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 research, 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 daily\(^1\). 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 osteoporosis\(^2\). This often causes heavy smokers in having lesser amount of teeth in their oral cavity\(^3\). 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 harm\(^6\). Researchers also show that for post-menopausal woman who smoke tend to lose cortical bone like tubular and midshaft bone 50% faster than nonsmokers\(^7\). 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-smokers\(^8\).

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 matlap software to determine the bone density of the mandibular jaw\(^9\).

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 reduced\(^12\). 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 fracture\(^13\). 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 mineralization\(^14\).
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.

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**Figure 1. Chat lines of inquiry**

**Figure 2: Panoramic Radiograph with Regions of Interest (Red Colour Boxes) with 50x50 Pixels Located Below Mental Foramens 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 radiograph 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

<table>
<thead>
<tr>
<th>Age</th>
<th>Male Smokers</th>
<th>Female Smokers</th>
<th>Total</th>
<th>Male Non-smokers</th>
<th>Female Non-smokers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
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<td>2</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>30-39</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>40-49</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>7</td>
<td>30</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 2. Percentage of Trabecular and Marrow in Male and Female Smokers to Male and Female Non-Smokers in Region 3 and 4.

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean for Male and Female Smokers Trabecular (%)</th>
<th>Marrow (%)</th>
<th>Mean for Male and Female Non-Smokers Trabecular (%)</th>
<th>Marrow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>19.916</td>
<td>80.084</td>
<td>29.321</td>
<td>70.679</td>
</tr>
<tr>
<td>30-39</td>
<td>25.652</td>
<td>74.348</td>
<td>30.625</td>
<td>69.375</td>
</tr>
<tr>
<td>40-49</td>
<td>18.322</td>
<td>81.678</td>
<td>30.003</td>
<td>69.997</td>
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<tr>
<td>Mean</td>
<td>21.297</td>
<td>78.703</td>
<td>29.983</td>
<td>70.017</td>
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</table>
Table 3. Percentage of Trabecular and Marrow in Male Smokers to Male Non-Smokers in Region 3 and 4.

<table>
<thead>
<tr>
<th>Age</th>
<th>Male Smokers Trabecular (%)</th>
<th>Male Non-Smokers Trabecular (%)</th>
<th>Male Smokers Marrow (%)</th>
<th>Male Non-Smokers Marrow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>19.435</td>
<td>27.692</td>
<td>80.565</td>
<td>72.308</td>
</tr>
<tr>
<td>30-39</td>
<td>25.656</td>
<td>30.694</td>
<td>74.344</td>
<td>69.306</td>
</tr>
<tr>
<td>40-49</td>
<td>18.265</td>
<td>30.181</td>
<td>81.735</td>
<td>69.819</td>
</tr>
<tr>
<td>Mean</td>
<td>21.119</td>
<td>29.522</td>
<td>78.881</td>
<td>70.478</td>
</tr>
</tbody>
</table>

Table 4. Percentage of Trabecular and Marrow in Female Smokers to Female Non-Smokers in Region 3 and 4.

<table>
<thead>
<tr>
<th>Age</th>
<th>Female Smokers Trabecular (%)</th>
<th>Female Non-Smokers Trabecular (%)</th>
<th>Female Smokers Marrow (%)</th>
<th>Female Non-Smokers Marrow (%)</th>
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</thead>
<tbody>
<tr>
<td>20-29</td>
<td>20.396</td>
<td>30.950</td>
<td>79.604</td>
<td>69.050</td>
</tr>
<tr>
<td>30-39</td>
<td>25.593</td>
<td>30.556</td>
<td>74.407</td>
<td>69.444</td>
</tr>
<tr>
<td>40-49</td>
<td>18.378</td>
<td>29.826</td>
<td>81.622</td>
<td>70.174</td>
</tr>
<tr>
<td>Mean</td>
<td>21.456</td>
<td>30.444</td>
<td>78.544</td>
<td>69.556</td>
</tr>
</tbody>
</table>

Table 5. Percentage of Trabecular and Marrow in Male Smokers to Female Smokers in Region 3 and 4.

<table>
<thead>
<tr>
<th>Age</th>
<th>Male Smokers Trabecular (%)</th>
<th>Female Smokers Trabecular (%)</th>
<th>Male Smokers Marrow (%)</th>
<th>Female Smokers Marrow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>19.435</td>
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<td>80.565</td>
<td>79.604</td>
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<tr>
<td>Mean</td>
<td>21.119</td>
<td>21.456</td>
<td>78.881</td>
<td>78.544</td>
</tr>
</tbody>
</table>

Table 4.6. Percentage of Trabecular and Marrow in Non-Smokers Male to Female Non-Smokers in Region 3 and 4.

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Male Non-Smokers Trabecular (%)</th>
<th>Male Non-Smokers Marrow (%)</th>
<th>Female Non-Smokers Trabecular (%)</th>
<th>Female Non-Smokers Marrow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>27.692</td>
<td>72.308</td>
<td>30.950</td>
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<tr>
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<tr>
<td>40-49</td>
<td>30.181</td>
<td>69.819</td>
<td>29.826</td>
<td>70.174</td>
</tr>
<tr>
<td>Mean</td>
<td>29.522</td>
<td>70.478</td>
<td>30.444</td>
<td>69.556</td>
</tr>
</tbody>
</table>
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. 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 percentage 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. 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. A French study of 719 men aged 51–85 years reported that former smokers had a higher BMD at the forearm than current smokers. 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 smoking19,20. 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. 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 metabolisme. 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.

Besides smoking, 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 percentage in BMD per year. This will result in the loss of BMD up to 15-35 percentage 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 are 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. 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). Patient 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)
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:

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**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
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. This is also supported by N. Kaka et al, found that resorption progresses in direct proportion to age, due to the culmulative effects that affect bone resorption such as calculus and caries. After age of 30, men and women experience bone loss at about 1% yearly. 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. 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.

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. 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.

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. 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. 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. The deficit in cortical bone results in larger trabecular spaces, and thinning of the trabecular in the cancellous bone. In addition to that the trabecular bone is more active in bone remodeling and this makes the posterior mandible more susceptible to bone resorption. The course cancellous bone is a characteristic of a healthy skeleton, while the fine cancellous bone is associated with early fracture callus.

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.

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. 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.

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.
REFERENCES

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