CHAPTER I
INTRODUCTION

1.1 Research Background

Recently, there have been some studies regarding the influence of malocclusion towards the bone density. Bone density is known as the amount of mineral in bone tissue or bone mineral density; it follows the concept of mass of mineral per volume of bone. Measurement of bone density is commonly used in medical and dental field as an indicator of risk of fracture and osteoporosis. The procedure often performed in the installation of radiology departments of hospitals, it is commonly painless and non-invasive and involves low exposure of radiation (Cranney et al., 2007).

In recent research, the measurement of bone density of jaw has been introduced by several approaches. Assessment of jaw bone density may be considered useful as well as necessary in many clinical situations, for instance, oral or systemic diseases, planning of implant, therapeutic evaluation and follow-up and especially orthodontic treatments for malocclusion patients. Bone density varies throughout regions of the jaws and may be affected by many factors including osteoporosis (Gulsahi et al., 2010). Therefore, researches between bone mineral density and malocclusion are important and relevant for clinician in understanding and planning of treatment for malocclusion patients to avoid any possible side effects.
Several studies had shown that one of the most prevalent developmental anomalies of craniofacial structure is malocclusion (Joshi et al., 2014). Edward Angle proposed that malocclusion is the incorrect relationship between the teeth of both the maxillary and mandibular arches when they approach each other during occlusion. He classified the misalignment based on the relative position of the permanent maxillary first molar. Angle’s classification of malocclusion comprises of 3 classes, which are, Class I malocclusion, Class II malocclusion and Class III malocclusion (Proffit, 2007).

Some findings suggest that maximization of the chewing pattern and gaining of appropriate masticatory function is disrupted by malocclusion. Altered mechanical loading to the mandible may cause significant effects to bone mineral in mandible (Nakamura et al., 2013). The amount of possible tooth movement depends by the management of different malocclusion patterns, especially in patients with severe malocclusion, because moving the teeth is limited by the bone density as well as the anatomy of the alveolar bone and the condition of periodontal health (Al-Masri et al., 2015). Hence, knowledge about jaw regions with low bone density might assist in orthodontic treatment planning and determination of its prognosis.

Researches on jaw bone densities have received increasing attention over the past few years and most studies have shown relevant relationships between these parameters. Patients with different levels of bone densities can be predicted by using dental radiographs, especially panoramic images. Most studies have focused on the thickness and integrity of the inferior border of the mandible. Research supported by the National Institute of Arthritis and Musculoskeletal and Skin
Diseases (NIAMS) suggests that dental radiographs may be used as a screening tool for low mineral bone density (Gulsahi et al., 2010). Panoramic radiography provides an overview of the jaws and surrounding structures and allows the clinician to view a large area of both the maxilla and mandible on a single film. It is frequently used as initial diagnostic image of some alterations and the clinician will verify the need of other more detailed and more accurate examinations based on it. (White, 207) In dental clinical practice, panoramic radiography is one of the most indicated radiographic examinations by dentists because it provides a general overview of dentomaxilomandibular structures and it is not so costly for patients (Haring, 2000). Researchers found that radiograph images were highly effective in distinguishing people with low bone density from those with normal bone density (Gulsahi et al., 2010).

In a previous study, it showed that the relationship between gender and the mandibular bone density was evaluated. It was observed that the average bone density of mandible is significantly higher in male than female. According to Horner and Devlin, they also stated that female patients generally had less dense mandibles than men (Celenk, 2008). In recent research, boys presented with high number of class II and class III malocclusion which is in correspondence to the results of Onyeaso who reported that males were found to have significantly more of classes II and III molar relationships than females (Siddegowda and Satish, 2014).

The bone quality of adolescents and adults has become an increasingly important medical concern and concern for bone mineral density in adolescents and adults has
led to increased interest in bone densitometry (Bianchi, 2007). The complete eruption of permanent dentition excluding the third molars ends at 12 to 13 years old. Bone is constantly changing, that is, old bone is removed and replaced by new bone (Seeman, 2003). During childhood, more bone is produced than removed, so the skeleton grows in both size and strength. For most people, bone mass peaks during the third decade of life. By this age, men typically have accumulated more bone mass than women. After this point, the amount of bone typically begins to decline slowly as removal of old bone exceeds formation of new bone (Niams.nih.gov, 2016). Thus, patients who aged from 13 to 30 years old with malocclusion classifications are to be selected in the evaluation of jaw bone density.

Based on the collected information and aforementioned explanation, even though there are many researches focused on measurement of bone density in many aspects, however there is still very small number of studies carried out in Indonesia on malocclusion affecting jaw bone mineral density, therefore the author is interested in investigating the measurements of bone density of malocclusion male patients based on panoramic radiograph at the Radiology Installation of the Rumah Sakit Gigi dan Mulut (RSGM), Dentistry Faculty of Padjadjaran University.

1.2 Problem Identification

What is the results of the measurement of bone density on panoramic radiographs with Angle’s malocclusion classification of male patients aged 13-30 in RSGM UNPAD.
1.3 Aim of Research

The aim of this research is to determine the results of the measurement of bone density on panoramic radiographs with Angle’s malocclusion classification of male patients aged 13-30 in RSGM UNPAD.

1.4 Research Benefit

Theoretically, the benefit of this research is to serve as literature and a source of information that can be used as future reference by dentist and researchers who are studying the bone density of malocclusion patients.

Practically, the benefit of this research is that dentist can use the result of the study in improving the standards of malocclusion treatment when dealing with malocclusion patients.

1.5 Conceptual Framework

Facial profiles can explain abnormalities in bone growth from the vertical dimension measurement. Extreme vertical bone growth may lead to increased angle between the ramus and body of mandible, anterior open bite malocclusion and lips apart at rest. According to some research, malocclusion is considered to decrease the masticatory forces on teeth and reduced masticatory muscle activity, which in turn may have affected bone density as well as the quality of bone of the condyle. Likewise, a reduced late-closing phase also known as power phase of the chewing cycle indicates decreased masticatory muscle activity, which could affect condylar growth and decrease bone mineral density (Nakamura et al., 2013).
Several studies have highlighted that the presence of malocclusion in males was associated with lower total bone mineral density, whereas neither the number of missing teeth nor the prevalence of caries was associated with deficits in bone mineral density (Konstantynowicz et al., 2007). According to Sciote, malocclusion causes restricted and inefficient chewing and capable to cause reduction of the volume of masseter and temporalis muscle fibers and will disrupt the bone architecture. Therefore, it will decrease bone architecture from the ramus of

**Diagram 1.1: Conceptual Framework**
mandible and regions of the base which involves the insertion places of the masseter muscle. Thus, it might have significant reduction at the particular region (Sciote et al., 2012).

The misalignment of teeth can cause excessive loads on the periodontium which is recognized as destructive forces to the ligaments and bone which grips the teeth in respective position, then muscles of head and mandibular joint. Consequently, untreated malocclusion is at high risk in causing periodontal diseases, temporomandibular disorders, craniofacial growth changes and bone mineral reduction (Nakamura et al., 2013).

In some previous researches, the prevalence of malocclusion among male adolescents was associated with lower skeletal mass independent of caries indices, oral hygiene, consumption of sweets, or physical activity. Male adolescents who had previously had orthodontic intervention or were newly diagnosed with malocclusion also had lower total bone mineral density compared to those without malocclusion. Hence, a lower systemic bone mineral, bone size, or both, may be directly or indirectly associated with the occurrence of malocclusion during growth. The association may be explained by the assumption that the possible factor that produces malocclusion also affects the mass and size of the bone (Konstantynowicz et al., 2007).

Bone mineral density can be measured by using dental images such as panoramic radiograph; the panoramic radiograph provides a general view of the structures in the region of interest. Structures that can be seen on a panoramic radiograph are the teeth, alveolar ridges, bone underneath the ridge, periodontal tissues and anatomical
limits which include the mandibular canal, mental foramen and other structures. Although panoramic radiographs do not reveal fine details and are not as specific as other intraoral radiographs, however it provides a practical general view of all dentition, sinuses, both maxilla and mandible and both side of temporomandibular joints (Dumitru, 2008).

It can be done a preliminary, limited appreciation of the trabacular bone density on the panoramic radiograph, based on the structures of opacity of the bone and on identifying the intertrabecular spaces. Appreciation of bone density depends on the following: uniform radiograph technique, using similar parameters; mineralization of compact bone, which can sometimes hide the transparency of spongy bone as well as subjectivism of the researchers (Dumitru, 2008).

Image J software, which is one of the panoramic radiographic image processing program is used to measure mandibular bone mineral density. In the author’s research, digital panoramic radiography is being selected, and 50x50 pixel image processing program (ImageJ) is used to determine the bone mineral density related to malocclusion at the region of interest in the mandible (Hoseini Zarch, Bagherpour, Javadian Langaroodi, Ahmadian Yazdi, & Safaei, 2011).

1.6 Research Methodology

The method of the research is descriptive with cross-sectional study.