Difference of Bigonial Width Batak Tribe in Medan City According to Age Groups in Terms of Panoramic Radiograph

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Abstract: Changes in mandibular morphology will occur during life-long growth and development, such as the bigonial width, which is one of the parameters of growth and development of the mandible. The changes of bigonial width can be measured using panoramic radiograph. The objective of this research was to determine the difference of bigonial width of Batak tribe in Medan according to age groups based on panoramic radiograph. The type of this research is analytical research using cross-sectional study with a total sample of 150 people divided into five age groups, according to inclusion and exclusion criteria. Group 1 (age 4-12 years), group 2 (13-24 years, group 3 (25-34 years), group 4 (35-60 years), and group 5 (> 60 years). Measurements on the digital panoramic radiograph are done by computerized. Data that obtained was analyzed with Oneway ANOVA and LSD. The mean value from the highest to the lowest of bigonial width, sequentially, were in group 3 (163,283 mm ± 9,947 mm), group 4 (157,580 mm ± 7,776 mm), group 5 (155,623 mm ± 12,597 mm), group 2 (147,787 mm ± 9,108 mm), group 1 (141.917 mm ± 10.992 mm).

1 INTRODUCTION

Craniofacial is a very specific part of the body, which is easily recognizable and distinguished between one individual to another, and can be used to assess one's growth and development. (Bourzgui, 2012). The mandible is one of the craniofacial parts, where many potential landmarks provide diagnostic information about growth and development related to age, sex, and race. (Rachmadiani, *et al.,* 2017).

Physical assessment of one's growth can be done one of them by radiographic measurement. Measurement of the mandible as one of the parameters of growth and development with radiography can use panoramic radiography (Durtschi, *et al.,* 2009) but it can also be used as an estimate of age in forensics. (Leversha *et al.,* 2015). Study by means of radiographic measurements on the mandible for an estimated age apart from the gonial angle, the height of the ramus was also performed on the bigonial width. (Manigandan *et al.,* 2015) Bigonial width is the horizontal distance between two right and left gonial points. Bigonial width measurements were performed on panoramic radiographs.(Al-Shamout *et al.,* 2012)

Indonesia is an archipelagic country, with multicultural or multi-ethnic groups with a very large number. (Tumonggor *et al.,* 2013) Batak nation is one of the tribe inhabiting the province of North Sumatra, with a sizeable population. The Batak tribe has five sub-tribes and each major area. Batak sub-tribe in question are: Batak Karo, Batak Simalungun, Batak Dairi, Batak Toba, Batak Mandailing. In the Batak tribe (sub-Ras Proto Melayu), there is a customary group Dalihan Na Tolu, although the term is different but the same meaning. (Manurung, 2016) This study was conducted to determine the differences size of mandibular bigonial width in Batak tribe at Rumah Sakit Gigi dan Mulut Faculty of Dentistry, Universitas Sumatera Utara according to age group in terms of panoramic radiography. The purpose of this study was to find out the difference mean value of bigonial width mandibular of Batak tribe in Medan according to age group in terms of panoramic radiograph, which can be used and

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become a guideline in the care and growth of a person.

2 METHODS

This analytical research conducted using cross-sectional design, carried out at Oral-Maxillo Facial Radiology, Faculty of Dentistry, Universitas Sumatera Utara. The population of this study was Batak tribe with three generations above who came to Rumah Sakit Gigi dan Mulut Faculty of Dentistry, Universitas Sumatera Utara and live in Medan City. The total sample size was 150 people, divided into five age groups. Group 1 consists of 4-12 years old, group 2 consists of 13-24 years old, group 3 consists of 25-34 years old, group 4 consists of 35-60 years old, and group 5 consists of >60 years old. Each age group of samples consisted of 30 people.

Sample selection method was done by purposive sampling method by fulfilled inclusion and exclusion criteria. Inclusion criteria: complete teeth (in primary dentition period consisting of 20 teeth and in permanent dentition period consisting of 28 teeth, except for third molar) never received orthodontic treatment, did not use dentures. Particularly in the age at mixed tooth period, there is no premature loss deciduous teeth and missing of permanent teeth, and in group 5 (age> 60 years): full edentulous. Exclusion criteria: suffered from systemic diseases or received treatment, experienced of jaw surgery, odontectomy, suffered from micrognathia, pathological conditions in the mandible, persistence of deciduous teeth, experienced deep caries with exposure to the pulp and crown loss, received fullcrown or space maintainer/space regainer treatments.

After completing the questionnaire and informed consent, a digital of the panoramic radiography was performed on the sample using Orthopantomograph Instrumentarium, model QC 200 D 1-4-1, 2012. The parameters are computerized on digital panoramic radiograph (Fig. 1). The one-way Anova and Multiple Comparison LSD test was done to analyze the calculated data. Ethical clearance was obtained from the Research Ethics Committees of Faculty of Medicine, Universitas Sumatera Utara No. 345/TGL/KEPK FK USU-RSUP HAM/2017.

3 RESULTS

The results of normality test using one-sample Kolmogorov-Smirnov Test showed that the variables have normal distribution with $p>0.05$. Table 1 showed the mean value of bigonial width in each age group (ANOVA test, p value = 0.000 < 0.05). The mean value of bigonial width from the highest to the lowest, sequentially, were in group 3 (25-34 years), group 4 (35-60 years), group 5 (>60 years), group 2 (13-24 years), and group 1 (4-12 years).

Multiple comparison test was performed after ANOVA analysis. Table 2 showed the significant differences (Multiple Comparison LSD Test result) according to age groups ($p< 0.05$).

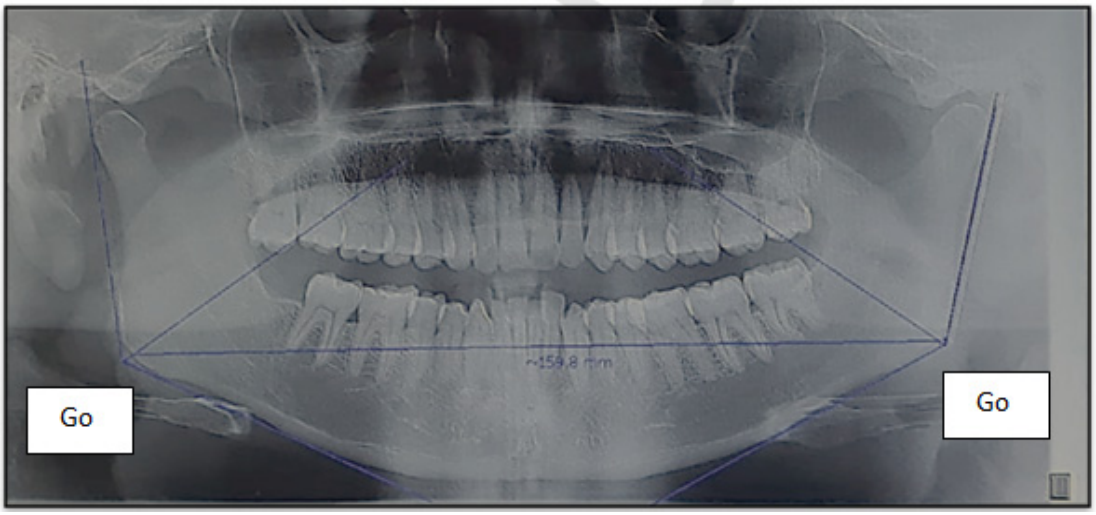

Figure 1: Bigonial width in panoramic radiograph (private document).

Table 1: The mean value of the result of the measurement of bigonial width Batak tribe.

Groups (years)	n	Mean ± Std. Deviation	P
1 (4-12y)	30	141.917±10.992	.000*
2 (13-24y)	30	147.787±9.108	
3 (25-34y)	30	163.283±9.947	
4 (35-60y)	30	157.580±7.776	
5 (>60y)	30	155.623±12.611	
Total	150	153.238±12.597	

*One-way Anova test, sig. p<0.05

Table 2: Multiple Comparison LSD Test between five age groups in mandibular bigonial width Batak tribe in Medan according to age groups.

(I) Group (years)	(J) Group (years)	P
1 (4-12y)	2 (13-24)	.028*
	3 (25-34)	.001*
	4 (35-60)	.001*
	5 (>60)	.001*
2 (13-24y)	1 (4-12)	.028*
	3 (25-34)	.001*
	4 (35-60)	.001*
	5 (>60)	.003*
3 (25-34y)	1 (4-12)	.001*
	2 (13-24)	.001*
	4 (35-60)	.032*
	5 (>60)	.004*
4 (35-60y)	1 (4-12)	.001*
	2 (13-24)	.001*
	3 (25-34)	.032*
	5 (>60)	.460
5 (>60y)	1 (4-12)	.001*
	2 (13-24)	.003*
	3 (25-34)	.004*
	4 (35-60)	.460

4 DISCUSSION

In this study the average values of bigonial width Batak tribe of five age groups showed the mean value from the highest to the lowest, sequentially, were in group 3 (25-34 years), group 4 (35-60 years), group 5 (>60 years), group 2 (13-24 years), and group 1 (4-12 years). There was a significant difference in bigonial width from group 1 (4-12 years) to other groups, from group 2 (13-24 years) to other groups, and group 3 (25-34 years) to other groups, but there was not significant difference in bigonial width from group 4 (35-60 years) to group 5 (>60 years) (Table 2). A study conducted by Al-Shamout *et al.,*, showed that there was a significant difference in the mean values of bigonial width between the age group of 11-19 years with the age group of 20-29 years, 30-39 years, 40-49 years, and 50- 59 years old. Bigonial width will change with age change.[6] The results of the same study also by Ghaffari *et al.,* which mentions a significant decrease in bigonial width size from the 21-30, 31-40, to 41-50 year age groups. (Ghaffari *et al.,* 2013).

The remodeling process is the process by which old bone is removed from the skeleton (resorption) replaced with new bone (ossification/ new bone formation). The remodeling process occurs throughout life, by removing old bone continuously with new protein matrix and mineralization matrix to form new bone. (Kini *et al.,* 2012) The time of children and adolescents is a very important time to maximize accumulation of bone formation, due to the process of growth, development, and remodeling of bone. In both men and women, it is generally believed that bone mass increased substantially during the first two decades to reach peak bone mass in adolescence or young adulthood. Several studies have shown that peak mass bone is achieved at the early age of 20 years but other data suggest that bone mineral still accumulates in the third decade of life. (Baxter-Jones *et al.,* 2011)

After birth, the mandibular body gradually extends towards the horizontal especially behind the foramen mentale to produce a place for the permanent teeth. (Al-Shamout *et al.,* 2012) During the process of tooth eruption in the mandible, in the process of growth and development of the mandible, in addition to the process of remodeling, there is also anterior and inferior displacement. The endocondrium of the condyle has hardening, and affects the growth of the posterior mandible. Apposition and remodeling will cause the mandible to grow larger. (Reynolds *et al.,* 2011; Ghosh *et al.,* 2009)

The results of this study indicate the maximum growth of mandibular to lateral direction occurs in the age group 13-24 years, to reach the optimal size of bigonial width in the age group 25-34 years. This is likely due to the mandibular basal bone morphology generally altered by bone aposition on the outer (buccal and labial) surfaces of the mandible to provide a spot of tooth eruption, and resorption on the lingual surface of the mandible. At the age after 35 years the mandible will experience a minimum growth that occurs until age> 60 years (there is menopause period for the woman) which is likely due to a greater resorbtion than bone apposition, especially in the age group> 60 years who have teeth lost entirely. (Ghosh *et al.,* 2009)

From the transverse aspect, after the first year of life, the growth in the posterior region of ramus is in the form of the letter "V". Changes in the function of chewing muscles, especially in the angle of gonial regions may also be the cause of the bigger width increase. The gonial angle is a part of the mandible that is directly related to the massetter and internal pteryigoid muscles. During the craniofacial growth period, the mandible undergoes continuous repositioning in order to perform optimally function. The rami grows in divergent direction, in order to obtain a connection with the maxilla in order to function normally. (Singh, 2007) A study conducted by Bishara *et al.,* on the mandible arch, showed mandibular growth in the lateral direction, with an increase in 3.7 mm intercanine width between 3-13 years, but decreased by 1.2 mm by 13 to 45 years. The intermolar width increases by 1.5 mm at the age between 3-5 years and 1 mm between 8-13 years but decreases 1 mm at the age of approximately 45 years. (Standring, 2008) The results of this study are also supported by Leversha *et al.,* examined the bigonial width that grew from 18-29 years old to 30-39 years old, and decreased in the 40-49, 50-59, and 60-69 years age group. (Leversha *et al.,* 2015)

In adolescence, there is an increase in the acceleration of growth, changes in size and shape, and changes in the proportion of muscle, fat, and bone. During puberty, there is a considerable increase in bone mass due to increased bone size (Sharma *et al.,* 2014) where the rate of bone formation process is faster than resorption. However, this growth rate will stop when the linear growth stops, and bone mass peaks someone is reached, occurring at the age of 15-25 years. Total bone mass usually remains constant for about 10 years, because the rate of bone formation and resorption is balanced. Then the bone mass will slowly decrease as a result of the dominance of the resorbsi process in the third decade of life to the fourth. (Lau *et al.,* 2011)

There was not significant difference in bigonial width from group 4 (35-60 years) to group 5 (>60 years). This is likely due to the large age range in the sample used in group 4 (35-60 years). Where the number of samples used with age 35-40 years as many as 5 people and ages 41-60 years as many as 25 people, the age at which bone loss is more, and minimal bone growth. The dominant effect of aging on bone is the loss of bone mass and strength. At the age of the third decade to the fourth decade of life, total bone mass will begin to decline. By age 80, it is estimated that the body's total bone mass will be about 50% of its peak value. Loss of bone mass from the jaw is caused not only by the teeth, decreased bone density is caused by the age factor, so the bones become more fragile. Fractures occur more easily and the healing process becomes slower. (Lau *et al.,* 2011; Boskey *et al.,* 2010)

Parathyroid hormone (PTH), an 84-amino acid peptide secreted by the parathyroid gland is important as a systemic regulator of calcium homeostasis, serves to regulate the concentration of calcium and serum phosphorus through receptor-mediation, combined actions in the bones, intestines, and kidneys. High serum PTH levels, increase osteoclastic bone absorption, as seen in primary and secondary hyperparathyroidism. Low PTH levels, increase osteoblastic bone formation, especially if delivered episodically. The skeletal effect of PTH is mediated through osteoblasts, because it is the main expression of PTH receptors. However, osteoblasts communicate with osteoclasts to mediate the effects of PTH. Many factors may be involved in increasing serum PTH levels in the elderly. Vitamin D deficiency is quite common which can contribute to elevated serum PTH levels by decreasing calcium resorption from the gastrointestinal tract. Moreover estrogen deficiency results in reducing intestinal calcium absorption as well as renal tubular calcium disrupted reabsorption, which leads to chronic negative calcium balance. Vitamin D is an important factor in the regulation of calcium metabolism. 1,25-Dihydroxy vitamin D3, the active form of vitamin D which has the effect of increasing intestinal calcium absorption, decreasing serum PTH levels through direct inhibition of PTH secretion, and also indirectly, through inhibition of PTH secretion with elevated serum calcium levels. Therefore, vitamin D has the overall effect of decreasing bone resorption mediated by PTH. Vitamin D deficiency often occurs with advanced aging, and this may be another contributor to the pathogenesis of senile osteoporosis. Although severe vitamin D deficiency results in the development of osteomalacia in adults, mild deficiencies can cause a secondary state of hyperparathyroidism, with the result of developing osteoporosis. (Kini *et al.,* 2012; Lau *et al.,* 2011; Boskey *et al.,* 2010; Feng *et al.,* 2011)

The facial skeleton has a profound effect on one's appearance. The main characteristic of adolescents is good skeletal structural support. The result of facial aging is a combination of soft tissue and bone changes, with bone loss in certain areas of the facial bone contributing significantly to aging facial features. Conceptually it is important to appreciate that in most individuals with premature aging, facial frames can be inherently inadequate. Thus, changes

in the facial bone resulting from the aging process must be resolved to get a natural facial rejuvenation. (Mendelson *et al.,* 2012)

The mandible is the bone that forms the lower part of the face, chin, and mandibular angle. The mandible provides attachment for the mastication muscles, tongue, and the floor of the mouth. (Burns, 2013) According to Enomoto *et al.*,, mastication affects the growth and development of the mandible. The mechanical stress induced by mastication greatly affects the condyle cartilage and the mandible around the mastication muscle, and alters the growth and development pattern of the mandible. (Enomoto *et al.,* 2010) Many researches have been done to evaluate mandibular morphology by age, such as measurements of height and width of ramus, condyle height, and bigonial width. The morphological changes of the mandible after birth are affected by the teeth (mastication) and age. Age, systemic factors, and tooth loss may lead to changes in mandibular morphology. (Liu *et al.,* 2010; Huumonen *et al.,* 2010; Shaw *et al.,* 2010; Chole *et al.,* 2013; Shilpa *et al.,* 2014) Increasing age, changes in the function and structure of mastication muscles that occur in edentulous patients lead to reduced contraction in activity and decreased muscle density compared with toothed patients. The strength of the masseter and medial pterygoid muscle contractions that work in the area of the gonial angle, also affect the basic form of the mandible.(Thakur *et al.,* 2013; Oksayan *et al.,* 2014)

In computed tomographic scans can be seen the activity of electromyography and lower muscle density on the edentulous subject than the dentulous subject. The occurrence of masticatory muscle atrophy may be one of the factors that cause mandibular changes. (Baxter-Jones *et al.,* 2011; M.Reynolds *et al.,* 2011; Shaw *et al.,* 2010; Chole *et al.,* 2013; Shilpa *et al.,* 2014) Another factor that may cause the changes is the loss of intermaxillary support due to missing teeth, allowing the masseter and medial pterygoid muscles to draw an unobstructed pull on the mandible. (Baxter-Jones *et al.,* 2011) A significant limitation with currently available uses is data obtained from digital panoramic radiographs. The ideal study is linear to show the aging changes in the same individual. However, the study that can be done in this field is cross-sectional population research based on the comparison between individuals in different age groups, so it cannot see significant changes in the age-related mandibular of the same individual.

5 CONCLUSION

The conclusion of this study is that group 3 (25-34 years old) has the highest mean value of bigonial width. There is difference of bigonial width Batak tribe in Medan according to age group in terms of panoramic radiography that can be affected by teeth and age. Statistically significant differences in bigonial width was group 1 (4-12 years), 2 (13-24 years), and 3 (25-34 years) to the other groups, but there is not significant differences in bigonial width for group 4 (35-60 years) to group 5 (>60 years).

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