentrations of melanin in the tissues might be at an increased risk. Gingival pigmentation in Asian populations was estimated to be 34.9%³.

The high prevalence of gingival pigmentation enhanced by excessive active smoking could be explained by the high affinity activity of polycyclic amines such as nicotine and benzopyrene in tobacco smoke on melanocytes^{1,3}. Two pathways by which stimulatory substances in ETS enter melanocytes in the gingiva of children are the penetration through the oral mucosa and bloodstream. Stimulatory agents of pigmentation can be introduced via saliva and reach the gingival epithelium. However, the majority of ETS is inhaled through the nose, and thus, indirect stimulation by nicotine and benzopyrene via the bloodstream could



Figure 1.Pigmented gingiva in children¹².

explain the enhanced pigmentation in children exposed to second hand smoke. A case-control study by Hanioka et al. in a Japanese population determined that 61% of children had ≥ 1 smoking parent. Gingival pigmentation was observed in 71% to 78% of children. The percentage of smoking parents was higher in children with gingival pigmentation (70% to 71%) than in those who lacked pigmentation (35%), which suggested that the pigmentation in the gingiva of children was associated with passive smoking³.

Increased incidence of caries

In children exposed to ETS, an increased incidence of caries and pigmentation of the gingiva were documented^{3,14,15}. Dental caries occurs predominantly in younger children, and various factors may influence development of dental caries including passive smoking. The basic etiology of dental caries is attributed to the interaction among a susceptible tooth surface (tooth), fermentable carbohydrates (sugar), and specific bacteria (microorganisms), in particular, *Streptococcus mutans*, which converts carbohydrates into acids¹⁶.

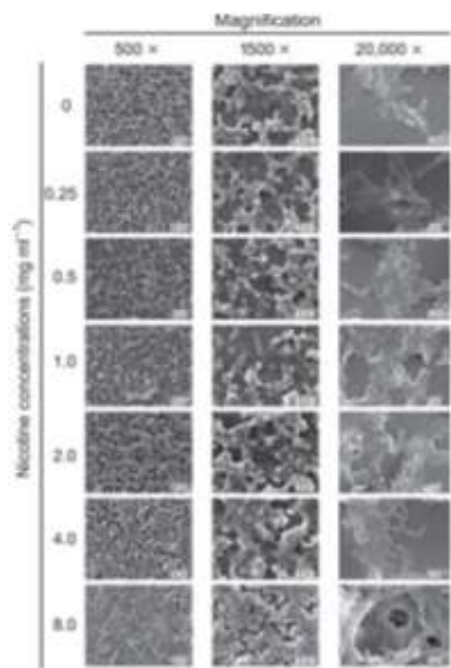


Figure. 2. Scanning electron microscopy images of *Streptococcus mutans* UA159 treated with 0, 0.25, 0.5, 1.0, 2.0, 4.0, and 8.0 mg ml⁻¹ of nicotine for 24 h. Images were obtained at 500X (A1-G1), 1,500X (A2-G2), and 20,000X (A3-G3) magnifications. Groups treated with high concentrations of nicotine had a thicker biofilm with more spherical bacterial cells than groups treated with low concentrations of nicotine. More bacterial cells were present in the gaps (white arrows) between the biofilm accumulations (black arrows) in groups treated with 0–1.0 mg ml⁻¹ of nicotine than in groups treated with 2.0–8.0 mg ml⁻¹ of nicotine¹⁷.



Figure 3. Summary of the biological mechanism of SHS directly or indirectly affecting dental caries in children according to explanation of the etiology of dental caries¹⁶.

In Turkey, *S. mutans* colonization was positively associated with DMFT scores of primary teeth in children exposed to passive smoke. In Japan, children exposed to tobacco when in utero were observed to have a higher prevalence of caries than unexposed children. The ability of nicotine to enhance the growth of biofilm cells appeared to be significant and universal. from the scanning electron microscopy images, that nicotine enhanced the *S. mutans* biofilm mass¹⁷.

One homogeneous gene sequence of b2 nicotinic acetylcholine receptors was found in *S. mutans* and its expression was up-regulated by 1.0 mg ml⁻¹ of nicotine. Nicotine has been shown to cause oxidative stress in human cells, and the transcriptional repressor, Rex, has been reported to regulate the *S. mutans* oxidative stress response and biofilm formation. Both Falkler et al. and Keene & Johnson have suggested that nicotine affects *S. mutans* gene expression; unfortunately, there are still questions about how metabolic processes are involved, whether or not the processes are related to lactic acid production, as well as which mRNAs are related to biofilm formation. In vitro study of Huang et al., nicotine enhanced biofilm formation and biofilm metabolism of *S. mutans*, and therefore nicotine may be one of the contributors of caries development in smokers¹⁷.

Recent studies on the association of passive smoking with early childhood caries exhibited potential to infer a causal association. Evidence of a causal association between passive smoking and early childhood caries is possible by the assessments based on

standardized elements of evaluation excluding biological plausibility. Further studies should be conducted to examine whether passive smoking is a true risk of early childhood caries by employing unmeasured covariates in the past studies. For example, including a variable of salivary function might validate biological plausibility¹⁶.

The underlying mechanism could be explained as a modulation of existing etiology of dental caries. Passive smoking may directly influence tooth and oral microorganisms. Exposure to environmental tobacco smoke during the period of tooth formation may influence mineralization. Environmental cadmium exposure may be independently associated with increased risk of early childhood caries. Colonization of cariogenic bacteria on rough tooth surfaces could be enhanced by Exposure to environmental tobacco smoke. The number of cariogenic microorganisms may increase with a decrease in immune function. Exposure to environmental tobacco smoke may predispose subjects to infections through suppression or modulation of the immune system. Blood levels of vitamin C in smokers and children who reside with smoking parents were decreased. Decreased vitamin C levels were associated with the growth of *S. mutans*. The influence of sugar would be an indirect and apparent relationship because of unhealthy lifestyles of smoking parents¹⁶.

Another notable factor in addition to etiologic factors is the salivary gland. Saliva contains various biologically active components and affects basic factors of dental caries etiology. The buffering capacity of saliva decreases and the numbers of lactobacilli and *S. mutans* in saliva increases in smokers and children who reside with smokers. Low levels of saliva because of low salivary gland function may also enhance the colonization of cariogenic bacteria on rough tooth surfaces and interrupt clearance of fermentable carbohydrate from the mouth. Decreased function of the salivary gland may also influence remineralization of tooth surfaces. The tentative effects of passive smoking regarding to tooth formation and salivary gland function would be altered during pregnancy as well as after delivery. Children may inhale exposure to environmental tobacco smoke through the mouth because of nasal congestion, and breastfeeding from a mother who smokes may result in toxic substances being delivered to the child's mouth. Tobacco smoking was associated with elevated levels of *S. Mutans* and lactobacilli in saliva. These findings may indicate increased susceptibility to dental caries in children who reside with smoking parents, possibly resulting in the early colonization of *S. mutans*¹⁶.

Periodontal health affects

In the past 25 years, there has also been an increasing awareness of the role of cigarette consumption in oral health problems such as periodontal disease. Smoking is considered the major risk factor in the prevalence, extent and severity of periodontal diseases^{5,18}. Clinical studies have demonstrated that smokers have more severe periodontal disease, with increased bone loss, greater periodontal attachment loss, more gingival recession and periodontal pocket formation¹⁸.

Recently, it was reported that among adults who had never smoked cigarettes, the odds of having periodontal disease were 1.6 times greater for persons exposed to passive smoking

than for persons not exposed, after controlling for known risk factors for periodontal disease. This result suggested that passive smoking may also have a harmful effect on periodontal health⁵. Exposure to environmental tobacco smoke caused poorer attachment of the teeth to the gum and supporting structures in children². According to the result of Erdemir et al. research, passive smoking may negatively influence the periodontal attachment in children, but the reason is unclear. It may be due to a retarded growth rate of the periodontal tissues and it seems possible that exposure to environmental tobacco smoke might affect the development of the periodontal tissues in children. The speculation that tobacco smoke by-products do not primarily act on the periodontium by causing deepening of pockets but rather by interfering with (re)generation properties of the connective tissues⁵.

Recent studies have also suggested that passive smoking may be associated with periodontal diseases. Erdemir et al.²⁵ evaluated 109 children (range 6–12 years), classified as either exposed to passive tobacco (n = 51) or as unexposed (n = 58). The authors showed higher cotinine levels and greater attachment loss in passive smokers, when compared to unexposed children. Nishida et al. conducted a 2 year longitudinal study and observed that passive smoking increases the salivary levels of albumin, aspartate aminotransferase and lactoferrin. The authors suggested that passive smoking may affect inflammatory response and may be associated with a greater risk for periodontitis progression^{5,18}. Ronchetti et al. [1994] reported that the salivary cotinine concentration is a reliable indicator of exposure to passive tobacco smoking. Blood levels of cotinine most closely reflect the dose of nicotine absorbed from passive tobacco smoking. Yamamoto et al. [2005] reported that passive smokers as defined by salivary cotinine displayed a significantly more severe periodontal status than non-smokers and argued that passive smoking should be considered as an independent risk indicator of periodontal disease⁵. A few reports have documented an association between cotinine level in serum and saliva and periodontal parameters such as probing depth (PD) and clinical attachment loss⁵.

Exposure to direct and passive tobacco smoking has significant impact on the gingival and oropharyngeal flora in children as well as adults¹⁹. It has been reported that smokers may present a significantly greater plaque index and that the average number of bleeding sites in smokers (27%) is smaller than in nonsmokers (40%). Microbiological studies showed that smokers had a higher prevalence of bacterial species related to periodontal disease compared to non-smokers, including *Porphyromonas gingivalis*, *Aggregatibacter actinomycetemcomitans*, *Bacteroides forsythus*, *Prevotella intermedia*, *Fusobacterium nucleatum*. However, some authors reported no differences between smokers and nonsmokers with respect to the detection of periodontal pathogens, both in terms of prevalence and amount of bacteria in the subgingival microbiota. Recent studies, using real time PCR, have demonstrated a positive relationship between degree of smoking and amount of bacteria/probing depth¹⁸.

In general, nicotine has been reported to adversely affect proliferation, attachment and chemotaxis of periodontal ligament cells, and induce pro-inflammatory cytokine production by human gingival fibroblasts synergistically with lipopolysaccharide from *Escherichia coli*

and *P. gingivalis*¹⁸. An additional analysis of gingival tissue adjacent to periodontitis sites showed that matrix metalloproteinase (MMP)- 2 levels were higher in the exposed versus non-exposed animals. This finding suggests that MMP-2 may be one of the molecules responsible for the increased tissue degradation observed in the periodontal tissues of smokers. In general, these results suggest that nicotine seems to be a key molecule for the intensified periodontal destruction observed in smokers and may contribute, at least partially, to the negative impact of cigarette smoke as a whole¹⁸.

Delayed in the development of teeth.

The major finding of the Avsar et al. research in 2013 was that the dental age of PS subjects was significantly lower compared with the dental age in the control group¹⁰. Similarly, Kieser et al. [1996] observed approximately a 4 month delay in the maturation of permanent teeth in Caucasoid children exposed to tobacco smoke from both parents as compared with the children of nonsmokers^{5,10}.

Qianqian Dong et al, studied the effects of maternal passive smoking on the morphology and mineralization of dental hard tissue in offspring rats. They found that passive smoking can affect both the quantity and quality of dental hard tissue development in offspring rats. The mechanisms through which maternal passive smoking affects the morphology of dental hard tissue have not yet been reported. Other research gives some indication of possible mechanisms. Nicotine, a major toxic component of tobacco, can affect cell differentiation and proliferation. Ameloblast and odontoblast proliferation and differentiation is the basis of dental hard tissue production. Nicotine can also affect the blood supply to organs, causing local ischaemia and hypoxia, and carbon monoxide binds to haemoglobin in red blood cells, preventing affected cells from carrying a full load of oxygen so that it can aggravate this effect. As a growing organ, blood supply is the basis of tooth development. Tar and other ingredients can produce large amounts of oxygen free radicals that can poison cells. The results of their study show that maternal passive smoking can lead to offspring dental hard tissue of a small size and poor quality⁴.

According to previous investigations, the possible effect of passive smoking on dental development results from a specific effect on tooth odontogenesis. The calcification of permanent teeth starts approximately at the time of birth with the first molars and incisors¹⁰. It is important to point out that the family members investigated in our study had smoked at home since the birth of the child. During this active growth, teeth are susceptible to environmental disturbances, and nicotine may interfere with the reciprocal induction between ectomesenchymally derived tissues and oral ectoderm, disrupting subsequent normal odontogenesis. According to Saad [1991] and Chowdhury and Bromage [2000], by providing nicotine during and after the fetal cycle, changes in dental structure occur because of developmental perturbations induced by this toxin. The disturbance of mineral metabolism could be one possible mechanism leading to deviations in tooth maturation. Ayçiçek et al. [2005] suggested that active or passive maternal smoking causes potent oxidative stress. According to Heikkinen et al. [1992], it is possible that the extra carbon

dioxide caused by the defect in oxygenation may lead to acidosis, which in turn could disturb post-mitotic hard tissue crystallisation. Other pathogenetic mechanisms could be related to nicotine and hydrocarbons and to their mutative capacity, or these mechanisms may be simply related to poorer nutrition because of the loss of maternal appetite from smoking^{1,10}.

CONCLUSION

Children as a passive smoker may be exposed to adverse impacts on health caused by exposure to environmental tobacco smoke, including disruption of the dental and oral health, such as melanin pigmentation of the gingiva, increased incidence of caries, affected periodontal health and delayed in the development of teeth. The effects of passive smoking on dental and oral health should be investigated further in future research. Necessary interventions and policy to increase parental awareness about the effects of tobacco smoke and non-smoking household implement to reduce exposure to tobacco smoke in children.

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Antimicrobial Effects Of Chlorhexidine Against Cariogenic Bacteria Of Early Childhood Caries : (Literature Study Article)

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ABSTRACT

The prevalence of caries in Indonesia approximately 90% of the population toddler in Indonesia. The most common of primary teeth caries are rampant caries and caries bottle syndrome. Dental plaque is the main source for dental caries. Some literatures show the daily use of an efficient antimicrobial product such as Chlorhexidine can be very beneficial in plaque control and, thus, prevention of caries, but the long-term effects are still being reviewed. This article aims to identification the antimicrobial effects of Chlorhexidine (CHX) against cariogenic bacteria and its relationship with the Early Childhood Caries (ECC). In recent years, new approaches have been considered to control ECC such as topical application of antimicrobial agents on the surface of those teeth that are at risk of or affected by ECC. As an anti caries agent, CHX is used at concentrations ranging from 0.1 to 40 percent in solutions, gels, chewing tablets, and varnishes. A previous meta-analysis of selected studies gave an overall caries inhibiting effect of CHX of around 46 percent. Several studies have used CHX for ECC prevention with varying effectiveness depending on concentration, frequency of application and the age of participants. As an anti caries agent, CHX therapies should be used as adjuncts to a regular caries preventive program for patients at higher risk for caries. Regular tooth brushing and good diets should be used in conjunction with CHX to prevent recolonization of Mutans Streptococci (MS) in children.

Key words: Antimicrobial, Chlorhexidine, Mutans Streptococci, Early Childhood Caries

INTRODUCTION

Prevalence of Early Childhood caries (ECC) reaches high levels in developing countries, the severity increases with age. The prevalence of caries in children 3-5 years old in Indonesia continues to increase. The prevalence of caries in toddlers in Indonesia is approximately 90.05%. Because of the high prevalence of these can affect children's quality of life and higher potential caries risk of primary teeth, the ECC is the most serious

condition that can harm children. Healthy primary teeth are essential for the development of the adequate stomatognathic system and important for speech, mastication, prevention of oral bad habits, and acts as a guiding permanent tooth eruption. In addition to the childhood, the aesthetics of anterior teeth encourage the development of normal personality thus increasing confidence and can affect children's quality of life in the future.^{1,2}

Dental caries is a common chronic infectious transmissible disease resulting from tooth-adherent specific bacteria, primarily Mutans Streptococci (MS) that metabolize sugars to produce acid which, over time, demineralizes tooth structure. Understanding the acquisition of cariogenic microbes improves preventive strategies. Microbial risk markers for ECC include MS and Lactobacillus species.³

Prevention of early childhood caries (ECC) continues to be a challenge in many disadvantaged communities. Although early colonization by MS has been identified as a risk factor for ECC, antimicrobial agents that are suitable for controlling cariogenic bacteria have not been extensively tested for preventing ECC.^{4,5} Therefore, this article will describe ECC and the antimicrobial effect of chlorhexidine (CHX) for prevention of ECC.

LITERATURE REVIEW

Early Childhood Caries (ECC)

There are several definitions of Early Childhood Caries according to the American Dental Association (ADA). ECC is characterized by one or more decayed teeth (non-cavitated or cavitated lesions) missing teeth (due to caries), or filled tooth surfaces in any primary tooth in a preschool age between birth to 71 month of age.^{6,7} Early Childhood caries (ECC) is a term to describe a unique pattern of carious lesions in infants, toddlers and preschoolers. This term replaces the bottle or nursing caries term that previously used to describe of rampant caries in primary teeth caused by the use of a bottle feeding or other liquids, including carbohydrates in the long term.^{1,6}

Severe Early Childhood Caries (S-ECC) has replaced the term *rampant caries*, characterized by one of the following criteria : a) In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC), b) From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or c) a decayed, missing, or filled (dmft) score of ≥ 4 (age 3), ≥ 5 (age 4), or ≥ 6 (age 5) surfaces constitutes S-ECC.^{3,7,8}

Etiology

ECC is a result of the interaction of the factors involved in other types of dental caries (cariogenic bacteria, refine carbohydrates, and host factors). However, the dietary factors also include frequent consumption of liquids containing fermentable carbohydrates, particularly through a nursing bottle at sleep times, juices, sodas, infant formula and sweetened beverages have been implicated in ECC. Low salivary flow during sleep can

reduce remineralization and acid buffering, so that when the children are asleep still attached to the substrate cariogenic on teeth can cause the occurrence of ECC.^{4,7,9,10}

Demineralization caused by the production of acid produced by MS and Lactobacillus. Specifically, bacteria, acid, food debris and saliva combine to form substances as plaque attached to the teeth. Most of the investigations have shown that in children with ECC, MS has regularly exceeded 30% of the cultivable plaque flora. These bacterial masses are often associated with carious lesions, white spot lesions, and sound tooth surfaces near the lesions. Conversely, MS typically constitutes less than 0.1% of the plaque flora in children with negligible to no caries activity. Each child drank sweet liquid, the acid will attack the teeth at least 20 minutes and after that the teeth will damage.^{1,11-13}

There are children who do not consume sugary foods and do not drink milk or other sweet drinks at night, but have caries. This may be due to factors of vulnerability tooth (host), in which the immature enamel after the eruption, and the presence of enamel defects like hypoplasia.²

Characteristics and Clinical Features

The clinical features of ECC are usually first involves labial and palatal surfaces primary maxillary incisivus. As tooth decay continues, the caries may involve primary maxillary molars even entire primary teeth. Primary mandibular incisivus is rare affected by caries, except in the most severe case.²

Chlorhexidine (CHX)

CHX has a long history of use in caries prevention trials. Some studies have found it efficacious, while others have not. This agent (CHX) remains the gold standard as antiplaque



Figure 1. The Clinical features of ECC stages of Phase I-IV (left-right)¹³

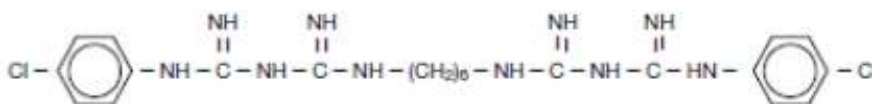


Figure 2. Molecular Formula of Chlorhexidine¹⁷

and antigingivitis agent.¹⁴CHX is a bisbiguanide with both hydrophilic and hydrophobic properties. The positively charged molecule may bind to negatively charged groups, i.e to phosphate, carboxyl or sulfate groups on the oral mucosa, on microorganisms and in the pellicle. The microbial membrane integrity may be disrupted by interactions with the hydrophobic portion of the molecule, causing disturbance of the membrane function. At high concentration, CHX is bactericidal, causing leakage of low molecular weight cell constituents and precipitation of cell contents. This damage is irreversible. At lower concentration the effect is bacteriostatic, causing interference with normal membrane function or leakage of cell constituents.¹⁵⁻¹⁷

CHX reduces MS but does not usually eliminate it except with intensive, high concentration, and repeated applications. Intervention with multiple applications over periods of months of 0.12% chlorhexidine gluconate can significantly reduce MS levels and in combination with fluoride therapy can markedly lower the risk for future caries. But, it is much less active against Lactobacilli (LB).⁵

Despite the widespread clinical use of CHX, reports of untoward effects are few. Local adverse effect, such as discoloration of teeth, tongue, restoration and dentures desquamation and soreness of oral mucosa, taste disturbances and bitter taste, however, are frequently reported. Reducing the concentration of CHX reduces the local adverse effect.^{15,17,18}

CHX Mouthrinses

CHX mouth rinses are available in the form of 0.2% and 0.12%. There is equal efficacy for 0.2% and 0.12% rinses when used at appropriate similar doses. The usually prescribed dosage for CHX mouthrinses has been 10 ml of a 0.2% solution twice daily, by using 15 ml of 0.12% CHX a similar dosage is obtained, and the efficacy is comparable.^{17,19} The time of rinsing is 30 or 60 seconds depending on the adsorption rate of antiseptics to the oral surfaces (50% of CHX binds to receptors within 15 seconds) but this does vary from individual to individual. The plaque inhibiting effect of a 0.2% CHX with rinsing times of 15, 30 and 60 seconds following a 72 hour non brushing period showed no difference. The ideal regimen is twice daily (morning and night) which will have a substantivity for 12 hours.¹⁹

Of the studies that evaluated the long-term effects of treatment using CHX solutions, only one (0.12% CHX) had a lasting effect in reducing salivary MS levels (i.e., 6 weeks); the treatment period in this case was prolonged, that is, 6 weeks as well. Treatments using 0.12% CHX solutions for 1 or 2 weeks, with 1 or 2 rinsing daily, did not produce any significant long-term reduction in salivary MS. Increasing the CHX concentration to 0.2% and the treatment period to 4 weeks produced results similar to studies using a lower concentration or shorter treatment period.²⁰

CHX Gel

CHX gel at concentration 0.2%, 0.5%, and 1% is applied with a toothbrush, while 1% and 5% gels are applied through professional prophylaxis and with the aid of individual trays. Professional prophylaxis with 1% CHX gel causes a short term decrease in MS levels.

Three sessions of professional prophylaxis over a 1-week period produced a significant decrease for 2 weeks. When prophylaxis was conducted only once, a 3-day decrease in MS was observed. Raising the concentration of CHX gel from 1% to 5% does not appear to enhance its ability to lower MS levels.²⁰

CHX Toothpastes

0.12% of CHX with 1 parts per million of fluoride has anti plaque effects similar to CHX mouthwash. However there were difficulties in incorporating CHX into gels and toothpastes. 1% CHX used as slurries and rinsed twice per day for one minute causes significant reduction in the plaque and gingival scores but also causes stains. CHX in dentifrices gained little attention due to its possible interaction with anionic ingredients contained in toothpaste and competition for oral retention sites.¹⁹

CHX Sprays

0.1% and 0.2% sprays have similar plaque inhibition properties of 0.2% mouthwash. It is well received by physically and mentally handicapped patients.¹⁹

CHX Varnish

CHX varnishes with concentrations of 1% (Cervitec®), 10% (Chlorzoin®), 20% (BioC®), and 35% (EC40®) are currently on the market.²⁰ CHX-containing varnishes were developed to increase the substantivity, length of the time of suppression and effectiveness of the delivery of CHX to sites colonized by MS. CHX varnish has been shown to reduce the numbers of MS in several studies. Suppression of MS for periods of up to five months has been achieved by the application of a varnish containing a high concentration of CHX (40%). 40% CHX Varnish has a greater effect on the period of decreased MS levels compared with lower concentrations.^{20,21}

CHX Sugar free Chewing Gum

CHX remains unbound in this form. It contains 20mg of CHX diacetate. It is advised to chew 2 pieces twice per day for 10 minutes, and the efficacy is comparable with CHX mouthrinses. This procedure can cause less stains. It is a good method of using CHX for a long period of time.¹⁹

DISCUSSION

Prevention Of ECC

There are three general approaches that have been used to prevent ECC [Figure 3]. Health promotion programs to stimulate tooth brushing have been among the most successful educational programs.¹²



Figure 3. Strategies for the prevention of ECC12

Biofilm Mechanisms

Virulent biofilms that are tightly adherent to oral surfaces are a primary cause of infectious diseases in the mouth, including dental caries. However, teeth may be covered by biofilm without always presenting visible signs of caries. The formation of an exopolysaccharide-rich biofilm matrix, acidification of the milieu and persistent low pH at the tooth-biofilm interface are major controlling virulence factors that modulate dental caries pathogenesis.^{17,22,23}

Some literature shows MS plays a key role in the development of virulent biofilms, although additional microorganisms may be also involved in the pathogenesis of the disease. This bacterium (i) effectively utilizes dietary sucrose (and possibly starch) to rapidly synthesize EPS through the activity of glucosyltransferases (Gtfs) and a fructosyltransferase (Ftf) that are adsorbed to saliva-coated tooth enamel surfaces, (ii) adheres tenaciously to glucan-coated surfaces, and (iii) is both acidogenic and acid tolerant, and has components protein as glucan binding proteins (glucan binding protein/Gbp), which is closely connected with the process.^{17,22,23}

Cariogenic biofilm microbes trigger for the initial adhesion of subsequent and further accumulation on the surface of the tooth, which is dominated by the mediation dependent sucrose mechanism. Figure 3 a) The Gtfs secreted by MS are incorporated into pellicle (particularly GtfC) and adsorb on bacterial surfaces (mainly GtfB), including microorganisms that do not produce Gtfs (e.g. *Actinomyces* spp.). b) Surface adsorbed GtfB and GtfC rapidly utilize dietary sucrose (and starch hydrolysates) to synthesize insoluble and soluble glucans in situ; the soluble glucans formed by GtfD could serve as primers for GtfB enhancing overall synthesis of EPS. The Gtfs adsorbed onto enamel and microbial surfaces provide in situ an insoluble matrix for dental plaque-biofilm. Concomitantly, dietary carbohydrates (CHO) are metabolized into acids by acidogenic/aciduric organisms (e.g. MS). c) The glucan molecules provide avid binding sites on surfaces for MS and other microorganisms mediating tight bacterial clustering and adherence to the tooth enamel (through glucan-glucan and glucan-Gbp interactions). Furthermore, Gtf-adsorbed bacteria de facto become

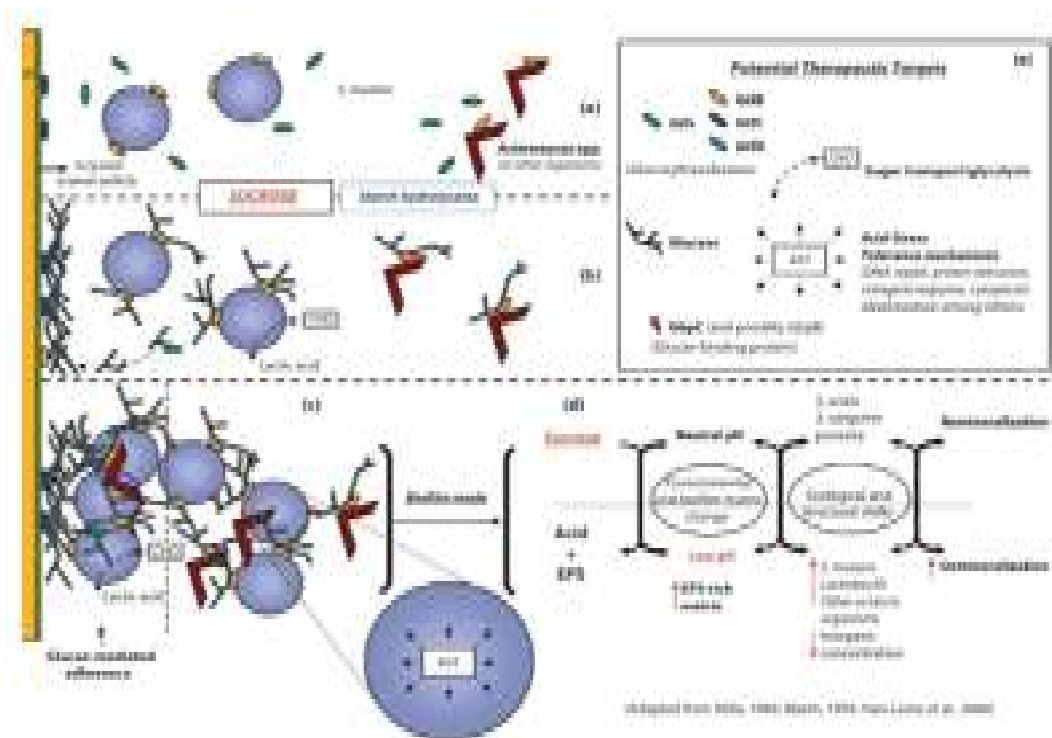


Figure 4. Cariogenic biofilm formation (a– d) and potential targets (e) for disruption by natural products.²³

glucan producers binding to tooth and microbial surfaces by the same mechanisms. This model could explain the rapid formation and accumulation of highly cohesive-adherent plaque in the presence of sucrose (and possibly starch) even if the number of MS is relatively low. After the establishment of a glucan-rich biofilm matrix, ecological pressure (e.g. pH) will determine which bacteria may survive and dominate within plaque under frequent sucrose (or other fermentable carbohydrate) exposure. d) If biofilm remains on tooth surfaces with frequent consumption of high carbohydrate diet (especially sucrose), the amount of EPS and extent of acidification of the matrix will be increased. Such conditions cause biochemical, ecological and structural changes favoring the survival and dominance of highly acid stress-tolerant organisms in cohesive and firmly attached biofilms. The low-pH environment at the tooth-biofilm interface results in enhanced demineralization of enamel. (Figure 4)²³

Chemical Plaque Control

An important strategy for caries control in young children hinges on the removal of the cariogenic bacteria. Although tooth brushing has been found to be clinically efficient in reducing their numbers, removal of MS by oral antiseptics has additional benefits in the case of those children whose carers are unable to brush effectively.¹⁸

Chemical agents can reduce biofilm mass at various stage of biofilm formation or maturation through one or more of the following mechanisms: 1) Inhibition of microbial adhesion and colonization, 2) Inhibition of microbial growth and metabolism, 3) disruption of mature biofilms and the detachment of biofilm microorganisms, 4) Modification of biofilm biochemistry and ecology.¹⁷

Based on research conducted by Li and Tanner⁴ found that moderate reductions in cariogenic bacterial levels, mainly in mutans streptococci (MS), were demonstrated following the use of antimicrobial agents. The results varied depending on the different approaches used. In most of the reviewed studies MS levels were reduced after treatment, but the bacterial regrowth occurred once the treatment had ceased, and new caries lesions developed, particularly in high-risk children. However, studies of the long-term benefits of ECC prevention are lacking.⁴

Table 1: Brief Overview Of Various Topical Antimicrobial Agents.¹⁰

Author Name	Agent used	Comments
Marinho et al. 2013 [34]	Fluoride varnish	Substantial caries inhibiting effect of fluoride varnish in both permanent and primary dentition
Rosenblatt et al. 2009 [23]	Silver diamine fluoride	SDF can be an effective agent in preventing new caries lesion and in arresting dental caries in primary teeth.
Petti and Hausen 2006 [38]	Chlorhexidine varnish	CHX gel showed moderate anti-MS-effect but negligible caries preventive effect.
Simaraviri et al. 2000 [32]	Povidone iodine	Povidone iodine application can be a good alternative to control caries in children affected with ECC.
Chan et al. 2012 [58]	Xylitol wipes	7 times fewer children from the xylitol-wipe group developing new caries compared with the placebo group
He et al. 2006 [46]	Liquorice	Glycyrrhizol A and B in liquorice have demonstrated substantial antimicrobial activity against <i>S. mutans</i>

Table 2. Caries Preventive Agents Non Fluoride- Evidence-Based Clinical Recommendations²⁶

Recommendations for patients at higher risk for caries. Adjuncts to a regular caries preventive program				
Toothbrushing	Advise parents and caregivers of children 6 years or older that use of sucrose-free alcohol (xylitol) only, or alcohol combinations showing gains for 10 to 15 minutes after meals may reduce incidence of recurrent caries.			Strong
	Advise adults that use of sucrose-free alcohol (xylitol only or polyol combinations) showing gains for 10 to 15 minutes after meals may reduce incidence of recurrent caries.			Expert Opinion
	Advise parents and caregivers of children 6 years or older that the daily use of xylitol-containing lozenges or hard candy that are dissolved slowly in the mouth after meals may reduce incidence of recurrent caries. (B-; 8 patients/10000 over 100 days to three months)			Expert Opinion
Chlorhexidine (Tooth Rinse)	Apply 0.12 percent of chlorhexidine mouthwash every three months to reduce the incidence of root caries.			Strong
	Applying 0.6 to 1.0 percent chlorhexidine gel alone or in combination with fluoride for caries prevention of root caries is not recommended .			Against
	Using 0.12 percent chlorhexidine rinse alone or in combination with fluoride for prevention of root caries is not recommended .			Against
Chlorhexidine (Tooth Paste)	Applying 0.12 percent of chlorhexidine/fluoride tooth paste or in combination with fluoride for prevention of coronal caries is not recommended .			Against
	Applying 0.12 to 0.20 percent chlorhexidine tooth paste or in combination with fluoride for prevention of coronal caries is not recommended .			Against
	Applying 0.12 to 0.20 percent chlorhexidine gel alone or in combination with fluoride for prevention of coronal caries is not recommended .			Against
	Using 0.12 percent chlorhexidine (tooth paste or in combination with fluoride for prevention of coronal caries is not recommended .			Against

Strong
 Evidence strongly supports providing this intervention

In Favor
 Evidence favors providing the intervention

Weak
 Evidence suggests implementing this intervention only after alternatives have been considered

Against
 Evidence suggests not implementing this intervention

Expert Opinion
 Evidence is lacking. Any recommendation for or against is based on expert opinion

Effects Of Chlorhexidine Against Cariogenic Bacteria

The *in vitro* antimicrobial effect of CHX is not outstanding, but the spectrum is broad. Gram positive microorganisms are generally more sensitive to CHX than are Gram-negative microorganisms. MS are particularly sensitive, whereas, for instance, *Streptococcus sanguinis* exhibits great variation in susceptibility among strains. The clinical antimicrobial and antibiofilm effect CHX is better than for other agents with similar or even better *in vitro* antimicrobial efficacy. This superior effect has been ascribed mainly to the substantivity of CHX and to the fact that CHX retains its antimicrobial effect even when adsorbed to surfaces. As a result of the direct antimicrobial effect, CHX reduce the metabolic activity of the dental biofilm, thus decreasing acid challenge after sucrose or glucose intake. CHX may also inhibit the enzyme glucosyltransferase, which is essential for microbial accumulation on tooth surfaces, and the metabolic enzyme phosphoenolpyruvate phosphotransferase, which is involved in the transport and phosphorylation of glucose across the membrane.¹⁵⁻¹⁷

Some studies have used CHX for the prevention of ECC with a wide range of effectiveness depending on the concentration, frequency of application and the age of subject. As an anti caries agent, CHX is used at concentrations ranging from 0.1 to 40 percent in solutions, gels, chewing tablets, and varnishes. A previous meta-analysis of selected studies gave an overall caries inhibiting effect of CHX of around 46 percent.^{4,10,18}

There is an investigation on toddler children showed that 6 monthly applications of 40% CHX varnish resulted in significant caries reduction in 4–5-year-old children.^{5,18} Wan and co-workers²⁴ conducted the first placebo controlled randomized double-blind clinical trial using weekly applications of 0.2% CHX gel in infants colonized with MS and showed that the numbers of MS were significantly reduced in the first three months especially for infants with relatively low initial MS counts (< 300 cfu/ml) and suggested that the application of CHX gel pre-colonization or immediately post-colonization may prevent or delay MS colonization in infants.²⁵

According to a literature review by Gold²¹ concluded that “CHX rinses should not be recommended for use in caries prevention due to a current lack of evidence” and that the evidence on the effectiveness of CHX gels and varnishes was “suggestive but incomplete”. Additionally, there is uncertainty about which formulation of oral product may provide the best mode of CHX delivery for caries prevention. Reports have claimed that CHX varnishes achieve the most persistent reduction in MS followed by gels and mouthrinses, but there is still a degree of uncertainty on the comparative effectiveness of these agents.^{20,27}

A recent review mentioned that the majority of clinical trials on CHX were performed using CHX-containing varnishes, and results were inconclusive on the anti-caries effect for children and adolescents with regular fluoride exposure. However, the same review found that four out of five studies which investigated the effect of CHX varnish on fissure caries were effective in preventing caries in children with low fluoride exposure.¹⁸

The main clinical problem with the use of CHX is the difficulty in suppressing or eliminating MS for an extended period of time. In many clinical studies, the organisms re-colonized the dentition. However, the re-colonization time varied among subjects.²¹

The results of research conducted Law and Seow¹⁸ showed that daily brushing with 0.2% CHX gel has the potential to remove MS in preschool children who have been infected with the bacteria. The increasing ability of elimination of MS with increasing time suggests that prolonged brushing of CHX gel is required for success. The effectiveness of tooth brushing in decreasing MS has also been demonstrated in a previous study which reported that there is elimination of MS from children when they have better tooth brushing habits. Another trend which was noticed from analysis of post-treatment results was that less snacking frequencies were associated with less re-colonization of MS. Both these trends thus support previous reports that other good dental habits are important to prevent long-term re-colonization of MS.¹⁸

CONCLUSIONS

As an Anti caries agent, CHX therapies should be used as adjuncts to a regular caries preventive program for patients at higher risk for caries. Several studies have used CHX for ECC prevention with varying effectiveness depending on concentration, frequency of application and age of the subjects. Regular tooth brushing and good diets should be used in conjunction with CHX to prevent re-colonization of MS in children.

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Mechanism Of Zinc In Oral Cavity For Reducing Enamel Demineralization (Literature Study Article)

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ABSTRACT

Zinc [Zn^{2+}] is an element which is found in many parts of the human body including oral cavity. This element is present naturally in plaque, saliva, and enamel. Furthermore, zinc can also be formulated into oral health products as antibacterial agents for instance mouthrinses and toothpastes, yet their mechanism of interaction with enamel is not clearly understood. The purpose of this literature study is to understand the mechanism of zinc in oral cavity for reducing enamel demineralization. Zinc is formulated into oral health products to control plaque, reduce malodour, and inhibit calculus formation. It has good oral substantivity, and high concentrations can retain for many hours in plaque and saliva following delivery from mouthrinses and toothpastes. Although low concentrations of zinc can minimize enamel demineralization and modify remineralization very well, during caries clinical trial, the addition of zinc to fluoride toothpastes has not affected its ability to reduce caries. Zinc competes with calcium for bacterial binding sites in biofilms and it has been proposed that half of the bound zinc would be released under cariogenic conditions, through, for example, protonation of carboxylate and phosphate in bacterial lipoteichoic acid. The mechanism of zinc in oral cavity for reducing enamel demineralization is by reducing calcium [Ca^{2+}] and phosphate ions [PO_4^{3-}] release, mainly on the enamel surfaces at PO_4^{3-} sites in the HAp lattice to possibly form an α -hopeite-like phase.

Keywords: mechanism, zinc, enamel, antibacterial, demineralization

INTRODUCTION

Zinc [Zn^{2+}] is an element which is ubiquitous in human body including oral cavity. This element is present naturally in plaque, saliva, and enamel. Zinc is also added to oral

health products for instance mouthrinses and toothpastes as antibacterial agents yet their mechanism of interaction with enamel is not clearly understood.¹⁻³

The mechanism of uptake of zinc by dental tissues is not known possibly because the inorganic zinc is acquired by exchange with calcium in the hydroxyapatite crystals. This concept is supported by the present observation of competition between Zn^{2+} with Ca^{2+} for positions on the crystal surface.⁴

Uptake and release of zinc are mediated by the bone reservoir. It is found in foods including meat, cereals, milk, and milk products. Zinc is involved in biomineralization, where it stimulates both bone growth and mineralization and influences osteoclast activity. Zinc-doped hydroxyapatite may improve bone formation around implant materials.¹ The finding of Rathje (1941) that zinc hydroxyapatite can be formed by titration of Zn^{2+} with phosphate solutions at neutral pH also provides presumptive evidence of exchangeability between zinc and calcium in the apatite lattice.⁴ The purpose of this literature study is to understand the mechanism of zinc in oral cavity for reducing enamel demineralization so that further damage of the teeth can be prevented as early as possible. Pediatric dentist can be a pioneer in the prevention to help maintain oral health of children from an early age.

LITERATURE REVIEW

The Role of Zinc in The Oral Cavity

Large amounts of zinc present in teeth are acquired before eruption.^{1,3,4} Pre-eruptive deposition is undoubtedly favoured by the high concentrations of zinc known to be present in extracellular fluids of young individuals. Plasma zinc decreased markedly with the increasing age, the level is three times greater in fetuses than in adults.^{4,5} Even though erupted teeth showed greater concentrations of zinc than unerupted teeth from the same area, there is no increased concentration gradually with age.⁴ After eruption, zinc concentration at the surface of the teeth apparently increases further, suggesting that some incorporation does occur to the oral fluids during post-eruptive exposure. It seems probable that this is facilitated by many sub-clinical caries events, in a similar way to the post-eruptive uptake of fluoride, where repeated demineralization and remineralization remodel the outermost layer of enamel. This extra zinc is apparently lost over the following two or three decades, in the same way to fluoride.¹ It is still reasonable to assume that zinc is acquired throughout life, because this is known to be the case in bone.^{1,4}

Zinc accumulates in the structure of the tooth surface and occurs at low concentrations below the surface of the material, thus indicating a distributive pattern similar to fluoride and lead. The concentration of zinc in the enamel surface in different areas ranging from 430 - 2100 ppm and may vary by a factor of up to 10 or more in different portions of enamel, and by a slightly smaller factor in dentine. The concentration of zinc found in molar are often of the same order as the fluoride concentration. In the enamel, zinc major precipitation occurred before tooth eruption. In contrast to the fluoride, zinc deposition after the eruption seemed irregular.⁴

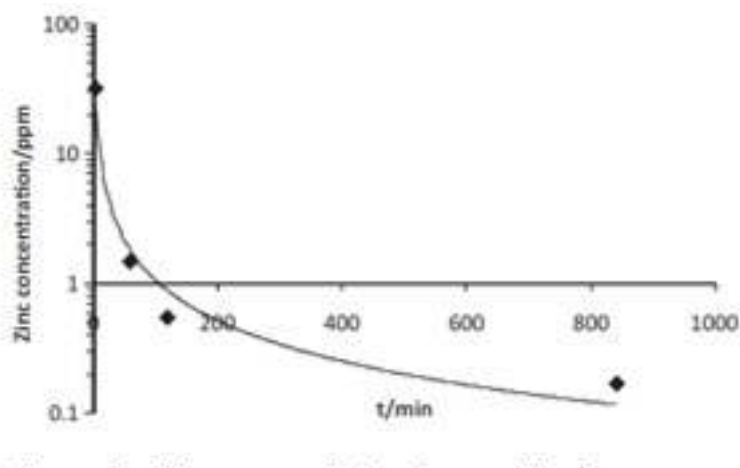
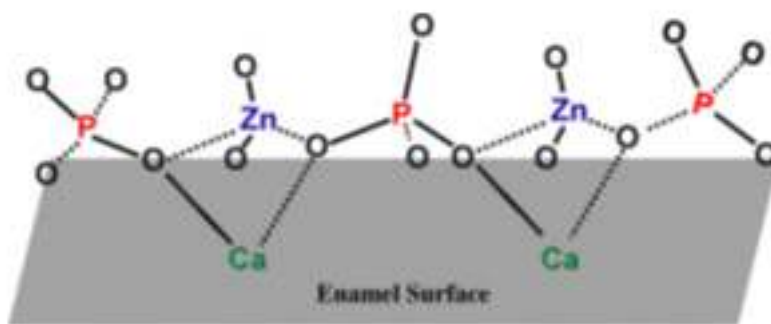


Table 1. Some reported concentrations of zinc in plaque and saliva, with standard deviations



in brackets (except * where ranges are quoted). Concentrations for 'dry' plaque have been reduced sevenfold to facilitate comparison.¹

Zinc is also found naturally in dental plaque, but comparison between reported values is not straightforward, as concentrations for 'wet' or 'dry' plaque are reported. However, assuming that drying increases the apparent concentration sevenfold,¹ values are broadly similar (Table 1). Zinc is taken up by the salivary pellicle^{1,6} and it seems likely that the oral mucosa is the most important oral reservoir, though insufficient data exist to support this proposition conclusively.^{1,7}

Zinc competes with calcium for bacterial binding-sites in biofilms. Half of the bound zinc would be released under cariogenic conditions, through, for example, protonation of carboxylate and phosphate groups in bacterial lipoteichoic acid.^{1,8}

Applying Zinc Through Toothpastes And Mouthrinses

Zinc is also present naturally in both plaque and saliva, with reported 'INTRODUCTION'

concentrations of 0.01-0.2 ppm in saliva and 5-30 ppm in plaque. Nevertheless, typical concentrations of zinc range between 1,400 and 6,000 ppm in toothpastes and between 200 and 300 ppm in mouthrinses.^{1,9}

Zinc is added to toothpastes and mouthrinses, as an antibacterial agent to help to control plaque, to reduce oral malodour and to reduce calculus formation through crystal-growth modification / inhibition.^{1,9} Following application, relatively large amounts of the applied zinc dose are retained in the mouth, with reported values typically between about 15-40%.¹ Good oral substantivity was confirmed by Gilbert and Ingram, who reported that when zinc was applied from a toothpaste, of the remaining 30% retained in the mouth, only a further 5.7% was removed by rinsing three times.^{1,6,10}

Zinc is cleared from saliva bi-modally, with relatively high post-application concentrations falling rapidly over 30-60 min, after which low concentrations, significantly elevated when compared to baseline, may persist for hours (Figure 1).^{1,6,11}

This tendency reflects rapid clearance of loosely-bound zinc followed by slower clearance of more firmly-bound zinc, as is the case for fluoride. A similar tendency is seen in plaque, but elevated concentrations can persist for at least 12 hours after application. Repeated application of zinc has shown that a build-up effect occurs in plaque, as for fluoride.^{1,11,12}

Zinc Ability to Reduce Demineralization

Enamel is a defective form of hydroxyapatite, and hydroxyapatite has often been used as an enamel analogue during mechanistic demineralization and remineralization studies. In simple terms, zinc can interact with hydroxyapatite by adsorption onto crystal surfaces and/or incorporation into the crystal lattice. Adsorption on a high area of energy is one of the possibilities.¹

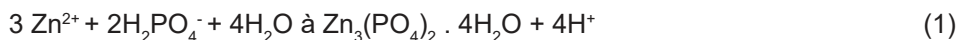
Enamel demineralization rates were increasingly reduced with successive increases in $[Zn^{2+}]$ in the acid solutions. The rapid and substantial ($\pm 60\%$) reduction in PRML enamel between 0.1 and 36 ppm $[Zn^{2+}]$ could be explained by the almost instantaneous occupancy of the abundant PO_4^{3-} binding sites and/or 'active' dissolution sites by zinc ions. As these sites become occupied, the rate of demineralization is effectively reduced. This mechanism shows characteristic features of a saturation-binding exponential curve, and indicates a surface phenomenon between zinc and enamel. The ability of zinc to substantially reduce enamel demineralization at these sorts of concentrations (0.1-36 ppm) potentially could have significant clinical implications relevant to those levels typically present in saliva and plaque fluid.^{9,13}

A bigger difference between $PRML_{\text{enamel}}$ values was measured at lower concentrations of Zn^{2+} than at higher concentrations, with up to 60% reduction measured at 36 ppm and 90% at 3565 ppm. It is speculated that the accumulation / adsorption of zinc on the enamel surface with increasing $[Zn^{2+}]$ would best explain this finding. The apparent change in gradients in the log-linear curve indicates that the mechanistic behaviour of zinc is concentration dependent, and that more than one mechanism is probably occurring between increasing

[Zn²⁺] and the tooth enamel surface under acid conditions. Mohammed et al. (2014)¹¹ previously suggested that zinc acts at PO₄³⁻ sites in its mechanism in reducing enamel mineral loss, and forms an α-hopeite-like phase once surface adsorption is completed.^{9,11,13}

The structure of α-hopeite consists of ZnO₂(H₂O)₄ octahedra, ZnO₄ tetrahedra, and PO₄ tetrahedra, none of which are regular; these polyhedra have corners and edges. Previous studies have reported the growth of crystals of α-hopeite on the outermost surfaces of zinc-containing dental cements, which is in direct contact to enamel and dentine.¹¹

Many studies have demonstrated that hydroxyapatite can bind to a variety of divalent metal cations and has a high capacity for the removal of Zn²⁺ and other metal cations in aqueous solutions. One could also perceive it as metal cations bind to surface sites on hydroxyapatite. Whichever way round it may be, the uptake of zinc from aqueous solution to coexist on the apatite surface may occur non-exclusively by three main processes: (1) surface adsorption or complexation, which is limited to the accumulation of sorbate on the external surface of the apatite; (2) absorption, ion exchange or diffusion into the solid; and (3) dissolution of hydroxyapatite and precipitation of metal phosphates or coprecipitation (substitution of Ca in hydroxyapatite by metals during recrystallization). The interaction of zinc with hydroxyapatite/enamel is very likely to occur by more than one mechanism, and would most certainly vary depending on the pH conditions of reaction and saturation levels with respect to hydroxyapatite of the system used.^{11,14,15}



The low pH condition releases dissolved calcium and phosphate ions into the aqueous solution, however in the presence of zinc ions, precipitation of a α-hopeite-like phase is promoted on enamel surfaces, which in turn suppresses the release of further phosphate ions from the apatite structure (Equation (1)). This dissolution or reprecipitation mechanism would also explain the reduction in free [PO₄³⁻] measured in solution with increasing zinc ions. Nevertheless, it does appear that with increasing [Zn²⁺] in the acid solutions, the driving force for the formation of a zinc phosphate species is much greater than the dissolution of apatite, and reduction in demineralization is observed as a function of [Zn²⁺]. The results indicate that the formation of a hopeite-like phase is very dependent on pH and a high zinc concentration.¹¹

The adsorption of zinc and formation of a complex at the apatite surfaces is also a possibility in zinc's mechanistic interaction with enamel. Figure 2 is a schematic model illustrating the possible coordination geometry of Zn²⁺ at the exposed PO₄³⁻ sites on enamel surfaces, in which it is more energetically favourable for zinc to adopt a tetrahedral configuration. The formation of these zinc adsorption complexes would be dependent on the zinc concentration and the surface area for reaction for instance the availability of PO₄³⁻ binding sites on the apatite surfaces. As the PO₄³⁻ binding sites become saturated with zinc ions, there is a significant reduction in tooth mineral loss. In principle, the phosphate ion is probably the most important component of hydroxyapatite both inside and outside

the lattice. Its state of protonation significantly affects the stability and/or dissolution of the crystal. With a decrease in pH, some of the PO_4^{3-} ions, most likely those situated at the accessible surfaces of the crystals, becomes protonated to form H_2PO_4^- , thus lowering the solubility of the mineral.¹¹

Fluoride-uptake (from SMFP) to enamel lesions was reduced by 60% in the presence of zinc citrate. It was suggested that zinc may have reacted with phosphates in the enamel lesions and that subsequent precipitation blocked pores at the surface of the lesion, or that zinc-MFP complexes may have inhibited uptake. Subsequently, however, fluoride-uptake to enamel lesions from a zinc / SMFP toothpaste was shown to be substantially greater than from its control, although no difference was seen when a sound enamel substrate was used, and zinc citrate in a sodium fluoride toothpaste had no effect on fluoride-uptake to lesions.^{1,7}

It has been predicted that zinc replaces calcium in the hydroxyapatite lattice, preferentially in the Ca(II) position, and that for fluorapatite, the 'columnar' Ca (I) position would be preferred, although recently it has been suggested that simple ionic exchange mechanisms might be too simplistic.¹⁶ It adopts tetrahedral coordination as might be expected. Some 'relaxation' of the surrounding oxygens is reported, made possible by the smaller ionic radius of zinc, when compared to calcium.¹

Covalent zinc-oxygen bonds are predicted, whereas bonds in hydroxyapatite are ionic in nature. When zinc is incorporated into both carbonated and non-carbonated hydroxyapatite then its solubility is generally reduced. Reduced acid reactivity in zinc-substituted carbonated apatites, a closer analogue to human enamel than non-carbonated hydroxyapatite, may be linked to the reduction of paracrystalline disorder, the production of larger crystals during precipitation and the formation of crystals with fewer structural defects than in non zinc-substituted carbonated apatites.^{1,17,18}

An inverse relationship between enamel fluoride and enamel carbonate contents has long been suggested. However, a combination of zinc and fluoride was even more effective at reducing carbonate-induced crystal structural disorder in the hydroxyapatite lattice, when compared to fluoride alone, or to other combinations of fluoride and metal ions.¹⁹ However, given concentrations found in the mouth, it is not clear if sufficient zinc would be incorporated to affect enamel solubility markedly. Carious enamel lesions remineralised under simulated plaque-fluid conditions, in the presence of zinc and fluoride, contained relatively little zinc, and in the region of maximum remineralization, only INTRODUCTION concentrations, suggesting displacement of zinc by calcium. Other authors have suggested that zinc was incorporated into enamel during remineralization in situ, but again, the increase in zinc concentration was modest.^{1,16}

A reduction in enamel demineralisation with the use of a zinc-containing fluoride toothpaste was reported during an in situ study. Lesions in the zinc / fluoride group did not demineralise significantly when compared to baseline, whereas those in the fluoride control group did.²¹ However, it was concluded that this could not be attributed wholly to direct interaction with the enamel substrate, and may have been the result of antibacterial effects to some extent.¹ Churchley et al. report a similar antidemineralization effect in this issue.²²

DISCUSSION

Zinc is added to toothpastes and mouth rinses, as an antibacterial agent to help to control plaque, to reduce oral malodour, and to inhibit calculus formation. It has good oral substantivity, and the high concentrations can retain for many hours in plaque and saliva after the use of mouthwash and toothpaste.^{1,9,11}

Alternatively, the precipitation of hopeite, observed during zinc-adsorption studies, may be implicated, and data from some studies suggest that above 1 ppm, hopeite dominates the surface-properties of hydroxyapatite under certain conditions. Zinc uptake was reported to have continued beyond the point of complete monolayer coverage with increasing solution concentration, and the proposed explanation was the precipitation of hopeite once surface adsorption was complete, again a concentration-dependent effect.¹

Other reports tend to support an adsorption mechanism. Zinc was readily displaced from hydroxyapatite by calcium in an equimolar way. While hydroxyapatite specimens were exposed to a demineralising solution, whose zinc concentration was increased and then decreased. As zinc concentration increased, dissolution decreased but when the zinc concentrations was subsequently reduced, dissolution rates quickly increased again. This lack of a zinc 'memory' in the hydroxyapatite specimens used also suggests an adsorption mechanism. However, other factors, such as changes in pH during reactions, and use or otherwise of pre-equilibrated systems, can modify zinc/hydroxyapatite interactions. The two mechanisms are apparently not mutually exclusive and it is likely that both are implicated in reduced solubility of hydroxyapatites and apatites, in the presence of zinc, to a greater or lesser extent.¹

Zinc had no effect on the anti-caries effect of fluoride during a rat-caries study²³ and in a three-year caries clinical trial (CCT), the addition of zinc to fluoride toothpastes, containing 1000, 1500 and 2500 ppm fluoride (as sodium monofluorophosphate (SMFP)), had no effect on caries, either positive or detrimental, at any of the fluoride concentrations even though use of the zinc-containing toothpastes reduced calculus during the same trial.^{24,25} During a subsequent CCT, no significant difference in anti-caries effectiveness was observed, between two zinc-containing fluoride toothpastes and a non-zinc fluoride control formulation.²⁶

Demineralization may be reduced at Zn^{2+} concentrations found in plaque fluid following the use of Zn^{2+} -containing toothpastes (231 μM).⁷ It has also been shown that this concentration can increase the remineralization of subsurface lesions, by retarding fluoride-induced lesion arrest and increasing lesion consolidation.¹ However, Lippert²⁷ reported that the effect is dependent on relatively high fluoride concentrations, and high Zn^{2+} concentrations can reduce remineralization.

While zinc has anti-microbial properties, no consistent link has yet been established between anti-microbial efficacy and caries reductions, except in the rather extreme case of, for example, use of chlorhexidine, or in the complete absence of the microflora. Given zinc's potential to affect both demineralization and remineralization, this apparent lack of

a consistent effect of zinc on caries would seem to be contradictory.¹ Whereas data from caries clinical trials suggest that Zn^{2+} has no net effect on caries reductions resulting from the use of fluoride toothpastes,^{25,26} it seems unlikely that any effect on demineralization exactly outweighs any possible effect on remineralization, and that caries status risk should also be considered.

Studies into the effect of zinc concentrations in human enamel and caries incidence have failed to show a consistent, significant correlation. One factor which has been proposed as a confounding influence is that zinc is a common component of dental restorations, leading to contamination in subjects who have been caries-prone.^{1,9}

Zinc, along with other metal cations, has long been associated with reductions in enamel solubility and can also modify crystal-growth of the calcium phosphates implicated in remineralization. Therefore, it has the potential to influence the dynamic demineralization and remineralization balance in the oral cavity.^{1,4,21} However, data from pH-cycling studies where zinc and fluoride were delivered from a toothpaste and both demineralization and remineralization were alternated do not suggest an overall zinc effect.²¹ Increased remineralization after application of dipping solutions containing zinc has been reported,²⁸ but the presence of strontium, also capable of affecting enamel demineralization and remineralization²⁹ was a confounding factor and the role of zinc cannot easily be concluded.

CONCLUSION

The mechanism of zinc in the oral cavity in reducing enamel demineralization is by reducing the release of calcium [Ca^{2+}] and phosphate [PO_4^{3-}] ions especially the enamel surface in the PO_4^{3-} area on hydroxyapatite lattice to allow the formation of an α -hopeite-like phase.

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Relation Of Proper Breastfeeding Latch On To The Dentofacial Structure Development

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ABSTRACT

Breastfeeding has been cited as important factors responsible for correct development of dentofacial structures. Breastfeeding contributes to the orofacial muscle development, prevent oral habits and malocclusion. A successful breastfeeding depends on proper latch of infant lip and tongue while breastfeeding. This literature review will explain about proper breastfeeding latch on and identified latch on difficulties caused by anatomic variations and developmental disturbance. The mechanism of breastfeeding involve orofacial muscle system to coordinate procedures for sucking, breathing, and swallowing. This mechanism will stimulate proper orofacial muscle development. Proper latch on will help infant to removes milk from the breast. Most problems with latching on during breastfeeding can be solved with adjustment of latch on position except for problems caused by anatomic variation or developmental problems of infant's mouth area. A proper breastfeeding latch on will ensure successful breastfeeding and also stimulate orofacial muscle development. Dentist can identify and treat infant oral anatomical disturbance to achieve proper latch on.

Keywords: breastfeeding latch on, dentofacial structure development, oral habits, malocclusion

INTRODUCTION

Dentofacial growth and development are affected by functional stimuli such as sucking, chewing, swallowing and breathing. Nutritive sucking, which includes breastfeeding and bottle-feeding and non-nutritive sucking (NNS), which includes pacifier and digit sucking, have been associated with growth and development of the maxillomandibular complex. Breastfeeding has been cited as one of the environmental factors responsible for correct development of dentofacial structures.¹⁻³

Mastication continues the process of stimulation of the orofacial muscles that began with sucking at the breast. When performed correctly, it also plays a role in the development of the maxilla and mandible and contributed together with genetic and environmental factors, to the stability of dental occlusion and functional and muscle balance. Where as sucking at the breast has a favorable effect on masticatory function, other forms of sucking, such as those involved in bottlefeeding and pacifier use, produce different functional stimuli, which may jeopardize oral motor development and the position and strength of stomatognathic structures, with a detrimental impact on oral functions, including mastication. ⁴⁻⁶

The longer the children are breast-fed, the less chance they have of non nutritive sucking habits (NNSH) such as pacifier sucking or thumb sucking, and consequently, and the lower the probability of developing malocclusion in childhood. Montaldo et al ³ reported that children with bottle or complementary feeding showed a higher risk of acquiring NNSH after the first year of life which is associated with a greater risk of crossbite, open bite, class II molar relationship. Kobayashi ⁷ reported association between exclusive breastfeeding duration and the prevalence of posterior crossbite in the deciduous dentition. Anterior openbite and posterior crossbite are mostly analyzed dentoalveolar malocclusions considering as the impact of breastfeeding and bottlefeeding duration. ^{2,3,5,6,8,9}

Bottlefeeding has been shown to have direct and indirect harmful effects on some aspects of the child's health. Bottle feeding was a statistically significant risk factor for respiratory patterns because more than half of the children with a predominantly mouth breathing pattern used a bottle. Mouth breathing children are more predisposed to the development of facial changes, poor dental positioning, improper posture, and speech disorders. ¹⁰

Breastfeeding is associated with health benefits for infants and mothers. The WHO recommends exclusive breastfeeding until six months of age and complementary breastfeeding up to the age of 2 years or older. However problems with the baby failing to latch, failing to latch properly, and problems with mother's experience of breastfeeding pain are prevalent in the early postpartum period, and these problems contribute to supplementation of breastfed infant and breastfeeding discontinuation. ^{2,10,11} This literature review will explain about relation of proper breastfeeding latch on to the dentofacial structure development. The literature also review about latch on difficulties caused by oral anatomic variations and developmental disturbance.

LITERATURE REVIEW

A successful breastfeeding depends on proper position and latch on of infant lip and tongue while breastfeeding. Proper breastfeeding position and latch on will help infant to removes milk from the breast. ¹¹ There are a variety of common body position for the mother that will encouraged to find postures that are both comfortable for mother and allow the infant to achieve pain free suckling with maximal transfer. We can see the variety of common body position in Table 1. ¹¹⁻¹³

Table 1. Common body position for breastfeeding.¹¹

Position	Description
Cradle or Madonna position	The infant lies on its side, facing the mother, with the side of the its head and body resting on the mother's forearm of the arm next to the breast to be used
Cross cradle posture	The infant lies on its side, facing the mother, with the side of the its head and body resting on the mother's forearm on the opposite side of the breast to be used. This posture considered especially useful for the mother of a newborn or preterm infant.
Football or clutch	A sitting position in which the infant lies on its back, curled between the side of the mother's chest and her arm. The infant's upper body is supported by the mother's forearm. The mother's hand supports the infant's neck and shoulders. The infant's hips are fleed up along the chair back or other surface that the mother is leaning against.
Semi reclining	The mother leans back and the baby lies against her body, chest to chest, usually prone.
Side-lying	The mother lies on her side. The infant is placed on its side, lying chest to chest with mother. The mothers's arm closest to the mattress supports the infant's back.
Australian	The mother is 'down under', lying on her back with the baby supported on her chest. This posture allows the infant to be in maximal control of the feeding and is especially valuable when the milk flow is faster than the infant can handle.

After getting the proper position, the proper latch on is needed for infant to be able to get milk optimally without leaving any pain on mother's breast. The proper latch on of infant's mouth to the mother's breast is when infant that is ready to breastfed, their mouth will be wide open. The infant should be moved to breast during the gape so that the mouth is still wide open and the tongue extends over the lower lip. The chin should reach the breast first. This assures that the lips are positioned as far back as possible on to the breast, not turned in or overly flanged back. Asses for a gape over 140°. In humans only the lower jaw can move to accomodate this angle and so the infant's head must tilt back sufficient to accomodate the maximal dropping of the jaw. The resulting positioning of the baby's mouth on the breast is called the asymmetric latch, which is characterized by more of the areola visible at the baby's top lip compared to the bottom. Adequate milk removal is essential to sustain milk synthesis for a successful lactation.^{11,14,15}

To be successful in breastfeeding, if a problem occurs, an assesment should be done to find out what the main problems are. The steps of a clinical breastfeeding assesment are as follows ¹² :

Determine whether the breastfeeding problem is the result of

Basic positioning or latch on difficulties

An underlying anatomical problem in the infant (or a problematic interaction with the mother's anatomy)

An underlying neurological problem in the infant

Analyze the steps needed to alleviate the problem

Collaborate with parents on individualized plan for them to follow at home to meet their breastfeeding goals with both short term and long term objectives.

Provide education, anticipatory guidance, demonstration, and return demonstration of the techniques to be followed.

Arrange for follow-up

The development of human dentofacial structure divided into prenatal and postnatal development. On prenatal development, there are three germ layers known as ectoderm layer, mesoderm layer, and endoderm layer. The three primary germ layers serve as a basis for differentiating the tissues and organs of dentofacial structure that are largely derived from each of the layers. Rooting and suckling reflex developed on prenatal development. Muscular response to a stimulus first develops in the perioral region, as a result of tactile cutaneous stimuli applied to the lips, indicating that the trigeminal nerve is the first cranial nerve to become active; the earliest movements in response to such exteroceptive stimuli have been elicited at 7½ weeks of menstrual age. At birth, the suckling muscles of the lips (orbicularis oris) and cheeks (buccinators) are relatively better developed than the muscles of mastication^{8,16-19}

Dentofacial structure comprising the following: the face (orthognathofacial complex) and the masticatory apparatus which composed of the jaw bones, their joints and musculature, and the teeth. Each of the dentofacial entities possesses different characteristics of growth, development, maturation, and function, yet each unit is so integrated with the others that coordination of the growth of all is required for normal development. The face may be divided approximately into thirds : the upper, middle, and lower approximately by the horizontal planes passing through the pupils of the eyes and the rima oris. The upper third of the face is predominantly of neurocranial composition, with the frontal bone of the calvaria primarily responsible for the forehead. The middle third is the most complex skeletally, composed partly of the cranial base and incorporating both the nasal extension of the upper third and part of the masticatory apparatus including the maxilla and its dentition. The lower third of the face completes the masticatory apparatus, being composed skeletally of the mandible and its dentition.¹⁶

On post natal development, the upper third of the face initially grows the most rapidly, in keeping with its neurocranial association and the precocious development of the frontal lobes of the brain. It is also the first to achieve its ultimate growth potential, ceasing to grow significantly after 12 years of age. In contrast, the middle and lower thirds grow more slowly over a prolonged period, not ceasing growth until late adolescence. Completion of the masticatory apparatus by eruption of the third molars (at 18 to 25 years of age) marks the cessation of growth of the lower two-thirds of the face (Fig. 9-2).¹⁶

Growth of the maxilla and mandible depends on the influence of several functional matrices that act upon different areas of the bone, thus theoretically allowing its subdivision into skeletal units. In maxilla, the basal body develops beneath the infraorbital nerve, later surrounding it to form the infraorbital canal. The orbital unit, the nasal, and the teeth provide the functional matrix. The complex action of these functional forces on the facial bones results in different effects on different sutures (Figure 3). The growth pattern of mandible subunits is also influenced by a functional matrix that acts upon the bone. The teeth, the action of the temporalis muscle, the masseter and medial pterygoid muscles, and the lateral pterygoid provide the functional matrix. The functioning of the related tongue and perioral muscles and the expansion of the oral and pharyngeal cavities provide stimuli for mandibular growth to reach its full potential. The mandible undergoes the most growth postnatally and evidences the greatest variation in morphology. The growth pattern of the dental alveolar arch related to the sequence of tooth eruption. Tongue movement and lips pressure will become guidance for tooth eruption to achieve normal occlusion.¹⁶

Breastfeeding promotes harmonious development of dentofacial structure and stimulates intensive major stimuli for growth of the temporomandibular joint and, consequently, encourage harmonious growth and development of the facial region.^{4,5}

Oral structures that related to breastfeeding process are: lips, tongue, cheek, jaws, hard and soft palate. Lips help locate the nipple and bring it into the mouth. Lips also stabilize the position of the nipple-areolar complex within mouth and become anterior seal. During breastfeeding the tongue actively brings the nipple into the mouth, shapes the nipple and areola into a teat and stabilizes the teat's position. The muscles involved in breastfeeding are the same muscles that will later (from the age of 6 months onward) carry out mastication. Tongue helps seal the oral cavity anteriorly and posteriorly. Tongue will change configuration and increasing the volume of the oral cavity to create negative pressure or suction. Cheeks provide stability and maintain the shape of the mouth. The jaw provides a base for movement of the tongue, lips, and cheeks. Downward movement during sucking expands the size of the sealed oral cavity to create suction. Hard palate helps compress nipple and maintain nipple position and soft palate assists in creating posterior seal and elevates during swallow. Soft palate assists in creating posterior seal and elevates during swallow.^{4,5,21,22}

The infant human mouth is particularly well designed for sucking but some infants with complicating issues may need special assistance or latch on adjustments on breastfeeding. Most problems with latch on during breastfeeding can be solved with adjustment of latch on position except for problems caused by anatomic variation or developmental problems of infant's mouth area. A visual examination of the infants's oral structures will provide useful information regarding the structures at rest and in isolated movement.^{12,13}

Latch on difficulties can be the result of anatomical problems in the infant or problematic interaction with the mother's anatomy. There are numbers of oral facial anomalies in infants that interrupt the proper latch of the infant such as: ankyloglossia, lip tie, cleft lip and/ or cleft palate, asymmetrical mandibles or tilted jaws with or without torticollis, macroglossia,

and micrognathia. Breastfeeding difficulties will increase the risk of early weaning. Early weaning lead to oral habits and contribute to faulty dentofacial growth and development.

11–13,22,23

DISCUSSION

Latch on difficulties are problems often found by mothers in the beginning phase of breastfeeding. It is also become main factors of breastfeeding failure. Latch on failure can cause: breast pain during breastfeeding, inhibition of oxytocin hormone activity, milk not optimally removed, milk production decreases due to inhibition of prolaktin hormone activity, and increase the risk of early weaning and supplementation.^{12,13}

The correct functions of the dentofacial complex (breathing, swallowing, and chewing) have a major influence on the growth and correct development of face, jaws, and dentition. Breathing, swallowing, and chewing process involved coordinated activities from muscles and oral structures in the dentofacial complex. Breastfeeding process involved breathing, swallowing, and chewing cordination. Activity of the muscles and oral structures during the process will become stimuli for the development of dentofacial complex related to the matrix functional theory of Moss.^{8,12,22}

Children who are exclusively breastfed (EBF) during the first months of life exhibit a physiological suction pattern with more sucking movements, and are better coordinated when compared to those who are artificially bottle fed; this phenomenon occurs because the orofacial muscles are exercised less in bottle fed infants, making those muscles more flaccid and hypotonic. The movements of milking executed by infants when breastfeeding favor a balance in the perioral muscle forces, and are key factors for the proper growth of the bones and the orofacial muscles, promoting the normal development of the stomatognathic system. When early weaning occurs, the child is unable to perform physiological movements and synchronized suction, and generally presents a tendency toward developing harmful oral habits, such as bottlefeeding or non nutritive sucking habits, which can interfere in the process of nasal breathing and increase the risk of mouth breathing. Chen (2015) studied the multiple interactions between feeding practice, non nutritive sucking habits and occlusal characteristics. He reported that even in the absence of non nutritive sucking habits, failure to breastfeed for a sufficient length of time may negatively affect maxillary arch growth and may lead to malocclusion in the form of a posterior crossbite.^{1,10}

The swallowing pattern matures from infantile to mature or somatic type in most children from the ages of 2 to 4 years. If this does not happen because of obstacles in the mouth that prevent the normal position of the tongue (dummy, finger), the tongue must take a lower position in the anterior part of the mouth. Several factors can account for persistence of an atypical swallowing pattern. Graber et al⁸ reported that finger or dummy sucking, bottle feeding, mouth breathing, and tongue sucking can all contribute to cause the swallowing pattern to mature more slowly. Furthermore, non nutritive sucking habits are reported to be the reason for the retained visceral or atypical swallowing pattern, described

by forward tongue posture and tongue thrusting during swallowing, contraction of the perioral muscles, excessive buccinator hyperactivity, and swallowing without tooth contact. The most alarming finding of Graber's study was that 60% of the children at the age of 3 years were still bottlefed; this equals the percentage of children with an atypical swallowing pattern.^{8,16}

Until the primary first molars erupt, the infant swallows with jaws separated and tongue thrust forward, predominantly using the facial muscles (orbicularis oris and buccinators) innervated by the facial nerve. This pattern, known as the infantile swallow, is an unconditioned congenital reflex related to sucking reflex. Contrary to the action in adults, the infant's lips suck during swallowing and make stronger movements than the tongue. After the eruption of the posterior primary teeth at 18 months of age onward, the child tends to swallow with the teeth brought together by masticatory muscle action, without a tongue thrust. This mature swallow is an acquired conditioned reflex and is intermingled with the infantile swallow during a transition period. As the child grows older, variation in the pattern decreases as the adult swallowing pattern is increasingly adopted. The movements of the mature swallow are primarily of those muscles innervated by the trigeminal nerve (ie, the muscles of mastication and the mylohyoid).

Oral habits related to persistence of infantile swallow. Tongue thrust in persistence infantile swallow during childhood dentition produce abnormal myofunctional pressure such as hypo or hypertonicity in orbicularis oris-buccinator complex. This leads to dental malocclusion. Inadequate tonicity of the buccinator and the orbicular of the mouth muscles as well as incorrect tongue position during sucking disturbs the dynamic balance among tongue, cheeks and lips leading to altered development of both jaws.^{5,16}

The first step of clinical breastfeeding assessment is to determine whether the breastfeeding problem is the result of basic positioning or latch on difficulties. Proper treatment should be done when an underlying oral anatomical problem in the infant occur. Kotlow and Hazelbaker reported that latch on improvement has been shown after frenotomy as a resolve of a lip tie and ankyloglossia problems. Besides surgery treat, cleft lip and cleft palate need specific breastfeeding technique and feeding therapy in order to solve nutrition problems. The prognosis for successful feeding of an infant with a cleft palate depends on the size and position of the defect (soft palate, hard palate) as well as the associated lesions. Application of an orthopedic appliance to the neonatal maxilla to close the gap, thus aiding nursing, stimulating orofacial development, developing the palatal shelves, preventing tongue distortions, preventing nasal septum irritation, and decreasing the number of ear infections. This will make it easier for the plastic surgeon and help the mother psychologically as well. Other oral anomalies need different approach.^{13,22,24,25,23}

Oral structure conditions related latch on difficulties needs to be treated so that a successful breastfeeding process and normal dentofacial development can be achieved. Latch on and position adjustment, and also certain breastfeeding techniques counseling by lactation counselor are several approaches to solve latch on difficulties. Surgery and specific dental procedure for oral anatomical anomalies require multidisciplinary approach involving

dentist, oral surgeon, pedodontist, prostodontist, ortodontist, physioterapist, feeding therapist.

CONCLUSIONS

A proper breastfeeding latch on will ensure successful breastfeeding and also stimulate dentofacial structure development. Dentist can identify and treat infant oral anatomical disturbance to achieve proper latch on breastfeeding.

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Delayed Tooth Eruption In Children : An Update Review For Dentist (Literature Review)

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ABSTRACT

Tooth eruption is a continuous physiologic complex process, that can be influenced by number of factors. Timing and sequence of tooth eruption are important for clinical and academic reason. Specially in dental treatment planning and forensic dentistry. Delayed tooth eruption (DTE) is a pathologic condition which is often encountered a dentist. This symptom could be worry by the parents. They think that the children suffering from dangerous diseases. Significant deviation from the established pattern should alert the clinician to make investigation to evaluate and manage the DTE. To review specially for dentist that must have comprehensive understanding about DTE. A dentist should be responsive and sensitive about the concerns of parents, by providing a comprehensive explanation of these condition. It is about aetiology, clinical implications, investigations, methodology for diagnosis and treatment, etc . Delayed tooth eruption (DTE) is the failure of the teeth to erupt into the oral cavity at the usual developmental time. It deviates significantly from norms established for different races, ethnicities, and sexes. This condition often associated with many factors (local and systemic). Delayed tooth eruption (DTE) is the most common pathologic condition in eruption process. A dentist was highly requested to understand about DTE. The dentist should take a comprehensive interview, to find the history of systemic condition, do a proper clinical examination, establishing diagnosis and performing appropriate treatment plan.

Keywords : tooth eruption, delayed tooth eruption, dentist

INTRODUCTION

Tooth eruption is defined as the movement of the tooth from the deeper portion of the jaws from its site of development in alveolar bone to the occlusal plane in the oral cavity until it achieves occlusal contact with adjacent and opposing teeth.^{1,2} Estimation of eruption schedule is a very valuable information in diagnosis and treatment planning during developmental age. It is include diagnosis of developmental oral disturbances in early childhood period. Dental age is the key factor for caries prevention programs, orthodontic, clinical, academic, research, forensic sciences and anthropology.³⁻⁵

Deciduous tooth eruption and their exfoliation followed by eruption of permanent dentition is an orderly sequential and assumed as important milestone and specific event during child's growth and development. Parents mostly anxious about the variation of timing of tooth eruption. They think that the children suffering from dangerous systemic diseases.⁶⁻⁸

Eruption is a physiologic, complex and tightly regulated process that strongly influences normal development of the craniofacial complex. The tooth begins its movement when the crown formation is completed. Tooth erupts into the oral cavity approximately $\frac{3}{4}$ of root is formed and reach the occlusion before the complete formation.^{1,2,9}

Tooth eruption occurs over a broad chronological range and its influenced by factor likes genetics, gender, nutrition, pre-term birth, socioeconomic, craniofacial morphology, hormonal and systemic disease. Any other factors which are also suggested could affect tooth eruption are climate, race, diet and geographical factors.^{2,10,11}

Delayed tooth eruption (DTE) is a pathologic condition which is the most common encountered deviation from normal eruption time. It can directly affect the accurate diagnosis overall treatment planning and have significant impact on patient's proper oral health care. DTE can be as an indicator of a pathological condition, which is occur earlier, such as nutritional status, low birth weight, systemic disease and local factors. A significant deviation from the established pattern should alert the clinician to make investigation to evaluate and manage the DTE. Many effort are made to increase the knowledge about tooth eruption, not only about chronology and sequence, but also about causes that may interfere the eruption process.^{9,12}

Dentist should have enough knowledge about DTE. The dentist should take a comprehensive interview, to find the history of symptom and systemic condition, do a proper clinical examination, cooperation with the expert, establishing diagnosis and performing appropriate treatment plan.

LITERATURE REVIEW

Definition and terminology

Significant deviations from established norms of eruption time are often founded in clinical practice. Premature eruption is noted, but DTE is the most common encountered deviation from normal pattern. Eruption is the developmental process for moving a tooth from its crypt position through the alveolar into its position in the oral cavity with the antagonist. Many terms are used in literature to describe disorders of tooth eruption. It seems to be considerable confusion concerning their usage. The terms such as delayed eruption, primary retention, impacted teeth, embedded teeth, pseudoanodontia, late eruption, retarded eruption, arrested eruption, primary failure of eruption, impaired eruption and submerged.^{7,9}

The literature mentions other terminology : (1) chronologically normal eruption is defined as the condition in which dental eruption take place at time around the medium eruption age. The interval represented by : $\pm 2 \times \text{SD}$. (2) chronologically delayed eruption

(CDE) is the situation in which dental eruption takes place at time moments beyond the interval + 2 X SD. (3) Biologically normal eruption is defined as situation in which at the moment of tooth's emergence it's root is $\pm 2/3$ formed. (4) Biologically retarded eruption is condition that associated with delay of root's maturation ($<2/3$). Coordination between dental development and eruption : normal. (5) Biologically delayed eruption, is situation in which CDE is associated with normal or greater root maturity ($=2/3$). Coordination between dental development and eruption : abnormal. (6) Localized DTE affect 1 or a few teeth, and usually associated with local causes. (7) Generally DTE affects all teeth, usually associated with general or generic disease.¹³⁻¹⁵.

Pathogenesis

The situations can explain a delayed eruption : (1) late dental maturation/late eruption; in such case, a good coordination between normal dental development and eruption but they occur late, (2) late eruption in which case dental maturation or formation is normal. Teeth form normally and can even have completed their formation, but they are blocked, as a result of mechanical obstruction, be it idiopathic or pathological in origin or because of disruption to the eruptive mechanism itself. The teeth cannot come out and thus become impacted or embedded, which is the ultimate stage of the evolution of late eruption. Eruption failure may affect one or a number of teeth, primary or permanent dentition, and can be partial or complete.^{16,17}

The knowledge of the biology of tooth eruption are increased. The interaction among osteoblast, osteoclast and dental follicle is a complex interplay of regulatory genes that encode transcription factors, onco-genes, and soluble factors. The treatment both simplex and complex dental complications that arise from abnormal tooth eruption, as seen in numerous genetic and acquired disorders, knowledge about basic molecular mechanisms involved is essential.^{18,19}

Determinant Factors

Teeth eruption is not always correlated with somatic development. Children with growth disturbances may exhibit delayed eruption or the delay may be due to other causes such as gingival overgrowth due to medication such as phenytoin.²⁰ Various factors affect tooth eruption divided into 3 categories : local factors, systemic factors and environment factor (Table 1).

Table 1. Causative factors delayed tooth eruption.^{1-3,21,22}

Local Factor	Systemic factor	Environment factor
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Physical obstruction Supernumerary teeth Tumours Mucosal barriers Gingival hyperplasia	Genetic Genetic factor estimated contribute about 78% in tooth eruption process. Down's syndrome Cleidocranial dysostosis Apert syndrome Gardner syndrome Carpenter syndrome Garlin syndrome Osteopetrosis Sclerosteosis Pyknodysostosis Hereditary osteodystrophy Osteogenesis type 1 Progeria	Nutritional status
Injuries of deciduous teeth Premature loss of primary teeth Dilacerations Ankyloses Delayed root resorption	Sex The teeth of girls erupt slightly earlier than boys. There was no sex difference up to the stage of calcification. The difference begins only from the crown completion stage.	Socio-economic condition Retarded eruption of anterior teeth and accelerated emergences of the posterior dentition is linked to low social economic status.
Carious primary teeth Apical periodontitis/cystic transformation of non vital primary teeth.	Preterm birth-Birth weight Low birth weight is associated with DTE. According to World Health organization is defined as birth occurring before 37 weeks of gestation or if the birth weight is below 2500 g.	Ethnic group Primary teeth erupt as well as variation eruption pattern between different ethnic group.
Impacted primary teeth	Hormone : Thyroid, pituitary (growth hormone), and parathyroid hormones are essential for normal teeth eruption.	
Arch length deficiency	Systemic disorders : Hypothyroidism Hypopituitarism Hypoparathyroidism Pseudohypoparathyroidism Hemifacial atrophy Cerebral palsy Drugs HIV Long-term chemotherapy Renal failure Idiopathic	
Abnormal tooth development : defect in size, shape, structure and color. Regional odontodysplasia Dilacerations Radiation damage Segmental odontomaxillary dysplasia	Racial group Individual primary teeth erupt as well as variation eruption pattern between different racial group.	
Oral cleft The malformation causes injury to the face. The cleft can affect the alveolar ridge.		

Clinical Implication

Deciduous teeth may be retained for a long time beyond their norm timing. Such teeth are usually have no permanent successor or it is impacted. The upper lateral incisor is the most common retained in primary dentition. Less frequently the mandibular second primary molars and rarely the lower central incisor. In permanent dentition, DTE is often seen in maxillary canines.^{9,23}

DTE in primary teeth, supernumerary teeth, severe crowding can cause impaction of the anterior teeth. If over retained primary tooth or supernumerary tooth is removed, permanent tooth will erupt. Primary failure of eruption is an unusual eruption problem that affects the posterior teeth. It present as posterior open bite. It is diagnosed when a tooth fails to erupt despite the presence of adequate space and the absence of overlying hard tissue that prevent eruption. Furthermore, all teeth distal to the affected tooth also fail to erupt. The cause of primary failure of eruption is unknown, but suggested to have genetic factor. Retention of the deciduous tooth can lead to deflection of the succedaneum tooth and restorative damage of the adjacent teeth.^{9,24,25}

Becker et al, state that abnormalities of the lateral incisor occur so frequently in case of delayed canine eruption. A developmental anomaly can exist in this part of the maxilla, which contains one of the embryonic fusion lines, and DTE of the canines in many cases could be a part of a hereditary syndrome.^{9,26}

Management

Delayed eruption in primary dentition requires no treatment other than determining that all teeth are present. Parents must be reassured that there is considerable variability in the teeth eruption (± 6 months for primary teeth; ± 1 year for permanent teeth).²⁰ DTE is a complex process. When the tooth do not erupt at the established norms, a careful investigation should be performed. According to many literatures, a wide variety of disorders are associated with DTE. Clinical examination including overall physical evaluation should be done systematically. Intra oral examination must be done properly. It is include inspection and palpation.^{7,9}

The inspection of soft tissue, and inspection left – right are important. It will be given the sign of significant dental eruption deviations are frequently unilateral. Inspection of infra occlusal, can be an information of ankyloses. Palpation of the alveolar ridges will shows the characteristic to erupting teeth; reveal prominences on alveolar ridge. Radiographic examination is useful to evaluate bone density, skeletal maturity in cooperation with paediatrician or endocrinologist. It will be an information about dental number anomalies, dental shape, dental size, position, structure, presence of tumours, cysts, and root development evaluation. Family information about medical history about the symptom must be investigated. The management of DTE which is associated with systemic disorders, needs cooperation with the experts.^{3,7,9}

The treatment of DTE is based on etiology. There are many techniques which is recommended for DTE, (1) surgical (extraction, obstacles removal, uncovering of affected

teeth), (2) orthodontics (traction, creation and space maintenance), (3) diagnosis and treatment of systemic disease.^{3,7,9}

DISCUSSION

Late eruptions are less frequent in temporary dentition compare with in permanent dentition. Eruption is considered to be late when it occurs more than 6 months beyond the average age limit of eruption for temporary teeth and more than 1 year for permanent teeth.²⁰

Tooth eruption's disturbances are most commonly attributed to mechanical interferences caused by supernumerary teeth, crowding, and soft tissue impaction as well as by odontogenic tumours and cyst. When the eruption process is disturbed, we are presented with a clinical situation that is challenging to diagnose and treat.¹⁸

Tooth eruption is a biological complex process, which is various factors could affect it. Literature assume that there is a correlation of the dental age with chronological age of a child. Several revolutionary changes are observed in human dentition, eruption may also be show some changes over period time. A change in timing of eruption of first deciduous teeth has been observed in present. According to Monika et al (2014) research, there is statistically significant differences between eruption age and pattern times in two generations who had more than a decade of age, differences with respect to ages and genders. In context of feeding patterns.^{22,27-29}

Variation in tooth eruption is found to be multi-factorial. Skeletal growth and tooth eruption have a strong association. Malnutrition in early childhood affects tooth eruption. It can cause delayed emergence of teeth. DTE leads to exposure of the teeth in the oral environment for a lesser period of time. This may lead to delay caries acquisition. Regarding to study by Syukra (2012), and Delgado et al (1973) mention that nutritional status influences the timing of tooth eruption. Mean while Robin et al (2013), in his research conclude that eruption time increases with decrease in BMI value, while deft + DMFT score increases with in BMI value.^{10,30-32}

Every milestone of child's development, is a valuable clinical information for clinician. Including eruption of first deciduous teeth. This chronological milestones are influenced by many factor. Any alterations in this process causes suspicion of underlying disease. This causes anxiety for parents and leads to futile investigations such as radiographs, as most parents came for such self advised investigations.^{22,33,34}

The delay in tooth eruption, although reported in the literature, is rarely considered during the physical examination, and is often dismissed as a complaint and rarely considered for the differential diagnosis of hypothyroidism. It is therefore recommended that health care professionals pay attention to this clinical sign, which should be monitored by a multidisciplinary team. In the context of the teenager need for peer approval, aesthetic considerations are of great importance.³⁵

Nowadays, there is 25 human syndromic conditions that involve disruptions in the

eruption process, approximately half have led to the identification of causative genetic mutation. But, while most eruption defect are genetic syndrome, they can also be non-familial (cause by sporadic mutation), as is thought to be the case in primary failure of eruption. Moreover, flaws in the eruption process not only have genetically distinct etiologies, but also result in several different eruption phenotypes. The eruption phenotype can be further characterized by whether the process is merely delayed or fails completely. Therefore delayed eruption more frequently than complete failure eruption.^{18,36,37}

When the eruption process is disturbed, it's a clinical situation that is challenging to diagnose and treat. Limited therapeutic interventions are available today offer very little promise of completely correcting the inevitable orthodontic and prosthodontic complications that result from a delay or failure of eruption. As research advances are made, it is now foreseeable that future treatment modalities could include therapeutics that re-create eruption events. Critical to the success of such treatment would be the diagnostic tools that can positively distinguish between the various types of tooth eruption defects and ultimately target the appropriate treatment regimen.^{18,38}

There are new and enabling technologies such as laser capture microdissection, DNA chips, proteomic arrays, and functional assays with reliable cell line. The knowledge will not only provide us with better understanding of tooth eruption, process, but will also lead to the development of effective therapeutic interventions for these otherwise clinically challenging eruption defects. The clinician can select the appropriate treatment for the patient based on the underlying cause of the eruption problem.^{18,39}

CONCLUSION

Tooth eruption is biological complex process which is influenced by many factor such as genetics, gender, nutrition, pre-term birth, socioeconomic, craniofacial morphology, hormonal and systemic disease. Dental age is the key factor for caries prevention programs, orthodontic, clinical, academic, research, forensic sciences and anthropology. Delayed tooth eruption (DTE) is the most common pathologic condition which is often encountered a dentist. Dentist should have enough knowledge about DTE. The knowledge include a comprehensive interview, proper clinical examination, cooperation with the expert, establishing diagnosis and treatment plan.

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Treatment Of Intrusion In Anterior Teeth Using Orthodontics Procedure (Literature Study Article)

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ABSTRACT

Children are susceptible to trauma because of incomplete physical and cognitive development. An intrusive injury caused by a force in axial direction results in displacement of the tooth within its socket. Both the primary and permanent teeth could get an intrusion as a result of trauma. Intrusive injury can involve damage to periodontal tissues, root canals, and alveolar bone. The treatment depends on the severity of the intrusion. Orthodontic procedure is one of the treatments that can be done if there is no spontaneous movement of the teeth. In primary teeth, the dentist should check the direction of movement for the intruded teeth. For intrusion of the primary maxillary central incisor that move towards to the buccal and there is an adequate distance to the permanent teeth, then orthodontic approach could be possible. Orthodontic appliance that can be used include acrylic framework, buttons, and elastic. For intrusion of the anterior permanent teeth, operator needsto take notice the closure of the apical foramen. Orthodontic procedures that could be applied are elastomeric chain, multiloop archwires, superelastic flexible continuous wires, or superelastic segmental overlay wire to pull out the intruded teeth. Treatment of intrusion in anterior primary and permanent teeth can use orthodontic appliances, but the type of orthodontic appliance that is used should be adapted to the condition of the teeth.

Key words: Trauma, Intrusion, Orthodontic procedure

INTRODUCTION

Intrusion is defined as the displacement of the tooth into its socket due to axial force^{1,2}and is considered one of the most severe types of dental trauma. Intrusion leads to the crushing of periodontal ligament (PDL) fibers, the neurovascular bundle and the alveolar bone.^{1,3,4}Sometimes a tooth will be completely intruded into alveolar bone, mistakenly assumed to be lost or incisal part may remain visible with clinical crown length shorter than the adjacent non traumatic tooth.^{2,5,6}

The most common etiology factor for causing tooth injury is falling during playtime and collision.^{4,6-8} Up to 40% of preschool children suffer injuries to their primary teeth, with the peak incidence occur during toddler stages (2 to 3 years) when young children are developing their mobility skills.^{7,8} At this age, home is the place where most trauma occurs in males and females as a result of falls.⁹ Automobile accidents cause many dental injuries in the teenage years, particularly when occupants that are not wearing seatbelts hit the steering wheel or dashboard. Many apparently minor dental injuries go unreported, so it is safe to assume that up to half of all children suffer some dental trauma. Children who participate in contact sports are at greater risk for dental trauma, although the use of mouth guards reduces their frequency.⁴

Most of the intrusions occurs in children who are 2 years old and younger. Boys were slightly more susceptible to tooth injuries than girls.¹⁰ Intrusion injuries are comparatively rare in the permanent teeth, constituting only 0.5-2% of all dental trauma affecting adult dentition and is more common in the primary dentition.^{1,3,11} Maxillary central incisors are the most common injured teeth, followed by the maxillary lateral incisors and the mandibular incisors.^{4,12} The ability of the upper lip to protect the maxillary teeth is affected by the degree of prominence of the anterior teeth. The normal horizontal distance between the maxillary and mandibular incisors (overjet) is between 1 to 3 mm. Overjets greater than 4 mm increase the likelihood of dental injury by 2 to 3 times.^{4,6}

Emergency situations involving children causes a lot of anxiety for parents who are not confident enough to help their children with first aid, and therefore seek treatment in the emergency room. Bleeding and severe lacerations require control and special attention. Bruises, scars, and other soft tissue damage should be assessed and treated well. Pain relieve is important to be given before cleaning the wound. Evaluation of the use of sedation is also a priority. If the wound requires stitches, start from the affected skin area later in the mucosa. Dental examination will reveal if there is a fracture or displacement position. Moreover, the extent of trauma is not always visible during the first inspection, so that the maintenance action requiring immediate intervention and long term follow-up. Prognosis can best be assured if pediatric patients are evaluated as soon as possible after trauma.^{5,8}



Figure 1. Patient exhibiting the classic trauma susceptible features of (A) inadequate lip coverage of the incisors and (B) increased overjet.¹³

OBJECTIVES

Management of traumatic intrusion is considered very empirical and there are some contradictions in choosing one of three treatment approaches currently accepted, including passive repositioning by observation intruded tooth and active repositioning by orthodontic procedures or surgical.^{14,15} Surgical reposition or active orthodontic should be considered because it allegedly can relieve the compression zone in the area of pulp and periodontal, and also protect against ankylosis by creating a distance between the surface of the root and the bone socket bumped. Reposition orthodontic is believed to be more protective of root resorption than surgical repositioning and enables marginal bone improvements along the socket by repositioning the teeth slowly.³ Treatment for anterior tooth injury can be categorized as primary, secondary, and tertiary treatment. Recommendations for all types of primary and secondary treatment has become more standardized.¹³

Primary treatment

Primary care is the initial treatment provided as soon as possible after trauma. Generally, this treatment is time dependent, and the outcomes are more positive with immediate treatment. When a tooth has been displaced, the clinician treats the displacement by placing the tooth back into proper position. Once the tooth is positioned, it is splinted to hold the tooth in position. Active orthodontic treatment is not part of primary care.¹³

Oral hygiene instructions should be given to the patient. Patients are instructed to apply mouth rinse twice daily in morning and evening using 0,1% chlorhexidine mouthwash and also brush the traumatized area gently with a toothbrush dipped in chlorhexidine.^{1,16} Patients prescribed amoxicillin 250 mg 3 times daily for 7 days. These preventive measures were critical to minimize bacteria load in the periodontium, prevent the development of infection and promote healing process.¹⁶ Patients are also advised to follow a soft diet for a week.¹

Secondary treatment

The secondary level of treatment consists of monitoring the pulp and periodontal tissue for healing and treatment. It also involves orthodontic procedures of displaced tooth. The main objective for the clinician is to provide treatment that will maximize the healing capabilities of both the pulpal and periodontal ligament tissues. Outcomes will vary depending on the amount of tooth displacement, the developmental stage of the tooth, and splinting times and methods.¹³

Treatment of tooth displacement becomes more complicated when time interval between trauma and treatment is extended. Although one would suspect the patient would present to the dentist on time, frequently it is not the case. Extended waiting time in emergency department and inability of the emergency department personnel to provide definitive dental treatment will extend treatment time. In some cases, patients requires medical care before dental care to stabilize or treat injuries such as associated head trauma. In other instances, dentists not familiar with trauma would recommend no immediate treatment or



Figure 1. Patient exhibiting the classic trauma susceptible features of (A) inadequate lip coverage of the incisors and (B) increased overjet.¹³



Figure 2. A. Intrusive 0-2 mm, B. Intrusive 2-4 mm, C. Intrusive >4mm.¹⁰

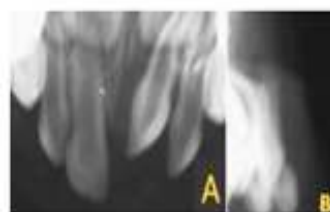


Figure 3. A. The intruded tooth appears shorter than its contralateral in the periapical X-ray. B. In the lateral X-ray, the apex of the intruded tooth is displaced through the labial bone plate.⁵



Figure 4. Extrusion for 11 with applying orthodontic bonding and elastic force.¹¹

delay treatment of displaced tooth. In this cases in which there has been a great deal of time between trauma and treatment, there would be considerable swelling and fluid accumulation around the injured tooth. At other times, healing process has begun, with soft tissue clotting



Figure 5. The use of open coil spring combined with an elastic.¹



Figure 6. Extrusion 11 by orthodontic tooth bonding and application of elastic force. ⁷



Figure 7. Elastomeric chain



Figure 8. Multiloop archwires

and reorganization occurring in the trauma area. Sometimes displaced tooth is very difficult and almost impossible to reposition and splint without additional luxation or extraction and reimplantation.¹³



Figure 9. Super elastic flexible continuous wires



Figure 10. Super elastic segmental overlay wire

Tertiary Care

Essentially, tertiary treatment addresses the ramification of orthodontic treatment for previously traumatized tooth. Timing of orthodontic treatment after the trauma is an unresolved issue. "Cooling off" period is recommended to reduce the possibility of collateral damage, especially root resorption, which may occur orthodontic force from the level of force applied normal to the affected tooth trauma.^{12,13} Kindelan et al suggest 3 month of waiting period before orthodontic treatment for minor injuries and 6 months to 1 year for more severe injuries, on the basis of expert opinion.^{13,14}

DISCUSSION

Management of an intruded primary incisor depends on several variables including direction of intrusion, degree of intrusion, presence of alveolar bone fracture.¹⁵ Intrusion of primary incisor tooth showing high risk of damage for permanent teeth and parents of children who suffered the injury must be notified in the event of injury.⁴ Intruded teeth may invade the follicle of the permanent tooth and destroy the enamel matrix depending on the severity of the intrusion. Trauma during the primary dentition stage can also affect the underlying permanent tooth germ by a direct contact of the impacting object with the developing permanent tooth.¹⁶

A lateral anterior view can also be helpful to determine the relationship between an intruded primary tooth and its developing permanent successor.⁴ The extent of intrusion was classified as follow (Figure 2) : mild < 2 mm, moderate 2-4 mm, and severe >4mm.⁸

In periapical X-ray, if the apex is displaced toward or through the labial bone plate, the apical tip can be seen and the tooth appears to be shorter than its contralateral (Fig.A). When apex is displaced towards the permanent tooth germ, the apical tip cannot be seen and the

tooth appears to be elongated. Extra oral radiographic exposure with size 2 film allows the labial displacement of the apex of the intruded tooth only to be visualized. This additional information has been useful to confirm that the apex is not in close proximity to the labial surface of the permanent successor (Fig.B). A recent article leads to the conclusion that the lateral extra oral radiograph should no longer be routinely used for diagnostic purposes in intrusion. It was found to have limited value in showing labial alignment, especially after intruded lateral incisors and in cases of multiple intrusions. Diagnosis should be based on clinical findings and examination of a periapical radiograph.¹⁷

Normally apex of the primary incisor tooth located nearby the buccal surface of permanent tooth. Apex of primary tooth that encourage coronal of permanent tooth could be very dangerous.^{6,18,19} More than 80% of cases, apex tip of maxillary incisor tooth has a buccal arch that direct away from permanent tooth.^{4,20} If the apex of intruded primary tooth displaced toward palatal, it is recommend to extraction the tooth, but if the movement of apex toward to buccal is recommended spontaneous reeruption.^{21,16} In generally reeruption will be in 2-3 weeks. If reeruption fails, ankylosing should be suspected. Ankylosis of teeth can interfere with the permanent tooth eruption.^{4,18}

For intrusive primary tooth where apex movement toward the buccal and does not interfere with the permanent tooth bud, but reeruption doesn't occur within 4 weeks, the active orthodontic repositioning can be used. Orthodontic appliance that can be used include acrylic framework with elastic rondel that associated with button to the intruded tooth surface. Rondel elastic replaced every day, and used for 2 weeks.² Although for majority of the literature recommended to take extraction in intrusive anterior incisor primary tooth which do not undergo spontaneous reeruption, but in some cases intrusion orthodontic repositioning can be done with customized appliance.

Latest recommendations based on the guideline IADT (International Association for Dental Traumatology) for dental care intrusion permanent teeth that can be seen from the closing apikal.⁴ At the young permanent dentition with immature apex, orthodontic procedures can be used on teeth that immediate intruded (3-6 mm) and severe intruded (> 6 mm). For teeth that are mild intruded often have reeruption spontaneously after 2-4 weeks. In the case of the intruded tooth moderate and severe, not erupted spontaneously in 2-3 weeks it is necessary to reposition in orthodontics. Reposition active with orthodontic procedures allowing marginal bone healing slowly^{4,11,22} Repositioning time with orthodontic appliance around 3-4 weeks.²²

For mature permanent teeth and mild intruded teeth (3 mm), tooth can be spontaneous reeruption. But if there is no movement in 2-3 weeks, it is necessary to reposition with orthodontic procedures. For intermediate intruded teeth (3-6 mm), both of surgical or orthodontic repositioning can be used. Surgical reposition used in acute phase, while the orthodontic repositioning can be done if it has been through some time.

Severe intruded teeth (>6mm) need to be repositioned surgically and use of physiological splint for 1-2 weeks.^{3,11,23} Orthodontic procedures that could be applied are use of the bracket with spring and elastic, while the force used was slow continuous in to proper direction.¹

Some thoughtful choice to make traction on the traumatized tooth are elastomeric chain, multiloop archwires, super elastic flexible continuous wires, or super elastic segmental overlay wire.

Elastomeric chain

Although the concept of a heavy straight wire bonded to the teeth with elastomeric chains extended to the teeth appears simple, but its adjustment and placement are challenging to provide heavy, rapidly decaying forces to the teeth.²³

Multiloop archwires

For many clinicians it simply too difficult to bend multiloop archwires and can cause additional soft tissue irritation.

Superelastic flexible continuous wires

The new superelastic wires cannot be formed, so no wire bending is required. They provide light, continuous forces and require little adjustment. Some superelastic wires undergo thermal transformation that can even further enhance their properties and usefulness.

Super elastic segmental overlay wire

Super elastic wires used appropriately can simplify post trauma tooth movement. Using a formable base wire and a segment of super elastic wire tied loosely with steel ligatures will provide a light continuous force, stability in the anchorage units, and reduced friction.

Follow up treatment

For intrusion injuries, it has been recommended that splint removal occur at the two week follow up appointment and that clinical and radiographic re-examination occur at two, four, and six weeks, 6 months, and then yearly for five years until tooth exfoliation.^{3,10,24}

Successful of treatment depends on several factors, such as orthodontic repositioning as soon as possible, on time intracanal treatment, complete interdisciplinary cooperation. At any rate the most important factor is dental care and control periodically and consistently. The importance of routine control and good influence either from patient or patient's parents cannot be forced.²⁵ A good recommendation is control patients once a week during the first 3 weeks, due to the risk of infection during the period reeruption. Signs of infection appear is swelling, mobility, abscess formation, usually associated with poor oral hygiene after injury.⁵

Root canal therapy with incomplete root development should be monitored closely with root canal treatment that indicated followed by a diagnosis of pulp necrosis. Circulation in trauma injury pulp often restrained, resulting ischemia and collapse of blood vessel's wall. Gradually revascularization and pulp innervation may occur, it is result in the size of the apical foramen be adequate to the occurrence of vascular growth and inhibit infection from ischemia pulp. If the pulp revascularization persist or occur, then some changes to the pulp may occur as hialinisasi, deposit amorphous and diffuse calcification. This diffuse form of hard tissue sometimes progressed to the point of loss of overall root canal. The recommended time to start the root canal treatment is about 2 weeks after trauma.^{20,26}

CONCLUSION

Both primary and permanent anterior teeth, orthodontic repositioning can be used as treatment for intrusion. The choice of right appliance can speed up wound healing and return displaced tooth displacement into proper direction.

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The Use Of Polyethylene Fiber In Anterior Primary Teeth Restoration With Extensive Decay

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ABSTRACT

Caries in primary anterior teeth with extensive crown decay has high incidence in early childhood caries (ECC), it cause loss of part or all structure of the tooth crown. If not treated, it can lead some problems such reduced vertical dimension, insufficiency of mastication, esthetic problem, development of parafunctional habits like tongue thrusting, and psychological problems. The final restoration of anterior teeth after endodontic treatment should include esthetic and mechanical resistance to fracture or loss of the restoration, so it takes a retainer intracanal that may increase the retention of restoration in rebuilding the structure of the crown. The aim of this paper is to describe polyethylene fiber as a retainer intracanal (short post technique) in anterior primary teeth using composite resin restorations. Polyethylene fibers can improve the impact strength, modulus of elasticity and flexural strength of the composite resin and provide good esthetic results. The use of polyethylene fiber as intracanal retainer in composite resin restoration of anterior primary teeth showed excellent clinical performance after 30 months. Conclusion; The use of polyethylene fiber as a retainer intracanal in composite resin restorations of anterior primary teeth may provide promising results.

Keywords: Polyethylene fiber, composite resin restoration, anterior primary teeth

INTRODUCTION

Early childhood caries (ECC) has been defined as ‘the presence of one or more decayed, missing due to caries, or filled tooth surfaces in any primary teeth in children under 6 years of age. Clinical examination of this condition discloses a distinctive pattern. The teeth most often involved are the maxillary central incisors, lateral incisors and the

maxillary and mandibular 1st primary molars.¹ The maxillary primary incisors are the most severely affected with deep carious lesions usually involving the pulp. In severe cases, ECC can even lead to total loss of the crown structure. If not treated, it can lead some problems such reduced vertical dimension, insufficiency of mastication, esthetic problem, development of parafunctional habits like tongue thrusting that can caused malocclusion, and psychological problems.^{2,3} Restoring the primary anterior teeth to its previous function, form and esthetics presents a challenge to the Pediatric Dentist. The children who require this treatment are usually the youngest and least manageable group of patients. In addition, these teeth have short and narrow crowns leaving only a small surface for bonding, a pulp chamber that is relatively large to the crown size and enamel which is inheritantly difficult to etch due to its aprismatic structure. Because of the reduced coronal structure, direct restorative procedures do not always give satisfactory results.^{1,3}

Clinicians have made several attempts to restore such grossly carious primary anterior teeth with different and innovative root canal retentive post and core systems so that the primary teeth can be retained until their replacement by successors. Posts of various designs have been introduced over the years, including and nickel-titanium and other metallic posts, orthodontic wires, biological posts, short composite resin posts, fiber glass posts, and polyethylene fiber posts.⁴

The aim of this paper is to describe polyethylene fiber as a retainer intracanal (short post technique) in anterior primary teeth using composite resin restorations.

LITERATURE REVIEW

Restoring primary anterior teeth with severe loss of coronal structure is challenging for the pedodontists. The principle goal of pediatric restorative dentistry is to restore the damaged teeth to enable them perform normal function and also good esthetic achievement.^{3,5,6}

Anterior primary teeth with grossly decayed, it lack a coronal structure, leading to decreased support and adhesion for a composite crown, it is make these treatments difficult, with high rate of failure (figure.1). To get retention and provide stability for such reconstructed crowns, use of intracanal retainers after endodontic treatment is necessary. Use of a resin based composite reinforced with polyethylene fibers is preferred and the technique is referred to as the 'short post technique', which requires root canal treatment and a short composite post.^{3,5-8}

Innovations for short retentive posts are needed in primary dentition due to the physiological resorption that occurs in primary dentition, unlike the post and core used in adult dentition. Intra-canal placement is around 3mm that is the cervical one-third of the canal so it does not interfere with deciduous tooth root resorption and permanent tooth eruption.⁴ Polyethylene fiber was introduced in the market in 1992, which is an ingredient in the form of ribbons with woven very strong so-called locked-stitched threads, this material effectively distribute pressure through the webbing without channeling the pressure back to the resin, a fiber-binding and has the property of strengthening the structure of remaining



Figure 1. Severe decayed primary maxillary teeth⁸



A

B

Figure 2. Architectural structure overview Ribbon Fiber in the Scanning Electron

Microscope (SEM): A. Polyethylene Fibers Leno-Weave, B. Braided Polyethylene Fibers¹⁵

dentine.^{9,10}

Polyethylene fiber is divided into two types of leno-weave polyethylene fibers (Ribbond®) and braided polyethylene fibers (Construct, Kerr®), but that is often used is ribbond (fig.2&3).^{9,11,12} Fiber polyethylene has a lot of clinical benefits such as periodontal splint, bridge on anterior teeth, orthodontic retainer, as well as preparations for the restoration of porcelain crowns both the anterior and posterior teeth.^{3,11-14}

indications of using post in primary teeth are the teeth with crowns damages of more than ½ part and there is at least 1 mm of tooth structure supra-gingival. The main reason for using a post is to reestablish the shape and form of a severely decayed or fractured maxillary anterior tooth crown while it provides support for the final restoration. The posts also increase the resistance of the restored teeth to mechanical load.⁴

Short post technique using polyethylene fiber performed on teeth after endodontic treatment (figure.4). The step wise treatments of this technique are: **First step**, space should be prepared for the post with removal 2 mm the coronal portion of the root filling (2-3 mm under CEJ) (figure 5). After that a thin layer of fast-setting GIC is condensed above the filler as a barrier between the filler material and resin restorations to prevent influence on the hardening process of resin composites.^{1, 3, 5-7, 10-11}

Second step, post insertion; Both coronal structure and root space were etched with 37% phosphoric acid, rinsed for 15 s and dried gently with a weak air stream. Bonding agent was applied, and then light cure. Polyethylene fiber is cut in lengths of 5 mm so that 3mm could be inserted into the canal, with a core of 2-3 mm to reinforce the coronal

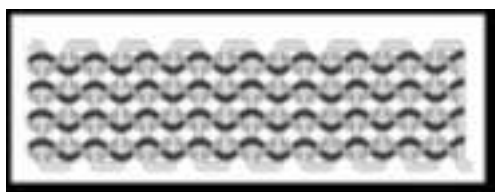


Figure 3. Schematic structure of the Ribbon[®]



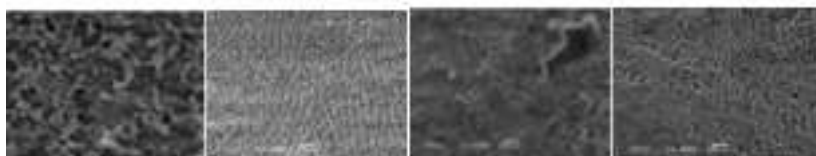
Figure 4. Radiographic image of teeth after obturation¹



Figure 6. Polyethylene fiber could be 3mm inserted into the canal, with a core of 2-3 mm.³



Figure 7. Trial fit and morphology restored with strip crowns.⁴



structure. Fiber was wetted with bonding agent before placed in the slot of the root canal, then stabilized with flow composite material and light cure for 120 s to ensure complete polymerization of the fiber/composite resin complex throughout the canal (figure.6)^{1-3,5-7,10,11}

Third step, final restoration; the post was covered with flowable composite, and the coronal restoration was completed using resin composite and strip crowns. Excess composite was removed through small holes punched in the palatal surfaces of the strip crowns, which had been preselected based on tooth mesial-distal width measurements. After polymerization of the buccal and palatal surfaces, the strip crown form was removed by inserting the sharp tip of an explorer between the crown form and the polymerized resin composite at the gingival margin (figure 7). The occlusion was checked, and the final finishing and polishing was performed using diamond burs. After the restoration was completed, the patient and her parents were once again instructed on proper dietary and oral hygiene habits as well as the importance of periodic dental visits for the preservation of the primary dentition.^{1, 3, 5-7, 10-11}

Restoration of fiber reinforced composite (FRC) provides good aesthetic results because it is almost invisible in the resin matrix. This is because the nature of translucency compared to other fiber types. This material is easy to use, short in time so suitable for use in children. Secondary optical properties of polyethylene fiber optical properties allow light to pass through the tooth and restorative material to reflect, refract, absorb and transmit light according to the optical density of hydroxyapatite crystals, enamel rod, and the dentinal tubules.^{15,16}

In addition to the aesthetic, mechanical resistance is also something to be desired in the restoration of anterior teeth. Some literature suggests that the biomechanical properties of the fiber reinforced composite is similar to dentin. Polyethylene Fiber can improve impact strength, elastic modulus, and flexural strength of the composite resin. This material has a much better strength than glass fiber and thus require special scissors to cut it.¹¹ Each factory making fiber reinforced composite with a fiber composition that is different. Volume fiber contained typically 50-70%. The content of this fiber number that will affect the strength.¹³

An ideal restoration design for a post systems require modulus of elasticity approaching dentin 14-18 GPa. The modulus of elasticity is a relative rigidity of a restorative material in the elastic range. Polyethylene fiber post has a modulus of elasticity of 1,397 GPa and when joined with flowable resin and adhesive resin, modulus of elasticity increased to 23.6 GPa.⁹ The modulus of elasticity resin cement dual cure is 18 GPa and composite resin 16 GPa.¹⁷ Therefore the use of polyethylene fiber is growing because of its function in improving the durability of the composite resin bonding.¹¹

Etching with 37% phosphoric acid material aimed removed the smear layer, forming microporosity on enamel and demineralized the dentine. Applications of bonding material will create micro-mechanical bonding with enamel and form hybridized layer.³ The effect of etching on enamel of primary teeth is different from the enamel of permanent teeth because of their thick prism-less layer of primary enamel. Zilberman et al in their publication showed the effect of 20, 40, 60 and 80 seconds etching on four primary molar teeth. After 20 seconds the etching solution affected only the aprismatic layer. After 40 seconds the etching solution

affected the aprismatic layer on three primary molars and on only one molar the prisms were exposed. After 60 seconds on three primary molars the prisms were exposed and after 80 seconds no significant difference was observed when compared to 60 seconds. Based on these observations an etching time of 60 seconds, to reach the prismatic layer and effect the inter-prismatic sheath (fig.8).¹⁷ Another factor that added to the success of these techniques was the use of the bonding agent that increased the resistance of the core to the torsional forces.¹

Flowable composite resin is a good alternative to use because the free radical polymerization of the composite will flow into the woven fiber, thus increasing fracture strength of non-vital teeth. To ensure the polymerization of the composite flow, this material is inserted into the root canal and performed high- intensity curing cycle for 120 seconds.⁶ Clinical and radiographic examination after one, three, and six months revealed the presence of an intact crown and the absence of periapical pathology, confirming the efficacy of the combined technique. The average successful treatment of primary teeth with this technique is still showing good results after 30 months of treatment.^{3,6,7}

CONCLUSION

The use of polyethylene fiber as intracanal retention with short post technique can be used to restore the anterior primary teeth with extensive decay. Treatment with this technique are simple and does not require a long time and can give good results in restoring function and esthetics of teeth in children.

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A New Calcium Silicate-Based Cement (Biodentine) Use In Apexification Treatment (Literature Study Article)

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ABSTRACT

Biodentine is a calcium-silicate based material that has drawn attention in recent years and has been advocated to be used in various clinical applications, such as root perforations, apexification, resorptions, retrograde fillings, pulp capping procedures, and dentine replacement. Calcium hydroxide and MTA have become the material of choice for immature permanent teeth apexification but Biodentine promising as an alternative material for treatment apexification. The material is claimed to possess better physical and biological properties compared to other tricalcium silicate cements such as mineral trioxide aggregate (MTA) and Bioaggregate (Bioaggregate). This article literature study will review the composition, physical properties, biocompatibility and clinical outcomes Biodentine on apexification. Objective: to review the composition, physical properties, biocompatibility and clinical outcomes Biodentine on apexification. Discussion: The biggest challenge in treating the root canals with open apex is formed apical barrier. Apexification treatment of immature permanent teeth with pulp necrosis is endodontic procedure to achieve induce apical closure through the formation of mineralized tissue and repair of periapical tissue. Biodentine has been developed as a permanent dentine substitute material whenever original dentine is damaged. The other main advantages of Biodentine over MTA are its greater viscosity, shorter setting time (about 12 min), better handling, and higher compressive strength. Conversely, the radiopacity of Biodentine was significantly lower compared to other materials. Ions of calcium silicate cement in contact with mesenchymal stem cells that will differentiate into osteoblasts, causing deposition of apatite into the surface of the roots cement. Furthermore, the Hertwig's epithelial root is involved in regulating differentiation of periodontal ligament stem cells and forming cementum-like tissue. In conclusion, Biodentine material can be used efficient for apexification procedures. Methods of Biodentine apical plug can be an effective method but necessary clinical trials and further investigations.

Keywords: Biodentine, biokompatibilitas, apexification

INTRODUCTION

For many years, calcium hydroxide ($\text{Ca}(\text{OH})_2$) has been used to establish apical closure by inducing apexification. This technique, first introduced by Kaiser and later spread by Frank, allows hard tissue deposition at root-end. It restricts bacterial infection and establishes a suitable environment for periapical repair. Although calcium hydroxide apexification has a success rates in 50-90% range, but disadvantages of $\text{Ca}(\text{OH})_2$ in its utilization such as the need of multiple appointments, the long period of treatment, susceptibility to fracture and coronal microleakage during treatment. Also, the formed barrier apparently calcified, but sometimes in fact it porosity and contains small amounts of soft tissue.^{1,2}

Synthetic apical barriers have popularized as alternatives to the traditional calcium hydroxide apexification method. Calcium silicate-based cements, such as mineral trioxide aggregate (MTA), are usually indicated to seal furcal and lateral root perforations, as well as rootend filling. Mineral trioxide aggregate (MTA) has successfully evolved as a material of choice for this procedure because of its sealing properties and biocompatibility. Several studies demonstrate its capacity to induce odontoblast differentiation, good radiopacity, low solubility, high pH, expansion after setting, and antimicrobial activity. However, the prolonged setting times, difficulties in handling, and coronal discolorisation, had led to find other alternative materials. Recently, a new calcium silicate based material, Biodentine, has been introduced to preserve the properties and clinical applications of MTA without its negative characteristics.^{3,4}

The aim of literature article study was to review the composition, physical properties, biocompatibility and clinical result involving the use of Biodentine materials in apexification treatment. A comprehensive systematic literature search for all publications was performed in Medline (PubMed), SciELO and Scopus using the terms Biodentine, "tricalcium silicate", Ca_3SiO_5 , "dentine substitute" and "dentin substitute". Randomised control trials (RCT), case control studies, case series, case reports, in vitro studies, animal studies and short communications in English language were considered for this review.

DISCUSSION

The biggest endodontic challenge while treat a tooth with open apex is obtaining an apical seal. The main objective of treatment for these tooth is apexification. Apexification can be defined as a 'method to induce a calcified barrier in a root with an open apex or the continued apical development of teeth with incomplete roots and a necrotic pulp. This material is clinically indicated for direct and indirect pulp capping, pulpotomy, furcation and lateral perforation repairment, retrograde filling and apexification. Biodentine has been developed as a permanent dentine substitute material once original dentine is damaged. The material have dentin-like mechanical properties and can be used on both crowns and roots.⁵⁻¹⁰

Composition of Biodentine

Biodentine has similar composition with MTA and can be alternate for MTA. Biodentine is a new bioactive cement for dentine substitute, which is composed powder and liquid. The powder consists of tricalcium silicate, dicalcium silicate, calcium carbonate, calcium oxide and zirconium oxide and the liquid consists of a water-soluble polymer and calcium chloride, which can accelerates setting reaction. 15% calcium carbonate was used in the powder leading to fast setting time.^{11,12}

Clinical limitation of Biodentine is low radiopacity. Eventhough presence of X-ray opacifier (zirconium oxide) to identify secondary caries and assessment root canal improvement, but its radiopacity is lower than MTA which containing bismuth oxide. Lower radiopacity established difficultie of retrograde filling visualization when the amount of material used is little. In addition, the risk of material left on the bone cavity is increases. The powder is mixed with 5 drops of liquid and mixed in the dental triturator for 30 seconds (Figure 1).^{13,14}



Figure 1 Biodentine. (a) Biodentine is commercialized as predosed sets including a capsule containing the powder and a liquid. (b) After pouring the liquid, the capsule must be vibrated at 4 000 r \cdot min⁻¹ for 30 s.¹³

The highly purified powder is manufactured in a laboratory using the sol-gel method. The powder mainly consists of tricalcium silicate and dicalcium silicate that same component of Portland cement and MTA. In addition, the powder also contains calcium carbonate, calcium oxide, iron oxide, and zirconium oxide. The liquid consists of calcium chloride and a water-soluble polymer. Tricalcium silicate and dicalcium silicate are the main component of the powder and they regulate setting reaction. Calcium carbonate and calcium oxide related to biocompatibility and calcium content. They act as fillers, improving the mechanical properties of cement. In addition, as an active agent, calcium carbonate is implicated in the process of hydration. Iron oxide is added to provide shade. While as, zirconium dioxide serves as a radiopacifier. Calcium chloride in the liquid accelerates the setting reaction and improves the physicochemical properties of cement. The hydrosoluble polymer is based on polycarboxylate and it reduces the amount of water and maintaining consistency of the mixture (Table 1).^{15,16}

Table 1. Composition and functions of constituents¹⁵

		Functions of constituents
Powder	Tri-calcium Silicate (3CaOSiO ₂)	Main core material
	Di-calcium Silicate (2CaOSiO ₂)	Second core
	Calcium Carbonate and Oxide (CaCO ₃ and CaO ₂)	material
	Iron Oxide (FeO ₂)	Filler
	Zirconium Oxide (ZrO ₂)	Shade
Liquid	Calcium chloride (CaCl ₂ .2H ₂ O)	Radiopacifier
	Hydrosoluble polymer	Accelerator
		Water reducing agent

Physical Properties of Biodentine

Grech et al. demonstrated negative solubility values for prototype cement, Bioaggregate and Biodentine in study of physical properties assessment of materials. They related this result to the deposition of substances such as hydroxyapatite on material surface when in contact with synthetic tissue fluids. This property is favorable because the material does not lose particle to result stability dimensional. The tricalcium silicate grains in Biodentine were also reported to be finer and calcium chloride and a water soluble polymer were included in the liquid portion. Gunter et al. reported that the particle size of Biodentine is smaller and uniform that increase Biodentine penetration into tubular and provide better mechanical retention. Biodentine is better than other calcium silicate materials. The compressive strength, elasticity modulus and microhardness are similar with natural dentine. Due its material properties improvement, Biodentine has advantage as alternatives in treatment of teeth with open apex.^{17,19}

Biocompatibility of Biodentine

Biocompatibility of a dental material is major factor that should be taken into consideration specifically when it is used in pulp capping, perforation repair or as a retrograde filling. During the aforementioned procedures, the material in direct contact with the connective tissue and has the potential to affect the viability of periradicular and pulpal cells. Currently, there is limited information available about the cytotoxicity of Biodentine to periodontal cells. The biocompatibility of Biodentine has been also demonstrated on human bone marrow stem cells. This bioactive cement increase the expression level of runt-related transcription factor 2 (Runx 2) and stimulate osteogenic differentiation of human bone marrow stem cells. Runx2 is a transcription factor required for differentiation of pluripotent mesenchymal cells into osteoblast. Runx2 is also important for the formation of teeth. Recently, one study showed that Biodentine caused a gingival fibroblast reaction similar with MTA.^{20,21}

The Clinical Results Using Biodentine on Apexification

Camilleri et al. reported superior results compared to MTA, because hydroxyapatite apposition was observed on the surface of Biodentine is greater when exposed to tissue fluids, good color stability, low genotoxicity, and low cytotoxic, makes Biodentine as ideal material in endodontic practice. Lee et al suggested the use Biodentine, MTA and Bioaggregate as root apex filler because on contact with mesenchymal stem cells will induce osteoblast differentiation. Several studies underlined the importance of a combination of biological microenvironment specific local and circulating soluble calcium and phosphate levels to achieve bone regeneration. Microenvironment with the presence of calcium silicate cement, can induce stem cell of papilla apical and specific signaling factor for cell differentiation. The calcium ions and presence of Si-OH groups of calcium silicate cements induce apical sealing through the deposition of apatite onto the surface of the root cement. Furthermore, the Hertwig epithelial root sheath is involved in regulating differentiation of periodontal ligament stem cells and forming cementum-like tissue.²³⁻²⁶

Several authors describe case reports of apexification procedures in immature permanent teeth with an apical plug of Biodentine. The first case was reported by Nayak and Hasan, who uses Biodentine as an apical barrier and synthetic collagen membrane as matrix after 1 month dressings with calcium hidroksida dressing. Sinha et al had used a triple antibiotics paste in the root canal for a week before placing an apical plug of Biodentine. A 12-month follow-up with a cone-beam computed tomography showed progressive involution of periapical radiolucency, with good healing of periapical tissue and absence of clinical symptoms. Single visit apexification procedure of traumatically injured tooth with Biodentine revealed that this bioactive and biocompatible calcium-based cement can regenerate damaged dental tissue and promising alternative to the multi-visit technique apexification. In all case reported of apical closure thickness was 5 mm, and root canal refilled with gutta-percha and resin based sealer.²⁰⁻²⁴

In recent study, Sawyer et al stated that the flexural strength of dentin on contact with Biodentine decreased significantly after 2 and 3 months in study of effect prolonged contact of dentin with two calcium silicate-based material, MTA Plus and Biodentine. Also, they stated that the fracture resistance of roots will probably not adversely affect when these calcium silicatebased materials are used as apical plug material. Biomineralization ability of Biodentine on dentine is more prominent than MTA because Biodentine specimens showed dentin area that rich Ca and Si wider and deeper. Also, when on contact with dentin, Biodentine form a tag-like structures along the interfacial layer. This layer is called the infiltration zone is formed due to the formation of minerals and hidroxyapatite. Biodentine also proved to have less porosity than DiaRoot BA, which can affect the physical properties of these materials; such as absorption, permeability, density, and strength.^{18,25}

Formation of interfacial layer and tag-like structures responsible for the marginal seal of MTA. This idea is supported by the finding that immersion in phosphate-buffered saline (PBS) decreased the marginal leakage of MTA apical plug. It has also reported that immersion of MTA in PBS increases push-out strength, show that the ability of biomineralization confers

better resistance of material against dislodgement, most likely through the formation of tag, which is a micromechanical anchorage. Biodentine is believed to have similar ability with MTA. In study of Han and Okiji concluded that Biodentine and MTA cause Ca and Si absorption in root canal dentin adjacent to PBS. Uptake Ca and Si in root canal dentin with Biodentine is greater than MTA.^{24,26}

Capability of marginal seal in calcium silicate-based materials is attributed to produce apatite crystals surface when in contact with phosphates in tissue fluids. The precipitates of crystalline are formed through interaction of calcium and hydroxyl ions released from set material with phosphates. The apatite crystals formed have been identified as calcium-deficient B-type carbonated apatite precipitates produced via an amorphous calcium phosphate phase. Biodentine shows apatite formation after immersion in phosphate solution, indicative of its bioactivity. Dentine may uptake several elements released from bioactive materials, and such a phenomenon may cause dentine chemical and structural modification.^{25,26}

Han and Okiji compared uptake of calcium and silicon adjacent root canal dentine in the presence of phosphate buffered saline using Biodentine and ProRoot MTA. The results showed that both materials formed a tag-like structure composed of the material itself or calcium- or phosphate rich crystalline deposits. The thickness of calcium and silicon -rich layers increased over time, and the thickness of calcium and silicon-rich layer in Biodentine is significantly greater than MTA after 30 and 90 days, it can be concluded that the absorption elements by dentin in Biodentine is greater than MTA. This findings suggest that apatite formation contributes to reduction of leakage not only to fill gap along the interfacial but also through dentin interaction as apatite deposition intrafibrillar.^{22,24}

Han and Okiji reported that Biodentine releases more ion of CaCC and formation more calcium phosphate precipitate and dentin areas that rich Ca and Si is thicker. Instead, Kim et al. find that the thickness of interfacial layer in MTA was significantly higher than Biodentine.^{24,22}

CONCLUSION

Biodentine clinical advantage lies in increasing the mechanical properties, its ability to form a good marginal closure and setting a fast time, so it can be used efficiently for apexification procedure. Biodentine apical closure method may be an effective method but necessary clinical trials and further investigation.

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Amelogenesis Imperfecta Early Treatment With Progressive Conservative Adhesive Concept

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ABSTRACT

Amelogenesis imperfecta (AI) is herited disorders primarily affecting dental enamel. There are three types of AI : hipocalsification, hypoplasia, and hypomaturation. Teeth with AI have abnormal color between white opaque, yellow, brown to grey. AI causing tooth sensitivity and aesthetics problem. AI is not about only primary teeth but also in the permanent dentition. This paper is about AI management with adhesive conservative treatment. At the beginning of the treatment, patient is given onlay restorations of composite resin bonded with adhesive resin cement material. Composite resin materials for onlay, widely used due to mechanical properties and good aesthetics, and the costs are relatively low, especially when compared to full ceramic or ceramic metal crown. The purpose of this treatment approach is illustrating the concept of rehabilitation based on progressive conservative care and followed by full crown restoration, first phase of the AI treatment cases from early age to adult patient. The conclusion is AI treatment can be done with adhesive restorations and there are two phases of interventions first with composite onlay and followed by full crown in adulthood.

Keywords: amelogenesis imperfect treatment, adhesive restoration, dental aesthetics

INTRODUCTION

Amelogenesis imperfecta (AI) is a disorder group of hereditary development that affects the dental enamel structure which is marked by clinical alterations without association with systemic abnormalities and diseases.^{1,2} AI is a term for a clinically and genetically heterogeneous group of conditions that affect the dental enamel, occasionally in conjunction with other dental, oral and extraoral tissues.³ AI is also known by varied names such as hereditary enamel dysplasia, hereditary brown enamel, and hereditary brown opalescent teeth.¹

AI can affect partially or totally the teeth of both primary and permanent dentitions. The incidence of AI ranges from 1 in 718 to 1 in 14,000 depending on the population studied.^{4,5} AI is a collective term for a number of conditions with defect of enamel formation. Many cases are inherited, either as an X-linked, autosomal dominant, or autosomal recessive trait.³ The main sequel to patients with AI is represented by dental sensitivity and breakdown of hard tissues due to weak mechanical properties of affected teeth.⁶ Still, there are marked impacts on children and adolescents as a result of AI, including aesthetics, function, and psychosocial aspects. Thus, attention should be taken to multiapproach treatment, aiming to determine the correct immediate and long-term planning follow-up.²

Patients with AI are also affected by their poor esthetics, tooth sensitivity, and decrease of occlusal vertical dimensions through loss of tooth structure. AI patients may experience compromised chewing function due to tooth sensitivity and the short clinical crowns caused by attrition and/or incomplete eruption.²

The aim of this article is to describe, step by step, a rehabilitation concept based on conservative and progressive adhesive treatments by means of freehand bonded restorations, onlays, and, once complete soft and hard tissue maturation is achieved, adhesive ceramic crowns.²

LITERATURE REVIEW

Amelogenesis Imperfecta

Amelogenesis imperfecta is a group of inherited defects of dental enamel formation that show both clinical and genetic heterogeneity.⁷⁻⁹ Dental enamel is a highly mineralised tissue with over 95% of its volume occupied by unusually large, highly organised, hydroxyapatite crystals. This formation is highly controlled through interactions of a number of organic matrix molecules that include enamelin, (ENAM; 4q21) amelogenin (AMELX; Xp22.3-p22.1), ameloblastin (AMBN; 4q21), tuftelin (TUFT1; 1q21), amelotin (AMELOTIN; 4q13), dentine sialophosphoprotein (DSPP; 4q21.3) and a variety of enzymes such as kallikrein 4 (KLK4; 19q13.3-q13.4) and matrix metalloproteinase 20 (MMP20; 11q22.3-q23).^{5,10,11}

There are several classifications based primarily on phenotype with the mode of inheritance being used in some systems as a secondary factor in allocating a case into a particular category.⁴ According to the phenotypes and clinical aspects, AI can be classified into categories, such as type I that involves disturbances related to enamel secretion (hypoplastic), type II related to enamel maturation (hypomature), type III that affects the mineralization process (hypocalcified), and type IV, which is marked by the involvement of hypoplastic and hypomature enamel defects associated with taurodontism. Clinically, AI is under dependence of disturbance types and presents with a thin enamel layer (hypoplastic), roughness texture (hypomature), a mottled appearance, opaque white to yellow-brown (hypocalcified), or association with one or two characteristics. To determine the presence of AI, an accurate diagnosis with other enamel defects and verification of alteration symmetric pattern linked to genetic inheritance are mandatory.^{5,12}

Table 1. Classification of AI proposed by Witkop²

Type I	Hypoplastic
IA	Hypoplastic, pitted autosomal dominant
IB	Hypoplastic, local autosomal dominant
IC	Hypoplastic, local autosomal recessive
ID	Hypoplastic, smooth autosomal dominant
IE	Hypoplastic, smooth X-linked dominant
IF	Hypoplastic, rough autosomal dominant
IG	Enamel agenesis, autosomal recessive
Type II	Hypomaturation
IIA	Hypomaturation, pigmented autosomal recessive
IIB	Hypomaturation, X-linked recessive
IIC	Snow-capped teeth, X-linked
IID	Snow-capped teeth, autosomal dominant
Type III	Hypocalcified
IIIA	autosomal dominant
IIIB	autosomal recessive
Type IV	Hypomaturation hypoplastic with taurodontism
IVA	Hypomaturation-hypoplastic with taurodontism, autosomal dominant
IVB	Hypomaturation-hypoplastic with taurodontism, autosomal recessive

Clinical Features

Hypoplastic AI: Hypoplastic form on AI is characterized by thin enamel with yellowish - brown color, rough or smooth and glossy, square-shaped crown, lack of contact between adjacent teeth, flat occlusal surfaces of the posterior teeth due to attrition, and with/without grooves and pitting. Radiographically, in hypoplastic type, there is a presence of thin radiopaque layer of enamel with normal radiodensity. Histologically, in hypoplastic type, defect is in enamel matrix formation.¹

Hypocalcified AI: Hypocalcified form of AI is the most common type and is characterized by normal size and shape of crown, softer enamel which wears down rapidly and can be removed by a prophylaxis instrument, and become pigmented-dark brown colored. Radiographically, in hypocalcified form, thickness of enamel is normal but radiodensity of enamel is less than that of dentin. Histologically, in hypocalcification type, defects of matrix structure and mineralization is seen.¹

Hypomaturation AI: Hypomaturation form of AI is characterized by normal thickness of enamel but softer than normal but harder than hypocalcified type and may crack away from the crown, mottled-colored cloudy white/yellow/brown/ snow capped. Radiographically, radiodensity of enamel is similar to that of dentin. Histologically, in hypomaturation type, alterations in enamel rod and rod sheath structures had been noted in various studies. In hypoplastic hypomaturation with taurodontism, the enamel is thin, mottled yellow to brown, and pitted. Molar teeth exhibit taurodontism and other teeth have enlarged pulp chambers.¹

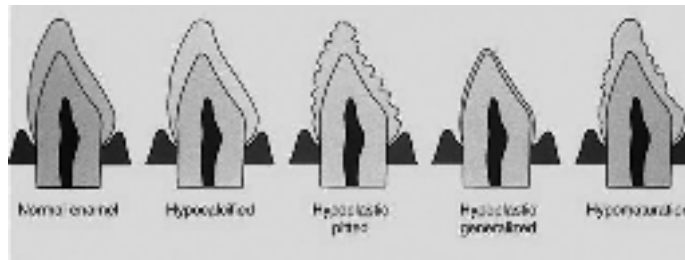


Figure 1. Amelogenesis imperfecta. Diagram of enamel defects of basic types. Hypocalcified - normal thickness, smooth surface, less hardness. Hypoplastic, pitted - normal thickness, pitted surface, normal hardness. Hypoplastic, generalized - reduced thickness, smooth surface, normal hardness. Hypomaturation - normal thickness, chipped surface, less hardness, opaque white coloration.¹³



Figure 2. Phenotypic descriptions of amelogenesis imperfecta: hypoplastic (a, b, c, d), Hypocalcified (e, f), hypomature (g, h).¹³

Often AI patients experience difficulty in maintaining oral hygiene, decreased masticatory function, and a lower self-esteem, affecting their over-all quality of life. Furthermore, most variants of AI require extensive dental treatment, which can be time consuming and often poses a significant economic burden on their family. Clinicians must therefore consider treatment alternatives to balance the patient's esthetics and functional needs, the status of patient's growth and development, the financial implications for the patient's family, and the long-term prognosis.^{6,7}

Adhesive restoration

The treatment plan should accommodate factors including the patient's age, socioeconomic status, disease type and severity, and overall oral condition. Affected patients are typically treated with hard porcelain crowns, composite restorations, stainless steel crowns, laminate applications, or overdenture applications.¹⁴ The therapeutic goals for

these patients should focus on recovering aesthetic appearance and functional phonation, as well as preserving gingival health.¹ Permanent dentition may be protected by use of full cast crowns on posterior teeth and veneers on anterior teeth. Root canal treatment and esthetic crown replacement for decayed teeth should be done to achieve the Jackson's triad of esthetic harmony, structural balance and functional efficiency. Amelogenesis imperfecta presents with problems of socialization, function and discomfort which may be managed by early vigorous intervention, both preventively and restoratively. Treatment of hypoplastic and hypocalcified type AI is comparatively different. Sundell reported that teeth were treated with prosthetic restoration in hypocalcified AI, while hypoplastic type teeth were treated with composite restoration. A multidisciplinary approach consisting of an orthodontist, prosthodontist and endodontist should be planned. Treatment planning must focus on early diagnosis, pain management, prevention, stabilization, restoration of defects, and regular long-term management.

The advantages of the direct laminate technique are its low cost, that the restoration may be evaluated as a reversible treatment procedure, and that the restoration may be repaired intraorally.⁴ When a more conservative approach is desired, RMGI (Resin Modified Glass Ionomer)) is recommended in occlusal non-stress bearing areas because of its fluoride releasing and chemically retentive ability, while composites resin provide acceptable resistance to occlusal wear in stress bearing tooth surfaces. Unfortunately, very little evidence exists to support the long-term use of glass ionomer cements and resin modified glass ionomer cements.³

Composite veneers and composite resin restorations have been advocated to mask discoloration and improve dental esthetics. Composite resin restorations can be placed with minimal tooth preparation or no tooth preparation to preserve tooth structure and is a favorable treatment option for partially erupted teeth. Rada reported composite resins provided satisfactory esthetics and durability.¹⁵ However, a high failure rate associated with insufficient bonding between the composite resin restoration and enamel among variants of AI has been reported in the past. Several approaches have been documented to improve bonding strength between composite resin restoration and enamel.³

Although composite resins are esthetic and easy to manipulate, they have some undesired properties such as staining, micro leakage, low abrasion resistance, and plaque accumulation, so they are more appropriate to use for anomalies limited with enamel and as provisional restorations. Drinking hot coffee, carbonated beverages or alcohol may increase discoloration.⁴ Increasing the particle size of the resin by decreasing the proportion of organic filler matrix can decrease the change in color. Hybrid composite resins were used in this case because they have good mechanical resistance and can be polished. Light-cured hybrid composite resins are both esthetic and easy to manipulate. In the twelve-month follow-up, there was no remarkable color change, fracture, or damage of the composite restorations. Periodontal tissues remained healthy, and there was no plaque accumulation on the gingival side of the restorations. Porcelain laminate veneers, metal ceramic crowns, and all-ceramic crowns are expensive and need tooth preparation. These

kinds of restorations also take a long time and are irreversible. Based on this knowledge, a direct composite laminate technique may be an important choice for treatment compared with other fixed dental prostheses.⁴

Treatment

Child with AI may need restorations and scaling; however, sensitivity can be a challenge to providing this treatment. Local anaesthesia (LA) is an essential tool in helping these children receive treatment. Even a simple, fine scale may require LA over a few visits. The hygienist or therapist can form an essential part of the team by providing this care at regular intervals. They can also assist with motivation, continuing preventative advice and support. One must also consider sensitivity of other teeth when providing a restoration, as although the tooth being treated is anaesthetised, it is not uncommon for the child to complain of sensitivity on the opposite side of the mouth. Providing treatment using non-latex dam can reduce the sensitivity experienced during treatment. The management of individuals affected by AI has been described as three stages : ⁴¹. Temporary phase — undertaken during the primary and mixed dentition; 2. Transitional phase – when all permanent teeth have erupted and continue till adulthood; 3. Permanent phase – occurs in adulthood.

Primary Dentition

In a child requiring management of their primary dentition the following should be considered: 1. That the treatment provided reflects the degree of symptoms or wear experienced ; 2. Glass ionomer or composite direct veneers of anterior teeth to address aesthetics; 3. Stainless steel crowns (SSC) or glass ionomer restorations on the occlusal surfaces of primary molars, where it is not possible to place SSC. Orthodontic separators between molars will assist placement of SSC. No tooth preparation is required to undertake this treatment, assuming the dentition is caries free. In an anxious or young child compromise may be necessary.

Mixed Dentition

The permanent teeth will also be affected by AI and need to be assessed and possibly protected as soon as is practicable. Management considerations at this stage are:

Gold onlays/crowns (depending on the clinical indication or sensitivity of the teeth) or SSC for first permanent molars when they have fully erupted. SSC require less cooperation from the child and also have the advantage of being completed in one visit. However, gold restorations will be more definitive and the margins can be kept supragingivally to aid hygiene and gingival health.

Teeth can take a protracted time to erupt and thus damage can occur while waiting. In this situation, one may need to consider placing glass ionomer occlusally until full eruption or in protracted cases, consider excising the residual operculum to expose the whole crown and then proceed with restorations

For permanent incisors direct or indirect composite veneers will improve aesthetics, reduce sensitivity and reduce incisal wear. Direct composites have the advantage that they can be started as soon as there is sufficient tooth erupted and added to as further eruption occurs. However, the child and parent should be warned that with continuing eruption and gingival maturation, the margins of any restoration will become visible and additional treatment will be required, at intervals, to maintain good aesthetics.

Permanent Dentition

With regard to premolars and permanent canines, it should be remembered that minimal intervention is the ideal treatment plan. If premolars are not in occlusion and they are not particularly sensitive then no intervention may be required. The aesthetics of premolars are often not a concern. When wear and sensitivity are an issue, full coronal coverage can be provided with indirect or direct composite onlays.

Canines are more likely to be an aesthetic concern in addition to sensitivity and wear. As with permanent incisors, composite can solve these problems. As with the primary dentition, permanent tooth preparation is not usually needed because one of the aims of treatment is to preserve as much tooth structure as possible. It is also important to remember immature and young teeth have very large pulp chambers. When the teeth are more developed, tooth preparation and porcelain can be considered for definitive restorations.

It is important to monitor the permanent dentition as it starts to mature. Delayed eruption and resorption of teeth need to be identified and consideration given to management. Options for resorbing teeth include extraction of the affected teeth or attempting to orthodontically extrude them before too much resorption occurs. An orthodontic option can also be considered for failure of eruption but these issues will be further discussed in the third paper of this series. Definitive management of the dentition can not occur until full dental and gingival maturity, that is, adulthood. It is the responsibility of the dentist managing the child's dental care to help maintain the dentition until that time. However, early consideration of the long term plan for the individual can ensure that one is working towards the long term objective, thus the opinions of the orthodontist and restorative dentist are valuable. Joint speciality clinics can be very useful for this cohort of children to ensure a multi disciplinary approach.

Behaviour Management

Children with AI can be dentally anxious like any other child, however, these children have the added pressures of AI. The use of behavioural management techniques and sedation will be of great value to the clinician and patient alike.¹⁰ In some children it may be the only way to achieve any treatment. Even so, some children cannot manage dental treatment of the simplest nature while awake. In children with such severe anxiety it may be necessary to consider general anaesthesia (GA). Although this may seem drastic in a child that has no infection or dental caries, failure to protect the dentition at this early stage may well result in a dentition too poor to restore in adulthood. However, one must always bear in mind that using GA is not a risk-free procedure.

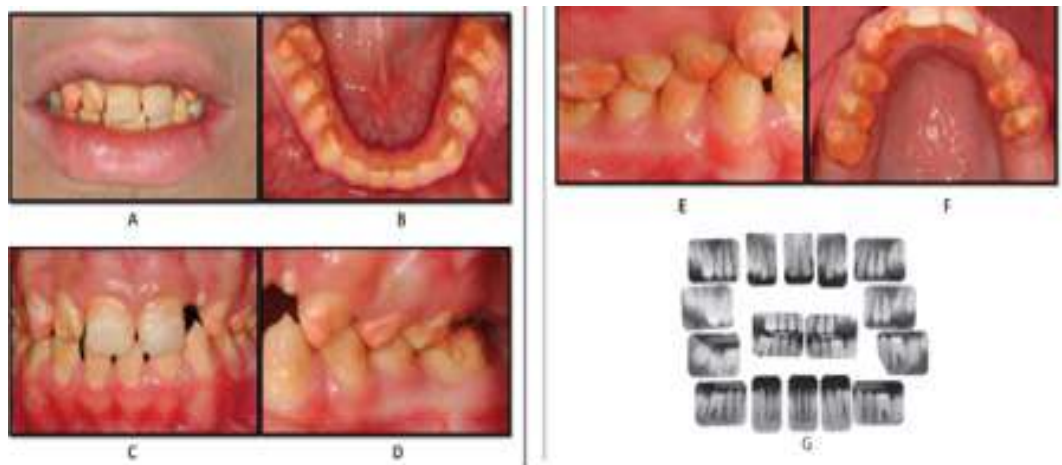


Figure 1. (a-g): Clinical views at the patient's first appointment. Two composite restorations on the upper central incisors as well as glass ionomer cements in posterior areas can be seen in these photos. The last image represents the corresponding treatment status.



Figure 2. (a-e): Intraoral view of the conservative preparations for resin composite onlays and clinical view after posterior onlays placement.



Figure 3. (a-h): Intraoral view of the preparations for freehand bonded composite restorations and clinical view after teeth rehydration. Last image shows the clinical view after the placement of a cantilever bonded bridge 22-23



Figure 4. (a-k): Clinical views at the end of the treatment, together with the final treatment status at the 3-month recall. Except for the lithium disilicate bridge from 21–23, all other teeth are single-unit lithium disilicate bonded crowns. The last image represents the final radiographic status.

DISCUSSION

As with all children, initial experience of the dental profession plays a part in their cooperation for the future. Children with AI often require extensive dental treatment throughout their lives, therefore it is essential to ensure the initial experiences are positive. However, this can be hard to achieve when a child may be experiencing sensitivity when brushing their teeth and eating/drinking cold things. Seeing a child as early as possible will enable the clinician to build up a rapport with the child and parents/carers.

Consideration needs to be given as to when and how appointments are arranged to try and support the family, as multiple visits will impact on schooling and be a challenge for working parents. Naturally, a parent will want what is best for their child and in some cases, may put pressure on the child and clinician to achieve the ideal. This can be a very difficult situation for all involved and the clinician may have to become an advocate for the child. The study from Coffield *et al.* demonstrated that AI has a detrimental effect on perceived wellbeing in adulthood,⁶ which may also be the case in childhood. However, it is imperative to look towards the long term goal of a well-adjusted dental patient who has a pain free, aesthetic dentition in adulthood rather than creating a dental phobic.

Children with AI can have high dental needs and may present many dental challenges. Understanding, patience, behavioural management skills and sedation are valuable tools for helping a child to maintain their dentition. Ensuring a child is pain free is essential. However, improvement of aesthetics is probably greeted with as much enthusiasm by the child and family. Prevention of excessive wear should also be a priority to ensure that there is sufficient dentition to restore in adulthood. A multi disciplinary team involving general dental practitioners, paediatric dentists, orthodontists, restorative colleagues, therapists and hygienists can be beneficial in managing this cohort of patients.²

The rehabilitation treatment is indicated in paediatric patients with AI. It is important to ensure the development of the craniofacial as well as psychology aspects of the children. The main goal of this treatment is to improve the quality of life, which includes improving the function, protecting the enamel structure, and reducing the sensitivity.¹⁶ Additionally, the treatment proposed is to improve the aesthetic aspects.¹⁶ The treatment planning for AI is complex and varies according to the patient's age, symptoms, type and severity of the defect, and the intraoral situation at the time the treatment.

Adhesive treatment is modern dentistry's answer to more invasive prosthetic approach. Bonding procedures have been demonstrated to be a solid tool on which dentists can stand and believe. Resin composite allowed for minimal intervention in this severely compromised case where teeth were affected by amelogenesis imperfecta.¹⁷ The composite resins crowns for posterior teeth allowed a better relationship between the upper and lower arches, protected the enamel structure, and promoted an adequate vertical dimension for the patient, improving the masticatory function. This is an adequate treatment until the ideal age and development of the dental structure for a definitive rehabilitation. Cost-effective restorative techniques involving these composite-resin crowns were previously shown for

the restoration of a young patient with amelogenesis imperfecta.¹⁸

Another treatment option is the use of steel crowns, that is, an extremely durable restoration, being indicated for several clinical situations, such as large carious lesions involving multiple surfaces and children with high caries risk. However, present some disadvantages, such as its use in primary teeth and lack of esthetics.¹⁸ During this first restorative phase minimally invasive dentistry was performed, only the most external, porous enamel layer was removed before resin composite placement. At the end of the hard and soft tissue development, an adhesive fixed prosthetic approach was chosen in order to finalize the restoration, always keeping in mind to sacrifice only a minimum of tooth substance. The main advantage of the presented two-stage adhesive approach is that resin composite restorations require almost no maintenance except common polishing procedures. This is a very favorable intermediate solution while waiting for completion of the patient's soft and hard tissue maturation.¹⁷

Furthermore, the first stage can be used as a testing period to check oral hygiene and to determine the definitive form and shade of teeth to be restored. Composite material has some advantages when compared with ceramic restorations: It is less expensive; it allows a direct approach, thus avoiding costs of a dental technician; and it is easily repairable. On the other hand, ceramics may be superior to resin composites in terms of aesthetic, gloss durability, and plaque accumulation. That is why as soon as the patient reached complete soft and hard tissue development, a fixed-adhesive prosthetic approach was used.^{17,19}

With respect to the choice of the ceramic material, among all different products on the market, lithium disilicate crowns were preferred due to their clinical and mechanical advantages. They exhibit high durability, do not appreciably wear the opposing natural dentition, and have already proven that they may be used in clinical situations with promising results. Furthermore, the use of bonding procedures for disilicate crowns have already shown to increase clinical success, offering stable, esthetic, and natural-looking restored teeth to patients.¹

Specific Treatment Considerations

In the primary dentition, the dental treatment of affected children aims to ensure favorable conditions for the eruption of the permanent teeth as well as for the normal growth of the facial bones and the temporomandibular joints. Upon eruption of the primary molars stainless steel crowns are placed to prevent the development of caries and the attrition of defective enamel, while maintaining adequate space and vertical dimension of occlusion.⁴

In the primary anterior teeth, polycarbonate crowns, resin modified glass ionomers (RMGI), prefabricated crowns (stainless steel crowns with or without esthetic facing) or direct composite resin can be used as alternative restorations. In the mixed dentition, the treatment goals are to preserve tooth structures, maintain tooth vitality, decrease tooth sensitivity, vertical dimension, and improve esthetics.⁴

When permanent first molars and anterior teeth erupt, orthodontic and prosthetic assessment is essential. However, rehabilitation in the mixed dentition is complex, since

teeth have different eruption sequence, and definitive treatment cannot be rendered until complete eruption of the permanent dentition. As for permanent molars, stainless steel crowns are often recommended because they provide sufficient and stable vertical dimension of occlusion. In addition, casting onlays bonded onto the posterior teeth and composite resin restorations on occlusal surface have also been used as conservative approaches to increase vertical dimension of occlusion.⁴

Several treatment modalities have been reported to improve dental esthetics. Direct or indirect composite resin veneers may be used to mask the discoloration and improve the crown morphology and contact with adjacent teeth. Also, full-coverage adhesive composite resin or polycarbonate crowns have also been advocated.⁴ In the permanent dentition, the final treatment objectives are to diminish tooth sensitivity and to restore vertical dimension of occlusion, function, as well as esthetics. The final treatment often starts as soon as clinical height of the crown and the gingival tissue have been stabilized and the pulp tissues have receded. Full mouth rehabilitation combined with a multidisciplinary approach may be advantageous.⁴

Treatment could also include orthognathic surgery. Crown lengthening and gingival recontouring may be indicated in case of short clinical crowns and gingival hyperplasia. Orthodontic treatments may be used to close interdental spaces prior to restoration and correct the anterior open bite malocclusion. Root canal therapy is indicated when pulp exposures are caused by severe attrition or tooth reduction. Orthognathic surgery may be indicated in case of severe malocclusion. Consultation with the appropriate specialists may help in developing a comprehensive treatment plan for each individual.⁴

In patients with hypocalcified AI, there is insufficient enamel for bonding. Glass ionomer cements and composite resin restorations might initially be successful, but the long term prognosis is guarded as the hypocalcified enamel may fracture, causing defective margins and broken restorations. Full coverage restorations are commonly recommended for hypocalcified AI. In case of hypomaturation AI, the defective enamel contains excessive organic matter that overtime becomes porous and stained; the defective enamel should be removed before placement of restorations.⁴

There are a number of alternatives for the treatment of teeth affected by AI. The treatment of patients with AI presents an interesting challenge to the dentist. The main clinical characteristics are extensive loss of tooth tissue, poor esthetics, and tooth sensitivity. The treatment plan usually varies and many factors have to be taken into consideration—age of the patient, socioeconomic status, and severity of the disorder.

The need for crown lengthening is dictated by dental and patient factors. After crown lengthening it should be possible to put restoration margins above, or at, the gingival margin. It is well documented in the literature that this creates a more favorable condition to allow periodontal health. It was found that margins of fixed prosthodontics significantly compromise the gingival health, if placed below the gingival margin. In a study it was found that subgingival margins demonstrated higher plaque, gingival index scores, and probing depths. In addition, when the bacterial morphotypes were examined,

there was an increase in the spirochetes, fusiforms, rods, and filamentous bacteria. There is an additional benefit of ease of impression taking, cleansing, and detection of secondary caries. Hence, periodontal health is the cornerstone of any successful restorative procedure. Therefore, the correct handling of the periodontal tissues during restoration of the tooth is important to the restoration's future success. Thus, it is necessary to prepare periodontal tissues properly before restorative treatment to ensure good form, function, and esthetics of masticatory apparatus and patient comfort. In time bad quality restorations alters the periodontal tissues. Precision of restorations as well as relationship with the periodontium is important. Sometimes even precise restoration can induce inflammation of the periodontal tissue. It is important to know what gingival biological width is, what happens when it is altered, what is lengthening of the clinical crown, and when it should be done. In order to avoid pathologic changes and to predict treatment results more precisely, it is necessary to keep gingival biological width unaltered during teeth restoration. If there is less than 2 mm distance from restoration's margin to marginal bone clinical crown lengthening possibility should be considered in dental treatment plan. The choice depends on the relationship of crown–root–alveolar bone and esthetic expectations. The clinical tooth crown could be lengthened surgically or by combining the methods of orthodontic eruption and surgery.

This clinical report describes a treatment sequence based on an interdisciplinary approach. The treatment is usually combined to meet the biological, restorative, and esthetic requirements imposed by short clinical crowns. This technique is generally used to improve esthetics and takes the form of a gingivectomy, to excise the soft tissue. Normally, the gingival margin is 1 mm coronal to the cementsoenamel junction. If it is greater, then the clinical crown is shorter than the anatomical crown. In thin tissue biotypes, a gingivectomy will expose more of the crown and improve the appearance. It may be achieved with a scalpel, or with the use of electrosurgery.⁶

CONCLUSION

The advance in techniques and increase in availability of various dental materials, many studies have shown the use of glass ionomer cements, composite resin veneers, porcelain veneers, stainless steel crowns, labfabricated crowns, and/or over dentures can restore the affected teeth. In the patients with hypoplastic AI, enamel is usually sufficient for bonding so composite resin restoration may be successful masking discoloration and improving crown morphology.¹⁷

In patients with hypocalcified AI, there is insufficient enamel for bonding. Glass ionomer cements and composite resin restorations might initially be successful, but the long term prognosis is guarded as the hypocalcified enamel may fracture, causing defective margins and broken restorations. Full coverage restorations are commonly recommended for hypocalcified AI. In case of hypomaturation AI, the defective enamel contains excessive organic matter that overtime becomes porous and stained; the defective enamel should be removed before placement of restorations.⁴

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Crown Restoration Is An Appropriate Choice For Treatment Amelogenesis Imperfecta Cases

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ABSTRACT

The existence of interference in the formation of enamel, which one can cause amelogenesis imperfecta (AI) that consisting of hypoplastic, hipocalsified or both of that. The prevalence of AI is between 1 : 700 to 1: 14.000. AI is a genetic disorder that affects the structure of enamel. In AI occurs on the tooth brittleness causing the teeth become sensitive, disorders of mastication and esthetic problem. Several choices of care and treatment given depends on the type of AI. Crown restoration is one treatment that can be given in this case. The aim of this literature to determine the effectiveness and longevity of the crown restoration treatment in children with AI. AI is a hereditary condition that affects the formation of enamel matrix and the mineralization process enamel of primary and permanent teeth. AI is a group of clinically and genetically heterogeneous conditions that affect the quantity and quality of the enamel, which can affect the overall appearance of some or all of the teeth. AI consists of 4 types : type I / hypoplastic, type II / hipomaturasi, type III / hipokalsifikasi and type IV / hipomaturasi-hypoplastic with taurodontism. The characteristics of AI as lack enamel / no enamel, pulp calcifications, malformations roots, unerupted teeth, permanent teeth impaction, progressive root resorption and crowns, and tooth sensitivity. These factors led to disruption of aesthetics and masticatory function. Some recommendations suggest treatment using a crown restoration. The crown restoration is one treatment that can be done in order to restore the esthetic and masticatory functions. This treatment can last longer compared to other conservative treatments.

Keywords: amelogenesis imperfecta, crown restoration

INTRODUCTION

Tooth enamel is the most highly mineralized structure in the human body, with 85% of its volume composed by hydroxyapatite crystals. The physiological functions and physical properties of the enamel are directly related to the composition, morphology, disposition, and the mineral components within the tissue. During organogenesis, the enamel transitions form a soft and pliable tissue to its final form that is almost entirely devoid of protein. The final composition of enamel is a reflection of the unique molecular and cellular activities that take place during its organogenesis. Deviations from this pattern may lead to amelogenesis imperfecta (AI).¹

AI is a hereditary condition that affects the formation of the enamel matrix or the enamel mineralization process of both the primary and secondary dentition. It is clinically and genetically heterogeneous group of conditions that affects both the quantity and quality of the enamel structure and overall appearance of all or nearly all the teeth. The prevalence AI varies depending on the population, which ranges from 1: 700 to 1: 14,000. AI is produced by the incomplete development of tooth enamel caused by incomplete differentiation by ameloblast.¹⁻⁹

AI can be inherited in an X-linked manner or as an autosomal dominant or recessive trait. However, there are a cases where the diagnosis of AI remains tentative in apparently sporadic cases of enamel defects. Ultimately, it anticipated that molecular genetic tools will allow more precise diagnosis. The clinical features of AI include deficiencies enamel, calcification of the pulp, malformation roots, delayed tooth eruption or not eruption, impaction of permanent teeth, roots progressive and resorption crowns, congenital tooth loss, high tooth sensitivity, low risk caries and early teeth attrition. Due to the thickness of the enamel decreases, the teeth are smaller for the lack of contact between adjacent teeth. Poor oral hygiene and breathe through the mouth associated with gingivitis and gingival hyperplasia can also been seen.^{6,8}

Classification AI

There are four main classifications of AI : (1) Hypoplastic AI, yellowish brown teeth, rough texture, and there are many gaps between the teeth. Characterized by reduced thickness of enamel. Clinically present as pitting, grooves or large enamel defects. Radiographically, normal contrast exists between the enamel and dentin. (2) Hypomaturated AI, clinically showed normal size crown and there is contact between the adjacent teeth. The teeth are yellowish brown mottled enamel and softer than normal enamel. Dentin is often exposed due to enamel chipping away from the crown of the tooth. (3) Hypocalcified AI, normal enamel thickness but rough and thin after tooth eruption. Radiographically, enamel appears less radiopaque than dentin. (4) Hypomaturational-hypoplastic with taurodontism AI, characterized by hypomaturated enamel in mottled white-yellow-brown enamel and thin in the area hipomaturational. Pthe permanent molars associated with this condition have taurodontism. In addition, other teeth may also have enlarged pulp chambers.^{1-4,9-10}



Figure 1. Hypoplastic AI



Figure 2. Hypocalcified AI



Figure 3. Hypomatured AI



Figure 4. Hypocalcified-hypomatured AI

Each type of AI has subtypes differentiated by mode of inheritance. This classification system takes into consideration 15 subtypes based on clinical features and inheritance patterns. The variability of the appearance of the different types of AI makes identification difficult. Some dentitions will appear normal to the untrained eye, while other types of AI will be disfiguring. Hypomaturation-hypoplastic with taurodontism types of AI also associated with the tricho-dento-osseus syndrome.²

Pathologies associated with AI is enlarged follicles, permanent teeth affected, ectopic eruption, congenitally missing teeth, resorption crown and/or root, and calcification of the pulp. The second molar agenesis have also been observed. Although rare in AI, enamel resorption and ankylosis have been reported. In addition, the incidence of anterior open bite was 50% in cases of hypoplastic AI, 31% in hypomaturation, and 60% in hypocalcified.¹¹

Based on classification mentioned above, there are a variety of treatments that will be given depending on the type of AI and character of the damage to the enamel. One of treatment option is crown restoration using the technique IPS e.max Press. This literature aims to determine the effectiveness and longevity of the crown restoration treatments in the case of AI.¹²

LITERATURE REVIEW

The severity of AI can vary significantly between patients and often it is difficult to make a diagnosis of the phenotype from clinical examination alone. The clinical presentation can range from mild discoloration, slight pitting, minimal post eruptive breakdown of enamel to severe discolouration, pitting or significant tooth surface loss due to rapid post eruptive breakdown of hypomineralised enamel.⁴

Most patients with AI will first present to a general dental practitioner whose role in the management may involve a timely referral to the paediatric or restorative specialist, depending on the patient's age. This may be for treatment of complex cases or for treatment planning and advice in management of simpler cases. The pediatric specialist's role in the management of AI is to provide support and reassurance to the child and parents, motivate the child to maintain good oral hygiene and diet, preserve tooth structure and esthetics and prevent pain, pathology and early tooth loss. The treatment provided by the pediatric specialist can be referred to as a transitional phase. Once the patient reaches late adolescence or early adulthood they are often referred to restorative specialist for life long management of their dentition in conjunction with the patient's general dental practitioner via a shared care approach.⁴

Clinical Manifestation of AI

Although AI influence the formation of enamel, various clinical manifestations may also arise, such as low caries, rapidly attrition, excessive deposition of calculus, and gingival hyperplasia. Clinical severity varies from each type of AI. Low caries has been reported in children with severe hypoplastic type and hypomineralized AI. Lost contact proximal and rapid attrition is generally associated with hypoplastic AI which contributes to the low

caries occur. Rapid and excessive calculus formation has been reported as a common finding associated with the type of hypomaturation and hypocalcified AI. The factors that contribute to excessive accumulation of calculus is rough enamel surface, salivary flow rate, composition, oral hygiene capabilities are the result of secondary tooth sensitivity and oral microflora changed. In addition, the condition of the gingiva and poor oral hygiene among patients with AI have been reported. It can be assumed that the morphology of the teeth and poor oral hygiene can accelerate the accumulation of plaque or increase tooth sensitivity, so that becomes a challenge for tooth care providers.¹⁰

Patients with AI also has an ugly esthetic, tooth sensitivity, and decreased occlusal vertical dimension due to loss of tooth structure. Patients with AI also have an disruption a masticatory function because the sensitivity of teeth and short clinical crowns caused by attrition and/or full eruption. Unfortunately, restorative treatment for patients with AI often are not done at an early age because the problems related to tooth sensitivity, difficulties in managing long-term care needs and costs. Deep bite, short clinical crowns and the changing dimensions of mesiodistal dental treatment complexity resulted.¹⁰

Restorative Treatment Options

Treatment options available to restore patients with AI vary considerably depending on several factors such as age of the patient, patient motivation, periodontal condition, endodontic status, loss of tooth structure, severity of disorder, socioeconomic status and most importantly the patient's availability for treatment and cooperation. Often these patients preent young and want a quick result which will improve the appearance of their teeth allowing them to be accepted by their peers and society in general. However, adopting a stepwise approach is essential to help preserve and retain the patient's own teeth for as long as possible and avoid or delay the need for prosthetic replacement.⁴

Based on the literature has been presented, there are several different treatment options is the use of the use of glass ionomer cements, composite resin, stainless steel crowns, lab-fabricated crowns, and even multiple extractions necessitating an overdenture. In recent years, the development of all-ceramic restorations has made it possible to make crown restorations with quality and longevity comparable to metal-ceramic crowns. Recently, high-termed pressed lithium disilicate glass crowns (IPS e.max Press) showed similar clinical outcomes to presintered zirconium dioxide covered by porcelain (Procera AllCeram) and metal- ceramic crowns. Procera and IPS e.max Press have different properties. In Procera, the tendency for chipping is higher, transparency lower, and the need for thickness of material higher, as more tooth material needs to be removed. However, IPS e.max Press has a transparency that can restore the color.^{1,11,13}

IPS e.max Press methods and Procera crowns showed higher survival rate than composite resin restorations in group AI. Previous high survival rates have been shown in the treatment using the Procera Zirconia. Empress veneers, partial coverage restorations and full crowns have a survival rate was significantly shorter than the IPS e.max Press and Procera crowns filled with Zirconia Inner Copings.¹¹

In the technique IPS e.max Press the amount of tooth substance to be removed is less than the metal-ceramic combinations. IPS e.max Press using interdental spaces before the mesial movement of the teeth, tooth substance decline, especially in patients with thin enamel. History of dental trauma can disrupt cell capacity of the pulp to make preparation. The results showed that there is an increased risk of complications in the dental pulp is experiencing trauma.¹¹

IPS e.max Press is a lithium disilicate glass- ceramic ingot for use with the press technique (Fig. 1). The ingots are available in four degrees of opacity. These ingots have been developed on the basis of a lithium silicate glass ceramic. The ingots are produced by bulk casting. A continuous manufacturing process based on glass technology (casting/pressing procedure) is utilized in the manufacture of the ingots. This new technology uses optimized processing parameters, which prevent the formation of defects (pores, pigments, etc) in the bulk of the ingot. As lithium disilicate glass ceramic and zirconium oxide (IPS e.max ZirCAD) feature a similar coefficient of thermal expansion, the same layering ceramic (IPS e.max Ceram) can be used in conjunction with both of these materials. IPS e.max Press is processed in the dental laboratory with the known Empress pressing equipment. This equipment is distinguished for providing a high accuracy of fit.^{14-15,17}

IPS e.max Press consists of a selection of press equipment and software CAD/CAM for lithium disilicate can be suppressed from the form of ingots or molded from block form. First of all teeth cleaned, then printed out in order to get the model. Then the design is made by using wax teeth. Technicians also can make design computerized/digital by using software CAD/CAM. Once the design is finalized teeth, and then pressed by using ingot that has been melted down and incorporated into a press machine. We can selected one of the four kinds of the ingot in order to obtain a more esthetic result depends on the technique to be used in order to adjust the adjacent teeth. After the ingot in the press using a machine, then obtained the results desired crown. After that the crown is cleaned and trimmed again into anatomic shape and in cemented on teeth that have been preparation.¹⁷



Figure 5. The system are used for the scan, design, and milling of the veneer restorations

An advantage of the IPS e.max Press are (1) high-strength materials for long-lasting clinical results; (2) lifelike esthetics; (3) four different levels of opacity of the ingots for maximum flexibility; (4) minimally invasive, accurately fitting restoration; (5) selection of cementation depending on the indication.¹⁷ When comparing groups of Procera and IPS e.max Press, Lundgren, et al¹⁴, they found no differences related to age at crown therapy, types of AI, gender, history of trauma, or apical status. Based on the quality criteria of the California Dental Association, there are no significant differences between the quality of Procera crowns and IPS e.max Press after 2 years.¹⁴ The advantage of using a treatment crown restorations that growth and development of the jaws to be better, better esthetics, strength longer and can maintain the vertical dimension.

DISCUSSION

The current guidelines for restorative treatment in children and adolescents is recommended to cover the surface with direct composite resin or composite resin veneers to adulthood and recommend stainless steel crown for the first permanent molars. But the longevity of this restoration seems to be limited, so frequent replacement of restorations failed. One study reports significantly worse said bond strength on enamel for restoration in the form hipomineralisasi / hipomaturasi of AI.⁶

The main goal of treatment is to solve every problem but with a comprehensive treatment plan for the overall care needs in the future. A comprehensive approach and timely needs to be done to reassure the patient and family in order to get a good treatment. The preventive maintenance that can be done that early identification. Periodic checks regularly can identify the teeth requiring treatment at the time of eruption. It is need a good oral hygiene, removal of calculus, and the use of mouthwash in order to improve periodontal health. Application of fluoride and desensitizing agents can reduce the sensitivity of the tooth.²

Restorative treatment is required for the performance, quality, and number of enamel and dentin affected. Will determine the type of restoration that is required in order to obtain an aesthetic function, mastication, and functional health. When the enamel is intact but change color, bleaching can be done to improve the appearance. If the enamel occurs hypocalcified, then treatment with composite resin or porcelain veneer can be done.²

During the primary dentition, it is important to restore the teeth for adequate function and to maintain adequate arch parameters. Primary teeth may require composite or veneered anterior crowns with posterior full coverage steel or veneered crowns.² The permanent dentition usually involves a complex treatment plan with specialists from multiple disciplines. Periodontics, endodontics, and orthodontics may be necessary and treatment could include orthognathic surgery. The prosthetic treatment may require veneers, full coverage crowns, implants, and fixed or removable prostheses. The fabrication of an occlusal splint may be needed to reestablish vertical dimension when full mouth rehabilitation is necessary. Therapy will need to be planned carefully in phases as teeth erupt and the need arises.²

Conclusion

There are various kinds of treatment options in patients with AI. The various kinds of treatment options, crown restoration treatment options are often used. Crown restoration is one treatment that can be done in order to restore the esthetic and masticatory functions. This treatment can last longer compared to other conservative treatments.

IPS e.max Press is a restorative choice. Dentists and technicians now have the material to do restorations in the anterior or posterior teeth. With four different opacities or translucencies available, various choice of esthetic restoration can be done. Dentists and technicians now have the opportunity to be more creative to the patient.¹⁷

From a various selection of restorative on AI, there are a variety treatment for the patient with AI. Proper diagnosis and specific treatment for each patient with AI can provide treatment maximum results.^{6,7}

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Pre-Eminence Of Giomer As Restoration Material And Caries Prevention In Children: A Literature Review

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ABSTRACT

Researchers are still trying to develop the most ideal restorative materials to replace the missing tooth tissue. Glass ionomer cement (GIC) is best known as restorative material that used for caries prevention, with the ability to release high fluoride but has a weakness in the mechanical strength. The latest restoration development to overcome the disadvantages of glass ionomer cement (GIC), known by the name of Giomer. Giomer, a restorative material developed by PRG (Pre-reacted Glass ionomer) technology, combines the advantages of composite and caries prevention capabilities of conventional glass ionomer. Merging of the two materials make giomer as a superior restorative material. This literature review will discuss the advantages and application giomer as a restorative material and prevention of dental caries children through a review of literatures and journals research collected. In conclusion, Giomer, a restorative material that was developed with the latest technology through the reaction of the filler pre-reacted glass ionomer (PRG) is most effective in preventing dental caries because it can increase the remineralization, prevent adhesion of plaque that is appropriate for pediatric patients with a high caries risk.

Keywords : Giomer, Restoration, Caries Prevention, Pre-Reacted Glass Ionomer (PRG)

INTRODUCTION

Dental caries is one of the most common diseases and generally occurs in all countries. Results from the US National Health and Nutrition Examination Survey show that caries is the most common chronic disease in children.¹ According to data from World Dental Federation (FDI) the number of dental caries throughout the world, especially in industrialized countries reaches 60% -90% in school age children.² Data from the National Institute of Dental and Craniofacial Research (NIH) shows the prevalence of dental caries

in America for primary teeth of children ages 2 to 11 years are 42% and for permanent dentition ages 6 to 11 years at 21%.³ In Indonesia, the data collected by the National Health Research (Rikesnas) in 2013 obtained dental caries ages 1 to 4 years are 10.4%, 28.9% for 5-9 years, and 10-14 years are 25.2 %. The statistics show the high level of caries in children.⁴

Dental materials most commonly used as a prevention and restoration of children's teeth is a Glass Ionomer Cement (GIC). Two main properties of GIC that make these materials accepted as one of the dental materials, because of its ability to bond chemically to the enamel and dentin through ion exchange mechanism and because their ability to release fluoride so as to eliminate the sensitivity and prevent secondary caries.^{5,6} Unfortunately, GIC also has weakness as it's porous, low mechanical resistance, especially on the occlusal, soluble and less aesthetic.^{5,7}

One of dental restorative material that is able to overcome the lack of GIC is a composite resin. Composites have tooth-colored aesthetic properties, better resistance than the GIC, and unsoluble easily. There is a polymerization shrinkage which can cause secondary caries. It becomes shortage of these composite resin restorations.⁸ Researchers are still trying to develop the most ideal restorative materials to replace the missing tooth tissue. The search for a material that has the fluoride releasing capability of conventional glass ionomer and the durability of composites led to the introduction of polyacid modified composite or compomers.^{9,10} Compomers as a material that polymerizes by light activation for strength, followed by slow acid-base reaction. This material is capable of releasing fluoride, but lower than conventional glass ionomer and does not have the ability to recharge fluor.¹⁰

A new different material from the resin modified glass ionomer and composites have been developed. The material is introduced by Shofu Inc. (Kyoto, Japan in 2000) named Giomers, in which they created a stable Glass-ionomer phase on a glass core in which they induced an acid-base reaction between fluoride containing glass and polycarboxylic acid in the presence of water-developed as Pre-Reacted Glass-ionomer (PRG) filler. Robert et al first remarked the fact that the fluoride releasing mechanism of glass ionomer cement was derived from its acid-base reaction phase between ion leachable fluoroaluminosilicate glass and polyalkenoic acid in permeable polyalkenoate matrices, and newly developed a revolutionary Prereacted glass ionomer (PRG) filler technology. So the fluoride ion release was because of the formation of the acid base reaction phase on the surface of the glass core.¹⁰

This PRG technology was applied to the filler component of resin composite materials to provide a bioactive result that released and was recharged with fluoride-like a traditional glass ionomer cement-all the while maintaining the original physical properties of the resin composite system, has aesthetic color of natural teeth, reduce micro leakage and were able to increase the release of fluor compared with other resin materials.^{9,10}

This paper will discuss the advantages and applications giomer as a restorative material and prevention of dental caries in children. The literature review was collected through articles, books and research journals.

LITERATURE REVIEW

Giomer is a fluoride-releasing, resin-based dental adhesive material that comprises PRG fillers. PRG fillers are fabricated by the acid-base reaction between fluoroaluminosilicate glass (FASG) and polyalkenoic acid (PAA) in the presence of water to form a wet siliceous hydrogel. PRG fillers can be composed of pre-reacted siliceous hydrogel are able to achieve high levels of fluoride release and giomer recharge. Fluor in this reaction has a function to reduce the solubility of tooth mineral and decrease acid production of cariogenic bacteria.^{10,12}After freeze-drying, the desiccated xerogel was further milled and silanized to form PRG fillers of a specific size range about 0,01 dan 5 µm.¹³

Thus, Giomer material has been introduced as the true hybridization of glass ionomer and composite resin, containing surface pre-reacted glass ionomer (SPRG) filler particles within a resin matrix so that the core glass is protected from humidity. Giomer combines the fluoride release, recharge of GIC and the esthetics, physical and handling properties of composite resins.^{11,12} The PRG-fillers depending on the degree of reaction of the glass ionomer with the acid are divided into two types, and are included into the formulation of giomer products. S-PRG, the reaction is detected in surface-loans and are called surface reaction (surface reaction type, S-PRG fillers). F-PRG, the reactions proceeded throughout and called are complete reactions (full reaction type, F-PRG fillers), to make the production of F-PRG- the presence of large quantities of water. The use of both types of PRG fillers promote rapid fluoride release through a ligand exchange within the prereacted hydrogel. So the F-PRG, fillers would release a huge amount of fluoride as the core of the particle is completely reacted unlike in the S-PRG fillers, the F-PRG would degrade faster than S-PRG fillers. The further advantage of S-PRG is that it releases five ions other than fluoride which have beneficial properties. The ions are Al, B, Na, Si, Sr ions.¹⁰

Table 1. The basic composition contained in Modified Resin, Resin Modified Glass ionomer, and Giomer¹⁵

Material	Number of components	Require mixing	Active ingredients
Modified composites	1 or 2	2 components – yes 1 component – no (compomers)	Fluoroaluminosilicate glass Methacrylate resin* (acid modified) Activators/initiators/stabilizers
Resin-modified glass ionomers	2 or 3	Yes	Fluoroaluminosilicate glass Methacrylate polyacid Hydroxyethylmethacrylate (HEMA) Water Activators/initiators/stabilizers
Giomer	1	No (single paste)	Aluminosilicate glass pre-reacted with poly acid Dimethacrylate resin matrix

* Acid-modified products referred to as acid-modified composites.

Figure 1. Average of fluor ion release from each materials for 38 days¹⁶

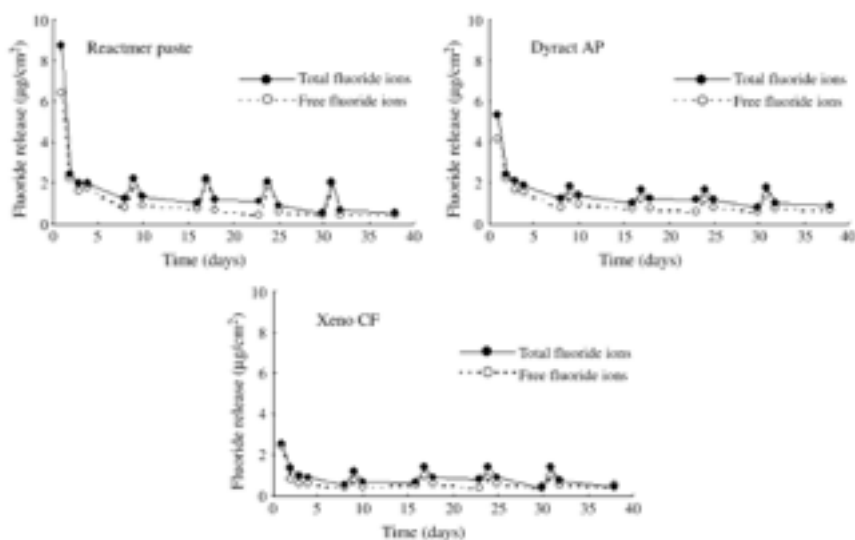


Table 2. Composition of several types of Giomer¹¹

Giomer material description	Material name	Composition	Manufacturer & website
A nano-hybrid composite with fluoride release and recharge	Beautiful II	Base resin: Bis-GMA (7.5 wt%)/TEGDMA (5 wt%) resin Filler: Multifunctional glass filler and S-PRG (Surface Pre-Reacted Glass-ionomer) filler based on fluoroboroluminosilicate glass. Filler loading: 83.3 wt% (68.6 vol%) Particle size range: 0.01–4.0 µm Mean particle size: 0.8 µm DL-Camphorquinone	Shofu, Kyoto, Japan. www.shofu.com
A flowable nano-hybrid composite with fluoride release and recharge	Beautiful Flow Plus. F00	Base resin: Bis-GMA (15 wt%)/TEGDMA (13 wt%) resin Filler: Multifunctional glass filler and S-PRG filler based on fluoroboroluminosilicate glass. Filler loading: 67.3 wt% (47.0 vol%) Particle size range: 0.01–4.0 µm Mean particle size: 0.8 µm DL-Camphorquinone	
A self-etching fluoride releasing two step adhesive system	FL-Bond II	Primer: Carboxylic acid monomer, Phosphonic acid monomer, 6-MHPA, Water, Solvent, Photo-initiator Adhesive: HEMA, UDMA, TEGDMA, 40% fluoride releasing and recharging S-PRG filler. Photo-initiator.	

Bis-GMA: bisphenol-A-diglycidyl methacrylate; TEGDMA: triethyleneglycol dimethacrylate; 6-MHPA: 6-methacryloxyhexyl 3-phosphonoacetate; HEMA: 2-hydroxyethyl methacrylate; UDMA: urethane dimethacrylate; S-PRG filler: Surface pre-reacted glass-ionomer filler.

Recently, improvement on the PRG technology has been developed that resulting in the development of Modified “S-PRG filler” which consists of a Three-layered structure with an original glass core of multifunctional fluoro-boro-alminosilicate glass and two-surface layers that form a pre-reacted glass-ionomer phase on the surface of a glass core and a reinforced modified layer that covers the surface of pre-reacted glass-ionomer phase.

This trilaminar structure forms a type of stable glass ionomer which allows ion release and recharge to take place, while protecting the glass core from the damaging effects of moisture, greatly improving long-term durability. Fujimoto demonstrated that the new fluoride releasing restorative system with modified S-PRG filler also releases the F-ion as well as other ions such as Al, B, Na, Si, and Sr.¹⁰

Composition

This product is similar to modified composite except in acid-base reactions are completed prior to mixing with the resin filler. The aluminosilicate glass is reacted with polyacid in order to form a pre-reacted glasspolyalkenoate complex. The essential nature of the full reaction material are some of hydroxyethyl methacrylate reaction is needed in order to allow the mixing of the hydrophobic resin with glass fully reacted.¹⁵

The principle of the formulation and manufacturing process is that fluoride is released from the glass particles during the acid-base reaction and when the glass polyalkenoate complex is blended with resin the fluoride becomes available for release. In the surface reaction products only the surfaces of the glass particles are consumed and for these products the mechanical reinforcing effect of the filler particles is given priority over fluoride release. For the full reaction products fluoride release is prioritized at the expense of mechanical properties.¹⁵

Characteristics of Giomer

The characteristic of giomer can be divided into biological properties, physical / Mechanical properties, and optical properties

Biological properties

Biological properties that are included in giomer's characteristics include the release of fluoride and fluoride recharge, ion release and modulation effects, antibacterial, and adhesion of streptococcus mutans biofilm, cytotoxicity. Preston and Han reported that the ability of a material to exhibit fluoride recharge depends on its ability to retain fluoride. The recharge ability is governed by the number of sites available within a material able to retain absorbed fluoride. Fluoride release provide more sites which are available and take effect of fluoride recharge.^{10,15}

A study conducted by Naoum 2011, compared the fluoride release and recharge between different fluoride releasing materials and reported that the fluoride release and recharge was maximum for giomer products. But Fuji IX Extra (glass ionomer) demonstrated greater fluoride release and recharge compared to the other three composite and giomer as well. This could be explained on the basis on resin matrix that is permeability, hydrophilic nature of matrix which encompasses the filler particles.^{10,12}

Effect modulation by ion release S-PRG filler is capable to release six different ions, such as Na⁺, BO₃⁻, Al³⁺, F⁻, Sr²⁺, SiO₂⁻.

Adherence of streptococcus mutans/Anti-plaque effect

The colonization of dental plaque by *S. mutans* plays a causative role in dental caries. Nishio and Yamamoto 2002, Found that fluoride released from S-PRG fillers was connected with the prevention of plaque accumulation on the surface of experimental resin composite containing S-PRG fillers. Other commercial composite resins showed matured plaque on their surfaces after 24 hours compared to giomer. On the surface of a tooth restored using Beautifil II a “material film” layer is formed by saliva that is reported to minimize plaque adhesion and inhibit bacterial colonization. Although this “material film” layer may be removed by brushing, subsequent layers are reproduced by saliva. Therefore S-PRG filler has a function of inhibiting plaque accumulation.^{10,12}

Recently, an in vivo experiment showed that less dental plaque was formed on S-PRG-containing resin materials than on two alternative materials. In addition, the adherence of *S. Mutans* to the saliva-treated resin surface was significantly lower on the S-PRG-containing resin than that on the other two materials, despite none of the materials possessing significant bactericidal activity. From these results, we can conclude that S-PRG can inhibit *S. Mutans* in both solid resin and soluble forms.¹⁰

Cytotoxicity

It has been revealed that the low initial pH of dental materials may lead to cytotoxic reactions. Since giomer employs prereacted glass ionomer technology, the fluoroaluminosilicate glass reacts with polyalkenoic acid in water prior to the inclusion into silica-filled urethane resin, it seems that the initial pH in giomer does not decrease as much as that of resin ionomer and conventional GIC. A study demonstrated that the resin modified glass ionomers maintained a low surface pH for at least the first 60 min of setting. Huang et al. had demonstrated that resin-modified glass ionomer cement was cytotoxic to cultured human gingival fibroblasts by inhibiting cell growth, attachment and proliferation. In vitro study reported that giomer composite is a non-toxic material for human gingival fibroblasts.¹⁰

Physical properties/mechanical properties

Giomer has physical and mechanical properties with shear bond strength =12.39 Mpa, vickers hardness: 62 Hv, wear resistance: 0.52 wt%. Study conducted by Quader, reported

Table 3. Ion release and modulation effect¹⁰

Ions Released by S-PRG Filler		Bioactive Properties
Na ⁺	Sodium ion	Water soluble/induces the function of 5 other ions
BO ³⁻	Borate ions	Bactericidal activity/ Promotion of bone formation, prevention of bacterial adhesion, antiplaque properties
Al ³⁺	Aluminium ions	Control of hypersensitivity
SiO ²⁺	Silicate ion	Calcification of bone
Sr ²⁺	Strontium ion	Effect of neutralization and acid buffer, promotes formation of bone tissue and calcification/ Improves of acid resistance
F ⁻	Fluoride ions	Creation of fluoroapatite (formation of acid insoluble crystals- caries prevention, antibacterial effect, Remineralization in decalcifies lesions

the Comparative Compressive strength of Giomer, Compomer and Composite (246 Mpa, 151.943 Mpa and 146.265 Mpa respectively).^{10,15} The flexural strength values for a range of resin modified glass ionomers and modified composites are given in Table 4 along with the minimum values required in the ISO Standards. Some of the single component acid-modified composites have a strength value which clearly satisfies the requirement of ISO 4949 for resin-based materials. In general terms, incorporating increasing amounts of resin in a glass-ionomer system does seem to have the effect of strengthening and toughening these otherwise brittle materials.¹⁵

Table 4. Flexural strength (at 24 hours) of resin-modified requirements of ISO 9917-2 and ISO 4949.¹⁵

Material	Components	Mixing	Flexural strength (MPa)
Resin modified glass ionomers	2	Yes	25-60
	3	Yes	65-80
Modified composites	2	Yes	35-40
	1 ^a	No	100-120
Giomer - full reaction type	1	No	70
Giomer - surface reaction type	1	No	110
Requirements of ISO 9917-2 ^b	-	-	20 (minimum)
Requirements of ISO 4049 ^c	-	-	80 (minimum)

^a Compomers.

^b Light-activated water-based cement.

^c Resin-based filling materials.



Figure 2. After preparation and decay removal the surface is ready to be restored. A selective etching technique was used and only enamel etched. A universal dentin bonding agent applied. Thorough air thinning is done to evaporate the solvent which leads to less sensitivity and increased bond strengths.

Light curing was done for 20 seconds. A giomer flowable material (BeautiFil Flow Plus, Shofu, San Marcos CA) was placed in a 0.5 to 1.0 mm thick layer lining all dentin and cured for ten seconds. A 0.5 to 1.0 mm layer of the same highly adaptable flowable was placed on all cavosurface margins. Light curing of this material was done for ten seconds.¹⁷



Figure 3. The result is a well-sealed and polymerized dentinal and marginal surfaces. By being polymerized before the bulk fill material is placed ensures that polymerization stresses are resolved before the bulk material is placed. Separation between this layer and the bulk fill for any reason would be less deleterious to the overall success. The remainder of the restoration is ready for filling. Almost any type of material can be used at this point depending upon aesthetics and physical properties.¹⁷



Figure 4. A small amount of the flowable material was placed into the preparation and forced out as the more viscous bulk fill packable material (BeautiFil Bulk, Shofu) was squeezed in from a compule. After shaping with a #6 round high speed bur the result is a very well sealed restoration without evidence of white lines associated with stresses on the cavo surface margins.¹⁷



Figure 5. Occlusion was then checked and polishing done with a rubber cup (One Gloss, Shofu) leaving a smooth and easily maintained surface. Light curing was done again after all finishing was completed.¹⁷

Optical properties

The patented filler technology integrates the light transmission and diffusion properties of natural teeth. This enables naturally appearing restorations with even one layer. The filler structure has been developed to simulate the internal structure of natural teeth with ideal light transmission and optical characteristics. The moderate translucency and light transmission of enamel combined with the light-diffusion of dentin offers predictable aesthetics with a close shade match to natural teeth. Excellent natural shade reproduction can be achieved with a chameleon effect, using a single shade that blends well with surrounding teeth making the restoration undetectable. In aesthetically demanding cases additional shades can be used to achieve exceptional results. Fluorescence close to natural teeth and radiopacity of 3.4 AI : mm, exceptional radiopacity, 70% greater than enamel and 200% greater than dentin and 1.7 times of Enamel and 3 times higher than dentin. It has a depth of cure: 5.9 mm.^{10,15}

Indications of Giomer

Indications of giomer among others restorations of Class I, III, IV and V cavities and selectively Class II cavities, restorations in deciduous teeth, base / liner under restorations, fissure sealant, undercut blockout, restorations of fractured porcelain and composites, restoration of cervical erosion and root caries, repair of fractured incisal edges, veneers and posts, direct cosmetic repairs, pulp capping agent.¹⁰

Application procedure of giomer

One of the most efficient restoration in a clinical setting is the class I. Giomer restoration techniques are same as the composite and compomer restoration techniques. However, they can be the most challenging to achieve great margins and symptom free patients because of the so-called "configuration factor" (C-factor). Also because of the lack of walls that polymerization shrinkage can be compensated from. By using the giomer at the margins and on dentin the restoration has anti-microbial and fluoride releasing activity in those areas even if another type of bulk fill material was used. Likewise, pre-curing of the materials along the dentin and at the margins ensures complete polymerization that is enhanced with each subsequent layer that is placed and cured.¹⁷

DISCUSSION

Giomer is created with glass ionomer stable phase in the core glass by acid-base reaction between fluoride-containing glass and polycarboxylic acid in the presence of water, was developed as a Pre-reacted Glass ionomer (PRG) filler. PRG filler has excellent characteristics of the resin and glass ionomer. Giomer is known in some products such as composite resin, bonding agent, resin cements, sealants, coatings and bonding materials for orthodontic.

The main advantages of the giomer's product is the ability to release and ability to recharge fluor so as can prevent the occurrence of secondary caries. This is according

to research by Itota T, et al who described that giomer result in fluoride release in large quantities compared to the composites and compomer. Properties of glass containing fluor which is inserted into the material and the glass matrix layer surrounding the glass filler can be the reason of the research result. Recharge fluoride in giomer materials also show a better value than the composite and compomer. This is probably because the giomer material has a matrix of glass ionomer which remains around the filler particles glass.¹⁷ It is also makes giomer received as a materials in dentistry because of its antibacterial properties and can prevent the attachment of biofilm.¹⁰ Conventional glass ionomer when it compared with giomer still show superior value in fluoride release and recharge.¹⁷

Another advantage of giomer is physical properties / mechanical which is compared with two others resin materials show the most value of compressive and flexural strength for giomer.^{15,17} This is according to research Quader et al and Walia et al which show PRG-based filler resin and polymer matrix and cross reactions produce greater physical strength than the acid-base reaction of glass ionomer so that this material is suitable for occlusal restoration.^{17,18} The maximum result with a sealed margin and no visible white line in restoration is determined by operator expertise.

Filler structure which has been developed in giomer generate internal structure of natural teeth by light transmission and ideal optical characteristics that is suitable for areas that require restoration aesthetic appearance. It has been proved by several researchers who used giomer material for restoration in the anterior and posterior regions and showed a good results even after the evaluation some time. Hashimura et al have investigated the use of giomer materials in overcoming the color changes on the crown due to trauma, periapical lesions, drugs or systemic disease with a satisfactory result.¹⁹

CONCLUSION

Giomer is a special restorative material in dentistry which combines the advantages of glass ionomer and composite. S-PRG technology not only provide benefits in the mechanical strength of the composite material but also able to release ions, including fluoride and capable of recharging as a preventive effect of secondary caries. It also has the effect of anti-plaque, anti-bacterial, aesthetic value like a natural tooth appearance. The giomer advantages make this material suitable for use as a dental restorative material of children.

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Evaluation Of Apexification Treatment On Central Incisive Of Young Permanent Tooth Due To Traumatic Injury : A Case Report

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ABSTRACT

Trauma is a kind of wound which occur either physically or psychologically, caused by violence and followed by discontinuity of normal tissue function. Tooth trauma is an injury occurring on hard tissue of teeth or periodontal tissue. Tooth injury on children may be caused by trauma which occurs either on primary or permanent tooth. The commonly occurring trauma is involving the upper anterior teeth rather than the upper posterior or the lower anterior teeth. This case happen mostly due to incompetency of the lips, cheeks, and the chin. This case report explains about the treatment of young permanent teeth necrosis on traumatic injury patients. Patient is a nine-year-old girl coming to Departemen IKGA Rumah Sakit Gigi dan Mulut clinic with a chief complaint of a broken upper anterior tooth following a bike accident in a week before. On the day of the accident, there was a fracture of crown's anterior tooth, inflammation on the gum around upper left of central incisive teeth, bleeding, and ache. At the following night on the same day, the patient had been able to eat without experiencing any aches on that particular tooth. During the oral examination, there was no swell nor ache found. The patient underwent apexification treatment on 21 tooth. After 3 months time, there was thickening and barrier forming on the apex seen from the changes on the dental photo radiograph. There was no clinical complaint. The result of dental photo radiograph showed that the root of tooth 21 hadn't fully closed. Radiographic examination after 8 months of treatment showed discontinuos of lamina dura and dissolution of calcium hydroxide in root canals. Diagnosis and selection of proper dental treatment has a key rule in controlling possible complication caused by trauma on a young permanent tooth. This case is still on progress in order to obtain a maximum result.

Keywords : young permanent tooth, apexification, traumatic injury.

INTRODUCTION

Trauma is a kind of wound which occur either physically or psychologically, caused by violence and followed by discontinuity of normal tissue function.¹ Tooth trauma is an injury occurring on hard tissue of teeth or periodontal tissue. Tooth injury on children may be caused by trauma which occurs either on primary or permanent tooth. The commonly occurring trauma is involving the upper anterior teeth rather than the upper posterior or the lower anterior teeth. This case happen mostly due to incompetency of the lips, cheeks, and the chin. The frequency of trauma tends to increase when the child begins to crawl, stand up, learning to walk, and usually associated with the lack of motoric coordination.^{2,10} The prevalence of dental trauma decline in children above 5 years due to the child's motoric coordination is getting better, but it will increase again to a period of 8-12 years as well as the increase of their physical activities. Some trauma causes often occur in the period of 8-12 years are accident on the playground, bicycling, skateboarding, or during exercise such as martial arts, football, basketball, running, roller skate, and swimming.^{4,5,8} Manifestation in primary teeth trauma is more often a change of position than crown fracture. This is caused by the alveolar bone and supporting tissue is still in a period of growth and development that the tooth is easy to move. Trauma not only endanger the health of the teeth, but also affect self-esteem and quality of life as well as the patient's beliefs to keep their teeth as long as possible.^{3,8}

CASE REPORT

Patient is a nine-year-old girl coming to Departemen IKGA Rumah Sakit Gigi dan Mulut clinic with a chief complaint of a broken upper anterior tooth following a bike accident in a week before. On the day of the accident, there was a fracture of crown's anterior tooth, inflammation on the gum around upper left of central incisive teeth, bleeding, and ache. At the following night on the same day, the patient had been able to eat without experiencing any aches on that particular tooth. During the oral examination, there was no swell nor ache found.

CASE MANAGEMENT AND DISCUSSION

Physical trauma of teeth results in dentinal fluid desiccation that may cause sufficient damage to the pulp and its blood supply to result in inflammation. This immediate response results in the production of endogenous inflammatory mediators, that is, kinins, neuropeptides and prostaglandins, which increase vascular permeability, blood stasis, and leukocyte extravasations (4). The resultant compromised circulation may lead to haematogenous pulpal infection. In severe trauma with the immediate interruption of the blood supply, the pulp becomes necrotic without bacterial invasion and this occurs due to interruption of blood supply.^{6,8}

Ellis and Davey classify the anterior teeth trauma according to the amount of tooth structure is involved, in the following :⁹

Class 1 - Simple fracture of the crown-involving little or no dentin

Class 2 - Extensive fracture of the crown –involving considerable dentin, but not the pulp

Class 3 - Extensive fracture of the crown –involving considerable dentin, and exposing the dental pulp

Class 4 - The traumatized tooth which becomes nonvital-with or without loss of crown structure

Class 5 - Teeth lost as a trauma

Class 6 - Fracture of the root - with or without loss of crown structure

Class 7 - Displacement of the tooth-without fracture of crown or root

Class 8 - Fracture of the crown en masse and its replacement.

World Health Organization (WHO) recommends an application of the International Classification of Diseases to Dentistry and Stomatology applied to both primary teeth and permanent teeth, which is a damage to the dental hard tissues and pulp as follows:

Cracks crown (enamel infraction), is a fracture on email without loss of tooth structure in a horizontal or vertical direction.

Fracture complex email (uncomplicated crown fracture), is a fracture on the enamel layer only.

Complex crown fracture (complicated crown fracture), is a fracture that involve email, dentin, and pulp.

Uncomplicated crown root fracture, is a fracture involving enamel, dentin and cementum but does not involve the pulp

Complicated crown root fracture, is a fracture involving enamel, dentin, cementum and causing pulp exposure.

Fracture root (root fracture) is a fracture involving dentin, pulp, and cementum.

Intra-oral examination showed a Ellis fracture grade 3 or complex crown fracture (complicated crown fracture) (Figure 1) involving enamel and dentin, and pulp. There was no discoloration of fracture teeth, negative reaction of vitality test, and pulp polyp (Figure 2). Hyperplastic pulpitis is a form of irreversible pulpitis and is also known as a pulp polyp. It occurs as a result of proliferation of chronically inflamed young pulp tissue. Treatment involves root canal therapy or extraction.¹⁰

The size of the pulp exposure, the color, and amount of hemorrhage are important factors in diagnosing the extent of inflammation in a pulp exposed by caries. The presence of excessive^{8,11,12,13} or deep purple colored¹² hemorrhage from an exposed or amputated pulp is evidence of extensive inflammation in both primary and young permanent teeth. A true carious exposure is always accompanied by pulpal inflammation,^{8,11,13} and even a pinpoint carious exposure can be associated with pulpal inflammation ranging from minimal to extensive or even complete necrosis.¹⁴

Sometimes a final working diagnosis can be reached only by direct evaluation of the



Figure 1. Complex Crown Fracture (Complicated Crown Fracture)



Figure 2. Pulp Polyp



Figure 3. Persistent Hemorrhage from The Pulp Chamber

pulp tissue, and a decision about treatment is made accordingly. For example, if a pulpotomy is planned in a primary molar, the nature of the bleeding from the amputation site should be normal, and hemostasis should be evident after 2 to 3 minutes of light pressure with a moistened cotton pellet. Significant bleeding beyond this point indicates inflammation of the radicular pulp, and a more radical treatment such as pulpectomy or extraction should be considered. Conversely, if a pulp polyp is present and bleeding stops normally after coronal pulp amputation, a pulpotomy may be performed instead of a more radical procedure.¹²



Figure 4. A Young Permanent Tooth (21) with Wide-Open Apical Foramen



Figure 5. Radiographic Examination after 3 months Treatment



Figure 6. Radiographic Examination after 8 Months of Treatment

In the case of an immature permanent tooth, persistent hemorrhage after several minutes of sodium hypochlorite application is an indication of serious pulp inflammation, and a tooth initially scheduled for a direct MTA pulp cap may be a better candidate for a pulpotomy, apexification, or pulp regeneration.¹⁴ In the patient case, after disposing the pulp polyp, there was a persistent hemorrhage after several minutes from the pulp chamber (figure 3), so it was decided to conduct an apexification treatment. Apexification is defined as a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp.¹⁵

Radiographic examination shows a young permanent tooth (21) with wide-open apical foramen (figure 4). Advance care planning is apexification treatment with dressing calcium hydroxide. On the first visit day, the patient underwent an open access of root canal. Working length of root canal was 1 mm from the apical determined through x-rays. Disposal of pulp polyp was done under local anesthesia and excavator that had been heated. Furthermore, debridement of root canal had been done using Hedstrom file size 30 to dispose necrotic tissue. After the disposal of necrotic tissue, irrigation of root canal was conducted by 0.12% Chlorhexidin solution. The root canal was dried with paper point and calcium hydroxide paste was applied using lentulo and plugger. After all, the crown of tooth was restored with ZnOE cementbase and temporary filling.

According to Casamassimo⁷, calcium hydroxide could be used as a root canal disinfection due to the high PH and low solubility that keeps its antimicrobial effect for a long period of time. Calcium hydroxide assists in the debridement of the root canal, because it increases the dissolution of necrotic tissue when used alone or in combination with sodium hypochlorite. The tissue reaction and outcome of treating exposed pulp with calcium hydroxide has been intensively studied. When calcium hydroxide is applied to a pulp exposure, it causes superficial cell death with the result that adjacent tissues lose their structure and liquefaction necrosis occurs with squal coagulation necrosis.²³ These tissues become diffusely calcified, beneath which there is hard tissue formation^{23,24} a dentine bridge occurs at the junction of necrotic and vital inflamed tissues.²¹ It is believed that calcium hydroxide works as a low-grade irritant to stimulate the formation of hard tissue bridge.²⁵ Underlying tissues react to irritant by producing collagen, which is partially mineralized; coagulated tissues are calcified and differentiation of dentine occurs.²² Sometimes, in spite of dentine bridge formation, chronic inflammation continues, and the pulp becomes necrotic cause of presence of blood clot or the formation of an abscess within the inflamed pulp tissues. In these cases root canal treatment is indicated.²⁶ Figure 5 shows a dissolution appearance from calcium hydroxide, constriction of size the pulp cavity and root canal on the 21 tooth after 3 months treatment.

The frequency of calcium hydroxide dressing change is one of the few variables within the operator's control, which also has an effect on the speed of barrier formation. Chosack and colleagues²⁰ demonstrated that frequent replacement of calcium hydroxide dressing did not enhance either the speed or the quality of the apical barrier formation in monkeys. There are number of studies^{7,16,17} showing that, when the frequency of change was low, rapid barrier formation was seen and there were also some studies where the frequency of change was high, there was slow barrier formation. Hence it is confirmed that, if the root apex is disturbed by repeated instrumentation and dressing changes, then the time required for apex formation prolongs.¹⁸

The most common medicament used for apexification is the calcium hydroxide. The average time taken for apexification to complete using calcium hydroxide is 5-20 months.^{27,28} So in this period, how frequently the calcium hydroxide dressing should be changed is a controversy in the endodontic literature. Majority of studies have suggested that, the initial

change should be at 1 month and subsequent 3-month intervals,²⁹ while others advocate changing at 1 month and again at 6-8 month intervals until apical barrier formation takes place. Thus a single dressing is enough to induce the apical barrier formation.^{19,20} In the following case, the replacement of calcium hydroxide dressing performed at the first visit, 1st month visit, and month 3rd months visit. Radiograph on 8 months visit shows a picture of dissolution appearance of calcium hydroxide in root canals and discontinuos of lamina dura, then it has not demonstrated the success of the treatment (Figure 6).

CONCLUSION

Diagnosis and selection of proper dental treatment has a key rule in controlling possible complication caused by trauma on a young permanent tooth. This case is still on progress in order to obtain a maximum result.

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Aesthetic Rehabilitation And Dental Preventive Of The Primary Dentition Affected By Enamel Hypoplasia: Case Report

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ABSTRACT

Enamel hypoplasia (EH) is defined as a deficiency of enamel formation. This is seen clinically as pits, grooves, or generalized lack of surface enamel. Enamel hypoplasia is important clinically because it can result in increased caries susceptibility, increased wear, tooth sensitivity and poor esthetics. This type of enamel defect may also provide valuable clues about the child's early environment and may be predictive of similar disturbances in the permanent dentition. Management of dental enamel hypoplasia in the form of dental restorations and dental preventive aims to restore the function of teeth and improve esthetics. This case report aims to provide information about the characteristics of clinical, preventive treatment and rehabilitation of patients with enamel hypoplasia based on cases handled. A boy aged 2 years come to the Department of Pediatric Dentistry Faculty of Dentistry Padjadjaran University escorted by his mother. The mother of the patient complain of dental discoloration, occurred since the eruption of the tooth, the tooth is fragile, disturbing the aesthetics and appearance, ache when consuming food and cold drinks. No other family members who have similar abnormalities. Intra-oral clinical examination shows there is loss of enamel in almost all the anterior primary dentition except in the cervical area of the tooth. Based on the clinical picture and investigations are known patients have email hypoplasia. Management include behavioral management, caries risk assessment, analysis of diet, oral hygiene instruction to parents, strip crown compomer restorations, oral prophylaxis with topical use of fluoride toothpaste CPP / ACP. Aesthetic and preventive dental rehabilitation in children with enamel hypoplasia done as a precaution against further tooth decay, restore tooth function, and improve aesthetics. Regular visits to the dentist, comprehensive dental care, and good cooperation between parents, dentists, and patients support the achievement of treatment success

KEY WORDS: Enamel Hypoplasia, Esthetic Rehabilitation, Dental Preventive, Children

INTRODUCTION

Developmental defects of enamel (DDE) are commonly encountered in clinical practice, and may be defined as aberrations in the quality and quantity of dental enamel which are caused by disruption and/or damage to the enamel organ. The presentation and severity of the defect are usually dependent on the stage of development during which the insult occurs as well as the extent and duration of the insult.¹ Enamel hypoplasia is the result of disruption in the process of enamel matrix formation, which in turn causes defect in quality and thickness of enamel.² Enamel hypoplasia is the most common abnormality of development and mineralization of human teeth. The lesion is manifested as a quantitative defect of enamel tissue resulting from an injury to the formative cells, the ameloblasts.³ Enamel hypoplasia can occur on any tooth or on multiple teeth. It can appear white, yellow or brownish in color with a rough or pitted surface. In the less affected teeth the tooth surface may show a sulcus, pits, or fissures. In more severe cases the teeth will display deeper pits, horizontally disposed. In very severe cases the quality of the enamel is affected as well as the quantity may show a considerable loss of enamel, suggesting a more prolonged disturbance of ameloblastic function. Radiographically, hypoplasia may be seen as radiolucent lines or spots within the typical radiopacity of the enamel.^{4,5} Evaluation was carefully performed by means of visual clinical examination under natural light with a dental mirror and dental probe after drying the teeth with gauze for elimination of saliva and plaque that might hide the defect.⁶

This distinctive deficiency of enamel in primary teeth was initially described in the anthropological literature by Jørgensen (1956), in a sample of modern and Mediaeval Danish.⁷ Enamel formation of primary teeth begins in 14th week of intrauterine life and continues up to the first year of postnatal life. Any alteration during the prenatal, perinatal and postnatal periods, i.e. when the enamel matrix is going through the secretion or maturation phase, can result in enamel defects.⁸

Some years ago surveys showed that 3 to 15% of young adults had enamel hypoplasia in the permanent teeth, and, Pedersen reported that 14% of 2- to 4-year-old children had mild enamel hypoplasia in the primary teeth.³ The published prevalence of EH in the primary dentition varies from 2-99% of children examined depending on the racial, ethnic, nutritional, or socioeconomic status of the child, birth weight, the type of classification system used, and the method of examination. There is a greater prevalence of EH in children from developing countries, children with chronic or acute malnutrition, and children with very low birth weight. Other factors that are significantly associated with EH include a history of maternal smoking, lack of prenatal care during the first trimester, elevated blood lead levels, postnatal measles infection and perinatal intubation.⁹ However, restoration of these defects is important not only because of esthetic and functional concerns but also because of the psychological impact this improvement effects. The appearance of a disfigured smile negatively affects the psychoemotional development of children, increasing their problems with social relation¹⁰ This clinical report describes to provide information about the characteristics of clinical,

preventive treatment and rehabilitation of patients with enamel hypoplasia based on cases handled.

CASE REPORT

A boy aged 2 years came escorted by his mother to the Department of Dentistry Children of the Hospital University of Padjadjaran with complaints discoloration of teeth, occurred since the tooth eruption, the tooth surface uneven and easily fragile, disturbing the aesthetics and appearance, and ache when consuming food and drinks cold. Children was never brought to a general dentist before. Management of children’s oral health based solely on the ability of the patient’s parents. The boy looked nervous when walked into the room dental clinic, but did not rebel. The patient is the only child and was born in Bandung, June 5, 2013.

When it comes to do introductions with the patient and the patient’s parents. during this session the dentist do medical interview and clinical assessment of the patient, caries risk assessment, analysis of diet and oral hygiene instructions to the patient’s parents. This patient caries risk assessment shows the results of high risk (Table 1). While the analysis of the diet in these patients got snacks containing sugar (Table 2).

Table 1. Caries Risk Assessment.

Factor		High Risk	Moderate Risk	Low Risk
Biology	The patients came from lower socioeconomic status			No
	Patients get snacks or drinks that contain sugar> 3 times daily	Yes		
	Patients children with special needs			No
	Immigrant	-	-	-
Protection	Patients received drinking water containing fluorine optimally	No		
	Patients brushing teeth twice a day with toothpaste containing fluoride			Yes
	Patients received fluoride applications by professionals	No		
	Patients gain additional protection (eg xylitol, MIE paste, and antimicrobial)	No		
	Routine Dental Care	No		
Clinical	Patients had ≥1 teeth with interproximal lesions	Yes		
	Patient with white spot lesion or active enamel defect	Yes		
	Patients with low salivary flow		No	
	Patients with definitive restoration		No	
	Patients using intraoral appliance		No	

Table 2. Diet Analysis

Type Food	Day- 1	Day-2	Day-3
Morning			
:Breakfast	Rice+Egg ½ Boiled	Rice+Meatballs	Rice+Egg ½ Boiled
Snack	<i>Coco crunch</i> +Milk	<i>Coco crunch</i> +Milk	<i>Coco crunch</i> +Milk
Afternoon	Rice +Fried Chicke+ Spinach	Rice+ Fried Prawn	Rice+Beef Sausage
Snack	Banana	Banana	Apple
Night	Fried Rice	Rice+ soybeans+Vegetable soup	Rice+Fried Fish+Pumpkin
Snack	Biscuit	Potato Crackers	Fried Corn with Flour



Figure 1. Posture and Physical Characteristic Analysis.



Figure 2. Intraoral Appearance.

Prenatal history of the mother's health during pregnancy experienced chicken pox at the age of 4 months. In addition, the mother of taking vitamins for health during pregnancy. Age of the mother during pregnancy 22 years. Father 24 years of age. Both parents do not have the same family line. TORCH test negative. Father of the patients do not consume alcohol and no smoking habits. Mother routine prenatal examination to an obstetrician. Perinatal history of the patient born during the pregnancy of 10 months / 40 weeks. Labor history with induction by an obstetrician. There are no problems during parturition, but the baby experienced neonatal infection with respiratory distress. Patients born with low birth weight (LBW) is 2.6 kg. Patient blood group A. Children exclusively breastfed until the age of 3 months.

A history of postnatal patient showed normal clinical circumstances of his age. There is no accompanying systemic disease. At the age of growth and development, children gained weight in accordance with his age and no drugs are routinely consumed by children. Educational history of the parents of patients consists of a father and mother who educated Bachelor degree. Mother worked as a housewife and Father as self-employed. No other family members who have similar abnormalities. Currently patients attending Preschool.

Posture and physical appearance of normal children. Patients can walk normally. Normal muscle tone, extremities, and head. There is no accompanying systemic disease. Extra-oral clinical examination showed a small mouth opening, a convex face profile. Medical history of the patient, the patient never went to the dentist and never complained of toothache. Patients have a normal number of teeth and normal tooth eruption. Patients are only given exclusive breastfeeding until the age of 3 months. Solid food intake of breast milk substitutes are given until today.

Clinical examination showed intra oral dental plaque throughout the region. Normal palate and tongue. Normal dental occlusion. Odontogram patient showed teeth surfaces that are not smooth, email structural deficiency in the form of planar and pit in nearly all deciduous teeth are grayish to brownish exception to the cervical area of the tooth, with the degree of severity varies. Degree the most severe in the region of the anterior maxilla with part incisors are eroded and broken so that the open dentin and anatomic shape is not good, and the lightest region of the posterior maxilla and mandible with pit and groove on the cusp area.

X-ray examination showed there was no difference picture of enamel and dentine in the region of the anterior maxillary, whereas the anterior region mandible, and posterior maxilla and mandible showing thin email surrounds the tooth crown. Based on the clinical picture and investigations, patients have enamel hypoplasia with a variety degree of severity. Until now, patients must be assisted by his mother to clean her teeth. Dental cleaning done by using a toothbrush smeared toothpaste twice a day. Never before has given fluoride therapy.

Before starting dental treatment, the patient's parents are given information on a treatment plan that will be carried out. Protocol managing cases in case reports of patients include behavioral management approach to visual methods through photographs and

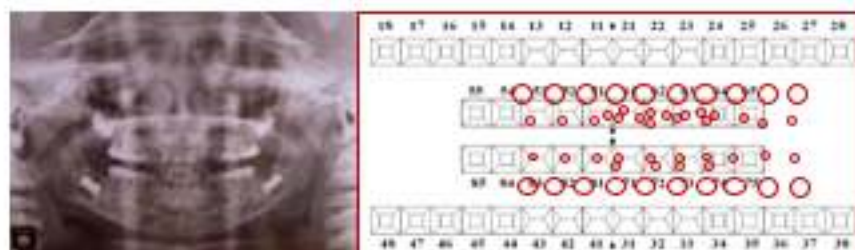


Figure 3. (A) Panoramic X-rays That Shows Abnormalities Enamel Hypoplasia; (B) Odontogram Enamel Hypoplasia.



Figure 4. (A) Patients Helped by His Mother to Brushing His Teeth; (B) Dental Treatment in Patients with Enamel Hypoplasia.



Figure 5. Intraoral Appearance After Crown Restoration.



Figure 6. Clinical Appearance After Crown Restoration.

youtube associated with dental treatment in children, modelling by walking around the room at the clinic pedodontist to see friends his age who are in dental care, as well as “tell show do” to explain the dental treatment to be performed. Moreover, anamnesis explore the clinical characteristics of the patient’s status, caries risk assessment, analysis of diet, oral hygiene instruction time at home for elderly patients, as well as applications CPP / ACP paste (GC Tooth Mousse without flouride, Recaldent™, Australia/NZ) at night after brushing and before bed.

Preventive approach is given before starting dental treatment, including dental health education (DHE) by teaching patients how to brush teeth, and brushing his teeth without the help of his mother. Plaque score on each visit to determine the success of treatments and applications of topical fluoride (60 Second Taste® Gel, Pascal Company, US). This effort is expected to inhibit the activity of caries as a preventive measure.

Dental management of patients were divided into two steps. The first step is the endodontic treatment and the second step is a dental restoration. 51 teeth that have undergone disposal pulp necrosis done carious lesions and open cavity preparation. Determining the length of work done using intraoral periapical radiographs. Pulp tissue taken using K-Files. Irrigation is done repeatedly, and the root canal is dried using paper points. Filling the root canal performed using zinc oxide eugenol paste material condensed using Plugger instruments. Restoration of the tooth crown part is done by using a strip crown (TDV Crown Form Deciduous, Brazil) and compomer (Dyrax Extra Compule A3, Dentsply, US). The crowning piece that has been missing in the teeth 52, 61, 62 carried out restoration by the strip crown (TDV Crown Form Deciduous, Brazil) and compomer (Dyrax Extra Compule A3, Dentsply, US). The entire anterior and posterior Maxillary and Mandible have enamel defects, restoring the tooth crown by using flowable compomer (Dyrax Flow Syringe A3, Dentsply, US). Checking occlusion and eliminate all interference performed on all parts that have been restored. Finishing and polishing restorations performed by using the polishing disk.

Stages of dental care in these patients lasted for four months, considering the age of the patients who were younger, less cooperative when a routine visit to the dentist, and dental treatment session length is quite short. Each session performed dental treatments patients are always given positive reinforcement, as a behavioral management. Key to the success of dental care is to conduct follow-up visits to the dentist who performed every 6 months after dental treatment completed. Until now, dentists still planning further follow-up on these patients for visits to come.

DISCUSSION

This case report describes a boy aged 2 years attending with a discoloration of the teeth, the tooth surface uneven and easily fragile, disturbance of aesthetics and appearance, as well as the sense of pain when consuming cold foods and beverages. Intra-oral clinical examination shows there is loss of enamel in almost all the anterior primary dentition except

in the cervical area of the tooth. Patients had a high caries risk, and diet analysis obtained snack that contains sugar. This situation can relate to abnormalities in the structure of enamel.

Based on the clinical picture and investigations are known patients have enamel hypoplasia. Enamel hypoplasia are developmental defects in the form of pits, horizontal lines, or grooves in tooth enamel (or occasionally, altogether missing enamel). They result from disturbances to ameloblasts (enamel-forming cells) during the secretory phase of enamel formation.¹¹ Patients with enamel problems can present with (1) poor esthetics; (2) thermal sensitivity; (3) attrition; (4) secondary caries; (5) tooth discoloration; (6) malocclusion; and (7) periodontal problems. The patient's complaint, in conjunction with the defects' biochemical and morphohistological characteristics, may affect the prognosis and management.¹² As incisor teeth affected by this defect can result in compromised aesthetics due to staining and morphological alterations, children with this defect on the teeth may experience feelings of anxiety and social embarrassment regarding their dental appearance. Furthermore, in many affected children there is increased dental sensitivity due to enamel hypomineralization and exposed dentine.¹

Patients have risk factors in the womb, infections during pregnancy such as chicken pox infection at 4 months of gestation. In addition, patients had a history born with low birth weight and neonatal infection with respiratory distress. There is a greater prevalence of EH in children from developing countries, children with chronic or acute malnutrition, and children with very low birth weight.⁹ Lai, *et al.* (1997) have reported high prevalence of developmental enamel defects had been found, with the highest frequency of more than 70% in very-low birthweight (< 1500 g, VLBW) children, and lower frequency of approximately 40% in the low birthweight groups (1500-2000 g, LBW). The etiological factors associated with these defects include systemic metabolic changes associated with prematurity as well as local traumatic forces resulting from laryngoscopy and intubation during the neonatal period.¹³ Systemic causes associated with enamel hypoplasia include rickets of prematurity, infection during pregnancy or infancy, respiratory distress, neonatal asphyxia, maternal pre-eclampsia, maternal diabetes, poor prenatal and postnatal nutrition, hypoxia, hyperbilirubinemia, neonatal infection, and exposure to toxic chemical and a variety of hereditary disorder.^{5,14} Enamel formation of primary teeth begins in 14th week of intrauterine life and continues up to the first year of postnatal life. Any alteration during the prenatal, perinatal and postnatal periods, i.e. when the enamel matrix is going through the secretion or maturation phase, can result in enamel defects.⁸ Infection during pregnancy, low birth weight and neonatal infections may explain the occurrence of enamel hypoplasia in this case.

There are several types of classification that indicates the severity of hypoplasia email. Jenkins divide the severity of hypoplasia of the email in the deciduous dentition, there are (1) N: Normal, (2) Hy-: Mild Hypoplasia, (3) Hy: Moderate hypoplasia, (4) Hy+: Severe hypoplasia, (5) HyG: Gross hypoplasia.¹⁵ The presence or absence of lesions, their location, and their characteristics were recorded using Developmental Defect of Enamel Index (DDE

Index), an epidemiological index developed by the Commission on Oral Health, Research and Epidemiology of the Federation Dentaire Internationale (1982). In this classification system defects are categorized as: (0) normal, (1) white-cream enamel opacities (WCO), (2) yellow-brown enamel opacities (YBO), (3) hypoplasia: pits, (4) hypoplasia: horizontal grooves, (5) hypoplasia: vertical grooves, (6) hypoplasia: missing enamel, (7) hypoplasia: discolored enamel, and (8) combination of enamel hypoplasia. Hypoplasia is defined as a quantitative defect of enamel associated with a reduced thickness of enamel. Location of the defects was recorded by surface (facial, lingual, mesial, distal, or incisal/cuspal) and location on the affected surface (gingival third, middle third, or incisal third).¹⁶The severity of enamel hypoplasia in this case, the anterior maxilla is 7 to Hy+. Posterior maxilla teeth 7 with Hy-. Anterior mandible teeth 6 with Hy. Posterior mandible teeth 6 with Hy-.

Enamel hypoplasia can appear on the tooth in three different forms: linear, pit or planar. Linear enamel hypoplasia (LEHs) are defined as grooves on the enamel surface. LEHs tend to run horizontally, and parallel to the cemento-enamel junction. In contrast, pit enamel hypoplasia are well-defined pits in the enamel surface. These can appear as a linear array, a non-linear array or single, isolated pits. In contrast, planar enamel hypoplasia results from the absence of whole sections of enamel from the tooth.¹⁷In this case report anterior region maxilla and mandible has a planar shape enamel hypoplasia and appear gray to brownish except in the cervical area of the tooth, The most severe degrees at anterior region maxilla with incisal parts are eroded and broken so that open dentin and anatomic shape is not good, while the mild degrees by posterior region of the maxilla and mandible has pit and groove shape enamel hypoplasia.

Management of enamel hypoplasia in the primary dentition should focus on early diagnosis and preventive care. Screening and early detection of DDE and caries is one of the benefits of having a child's first oral examination by 12 months of age. As few parents and other health professions are aware of this recommendation, community education is required. As defect predisposes the teeth to increased caries risk and toothwear, parents need to be informed that teeth with enamel defects are highly susceptible to decay and erosion from acids in foods and drinks. Preventive advice given to parents should include replacing cariogenic snacks with healthy foods, twice daily toothbrushing, and topical fluoride application. In addition, treatment with other remineralizing agents such as casein phosphopeptide amorphous calcium phosphate (CPP-ACP) can provide a reservoir of calcium and phosphate which will help remineralize the hypomineralized areas and early carious lesions on the tooth surface. In cases of extensive enamel hypoplasia in the permanent dentition, interdisciplinary team management involving general practitioners, specialist paediatric dentists and orthodontists may be necessary.¹

In this case given dental preventive approach requires good cooperation between parents, dentist, or the individuals themselves. Parents are given instruction on oral hygiene and application CPP/ACP paste (GC Tooth Mousse without fluoride, Recaldent™, Australia/NZ) at home, as well as replacing cariogenic snacks with healthy foods. In addition, the approach taken by the patient is dental health education (DHE) how to brush their own

teeth, and youtube related dental care to children using visual methods. The dentist should focus on early diagnosis and preventive care includes screening and early detection of DDE and caries, caries risk assessment and analysis of diet, plaque score at each visit, as well as topical fluoride application (60 Second Taste® Gel, Pascal Company, US).

According to AAPD (2012), behavioral management is one form of approach to non-pharmacological management of dental for children, including in the form of modeling, "tell show do", as well as the positive reinforcement that is applied in this case reports that aim to reduce patient anxiety and shaping positive behavior in dental care.¹⁸

Appropriate treatment in cases with enamel hypoplasia in the deciduous dentition are restorations that can bond to dentine as well as enamel such as resin-modified glass-ionomer Cements and polyacid modified composite resins are Likely to be suitable for sealing and restoring small lesions in primary teeth with defect. Stainless steel crowns are the restorations of choice for both primary and permanent molar teeth affected by enamel hypoplasia, as they offer the highest durability and best protection against further breakdown.¹ Restoration in this case using compomer (Dyrax Flow Syringe A3, Dyrax Extra Compule A3, Dentsply, US) similar to traditional composites and provides the fluoride release and some self-adhesive properties similar to glass ionomers.¹⁹

The management of patients with disorders of early dental enamel hypoplasia requires good cooperation between parents, dentists, and the individual himself. Aesthetic and preventive dental rehabilitation in children with enamel hypoplasia is done as a precaution against further tooth decay, restore tooth function, and improve aesthetics. Selection of proper dental restorations is a challenge for pedodontist to prevent further tooth decay.

CONCLUSION

A case report of a boy aged 2 years with complaints of discoloration occurred since the eruption of the tooth, the tooth surface uneven and easily fragile, disturbing the aesthetics and appearance, as well as to feel the pain when consuming cold foods and beverages. Intra-oral clinical examination shows there is loss of enamel in almost all the primary dentition except in the cervical area of the tooth. Patients with risk factors of infection while in the womb, low birth weight, neonatal infection with respiratory distress. Based on the clinical picture and investigations, Patients Diagnosed with email hypoplasia. Management of dental conducted in the form of a preventive approach and aesthetic rehabilitation. The success of dental care requires good cooperation between dentists, parents, and patients.

ACKNOWLEDGEMENT

This study was supported by Department of Pediatric Dentistry Faculty of Dentistry Padjadjaran University. The authors are grateful to Iwan Ahmad M, drg., Sp.KGA as well as lecturer Pediatric Dentistry for this case report.

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Early Class Iii Malocclusion Treatment Using Reverse Twin Block Appliance : A Case Report

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ABSTRACT

The skeletal and dental features in class III malocclusion are established early in childhood. Early correction of a developing Class III malocclusion is a complex challenge. Reverse twin block is an alternative treatment in interceptive approaches. This case report describes the use of reverse twin block for management of crossbite anterior in mixed dentition. Patient girls ages 8 years and 5 months visited RSGM UNPAD with chief complains anterior crossbite to be corrected, she had no bad habit. Intraoral showed the anterior crossbite at anterior teeth, -1 mm overjet, with molar relationship Angle class III. Based on cephalometric analysis, clinical examination, and model analysis, patient diagnosed with dentoalveolar malocclusion class III, and skeletal malocclusion type III. First phase treatment treated by reverse twin block appliance to correct anterior crossbite and second phase treatment will be using fixed orthodontic treatment to retain ideal occlusion. Anterior crossbite correction achieved after eight months with no damage to the tooth or periodontal tissue. Patient still wear the reverse twin block appliance to get posterior support and facial muscle balance. It is important to correct anterior crossbite as early as possible to allow an unrestricted growth of the maxilla and to guide the mandible to a normal position. Reverse twin block can be used successfully for early treatment of class III malocclusions in mixed dentition.

Keywords : anterior crossbite, class III malocclusion, interceptive treatment, reverse twin block.

INTRODUCTION

Noticeable characteristics of Class III malocclusion result in unpleasant aesthetics for a child, it is frequently show combinations of skeletal and dentoalveolar components. The characteristics of Class III malocclusion consequently lead parents to seek for orthodontic treatment at an early age.¹

Class III malocclusion is a less frequently observed clinical problem than Class II or Class I malocclusion. The incidence of skeletal class III is rather small in the population but it is one of the most difficult malocclusion to treat. Class III malocclusion occurring in less than 5% of the U.S population. The prevalence is greater in Asian populations. The estimated incidence of Class III malocclusion among the Korea, Japanese, and Chinese is 4% to 14%.²

In the past, the orthodontic literature portrayed the Class III problem as one of mandibular prognathism. Many of the studies now increasingly suggest that the majority of Class III malocclusions have maxillary retrusion. Guyer *et al.*, reported 63% Class III patients had maxillary skeletal retrusion with slightly prognathic or normal mandible. Sue *et al.*, found that 62% of their Class III cases involved maxillary retrusion.³

Class III malocclusion has been characterized by skeletal, functional, and dental discrepancies, which may or may not be associated with each other. The negative dentoskeletal discrepancy between the apical bases, at the sagittal dimension, is mainly verified by a concave profile caused by deficiency of the facial middle third, absence of a zygomatic prominence and excess of the facial lower third. These features can also be accompanied by maxillary atresia, lower lip protrusion, and/or an anterior crossbite ⁴.⁵. Anterior crossbite should be intercepted and treated at an early stage because it is a self-perpetuating condition which if not treated early might at a later stage require major orthodontic treatment ⁶.

Class III malocclusions are often seen with maxillary retrognathia, mandibular prognathia or a combination of both. Ellis and McNamara found that 65-67 % of all Class III malocclusion were characterized by maxillary retrognathia. Thus maxillary protraction is an important paradigm in early management of Class III malocclusion. A number of authors have recommended early treatment of developing Class III malocclusions to obtain growth modification. Early interception with orthopedic appliances would advance the maxilla and at the same time restrict the mandibular growth⁷. This enables a morphologic and functional condition that favours normal facial growth, in addition to establishing more acceptable esthetics in the early stages. The validity of two-phase treatment is supported by studies that show greater orthopedic effects when treatment is started in younger patients ⁸.

The aim of this study was to describe and discuss the treatment of a patient with Class III malocclusion, whose treatment protocol comprised two phases: interceptive (mechanical orthopedic appliances) and comprehensive (fixed orthodontic appliance).

CASE REPORT

An 8 years 5 months old female patient presented with a Class III malocclusion characterized by mid-face deficiency and an anterior cross bite. During the anamnesis, a good general health condition was observed without deleterious oral habits. She had no history of significant medical problems and no family history of hereditary disease. Her father also has class III malocclusion, and this was considered as a genetic factor. Her parents

were concerned about her appearance and wondered whether something could be done at an early age. The patient's soft-tissue profile was flat with a relative prominent lower lip. In the intraoral examination, at intercuspal position, the patient showed anterior mandibular displacement, mesial relationship of the primary molar and canines and an anterior crossbite with a negative overjet (-1 mm), thus characterizing a Class III malocclusion.

At centric relation, an edge-to-edge incisor relationship was observed, which improved the prognosis. Radiographic examination was performed aiming to complement the clinical examination for establish the diagnosis. A panoramic radiograph showed the presence of all permanent teeth either already erupted or at the several stages of formation, in mixed dentition. The lateral cephalogram evaluation at IP afforded detection of a Class III malocclusion and a retrognathic ANB angle.

The cephalometric assessment showed a skeletal Class III malocclusion (A point-Nasion-B point (ANB) angle of $-3,5^{\circ}$ and Wits of -4 mm) mainly due to mandibular prognathic (SNB $84,5^{\circ}$) with a normal horizontal growth pattern.

Cervical vertebrae maturation indicator (CVMI) assessment on lateral cephalogram indicated that patient was well before the initiation of the pubertal growth spurt. Inferior



Figure 1. Initial extraoral photograph.

borders of body of the vertebrae C2, C3, and C4 were flat. At this stage, 80-100% of pubertal growth remains as it is known that development of concavity at lower borders of C2, C3, C4 indicates initiation of growth spurt. Considering all these factors, the objective of phase I therapy, reverse twin block, was to improve skeletal jaw deformity, to achieve desirable anterior occlusion, and to normalize and enhance crainiofacial growth.³

CASE MANAGEMENT

In this clinical case, the treatment protocol comprised two phases : an interceptive phase and a comprehensive phase.

At Phase 1, after impression was made, the bite was also recorded in edge to-edge position with 2 mm inter-incisal clearance. Reverse Twin Block appliance with adam clasp in maxillary primary first molar region for protraction therapy was fabricated (Figure 3 A).The interceptive phase started immediately after the clinical and radiographic evaluation, with a removable orthopedic appliance: Reverse Twin Block.

Post treatment results revealed considerable improvement in soft tissue profile (Figure 4 A and B), with a positive incisor relationship. Maxilla had advanced sagittally by 2 mm, SNA angle had increased from 81° to 81,5° and there was 3mm increase in vertical dimension after active treatment. Superimpositions of the cephalometric tracings showed



Figure 2. Initial intraoral Photograph



Figure 3. (A) Bite registration in centric relation for reverse twin block fabrication design (B) Maxilla and mandible relation when Reverse Twin Block appliance inserted.



Figure 4. (A) Initial cephalometric radiograph. (B) Cephalometric radiograph after treatment with Reverse Twin Block.

that during the first phase the maxilla had moved substantially forward and slight downward and backward rotation of the mandible was seen (Figure 5 A). Patient still continue the treatment using reverse twin block appliance to achieve best result correcting her anterior crossbite and posterior interdigitation so the result will be more stable.

DISCUSSION

Individuals with Class III malocclusion may have combinations of skeletal and dentoalveolar components. Differential diagnosis of patients with true and pseudo Class



Figure 5. Post Treatment Extraoral Photograph

III malocclusion should be based on family history, dental assessment of molar and incisor relationships and functional assessment to determine presence of Centric Relation-Centric Occlusion shift on mandibular closure. Consideration of the various components is essential so that the underlying cause of the discrepancy can be treated appropriately.^{9, 10}

A typical character that could be found in Class III malocclusion is skeletal anterior crossbite which usually involves the whole segment instead of one or two teeth. Skeletal anterior crossbite appear due to skeletal discrepancies in growth of maxilla or mandible. This type of crossbite is best intercepted by growth modification using myofunctional or orthopedic appliances.⁶

Joondeph stated that “the objective of early orthodontic treatment is to create a more favorable environment for future dentofacial development. Interceptive treatment can reduce the amount of dental compensations to skeletal discrepancy that are often associated with a more severe malocclusion in late adolescence.” The goals of early interceptive treatment may include the following⁹: 1. To prevent progressive, irreversible soft-tissue or bony changes; 2. To improve skeletal discrepancies and provide a more favorable environment for normal growth; 3. To improve occlusal function; 4. To enhance and possibly shorten phase II comprehensive treatment; 5. To provide a more pleasing facial esthetic, thus improving the psychosocial development of the child.

It is generally believed that as a child grows it becomes increasingly difficult to protract the maxilla orthopedically³. Treatment of Class III malocclusion was thus initiated in the early transitional dentition in order to have maximum skeletal effects. According to McNamara,



Figure 6. Post Treatment Intraoral Photograph.

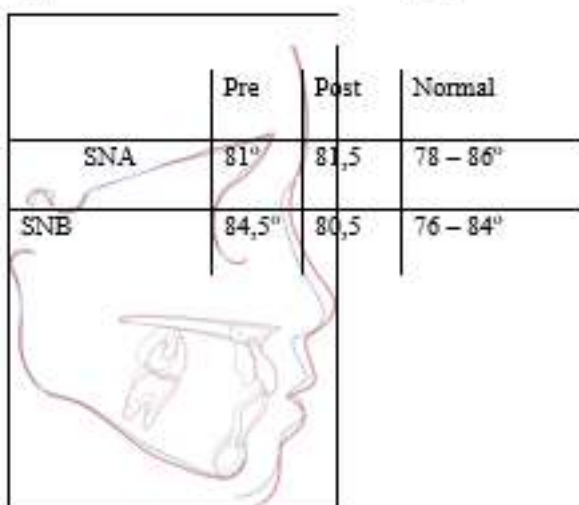


Figure 7. (A) Superimposition of the lateral cephalogram tracings at the beginning of the treatment (blue) and after the reverse traction of the maxilla (red). (B) Steiner Analysis pre and post treatment.

the best time to begin early Class III treatment is in the early mixed dentition coincident with eruption of the maxillary permanent central incisors. Prepubertal orthopedic treatment of Class III malocclusion is more effective both in the maxilla (which shows a supplementary growth of about 2 mm over Class III untreated controls) and in the mandible where it shows restriction in growth of about 3.5 mm over controls.^{11, 12} Numerous clinical reports have shown superior treatment outcomes in younger children with early mixed dentition.³

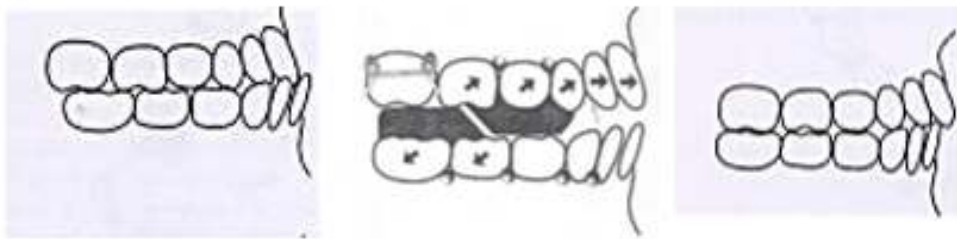


Figure 6. Mechanism of Reverse Twin Block appliance.¹⁴

Reverse Twin Block or also known as Class III Twin block is effective at correcting reverse overjet during the mixed dentition. It is an alternative to the Frankel FR III appliance or an upper removable appliance alone. Changes occur rapidly with a mean treatment time of only 6.6 months, which compares favourably with the FR III appliance that was shown to have a mean treatment time of 3.1 years and achieved similar results. Changes are mainly dento-alveolar, due to proclination of the upper incisors and retroclination of the lower incisors. Skeletal change is limited to slight downward and backward rotation of the mandible, with an associated increase in anterior, vertical dimension.¹³

Treatment during the deciduous or early mixed dentition has been shown to give more favourable skeletal changes during treatment with a functional appliance or rapid maxillary expansion and protraction headgear.¹⁵ The mean age of subjects in this series may have been older than ideal. With this limited skeletal change prognosis for maintenance of the incisor relationship will depend on future skeletal growth. The indications for treatment with the reverse Twin Block are those cases in the mixed dentition with a reverse overjet associated with a mild sagittal skeletal discrepancy and an average or reduced anterior vertical dimension.¹³

Even with early intervention, stability will depend on several factors, such as: maxillary and/or mandibular skeletal involvement, growth potential, age, family history, genetic influence, as well as patient compliance.^{4,10} Therefore, treatment overcorrection has been recommended to compensate the negative factors.

CONCLUSION

Class III malocclusion should be intercepted early, aiming to redirect growth, mainly when the maxilla is the primary etiologic factor, or when dental and/or functional factors are involved. The diagnosis, treatment planning, and prognosis depend on several characteristics, which should be carefully analyzed by the orthodontist, such as: patient age, growth potential, and pattern. The earlier the intervention, the greater the chances of positive responses, regarding transversal maxillary advancement and increase. An adequate use of appliances, with correct application of intensity and direction, in addition

to patient compliance are key elements for good outcomes. Reverse twin block or also known as Class III Twin Blocks can be used successfully for early treatment of Class III malocclusions. The appliance is easily fabricated and well tolerated. Treatment changes shown in this case series were proclination of the upper and retroclination of the lower incisors. There is some decrease in SNB with an increase in anterior vertical dimension.

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Follow Up Onlay Composite On The First Permanent Molar In Children: Case Report

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ABSTRACT

Onlay composite is one of the choices for post restoration of the root canal treatment that covers the entire cusp in permanent posterior teeth. Onlay can be made with a direct and indirect technique, have a similar teeth color character, not abrasive, resistant to staining restoration because of the food, the reduction of tooth structure is minimal, and good aesthetics. The purpose of this special report is that it gives information about the advantages of post restoration of the root canal treatment that covers the entire cusp in permanent posterior teeth. A girl patient, aged 10 years and 10 months, came to the Clinic Pediatric Dentistry, Dental Hospital University of Padjadjaran with a complaint that her back, bottom right teeth. The pain that's been coming and going has been happening since 2 months ago, she got a change to drink painkillers and wants to be treated. The patient likes to eat sweets and rarely brushes her teeth. Intraoral checkup shows that she has 46 non vital teeth. During the radiography checkup there was an expansion in the periodontal membrane, profunda caries and is diagnosed with pulp necrose. The treatment that was done are non vital pulpectomy and a follow up with making an onlay composite. Post treatment, the patient receives treatments that went out well and routinely perform periodic controls. As a pediatric dentist, we get to choose the right treatment for a follow up after root canals treatment by looking through the financing aspect, length of procedure, masticatory function and aesthetic function, one using composite onlay restorations.

Key Words: onlay composite, indirect, pulp nekrose, permanent teeth

INTRODUCTION

Dental caries is a major problem in the children oral cavity up till this day. Children aged 8-11 years are vulnerable to dental and mouth diseases, because most children at that age still have a behavior or habit that is less supportive on dental health. Young permanent first molars are the teeth with the highest caries incidence rate and has most damage that occurs in the first two years after that teeth erupts.¹

The incidence rate of caries in children and adolescents often occur on the first permanent molars. In America, Asia, and Brazil the incidence of caries in the first molars may reach 40-50% of the population, with the presence of cavities in the teeth, restorations, or the first molar tooth. Development of caries in the first molars occurs faster in the first two years, after the first molar tooth erupts with the possibility of dental damage until it reaches the pulp. Care that should be taken is the endodontic treatment by considering several factors such as the rest of the network crown, pulp vitality, closing the apical region, and level of patient compliance. Endodontic treated teeth need a good and final restoration to function optimally in the oral cavity. Such teeth are more brittle than vital tooth thereby increasing the likelihood of fracture while functioning.^{2,3}

The final restoration of teeth after root canal treatment is an integral part of the success, based on the fact that failure is more often caused by inadequate restoration than the results of the root canal treatment itself. An ideal restoration need to be able to protect the occlusal surface and replace the missing cusps in order to optimally protect the structure of the crown teeth and increase its endurance. Two major factors that are taken into consideration are the loss of tooth vitality and many network structure of teeth due care. Loss of teeth structure that are pretty significant on the teeth that experienced endodontic treatment, especially on posterior teeth, can weaken the cusp and cause tooth fracture more easily either by pressure or trauma mastication. To protect the projection of fractures or cracks, the tooth will be restored with *onlays*.

Onlays are dental reconstruction to cover up posterior teeth cusp and is designed to strengthen the teeth that became weak due to caries or a previous restoration. That is also a non plastic restoration for teeth that has a wider reconstruction and includes one or more teeth protrude, it can use semidirect or indirect techniques, these restoration might include rigid restoration made in a dental laboratory using a model of the tooth mold that was prepared and is then cemented to the teeth. The restoration generally requires repeated visits and placement of temporary fillings making it more expensive for patients. Some materials used in onlay restorations, such as: metal castings, composite resin and porcelain, or keramik.^{2,3,4} Quite a rapid progress in terms of dental materials, and concepts in restoration techniques, introducing the use of adhesive restorative materials. Adhesive composite resin restorations are widely used because the results are satisfying and lasting. The tendency of patients to choose tooth-colored material and material dense alternative to amalgam, became the reason of the increase of use of composites for posterior teeth restorations. Composites for posterior teeth were first introduced in the early 1980s and became very popular for adults today.^{3,5}

Onlay composite resin is a restoration that covers the entire cusp on posterior teeth which are made using composite resin material. *Onlays* can be made with some of the technique which includes; direct, semidirect, and indirect. Mechanical direct and semidirect is done in one visit, while the indirect technique requires at least two visits and the manufacturing is done by using *die*.⁶ The indications are as follows: to replace extensive amalgam restorations, extensive caries involving cusps teeth, and teeth that

require improved aesthetics. Contra indications include occlusal tooth that requires great strength, work areas that are not easily drained or hypersalivation, and deep subgingival preparations.^{7,8}

The technique of making indirect composite resin *onlay* is as follows: (1) Preparation of teeth for indirect resin inlays, *onlays*, or overlay differs from those that requires conventional metal materials. Preparation design is determined based on the mechanical properties of the composite materials of indirect and operator experience. Since the resistance and retention is determined by attachment to the enamel and dentin, more conservative preparation is done. To achieve optimal function and aesthetic results, following preparation instructions should be considered are; that all enamel should be supported by healthy dentin, all corners and edges are rounded inner need to avoid the pressure, all walls must flare or oblique proximal 5-15 degrees (without undercut), it must be ensured is the absence of undercut and minimum depth that can still be in the preparation of the *occlusal* surface is 1.5 mm; (2) printing and selecting as print materials like; *polyvinylsiloxane*, irreversible hydrocolloid, elastomer, or additional silicon. Note that the printed material can reach the deepest place. (3). Tooth color adjustments is made in the area of dentin and enamel. The color of the Dentin is adjusted with the exposed dentine, amalgam tattoo or if there is a stain, the cervical area of the buccal surface can be used. Enamel color by using images can also be performed. (4) Temporary restoration to seal the cavity may use non *eugenol* cement and cement-based resin. (5). Die making and restoration where the model set forth in the shape of die. Then from the die which has been prepared, the composite resin material is placed layer by layer, forming restoration shapes like direct restoration. The shape of the proximal, proximal contact, anatomical *occlusal* should be built. (6). *Try-in* with temporary fillings disassemble, cleaning the cavity, checking occlusions using articulating paper, reduce fillings when there is a traumatic occlusion using a finishing bur. Repeating it until there's no traumatic occlusion. (7). Cementing by way of restoration is removed and the cavity was cleaned with 37% phosphoric acid for 30 seconds, wash with water, then *onlay* resin composite in cement using a resin material. (8). Remove all the excess cement with a finishing bur, check occlusion and interproximal areas, then polish using a Polishing disc.^{3,7,8}

This special report aims to provide information about the benefits of restoration after root canal treatment using an *onlay* composite.

CASE REPORT

A girl patient age 10 years 10 month came to the clinic Pediatric Dental Hospital, University of Padjadjaran with complaints under the permanent first molars right cavities and intermittent pain about two months ago, the patient's general condition is good. Extra-oral examination found no abnormality. Intraoral examination obtained caries #46 reaches the pulp, percussions tests showed their complaints while the pressure test showed no complaints, # 85 residual roots with 2nd degree rocking, and #83 caries reaches the pulp with 2nd degree rocking.



Figure 1 (A).Pre treatment #46, (B) radiographic image showing the start before the treatments.

Radiographic examination on teeth #46 shows radiolucency in occlusal reaches the pulp chamber, periodontal membrane and *laminadura* which disappeared in the apical third of the mesial and distal roots, radiolucency that bounded unclear and indecisive on the *periapical*, and the formation of roots that are already perfect (Figure 1). Diagnosis of tooth # 46 is pulp necrosis with *periapical* abscess. The treatment plan for this case is the root canal treatment with the final restoration indirect composite *onlay*.

CASE MANAGEMENT

During the first visit proper diet instruction and Dental Health Education was given, extracting teeth #83 and #85, the caries excavation is done on teeth #46 and temporary filling are placed. During the second visit, access opening was done on teeth #46 then an assessment of the root canal using a K-file number 10. Preparation is done with *ProTaper* F2 until the size that's according to the length of employment with NaOCl irrigation of 2.5% concentration every time the appliance is replaced and dried with paper points. Once that is done sterilization with medicaments ChKM and it will filled temporarily than patient are instructed to control the next 3 days. Second treatment because paper point from the previous sterilization is still dirty and it still smells, therefore the sterilization will be done again using Ca(OH)_2 and temporary filling are placed. By the next visit, subjective complaints



Figure 2. (A). Radiographic image after teeth #46 is filled,(B). Clinical image post dental root canal treatment 46.

will already be found and from the objective percussion check up and the palpation there are no complaints, then the root canal is filled with *gutta percha* and *endomethasone* sealer *ProTaper* according to the length of the previous work, given the GIC base (Figure 2) and temporarily filled.

After one week of filling the root canal #46 tooth inspection, percussion, palpation, and subjective complaints are not obtained. After that preparations for the manufacture onlay is made (figure 3).

The next step is printing using print materials *hydrophilic vinyl polysiloxane* (Detaseal® hydroflow putty) with double impression technique (figure 4). Tooth color adjustments using shade guide (vitapan classical) are also made, then the printout was sent to a dental laboratory to make a die (figure 5) and onlay composite (figure 6), tooth which has been prepared will be restored temporarily.

In the next meeting, try in composite onlay is done where previously the temporary fillings were cleaned first and occlusion check using articulating paper, after that the tooth is cleaned with 37% phosphoric acid for 15-20 seconds, rinsed with water and then cleaned with a spray of wind, then it will proceed to bonding application and is irradiated for 20 seconds. *Silane* (ultradent) will be applied on the anatomical surface for 20 seconds followed by the bonding and irradiation for 20 seconds. Cementing *onlay* onto the tooth surface using dual curing cement resin breeze and then irradiating it for 5 seconds to clear excess cement in the proximal part of the sonde instrument and dental floss, then the entire surface will be irradiated for 20 seconds (Figure 7).

DISCUSSION

Cases about caries on the first molar teeth, specifically on the mandibular first molar tooth that has become the highest prevalence of revocation and most of them are caused by caries. The cause of teeth caries is the lack of attention, knowledge, awareness of parents and their child's hygiene and oral health. Other causes of dental caries are the fact that children rarely or never control the state of their teeth and mouth by going to the dentist every 6 months or 1 year at least once. First permanent molar is also the first tooth eruption at the age of 6-7 years, child discipline in maintaining the teeth were still lacking, as well as the anatomical shape of the first molar that has many fissures, resulting in retention of the tooth into a good food.^{1,2}

The need of aesthetic restoration isn't only limited on anterior teeth but also on posterior teeth. Teeth that suffered extensive damage and had lost much of the tooth structure requires a dentist that is able to create a restoration that has a good mechanical ability to function optimally and have aesthetic properties that can be accepted by the patient.^{8,9,10}

During this case, *onlay* resin composite post root canal treatment is chosen, because the remaining tooth tissue that is still adequate and still provides information regarding the benefits of restoration after root canal treatment using composite *onlay*. Indications of *onlay*



Figure 3. Onlay preparation on #46

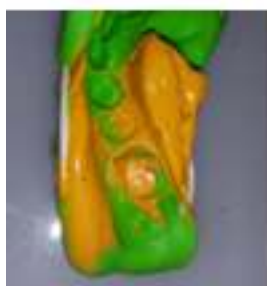


Figure 4. Print materials using double impression technique #46



Figure 5. Die



Figure 6. Onlay Composite for teeth 46

resin composite are replacing the amalgam restoration that's extensive, extensive caries involving knurl teeth and also teeth that requires good aesthetic. ^{9,10}

To fulfill these needs, the indirect restoration is an alternative that is often a choice. Indirect restoration is a restoration made outside the mouth, may it be in a laboratory or in a clinic, which will then be cemented on the teeth. ⁸ Up until today, there are many types of indirect restoration, such as; metal casts, porcelain, or only made of metal composite onlays. ¹⁰ Metal *onlays* are less favored because its unaesthetic colors, whilst porcelain *onlays* has a brittle nature and often leads to opposing teeth and the hardness of the ceramic materials causes difficulties if occlusal adjustment or contour is necessary. It may be easily broken during installation of trial, therefore complicating the operation. While the composite resin can be polished back easily and effectively, cheaper and excessive restoration on gingival areas can be disposed just by using a hand instrument. Resin composite *onlay* is rated to have the most advantages over these materials. ^{12,13}

During the preparation of the composite *onlays* the *occlusal* reduction should be in the same size and has sufficient thickness to obtain the strength of the material to avoid any fracture. Average of at least 1.5 mm in the central fossa and 2mm above the functional cusp. The preparation for the walls and base should be smooth and internal angles should be rounded to achieve the adaptation of the restorative material and walls diverging towards the *occlusal* at 2.5 degrees. No groove or sharp corners. *Isthmust* at least as wide 2 mm, all of the marginal must has butt joint cavo surface line angel at 90 degrees. Facial/ buccal and lingual walls should be extended to lusty email and circled cusp with smooth corners. There should not undercut that can interfere with insertion or removal of the restoration. Axial wall thickness made to provide a shoulder for restorative materials. ^{10,12}

The advantages of indirect composite resin restorations are indirect rather than direct restoration is can be avoided contraction due to polymerization of the composite material, so that the edge of the leakage can be avoided. Contact in the proximal can be made tight and the establishment of the anatomical contours easier. Disadvantages of indirect composite resin restoration are their dependence on the cement adhesive restorations, long processing time because it needs to go through the process of model molding and casting. ^{6,13}



Figure 7. Post treatment onlay composite in teeth 46

CONCLUSIONS

Indirect *onlay* composite restoration can be chosen by a pediatric dentist as one of the treatment choices that's suitable for a follow up after a root canal removal, because the teeth is more brittle and has a remaining tissue that's still adequate, by looking through the treatment that related to the remaining tooth structure, from the cost aspect, lead time, masticator and aesthetic function.

ACKNOWLEDGMENT

This study was supported by Department of Pediatric Dentistry Faculty of Dentistry Padjadjaran University. The authors are grateful to Prof. Dr. Willyanti Soewondo, drg., Sp.KGA (K) as well as lecturer Pediatric Dentistry for this case report.

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Early Treatment Of Mild Skeletal Class Iii Malocclusions Using Reverse Twin Block: Case Report

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ABSTRACT

The skeletal Class III malocclusion is one of the most difficult to treat by an orthodontic or orthopedic approach, and case selection is especially important before undertaking treatment. Early treatment of Class III malocclusion is often indicated to growth modification and counter the unfavorable developmental pattern. Early orthodontic treatment provided to patient during the mixed dentition and occasionally during the late primary dentition. Growth modification should be commenced before the pubertal growth spurt, that better potential growth can be achieved. Functional correction of class III malocclusion is achieved in the twin block technique by reversing the angulation of the inclined planes. A 9 years old girl was referred to department of pediatric dentistry RSGM FKG UNPAD with the chief complaint of inwardly placed upper front teeth. An intraoral examination revealed anterior crossbite on both central and lateral incisor with reverse overjet 1,5 mm and overbite 3 mm. Patient was treated using a modified functional appliance of skeletal growth, reverse twin block with maxillary three-way screw appliance. Bite registration done in maximum retrusion position. This case report aims to correct mild skeletal Class III malocclusion with anterior crossbite using reverse twinblock appliance. There were changes on both central and lateral incisor after treatment for 11 months. Patients can reach edge to edge bite when appliance removed. Patient are still ongoing treatment with reverse twinblock appliance. Reverse twinblock can be used as early treatments for mild cases of skeletal Class III malocclusion in mixed dentition period. This appliance is well acceptable by children.

Keywords: Early Treatment, Class III Malocclusion, Reverse Twin Block.

INTRODUCTION

The prevalence rates of Class III was reported to be around 1–3% in the Caucasians and around 13-14% among the Chinese and Japanese. Class III malocclusion is far more prevalent in Asian countries than in the West. The incidence of anterior crossbite is 2.3-

13 per cent among Japanese, 9.4-19 percent among Koreans and 12.8 per cent among Chinese and 14.5 percent in southern Chinese.^{1,2}

Class III malocclusions may be limited to dentoalveolar discrepancies but more frequently skeletal in nature. The characteristic features of class III malocclusion are present at an early age, usually between 3 and 5 years of age. The skeletal and dental features in class III malocclusion are established early in childhood and do not self-correct during child development.³ This type of malocclusion involves a number of cranial base and maxillary and mandibular skeletal and dental compensation components. This condition may be characterized by mandibular prognati, maxillary retrognati, and combination of both. Clinically, Class III malocclusions present in two forms, “pseudo or functional Class III” and “True Class III”.²

True skeletal Class III malocclusion happens because maxillary retrognati or mandibular prognati, or a combination of both. It is clearly seen Class III molar relationship during centric occlusion and the rest position. Pseudo-class III / habitual class III occurs because premature contact when the mandible moves from rest position to centric occlusion position, it indicates there is a movement sliding forward into the position of pseudo class III. Normal molar relationship seen in the resting position, but Class III molar relationship seen when the centric occlusion occurs.⁴

The skeletal Class III malocclusion is one of the most difficult to treat by an orthodontic or orthopedic approach, and case selection is especially important before undertaking treatment. There are three main treatment options for skeletal class III malocclusion: growth modification, orthodontic camouflage (dentoalveolar compensation), and orthognathic surgery.^{1,5} Early treatment of Class III malocclusion is often indicated to modify the growth and counter the unfavorable developmental pattern. Early orthodontic treatment provided to a patient during the mixed dentition and occasionally during the late deciduous dentition. The purpose of early treatment is to correct the existing or developing skeletal, dentoalveolar, and muscular imbalances to improve the environment before the eruption of the permanent dentition is complete.⁵⁻⁷

Early correction of a developing Class III malocclusion remains a complex challenge. Interceptive approaches include fixed appliances, removable appliances, removable functional appliances, chin cup, protraction headgear, and skeletal anchorage systems. Encouraging outcomes have been reported with use of reverse functional appliances, including the FR III and Reverse Twin Block appliances in cases involving Class III malocclusion.⁸ This orthodontic treatment is often seen as either a less-desirable alternative to surgery or as an option for patients with milder skeletal problems.⁷

Twin Blocks are simple removable bite blocks with occlusal inclined planes which act as functional appliance, designed for full time wear. It was invented by Dr. William J. Clark in 1977 and since then it has been a very popular functional appliance in the correction of malocclusion in growing patients.^{5,9}

This case report aims to see the success of reverse twin block appliance in correcting mild skeletal Class III malocclusion with anterior crossbite.

CASE REPORT

A 9 years old girl was referred to the Department of Pediatric Dentistry, Faculty of Dentistry, University of Padjadjaran, with a chief complaint of inwardly placed upper front teeth causing to an unpleasant appearance and wanted to be treated. Examinations of extraoral, intraoral, radiographic and TMJ, also analyses of model and cephalometric were conducted to this patient.

On extraoral examination were obtained that patient had a mesocephalic type of face, symmetrical, flat facial profile (Figure 1), competent lips, and no abnormalities of TMJ. On intraoral examination were found that there were mild crowding in the maxillary anterior teeth with class I molar relationship on the left side and Class III molar relationship on the right side. There were a restoration in 75, dental caries in 65, 73, 83, 85, residual roots of 53, 54, 64, 74, 84, no diastema, no missing teeth, oral hygiene was moderate, gingival/mucosal was normal, frenulum labii was normal, tongue was normal, palate was normal, tonsils were T1-T1, the median line wasn't shift (Figure 2). Overbite was 3 mm, negative overjet of 1.5 mm, crossbite in 11, 12, 21, 22, normal curve of spee, normal tooth eruption, normal mandibular closure, no impaction.

Panoramic radiograph obtained a normal form of condyles, symmetrical, balanced height of right and left condyles, no abnormalities of the maxillary sinus, no abnormalities of nasal septum cavity (Figure 3-A). Analyses of Steiner, Down and Wits were conducted with the cephalometric radiograph (Figure 3-B). The analyses found that the SNA was smaller than the normal value, the value of the SNB was within normal limits, and Wit's analysis showed a much negative value, so we got a diagnosis of a Class III skeletal with maxillary retrognathi and an mandibular ortognathi (Figure 3-C).

From the model analysis were obtained that patient had an overbite of 3 mm, overjet of -1.5 mm, crossbite in 11, 12, 21, 22, 41, 42, no diastema, the median line wasn't shift, as well as Class III molar relationship on the right side (Figure 4-A) and Class I on the left side (Figure 4-C). Sagittal and transversal analyses were conducted and obtained malposition of

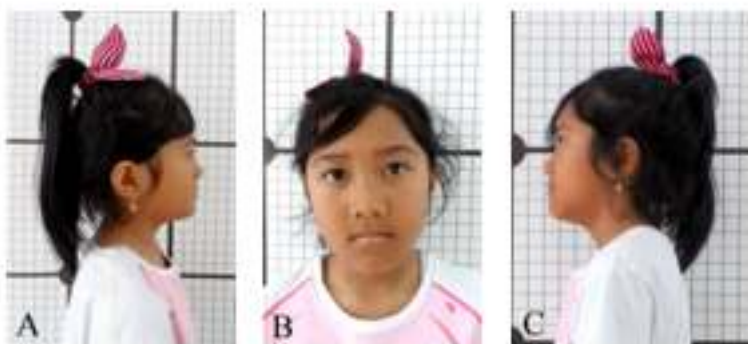


Figure 1. Patient's Profile Before Treatment. (A and C) Lateral View; (B) Frontal View.



Figure 2. Intra Oral Finding Before Treatment (A) Right Molar Relationships; (B) Reverse Overjet Occlusion; (C) Left Molar Relationships; (D) Occlusal View of Maxillary Arch; (F) Occlusal View of Mandibular Arch.

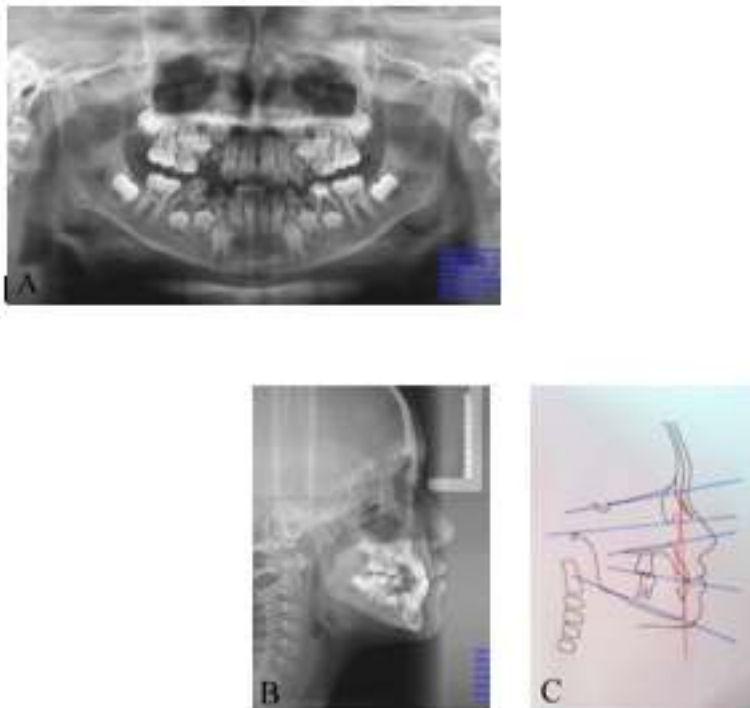


Figure 3. Radiograph Before Treatment. (A) Panoramic; (B) Cephalometric; (C) Cephalogram Analysis.

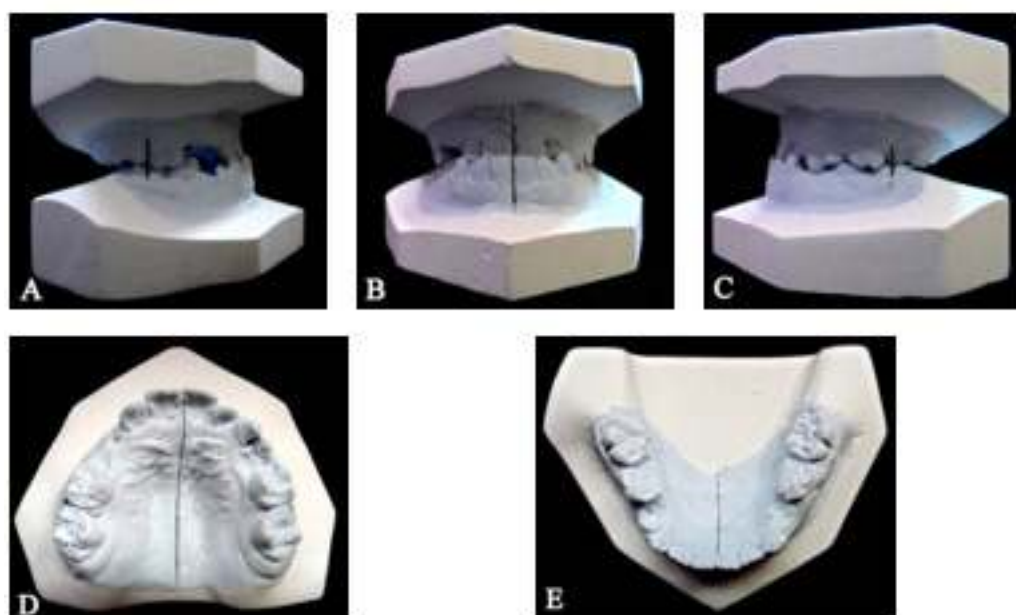


Figure 4. Study Model Before Treatment. (A) Right Molar Relationships; (B) Frontal View; (C) Left Molar Relationships; (D) Maxillary Arch; (E) Mandibular Arch.



Figure 5. Design Reverse Twin Block. (A) Maxillary; (B) Mandibular.



Figure 6. Reverse Twin Block Treatment. (A and B) Registering the construction bite; (C) Fitting reverse Twin Blocks; (D and E) Occlusal views of reverse Twin Blocks; (F) Occlusal contact is only on the inclined planes.



Figure 7. Patient's Profile After 8 Months of Treatment. (A and C) Lateral View; (B) Frontal View.



Figure 8. Intra Oral Finding After 8 Months of Treatment. (A) Right Molar Relationships; (B) Edge to Edge Occlusion; (C) Left Molar Relationships; (D) Occlusal View of Maxillary Arch; (E) Occlusal View of Mandibular Arch.



Figure 9. Radiograph After 8 months of Treatment. (A) Cephalometric; (B) Cephalogram Analysis.

21, 22, 36, and 46 (Figure 4-D and 4-E). On Moyers analysis for mix dentition showed that there was a shortage of space in the maxillary and an excess space in the mandibular, and the same results were obtained for Tanaka Johnston analysis.

Etiology of malocclusion caused by the persistence of deciduous teeth and genetic factors. It is discovered from clinical examination and anamnesis from their family members who also have the same condition. Based on the examinations that had been done, the diagnosis of the patient was Class III subdivision of dentoalveolar malocclusion and Class III skeletal malocclusion with maxillary anterior crowding, anterior crossbite in 11, 12, 21, 22, and a negative overjet.

CASE MANAGEMENT

Treatment in this patient was used reverse twin block appliances. Design with three-way screw expansion in the maxillary and adam clasp in 55, 65 with ball clasp at the distal and mesial 11, distal 21 (Figure 5-A). In mandibular, ball clasp in distal and mesial 31, distal 41 with adam clasp in 36, 46 (Figure 5-B).

Bite registration was done in maximum retrusion position, patient is asked to retrude the lower jaw into edge to edge relationship with 2-3 mm interincisal clearance (Figure 6-A and 6-B).

Occlusal surface of mandibular appliance was reduced 2 mm every 3-6 weeks to encourage the eruption of opponent teeth to reach the occlusion and activation three-way screw expansion of the maxillary appliance was conducted every 1 weeks. Patient is instructed to wear the appliance all day (24 hours especially at night time).

Table 1. CephalometricAnalysis

Variable	Normal Value	Pre-treatment	Interpretation	Post-treatment	Interpretation
< SNA	80-84°	77°	Retrognathic	79°	Retrognathic
< SNB	78-82°	81°	Orthognathic	80°	Orthognathic
< ANB	0-4°	-4°	Class III Skeletal	2°	Class I Skeletal
< I-NA	15-32°	30°	Normal	31°	Normal
< I-MPA	81,5-97°	94°	Normal	89°	Normal
AO-BO	0-3 mm	-8 mm	Class III Skeletal	-5 mm	Class III Skeletal

Patient showed profile improvement (Figure 7) and achieved edge-to-edge relationship on the upper and lower incisors (Figure 8-A to 8-C) after wearing the reverse twin block. Cephalometric analysis in Table 1 shows the change in the angle SNA, SNB, ANB, I-NA, I-MPA. There was a decrease in the value of AO-BO, but the results are still negative. Cephalogram analysis after 8 months of treatment is shown in Figure 9-B. Cephalometric superimposition before and after treatment were made on tracing paper (Figure 10). Currently patient is still on undergoing the treatment with a reverse twin block. A reverse



Figure 10. Cephalometric Superimposition.
Blue: Pre-treatment; Red: Post-treatment.



Figure 11. Reverse Twin Blocks



Figure 12. Management of Class III Malocclusion

twin block will be used until a negative overjet is corrected and a normal relationship between maxillary and mandibular incisors is reached, and at the same time the position of maxillary incisor teeth will be improved by the use of anterior expansion. The treatment will be continued with the use of fixed orthodontic appliance to correct the arrangement of teeth, followed by a retention period for at least 6 months.

DISCUSSION

A developing class III malocclusion presents with maxillary skeletal retrusion, mandibular skeletal protrusion, or a combination of the two. In addition to these sagittal

problems there may be posterior and anterior crossbites also present.³ These patient had skeletal class III malocclusion with maxillary retrognathi and mandibular ortognati, and also anterior crossbite present.

The early treatment of Class III malocclusion is always into two schools of thought. Some authors believed that skeletal alteration was impossible and that the dominance of genetic inheritance cannot be altered. They also suggested that any treatment on the deciduous dentition would be temporary and will not have any effect on the permanent dentition. However, researchers have found out many favorable outcomes for early treatment. The treatment of Class III malocclusion should be started as soon as we see the anterior cross bite. Tweed suggested treatment timings can be as early as 4 years of age.¹⁰

The timing of treatment of class III malocclusion is critical for optimum outcomes. Delaying appropriate treatment beyond the mixed dentition stage (10 years of age) will limit the effectiveness of orthopedic correction required to treat most of the class III malocclusions. More importantly, treating a class III malocclusion in the late deciduous and early mixed dentition stages has been shown to be more beneficial to the child because there is improved maxillary orthopedic correction combined with controlled mandibular growth than when treatment is undertaken in the later childhood growth stages.³

Patient was treated using a modified functional appliance of skeletal growth with maxillary three-way screw appliance. The highlight on the functional treatment is the modification of growth at ideal age, that the better growth potential can be achieved by determining the appropriate treatment time.

Reversed twin block harnessing occlusal forces as the functional mechanism to correct arch relationships by maxillary advancement, while using the lower arch as the means of anchorage. This appliance are designed to encourage maxillary development by the action of reverse occlusal inclined planes cut at a 70° angle to drive the upper teeth forwards by the forces of occlusion and at the same time, to restrict forward mandibular development (Figure 11). The maxillary appliance should include provision for three-way screw expansion to increase the size of the maxilla in both sagittal and transverse dimensions.⁵

Orthopedic correction is more likely to succeed by maxillary advancement rather than mandibular retraction, as it is difficult to reduce the potential for mandibular growth, except by surgery. The simplest clinical guideline is whether or not the patient can occlude squarely edge-to-edge on the upper and lower incisors. The ease with which the patient can achieve this position is an indication of the prognosis for correction.⁵

Functional correction of Class III malocclusion is achieved in Twin Block technique by reversing the angulation of the inclined planes to apply a forward component of force to the upper arch and a downward and distal force to the mandible in the lower molar region. The inclined planes are set at 70° to the occlusal plane with bite blocks covering lower first molars and upper deciduous molars or premolars, with sagittal screws to advance the upper incisors (Figure 12).⁵

Upper and lower bite blocks interlock at a 70° angle when engaged in full closure.

This causes a forward mandibular posture to an edge-to-edge position with the upper anteriors, provided the patient can comfortably maintain full occlusion on the appliances in that position. Twin Blocks are designed to be worn 24 hours per day to take full advantage of all functional forces applied to the dentition, including the forces of mastication.⁵

The primary effects of the reverse twin block appliance are dentoalveolar changes, as characterized by upper incisor proclination and lower incisor retroclination, with minimal skeletal effects.⁸ Once the appliance is delivered, the maxilla starts to advance anteriorly within 4 weeks. This will be evident with the patient's edge-to-edge bite anteriorly. Addition of acrylic to the inclined planes may be necessary to increase the forces over the maxilla and mandible to establish a positive overjet.³

Kidner *et al.*, in their evaluation of the reverse twin block appliance on 14 subjects less than 12 years of age, found that the changes were mainly dentoalveolar, with the skeletal changes limited to slight downward and backward rotation of the mandible. The average treatment time in their patients was only 6.6 months.³

As stated by Fardeen, *et al.*, patient compliance is always of great concern when treating patients with functional appliances, including Twin-block appliance.⁹ Duration of treatment in these patients was 11 months, because about at the beginning of treatment, patient do not wear the appliance for 24 hours. Patients have a habit of play a tongue and biting-lifting the mandibular appliance, this is the reason the mandibular appliance often broken. As a result, when the appliance repaired, there is a time lag patient don't use reverse twin block, all the functional strength which is applied to the teeth being lost. As described previously, it is considered by the authors to be the reason that duration of treatment in these patients more longer.

CONCLUSION

Skeletal Class III malocclusions treatment should be initiated as early as possible. Treatment with reverse twin block have an impact on the change in position of the teeth, sagittal changes, and correct overjet and overbite. Reverse Twin block appliance can be used successfully in the early treatment of Class III malocclusions. Case selection is very important and patient compliance is required for the successful treatment with a reverse twin block.

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Phase Of Treatment Agenesis Bilateral Canine Mandibular Permanent: A Case Report

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ABSTRACT

Agenesis or hypodontia is one of the most common tooth anomalies, characterized by the absence of tooth bud. Agenesis of permanent canine is a rare condition and occurs more often in the upper jaw. The literature reports that agenesis often occurs in the third molars, lateral incisors, central incisors and premolars both the upper and lower jaws in order of frequency of occurrence. This report presents a case of bilateral agenesis of the permanent canine mandibular in 10-year-old girls patient. Extra-oral, intraoral, panoramic, sefalometri and model analysis were carried out. The treatment plan of maxilla is to expand the jaw with quad helix, removable space maintainer in mandibular was taken due to premature loss of primary molars, stimulate the eruption premolars and as a removable partial denture as well as to sustain the growth and development running well. The purpose of this case report is to discuss agenesis of the permanent canine mandibular including various appliance and treatment. Dental agenesis treatment was done as early as possible with quick and precise management can provide optimal results treatment both function and aesthetic.

Keywords: agenesis, canine, mandibular, management.

INTRODUCTION

Congenital absence of one or more teeth from the dentition has been termed hypodontia. Hypodontia is one of the most common developmental anomalies, with the prevalence rate of 2.3–9.6% (excluding the third molars) in the normal population. Prevalence of hypodontia in the permanent dentition (excluding 3rd molars) is about 4.5–7.4% in Caucasians and the most frequently affected teeth are the mandibular second premolar (3.4%) and the maxillary lateral incisor (2.2%). Congenital absence of the canines in the permanent dentition is very rare and the reported incidence varies from 0.18 - 0.45%. It is more frequently seen in the permanent dentition compared with the primary.^{1,2,3}

Although the etiology of congenital agenesis of teeth is unclear, several factors such as a tendency toward genetic predilection, metabolic disorders, trauma, infection, radiation or idiopathic reasons are found to be responsible. Males are more often affected than females. Maxillary primary teeth are more often found affected by agenesis than mandibular primary teeth. In available literature reports missing teeth found bilaterally or unilaterally with a predisposition toward a similar phenomenon occurring in the permanent dentition. In the mandibular, the most affected teeth are central incisors, lateral incisors, second premolars, and third molars in descending order of their occurrence.⁴

Congenital agenesis of permanent canines in both maxilla and mandibular are extremely rare. This article describes a rare case of congenital absence of bilateral mandibular canines and case management.² The purpose of this case report is to discuss agenesis of the permanent canine mandibular including various appliance and treatment.

CASE REPORT AND MANAGEMENT

A 10-year-old healthy girl patient reported to clinic Pedodontic Dentistry Hospital of Padjadjaran University, with the complaint un-erupted teeth in the right lower posterior tooth region. Clinical examination revealed edentulous region posterior primary molar mandibular teeth on right side and absence primary canine on both side. There was history related caries infections posterior right region and extracted when she was 4 years old but no extraction history on left canine. The child was born to non-consanguineous parents. The pregnancy and delivery were uneventful. There was no history of any severe systemic diseases, any history of trauma, to the anterior region. Family history revealed no such finding in any members of the family.

Suspecting the congenital absence of both primary and permanent mandibular canines and premature loss primary molar, various radiograph were taken to confirm the provisional diagnosis. Also, sufficient space for the eruption of right premolars was found both clinically and radiograph. Patient and her parents had been informed regarding the absence of teeth.

The child exhibited a normal gait and posture. An extra-oral examination did not reveal any facial deformities. The patient's profile was flat, with a slightly retro-gnathic mandibular and pointed chin (Figure 1).

An intraoral examination revealed the mixed dentition stage with erupted canines, first premolars in the maxillary arch and erupted transposition first premolar, second premolar and fistula at first permanent molar in the mandibular left arch. The right mandibular posterior region did not show first and second premolar teeth, also canine primary teeth in both sides. (Figure 2) The adjoining alveolar ridge was typically knife edged, suggesting the possibility of the permanent mandibular posterior teeth being absent. To ascertain the patient's provisional diagnosis, she was subjected to a detailed radiographic evaluation. A panoramic radiograph revealed agenesis of canine permanent mandibular and premolars germ that would eruption. Vertical bone loss was seen on the edentulous region. There was



Figure 1. Extramoral view

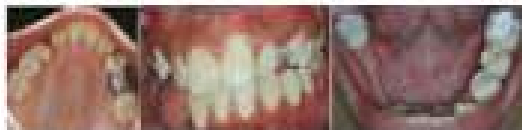


Figure 2. Intraoral photograph showing premature loss primary right molar and bilateral primary canine mandibular.



Figure 3. Radiograph showed the absence of canine permanent teeth on both mandibular quadrant and premolars germ that would eruption.

no evidence of formation of bilateral canines permanent teeth (Figure 3). The remaining permanent teeth were present in different formative or eruptive stages.

Based on cast analysis, Tanaka Johnston analysis, Moyers analysis, cephalometric analysis revealed diagnosis malocclusion class I dentoskeletal with diastema 22-24, 42-46, 3 mm median line shifting to left side in mandibular, agenesis 33,43, and premature loss 83,84,85.

CASE MANAGEMENT

After topical fluoride application and endodontic treatment 36, 16-26 banded with molar band and quad helix in palatal was assembled (figure 4). Treatment in maxilla used quad helix to get a space and improve dental arch by expand the maxilla, and then after get more space and dental arch become U-shaped, quad helix retained in the maxilla but not activated only provide as a retainer until the premolars and canines eruption (Figure 5). Furthermore, use of fixed orthodontic appliance to correct the malposition of teeth on maxilla and mandibular as well as close the excess space.

Removable space maintainer placed in mandibular because of premature loss molars, to stimulate the premolar eruption and also functions as a removable partial denture. After

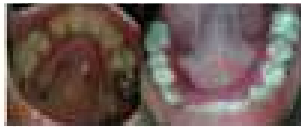


Figure 4. Quad helix in maxilla and removable space maintainer in mandibular

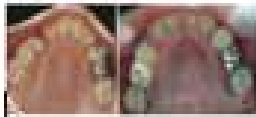


Figure 5. Before (v-shaped) and after (u-shaped) quad helix.



Figure 6. After 8 weeks, eruption second premolar and U-shaped maxilla



Figure 7. Radiograph (left before, right after 24 weeks) showed 45-46 mesial drifting and 44 un-erupted



Figure 8. After 24 weeks treatment, exposure first premolar (left-right). Procedure : incision, removal mucosa and bone, bonded with button, attached first and second premolar with elastomeric chain, final result.



Figure 9. First week after exposure premolar, 44 bonded with gold chain

8 weeks of treatment, second premolar eruption but up to 24 weeks of treatment no visible of first premolar emerge and the eruption as well as the first premolar shows the position of impaction to the buccal shelf and second premolar shows mesial drifting (figure 6,7). Therefore do surgical exposure and follow with fixed orthodontic as soon as possible to fix and pull out the first premolar.

All teeth in mandibular placed mini rooth .022 slot except first molar banded with buccal tube and inserted wire nickel-titanium round 012. No improvement position of the impacted premolar occurred during this time, thus warranting surgical exposure and orthodontic assisted eruption of this tooth. A surgical procedure was carried out under local anesthesia. Mucosa around first premolar discovered with rasparatorium, after premolar visible cleaned and dried the rest from bone and blood. An orthodontic eyelet, with button, was bonded to the premolar at the time of surgery, traction of the impacted premolar using elastomeric chain attached to the first and second premolar, gold chain can't bonded because un-cooperated patient and wetness area (Figure 8). Control one week post exposure, 44 bonded gold chain with the aim of preventing excessive force and note no orthodontic force has yet been applied to the impacted first premolar, which erupted spontaneously (Figure 9).

The patient was instructed to maintain good oral hygiene, as the success of the treatment was based on the health of the adjacent tissues. Patient was also instructed to maintain a regular follow-up protocol every 2 weeks. When this paper was made the treatment still ongoing.

DISCUSSION

The occurrence of bilateral lower permanent canines agenesis is even rare. Literature reported six cases of agenesis involving only the lower permanent canine. All subjects were Chinese. Two cases were bilateral. The present findings revealed a single case of bilateral lower canine agenesis, with a prevalence of 0.02 percent. Another report described one case of bilateral developmentally missing mandibular canines associated with a supplementary lower incisor. Another case with a single missing canine and concomitant multiple supernumerary teeth were presented. Numerical anomalies in the primary dentition are very rare. Further clinical examination was required in order to identify the persisting supernumerary incisor as a supplemental type. In this case there was no persisting supernumerary incisor and retained primary canines therefore this case was very rare.^{5,6,7}

Considering the rare agenesis, there was some suspicion this child may have some associated medical conditions (i.e. variant of ectodermal dysplasia). Therefore, suggested a medical geneticist was asked to evaluate the patient. Multifactorial etiology of congenital missing teeth, which combines genetic, epigenetic, and environmental factors, is noted. The genetic or the familial inheritance has been attributed as more significant etiological factor. Autosomal Dominant (AD), autosomal recessive (AR) and X-linked recessive pattern of inheritance have been associated with tooth agenesis; with AD pattern being the most prominent. Environmental factors like tooth bud infection, trauma, nutritional disturbances during pregnancy or infancy, smoking during pregnancy, maternal medications, irradiation at an early stage and somatic diseases (syphilis, scarlet fever and rickets) are also associated with tooth agenesis.^{6,7}

The association of tooth agenesis with other syndromes as well as other dental anomalies has also been reported in the literature. Congenitally missing teeth have been frequently reported in cases of oral and facial clefts, Rieger syndrome, Down syndrome, Witkop syndrome, Book syndrome, hemifacial microsomia and many others. Tooth agenesis has also been shown to accompany other conditions, such as microdontia, palatal impaction of canines, taurodontism, tooth transposition and rotation, ectopic eruption, retained primary teeth and alveolar bone hypoplasia. In this case report, agenesis could not be associated with any syndrome as the child was normal in all other aspects and did not suffer from any other abnormality. None of the family members suffered from the congenital abnormality, suggesting absence of a hereditary basis to the defect. In this case regarding the environmental causes, both the prenatal and postnatal history were non-contributory, as there was no history of trauma, radiotherapy, chemotherapy, or medication that the child may have been exposed to.^{6,7,8}

Kjaer et al., suggested a theory stating that tooth agenesis may result from an abnormality in the peripheral nerve supply, the overlying epithelium as seen in cases of ectodermal dysplasia or in the supporting bone. Upon clinical examination, the overlying mucosa was found to be normal and radiographic examination of the mandibular showed the presence of both a mental foramen and a mandibular canal, suggesting a normal neural innervation. Tooth pattern erupted have been explained by 2 hypothetical models: (1) the field theory; and (2) the clone theory. The former proposes that there is a regionally specified pattern of expression of ectomesenchymal genes, and the tooth most affected by a congenital abnormality is the last tooth in the field. The latter suggests that a clone of mesenchymal cells is programmed by epithelium to produce the tooth type. When considering these 2 theories, the clone theory explains the absence of all mandibular canines in this case, where the entire clone of mesenchymal cells could be missing. The most likely etiology may be a point mutation in the genes involved in the determination of the tooth pattern in the mandibular anterior region.⁸

There are other possibilities that should be considered in such cases when permanent canines are clinically found to be absent. If the permanent canine could not be palpated in the buccal sulcus by eleven years of age, ectopic eruption and impaction of the teeth must

be considered. Bone diseases, cysts, and tumors can cause ectopic eruption and impaction of the maxillary canines. Transposition may occur with the first premolars or lateral incisors although it is a rare finding. Early detection of impacted or missing canines may enable interceptive treatment and reduce the treatment time, complexity, and complications. Therefore when a permanent canine is clinically found to be missing, a radiographic investigation is essential to determine the presence and localization of the tooth and any associated pathology.^{3,8}

In this case used the maxillary Slow Expansion: quad helix because the narrow upper arch (v-shape) and there is a shortage of space for the eruption of the maxillary canines. It has been revealed that in the treatment of a narrow upper arch, quad helix appliance moving the upper molars and buccal to the alveolar socket. To overcome the tipping action on the use of quad helix, buccal root torque can be placed on the molar bands prior to cementation tool. The advantage of the quad helix turn helix is expanded maxillary teeth in a way that differential is “swept” into the teeth of a curved oval shape at the end occlusion.^{9,10}

Mechanism of action of the quad helix appliance is extending to the buccal and distal maxillary molar and extended arm like a fan has a sweeping action, which can be customized to extend the premolars and canines of the upper jaw. The study of the vector argued strength of quad helix in the anterior arm influence forced and effected molars. This result based on the fact, anterior arm is rigid portion on quad helix. Other studies have shown quad helix appliance has the ability to de-rotate molar more efficient than Haas, quad helix can expand anterior and posterior differently.⁹

As a guide to activate quad helix band was “halfway through” molar coronal before cementation. Although it requires some experience, it is possible to activate quad helix after quad helix cemented on teeth. In the complex cases where activation is required, it is recommended to remove the tool and then activate it before it was cemented. Initial expansion quad helix equals the distance half the width bucolingual of molar bands on both sides and at the incisal canine on both sides. In this case, quad helix made of stainless steel orthodontic wire 0.036 inch was soldered to the molar bands, cemented used glass ionomer lutting. Activation quad helix in this case was done before the appliance was cemented.¹⁰

Active stage of treatment an average of 30 days and a retention period of 6 weeks, total standard use an average of 75 days.¹¹ In this case the distance premolar before treatment and after treatment is measured from the top of cups buccal first premolars. Distance premolar before treatment of 40 mm and 8 weeks after treatment was 43 mm. The distance measured from margin gingiva molar before treatment 33 mm, after 8 weeks of treatment 35 mm. This is consistent with the statement that the quad helix has expansion capabilities to anterior and posterior differently. Space gained in the anterior can be used to provide space for eruption canines with fixed orthodontic treatment.

Mandibular treatment plan would be to minimize or consolidate the edentulous space, reduce the number of dental units (implants) required for restoration of the dentition, that is, without compromising facial profile, dental aesthetics, or function. The clinician should evaluate each dental arch and assess if extraction of selected deciduous teeth results in

guided eruption, reduction in edentulous space size and the need for artificial replacement of teeth. For instance, with guided eruption and orthodontic treatment, premolar substitution for missing mandibular canines can be considered. With premolar substitution, a clinician would eventually only need to replace canine and right second premolar.^{6,7}

In the mandibular arch, establishing whether extraction of the mandibular primary molars results in permanent molars shifting forward to take up space for missing second premolars is critical. This is determined to a great degree by the patient's overall skeletal pattern. With a step mandibular plane, teeth will drift forward more easily; analyzing the patient's radiographic determines that. It is advisable to keep in mind the overall goal of trying to reduce the number of teeth that eventually needs to be replaced.⁷

Restorative procedure involves fabrication of removable partial denture or adhesive denture as an immediate and temporary treatment to restore the missing teeth and esthetics. After the growth completion, fabrication of fixed partial prosthesis is the other treatment modality, if malocclusion is not a major problem. But in this case canine agenesis caused deficiency space that led to the first premolar mesial drifting thus replace the position of the missing canine. Therefore, in this case require orthodontic treatment and surgery exposure premolar to replace agenesis bilateral mandibular canine.¹²

Treatment approach has to be case specific and depends on condition of primary predecessor, number of missing teeth, status of occlusion/ occlusal condition and patient/ parent's preferences. Timely extraction of primary predecessors can be considered to allow spontaneous space closure with or without further orthodontic alignment or the primary canines can be retained until replacement with a suitable restoration when they are lost. This case was premature loss primary molars and agenesis canine mandibular presumption un-erupted primary canines made transposition first premolar required orthodontic treatment to correct the arch and diastema.¹²

Considerable research supports, the efficacy of rehabilitating a completely or partially edentulous mandibular using prosthesis supported by implants anchored in the anterior mandibular. But the agenesis can result in minimal volume of bone for the placement of end-osseous implants in locations favorable for subsequent restorations.^{7,12} However, premature loss causes deficiency of space in the mandibular and the age proper fixed orthodontic as an option.

Surgical exposure of the impacted premolar with orthodontic traction and eruption proved to be the most appropriate treatment option for this patient. Successfully managed impacted premolar cases were most frequently reported in adolescents; the oldest patients were in their late twenties. Factors such as the patient's medical history, dental status, oral hygiene, functional and occlusal relationships and attitude toward and compliance with treatment will influence treatment option.¹³

Operative orthodontic complications did not arise in this patient. The button bonded at surgery functioned successfully. The premolar roots, even in case where the root form was immature, reacted favorably to orthodontic forces. In this patient, had all the inherent growth potential commensurate with her age, enabling normal dentoalveolar development.

Thus complete alignment of the transversely impacted mandibular premolar was possible. The absence of growth potential, together with the disruption of the dentoalveolar bone formation by multiple childhood extractions in the older patient could not be surmounted. Based on the literature patient with older age this action is less successful than in younger patients. Andreasen showed that surgery should be restricted to the case, both the maxilla and mandibular, with no more than an inclination of 45 ° and a limited deviation from its normal position.¹³

Treatment in all the presented case includes restore aesthetics and function. Initially in this case, removable partial acrylic denture like space maintainer can be choose, afterwards surgical exposure premolar impaction and comprehensive orthodontic treatment to space closure and alignment arch.^{2,7,8,12}

CONCLUSION

The occurrence of this demands management with the aim to maintain the existing dentition, improve esthetics, allow proper mastication, and promote the child's emotional and psychological well-being. A pediatric dentist may be the first to observe this condition in a young child and, thus, is in a position to: educate the child about preventive care; maintain good oral hygiene; manage the child behavior; prevent future malocclusions; and counsel the child to help him or her cope with the situation. Thus, the role of the pediatric dentist in the treatment of children with congenitally missing teeth is very important.

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Dental Treatment In A Down Syndrome Adolescent Boy Patient: A Case Report

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ABSTRACT

Down syndrome is a genetic disorder in the form of trisomy 21, commonly associated with variety combination of morphological and structural defects, causing growth and developmental disturbance, both physically and mentally on the patient. Due to their intellectual disability, patients with Down syndrome have communication difficulties. Because of their condition, sometimes they have poor oral condition and dentists need to adapt and modify their treatment when treating Down syndrome patient. This case report aims to find out the successful dental treatments for adolescent Down syndrome patient. A 14 years-old Down syndrome adolescent boy patient accompanied with his parents came to RSGM UNPAD with complaint of deciduous teeth which causing pain while chewing. Clinical examinations found five persistence deciduous teeth and gingivitis. Dental treatments proposed included behavior management, Oral Hygiene Instruction (OHI) for the patient and his parents, persistence teeth extraction, dietary analysis, plaque removal, and topical fluoride application. Recall check-up in the next month showed a better oral hygiene with no gingivitis and no complaint in chewing. Patients with Down syndrome require adapted approach in examination and treatment for their oral health. It takes cooperation between patients, parents, and dentists so that oral health can be achieved.

Keywords: adolescent patient, Down syndrome, dental treatment, gingivitis, persistence deciduous teeth.

INTRODUCTION

Down Syndrome is a genetic disorder in the form of trisomy 21. Down Syndrome was first discovered by Langdon Down in 1866.^{1,2} The abnormality in the chromosome caused multiple physical defects and stunted growth.³ One of the most common physical defects in

Down Syndrome is the heart anomaly which occurred in about 40% of the Down Syndrome patients.^{1,2,4}

Children with Down Syndrome may have limitations on their mental and physical development, which entailed a needed modification for their oral hygiene approach as well as preventive care compared to normal children. Preventive care is not only limited to the patient, but also to their parents or caregiver of the patient. Even though the mental capability of Down Syndrome's patient varied, they have limited intellectual capacity which limit their capability to learn, communicate, and adapt towards their environment. A complete medical history is needed as well.

This case report explained a preventive care on a Down Syndrome adolescent boy patient with a modification care approach, including behavior management, Oral Hygiene Instruction (OHI) for the patient and his parents, dietary analysis, plaque removal, and topical fluoride application. In addition, there was a curative treatment by persistence teeth extraction. The objective of this case report is to see the success of oral treatment on an adolescent boy with Down Syndrome.

CASE REPORT

A 14 years-old boy came to Pediatric Dentistry Department, Dental Hospital of Padjadjaran University, with his parents to check on his mouth and teeth. The parents complained that their son has some persistence teeth which disrupted the process of chewing. On the first visit, introductions were made with the patient as well as the parents. Then, an anamneses with the patient's parents, physical check-up on the kid, preliminary examination for extraoral and intraoral, panoramic photo, and a caries risk assessment, dietary analysis, and oral hygiene instruction.

The anamneses resulted in the patient's identity, history of birth (prenatal, perinatal, and postnatal), history of patient's skills, history of patient's abnormality, and pedigree from both sides of the family. He is the first of two children and they came from a mid-social economy background. His father has a business and they live in one of the housing in South Bandung, West Java. The prenatal history showed that the marriage of the parents happened when his mother was 24 years-old and his father was 27 years-old. There was an



Figure 1. A. Patient's Fingers and Toes. B. Patient's Face and Head Profile



Figure 2. Pre-treatment Intraoral



Figure 3. Patient's Rontgen

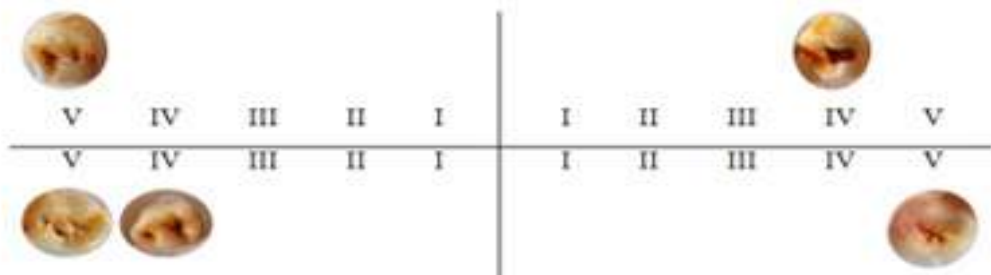


Figure 4. Five Extracted Persistence Teeth

attempt of abortion when the pregnancy was two weeks old. When his mother was 6-months pregnant, she got bronchitis and she consumed cefadroxil and dextromethorphan. Both parents didn't have history of alcoholism or smoking. The perinatal history showed the son was born on the ninth weeks on natural birth, with help from an obstetrician, but he didn't cry once he was outside, and he weighed 2.75kg. The postnatal history showed that the growth of his weigh didn't match those of normal kids. He had light flu during his first year. Patient



Figure 5. Patient was being trained to brush his teeth



Figure 6. Post-treatment Intraoral

had a heart operation for PDA when he was 2 years 1 month, suffered from Kawasaki when he was 4 years-old, and his hernia was operated when he was 6 years-old. His skills are a bit under-developed compared to normal kids. The eyes are a bit farsighted: right eye +0.75 and left eye -2.5, with astigmatism 1.75. He has mongoloid face. He has been diagnosed by Down Syndrome since birth because of all the symptoms. Other family members don't have any similar abnormalities.

The extraoral examination showed a concave face, muscle hypertonia, TMJ clicking (left-right), and asymmetric face. Normal fingers, a bit sandal gap on his toes, limp neck, hunchback posture, inefficient gait pattern for walking, normal shape and size of head, thick eyelid fissure, upslanting palpebral fissure, normal hair, and low set ears.

The intraoral examination found high frenulum labialis and lingualis, normal amount and shape of teeth, deep palate, macroglossia, class 3 Angle malocclusion, lots of plaque on the teeth, and 5 persistence teeth with mobility grade 2.

Supporting examination of panoramic image showed 5 persistence teeth, no periapical abnormalities, and TMJ imbalance (Figure 3). The result for caries risk assesment shown a midrisk caries (Table 2). On the first visit, operator gave a diet analysis table to be filled by parents at home for 3 days. On the second visit, the parents gave the filled diet analysis

table back (Table 1). The result showed a quite balance diet with enough carbs and sugar consumption. Operator told them to keep the balance diet as they already do at home.

Table 1. Patient's Diet Analysis

Type of Food	Day 1	Day 2	Day 3
Breakfast	Fried rice with eggs, Milk	Bread with sausage, Milk	Yellow rice, Milk
Snack	Fried flour, Water	Cake, Rice Cake, Water	Donut, Sweet Tea
Lunch	Rice, fried chicken, vegetables soup, water	Rice, spinach, fried fish, water	Rice, stir-fry pumpkin, eggs, water
Snack	Papaya	Apple	Banana
Dinner	Rice, fried chicken, vegetables and soup, water	Rice, spinach, fried fish, water	Rice, stir-fry broccoli, chicken, eggs, water

Table 2. Caries Risk Assessment

Factor		Patient	High Risk	Mid Risk	Low Risk
Biology	Patient from a low social economy status	Middle		X	
	Patient has snack or drinks with sugar > 3 times a day	No (1-2x)		X	
	Patient is a child with special needs	Yes	X		
	Patient is an immigrant	No		X	
Protection	Patient received water with fluoride optimally	No	X		
	Patient brushes the teeth twice a day with fluoride toothpaste	Yes			X
	Patient received fluoride application from specialist	No	X		
	Patient got extra care (such as: xylitol, pasta MI, anti-microbe)	No	X		
	Patient has routine dental care	No	X		
Clinical	Patient has ≥1 tooth with interproximal lesion	No			X
	Patient has white spot lesion or active email defect	No			X
	Patient has low flow of saliva	No			X
	Patient has defect restoration	No			X
	Patient uses intraoral care	No			X
Risk Caries Conclusion		Mid Risk			

Patient has limitation in speak, talk, social interaction, motoric skills, and cognitive retardation. Operator did behavior management, such as tell show do, modeling, and reinforcement during his examination and treatment. Behavioral management is carried out repeatedly and in a considerable time at each visit. Patient initially afraid, often resist during treatments, and can not stay long on the dental chair. After several visits, patients showed improved behavior during treatment.

Preventive care for the patient performed with giving oral hygiene instruction every time they visit, including to the patient himself and his parents. Operator did a prophylaxis and topical fluoride application on the seventh visit.

Curative treatment performed with extracting the persistence teeth start from the second visit. Extraction was done using local anesthetic after giving a prophylaxis antibiotic with amoxicillin 1600mg (32kg x 50mg/kg) per oral one hour before treatment. There were 5 persistence teeth, so it was done on 5 visits (from the second visit until the sixth visit) because the patient was uncooperative.

DISCUSSION

Down Syndrome can be caused by genetic factors and how old the mother was when she was pregnant.^{1,5,6} The Down Syndrome patient in this case hypothetically was not caused by genetic factors, because there are no family member who has the same disorder. His mother was still young (26 years old) by the time of pregnancy of this child, therefore, it is very likely that the cause of maternal age can be eliminated as well.

Patient did not immediately cry when he was born. This condition causes him to suffer asphyxia neonatarum. At the beginning of the birth process, each baby will experience a relative hypoxia and adaptation will occur as a result of the activity of breathing and crying. When the adaptation process is interrupted, the infants can be asphyxiated that will have an effect on vital organs system disorders such as the heart, lungs, kidneys and brain. Other symptoms of the condition included delay of growth and development of fine and gross motoric skill, as well as delayed intellectual development. It can be one of the causes of the patient's intellectual development delayed.^{7,8}

Patient was diagnosed by his pediatrician with Down Syndrome from birth because of the symptoms. Types of Down Syndrome in this patient has not been determined because the patient has not done chromosome test yet.

Preliminary examination is very important, including the patient's medical history, the history of past and current health condition, medication intake, history of hospitalization, and so on. After that, it is necessary to conduct a comprehensive oral examination, to determine the patient's manifestation and oral health status.^{7,8}

Down Syndrome patient generally have characteristics of delayed development, such as delays in speech, language, social skills, motor skills, even in some patients there are those who experience cognitive delays which generally indicate conditions of mild to heavy intellectual disability.³ Behavioral problems in Down Syndrome patients vary widely

as do normal children. But in cases of severe mental illness, Down Syndrome patients are generally difficult to treat in the normal treatment situation.¹

Patients have limitations in speech, language, social skills, motor skills, and cognitive delays. Operator had to do behavior management, such as tell show do, modeling, and reinforcement during his examination and treatment to manage his fear, resistance, and inability to stay long on dental chair. After several visits, the behavior management showed a result, the patient showed better behavior during treatment.

Social skills and cognitive delay in this patient make him different from other typical teenager. He is still sitting in the 4th grade of elementary school at the age of 14 years. The patient was also less concerned about the appearance and cleanliness of himself and lacks self-confidence as a teenager in general. This shows cognitive and social delays outcomes in patient. Operator's approach and communications need to be adapted to patient's conditions.^{3,4}

Motor, intellectual, and cognitive limitations limit him to do his oral hygiene, and therefore it was important to use preventive action.³ Preventive treatment for this patient was done by giving oral hygiene instruction to the patient and also their parents, prophylaxis, and also topical fluoride application. Due to patient's motor limitations, parents need to help and supervise their child in the process of brushing teeth. These preventive treatment will help to prevent longer and more complicated and curative treatment.³

Patient's extraoral examination results are in accordance with the conditions of extraoral Down syndrome patients. Concave facial profile is a manifestation of abnormal bone growth in the facial area (one third of the middle face). In Down Syndrome patient, the middle face growth is going abnormally, so it affect on the condition of the palate. Muscles hipotonus, asymmetrical face, sandal gap in the toes, neck limp, hunchback posture, inefficient gait pattern for walking, thick eyelid fissure, upslanting palpebral fisura, and low set ears are also common in Down Syndrome.^{3,4,6}

The less developed area of middle face also results in retrognathic relationship occlusion. Bad habits in patients with Down syndrome such as breathing through the mouth make them have deep palate and sometimes became an open bite.^{3,4,6} Other oral manifestations found in this patient are makroglosia, fissure of the lips and tongue, angular cheilitis, delayed growth and development of teeth, periodontal disease associated with tooth morphology, and poor oral hygiene. Patient's systemic conditions may also affect the health of periodontal tissues such as poor circulation, decreased humoral responses, and general physical regression during early life.

Five primary persistence teeth and their mobility grade 2 caused pain while the patient chewing food and he required a longer duration for meal than usual, this was according to his parents complain. Curative treatment was done by removing the persistence of primary teeth. Tooth extraction was performed under topical anesthesia after being given prophylaxis antibiotic with 1600 mg (32kgBB x 50mg / kg) amoxicillin per oral 1 hour before the treatment. Prophylaxis antibiotics is given to prevent endocarditis bacterialis because the patient has a history of heart disease^{5,8} and undergo heart surgery in his childhood. After

five persistence teeth had been removed, his parents claimed he can chew their food faster.

The majority of Down Syndrome patients have a high risk of caries,⁹ but this patient has medium risk of caries. Application of a good diet had been shown to reduce the risk of oral disease in children with Down syndrome.¹⁰ Class 3 malocclusion in this patient can be treated with orthodontic treatment with proper analysis. But there are two considerations for reasons as to why this treatment has not been done. First, patient has poor cooperative levels during treatment. Second, parents' were concerned that he/she might swallow orthodontic tools.

The monitoring of patient's oral hygiene were performed every visit, and they showed that it leads to better conditions. This suggests that modification preventive approach of oral health that includes assessment of caries, diet analysis, OHI emphasized to parents, and prophylaxis can help improving oral hygiene of the patient.

CONCLUSION

Down Syndrome patients need dental and oral health examination and treatment. It takes cooperation in between parents, teachers and dentists so that child's dental health can be achieved. Clear explanation to the parents about good diet and ways to maintain child's oral hygiene at home, are important as a primary preventive measure. Down Syndrome children also need to do regular dental visit so that children become familiar with the atmosphere of dental clinics and can be more cooperative during dental treatment. Dentists need knowledge about Down syndrome, its characteristics, and interdisciplinary cooperation in the treatment of Down Syndrome patient as to provide optimal care for them, especially in dental and oral health.

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Comprehensive Treatment Such As: Restorations, Extraction And Space Maintainer In Children With Poor Oral Condition: A Case Report

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ABSTRACT

Despite improvements in the oral health of children in recent decades, caries, tooth persistence and premature loss remains a serious threat to child welfare. This condition affects not only the patients, but also their families and even the communities in which they live. In that condition, there is early carious involvement and gross destruction of the teeth. This leads to problems like reduced vertical dimension, masticatory insufficiency, esthetics, development of parafunctional habits like tongue thrusting and psychological problems. This case showed management comprehensive treatment for children with poor oral condition. A 8 year old girl patient accompanied with her parents were reported to the Pediatric dentistry Clinic RSGM UNPAD with a chief complaint of pain in the molar teeth. Clinical examinations found dental caries, persistence almost all teeth in the maxilla and mandible. Based on panoramic radiograph, treatments that can be done are restorations such as stainless steel crown, glass ionomer and composite filling, pulp treatments, extractions and fixed space maintainer. During treatment the patient was given oral hygiene instruction and recommend daily use of tooth mouse. After all treatment were completed, fluoride topical, and fissure sealants, recall check up after three months was scheduled. Comprehensive treatment needed in handling children with poor oral condition. Long-term treatments for this patient must be done, due to anterior cross bite that patient has, the treatment such as orthodontic interceptive treatment or growth modification might be necessary.

Keywords: comprehensive dental treatment, oral health, restoration, space maintainer

INTRODUCTION

Dental caries can be defined using two criteria. First, caries is a bacterial infection caused by specific acidogenic bacteria in the plaque biofilm. Second, caries is a multi-factorial process of tooth demineralization and re-mineralization, which until cavitation is reversible. Caries is the point at which the process of bacterial demineralization of tooth

structure overwhelms the patients ability to re-mineralize tooth structure⁹. This currently involves considerable professional judgment. Caries detection is an activity during which the clinician looks for objective findings on individual teeth using visual/tactile senses, possibly with assistance from technology. Caries assessment should be used to determine a current diagnosis and prognosis for the future.^{1,2}

Although the prevalence of dental caries in infants and children has decreased in recent years, yet still affects children in the general population. Previous investigations have focused on etiologic factors associated with the development of caries. Biologically caries may be modified by a number of factors in children such as implantation of cariogenic bacteria, the immaturity of the host defense system and behavior patterns associated with eating and oral hygiene in early childhood. Caries characterized by the microbiological population density of oral *Streptococcus mutans* (MS). Scientific evidence indicates that the development of caries occur in three stages. The first stage is characterized by primary infection of the oral cavity by MS. The second phase is characterized by the accumulation of these organisms to the level of pathogens as a consequence of frequent and prolonged exposure to cariogenic substrates. The last stage occurs rapidly demineralization and cavitation resulting enamel caries.³

A primary tooth is retained beyond the time of normal exfoliation in some cases. This results in an extended life for that tooth and the condition is known as 'persistence'. A retained deciduous tooth, with good crown, roots, and supporting alveolar bone, can offer an adult patient many years of service. Thus, most of the deciduous teeth studied can continue to function. However, persistence teeth can lead to some clinical problems including periodontitis, profound caries, and ankylosis.¹⁴

Premature loss of deciduous teeth tooth is lost prematurely. Premature loss of deciduous teeth can reduce the arch that is required for the replacement tooth is likely to cause crowding, and permanent tooth impaction. Early loss of deciduous teeth can cause constriction of the arch, the permanent molar tooth movement to mesial, extrusion opposing teeth and permanent teeth impaction or jostled. Therefore we need a tool to maintain the room until a permanent replacement tooth eruption in order to obtain normal occlusion in permanent tooth. The tools used to maintain the room due to the early loss of deciduous teeth is the Space Maintainer (SM).¹⁵

Caries is not self-limiting. If treatment for caries is delayed, the child's condition become worse and become more difficult to treat, thus increasing the cost of treatment. The most common immediate consequences of untreated dental caries are dental pain, which affects children's routines, such as eating, talking, sleeping and playing. Children with caries in primary teeth early in life have a higher risk for caries additional coined in primary teeth and permanent teeth. Premature loss or damage overall anterior deciduous teeth are physically disabled, humiliating and psychologically traumatizing to a child. Untreated tooth can cause pain and infection causing damage to the permanent teeth developing and feelings of personal inability. Care of the damaged tooth will prevent pain and infection and help the children become better in emotional and social adjustment. But in fact, early

extraction or tooth loss incisive lead to children suffering from psychological trauma when performed dental procedures necessary to restore the tooth mereka.^{5,6}

This case report describes the comprehensive treatment in girls aged 8 years with poor oral condition. There is extensive damage to deciduous teeth caries upper and lower tooth that need treatment such as space maintainer, manufacture restoration and preventive measures such as topical application of fluoride and fissure sealant. This case showed management comprehensive treatment for children with poor oral condition. There are still a lot of case children with poor oral condition. Knowing the best treatment for this condition, we hope that children with poor oral condition case will be decrease.

CASE REPORT

8-year-old girl, was taken to the Department of Pediatric Dentistry RSGM FKG UNPAD accompanied by her parents, with chief complaint pain on left upper molar teeth and persistence that seen on nearly all the maxilla and mandible. Patients had a history of false oral hygiene maintenance, breastfed until the age of 2 years and the use of bottled milk until the age of 3.5 years.

No	Oral Finding	Diagnosis	Treatment Plan
1	55/NV/RR	retained root	pro extraction
2	54/NV/MIDP/CP	pulp nekrosis	pro extraction
3	51/NV/MIDP/CP	pulp nekrosis	pro extraction
4	52/NV/RR	retained tooth	pro extraction
5	55/VDO/CM	reversible pulpitis	Pro class II composite
6	62/NV/MIDP/CP	pulp nekrosis	pro extraction
7	63/NV/RR	retained root	pro extraction
8	64/NV/MOD	pulp nekrosis	Pro pulpotomi tretament
9	65/V/MOD/CP	irreversible pulpitis	Pro pulpotomi treatment with SSC for follow up
10	28/V/OCM	reversible pulpitis	Pro class I composite
11	75/ NV/RR	retained root caries	pro extraction
12	74/ NV/RR	retained root caries	pro extraction
13	83/V/L/CM	reversible pulpitis	Pro class V composite
14	84/ NV/RR	retained root caries	pro extraction
15	85/ NV/RR	retained root caries	pro extraction
16	48/V/O/CM	reversible pulpitis	Pro class I composite



Figure 1. (a) intraoral of patient, (b) anterior view, (c) maxilla and mandible before treatment

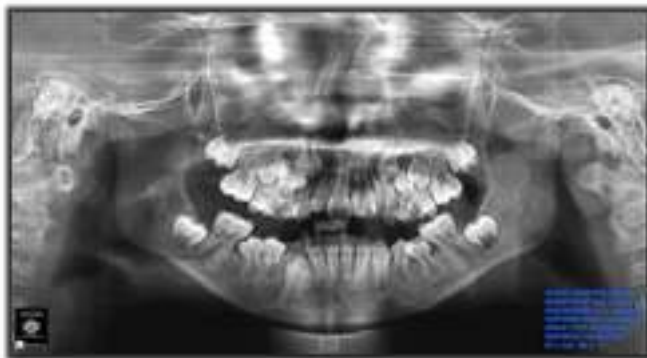


Figure 2. Panoramic Radiograph

Patient has healthy general history condition. Patient also has healthy dental condition and clinical examination obtained 51 62 persistence teeth, 52, 63 74 75 84 85 retained root, 26 46 83 54 55 64 65 cavity caries and 21 cross bite anterior as seen in figure 1A to 1C.

Based on the results of the panoramic photograph, showing 55 73 in dentin caries, 65 61 in caries pulp exposure, 51, 54 62 61 in pulp necrosis, 52, 63, 74, 84, 85 retained root. 65, 64 will be treated by pulpotomy treatment with follow-up of composite filling for 65 and stainless steel crown 64. Then 55 will be restored by composites, 73 will filling with glass ionomer and extractions of the tooth 52 54 61 63 74 84 85, after 54 extraction, it will be placed fixed space maintainer.

CASE MANAGEMENT

The first visit was performed dietary assessment and control plaque score. The second visit was performed a dental pulp treatments in 65 and 64 and dental fillings of 55 and 73. The third visit was performed extraction 51 52 and obturation 65 with follow-up. The fourth visit was performed extraction 62 63 74 75. The fifth visit was performed extraction and obturation 64 with followed-up SSC. The sixth visit was placed space maintainer and topical fluoride applied. After obtaining the informed consent from the parents, preoperative analysis performed. Orthodontic bands (thickness of 0.005 inches and 0.180 inches wide) adapted to the 55 followed by alginate mold to create a working model. Wire gauge 19 adapted and soldered to the band. Then the space maintainer cemented on 54 by using glass ionomer cement (Fuji 1) and the occlusion was checked. The seventh visit was controlled all the treatment. Patients are advised to avoid chewing solid foods and maintain oral hygiene. Each visit has always done control plaque score and oral hygiene instruction.

The seventh visit, first control patients performed after 24 hours followed by control every 3 months. Parent was informed that the equipment will be removed by a dentist after the permanent teeth erupt.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
rice, meat, crackers, milk/ yoghurt	Rice/ bread, chicken, vegetable, milk/ yoghurt	Rice/ bread, meat, vegetable, milk/ yoghurt	Rice/ bread, chicken, vegetable, milk/ yoghurt, cereal	Rice/ bread, meat, vegetable or fruit juice	Rice/ bread, chicken, vegetable, crackers, milk/ yoghurt	pasta/rice, meat, vegetable, ice cream

Figure 3. Dietary assessment for patient

During treatment patients and parents are taught how to brush their teeth and is recommended to use the tooth mouse as regular toothpaste. Once the space maintainer treatment is finished space fluoride topically applied containing 1:23% APF fluoride is preceded before polishing and plaque control. Fissure sealant was performed on the teeth 16 26 which have been partially erupted. Then scheduled to control every 3 months to monitor the status of the maintenance of oral hygiene, diet and control space maintainer.

DISCUSSION

Poor oral health conditions can have adverse consequences on physical and psychological health. However, the high burden of oral diseases is a challenge for health workers in almost every country around the world. Mouth diseases are often hidden and invisible, or they accepted as an inevitable consequence of life. However, there is clear evidence that oral disease that could not be avoided, but can be reduced or prevented



Figure 1. Frontal view of the patient.



Figure 2. (A) Diagnostic periapical radiograph of 13 and 11. (B) Periapical radiograph showed root end closure on 13 after approximately four months treated with calcium hydroxide. (C) Obstruction of 13 and 11. (D) One week after obstruction of 13 and 11.

through simple and effective action at all stages of the journey of life, both at the individual and population level.¹⁶

Poor oral health in infants and children destroys more than just a smile. Although largely preventable by early examination, identification of individual risk factors, parental counseling and education, and initiation of preventive care procedures such as topical fluoride application, the progressive nature of dental disease can quickly diminish the general health and quality of life for affected infants, toddlers, and children. Failure to identify and prevent dental disease has consequential and costly long-term adverse effects.¹⁶

Untreated dental disease compromises the child's ability to eat well, sleep well, and function well at home and at school. The unaesthetic nature of untreated dental decay compromises the child's self-esteem and social development.

Dental and oral diseases which not treated properly can lead to diminished its ability children and infants to eat, sleep and interfere with her activities at school and at home.

Figure 3. Dietary assessment for patient



Figure 4. (a) filling glass ionomer, (b) stainless steel crown restoration, (c) filling composite extractions, and (d) auxiliary fixed space maintainer

Dental and oral diseases such as dental caries is not treated properly can cause aesthetic problems, thereby reducing self-esteem and social development of children.¹⁶

In this case, patients are less motivated to maintain healthy teeth and mouth that cause poor condition of oral and dental health. Involvement extensive caries in anterior and posterior teeth, premature loss of deciduous teeth, and persistence is an indication of the need to evaluate patients comprehensively.⁶⁸⁹

In this case, the techniques behavior management in the form of desensitization applied. Desensitization is a way to reduce the fear or apprehension of a child by providing a stimulus that frightened or anxious little by little that is given continuously, until the child is not afraid or worried anymore because at first visit, patient looks anxious and afraid. The authors begin treatment with plaque control, then filling with ART, bur preparation and extraction.

The glass ionomer filling material and dental composite was used on 73 and 55. Glass ionomer is dental materials which are composed of a mixture of acid acrylic with glass powder used to fill cavities, particularly on the root surfaces of teeth. Glass ionomer is used

for small fillings in areas that do not need to hold a heavy mastication. Glass ionomer also have the effect of fluoride release, high humidity tolerance, easy to apply and can hinder the development of secondary caries. In this case 73, caries are at the root of the tooth and 73 is not support a heavy mastication. As for 55 filled by composite filling material. The cavity on 55 was a class 2 that requires a combustible material in shape to accommodate the anatomical shape of the natural tooth to be patched.

The thought of use fixed space maintainer band and loop due to the premature loss first molar and premolar tendency of delayed erupted fixed if the first molar lifted before the age of 8 years. Beside that, because of anterior component of force from this tooth which cause huge possibility of losing space. Band and loop is used to maintain the room and is indicated for premature loss of primary first molar before and after the eruption of the permanent first molar.

Space maintainer bands and loops type was used. This device is designed to maintain the space of the teeth in one quadrant. This device is used in cases of losing primary first molar and second molar, prevent migration to mesial associated with the eruption of permanent first molar, Band and loop is preferable because the manufacturing process is easier, working time is short, do not need anesthesia prior to mounting band because no preparation is done on the teeth, easier technique and more economical. In this case the missing teeth are 54 so that the author chose to use a band and loop space maintainer.

APF material was used for topical fluoride application because these materials contain fluoride as high as 1.23% fluoride. Fluoride has several mechanisms of protective action against caries. Topical fluoride in plaque and saliva inhibits enamel demineralization and enhance re-mineralization of enamel. Selection of topical fluoride in this case due to the high levels of fluoride, which is achieved by the use of a topical gel or varnish, producing a temporary layer of calcium fluoride as the surface of the enamel, and slowly release fluoride ions into the tooth structure. Fluoride is released when the pH drops when responding acid production and contribute to enamel re-mineralization or affect the metabolism of bacteria, in addition to topical fluoride is ingested it can also have the systemic effect.¹²

Fluoride has a great effect on the level of prevalence of caries. Moreover, fluoride can cause fluorosis through excessive exposure, especially in early childhood. Therefore, it takes a non-fluoride anti-caries ingredient. The latest technology for re-mineralization has been developed using fosfopeptida of the milk protein casein. The use of mouse tooth cream containing CPP-ACP (casein phosphopeptide-amorphous calcium phosphate) to improve SMH (enamel surface microhardness) of enamel is eroded significantly more than did 500 ppm NaF solution. CPP-ACP cream is effective in re-mineralization of early enamel lesions in primary teeth, more effective than 500 ppm NaF and can be used for the prevention of ECC. In severe cases ECC is very important use of toothpaste containing CPP-ACP cream regularly every day.¹³

Caries can cause loss of tooth of children at an early age, so that children suffering from developmental setbacks involving critical articulation in speech development. Children with poor oral state may also have physical developmental delays, especially height and

weight. The pain caused by caries can cause decreased appetite, ultimately resulting in a shortage gizi.^{5,6}

Treatment in the case of premature loss is with space maintainer, can be either fixed or removable prosthesis but removable prosthesis rarely used in children. Space maintainer can be defined as a device used to maintain space due to a premature lost, so that a replacement tooth can be erupted in the correct position in the arch. Common sense must be taken during the treatment plan or the making of decisions on the placement space maintainer on the incisor teeth. Lost of incisive is usually replaced because of four reasons: keeping room, function and aesthetics. Some dentists think that premature lifting of the oldest incisor teeth cause the loss of space for adjacent teeth shifted to the previous room occupied incisor teeth. However, there may be some influence on the formation of spacing between the incisor teeth, but no reduction in the size of the remaining space. This makes sense because there is no real movement or shifting of gears when the formation spacing shown in primary teeth. Because of these considerations, in the case of premature loss of the maxillary anterior was not been replaced.^{2,10,11}

Successful treatment depends mainly on the recall visit. Appointments should be established recall any visit by the dentist on the risk assessment of patients for other diseases in the future. Thus the importance of follow-up visits should be emphasized to the parents.⁴

Treating caries in stages of the disease to prevent the emergence, development, and tooth decay is the main call and the toughest challenges faced by dentists who treat children. Success in delaying the initiation of caries and caries suppress the emergence of new plays an important role for long-term oral health of children. The oral cavity is free of disease brought happiness and satisfaction not only for parents and children but also for the dental team who provide information, instruction, and reinforcement. Cooperation from patients and parents contributed to the success of treatment.⁴

After the whole treatment was done, patient was given preventive approach modification for oral health condition such as, caries assessment, dietary analysis, OHI and home care that was told to parents so they can perform the proper oral hygiene maintenance alone at home.

Patient now in growth and development stage and need periodic treatment to maintain patient's oral health status. In this case, patient still have cross bite anterior 21 and long-term treatment must be done such as interceptive orthodontic treatment to correct the cross bite.

CONCLUSION

Because conventional treatment is very expensive, alternative methods of treatment of children with poor oral health conditions are need to be sought. The use of fluoride is essential for the re-mineralization of early lesions but should be considered in conjunction with the potential to develop into fluorosis in permanent teeth because of their retention

topical agents. Preventive dentistry, home care, control regularly to the dentist as well as the cooperation of the patient and the parents are very important for patient's better quality life.

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Compehensive Treatment Of Injured Immature Permanent Anterior Teeth: A Case Report

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ABSTRACT

Dental trauma is a significant problem in children. The main etiology is falling, fights, accidents and sports. Maxillary anterior teeth are damaged or lost due to trauma can cause great psychological impact for children, because it deals with issues of aesthetics. The purpose of this study is to provide information about comprehensive treatment of injured immature permanent anterior teeth. A 12 years old boy came to Pediatric Dentistry Department of Padjadjaran University Oral and Maxillofacial Hospital complained about fracture and loss of upper front teeth because of accident that happened 2 weeks ago. Intra oral examination showed Ellis's class II fracture on 13 and 11, non-vital, swelling and redness on gingival margin. Furthermore, there's grade 1 mobility on 11 and missing of 12. Radiologic examination showed opened apex of 13, widening of periodontal membrane on 11 and 13, and diffuse radiolucency of apex on 11. Physical and extra oral examination showed no significant abnormalities. Patient's diagnoses are pulp necrosis on 13 with immature apex and pulp necrosis on 11 with periapical abscess. Treatment consisted of oral hygiene instruction, scaling and prophylaxis, apexification on 13 along with class IV composite restoration and non-vital pulpectomy on 11 with fiber post, core built up along with class IV composite restoration, orthodontic appliance to regain space of 12 and denture construction. Patient responded well to ongoing treatment. Successful treatment of injured immature permanent anterior teeth trauma case is influenced by growth and development aspect and requires comprehensive treatment.

Key words: Apexification, Dental trauma, Immature permanent anterior teeth

INTRODUCTION

Traumatic dental injuries (TDIs) occur with great frequency in preschool, school-age children, and young adults comprising, 5% of all injuries for which people seek treatment. A 12-year review of the literature reports that 25% of all school children experience dental

trauma and 33% of adults have experienced trauma to the permanent dentition, with the majority of injuries occurring before age nineteen. Luxation injuries are the most common TDIs in the primary dentition, whereas crown fractures are commonly reported for the permanent dentition. TDIs present a challenge to clinicians worldwide. Consequently, proper diagnosis, treatment planning and follow up are the critical issue to assure a favorable outcome.¹

Cautious case assessment and precise pulpal diagnosis is significant in the treatment of immature teeth with pulpal injury. Clinical assessment of pulpal status requires a comprehensive history of subjective symptoms, thorough clinical and radiographic examination and carrying out diagnostic tests. Precise pain history must be obtained. The duration, nature of the pain, aggravating and relieving factors must be considered. Duration of pain might vary, however pain that persist for more than a few seconds in a tooth with a vital pulp indicates irreversible pulpitis. When pain is spontaneous, severe and long lasting, this diagnosis is about certain. If the pain is throbbing in nature and the tooth is tender to touch, pulpal necrosis with apical periodontitis or acute abscess is expected. Substantiation from objective tests is essential. These comprise visual examination, percussion testing and thermal and electric pulp testing. The existence of a swelling or sinus tract denotes pulpal necrosis and acute or chronic abscess. Tenderness to percussion indicates inflammation in the periapical tissues. In the immature teeth, pulp vitality testing usually gives erratic response because the sensory plexus of nerves in the sub odontoblastic region is not well developed as root formation is incomplete, and any injury to it give unreliable responses.²

In radiographic examination, several projections and angulations are routinely recommended, but the clinician should decide which radiographs are required for the individual. The following are suggested: periapikal radiograph with a 90° horizontal angle with central beam through the tooth in question; occlusal view; periapical radiograph with lateral angulations from the mesial or distal aspect of the tooth in question.¹

All relevant diagnostic information, treatment, and treatment follow-up shall be documented in the patient's record. Any planned treatment should include consideration of: the patient's medical history; the value of each involved tooth in relation to the child's overall development; alternatives to pulp treatment; restorability of the tooth. When the infectious process cannot be arrested by the treatment methods included in this section, bony support cannot be regained, inadequate tooth structure remains for a restoration, or excessive pathologic root resorption exists, extraction should be considered.³

Selection of teeth for apexogenesis or apexification depends on clinical and radiographic features. If the patient reports within 24 hours of traumatic pulp exposure, apexogenesis is the treatment of choice. On the contrary, if the patient fails to report within 24 hours of pulp exposure or there are definite signs of pulp non-vitality, apexification is the only conservative treatment option left.⁴

According to American Association of Endodontists, Apexification is defined as a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp.⁵

Apexification requires the chemomechanical debridement of the canal followed by

placement of an intracanal medicament to assist or stimulate apical healing and formation of a horizontal apical barrier³ at the apical end of the root canal to facilitate the subsequent obturation of the canal without voids and excess material in the periapical tissue⁴. The most common material used in apexification is calcium hydroxide. Alternative material that can be used is Mineral Trioxide Aggregate (MTA).⁴ The purpose of this study is to provide information about comprehensive treatment of injured immature permanent anterior teeth based on case.

CASE REPORT

A 12 years old boy came to Pediatric Dentistry Department of Padjadjaran University Oral and Maxillofacial Hospital complained about fracture and loss of upper front teeth because of accident that happened 2 weeks ago. History showed that patient wore helmet during the accident and after involved in motorcycle accident, patient seeks for help at nearby clinic. There was no history of fainting and vomiting. After bleeding being controlled, physicians prescribed antibiotics and pain killers. There was no significant medical issue in this patient. Dental history showed that pain on dental area was severe and teeth were mobile at first but after approximately 5 days, the pain and teeth mobility reduced.

Intra oral examination showed Ellis's class II fracture on 13 and 11, non-vital (confirmed by thermal pulp testing and no pain on access preparation), tenderness to percussion, swelling and redness on gingival margin and no sinus tract. Furthermore, there's grade 1 mobility on 11, 1 mm extrusion on 11 and missing of 12 (Figure 1).

Radiologic examination showed single roots on 13 and 11, opened apex of 13, widening of periodontal membrane on 11 and 13, and diffuse radiolucency of apex on 13 and 11 (Figure 2A). Physical and extra oral examination showed no significant abnormalities. Patient's diagnoses are pulp necrosis on 13 with immature apex and pulp necrosis on 11 with periapical abscess.

Diagnoses from this case based on history taking, clinical finding, and additional examination consisted of radiologic examination. Patient's parent has given written consent about this publication.



Figure 1. Frontal view of the patient.

Treatment planning consisted of oral hygiene instruction, scaling and oral prophylaxis, apexification on 13 along with class IV composite restoration and non-vital pulpectomy on 11 with fiber post, core built up along with class IV composite restoration, orthodontic appliance to regain space of 12 and denture construction.

CASE MANAGEMENT

On the first appointment, after oral hygiene instruction, scaling and oral prophylaxis, access preparation was done on 11 and 13. Working length measurement showed 25 mm on 13 and 22 mm on 11 using periapical radiograph. Extirpation, reaming and filing was done in accordance with working length. Operator used conventional technique for cleaning and shaping on 13. Initial file on 13 was K-file no.55 (Dentsply Maillefer 50-90 25mm, Dentsply US) and master apical file was K-file no. 80 (Dentsply Maillefer 50-90 25mm, Dentsply US). On 11, operator cleaned and shaped the root canal using crown down technique (Protaper Universal for Hand Use 25 mm, Dentsply US) for cleaning and shaping root canal on 11. Master apical file was F4. Root canals were irrigated with sodium hypochlorite 0.5% on lateral lumen syringe tip, distilled water, and EDTA 17% (Prevest Denpro) to rinse smear layer. Afterward root canals were dried using paper point, and calcium hydroxide paste (Calcipex II® , Nippon Shika Yakuhin Co., Ltd, Shimonoseki, Japan) applied with paste syringe and a Lentulo spiral (Dentsply Maillefer, Dentsply US) until apex and temporary restored using glass ionomer (GC Gold Label Type 9 HS Posterior Extra, GC Corporation Tokyo Japan). Patient prescribed with chlorhexidine gargle 0.2% to reduce inflammation at gingival margin.

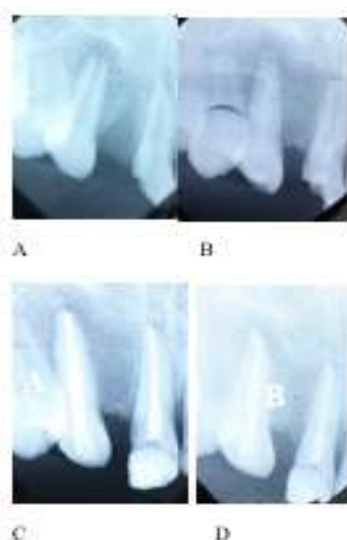


Figure 2. (A) Diagnostic periapical radiograph of 13 and 11. (B) Periapical radiograph showed root end closure on 13 after approximately four months treated with calcium hydroxide. (C) Obturation of 13 and 11. (D) One week after obturation of 13 and 11.

One month after first appointment, control was done. Patient came with no complaint, no significant clinical finding was found and percussion test was negative. Mobility on 11 and swelling has decreased. Furthermore radiographic examination was done using periapical radiograph to evaluate the absorption of calcium hydroxide. There was radiolucency on 1/3 apex on 13 and 11 root canals, diffuse radiolucency on apical 11. And then, operator opened the temporary restoration, cleaned the root canal and replaced the medicament with new calcium hydroxide. Glass ionomer was used as temporary filling on 13 and 11.

Three months after second appointment, patient came with no complaint. Percussion and mobility test was negative on both teeth. Later on, periapical radiograph was taken to evaluate calcified barrier (Figure 2B). There is a thin layer of radio opacity on the apex of 13 confirmed by constriction sense on root canal. And then, operator opened the temporary restoration, cleaned the root canal and dried using paper points. Obturation on 13 was done using lateral condensation method with conventional gutta percha points and Endometasone sealer (Endometasone N, Septodont France). Obturation on 11 was done using F4 Protaper gutta percha points (Protaper Universal Gutta Percha Points 25 mm, Dentsply US) with Endometasone sealer. Glass ionomer was used as temporary filling on 13 and 11. Periapical radiograph was taken to check the obturation (Figure 2C).

A week after third appointment, control was done. There is no compliance from the patient. Surrounding tissue was within normal limits. Periapical radiograph was taken and there was no significant abnormality (Figure 2D). Patient responded well to the treatment and follow-up is still ongoing.

DISCUSSION

When immature teeth suffer pulp necrosis, the root development ceases and apical closure cannot be achieved. Root canal treatment at this time is a significant challenge, because of the size of the canal, the thin and fragile dentin walls, and the large open apex. To manage these teeth, apexification has long been the treatment of choice, enjoying considerable success in preserving damaged immature teeth.⁶

Apexification is a method of inducing root end closure of an incompletely formed non-vital permanent tooth by removing the coronal and nonvital radicular tissue just short of the root end and placing a biocompatible agent such as calcium hydroxide in the canals for two to four weeks to disinfect the canal space.³

The length of the canal is established by radiographs, since the absence of an apical constriction may make electronic methods unreliable. A constant drying point, determined with paper points, may provide helpful additional information on length. Irrigation is central to the débridement of immature teeth, and with proper precautions, operators should not hesitate to benefit from the antimicrobial and tissue-solvent properties of NaOCl.⁷

In this case, operator use 0.5% NaOCl on lateral lumen syringe tip to minimize adverse reaction of NaOCl to the apical tissue because there are no constriction on this immature tooth. Followed by distilled water and EDTA 17% to rinse smear layer.

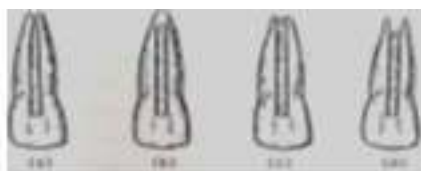


Figure 3. Various types of root closure in apexification. (A) Continued closure of canal and apex to a normal configuration. (B) Apex closes but canal remain with blunderbuss configuration. (C) No radiographic change, but a thin osteoid line barrier provides a definite step at or near apex. (D) Radiographic evidence of a barrier short of apex.¹⁰

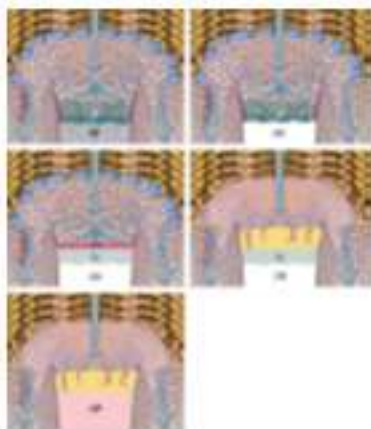


Figure 4. Calcium hydroxide induced ~~apexification~~ changes after pulp necrosis. (a) Infected pulp necrosis (NP) plus inflammation (IT) in the apical part of the root canal. (b) Dressing with calcium hydroxide (CH). (c) Because of its high pH effect upon dentin, calcium hydroxide (CH) causes the release of a number of wound healing signals (growth factors), and for some time, the high pH also may prevent bacteria from entering the wound healing site. CH induces by its high pH effect apical liquefaction (Li) and a coagulation zone (Co) of necrosis. (d) The response to the coagulation necrosis appears to be recruitment of new hard tissue forming cells from the apical tissues, these are usually of ~~odontoblastic~~ origin, but may also be osteoblasts. During this process, vascular inclusions may occur. After 6–18 month, a hard tissue barrier is formed. (e) Status after root filling with gutta-percha (GP).¹¹

After thorough débridement, the canal is dried and medicated with a fluid $\text{Ca}(\text{OH})_2$ paste, carried into the canal with a Lentulo spiral or injected from a proprietary paste syringe. The tooth is then sealed coronally, and the patient is recalled at 3-monthly intervals to wash out the $\text{Ca}(\text{OH})_2$ paste and inspect clinically (with the aid of a gutta-percha or paper point or by direct visual inspection through the microscope) and radiographically for the development of a calcified barrier.⁷

Abbott, 1998 suggested that after establish working length; irrigate and prepare the root canal, place calcium hydroxide paste within the canal. Between 4-6 weeks later replace calcium hydroxide and the temporary restoration. Two months later replace the calcium hydroxide and temporary restoration. Repeat for two or three months later until barrier has been completed. Finally place a root canal filling and restore the access cavity.⁸

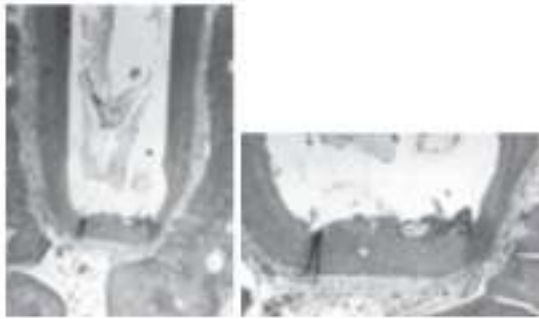


Figure 5. Histologic section of a dog's tooth after $\text{Ca}(\text{OH})_2$ apexification. (A) Cementum-like mineralized tissue is closing the wide-open root end. Debris is apparent within the canal because of inadequate decalcification before filling. (B) Higher magnification showing cellular detail; periodontal ligament is free of inflammation. Root canal filling material was lost in histologic preparation. Note presence of tissue communication through the apical barrier (stain H&E).³

The mineralized tissue can be composed of osteocementum, osteodentin or bone or some combination of three. This procedure should induce root end closure (apexification) at the apices of immature roots or result in an apical barrier as confirmed by clinical and radiographic evaluation. Apical closure can take various forms. It can be complete or incomplete hard tissue bridge a few millimeters short of the end of the root. It can be located at the tip of the root, or the bridging can be irregular mass of calcification traversing the apical one third of the root. In most cases, apical closure takes an irregular and aberrant form. Along with apical closure, root development or lengthening may or may not continue, but whatever the form, root development is usually irregular and aberrant. Weine classified this apical closure into 4 categories (Figure 3).^{3,9,10}

Figure 3. Various types of root closure in apexification. (A) Continued closure of canal and apex to a normal configuration. (B) Apex closes but canal remain with blunderbuss configuration. (C) No radiographic change, but a thin osteoid line barrier provides a definite stop at or near apex. (D) Radiographic evidence of a barrier short of apex.¹⁰

Apical barrier on 13 formed after being treated for four months with calcium hydroxide as seen in periapical radiograph and confirmed with tactile sense on clinical assessment (Figure 2B). Apical closure in this apexification case continued to close to a normal configuration (Figure 3A). Mechanism of root end closure is still unclear. Numerous theories and case report showed different mechanism of how calcium hydroxide can induce apical barrier (Figure 4).

Under ideal conditions, residual pulp tissue and the odontoblastic layer may form a matrix, such that the subsequent calcification can be guided by the reactivated epithelial cell rests of Malassez or nonperiapical pluripotent cells within bone. Barrier formation also depends on the degree of inflammation and pulp necrosis, displacement at the time of trauma, and number of calcium hydroxide dressings, which can complicate (or at least delay) treatment.¹¹

Calcium hydroxide can induce healing conditions because of its antibacterial behavior. As a result of its high pH, (most calcium hydroxide pastes have a pH of about 12.2) the highly reactive hydroxyl ions produce damage to the bacterial cytoplasmic membrane by denaturing protein and destroying lipoproteins, phospholipids, and unsaturated fatty acids. Consequently, these actions lead to bacterial vulnerability and alteration of the nutrient transport and DNA. Calcium hydroxide also hydrolyzes the toxic lipid A of bacterial endotoxin into atoxic fatty acids and amino sugars, thereby inactivating the inflammatory reaction and periapical bone resorption.^{8,11}

Siqueira and Lopes discussed the mechanism of its antimicrobial activity in detail. Calcium hydroxide assists in the debridement of the root canal, as it increases the dissolution of necrotic tissue when used alone or in combination with sodium hypochlorite.¹²

Frank in 1966 published three case histories of apical closure induced by calcium hydroxide. He assumed that the apical closure was related to Hertwig's epithelial root sheath.¹³

Mitchell and Shankwalker studied the osteogenic potential of calcium hydroxide and other materials when implanted into the connective tissue of rats. Of the materials used in comparative studies, only three gave any evidence of induced calcification. They concluded that calcium hydroxide had a unique potential to induce formation of heterotopic bone in this situation.¹⁴

In a primate study, bridging of the root end with osteodentin was reported after vital pulpectomy and canal medication with Ca(OH)₂/parachlorophenol paste. The material appeared to be distinct from but continuous with the cementum, dentin, and predentin at the root apex. The closure of the apex may be partial or complete but consistently has minute communications with the periapical tissues (see Figure 5). For this reason, apexification stimulated by pastes must always be followed by obturation of the canal with a permanent root canal filling, traditionally of thermoplastic gutta-percha and sealer, though MTA would be a good contemporary alternative.⁷

Adverse post-treatment clinical signs or symptoms of sensitivity, pain, or swelling should not be evident. There should be no radiographic evidence of external root resorption, lateral root pathosis, root fracture, or break-down of periradicular supporting tissues during or following therapy. The tooth should continue to erupt, and the alveolus should continue to grow in conjunction with the adjacent teeth.³

There are no clinical signs or symptoms of sensitivity, pain or swelling in the last appointment. No pathologic changes in radiographic assessment. The tooth continues to erupt and the alveolus continues to grow.

Although the apexification technique with Ca(OH)₂ has enjoyed considerable tooth-preserving success, the many disadvantages of this protracted treatment have justified a search for alternatives, such as artificial barrier techniques, with their potential for more rapid treatment, and regeneration techniques, with their potential for continued tooth development.⁷

CONCLUSION

Successful treatment of injured immature permanent anterior teeth trauma case is influenced by growth and development aspect and requires comprehensive treatment. Apexification has long been the treatment of choice to manage a non vital immature permanent tooth. Calcium hydroxide provides a viable alternative to achieve root end closure in an immature tooth.

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Fiber-Braid Reinforced Composite Loop Space Maintainer: An Alternative Design And Material Of Space Maintainer

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ABSTRACT

Early loss primary tooth, called premature loss of primary tooth was common situations that occur in the children. This condition presents a potential problem because drift of permanent or other primary teeth and malocclusion are common unless it can be prevented. The safest way to prevent the problem is to place a space maintainer that is effective, durable and economic. An appropriate use of space maintainer is to hold the space until the eruption of permanent teeth. The stainless steel band and loop appliance is the most commonly used fixed space maintainer in pediatric dentistry. But this appliance has several disadvantages. The purpose of this case report is to present a simple design of a "Fiber-Braid Reinforced Composite" (FBRC) loop space maintainer as an alternative design and material of space maintainer and discuss the advantages of this appliance. A girl 7 years old came to department of pediatric dentistry clinic RSGM UNPAD for dental check-up. A right lower back tooth was missed. The patient is advised to make a space maintainer to prevent the closure of the space by the teeth adjacent to it. Premature loss of this patient was treated by constructed loop space maintainer using a commercially available polyethylene fibres system (Fibre-Braid, Biodental Technologies, Macksville, northern NSW). Fiber-braid reinforced composite loop space maintainer can be used as an alternative design and material of space maintainer.

Keywords: Premature loss, fiber-braid reinforced composite, space maintainer

INTRODUCTION

Deciduous teeth have an important role for children so that its presence must be maintained in a healthy condition. If the deciduous teeth are difficult to maintain, for example, there is a severe dental disease, then in some cases, deciduous teeth can be loose prematurely and cause a bad effect on the occlusal development. It is therefore considered to maintain space for the permanent tooth replacement with the placement of space maintainer.

Early loss primary tooth, called premature loss of primary tooth was commons situation that occur in the children. This condition presents a potential problem because drift of permanent or other primary teeth and malocclusion are common unless it can be prevented.¹ Orthodontics interceptive can eliminate or overcome severity of malocclusion development, however, there are considerations in the treatment's complexity, duration and cost. The safest way to prevent further malocclusion associated with early loss of deciduous teeth is uses a space maintainer, which is quite effective, durable, and economical. The proper use of space maintainer is to keep the space until the eruption of the permanent teeth.²

The stainless steel band and loop appliance is the most commonly used fixed space maintainer in pediatric dentistry but this appliance has several disadvantages, as it needs a working model, may result in decalcification of tooth material under the bands, detached or looseness the band because of damaged or poor luting agent, possibility of soft tissue injury and possibility of metal allergies. The purpose of this case report is to present a simple design of a "Fiber-Braid Reinforced Composite" (FBRC) loop space maintainer as an alternative design and material of space maintainer and discuss the advantages of this appliance.

The objective of this case report is to present the other way to treat case with premature lost of primary tooth and demontrated a simple design of a "Fiber-Braid Reinforced Composite" (FBRC) loop space maintainer as an alternative design and material of space maintainer and discuss the advantages of this appliance

CASE REPORT

A girl 7-year-old came to department pediatric dentistry clinic RSGM UNPAD Bandung, accompanied by her parents to do her teeth examination.

On the first visit, the dentist do the anamneses with the patient and her parents in order to complete the patient's identity and general medical history, and also examine the intra oral condition. Afterwards the behavior of the patients for dental examination was being observed, and the examination of extra-oral and intra-oral was conducted. Panoramic x-ray examination, and oral hygiene instruction was also performed.

Of intra-oral examination it was shown that the teeth growing stages was the mixed dentition, it was also observed that there were no soft tissue abnormalities, neither teeth anomalies, nor persistence, but her right lower back tooth were missing. From anamnesis it is known that the missing tooth was because of the tooth extraction that done week ago. From the panoramic x-ray radiograph it was obtained that the range from permanent tooth to get to the occlusal plane is still quite a distance. Therefore, the tooth in which is a tooth 85 diagnosed as premature loss. Treatment plan was made to use space maintainer with new design and material, called fiber-braid reinforced composite loop space maintainer (FRCSM). Approach was performed in pediatric patient and information was providing to the patient's parents about the premature loss and FRCSM.

Diagnosis and Treatment Plan

No	Oral Finding	Diagnosis	Treatment Plan
1	64/V/MO/CM	reversible pulpitis	pro class II composite
2	65/V/O/CS	reversible pulpitis	pro class II composite
3	75/V/O/CS	pulp nekrosis	Already treat
4	74/NV/ML/CP	pulp nekrosis	Already treat
5	84/NV/MOD/CP	pulp nekrosis	Already treat
6	85/V/O/CS	missing teeth	pro SM

Dental Radiographic Examination



Figure 1. The Result of Panoramic X-Ray Radiograph indicated that the range from permanent tooth to get to occlusal plane is still quite a distance

CASE MANAGEMENT

Preventive Maintenance: Plaque score examination and Oral hygiene instruction (OHI) Curative Treatment: Curative treatment is done through several visits after the anamneses, a thorough examination of the general and oral cavity health and OHI

1. First Visit: Cavity preparation was being done for the class II composite on the tooth 64 and 65. Then etching, bonding and composite material applied over the tooth according of the instruction for using the manufacture material. Working model of the upper jaw and lower jaw were made by impression making proceed after analyze panoramic x-ray radiograph.
2. Second Visit: After proceed the FRSCM was done in the working model, try in the oral cavity was needed. Then if the fiber braid reinforced composite loop space maintainer was fitted, insertion of FRSCM was performed. This insertion of FRSCM can actually be performed directly in a single visit, but due to the age of patient, which was 7 years old, and the patient often get bored quickly, insertion was done in the second visit.
3. Third Visit: The first control is done a week after insertion.
4. Fourth Visit: The last control for a re-evaluation carried out four months after the first insertion.

Re-evaluated was done on August 16, 2016 to perform a clinical examination and oral hygiene maintenance instructions. Evaluation FRSCM insertion after one week also four months has a good result.



Figure 2. A. Tooth 85 was missing, B. FRCSM insertion in the tooth 85 region, C. FRCSM in the first control (a week after insertion), D. FRCSM in the second control (four months after insertion)

DISCUSSION

Premature tooth loss in primary teeth has different consequences, depending on which teeth that was missing and also the relationship of occlusion and alignment. The potential consequences must be considered in the assessment of orthodontic problems to determine whether the space maintainer is required and what is the most suitable type of space maintainer.³

There are various factors which should be considered when space maintainer is planned following the early loss of primary teeth.

1. Time elapsed since loss of teeth: It is usually advisable to place a space maintainer as soon as the primary teeth are lost or removed. Studies indicate that the maximum loss of space occurs within 6 months of extraction of teeth. It would be better to fabricate the appliance prior to extraction of the primary tooth and insert the appliance soon after the extraction. In this case: the primary tooth (85) were lost two weeks before insertion
2. Dental Age of the patient: The dental age of the patient should always be considered rather than chronological age. This is because too much variation in eruption of teeth is observed. It is usually observed that the permanent teeth erupt once $\frac{3}{4}$ th of their root development is complete. These criteria can be used to predict the age of eruption of the permanent teeth. In this case: the dental age estimation of this patient were presenting that the permanent tooth has erupted the $\frac{3}{4}$ th of the root development.
3. Thickness of bone covering the un-erupted teeth
4. The more is the bone covering the un-erupted tooth, the more would be the time it would take to erupt, and therefore space maintainer is indicated. For illustration, normally premolars take 4- 5 months to erupt through a bone of 1 mm. In this case: The bone that covering the un-erupted tooth was quite thick.
5. Sequence of Eruption of Teeth: Whenever a space maintainer is planned, adequate

consideration should be given to the adjacent developing and erupting teeth. The neighboring dentition can greatly influence the closure of the extraction space.

In this case: There are two neighboring dentition which is tooth 46 and 84. Tooth 46 already eruption with a good condition and tooth 84 have already treated with root canal treatment, didn't have complaint of that tooth, and no soft tissue abnormalities.

Design and Construction

The material used here was plasma etched braided fiber (Biodental, Macksville, northern NSW), etching and bonding (Te-Econom Plus®, Ivoclar Vivadent, Switzerland)

In this case report, two visits were made due to the consideration of non-cooperative patient. Therefore a working model was made. For the early execution in the working model, initially FRC loop framework is formed using the commercial polyethylene fiber system (plasma etched fiber braided Biodental) (Figure 3A). Fiber Braid with a length of 35 mm moistened with bonding (Te-Econom Plus®) (Figure 3B, 3C) to be formed form a loop, 5 mm from each end of the fiber left out spaced for mounting on its abutments (Figure 3D). A thin layer of restorative composite resin (Te-Econom Plus®) was added to the outside of the fiber, 5mm from each one final tip was left to provide the initial stiffness properties in the adaptation of the middle third of the buccal and lingual surfaces of molar teeth. Loop is then released from the tooth 46 in a working model; composite resin restorative (Te-Econom Plus®) was added to the inside of the loop except each end of its fiber and light-cured for 40 seconds. Loop then smoothed with finishing burs and sofex disc.

On the next visit, insertion was done to the patient. Buccal and lingual surfaces of the teeth then acid etched with phosphoric acid (Te-Econom Plus®) for 15 seconds, washed with water, dried, and the bonding agent (Te-Econom Plus®) is applied and cured for 40 seconds, according to manufacturers instruction. Loop then was to be placed on using restorative dental composite resin (Te-Econom Plus®) followed by polishing.

Lately fiber-reinforced composite resin (FRCR) has been introduced for a variety of applications in dentistry. Polyethylene fiber showed properties to the best in elasticity, translucency, adaptability, durability, resistant to traction and collision.⁴



Figure 3. A. Plasma Etched Braided Fiber Spool. B. Measurement approximate width of the tooth region 85 for placement of FRCSM. C. Composite Te-Econom Plus® (on Plasma Etched Braided Fiber). D. The result of FRCSM that try in the working model.

Various of space maintainer has been used in pediatric dentistry. Although these tools are effective, they have disadvantages such as multiple visits, the time required for laboratory procedures, damage to the cement, the formation of caries, the attachment to the gingival tissue, causing tilt or rotation of the teeth adjacent, breakage of solder joints, and require cytotoxic solder. These deficiencies suggest the need for new types of design of the space maintainer.⁴

The use of fiber for improvisation in mechanical materials has been used in aerospace technology, automobiles, and ships. The truth is, in lab tests and clinical used, fiber offers greater flexural strength than stainless steel, titanium, or zirconia. Fiber is very strong; these materials are used in a formula a race car and the B-2 stealth bomber. With the popularization of dental composites, is it reasonable for fiber reinforcements to become a useful material in dentistry. Different types of fiber used in dentistry, such as: carbon fiber (no esthetic), glass fiber, polypropylene, and polyethylene fiber. Glass fiber can be harmful to health when inhaled resulting in silicosis-type problems.⁴

Polyethylene fiber can be used in pediatric dentistry to splint traumatized teeth, restore fractured tooth, as the space keeper between the teeth, or in the post endodontic fixed retainers.

A few literature reports on use of polyethylene FRCR (fiber-braid) as space maintainer. Hence the present study has been taken up to develop a clinically acceptable, less time consuming, and patient friendly FRCR space maintainer as an alternative to band and loop stainless steel space maintainer.

The design in this case report involves the use of fiber-braid reinforced composite. Composite reinforced with polyethylene fiber or glass fibers can produce material to improve the mechanical properties, such as stiffness, strength, toughness, and fatigue-ness. Fiber produces increase in load on the brittle composite materials by acting as the stress-bearing component and by crack-stopping or crack-deflecting mechanism. Ramos *et al.* demonstrated composite test bars containing ribbon fibers had significantly higher fracture strength over non-reinforced test bars.⁵ The previous design of the FRC space maintainers (FRCSM) are rigidly bonded to the teeth adjacent to the space, which may adversely affect the growth and development, the exfoliation of primary teeth and the eruption permanent teeth. Whereas the design presented in this case report overcomes all the disadvantages of previous design of FRCSM, thus stimulating the stainless steel band and loop space maintainer. Ganjanan *et al* concluded that the ribbon space maintainers as well as repaired ribbon space maintainer are comparable to the conventional stainless steel band and loop in terms of physical strength. McDonald and Avery suggested that the band and loop space maintainer should be replaced once a year, to be examined, cleaned and applied fluoride on the tooth. FRC loop space maintainer seems to be able to eliminate these annual maintenance steps.⁵

CONCLUSION

Fiber-braid reinforced composite loop space maintainer is clinically acceptable and possible for use as an alternative design and material of space maintainer, but further study is needed to ensure the successful of this space maintainer by using more samples and done over a longer period of time than the time in this case report.

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A Treatment For Non Vital Anterior Immature Permanent Teeth Using Protaper Manual System (Hand Use) : A Case Report

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ABSTRACT

Treatments for non-vital immature permanent teeth with incompletely formed roots are apexifications, for non-vital pulp of a teeth with root close completely is pulpectomy. ProTaper Manual System file is a nickel-titanium (NiTi) file that was created to reduce the number of instruments used in endodontic treatment procedures. This case report describes a treatment of non-vital anterior immature permanent tooth using ProTaper Manual System (hand use). A 10-year-old female patient come to the clinic Department IKGA UNPAD Dental Hospital complaints a broken upper anterior tooth 1 month ago due to fallen. During the oral examination, there was no swell or ache found. Radiographs showed teeth 11 and 21 suffered an oblique fracture in two-thirds of the crown. At the root of the tooth root tip 11 seen yet completely closed, while 21 have been completely closed. The treatment for 11 is apexification and for 21 is pulpectomy using Protaper Manual System (hand use) and dressing using Ca (OH) 2 was treated for 11 and 21 was used gutta-percha. After 1 week treatment, clinically no pain complaints and negative percussion and surrounding tissues found no abnormality. 21 teeth continued with composite fillings. Radiography 1 month after treatment has been a slight closing of the apex of the tooth 11. ProTaper Manual System (hand use) can simplify the procedure particularly apexification endodontic treatment in an immature permanent tooth and also pulpectomy endodontic treatment. Apexification treatment results in the teeth 11 still continues to control after 6 months.

Keywords: non-vital endodontic treatment, immature permanent teeth, ProTaper System Manual (hand use).

INTRODUCTION

Treatments for non-vital immature permanent teeth with incompletely formed roots are apexifications, for nonvital pulp of a teeth with root close completely is pulpectomy. ProTaper Manual System file is a nickel-titanium (NiTi) file that was created to reduce the

number of instruments used in endodontic treatment procedures. This case report describes a treatment of non-vital anterior immature permanent tooth using ProTaper Manual System (hand use). A 10-year-old female patient came to the clinic Department IKGA UNPAD Dental Hospital complaints a broken upper anterior tooth 1 month ago due to fallen. During the oral examination, there was no swell or ache found. Radiographs showed teeth 11 and 21 suffered an oblique fracture in two-thirds of the crown. At the root of the tooth root tip 11 seen yet completely closed, while 21 have been completely closed. The treatment for 11 is apexification and for 21 is pulpectomy using Protaper Manual System (hand use) and dressing using Ca (OH) 2 was treated for 11 and 21 was used gutta-percha. After 1 week treatment, clinically no pain complaints and negative percussion and surrounding tissues found no abnormality. 21 teeth continued with composite fillings. Radiography 1 month after treatment has been a slight closing of the apex of the tooth 11. ProTaper Manual System (hand use) can simplify the procedure particularly apexification endodontic treatment in an immature permanent tooth and also pulpectomy endodontic treatment. Apexification treatment results in the teeth 11 still continues to control after 6 months.

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INTRODUCTION

Non-vital teeth can occur in children with permanent teeth that still in the process of growth and development. Trauma or caries in immature permanent teeth can lead to pulp necrosis, resulting in the formation of dentin stalled before root formation is complete.¹ In children or young age, anterior teeth are most vulnerable to the possibility of trauma to the posterior teeth pulp tissue death is generally caused by caries continues.² Immature permanent teeth that have experienced the necrosis of the pulp required endodontic treatment. Types of endodontic treatment in the non-vital immature permanent teeth chosen by closing the tip apex is seen from radiographs.

Pulpectomy is a root canal treatment procedure in irreversible pulpitis or necrosis caused by caries or trauma. Canals were disinfected and shaped by hand using a file with instrumentation manually or with rotary instruments. Dental care was done then restored with a restorative material that can prevent microleakage.³ Cleaning and shaping the root canal is the most important stages in endodontic treatment, apexification and also pulpectomy. ProTaper Manual system is designed to improve the efficiency of cutting dentin with flexibility, especially on the roots of the curve. ProTaper Manual file system has a convex design of triangular cross-sectional design with cutting-blades that have a combination of taper varying the cutter.⁴

Apexification is an endodontic treatment that aims to stimulate the further development of the process of forming the apex of the tooth that has not fully grown but has experienced

the death of the pulp to form a hard tissue.^{5,6} Apexification stimulate the pulp that has experienced the necrosis in order to form a barrier calcification at the apex of which is open. Distropic calcification process will occur in the apical granulation tissue that is form a solid mass. This calcified tissue integrates with predentin at the apex. Apexification does better in younger patients and adults.²

Indications apexification maintenance performed on non-vital teeth with the condition of the apical foramen is open or not yet fully formed. This treatment cannot be performed (contraindications) on non-vital young permanent teeth with periapical abnormalities.⁶ Non-vital dental care with an open apex in principle no different from non-vital tooth endodontic treatment, which includes cleaning and shaping the root canal, root canal disinfection and root canal obturation with fillers.² Writing this report is intended to discuss the treatment of young permanent teeth anterior non-vital ProTaper system manual (hand use).

CASE REPORT

A patient of 10 years old girls come to the clinic Department IKGA Dental Hospital UNPAD with complaints on a broken front tooth approximately 1 month earlier because of a fall. Based on the anamnesis of patients stated there was never any pain or swelling. On clinical examination looked teeth 11 and 21 fractures up to a third of the crown (Figure 1).



Figure 1. Clinical appearance of two-thirds oblique fractures in the crown 11 and 21.

The examination, there was not found swelling and pain. Percussion and palpation tests did not give a positive response. Radiographs (Figure 2) shos the teeth 11 and 21 suffered an oblique fracture in two-thirds of the crown. At the root of the tooth root tip 11 seen yet completely closed, while 21 have been shut down. Diagnosis 11 is necrotic pulp with an open apex, while 21 is the apex pulp necrosis has been completely closed. Treatment plan 11 is apexification by using calcium hydroxide $\text{Ca}(\text{OH})_2$, while 21 are non-vital pulpectomy with fillers guttaperca and endomethasone as a sealer. Root canal preparation for the treatment of both teeth using ProTaper manual system (hand use). Composite restorations will be the choise restoration after the endodontic treatment is completed.

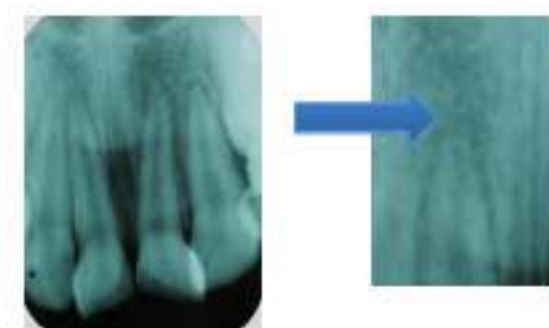


Figure 2. The radiographic periapical 11 and 21 show the closure of the roots that have not completely closed on the tooth 11.

CASE MANAGEMENT

Pulpectomy treatment performed on tooth 21. Root canal preparation was done by the method of crown down with ProTaper Manual System (hand use). At the first visit begins with the opening of the pulp chamber using a round bur, as well as the removal of the pulp tissue to find the orifice. The length of the work 21 is 23 mm. Stages of treatment starts from the exploration of the root canal K-Files no.15, shaping files S1 to enlarge the root canal. Shaping file is inserted into the root canal with slow motion clockwise to the apical, and removing it from the root canal with a counter-clockwise motion.

Shaper X (SX) is used to get rid of dentin selectively, relocate the root canal of the danger of perforation and achieve access to the perpendicular. Sx is inserted into the root canal with light pressure. File S1 performed by the same movement from apical to coronal and then dirigasi. Next, use S2 for file shaping phase 2. Irrigation is done every turn of the file. After shaping file to the second stage is completed, followed by finishing first file is F1 along the length of employment.

Examine the size of the apical foramen using K-file no. 20 until the working length. If according to the working length, the canal is ready for obturation done by using appropriate guttaperca with same size that is F1. F1 is the minimum size recommended. In this case, tooth 21 was prepared to finishing stages no.3 file F3. Having obtained the appropriate form of preparation, irrigation return and dried using paper point, previously performed the sterilization phase rockles use paper point and then sterile cotton pellets of filled temporary fillings. Patients were instructed to come back a week later.

Treatment for 11 is apexification. Working length obtained is 21 mm. Stages of preparation begins by using K-File no. 15 with a length of 2/3 of the length of employment (± 13.5 mm). Irrigate with NaOCl. Preparation with S1 file to the depth of working length (21 mm), followed by file S2, then irrigated with NaOCl. Magnification of the root canal with NaOCl irrigation F1 file and resume file F2 and F3. NaOCl. Irrigation channels dried root paper point. Application of calcium hydroxide paste (Calxyl) with lentulo and compacted by

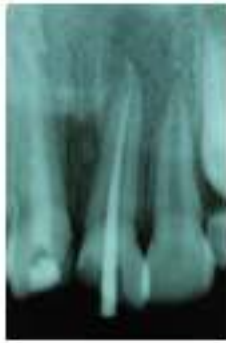


Figure 3. The radiographic periapical of the working length measurement and the trial 21.



Figure 4. Periapical radiographs showed root canal 11 containing pasta $\text{Ca}(\text{OH})_2$



Figure 5. Periapical radiographs showed filling with gutta percha filler F3 and endomethasone as sealer

the plugger. The pulp chamber containing pasta $\text{Ca}(\text{OH})_2$ and a sterile cotton pellet, cotton and given a thin layer of filled while and done taking periapical images (Figure 4).

Control taken on the second visit (1 week), the patient did not complain any clinical symptoms, negative on percussion test, and did not reveal any abnormalities in the surrounding tissue. Paper point used on 21 was clean in the sterilization test. Paper points obtained in a clean, white and odorless, so it is done charging with a filler material of gutta



Figure 6. There is thickening which describes the process of mineralization at the tip apex 11

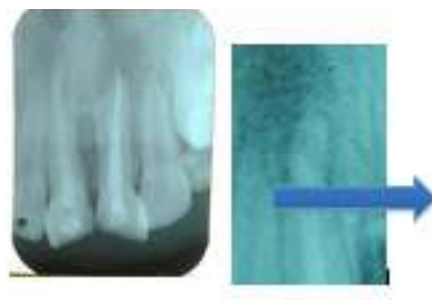


Figure 7. Closing occurred on the tooth root 11

percha F3 and endomethasone as sealer (Figure 5). Control at week 4 not reported any complaints, mobility, percussion and tenderness in 2nd gear. Photo periapical radiopaque shown on the root tip (Figure 6)

DISCUSSION

The prevalence of dental fractures due to trauma to the incisors immature permanent teeth around the world varied from 2.6% to 30% of cases.⁷ In the UK, O'Brien showed that one in five children have experienced a fracture due to trauma to the anterior teeth fixed before leaving the school.⁸ This case, the patient was 10 years old fractured crowns and open apex conditions caused by trauma. The pulp becomes necrotic before root growth is complete, and as a result the formation of dentin to a standstill.⁹

Apexification with $\text{Ca}(\text{OH})_2$ has shown a very satisfactory success. $\text{Ca}(\text{OH})_2$ will stimulate hard tissue surrounding form a network resembling cementum, the mineralized form of a dense mass.² Disadvantages in the use of $\text{Ca}(\text{OH})_2$ is the time it takes to see the formation of the apical barrier on the tooth before filling the root canal is long enough. The use of $\text{Ca}(\text{OH})_2$ long term may weaken dentin and root cause cervical fracture.¹¹

According to Witherspoon and Ham¹², 2011 one of the ingredients that can be used in apexification other than $\text{Ca}(\text{OH})_2$ is the MTA. MTA has a low solubility, opacity greater than dentin, and more biocompatible. Open MTA apical filling without forming apical calcified

barrier. MTA is excellence because it both biocompatible and anti bacterial, can provide a biologically active substrate for cell attachment so effective to minimize micro leakage. MTA is able to form dentinal bridge faster, thicker, and evenly.

In this case, apelsifikasi 11 using paste Ca(OH)_2 to be in direct contact with the periapical tissues. Control periodically for maintenance apexification more done in conjunction with the first month of treatment pulpectomy 21, a maintenance treatment every 1-2 weeks apexification runs 4 weeks and still do follow-up care. Control the 4th week there has been a process mineralization at the root end. Photo periapical radiopaque showed on the root tip (Figure 6), indicating the progress of treatments that lead to a good prognosis. Observation is still being conducted at months 6 and 12. When the closure of the apex and the formation osteocementum resemble other bone or tissue is reached, then the next treatment can be done. Filling of root canals using gutta percha.^{5,6}

Diagnosis of 21 is pulp necrosis due to trauma. Pulpectomy is the treatment choices because the apex of the tooth is already closed and the condition of non-vital pulp. Clinical examination, there are no complaints, percussion and negative press, and not mobility in the tooth. The results of root canal preparation using ProTaper manual system produces a smooth canal walls with a funnel shape follows the anatomy of the root canal, so that the process of filling the obturation pastes can be easier and more predictable success. Root canal preparation using ProTaper manual system is proven to provide satisfactory results, but the process requires a lot of time. According Nerkar at all ¹³. And Fahrin at all ¹⁴ says the use of a rotary instrument takes instrumentation faster, giving you easy access to all of the root canal and the rest of the network and debris more easily and quickly removed. However, the use of rotary instruments in addition to costs that are more expensive to endomotor and special handpiece, also needed expertise in using it.

CONCLUSION

Treatment for the young permanent anterior teeth using ProTaper Manual System (hand use) gives satisfactory results in treatment, pulpectomy and also apexification. The results obtained smooth canal walls with a funnel-shaped to follow the anatomy of the root canal, so that the process of filling the obturation pastes can be easier and more predictable success. Apexification treatment 11 are continued to control the 12th month.

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Patern Of Calculus Formation In Visually Impaired Children

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ABSTRACT

Background: Children with impaired vision have visual limitations that make it difficult to perform oral cavity health care. In addition, a disturbance the perception of light causing low salivary flow. It affects the fluid saturation levels of plaque and saliva, which plays an important role for the formation of calculus. **Objective:** The purpose of this study was to determine the pattern of calculus formation in children with visually impaired. **Materials and Method:** The research method was a retrospective study. Observations made by clinical examination at the OHI-S, debris index and calculus index in children with blindness and normal as control. This study done observation of saliva flow and pH. **Result:** The result would be observed to known calculus and debris formation. The results showed that OHI- score was an average of 3.2, with 80% higher calculus index. Salivary flow in childrent withvisuaaly impaired was significantly (<0.05) lower compared to normal children. Salivary pH was higher than normal children, although not significant ($p> 0.05$). There is a positive relationship between the index calculus and saliva flow and pH. **Conclusion:** It was concluded that the childrens with visually impaired have high calculus index. Formation of calculus are affected by pH and flow of saliva.

Key Words : children with blindness, calculus, saliva, OHI-S

INTRODUCTION

Visually impaired defined based on visual acuity. Visually impaired includes both low vision and blindness. Low vision is visual acuity of less than 6/18 and blindness is less than 3/60. It was estimated that the global population was likely to increase from 5.8 billion in 1996 to 7.9 billion by 2020, and most of the increase was estimated to occur in the developing world (WHO, 2009). In Indonesia, the prevalence of blindness is 0,4% on persons over 6 years. The largest numbers of blindness are in the elderly (0,5%). Prevalence of severe low vison are 1,49% and blindness are 0,5% in productive ages (15-

54 years). Its prevalence is rapidly increasing two-fold in the over 45 years group every 10 years (Riskesda, 2013).

Visually impaired may have a negative effect upon oral hygiene. Many blind and partially sighted individuals have worse oral hygiene than sighted peers (Mahoney, et.al., 2008). Solanski, et.al, 2014, showed that the mean value in good category was found to be 0.19 and 0.67, in fair category was 0.22 and 0.1 and in poor category was 0.40 and 0.23 in visually impaired children and normal children respectively. The health status influences numbers of prevalence of dental caries and periodontal diseases. Prevalence of dental caries was 60% and 31.5% in visually impaired and normal children respectively (Solanki, et.al 2014). In India was found to be around 46.88% (Parker, et.al., 2014). In Taiwan, Children with visually impaired have the mean of score Decay, Missing, Filling – Teeth (DMF-T) score was 16.0 (DT=4.4, MT=10.2, FT=1.4). Thirty-four percent have periodontal disease. Oral hygiene index-simplified (OHI-S) score were 2.52 (Samnieng, et.al., 2014).

The main reason for higher prevalence of dental caries in visually impaired individuals is the inadequate plaque removal. Visually impaired cannot visualize the plaque on the teeth surfaces (Prabhu, et.al., 2013). In disabled individuals, low powers of concentration and lack of motor skills and coordination is a factor in difficulty of their oral hygiene maintenance. Others mentioned that the most obvious challenge is the physical inability to adequately clean the oral cavity. Many individuals with a visual impairment may only seek oral health care when a problem arises, such as pain. (Mahoney, et.al., 2008; Parker, 2014). Chang and Shih (2004) said that students with visual impairments were less knowledgeable about their oral care. Eighty percent of these students with visual impairments did not realize the need to have regular dental visits, and only 18% of the students had routine dental care.

High DMFT/ dmft scores were manifest in groups of visually impaired children in many countries. Poor oral hygiene, gingivitis and periodontal diseases have been reported among visually impaired children in some studies. Inability to visualize the plaque on tooth surfaces resulting in inadequate plaque removal and therefore the progression of dental caries and inflammatory disease of the periodontium of visually impaired patients (Samnieng, et.al, 2014). Plaque accumulation on surface tooth will be mineralized to form calculus. Its mineralization can only occur if the fluid phase of plaque is supersaturated with the components of calculus. Saliva and plaque fluid are normally supersaturated with respect to various calcium phosphates, except when fermentable carbohydrates are being consumed, and thus most people are susceptible to calculus deposition, albeit at different rates (Arpita, et.al., 2014). Calcium and phosphate ions are both involved in calculus formation and in protecting against caries (Wu, et.al., 2008).

The pH of saliva has a wide range of 5-8. pH alkaline is important for deposition of calcium phosphate. The elevation of calcium and phosphorus concentration tends to form heavy calculus. Urea is a buffer present in total salivary fluid which is a product of amino acid and protein catabolism that causes a rapid increase in biofilm pH by

releasing ammonia and carbon dioxide when hydrolyzed by bacterial ureases. Ammonia produced from ureolysis of urea contributes to an increased plaque pH that is an essential factor in natural calculus formation. An increase in plaque pH by the production of ammonia from urea promotes calculus formation by increasing the saturation degree of calcium phosphate in plaque fluid (Arpita, et.al., 2014).

Saliva contains organic, inorganic and macromolecules material. In the general population, average of unstimulated salivary flow rate is 0.3 mL/min. The concentration of various components of saliva is markedly affected by variation in flow rate. The variation of salivary constituents over time may reflect hormonal factors, external influences and systemic conditions. Previous investigations have shown that the salivary flow rate fluctuates with the circadian cycle. It has been suggested that the unstimulated flow rate may be at its maximum in the mid afternoon. Moreover, variation of unstimulated whole saliva flow rate over different time-spans and at different times of the year yield changes in flow rate (Wu, et.al.,2008). Circadian rhythms are endogenous self-sustained oscillations with 24-hour periods that regulate diverse physiological and metabolic processes through complex gene regulation by "clock" transcription factors. The oral cavity is bathed by saliva, and its amount and content are modified within regular daily intervals. The salivary glands have a peripheral clock mechanism that functions both in normal light/dark conditions and in the absence of light (Zheng, et.al., 2012).

Samnieng (2015), said that saliva is regarded as one of the important factors in regulating oral health, with respect to both the volume produced and the constituents it contains. Disturbance of saliva flow result hyposalivation. The subjects were 73 visual impaired elderly, 43.8% were classified within the hyposalivation. Beside mal nutrition, hyposalivation was also affected by saliva flow rate. consistency with previous study reported that light is associated with salivary flow rate (Samnieng, et.al., 2014). The purpose of this study was to determine the pattern of calculus formation in children with visually impaired.

MATERIAL AND METHOD

The cross-sectional study was conducted on 5-16 year in special schools A Bintoro Jember. A total of 44 children were selected from a residential school for blind and 40 children from a normal school were kept as control. The selected subjects had a normal health status and no disability other than blindness, no systemic or mental diseases and at least four teeth in each quadrant. Prior consent was obtained from the respective school authorities and from parents/guardians through the school to conduct the study.

The oral examination was done for the children in their respective schools by making them seated on ordinary chair. The children were examined in the school using natural day light and sterilized instruments with participants seated on an ordinary chair. At least two 6,0).

RESULT

Of the subyek with impairment visually group and control group, CI, PI and pH saliva were shown in Table 1.

Table 1. CI, DI and OHI-S of visually impaired group and control group

Sample	Index CI	Index DI	OHI-s
Visually Impaired group	3	3	3,2
Control group	1,5	1,2	2

Table 1 can be seen that in visually impaired group score of CI, DI and OHI-S are higher than control group. Score of CI and DI are 3 mean that there are Heavy plaque accumulation is detected at the gingival margin and in the interdental spaces dan calculus covering greater than two-thirds of the buccal tooth surface and extending subgingivally. The score is bad. Score of control groups are 1,5 and 1,2. OHI-S score showed bad criteria in children with visually impaired and fair in cntrol group.

Percentage of score CI and DI in visually impaired was 80% bad criteria, only 20% have good criteria and fair. In control group 70% have fair criteria, 10% bad criteria and 20% good criteria. Average of saliva flow and pH could be seen in table 2Table 2. Saliva pH and Flow Saliva of visually impaired group and control group

Sample	Saliva pH	Saliva Flow
Visually impaired group	7,172±0,281	0,6 ± 0,34
Control group	6,823±0,132	1,3 ± 0,23

Table 2 showed that saliva pH in visually impaired were higher than control group that is7,172 and 6,823. Saliva flow in visually impaired were lower than control group that is 0,6 and 1,3. Statistic test using t-test independent sample showed that saliva pH are significantly different $p=0,000$ ($p<0,05$) between control group and visually impaired, however saliva flow in visually impaired have saliva flow rate low but not different significantly ($p>0,05$) with control group. Test of Pearson corellation have value $r=-653$ and $p=0,079$. The value explained that there are strong corelation between pH and calculus index, with direction of negatif corelation. Negative corelation is mean if saliva pH increasing so that calculus index is high. Negative corelation is also occure between saliva flow and calculus index. If saliva flow is low, calculus index will be high.

DISCUSSION

Children with special needs are those who have or are at increased risk for a chronic physical, developmental, behavioral or emotional condition and who also require health

and related services of a type or amount beyond that required by children generally. Visual impairments vary from total blindness to slight limitations of size, color, distance, and shape. Visual impairments tended to have a larger amount of dental plaque and were at a higher risk for dental diseases than were sighted individuals. Inability to visualize the plaque on tooth surfaces resulting in inadequate plaque removal and therefore the progression of dental caries and inflammatory disease of the periodontium of visual impaired patients (Samnieng, et.al.,2014).

Our results also reported data for poor oral hygiene in children with visual impairment. The poor oral hygiene in disabled individuals are a result low powers of concentration, lack of motor skills and manual coordination. The factor are be difficulty of their oral hygiene maintenance. In addition, the physical inability to adequately clean the oral cavity support poor oral hygiene (Parkar, et.al., 2014). The condition result plaque accumulation. As in this study shown that DI score is high that is childrent with visually impairment have bad criteria on plaque formation.

This result of study showed that flow saliva in children with visually impairment were lower than normal children. Low salivary flow rate might be cause of their visual problems,consistency with previous study reported that light is associated with salivary flow rate (Samnieng, 2015). Rantonen (2003) also nyatakan bahwa factors affecting unstimulated saliva flow rate are degree of hydration, body position, exposure to light, previous stimulation, circadian rhythms, circannual rhythms, and drugs. Widely accepted normal values for stimulated flow rates are 1.0 - 3.0 ml/min. Values below 0.7 ml/min are considered as hyposalivation, and values 0.7 – 1.0 ml/min low. Light deprivation decreased submandibular flow rate from 0.146 ml/min to 0.045 ml/min, a decrease of 69%. It is suggested that photic input through the retina provides stimulation to the salivary glands in the human through the superior cervical ganglion in a system similar to that present for the pineal. This implies that the sympathetic nervous system functions in the regulation of a component of the resting flow from both the parotid and submandibular glands (Shannon, et.al., 1975). Low saliva flow rate cause hyposalivation that result poor oral hygiene, disruption of speaking and mastication (Samnieng, 2015). Saliva flow is the lowest during sleep (Humphrey and Williamson, 2001).

Buffering action and clearance are a once of saliva function through the following components: bicarbonate, phosphate, urea, and amphoteric proteins and enzymes. Bicarbonate is the most important buffering system. It diffuses into plaque and acts as a buffer by neutralizing acids. Moreover, it generates ammonia to form amines, which also serve as a buffer by neutralizing acid. The buffering action of saliva works more efficiently during stimulated high saliva flow rates but is almost ineffective during periods of low flow with unstimulated saliva. Phosphate is likely to be important as a buffer only during unstimulated flow. The pH of saliva may not be as important a measure for buffering actions (Humphrey and Williamson, 2001). The pH of saliva has a wide range of 5-8. Studies had reported the importance of alkaline pH for deposition of calcium phosphate, thereby promoting plaque mineralization (Arpita, et.al., 2014). In this study shown that

pH saliva in children with visually impairment are higher than control group. Hal tersebut akan menyebabkan terjadinya perubahan pada sifat fisik dan komposisi plak. pH conditions in plaque, will markedly alter the supersaturations with respect to typical calcium phosphate precursor phases such as dicalcium phosphate dihydrate (DCPD) and octacalcium phosphate (OCP). Early calculus formations suggested that chemical changes occurred in the mouth which reduced the so-called "solvent power" of the saliva for calcium salts. Elevations in calcium and phosphorus concentration have been reported in heavy calculus formers (Arpita, et.al.,2014). Urea is a buffer present in total salivary fluid which is a product of amino acid and protein catabolism that causes a rapid increase in biofilm pH by releasing ammonia and carbon dioxide when hydrolyzed by bacterial ureases. Ammonia produced from ureolysis of urea contributes to an increased plaque pH that is an essential factor in natural calculus formation. A urea-induced pH response, which was the inverse of the Stephan pH curve induced by sucrose, has been observed in an in vitro biofilm culture system called "artificial mouth". The ureolytic pH response (an increase in plaque pH by the production of ammonia from urea) promotes calculus formation by increasing the saturation degree of calcium phosphate in plaque fluid (Ye Jin, et.al., 2002). The explanation support result of this study that is score of CI is higher in visually impairment than normal group. High score of CI are effected by high saliva pH. High CI and PI score. High saliva pH or alkaline can stimulate deposition of calcium phosphate in plaque so that was mineralized then calculus were form. Saliva flow rate was low result accumulation of plaque in tooth surface. Therefore 80% children with visually impairment have high CI.

CONCLUSION

The result of this study could be concluded that children with visually impairment have poor oral hygiene. Pattern of calculus formation was effected by saliva pH and saliva flow rate.

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The Level Of Care Needs Abnormalities Of Teeth And Periodontal Tissues In Children With Special Needs

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ABSTRACT

Background: Some surveys have shown that children with special needs have a higher prevalence of caries and oral cavity hygiene level is low. Special needs children have a high risk of oral cavity health problems compared with normal pediatric population, because of the inability of sensory and intellectual. **Objective:** The purpose of this study was to assess the care needs of oral disorders children with special needs at schools (SLB) A and C in Bintoro Jember. **Material and Method:** The research method used cross sectional survey of 66 children attending the SLB A and C Bintoro, whether they live in a dorm or go off home. Examination and diagnosis at the level of oral hygiene, dental abnormalities and periodontal disorders, then do the percentages on every treatment is needed. **Result** : These results indicate that 80% needs to be done DHE, 16.6% fillings, scaling of 12.88%, 7.82% endodontic treatment, treatment of periodontal tissue and 7.82%. SLB children who require sealant on molar teeth is 15%. **Conclusion:** It was concluded that in children SLB action is most needed is DHE, and therefore able to prevent caries and other oral disorders.

Key words: children with special needs, caries, periodontal disorders, mal occlusion

INTRODUCTION

Children with specialist need or disability is child who has limitation of physical, mental, intellectual, or sensory in long time to interact with the environment and behave in society so that can experience a complicated problem and difficulty to fully participate and effective based on equal rights¹. In Indonesia, education of children with specialist need was performed in extraordinary school (sekolah luar biasa / SLB) that is separated based on its disability condition. SLB A is place of education for children with blindness, wheares SLB C for children with disability, such as mental retardation, down syndrome, cerebral palsy and also autism². Blindness is visual acuity less than 3/603. Prevalence of blindness

in population over ≥ 6 years occurred decrease from 0,9% (2007) to 0,4% (2013). In child 24-59 month occurred increase 2x fold from 2010 to 2013 on child with blindness and child with down syndrome from 0,12% (2010) to 0,13% (2013)⁴. The term "intellectual disability" (ID), formerly "mental retardation," refers to significant limitations in both intellectual functioning and adaptive behavior, with onset before age 18 years. ID is a type of developmental disability (DD), a broader category representing various severe chronic conditions associated with physical impairments, mental impairments or both that are identified during childhood⁵.

Children with disabilities have high risk to occur the health problems in its oral cavity compared to normal child population⁶. The condition is caused by social status, education level, great of limitation to keep oral cavity health as outcome sensory and intellectual inability. In addition, parents and health workers lack of information, knowledge and care for children with disability⁷. The condition effected by sociodemographic, type and also severe its disability⁸. Some studies in children with visually impaired^{9,10} and children with disturbance of mental (cerebral palsy, autism, down syndrome)⁷, have oral health status lower compared to normal children population. Inability to visualize the plaque on tooth surfaces resulting in inadequate plaque removal and therefore the progression of dental caries and inflammatory disease of the periodontium of visual impaired patients¹¹. Many characteristics associated with IDD may contribute to an increased risk of experiencing oral disease. These include the presence of cognitive, physical and behavioral limitations that make it difficult to perform daily oral care and cooperate during dental visits⁵⁻⁹; medications that affect oral health ⁵⁻¹¹ and elevated rates of poverty⁵.

Persons with disabilities present with a range of conditions and levels of impairment. They need special dental care because they may require extra support to access dental services, partake in treatment, and derive full benefits from oral care. It may take more time to complete treatment for them. Some people with disabilities are incapable of carrying out obligations of a dental patient that is seeking dental care, keeping appointments, making payments and complying with instruction in dental chair and with home care. They are dependent to a varying degree on others to make dental care decisions for them, to transport them to the dental office, and to perform or assist them with daily oral hygiene¹².

Dental services for disabled people should be to prevent dental diseases, which require proper planning and implementation of services. Record of oral health status is an importing to perform treatment planning for patient with disability. The dental health care needs for persons with disability is defined as "any physical, developmental, mental, sensory, behavioral, cognitive, or emotional impairment or limiting condition that requires medical management, health care intervention, and/or use of specialized services or programs. Dental health care for individuals with special needs requires specialized knowledge acquired by additional training, as well as increased awareness and attention, adaptation, and accommodative measures beyond what are considered routine¹³.

Dental care needs are requirements of somebody on dental health services to prevent and relieve diseases and malformation. It can assignment as number of dental care needs that must be done in certain time to reach healthy tooth¹⁴. Good oral health is required

for disability because the severity of medical conditions and perceived general health are significantly correlated with dental functional status and severity of dental disease¹⁵. The aim of this study is to know level of dental care needs on oral cavity disease children with disability in SLB A dan SLB C di SLB Bintoro Jember.

MATERIAL AND METHOD

All of population (44 peoples) at SLB A (blindness) and (38 peoples) at SLB C (mental disorder), age between 6 to 19 years old were participate in this observational, cross-sectional and analytical study. The legal guardians of subjects agreed on their voluntary participation by signing an informed consent form. The examination was performed in the school, under natural light with mouth mirror, probe and sonde. Subjects were seated in ordinary chairs. A chip blower was used to dry the tooth and probing (with a straight probe) was used as the criteria for diagnosis. No radiographic examination was done.

Level of oral hygiene was evaluated used Oral Hygiene Index (OHI-S) (Greene and Vermilion). Assesment criteria OHI-S are : a. good (0-1,2); b. fair (1,3-3,0); c. poor, (3,1-6,0). To provide detailed data OHI-S were also examined Calculus Indeks (CI) and Debris indeks (DI). Oral health status was evaluated based on criteria of WHO¹⁶ using Caries experience (DMFT) (decayed, missed and restored permanent teeth).

The criteria are: a. Very low <1.2;b. Low 1.2–2.6; c. Moderate 2.7–4.4; d. High 4.5–6.5; e. Very high >6.5.

Periodontal disease was evaluated using the Gingival Index (GI) dari Loe and Silness. The criteria are: 0 = Normal gingiva; 1 = Mild inflammation, slight change in color, slight edema. No bleeding on probing; 2 = Moderate inflammation, redness, edema and glazing. Bleeding on probing; 3 = Severe inflammation, marked redness and edema.Ulceration. Tendency to spontaneous bleeding. Depth of fissure were examined to make planning preventive action. Result of studies the some index were used to assess dental care needs then analized with anava to know difference of groups. Appraisal of care needs level was based on WHO³ about criteria of care needs.

RESULT

Result of study on status oral hygiene showed that children with blindness (SLB A) have index OHI-S sligthtly higher than mental ratardation (SLB C) at 3,3 and 3,2 respectively and statistically not different significantly ($p>0,05$). All of OHI-S in two groups were bad criteria and 80% occured childrens in SLB A and 75% in SLB C. Criteria of OHI-S are in Table 1.

Table 1 seen that only 5% and 10% children with blindness and mental retardation have good oral status. If we performed deeper analysis to Calculus Index (CI) and debris Index (DI) showed children with blindness have score CI higher with bad criteria, wheares children with mental retardation have score of DI higher with bad criteria (Tabel 2)

Tabel 1. Scoring of OHI-S children in SLB A and SLB C

Scoring SLB A SLB C	
Good	5% 10%
Fair	15% 15%
Bad	80% 75%

Tabel 2. Score DI and CI in children of SLB A dan SLB C

Scoring SLBA SLB C DI CI DI CI	
Good	5% 7% 5% 20%
Fair	15% 13% 5% 10%
Bad	80% 80% 90% 70%

Tabel 3. Score Gingival Indeks in children SLB A and SLB C

Scoring SLB A SLB C	
0	Normal gingiva 15% 25%
1	Mild inflammation, slight change in color, slight edema. No bleeding on probing 40% 30%
2	Moderate inflammation, redness, edema and glazing. Bleeding on probing 40% 42%
3	Severe inflammation -- marked redness and edema.Ulceration. Tendency to spontaneous bleeding 5% 3%

Table 4. Criteria of caries incidence (DMFT-Index) in children of SLB A and SLB C C

Criteria DMF-T SLB A SLB C	
Very low	<1.2 7% 10%
Low	1.2–2.6 10% 5%
Moderate	2.7–4.4 50% 30%
High	4.5–6.5 30% 55%
Very High	>6.5 3% 5%

Gingival Indeks (GI) was to know the inflammation at periodontal tissue and gingiva (Table 3). The incidence of caries in children of SLB A and SLB C showed description different, could be seen at table 4. After do analysis from all of dental health index, obtained level of care needs in children with disability in SLB A and SLB C (Table 5).

The above Table shows that care needs in children SLB A treatment of periodontal have high percentage, especially scalling, wheares in children SLB C need filling treatment at one surface. Preventive care such as fissure sealant was also showed high percentage in children SLB A and C. Not all of children require fissure sealant because tooth is not indicated to fissure sealant as outcome caries in the pit and fissure or the fissure not deep. Pulp treatment dan restoration (include pulp capping and pulpotomi) have high percentage too. Only 5% in SLB A and 10% SLB C were not care needs.

Table 5. Percentage of dental and periodontal tissue care needs children with disability in SLB A and SLB-C

Type	Criteria	Percentage SLB A	SLB C
0	No needs care	5%	10%
P	Preventive and treatment of caries (white spot)	1%	3%
F	Fissure sealant	60%	50%

1	No needs care	5%	10%
2	Preventive and treatment of caries (white spot)	1%	3%
3	Fissure sealant	60%	50%
4	Veneer/coating	0	3%
5	Treatment of pulp and retoration	25%	40%
6	Extraction	30%	20%
7	Be requirement for others treatment (specialist) (scaling and periodontal treatment)	80%	69%
8	Be requirement for others treatment (specialist) (scaling and periodontal treatment)	80%	69%
9	Not recorded. The treatment is not include criteria above.		
		0	0

DISCUSSION

After known that children with disability have high risk to disruption of oral health. Phisically and mentally are as a main reason occurence of the disorder. Some research is also proved that oral health status in children with disability lower than normal children, such as oral hygiene, prevalence of caries, incidence of caries, periodontal health and also mal occlusion. This study showed that children with blindness and mental disorder have poor oral health but the both groups have pattern different. Percentage of calculus index in children with blindness was higher than mental disorder. Inability to see plaque at tooth surface result debris accumulation and then occured mineralization so that is formed calculus¹¹. Saliva plays role of important on calculus formation. The saliva is a complex fluid containing a variety of mucosal host defense factors from the different salivary glands and the crevicular fluid. There are glucose and nitrogenous products, such as urea and ammonia, role of important on calculus formation. In addition, pH saliva and plaque were also influence calculus formation. Alkaline pH is important for deposition of calcium phosphate, thereby promoting plaque mineralization. Production of ammonia from urea result a increasing pH promotes calculus formation by increasing the saturation degree of calcium phosphate in plaque fluid^{17, 18}. Merinda, et.al, proved that saliva pH children with blindness tend normal e.i 7,2. Saliva pH that tend normal, may enable cause precipitation of calcium phosphate, so that easy to form calculus and slight experience demineralization in tooth. Therefore the research was also shown that incidence of caries in children with blindness lower than children with mental disorder. Factor of light was estimated influence low saliva flow in children with

blindness¹¹, but its report is limited. Light related to circadian rhythm are endogenous self-sustained oscillations with 24-hour periods that regulate diverse physiological and metabolic processes through complex gene regulation by “clock” transcription factors. Salivary glands have a peripheral clock mechanism that functions both in normal light/dark conditions and in the absence of light. Abnormal expression of clock genes has been found in patients with reduced salivary flow. Therefore postulate that a clock mechanism that implies direct or indirect regulation of key genes important for saliva glandula physiology may be altered in diseases with abnormal salivary flow¹⁹. If the high calculus formation in oral cavity spread to sub gingiva result periodontal disease. Therefore score of GI Index is 85% with criteria fair to very bad (inflammation of gingiva with probing or without probing).

In the study showed result that children with mental retardation have incidence of caries higher than children with blindness, e.i. average of DMFT are 4,2 and 3,3 respectively. In accordance with Duddu, et.al.¹⁵ that dental caries is the most prevalent disease among disabled children worldwide and dental treatment is the greatest unattended health need of the disabled. This may be related to low physical ability of individual in tooth brushing, less capable of taking care of themselves and are often missed by oral health campaigns and there is a higher prevalence of untreated dental disease in handicapped children than in normal children.. Some of the important reasons may be inadequate recall system, practical difficulties during treatment sessions, socioeconomic status, underestimation of treatment need or pain, communication problem and lack of cooperation.

Oral health is part integral of body health. Poor oral health has a negative impact on nutrition, digestion, the ability to chew on food, speech and general health of individual but children and adolescents with disability appear to have poorer oral health than others. Good oral health is required for them because the severity of medical conditions and perceived general health are significantly correlated with dental functional status and severity of dental disease. For persons with disabilities, the effect of dental disease on general health and function appears greater than for similar groups without a disability. Proper care is required to manage side-effects of medication, for example, dry mouth, gingival overgrowth and problems with speech, swallowing, and taste¹⁵.

Planning to do care in children with disability is important. It will relate to the necessary technical expertise, cost, time and specialist skill to do care. Children with disability need specially attention and care. One of which is make dental care needs in disability. We find 80% children with blindness require scaling and periodontal treatment whereas children with mental disorder need dental filling. Action of preventive such as fissure sealant need done to prevent dental caries. In addition action in the clinic, ²⁰Shaw et.al., said that home care is essential to an effective plaque control and oral hygiene for special children is dependent on quality of care given by parents and guardians. Parents can be taught various techniques to enable them to care for their children's oral health more easily and completely. It is well-known that systematic counseling and plaque control programs have a good effect on dental health and similar schemes have been shown to reduce the risk of dental disease in disabled children¹⁵.

CONCLUSION

It was concluded that children with special needs have the status of poor oral cavity either in children with blindness as well as in children with mentally disabled. In children with blindness tend calculus index was high, whereas children mentally disabled high index was the incidence of caries. The main care needs for children with blindness were scaling and treatment of periodontal tissues and mentally disabled children were dental filling. However DHE treatment and fissure sealant were also needed for children with disabilities.

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The Relationship Between Dental Anxiety With The Level Of Cooperative Of Pediatric Patients On Tooth Extraction Procedure In The Education Hospital Of Brawijaya University

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ABSTRACT

Background: Children dental treatment generally begins at primary school age, 6-12 years of age. First unpleasant experience at this age can be an anxiety which develop into fear then persist into adulthood. Tooth extraction procedure is the highest trigger of dental anxiety in children. This anxiety will lead to negative behavior of children in the dental environment, so that represents a problem for dentist. **Purpose:** The purpose of this study was to determine the relationship between dental anxiety with the level of cooperative of pediatric patients on tooth extraction procedure in the Education Hospital of Brawijaya University. **Method:** The method used in this study was cross sectional analytic. Respondents of this study were 39 pediatric patients aged 6-12 years old. Dental anxiety level was assessed with Facial Image Scale and Corah's Dental Anxiety Scale before the treatment, while the cooperative behavior was observed during treatment using Frankl Behavioral Rating Scale. **Results:** The result of this study showed the low level of dental anxiety with cooperative behavior. Spearman test results showed that there was no significant correlation between dental anxiety as measured by Corah's Dental Anxiety Scale with the level of cooperative ($p>0,05$). However, there was weak significant correlation between dental anxiety as measured by Facial Image Scale (FIS) with the level of cooperative ($r=0,352$, $p=0,028$). **Conclusions:** The conclusion of this study was that the less of dental anxiety, children are more cooperative during dental treatment.

Keywords: dental anxiety, cooperative behavior, *Corah's Dental Anxiety Scale*, *Facial Image Scale*, *Frankl Behavioral Rating Scale*

INTRODUCTION

Dental treatment of children generally begin at primary school age, the age group 6-12 years. This age is a period of loss of primary teeth and future physical development.¹

If there is a first experience less enjoyable, it can be an anxiety that develops into fear then persist into adulthood.^{2,3}

In an effort to increase oral health of children, fear is an obstacle to the dentist can cause negative behaviors of children when undergoing treatment procedures.⁴ Due to further the child's behavior will greatly affect the success of dental and oral care.⁵

Every child who came to the dentist will show different behavior towards oral and dental care will be provided. There are children who behave cooperatively towards dental care and not a few who behave cooperatively.⁶ Therefore, a dentist must have the ability to determine the child's diagnosis of the patient's behavior.⁵

Dental anxiety is a world wide problem. Based on the research that has been done on the respondents coming from several countries, found 11.2% had high dental anxiety.⁷ The literature mentions several factors, among which personal factors, socioeconomic factors, and dental factors. From dental factors, one of which is caused by dental procedures.⁸

Research conducted by Alaki et al. (2012), of the 518 children studied levels of anxiety towards dental care, as much as 43.5% boys and 64.6% girls expressed anxiety about the tooth extraction procedure. Based on these results, we can conclude that the tooth extraction procedure is a dental procedure that led to the highest dental anxiety is feared in children. This can occur due to various factors, such as children have a fear of extraction tool to be inserted into his mouth which they deem to be harmful to themselves, fear of the pain they might feel when a tooth extraction takes place, and the fear of losing one tooth.⁹ Based on this background, the researchers intend to conduct research on the relationship between dental anxiety level cooperative behavior pediatric patients 6-12 years of age on tooth extraction procedures at the Pedodontology Department of Education Hospital of Brawijaya University (RSPUB), since previous research has not been done.

METHOD

This study was an observational analytic study with cross-sectional approach. Samples are pediatric patients 6-12 years of age who will do the procedure of tooth extraction at the Pedodontology Department of Education Hospital of Brawijaya University in September 2015 - January 2016. Using the formula Slovin, of 64 people as a population, obtained samples as many as 39 people. The instrument used was a questionnaire with interview techniques and direct observation.

Measurements performed dental anxiety before tooth extraction procedures by means of questionnaire respondents answered questions Corah's Dental Anxiety Scale and choosing one of the images of five rows of Facial Image Scale questionnaire images which correspond felt at the moment. While measuring the level of cooperative behavior by direct observation by researchers during a tooth extraction takes place using Frankl Behavior Rating Scale. Data were analyzed using Spearman correlation test.

RESULTS

In this study, the anxiety level of the sample based on the scores Corah's Dental Anxiety Scale the vast majority were not worried as many as 33 people (84.6%) as shown in table 1, while based on the score Facial Image Scale the vast majority were happy as many as 28 people (71.8%). The level of cooperative behavior that most respondents are positive in 28 (71.8%), as shown in table 2.

Based on existing theory, dental anxiety is influenced by factors such as age, gender, parental education and parental income. Therefore, the research analyzed the relationship between these variables.

Tabel 1. Sampel distribution based on dental anxiety level with Corah's Dental Anxiety Scale

Kecemasan	Frekuensi (n)	Persentase (%)
Tidak cemas	33	84.6
Bedang	4	10.3
Tinggi	1	2.6
Sangat cemas	1	2.6
Total	39	100.0

Tabel 2. Sampel distribution based on dental anxiety level with Facial Image Scale

Tabel 3. Analysis of relationship between dental anxiety based on Corah's Dental Anxiety Scale's score with level of cooperative behavior

Kecemasan Dental (Corah's DAC)		Tingkat Kooperatif				Total	P
		Sangat negatif	Negatif	Positif	Sangat positif		
Tidak cemas	n	1	2	24	6	33	0.05
	%	2.6%	5.1%	61.5%	15.4%	84.6%	
Bedang	n	1	0	3	0	4	
	%	2.6%	0%	7.7%	0%	10.3%	
Tinggi	n	0	0	1	0	1	
	%	0%	0%	2.6%	0%	2.6%	
Sangat cemas	n	0	1	0	0	1	
	%	0%	2.6%	0%	0%	2.6%	
Jumlah	n	2	2	28	6	38	
	%	5.1%	5.1%	71.8%	15.4%	100.0%	

Tabel 4. Analysis of relationship between dental anxiety based on Facial Image Scale's score with level of cooperative behavior

Kecemasan Dental (FIS)		Kecemasan				Total	P	R
		Sangat tenang	Tenang	Cemas	Sangat cemas			
Sangat tidak senang	n	0	0	0	0	0		
	%	.0%	.0%	.0%	.0%	.0%		
Total senang	n	0	5	1	0	6		
	%	.0%	8.3%	1.6%	.0%	7.7%		
Dislike-Dislike	n	0	0	1	0	1	.028	.352
	%	.0%	.0%	1.6%	.0%	2.0%		
Senang	n	1	0	25	2	28		
	%	2.6%	.0%	84.7%	3.7%	71.8%		
Sangat senang	n	1	1	1	4	7		
	%	2.6%	2.6%	2.6%	10.3%	17.9%		
Jumlah	n	2	5	26	6	39		
	%	5.1%	12.8%	66.7%	15.4%	100.0%		

In all age groups, the highest score by Corah's dental anxiety Dental Anxiety Scale is not anxious, while based on the Facial Image Scale is happy. In both sexes, the highest score by Corah's dental anxiety Dental Anxiety Scale is not anxious, while based on the Facial Image Scale is happy. At all levels of parental education, the highest score by Corah's dental anxiety Dental Anxiety Scale is not anxious, while based on the Facial Image Scale is happy. In all groups the amount of parental income, scores the most anxiety dental based Corah's Dental Anxiety Scale is not worried, except income groups ≤ 1 million, indicating that respondents were not worried, anxious being, and anxious height respectively of 1 (2, 6%). While based on the Facial Image Scale in all groups the amount of income that most parents are happy, except income groups ≤ 1 million, indicating that respondents were not happy, happy, and very excited respectively of 1 (2.6%).

To test the hypothesis put forward, performed statistical analysis using Spearman's test. Anxiety level dental measured by the method Corah's Dental Anxiety Scale linked to the degree of cooperative behavior, the result value of $p = 0.065$ ($p > 0.05$), the H_0 is accepted which means there is no significant relationship between anxiety dental measured by the method Corah's Dental Anxiety Scale with the level of cooperative behavior in pediatric patients tooth extraction procedure. While the results of statistical analysis of dental anxiety as measured by the method of Facial Image Scale with the level of cooperative behavior in pediatric patients tooth extraction procedure, the results obtained $p = 0.028$ ($p < 0.05$) with the value of the correlation (r) of 0.352, meaning that there is a meaningful relationship with positive direction and strength of the correlation is weak. The direction of a positive correlation indicates more fun, the more positive their cooperation behavioral level.

DISCUSSION

This study limits the age respondents, ages 6-12 years old because at this age children experienced the loss of deciduous teeth and future physical development. 1 In addition, the study was conducted in pediatric patients who receive tooth extraction procedure for the type of care that cause dental anxiety was highest in children.⁹

In this study, the anxiety level of 39 respondents prior to tooth extraction by a score Corah's Dental Anxiety Scale most is not worried as many as 33 people (84.6%). These results are in accordance with the anxiety level of the sample is based on a score of Facial Image Scale (FIS) that most are happy as many as 28 people (71.8%). Based on data taken with these two methods, it can be concluded that the majority of children's anxiety levels of patients who will receive a tooth extraction procedure in RSPUB is not worried. The results of this study are not consistent with studies conducted by Alaki et al. (2012) which shows that of the 518 children studied, as many as 43.5% boys and 64.6% girls expressed anxiety about the tooth extraction procedure.⁹

In this study, children's anxiety levels low because it is influenced by a visit many times that has been experienced and that will be scheduled. Treatments that are agreed scheduled by the operators have a positive impact reducing patient anxiety. Continuity of care aimed at building confidence in the child's dentist and clinic environment. This proved invaluable for a visit next child.¹⁰

Based on the data level of cooperative behavior, if very negative and negative incorporated into the uncooperative attitude, positive and strongly positive while inserted into a cooperative attitude, it can be concluded that the majority of respondents to cooperate (87.2%). This is according to research conducted by Mittal and Sharma (2012) in 180 children aged 6-12 years showed that all the children in the study of cooperative behavior. A total of 92.22% of children have a positive perception of the dental and oral care. They show a happy attitude and happy. Even five children between them showed ambition or her goal of becoming a dentist.¹¹

Each child who comes to the dentist to have dental health conditions vary and will exhibit different behavior towards dental care will be provided. There are children who cooperate towards dental care and some are refusing to do the examination gigi6. The child can be cared for if she showed a positive attitude towards treatment was performed. This suggests that the child's behavior will greatly affect the success of dental and oral care.⁵

Data processing results show that in all age categories, the highest score Corah's DAS is the respondent was not worried. Likewise with FIS scores were highest in all age categories, namely respondent happy. This shows that age does not affect the level of anxiety in pediatric patients RSP UB. The results are consistent with research conducted by Arapostathis et al. (2008), said that the level of anxiety in children is not related to age. The influence of age associated with immature psychological development in children.¹²

The number of respondents in this study amounted to 39 people, consisting of 27 female respondents and 12 male respondents. This shows that in the RSP UB, motivation of female respondents was higher than respondents gender male. This is supported by research conducted in Asia (Japan), Europe (Sweden), Middle East (Jordan), Kuwait, Palestine and North Africa (Libya) which consistently show that women have a caring and positive attitude in maintaining healthy teeth and a mouth like a visit to the dentist regularly, the frequency of tooth brushing and flossing than men.⁹

In this study, a score Corah's Dental Anxiety Scale highest based on gender, both in

men and women is not worried. Likewise Facial Image Scale highest score by sex, both in men and women is happy. The data indicate that gender does not affect levels of anxiety. This is according to research conducted by Donka G. Kirova is also said that there was no significant difference between men and women who experience dental anxiety.¹³

Based on the data obtained, at all levels of education of parents, the anxiety level of the vast majority were not anxious and happy. This shows that parental education does not show the effect on child dental anxiety level. Similarly, the amount of the income of parents does not affect the level of child dental anxiety. This is because any number of parents' income, the highest anxiety level was not anxious and happy. The relationship between dental anxiety with socio-economic status as measured by education and income there is not a clear choice.¹⁴

From the data obtained above, neither age, sex, education level of parents, as well as income parents do not show the effect on child dental anxiety level. This could be due to good communication between the operator and pediatric patients. It also is the oral clinical examination or early diagnostic to the patient due to patient selection tailored to the cases required by the operator, so that the interaction has occurred previously and is no longer the first meeting between the operator and patient. This is certainly affect the readiness of children to be treated.

In this study, based on a statistical analysis using Spearman's test is known that there is no significant correlation between dental anxiety were measured using Corah's Dental Anxiety Scale with the level of cooperative behavior in pediatric patients tooth extraction procedure. These results were obtained because at any level of anxiety, respondents are at a level of cooperative behavior positively.

These results differ from the results of analysis linking the level of cooperation with dental anxiety level as measured by the method of Facial Image Scale (FIS). Based on the results of statistical analysis showed a significant relationship between dental anxiety were measured using the Facial Image Scale (FIS) with a child patient compliance on a tooth extraction procedure with a positive correlation direction and strength of the correlation is weak. The direction of a positive correlation indicates more happy or anxious, the more positive their cooperation behavioral level.

Differences result of analysis of the relationship between these two variables is suspected because of a lack of understanding regarding the questionnaire for pediatric patients Corah's Dental Anxiety Scale although this questionnaire has been widely used in previous studies. This occurs because the incomprehension highest number of respondents in this study is the age of 6 years and 7 years cognitive abilities are lacking. This is consistent with the theory of human mental development of Piaget, the age of 6 years and 7 years are at the stage of preoperative (pre-operation) where assessment and consideration of children at the stage of intuitive thinking is based on the perception of their own experience, not on reasoning.¹⁵ These results also occur in other verbal methods such as the Children's Fear Survey Schedule - Dental subscale where children are less cognitive ability, they were unable to complete the questionnaire.¹⁶

Many measurement tool to assess the level of dental anxiety with different methods. The ideal measuring instrument should be valid, allowing for the ability of cognitive and linguistic skills are limited, and easy to do clinical assessment. Facial Image Scale meets all these requirements. In addition, FIS easier for children to assess the clinical situation because they only need to choose an existing row of pictures, even for very young children though.¹⁷ The simplicity of this method also allows the practitioner to identify children as early as possible patient anxiety. Therefore, measurement of dental anxiety in children aged 6-12 years is better to use the FIS.

In general, patients who are anxious tend to be uncooperative during dental visits. In fact, they tend to discourage and refuse treatment or cancel appointments with dokter9. Padahal cooperative behavior is important because it is key to the success of the dentist in the dental treatment and the child's mouth. A positive attitude indicates the child does not feel anxious about the treatment performed.¹⁸

Pediatric patients will notice the behavior of the dentist every time they visit the dentist. Patient visits a child at that time will affect the child's behavior on subsequent visits. Therefore, the dentist should be able to establish communication and a good relationship with the child patients to obtain the dental care and oral optimal. One way to do is to be friendly, friendly, and fun to them. In addition to the oral motivation such as coax and empathize, pediatric patients can also cooperate by doing physical interactions such as patting the back with a fine.¹⁹

In addition to dentists, parents play a role in anxiety experienced by children. Often parents use to scare their dentist so that children are well behaved. This makes the child think that the dentist is something creepy and will show a sense of anxiety at the time to the dentist.¹⁰ In doing dental and oral care in pediatric patients required treatment Pedodontic Triangle concept, namely the cooperation between children, parents, and the dentist is absolutely necessary. Children become the focus of the dentist and assisted by parents. Dental care of children will be centered on the orientation of the child as a patient and his parents, the dentist will act to direct parents on the treatment indicated to his son. This cooperation is necessary to reduce children's anxiety during dental treatment so that the child can behave cooperatively and care interventions can be successful.¹⁰

Constraints of this research that some children do not understand the questionnaire so as to be assisted by researchers in filling out questionnaires. The study also takes a long time for the selection of respondents should be tailored to the inclusion criteria. In addition, because some children come to RSPUB unaccompanied parents, researchers must come to the respondent's house to ask for informed consent to the parents.

CONCLUSIONS

The majority of patients with dental anxiety level on a child's tooth extraction procedure in Education Hospital of Brawijaya University(RSP) measured using the Facial Image Scale (FIS) is pleased.

The majority of patients with dental anxiety level on a child's tooth extraction procedure in Education Hospital of Brawijaya University(RSP) measured using Corah's Dental Anxiety Scale is not worried. The majority of the cooperative behavior of pediatric patients in a tooth extraction procedure in Education Hospital of Brawijaya University(RSP) measured using Frankl Behavior Rating Scale is a cooperative behavior. There is no relationship between dental anxiety with age, sex, education level of parents, and the amount of parental income.

SUGGESTIONS

For further development, it is advisable to do research on the level of anxiety and the level of cooperative behavior of children in the neighborhood dental care are different and larger samples to obtain data distribution is more varied so that the diagnosis and the relationship between these two variables can be more easily enforced clinically.

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RELATIONSHIP BETWEEN PERIODONTITIS WITH CONCENTRATION OF C-REACTIVE PROTEIN (CRP) SALIVA IN CHILDREN WITH DOWN SYNDROME CLINICAL DIAGNOSE

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ABSTRACT

Background: Down's syndrome is one of the genetic abnormalities that cause the occurrence of mental and physical limitations on the sufferer. The difference of the anatomy of the tooth and mouth as well as a decrease in psychomotor children down syndrome makes them have a low awareness of the difficulties and in doing the maintenance of oral health. So they often have disease in his mouth especially periodontitis. As much as 90% of down's syndrome children experiencing periodontitis. One of the biomarkers that appear on periodontitis is C-reactive protein. **Objectives:** this research aims to look at the relationship between periodontitis with C-reactive protein concentration of saliva in children with down syndrome a clinical diagnosis. **Materials and Method:** the number of sample study was 28 children who are divided into the groups of children with down's syndrome and the clinical diagnosis of children normally. Both groups performed a status severity of periodontitis and ELISA test is performed to assess the concentration of C-reactive protein saliva. Data research results tested by using Spearman Rank test. **Result:** The results of this research indicate that status of periodontitis is associated with C-reactive protein concentration of saliva in children with down's syndrome clinical diagnosis because it has value $p=0.021$ ($p<0,05$). The strength of the relationship between variables is strong ($CC = 0,609$). **Conclusion:** this research has a summary that there is relationship between the status of periodontitis with C-reactive protein concentration of saliva in children with down syndrome a clinical diagnosis.

Key Words: Periodontitis, C-reactive protein, down syndrome, saliva

INTRODUCTION

Down syndrome is a genetic disorder that most commonly cause intellectual limitations. This syndrome is a disorder most often occurs in children in the world. This disorder is caused by abnormalities in chromosome number 21 which having trisomi.¹ Down syndrome occurs on 1 in 650 live birth rate. The prevalence in North America reached 1 in 800 to 1000 births. The prevalence of Down syndrome in Indonesia reached more than 300 thousand inhabitants or 1 in 700 live birth rate. Patients with Down syndrome are more vulnerable to having diseases in tissues in the oral cavity which is associated with oral hygiene.²

Individuals with Down syndrome have a higher prevalence rate of dental and oral diseases than normal individuals. Low oral hygiene in these patients led to a patient susceptible to diseases of the periodontal tissues or called periodontitis.³ Previous studies stated the prevalence rate of 90% incidence of periodontitis in patients with Down syndrome aged less than 30 years. There are some etiology which cause high rates of periodontitis in Down syndrome individuals, from factors locals, systemic locals, or both of those factors.⁴

High prevalence of periodontitis in Down syndrome is caused by local factors such as low oral hygiene index which is signed by high calculus index. Dental and oral hygiene play an important role in the occurrence of diseases of the teeth and supporting tissues of the teeth. Debris and plaque on the teeth becomes a potential area for the growth of microorganisms that can invade the tooth supporting tissues, especially periodontal.³ One of the etiology of this disease is a mental disorder of and the decrease of neuromotoric in these patients. The mental disorder causes the individual has a sense of low awareness of oral health. The neuromotoric decrease also disrupt the function of the oral motoric such as the tongue hipotonus by as much as 82.9% prevalence rate. This oral function abnormalities lead to traumatic occlusion and dryness of the mouth or xerostomia that can increase the rate of risk of periodontitis. Inflammation by periodontal tissues in the incidence of periodontitis can be detected by measuring the concentrations of inflammatory biomarkers, one of them is C reactive protein.⁵

C-reactive protein (CRP) is a biomarker of inflammation in the acute phase. This protein is produced in the liver and can be increased up to 100 m /L in the blood in acute inflammatory states, while in the salivary levels of this protein increase to 2.5 ng/ml. Measurement of the quantity of CRP was also proved very useful in monitoring the progression of the disease caused by inflammation.^{6,7} There are as yet no study about the concentration of C-reactive protein as a marker of inflammation in periodontal tissues in down syndrome children until now so that by considering this, then research is needed to analyze the association of periodontitis with concentrations of salivary C-reactive protein.

METHODS

This research was a quantitative research which using laboratory observational method. The design of the study is a cross sectional study. This study used multiple tools

and materials, such as polypropylene tubes, ice box, freezer -20° C, dental probe, ELISA Kit C- reactive protein human saliva, centrifuges, polystyrene 96 well microtiter plate (microplate), micropipette (100-200 µL), ELISA reader, washing machine, rotator machine, and stationery. Research was conducted on two groups of children with a clinical diagnosis of Down syndrome and normal children as the control group. Number of study respondents in each group was 14 persons. Respondents were selected based on inclusion and exclusion criteria which was determined by researchers.

The inclusion criteria were respondents with periodontitis and were not taking antibiotics and mouthwash. The status of periodontitis was checking by using a dental probe. Respondents were then asked to secrete 2 ml saliva into polypropylene tubes that have been labelled a code and stored in a freezer at -20° C. The ELISA test is then performed to determine the concentration of C-reactive protein in the saliva samples. The test was preceded by preparing all samples and reagents to room temperature 37° C. Samples of saliva were centrifuged for 15 min at 3000 rpm and then all reagents were diluted using aquabidest. Plate layout was prepared and control fluid was inserted into the microplate according layout which have been determined before. Samples of saliva was have been diluted inserted into the microplate followed by CRP liquid sample and enzyme conjugate diluent. Microplate closed with adhesive cover on the microplate liquid was mixed using a rotator 500 rpm for 2 hours. Microplate washing machine washed using 4 times with 300 mL of wash buffer in each of the wells and then dried and then added TMB substrate solution into each of the wells and then was read using the ELISA reader.

Test result data were described and analyzed using a statistical software package for social sciences (SPSS). Test for normality using the Shapiro-Wilk test (total sample <50) and homogeneity test using levene test. Groups of samples were then tested with spearman to determine the relationship between variables.

RESULT

Sample Characteristics:The sample in this study consisted of two groups of children with a clinical diagnosis of Down syndrome and normal children group with a lifespan of 6-18 years. Research was located in SLB ABCD Kuncup Mas Banyumas, SLB C-C1 Yakut Purwokerto, and SD Negeri 3 Sokanegara. The number of research subjects were 14 children in each group. Respondents were children who have periodontitis by taking 2 ml saliva.

Status Periodontitis on Children with Down Syndrome Clinical Diagnosis and Normal Children The results of the examination of periodontitis status in both groups carried by probing into the periodontal tissues which were classified into mild periodontitis and severe periodontitis and examination results are shown in Table 1 and Table 2.

Source : Primary data, 2015 Table 1 and Table 2 show that severe periodontitis occurs more frequently in the group of children with a clinical diagnosis of Down syndrome with a percentage of 42.9% compared to normal children group as much as 35.7% so

Table 1. Status Periodontitis on Children with Down Syndrome Clinical Diagnosis

No	Periodontitis Status	Number	Percentage (100%)
1	Mild periodontitis	8	57,1
2	Severe periodontitis	6	42,9
Total		14	100

Source : Primary data, 2015

Table 2. Status Periodontitis on Normal Respondent

No	Periodontitis Status	Number	Percentage (100%)
1	Mild periodontitis	9	64,3
2	Severe periodontitis	5	35,7
Total		14	100

Table 3. C-reactive protein concentration on Children with Down Syndrome Clinical Diagnosis and Normal Children

No	<i>C-reactive protein</i>	Mean (pg/ml)	±SD
1	Down Syndrome	242,50	151,77
2	Normal	184,55	100,24

Source : Primary data, 2015

4. Relationship of Status Periodontitis with Salivary C-reactive protein Concentration
The relationship test results of two variables using the Spearman rank are shown in Table 4.

Table 4. Relationship Test Results with Spearman Rank

No	Respondents	p	CC
1	Down Syndrome	0,021	0,609
2	Normal	0,032	0,573

Source : Primary data, 2015

that it can be shown that periodontitis in the group of children with a clinical diagnosis of Down syndrome is heavier than normal children. The concentration of C-Reactive Protein (CRP) Saliva: The concentration of C-reactive protein (CRP) were measured in saliva of both groups using ELISA test. The results of measurements of the concentration of C-reactive protein is shown in Table 3. Table 4 shows that in both groups there is a relationship between periodontitis status with the concentration of salivary CRP as $p < 0.05$. The strength of the correlation in the group with a clinical diagnosis of Down syndrome is a strong character while in the correlation on normal group is moderate

DISCUSSION

Periodontitis on Children with Down Syndrome Clinical Diagnose

Based on the results of periodontitis status to both groups of children, showed that children with a clinical diagnosis of Down syndrome more likely to have severe periodontitis compared to normal children. The cause of this is due to several factors experienced by children with a clinical diagnosis of Down syndrome, the mental limitations, dental and orofacial anatomical differences, and systemic factors as well.⁸

The main factor that makes high rates of periodontitis in down syndrome children is a mental limitations experienced by this group of children. Mental disability causes children with a clinical diagnosis of Down syndrome have difficulty in maintaining the cleanliness of their teeth and mouth. The difficulty in cleaning teeth and mouth area could increasing plaque and calculus index on a group of children which is become local factors of periodontitis because plaque and calculus is the best substance for the growth of bacteria so that the bacteria can invade into the periodontal tissues easily. In addition to mental disability suffered by a group of children, physical limitations and differences in the anatomy of the mouth also causes patients have difficulty in doing the cleaning of teeth and cavities.^{3,8}

The anatomical differences in the oral cavity in patients seen from the Angle Class III malocclusions in most patients. Malocclusion causes these patients have specific clinical features, beside that, the underdevelopment of the bones in the jaw causing crowding on the teeth of the patient so plaque and calculus in the oral cavity is more difficult to clean.^{3,4} Down syndrome children having a destruction at the midline on the mandibular bone which makes arteries and capillaries in the area is narrowed so that the supply of blood and oxygen is decreased in these area. The low oxygen to be transported to the area of the mandibular cause periodontal tissue remodelling processes decreases fibroblast which is play a role in the formation of periodontal connective tissue.⁹

Another thing that causes high rates of periodontitis in children with a clinical diagnosis of Down syndrome is due to physical limitations experienced by these patients. Physical limitations also affect the occurrence of periodontitis caused by muscle weakness in patients with hipotonus muscular lips and tongue that causes patients have difficulty in swallowing. The decline in the function of the mouth trigger traumatic occlusion and the

patient's mouth becomes dry or xerostomia so could accelerate the periodontal tissue destruction periodontal.¹⁰ Systemic factors also play an important role in the process of inflammation in the body, especially in people with periodontal tissue. Systemic factors in the form of the immune system in people with Down syndrome have differences when compared with individuals normal.⁹ Immunodeficiency that occurs in people with Down syndrome plays an important role in the inflammatory process that occurs in patients with periodontal tissue. Down syndrome children have a characteristic as a decrease in the number and deformity of immature T cells that contribute to the process of phagocytosis against bacteria that cause infections in inflammation process.³ Thymus on Down Syndrome individuals is smaller than normal individuals that will be interference with T lymphocyte syndrome down individual.¹¹

T cells changing in patients with Down syndrome associated with trisomy of chromosome 21. Down syndrome critical region 1 (DSCR1) protein or now turned into a regulator of calcineurin (RCAN1) inhibit the action of transcription factors play a role in developing the nucleus and activation of T cells decrease in the quantity of mature T cells and immature T cells cause many disturbances in the humoral and selular immune system.¹²

The concentration of C-Reactive Protein (CRP) Saliva Clinical Diagnosis in Children with Down Syndrome

Based on this study showed that the average value of a group of children with a clinical diagnosis of Down syndrome is higher than the normal group of children both in periodontitis mild or severe periodontitis. This is due to differences in the number of children which was experiencing severe periodontitis and mild periodontitis. A group of children with a clinical diagnosis of Down syndrome experience more severe periodontitis compared with normal children so that the average value of CRP concentrations in a group of children with a Down Syndrome clinical diagnosis is higher than those normal children.

There are differences in CRP concentrations in both groups were also due to differences systemic conditions that may affect the quantity of CRP concentration. There are differences in the immune system that occurs in people with Down syndrome is the occurrence of abnormalities in polimorfonukelar leukocytes (PMN) and monocytes and the low number of T lymphocytes that play a role in the inflammatory process in the body. That systemic conditions create higher inflammation incidence in the patient's body so the salivary C-reactive protein concentration on Down syndrome children is higher than normal children.^{13,14}

Relationship Between Periodontitis with salivary C-reactive protein (CRP) concentrations

The correlation test results by using Spearman rank showed a high correlation between the severity of periodontitis status with the concentration of CRP in children with a clinical diagnosis of Down syndrome. CRP concentrations of each group also experienced an increase in severe periodontitis compared mild periodontitis. The

concentration of CRP increases as inflammation that occurs. Body inflammatory activates the body's defence system by releasing cytokines CRP proinflammasi.^{15,16} Circulation begins with cytokines that could against bacterial invasion. Cytokines such as IL-1, TNF- α , and IL-6 could trigger macrophages in the liver (cell Kuffer) which induces hepatocytes to produce C-reactive protein.¹⁷

Inflammation in the periodontal tissue that occurs is the result of the combination of various factors. Periodontitis begins with inoculation of periodontopathic bacteria such as *P. gingivalis*, *P. intermedia* and *T. forsythia*. These bacteria will invade periodontal tissues through lipopolysaccharide owned. Lipopolysaccharide will trigger the body's defence mechanism to release immune response like sitokin.¹⁸

The mechanism of releasing of CRP in saliva occurs through two routes namely systemic and peripheral processes, but research that explains the mechanism of the emergence of new peripheral CRP levels were performed on mice not humans. Systemic process will bring CRP that has been produced by the liver distributable diffusion and active transport into the bloodstream and to the GCF while the peripheral process will take place with the role of the glands Submandibularis.²⁰

Research on the mechanisms of releasing of CRP peripherals have been conducted in mice, but there is no literature that describes these mechanisms in humans and local inflammation expression that occurs in the periodontal tissues of mice make mRNA of CRP in acinar cells glands submandibular rat produces CRP as a result of induction of IL - 1 β and TNF- α locally that is releasing after the invasion of bacteria *P. gingivalis*. Based on this research both in normal individuals and children with a diagnosis of sindorma down will increase the concentration of CRP when inflamed especially periodontitis.^{21,22}

CONCLUSION

Based on the results and discussion can be concluded that the severe periodontitis on children with a clinical diagnosis of Down syndrome is higher compared to normal children, salivary CRP concentration, a higher in the group of children with a clinical diagnosis of Down syndrome, and the correlation is strong between the status of periodontitis with salivary CRP concentrations in children with a clinical diagnosis of down syndrome.

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