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Mandibular quality assessment in women aged 40-60 years using mandibular cortical index and antegonial index on panoramic radiographs

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ABSTRACT

Objectives: This study aimed to describe the cortical quality of the mandible in women aged 40-60 years by analyzing the mandibular cortical index and antegonial index on panoramic radiographs.

Materials and Methods: This study was a cross-sectional analytic descriptive study, population, and sample using secondary data on panoramic radiographs of women aged 40-60. The descriptive analysis technique used in this study was the average value (mean), standard deviation, and thickness of the mandibular cortex in radiographs of female patients aged 40-60 years.

Results: This study observed variations in mandibular cortical bone quality on panoramic radiographs, with increasing age, bone quality tends to decrease, and there is an effect of gender involvement. Women tend to have lower bone quality, one of which is due to hormonal factors. This study observed variations in mandibular cortical bone quality on panoramic radiographs, with increasing age, bone quality tends to decrease, and there is an effect of gender involvement. Women tend to have lower bone quality, one of which is due to hormonal factors. The age group at risk of osteoporosis had the lowest mandibular cortex width value in the age group of 51-60 years.

Conclusion: This study produced a variety of panoramic radiographs of the mandibular cortical bone quality. The value of the width of the mandibular cortex gradually decreases with age. The value of mandibular cortex width is higher in the younger generation.

INTRODUCTION

A panoramic radiograph is a radiographic technique using a film placed outside the oral cavity to examine the maxilla and mandible in one projection. Panoramic radiographs are known as pantomography or rotational radiography because of the radiographic procedure that produces a single tomographic image of the facial structures including the maxillary and mandibular arches and their supporting structures.[1]

Panoramic radiography can be used to predict low bone mineral density in patients. Several mandibular cortical indices have been developed to assess the quantity and quality of mandibular bone mass and to observe signs of resorption on panoramic radiographs. Radiomorphometric analysis is one of the analyzes that has been chosen and applied by many researchers in assessing bone quality, both qualitatively and quantitatively. One of the qualitative assessments is to use the Klementti method or better known as the MCI index (Mandibular Cortical Index), where the assessment is carried out visually by classifying the mandibular cortex into several categories according to its morphology. In addition, there are several quantitative assessments, one of which is the AI index (Antegonial Index) which measures cortical thickness in the anterior region of the gonion. These two parameters have been widely used in assessing the quality and signs of bone resorption, which has been shown to have a strong correlation with skeletal BMD (Bone Mineral Density), which can describe the state of osteoporosis.[2,3]

Aging can occur due to many factors, both intrinsic and extrinsic. Intrinsic factors here include genetics, changes in cellular components, hormones, and biochemistry, while extrinsic factors include nutrition, physical activity, comorbid medical conditions, and medications. Bone loss is closely related to age.

Osteoporosis can occur in any part of the bone including the jawbone. Early detection of cases of osteoporosis is necessary for effective prevention and treatment. Osteoporosis of the jawbone can be seen radiographically to see the density of the bone. Dentists have an important role to play in the early detection of cases of osteoporosis because dentists can indirectly see the effects of osteoporosis on the oral cavity. The effects of

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osteoporosis on the oral cavity that can be detected are tooth loss, resorption and reduced alveolar bone height, reduced mandibular inferior cortical width, and temporomandibular joint disorders. One way to establish the diagnosis of osteoporosis is to look at the results of radiographs.[4,5]

MATERIALS AND METHODS

This research has received ethical clearance approval from the Research Ethics Commission of the Faculty of Dental Medicine, Lambung Mangkurat University Banjarmasin No. 077/KEPKG-FKGULM/EC/VII/2022. This type of research is descriptive-analytic obtained from archives of panoramic radiographs of patients aged 40-60 years who have been recapitulated at the Radiology Installation of RSGM Gusti Hasan Aman Banjarmasin from January 2022 – August 2022. Analytical descriptive research is a method to see a picture of the phenomena that occur in a certain population, without treating the variables. This study uses a cross-sectional design, namely data collection on the independent variable, and the dependent variable is carried out simultaneously and one time at a time.[6]

Sampling in this study used a purposive sampling technique, namely taking samples that are relevant to the research objectives and have special characteristics. The number of samples in this study was calculated using a numerical descriptive formula, namely the Slovin formula. Based on the results of the above calculations, the minimum number of samples in the study was 57 samples.[7]

The inclusion criteria were: 1) Panoramic photos with complete patient data aged 40-60 years from January - August 2022. 2)Results of panoramic radiographs of patients aged 40-60 years from January - August 2022. 3) Results of panoramic radiographs with clear mandibular cortex. 4) The results of panoramic radiographs show the completeness of the object. The exclusion criteria were: 1) Panoramic radiograph results in the presence of disease affecting the mandibular bone. 2) Results of panoramic radiographs with mandibular fractures. 3) The results of panoramic radiographs cannot be interpreted. 4) The results of panoramic radiographs have overlapping. 5) The image contrast is too low or too high. 6) Photos with low sharpness, so the outer border is less clear. 7) Object details are lacking, so the differences in the anatomical parts of each part are less clear. 8) The photo results are distorted, so the size and shape are not the same as the original object. 9) Brightness radiographs that are too bright and too dark.

The radiograph photo was analyzed with ImageJ software version 1.53K using the Mandibular Cortical Index (MI) and Antegonial Index (AI) (normal value of ≥ 3.2 mm). Mandibular cortical index (MCI) refers to the cortical thickness of the inferior mandible as seen on panoramic radiographs on both sides of the mandible, slightly distal to the mental foramen. The MCI index is used to assess the appearance of the mandibular inferior cortex.[8,9] Mandibular cortical index (MCI) is classified into 3 groups according to the criteria

Figure 1. Mandibular cortical index, A) C1—Normal cortex; B) C2—Mild to moderate eroded cortex; and C) Severely eroded cortex[11]
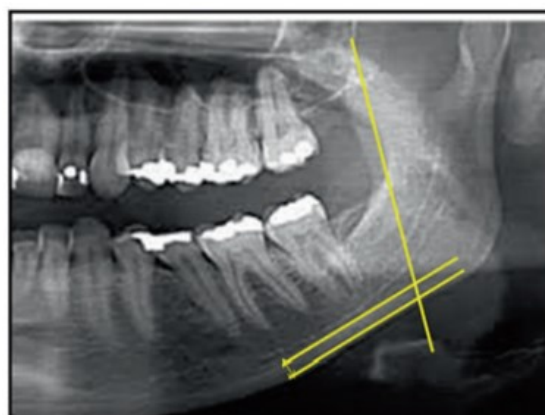

Figure 2. Antegonial Index

Table 1. Sample Characteristiics

Variable	Frequency	Percentage
Age		
40-45	25	44.64%
46-50	15	26.79%
51-55	12	21.43%
56-60	4	7.14%

Table 2. Average Mandibular Cortex Width Values based on AI (Antegonial Index)

Age	n	Mandibular Cortical Width (mm)	
		Right (Mean ± SD)	Left (Mean ± SD)
40-45	25	3,79 ± 0,22	3,64 ± 0,49
46-50	15	3,68 ± 0,71	3,58 ± 0,61
51-55	12	3,61 ± 0,46	3,50 ± 0,65
56-60	4	3,50 ± 0,54	3,49 ± 0,61
Total	56	3,61 ± 0,52	3,59 ± 0,56

Table 3. Osteoporosis Assessment Results with Mandibular Cortical Index

Age	C1	C2	C3
40-45	11	14	**0**
46-50	6	9	**0**
51-55	7	3	**2**
56-60	3	1	**0**
Total	**27**	**27**	**2**

Table 4. Average Values of Mandibular Cortex Width based on Osteoporosis and Not Osteoporosis Categories

Category	Mandibular Cortical Width Percentage
Risk of Osteoporosis	14.29%
No Risk of Osteoporosis	85.71%

described by Klemetti et al. as shown in Figure 1[10,8]: a. C1 – Normal Cortex: the endosteal edges of the cortex are flat and sharp; b. C2 – Mild to moderate abrasion of cortex: endosteal margin shows semilunar defects (lacunar resorption) or appears to form endosteal cortical residue; c. C3 – Severely Eroded Cortex: the cortical layer forms heavy and markedly porous endosteal cortical residue.

The antegonial index (AI) is a measure of the cortical width in the anterior region of the gonion at a point identified by extending the line of best fit at the anterior border of the ascending ramus to the lower border of the mandible. The antegonial index (AI) is a linear radiomorphometric measurement index that measures the thickness of the mandibular cortex in a line perpendicular to the mandibular cortex at the intersection with the tangent to the anterior border of the ramus (normal value >3.2mm).[10]

RESULTS

In this study, the sample was classified into four group of ages, 40-45, 46-50, 51-55 and 56-60 year old. The sample characteristics is shown in Table 1. Almost half of participants (44,64%) were in 40-45

years old with the least from group of 56-60 year old (7,14%).

The calculation of mandibular cortical width based on Antegonial Index of the group is shown in Table 2, while Table 3 shows the result of qualitative mandibula cortical index assessment. The average values of mandibular cortical width based on osteoporosis and not osteoporosis categoris is shown in Table 4.

DISCUSSION

The results of the above study in Table 2 show that the average value of the width of the mandibular cortex by age has significantly decreased. The 40-45-year-old group had a greater average mandibular cortex value, namely the right jaw 3.61 ± 0.46 and the left jaw 3.64 ± 0.49, while the 56-60-year-old group had an average cortex value of the lowest mandible, namely the right jaw 3.79 ± 0.22 and the left jaw 3.49 ± 0.61. The results of this study are in accordance with the research of Ledgerton et al. (1997) which stated that the width of the mandibular cortex gradually decreased with age.[12] Similar results were found in the study of Sghaireen et al. (2020) in his research stated that the value of the width of the mandibular cortex was higher at a younger age. [12,13,14]

Azhari (2017) in his research stated that the difference in the width of the mandibular cortex of the right and left jaws could be caused by a one-sided chewing pattern.[15] Physiologically the widths of the right and left mandibular cortex have different balances, but both have a small difference in density values so both are related to the detection of osteoporosis.[15,16] Low mandibular cortex width is also followed by tooth loss even though tooth loss has multifactorial causes, but several studies suggest that the number of lost teeth has decreased in people who have bone resorption or what is called osteoporosis. This is due to reduced bone density or bone thickness impacting the supporting tissues of the teeth which can cause tooth loss.[17] According to the International Osteoporosis Foundation (2020), several things affect the condition of a person's bone density, namely gender, age, race, long-term glucocorticoid therapy, lifestyle, and calcium intake.[18]

Bone is formed through 3 processes, namely: osteogenesis, modeling, and remodeling. All of these processes are mediated by osteoblasts which work together with osteoclasts as bone destroyers to form "Basic Multicellular Units" (BMU).[19] Bone formation is an important part of bone remodeling, in this process bone will be replaced with new bone. Cancellous and cortical bone remodeling occurs in a defined compartment and is referred to as the BMU. How BMU works is still being investigated, but recent findings suggest that osteocytes residing in the mineralized bone matrix play an early role in BMU formation, especially after bone breakdown. [20]

Bones are organs of the skeletal system that provide shape, structure, movement and protection for the human body. Bone is an active tissue that will undergo continuous physiological remodeling. This process has two aspects, bone formation by osteoblasts and bone resorption by osteoclast activity. This process is lifelong and allows the formation of new bone as long as calcium homeostasis remains sufficient for this activity. This process is accomplished and regulated by the action of various systemic hormones and local mediators. Osteoporosis is a disease related to the aging process and is not recognized because a decrease in bone mass can occur every year without any symptoms. Some symptoms may only be detected when they are in an ongoing stage. Osteoporosis is a systemic disease characterized by decreased bone mineral density (BMD) which increases bone fragility and fracture susceptibility.[21,22]

The process of osteoporosis begins at the age of 40-50 years, when men and women experience a process of decreasing bone mass. Bone mass decreases 5-10% every decade, but this process occurs more rapidly in women after menopause and is more common in women than men. Osteoporosis is associated with various factors, such as smoking, small stature, lack of activity, sun radiation, drugs that decrease bone mass, low calcium intake, consumption of caffeine and alcohol, diabetes mellitus and menopause.[21,23]

Osteoporosis begins with an imbalance between bone resorption and formation. Past research studies have demonstrated that some osteoporosis risk factors are modifiable, including dietary and lifestyle factors, while some factors are not modifiable.[24,25] Many oral manifestations of osteoporosis have been reported. The oral manifestations of osteoporosis are tooth loss, resorption and reduced alveolar bone height, reduced mandibular inferior cortical width and temporomandibular joint dysfunction.[5,25]

The dual energy X-ray absorptiometry (DXA) test is the gold standard in diagnosing osteoporosis, because bone mineral density (BMD) is a good predictor of fracture risk. DXA is an expensive technique and limited availability for routine use. DXA hardware in Indonesia is limited to large hospitals and it is difficult to make a specific diagnosis using DXA.[5,21]

Panoramic radiography is one of the tools to help establish the diagnosis. Panoramic radiographs are often used to view the overall condition of the teeth. The images produced on panoramic radiographs can be in the form of anatomical structures of the oral cavity, maxillary sinuses, temporomandibular joints, and hyoid bone. Panoramic radiographs are commonly used for diagnosis in oral surgery, periodontal disease, correcting tooth position and planning treatment for patients visiting the dentist for the first time. Abnormalities that can be seen on panoramic radiographs are osteoporosis, alveolar bone resorption and reduced mandibular cortical thickness.[26,10]

The quality and quantity of bone can be viewed from panoramic radiographic images through

radiomorphometric measurements. This measurement is useful in radiographically assessing mandibular bone changes Several radiomorphometric indices such as the Mandibular Cortical Index (MCI), Panoramic Mandibular Index (PMI), Mental Index (MI), Antegonial Index (AI), and Gonial Index (GI) have been applied. The Panoramic Radiomorphometry Index can be used in measuring bone mineral density as well as assessing the shape and cortical width of the mandible. Mandibular cortical bone is the bone at the lower border of the mandible, visible as a radiopaque shadow that extends along the mandibular border. Cortical bone is more easily seen than trabecular bone on radiographs.[27]

One of the measurements using panoramic radiography in assessing mandibular bone mass and observing signs of bone resorption is to use the antegonial index. Changes in the antegonial angle can be used as an indicator of mandibular growth in orthodontic dentistry and can also be used to observe signs of bone resorption.[28] Measurement of the antegonial index (AI) is done by making a line perpendicular to the lower edge of the mandible and the line connecting the anterior border of the ramus to the lower border of the mandible.[3] Noerjanto et al (2014) and Bajoria et al (2015) stated that the use of the antegonial index (AI) Panoramic radiography as a screening tool in assessing bone mass has greater sensitivity and specificity and is quite accurate.[29,28]

CONCLUSION

The conclusions were obtained there are a variety of panoramic radiographs of the mandibular cortical bone quality. The value of the width of the mandibular cortex gradually decreases with age. The value of mandibular cortex width is higher at a younger age.

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None.

FOOTNOTES

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