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ANALYSIS OF MANDIBULAR GONIAL ANGLE FOR GENDER DETERMINATION

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Abstract

The gonial angle through radiomorphometry can be used in determining gender because it is the part of the mandible that experiences quite prominent and large transformative changes. Gender is an important parameter in identification. This study aims to determine whether there are differences in the size of the gonial angle through radiomorphometry in determining sex on panoramic radiographs aged ≥ 20 years. The method used analytical observational methods with a cross sectional approach and total sampling was 52 research samples (21 men and 31 women) gonial angle on panoramic radiography. The results showed that there was a significant difference in the size of the mandibular gonial angle between men and women. This study concludes that the gonial angle via radiomorphometry can be used to determine gender in panoramic radiography.

Keywords: *Gonial Angle, Radiomorphometry, Panoramic Radiograph, Gender Determination*

1. Introduction

Identification can be done by determining the gender. The determination of sex with the help of the victim's frame has a truth level of more than 95% of cases (Maloth et al. 2017). The victim's frame that can be used in determining sex is the mandible. The mandible has high bone density and a dense layer of compact bone so that it can maintain the shape and contour of the bone structure due to environmental factors with a survival range of one year (Mobin and Sajja 2018). The mandible is one of the largest and most dimorphic skull bones in determining sex. The mandibular measurement parameter can be measured through the gonial angle. The gonial angle is one of the most dimorphic parts of the mandible in sex determination because it is directly related to the largest dimorphic morphological changes in size and remodeling of the ramus and body of the mandible during the growth and development of the mandible (Behl

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et al. 2020). Gonial can be evaluated by radiographic analysis. Radiography in measuring the gonial angle gives accurate results and can clearly show either the right or left region. Panoramic radiography can be used for reliable measurement of bilateral gonial angles without superimposition (Radhakrishnan, Nilambur and Vallikat 2017). Panoramic radiography on the posterior and lateral aspects of the mandible in measuring the mandibular gonial angle using panoramic radiography is reliable (Alfawzan 2020).

2. Method

This study used an analytic observational method with a cross-sectional approach. It was conducted at the Dental Radiology Installation, Dental and Oral Hospital, University of Jember with a sample population of secondary data from panoramic radiographs according to the inclusion criteria in February 2021-September 2022 (total sampling). This research was conducted from December 2022-February 2023.

This study used a non-probability sampling technique with the total sample method and obtained a total sample of 52 samples (21 males and 31 females) panoramic radiographs brand Texpano 77 Hi series 2014.

The sample inclusion criteria in this study include: men and women aged ≥ 20 years; panoramic radiographs come from the Dental and Oral Hospital of the University of Jember; radiographic scope clearly shows the object/structure being observed; visual panoramic radiographs include density, contrast, sharpness, and relatively good detail; panoramic radiograph with minimal distortion, panoramic radiographs do not contain ghost images or artifacts in the area to be observed. Meanwhile, the sample exclusion criteria in this study include: the mandible is fractured or there are abnormalities associated with the bone; the radiograph shows that the patient is undergoing orthodontic treatment; there is a positional error on the panoramic radiograph, namely the mandible appears excessively angled and appears excessively flat. The research has been declared passed by the Health Research Ethics Commission (KEPK) of the Faculty of Dentistry, University of Jember.

The tools and materials used in this research are panoramic radiograph soft files, computer/laptop, Cliniview 10.2.6 application, SPSS version 25 application, and Microsoft Excel application.

The way it works is to open the cliniview 10.2.6 application then measure the mandibular gonial angle. The gonial angle measurement can be done by determining the ramus line and mandibular line. The Ramus line is obtained by determining the Ar (Articulare) reference point, namely the external contour point of the cranial base and the dorsal contour of the head or neck of the condyle, the external contour point of the cranial base and the dorsal contour point of the condylar head and PMC (Process of the mandible), namely the largest convex point process of the mandible is on the posterior border while the mandibular line is obtained by determining the reference point IMCa (largest convex point on the inferior mandible in the posterior area) and IMCb (largest convex point on the inferior mandible in the anterior area). The confluence of the ramus line and mandibular line forms the mandibular gonial angle (Al-Gunaid 2019).

The data of this study were the mandibular gonial angles in males and females by three observers by analyzing the data using the SPSS version 25 application. The three observers were averaged and analyzed using the Intraclass Correlation Coefficient (ICC) test with a two-way mixed model aiming to know the consistency value of the measurements of the three

observers so that the data can be used. This research data can be used and then carried out the One-Sample Kolmogorov Smirnov Normality Test and the Levene Test. The test obtained that the data were normally distributed so that the data was carried out using parametric statistical techniques, namely the Independent T-test to see statistical differences in the size of the mandibular gonial angle (No.1798/UN25.8/KEPK/DL/2022).

The result of this research, the average values of the mandibular gonial angles for men and women were obtained which are listed in the table and figure below (Pigure 1).

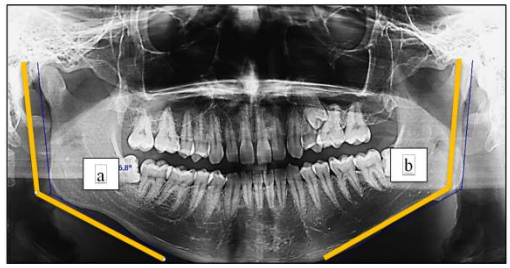

Figure 1. *Measurement of gonial angles. A. right region; B. left region*

3. Result and Discussion

Table 1. Average mandibular gonial angle by gender

Gonial Angles	Male	Range	Female	Range
right region	118,71^{o}	108,80^{o}-126,07^{o}	124,26^{o}	116,23^{o}-135,83^{o}
left region	119,99^{o}	110,97^{o}-127,47^{o}	123,79^{o}	116,43^{o}-135,13^{o}

Table 1 shows the mean value of the male gonial angle in the right region of 118.71^{o} with a range of 108.80^{o}-126.07^{o} and in the left region of 119.99^{o} with a range of 110.97^{o}-127.47^{o} while the gonial angle value for women in the right region is 124.26^{o} with a range of 116.23^{o} -135.83^{o} and the left region of 123.79^{o} with a range of 116.43^{o}-135.13^{o}.

Table 2. Independent T-test results of the right mandibular gonial angle between male and female

sig (2-tailed)	Mean Difference	Std. Eror Difference
0,000	5,54522	1,41047

* Independent T-test

Table 2 shows that the value with the Independent T-test is 0.000 in the right region for the male and female sex. These results indicate that the data significantly differs in the mandibular gonial angle of the male and female sexes in the right region because of the asymp.sig (2-tailed) value is less than 0.05.

Table 3. Independent T-test results of left mandibular gonial angle between male and female

sig (2-tailed)	Mean Difference	Std. Eror Difference
0,010	3,65389	1,35892

* Independent T-test

Table 3 shows, the value with Independent T-test is 0.010 for left region of male and female sex. These results indicate, data significantly differs in mandibular gonial angle of male and female sexes in left region because of the asymp.sig (2-tailed) value is less than 0.05.

Table 4. Independent T-test results for mandibular gonial angles for male in the right and left regions

Right and Left Gonial Angles	sig (2-tailed)	Mean Difference	Std. Error Difference
	0,329	1,41714	1,43292

* Independent T-test

Table 4 shows that the value with the Independent T-test is 0.329. These results indicate that there is no significant difference in the data on the mandibular gonial angle of the male sex in both the right and left regions because of the asymp.sig (2-tailed) value is more than 0.05.

Table 5. Independent T-test results for the mandibular gonial angle of women in the right and left regions

Right and Left Gonial Angles	sig (2-tailed)	Mean Difference	Std. Eror Difference
	0,714	0,47419	1.28635

* Independent T-test

Table 5 shows that the value of the Independent T-test is 0.714, in other words, there is no significant difference in the data on the right and left gonial angles of the female sex because the asymp.sig (2-tailed) value is more than 0.05.

This study used a sample age ≥ 20 years. This age was chosen because the size of the mandible has been maximized or the process of growth and development of the ramus and corpus has stopped (Vivian et.al, 2019). The gonial angle will decrease continuously and stop at the age of 21 years (Larrazabal and Juan 2017).

The results of this study found that there was a significant difference in the size of the mandibular gonial angle between male and female. Women have a larger mandibular gonial angle compared to men according to previous research conducted by Elfitri, Firdaus and Resti (2017), Sairam et al. (2018), Krishnan et al. (2019), Alfawzan (2020), Farahani et al. (2021), Shrimali et al. (2022), Ashem et al. (2022), and Ingaleshwar et al. (2022).

The reason there is a significant difference in the gonial angle of the mandible between male and female is due to hormonal factors. Estrogen, which is abundant in female, can affect bone metabolism, and testosterone, which is abundant in male, can be used as an effective factor in bone remodeling (Abuhijleh et al. 2019). Puberty female have an increase in mandibular growth and a decrease earlier, while pubertal male have an increased growth rate. The mandible is faster and the mandible is bigger (Azhari et.al, 2019).

The gonial angle is the angle that is used as a place for muscle attachment, both the masseter muscle and the medial pterygoid muscle so that the activity and size of these muscles can affect the morphology of the gonial angle (Tentolouri et al. 2022). Maximum masticatory

muscle strength can cause a small gonial angle size because the muscles that play a role have a high level of strength in bending the lower border of the mandible against the ramus (Abuhijleh et al. 2019). The greater degree of mastication is due to the thickness of the masticatory muscle fibers, masseter muscle, and medial pterygoid muscle in males (Chang et al. 2020). The cross-sectional area of the masticatory muscles can affect the masticatory bite maximum. The smaller the cross-sectional area of the muscle causes the minimum masticatory bite (Daboul et al. 2018).

The gonial angle plays a role in giving facial shape and is widely used as a parameter of changes in the mandible with age. The gonial angle at birth is around 175^{o} and decreases gradually during the growth period with a size of around 105^{o}-115^{o} (Vasil'ev, Paulsen, and Dydykin 2020). The gonial angle at birth has a slightly obtuse shape and will decrease with age and when you get older it will increase (Pereira, Lima, and da Silva 2020). The angle size increases. mandibular gonial can be caused by nutrition. Samples that have low nutrition experience a decrease in mandibular growth and excessive nutrition has accelerated mandibular growth so that low nutrition can cause mandibular growth to be disrupted (Lubis and Tiong 2021).

The varying size of the mandibular gonial angle can be influenced by external factors such as diet and vitamin D. The average gonial angle size of the sample with a soft diet is greater than the average gonial angle size of the sample with a hard diet (Kono et al. 2017). This condition is caused because a soft diet can affect mandibular growth negatively due to diet can affect masticatory muscle function due to mechanical loads that occur so that it can affect the growth of craniofacial structures, namely being able to increase the length of the mandible, especially the size of the mandibular gonial angle. A hard diet can be useful over a soft diet because it can repair bone damage during the growth process caused by a soft diet and a hard diet can increase the height of the ramus and the width of the condyles (Fujita and Maki 2018). Vitamin D from sun exposure can relate directly to bones and has a positive effect on hormones that regulate bone and the structure of bone (Abulmeaty 2017). The study by Kanemura et al. (2016) with a sample of 5 children aged 6-8 years, said that exposure to sunlight can affect the bone thickness and increase bone mineral density (BMD) in children exposed to sunlight for 28.8 minutes/day and children exposed to sunlight sun damage no bone after 2 years.

Differences in the size of the mandibular gonial angle between individuals can be influenced by racial factors. In research conducted by Srii et al. (2021) with a total of 350 samples consisting of 161 samples of the Mongoloid race and 189 samples of the Aryan race, the results of the right gonial angle of the Mongoloid race were 121.61^{o} and the left gonial angle of the Mongoloid was 122.64^{o} while the results of the right gonial angle of the Aryan race were 123.25^{o} and the left gonial angle of the Aryan race is 124.62^{o}.

Research conducted by Sitanggang et al. (2018) in the population of the mongoloid race there was a change in the size of the mandibular gonial angle due to the condition of the teeth and age. The condition of teeth with an edentulous condition has a larger gonial angle size. This statement is by research conducted by Pillai et al. (2018).

The results of this study also found that there was no significant difference in the size of the right and left mandibular gonial angles for both men and women by previous studies conducted by Hariemmy et al. (2018), the gonial angle on the right is 130,93^{o} and on the left is 130,94^{o}. As well as research conducted by Larrazabal and Sanchis (2018), Ozkan et al. (2019), and Shrestha et al. (2020).

4. Conclusion and Suggestion

The research that has been done shows that there is a significant difference in the size of the gonial angle of the mandible in men and women. The gonial angle in women is 124.26^{o} on the right area and 123.79^{o} on the left area, while in men it is 118.71^{o} on the right area and 119.99^{o} on the left area. The size of the mandibular gonial angle in women is larger than in men due to several factors including hormones, masticatory muscle strength, age, nutrition, diet, vitamin D, race, edentulous and others.

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