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CONTENT

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Analysis of gonial angle related to age in Surabaya population, Indonesia*

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Abstract

Background: Natural disasters potentially cause large numbers of death and a lot of them are yet identified due to the highly destroyed bodies of the victims. Therefore, an immediate identification should be required. The identification can be done age identification. Panoramic radiographs can be used to assess age by measuring the mandible from the gonial angle. Purpose: To analyze the significance of age determination using gonial angle as parameter from panoramic radiographs. Methods: A gonial angle was measured using panoramic radiographs from 251 samples with the RadiAnt DICOM Viewer 4.6.5 software. Result: The measurements of the gonial angle were divided into five groups. One Sample Kolmogorov Test showed p-value (0.001) <0.05, which means the data were not normally distributed. In this case, a Box-Cox power transformation might help make the data normal. Independent t-test showed significant value of 0.989 > 0.05 on gender, showing the gonial angle was not affected by gender, while the significant value of 0.006 <0.05 showed the opposite result. Moreover, one-way ANOVA test showed significant value achieved by group A (4-12 years) of 125.68º and followed by group E (41-62 years) of 124.85º, group D (31-40 years) of 123.63º, group B (13-20 years) of 122.86º and group C (21-30 years) of 122.04º. Conclusion: The gonial angle was influenced by age, and samples with younger age had greater angle than the older ones. The highest average value resulted in the following order: age group A, group E, group D, group B and group C.

Keywords: gender; mandible; panoramic radiography; gonial angle; age

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Introduction

Indonesia is one of the world's largest archipelagic country, with 17,499 islands stretching from Sabang to Merauke with a population of 238.5 million in 2010. Geographically, Indonesia is surrounded by two of the world's major oceans (the Indian Ocean and the Pacific Ocean), and geologically, it is located at the center of three plates: Indo-Australian plate, Eurasian plate, and Pacific plate (1,2). These natural conditions have caused a very potential and simultaneous mass casualty incident such as volcanic eruptions, earthquakes, tsunamis, floods, and landslides in Indonesia. Thus, the identification of victims remains in incidents are required, especially when it comes with unknown status or dismembered bodies (3). Identification can be done by using several methods, such as age, sex, race, and height. Age plays a substantial role in identifying the victims to help discover the true identity of the victims, with the purpose that the family of the victims will be at ease. The age of the victims can be estimated by bones and teeth (4). Age can also be estimated by identifying the cranium and examining the closure of the sutures and mandible. The mandible used to estimate age since it has a high bone density, strong, and has the ability to survive for a long time period. However, the mandible's growth and development will vary as we become older. The mandible grows and develops quickly when we are younger, but it slows down as we get older (5).

The age estimation process using mandible can be measured by the angle of the jaw, known as the gonial angle. Panoramic radiography shows one of the gonial angle measurement procedures (6). The gonial angle is one of the derived landmark for which formed by bisecting the angle formed by lines tangent to the posterior border of the ramus line (RL) and inferior border of the mandibular line (ML). Both internal and external factors are also influence the impact of the development of the gonial angle, including genetic factors, race, sex, nutritions, hormones, age, aging process, lifestyle, and medication (7). The changings of the gonial angle can be utilized as an indicator of mandibular growth in the orthodontic field; Moreover, the gonial angle can be used to see morphological changes in the mandible that occur during the aging process (8). The gonial angle can be utilized as an adjuvant and extra forensic measure, as well as a scientific growth scale to determine age groups (7).

Upadhyay et al. (2012) assessed the gonial angle of boys and females in two groups: mixed dentition and permanent dentition. His test results showed that there were no significant differences in the size of the gonial angle with age (7). Another study discovered that rising age caused the size of the gonial angle in males were decreasing by using 54 panoramic radiographs samples of male (9).

The study on age significance analysis based on gonial angle measurement of males and females divided into five age group has never been done in Surabaya population. Thus, we find it important to conduct the study on age significance analysis of gonial angle using panoramic radiographs in Surabaya population.

Material and Methods

This is an analytic observational reserach with cross sectional design to determine the significance of age based on gonial angle measurement. The sample population in this study were men and women patients who have done panoramic radiographs at the Dental and Oral Hospital, Airlangga University. The samples were secondary data from panoramic radiographs of men and women at RSGM-P FKG UNAIR at the Dental Radiology Lab, Universitas Airlangga which meets the sample criteria.

The inclusion criteria were panoramic radiographs that clearly legible, panoramic radiographs that included both right and left gonial angles as shown in Figure 1. Meanwhile, the exclusion criteria for the sample in this study are: the sample had Angle class III malocclusion, mouth breathing, bruxism and skeletal abnormalities. Age of groups will be divided based on: Age 4-12 years : Age of group A, Age 13-20 years : Age of group B, Age 21-30 years : Age of group C, Age 31-40 years : Age of group D, Age 41-62 years : Age of group E (middle age).

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The independent variables of this study were chronological age and sex which were obtained from the patient's medical record data. The dependent variable of this research was the gonial angle seen in the panoramic radiograph which has been measured using RadiAnt DICOM Viewer 4.6.5 software.

Figure 1 Result of Gonial Angle Measurement.

Results
There were 251 samples, the details written in Table 1. The results of the average value of the gonial angle in the age group A (4-12 years) female with a total of 26 samples at the right gonial angle 127.4º and the left gonial angle 125.4º , then male with a total of 26 samples at a right gonial angle of 126º and a left gonial angle of 123.8º. Age group B (13-20 years) females with a total of 25 samples at a right gonial angle of 121.1º and a left gonial angle of 121.0º, then males with a total of 21 samples at a right gonial angle of 124.8º and a left gonial angle of 125, 0º. Age group C (21-30 years) were females with 48 samples at 123º right gonial angle and 122º left gonial angle, then males with 26 samples at 122.6º right gonial angle and 121.3º left gonial angle.

Age group D (31-40 years) female with a total of 29 samples at the right gonial angle 124.7º and left gonial angle 123.6º, then male with a total of 14 samples at the right gonial angle 122.3º and the left gonial angle 122, 5º. Age group E (41-62 years) female with a total of 23 samples at the

right gonial angle 124.2º and left gonial angle 125.4º, then boys with a total of 9 samples at the right gonial angle 125.6º and the left gonial angle 124, 2º.

The data were tested for normality using the One-Sample Kolmogorov-Smirnov Test but the data are not normally distributed (p-value <0.05).
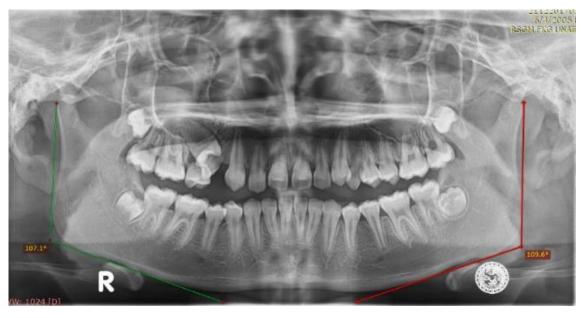
When results are not normally distributed, the data must be transformed to box cox transformation. After the data was transformed, a one-way ANOVA test was performed, Table 2. The test results stated that sex had a significant value of 0.989 (p-value <0.05), indicating that sex had no effect on the right and left gonial angles in both males and females. Meanwhile, age has a significant value of 0.006 (p-value <0.05), indicating that age affects the difference in gonial angle between male and female.

Table 3 shows that the age group 4-12 years has an average gonial angle greater than the others, so it can be sorted from the highest average value is age group A (4 -12 years) was 125.68º, age group E (41-62 years) is 124.85º, age group D (31-40 years) is 123.63º, age group B (13-20 years) is 122.86º and age group C (21-30 years) 122.04º.

Discussion
The results of this study indicate that the size of the gonial angle was influenced by the age, which shows the difference in the size of the gonial angle. The youngest (4-12 years) and oldest (41-

Table 1. Average score of gonial angle.

Remarks		n	Gonial angle average	
			Right	Left
Age group A (4-12 years old)	Female	26	127.4°	125.4°
	Male	26	126°	123.8°
Age group B (13-20 years old)	Female	25	121.1°	121°
	Male	25	124.8°	125°
Age group C (21-30 years old)	Female	48	123°	122°
	Male	26	122.6°	121.3°
Age group D (31-40 years old)	Female	29	124.7°	123.6°
	Male	14	122.3°	122.5°
Age group E (41-62 years old)	Female	23	124.2°	125.4°
	Male	9	125.6°	124.2°

Table 2. Two way Anova test result.

Group	Sig.	Remarks
Gender (independent test)	.989	No significant effect regarding to gender
Chronological age (one-way ANOVA)	.006	There is significant effect regarding to age

Table 3. Mean gonial angle in relation to different age groups.

Remarks	Number of subjects	Mean mandibular angle	Standard Deviation
Age group A (4-12 years old)	52	125.68	6.00
Age group B (13-20 years old)	50	122.86	8.41
Age group C (21-30 years old)	74	122.04	7.75
Age group D (31-40 years old)	43	123.63	7.32
Age group E (41-62 years old)	32	124.85	8.95

62 years) age groups have the largest mean gonial angle than other age groups. The possibility of large differences in males and females' gonial angle are according to age grouping might cause by several factors including genetics, nutrition, hormones, race, lifestyle, drug use, environment of each individual (8,9). While gender did not show a significant effect on the gonial angle. For female, this was probably due to the different types and textures of food which each of every individual has a different masticatory pressure depending on the strength of the teeth they have (10).

Every individual has a different number of teeth, the number of teeth might influence to muscle activity related to mastication, age and changes in the gonial angle. When the jaw loses teeth, the bone changes and causes an increase in the size of the gonial angle. There have been studies conducted on other factors that can influence the gonial angle, such as the functional and postural reciprocity of the cheeks, lips and tongue on individuals with edentulous that can alter the gonial angle (11). Another study on the gonial angle using panoramic radiographs, was conducted by Mathew et al (2017), most of them were carried out using the manual method of metric analysis on the shin. The size of the gonial angle was based on subjective evaluation, the value of the gonial angle cannot be absolute (12,13). In the comparison of the gonial angle for sex, no significant difference was observed between male and female (7).

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Conclusion

In this study, it can be concluded that the gonial angle was influenced by the age, gonial angle found to be greater at young age than older age. The order of the highest to the lowest gonial angle average as follows: group A (4-12 years), age of group E (41-62 years), age of group D (31-40 years), age of group B (13-20 years) and age of group C (21-30 years). The results obtained still have shortcomings in terms of measurements on panoramic radiographs, which could be caused by the poor quality of panoramic radiographs, or incorrect placement of patient's chin whether it was too high or low when panoramic radiograph was taken.

Declaration of Interest
None

Author contribution

All authors have contributed and agreed to submit the manuscript.
BFWRP was contributed to writing original draft, review, editing and conceptualization; AC and AK, MIM, BNR and AA are contributed to review and editing and conceptualization; BFWRP, MIM, BNR and AA are contributed to investigated and interpreted data, methodology and formal analysis; AA was contributed to supervision, reviewing and editing.

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