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Compatibility Mandible Gonial Angle Measurement On Digital Lateral Cephalometric And Panoramic Radiographs

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ABSTRACT

INTRODUCTION: The gonial angle is one of the most important anatomical shapes required for orthodontic treatment, prosthodontic and also as a data in forensic dentistry. Gonial angle measurement technique between panoramic and lateral cephalometric radiographs with the accurate results was still been controvertion.**Objective**:The purpose of this study was to determine the compatibility of the gonial angle on lateral cephalometric and panoramic radiographs. **Materials and methods**This study was using a correlative descriptive method with purposive sampling technique. A total of 122 lateral cephalograms and 122 panoramic radiographs were obtained from 35 males and 87 females. Gonial angle on lateral cephalometric radiographs were determined by the tangent of the ramal plane and mandibular plane, while in the panoramic radiographs gonial angle determined from two imaginary line inferior border of the mandible and the most posterior aspect of the ramus on left and right. This study was used Pearson's correlation coefficient and Bland-Altman plot for statistically analysis**. Results:** The mean gonial angle was 121.08 and 124.20 degres on panoramic and lateral cephalometric radiograph. There no significant differences between the right and left gonial angle and gonial angle measurement using panoramic and lateral cephalometric radiographs (r=0,95). Bland-Altman plot showed mostly subject point is between the limit of agreement, so that the agreement between the two methods is acceptable. **Conclusion:** The conclusion of this study showed that the gonial angle measured on panoramic radiographs have the same accuracy with the lateral cephalograms.

Keyword:gonial angle, panoramic radiography, cephalometric radiography

INTRODUCTION

The gonial angle is formed by the line tangent to the lower border of the mandible and the line tangent to the distal border of the ascending ramus.[1] The gonial angle size is influenced age, sex and status of the dentition. The gonial angle is used as a inclination guidance of the mandible on orthodontic treatment. This angle can also be used as a data forensic,[2] and is an important parameter in predicting the eruption of third molar.[3] Research conducted by William and Rogers (2006) managed to determine the sex of using anatomical skull and mandible including gonial angle of the mandible.[4]

Lateral cephalometric radiograph is a technique often used to measure this angle. An image of superimposition of the gonial angle on the right and left lateral cephalogram difficult to get an accurate measure of the gonial angle.[5] The existing shortcomings in lateral cephalometric radiographs were not found on panoramic radiographs, so lately panoramic radiographs are also used to measure the gonial angle.[6]

Until now, methods to measure accurately and reliably are still a debate for researchers previously[6]. Some researchers such as Akcam et al. (2003) found the image generated from panoramic radiographs affected by error magnification and displacement, causing distortion[7]. This leads to the lack of credibility of the resulting size of panoramic radiographs[8]. There are also researchers like Singh and Kenneth (2010) who found it difficult to get accurate results from lateral cephalometric radiographs for their image of superimposition of anatomical structures[9]. Therefore, this study was conducted to look at the suitability and see is there any significant difference in the size of gonial angle between panoramic and cephalometric radiographs.

Research on the use of panoramic and cephalometric radiographs in the lateral angle measurements gonial had previously been done by Booshehri et al. in 2012. The study was conducted in Yazd, Iran, where the indigenous population of the area is the Caucasoid race. The results of the study with a sample size of 80 panoramic radiographs and lateral cephalometric radiographs of 80 pieces was found that the concordance between the angular size gonial panoramic and cephalometric lateral radiographs of about 95%. In Indonesia, especially in Bandung with the majority of the population is Mongoloid race, there has been no report that examines the suitability of the angular size gonial as measured by radiographic cephalometric lateral and panoramic, so that those reasons make researchers are interested in doing research on the corner gonial in Dental Hospital mouth Dentistry, Padjadjaran University in Bandung. The purpose of this study was to measure and to determine the compatibility of the gonial angle on lateral cephalometric and panoramic radiographs.

MATERIALS AND METHODS

The descriptive correlative research design was done in Dentomaxillofacial Radiology

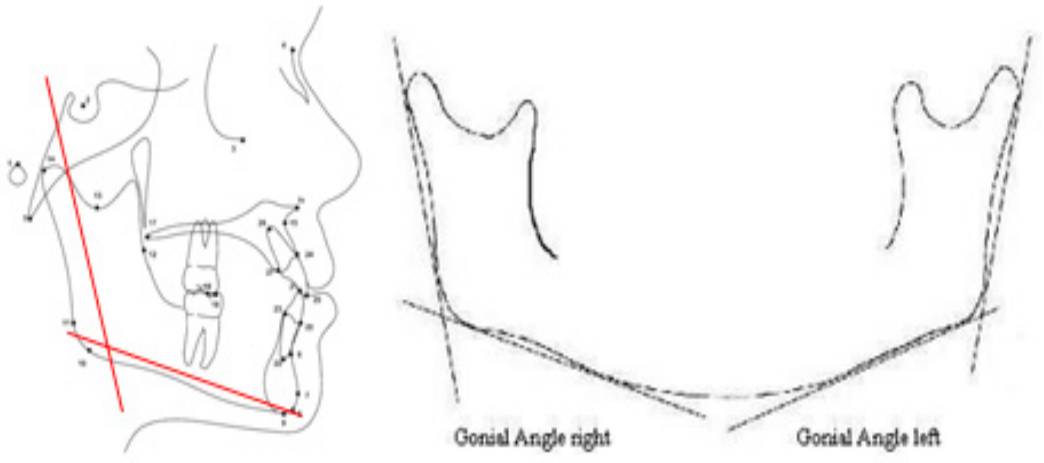

Figure 1. gonial angle measurements using panoramic radiographs and lateral cephalometric[6, 10]

Departement of Dental Hospital, Padjadjaran University, Bandung. The study involved panoramic and lateral cephalometric radiographs of 35 male and 87 female were taken from the radiographic data archive of radiology department throughout 2014. All samples have relationships with Class I occlusion with the gonial angle that can be measured.

Gonial angle on lateral cephalometric radiographs were determined by the intersection of the ramal plane and mandibular plane, while in the panoramic radiographs gonial angle determined from two imaginary line inferior border of the mandible and posterior rami on the left and right (figure 1). Angle measurements on both radiograph is performed using a computer with software EzImplant and EazyDent. The data obtained are presented in tables and diagrams are then analyzed by Bland-Altman plots and Pearson correlation test using the following formula[11]:

$$r = \frac{n\,\Sigma xy - \Sigma x\,\Sigma y}{\sqrt{n\,\Sigma x^2 - (\Sigma x)^2}.\sqrt{n\,\Sigma y^2 - (\Sigma y)^2}}$$

Where: r= Pearson correlation coefficientn= number of samplesx= lateral cephalometric radiographsy = panoramic radiographs

This study was conducted to look at the suitability of gonial angle measured by lateral cephalometric and panoramic radiographs. Statistical analysis was used to look at the suitability is the Pearson correlation analysis. Pearson correlation coefficient r value is -1 to +1. Sign (+) or (-) shows only the direction of the relationship, where the (+) indicates a unidirectional relationship (positive) while the (-) indicates a relationship in the opposite direction (negative). The correlation coefficient r can be interpreted as follows:

0.00 - 0.19: very low0.20 - 0.39: Low0.40 - 0.59: medium0.60 - 0.79: High0.80 - 1.0: very high

This study also uses statistical analysis of Bland-Altman plots were used to identify the consistency between the two methods of measurement on one subject. Bland-Altman graph have been selected for this study was conducted to test two different methods of measurement of one sample.[11, 12]

Pearson correlation analysis was made with the formulation of hypotheses as follows:

- H0: ρ = 0; There is no size suitability gonial angle on lateral cephalometricradiographs and panoramic Dental Hospital Padjadjaran University.
- H1: ρ ≠ 0; There is a significant conformity between the angular size gonial on lateral cephalometric and panoramic radiographs in Dental Hospital Padjadjaran University.

Criteria: Hypothesis (H1) is accepted if $t\text{-}_{count} > t\text{-}_{table}$, and vice versa if $t\text{-}_{coun} \leq t\text{-}_{table}$ then the hypothesis is rejected.

RESULTS

Table 1 shows the average size of gonial angle using a different measurement technique. From the table it can be seen no significant differences between the right and left gonial angle and gonial angle measurement using panoramic and lateral cephalometric radiographs.

Table 1. Average size gonial angle measurement using panoramic and lateral cephalometric radiographs

Variable	average size (Degree)
Right panoramic radiographs	120,80
Left panoramic radiographs	121,37
Panoramic radiographs	121,08
Lateral cephalometric radiographs	124,20

Table 2 below shows the correlation gonial angle measurements using panoramic radiographs and lateral cephalometric statistically. Pearson correlation value generated from these data is between 0.90 to 0.95 which means that these variables have a very strong relationship.

Table 2. Correlation Between Panoramic Radiography and lateral cephalometric radiographs in Gonial Angle Measurement

Variable	Pearson's correlation coefficient (r)	P value	t-count	t-table	Information
Right panoramic radiographs and Lateral cephalometric radiographs	0.93	0.00	11.978	1.979	Significant
Left panoramic radiographs and Lateral cephalometric radiographs	0.90	0.00	8.859	1.979	Significant
Panoramic radiographs and Lateral cephalometric radiographs	0.95	0.00	13.416	1.979	Significant

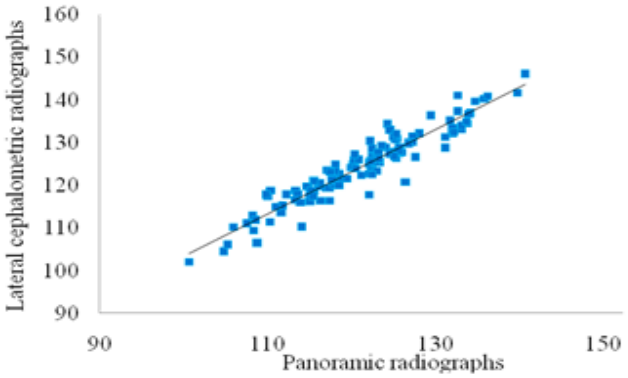

Figure 2. Correlation of Gonial Angle Size on Lateral Cephalometric radiographs and Panoramic

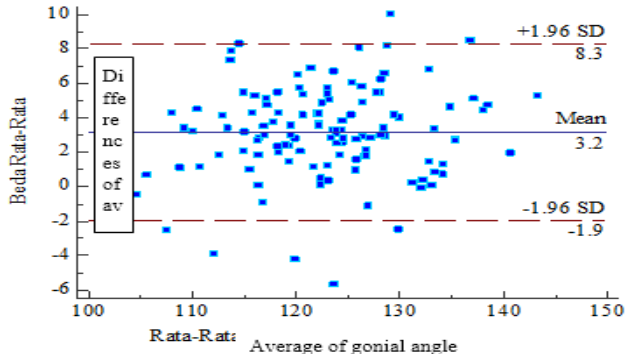

Figure 3. Bland-Altman graph for Assessing Suitability Gonial Angle Between Panoramic Radiography And Lateral Cephalometric

In figure 2 below shows the Pearson correlation coefficient values generated positive sign that indicates correlation gonial angle size as measured by radiographic panoramic and cephalometric lateral unidirectional. In this study it means the greater the size of the resulting gonial angle on lateral cephalometric radiographs, the higher the gonial angle size on panoramic radiographs.

Compatibility of the gonial angle sizedetermined based on the Bland-Altman graph above (figure 3). Correspondence between the two methods is determined based on the number of dots that are in the area limit of agreement (the area between the dotted lines). The graph shows the most points in between the limits of agreement, so that the agreement between the two methods is acceptable.

Judging from the results of hypothesis testing based on the value of t obtained by value t count> t-table. In accordance with the criteria of testing the hypothesis, then H0 and H1 (hypotheses) received, which means that there is a high suitability between gonial angle measurement using lateral cephalometric and panoramic radiographs.

From Table 3 it can be seen that the age group under 15 years had an average size of 126.18 degrees gonial angle on panoramic radiographs and 128.73 degrees on lateral cephalometric radiographs. From these data the Pearson correlation values of 0.935 and p-value of 0.00. The age group 15-29 years has an average size of 120.00 degrees gonial angle on panoramic radiographs and 123.50 degrees on lateral cephalometric radiographs. In this age group Pearson correlation values of 0.95 and a p-value of 0.00. While in the age group over 29 years gained an average size gonial angle of 117.84 degrees and 120.05 degrees on panoramic radiographs and lateral cephalometric with Pearson correlation value was about 0.947 and p value of 0.00. Thus, it is known that the measurement of gonial angles by age group using lateral cephalometric radiographs and panoramic radiographs have high suitability.

Table 4 below shows the gonial angle size in men and women. The males are known gonial angle size of 124.43 degrees on lateral cephalometric radiographs, while in the panoramic radiographs obtained an average size of gonial angle 121.44 degrees. Pearson correlation value of these data is 0.944 and p-value is 0.00. The average size gonial angle in women is equal to 124.17 degrees and 120.94 degrees on lateral cephalometric and panoramic radiographs. Pearson correlation value of these data is 0.952 and p-value is 0.00. It shows a high suitability gonial angle size as measured by lateral cephalometric radiographic techniques and panoramic radiographs by sex.

Table 3. Compatibility of Gonial Angle Size On Lateral cephalometric radiographs and Panoramic Based on Age Group

Age Group (Years)	Average Size Gonial Angle		Differences Average cephalometric radiographs and Panoramic (degrees)	Pearson Correlation Coefficient (r)	p-Value
	Panoramic Radiograph (degrees)	Lateral Cephalometric Radiograph (degrees)			
< 15	126.18	128.73	2.55	0.935	0.00
15-29	120.00	123.50	3.50	0.95	0.00
>29	117.84	120.05	2.21	0.947	0.00

Table 4. Compatibility of Gonial Angle Size On Lateral cephalometric radiographs and Panoramic Based on Sex

Gender	Average Size Gonial Angle		Differences Average cephalometric radiographs and Panoramic (degrees)	Pearson Correlation Coefficient (r)	p-Value
	Panoramic Radiograph (degrees)	Lateral Cephalometric Radiograph (degrees)			
Male	124.43	121.44	2.99	0.944	0.00
Female	124.17	120.94	3.23	0.952	0.00

DISCUSSION

Table 1 shows the gonial angle size on panoramic radiographs is 121.08 degrees which is smaller than the size of the angle of lateral cephalometric radiographs reviewed by 124.20 degrees. Statistically, this difference was not significant ($r = 0.95$; $p = 0.00$; $t\text{-}_{count} > t\text{-}_{table}$). This difference could be due to the possibility of error when the position of radiation exposure is not known by the authors, because this study used secondary data. Figure 3 shows that the majority of the sample point lies between the lines limits of agreement, so there is conformity gonial angle measurement between lateral cephalometric and panoramic radiographs.

Zangouei-Booshehri et al. get the same results on the research in 2012 in Iran.[5] They stated that the panoramic radiography can be used as a method of measuring the gonial angle with the same degree of accuracy with lateral cephalometric radiographs in the research. Several previous studies said that the panoramic radiography can not be trusted in the measurement of parameters of vertical face, but the angle measurements, this method is unreliable because the angle measurement is not affected by the distortion of radiographs, especially on the back and lateral mandible.[7] By maximizing the accuracy of the position of the head using light indicators, bite bite block in the right position as well as the selection of the right mandible, panoramic radiography can be used in measurement gonial angle.Based on the results of data processing research in Tables 2, 3 and 4 Pearson correlation values of all categories is almost close to 1, where it shows the relationship very high among gonial angle measurement using lateral cephalometric and panoramic radiographs are. Results of the study also note that the Pearson correlation value obtained is positive, so it can be said that gonial angle measurement using lateral cephalometric and panoramic radiographs have a direct relationship. Intention of the sentence is that the bigger the gonial angle produced on lateral cephalometric radiographs, the greater the size of the resulting gonial angle on lateral cephalometric radiographs. It is also supported by Booshehri seen from the research that has been done in 2012.

Gonial angle can be measured by both the lateral cephalometric and panoramic radiographs.[13,14] Panoramic radiography can produce the gonial angle almost as accurate as gonial angle measured using lateral cephalometric radiographs.[5]

Initially, gonial angle measured by lateral cephalometric radiographs, but after doing some research before, it is known that panoramic radiographs can also be used in measurement gonial angle. Measurements using panoramic radiographs have the advantage that it allows the measurement of the left and right gonial angle without superimposition that can affect the accuracy of measurement of the gonial angle.

Nohadani and Ruf (2008) said that the panoramic radiography cannot be used because the vertical size of panoramic radiographs are untrustworthy.[15] According Booshehri et al. (2012) angle measurements using panoramic radiographs can be trusted because the measurement is not affected by the distortion of the image, especially the posterior and lateral aspects of the mandible. Therefore panoramic radiographs can be used in the angle

measurement with good preparation of exposure.

This research also viewed gonial angle by age group. Researchers divided the sample into three age groups, namely under 15 years of age who represent a group of children, aged 15 to 29 years represents a group of teenagers and young adults as well as the age group above 29 years who represent groups of older adults.[16, 17] The division is based on age group by age group Wein et al. (2010) and Ferrari et al. (2010) which adopted of division organization age according to the World Health Organization (WHO). The purpose of this age grouping is to see change in angular size gonial with age.

Gonial angle is one of the important factors in assessing the morphology of basal bone and connecting the visible aging process of remodeling changes in the mandible.[18] Table 3 shows the difference in gonial angle size in the age group under 15 years (children), ages 15 to 29 (teens and young adults) years and above the age of 29 years (older adults) where the gonial angle size greater in children who will shrink by age teens and young adults and will grow smaller in the age group of older adults. This is according to research conducted by Upadhyay et al. in 2012 ago.

Gonial angle size varies in different age where gonial angle will decrease with age.[2] It is related to the growth of the mandible with age which at children the condyloid process almost be a straight line with the body of the mandible so that the gonial angle at this stage is still very blunt. As people age, the condyloid and coronoid process develop so that the gonial angle also shrinking.[19] Gonial angle will shrink until the age of about 25 to 35 years, and after that the gonial angle size will remain[2].

Booshehri et al., (2012) found gonial angle size between males and females are alike, but Gungor et al. (2007) pointed out that the gonial angle may differ between men and women.[20] It may be based on the genetic differences in growth patterns. The gonial angle generally larger in men about 3 to 5 degrees compared to women.[5] The gonial angle size is greater in males than in females can be attributed to the morphology of the mandible larger in males than in females. Men also have mastication force larger than females.[2]

This study results obtained that gonial angle difference based on gender is not meaningful. The average size of gonial angle in men is equal to 121.44 degrees slightly larger than in women that is equal to 120.94 degrees on panoramic radiographs, whereas in cephalometric radiographs of 124.43 degrees and 124.17 degrees in men and women. According Shahabi (2009), gender did not affect the size of gonial angle.[6] This is supported by research conducted by Chole et al. (2013) who found that the size gonial angle of 123.68 degrees in males and 124.39 degrees in women, with no significant differences between the two sexes.[21] The other study was conducted by Upadhyay et al. (2012) said that there is no difference in the size of gonial significant angle between men and women.[2]

The results of this study indicate that gonial angle measurements can be performed using lateral cephalometric and panoramic radiographs. The gonial angle measurement can be done using one of these techniques. Panoramic radiographs can be used as a comparison measure gonial angle on lateral cephalometric radiographs were too superimposition so difficult to determine the points determinants gonial angle.

This research was conducted using secondary data of Dentomaxillofacial Radiology Departement's archives of Dental Hospital, Padjadjaran University, Bandung, Indonesia by paying attention to the time limit and sampling technique that have been described previously. Researchers did not participate directly determine the position of the patient prior to radiation exposure so that there is the possibility of error to prepare the patient. Thus one of the weaknesses of this study is the distortion of radiographic results due to improper positioning of the patient is unknown to investigators.

CONCLUSION

The conclusion of this study showed that the gonial angle measured on panoramic radiographs has the same accuracy with the lateral cephalograms.

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