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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF THE ACCURACY OF PANORAMIC IMAGING AND LATERAL CEPHALOMETRICS BY MEASUREMENT OF THE RIGHT AND LEFT GONIAL ANGLES

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ABSTRACT

Introduction: Orthodontic treatment planning is complex and requires the ability to simultaneously analyze multiple data obtained from different orthodontic diagnostic records. Appropriate diagnosis and treatment planning depend on data derived from diagnostic aids such as clinical examinations, study models, and the relevant radiographs. Among which Lateral cephalography and panoramic radiography are important tools for treatment planning and are often recommended to orthodontic patients. The gonial angle is an important parameter for determining the growth pattern of an individual, assessing the growth pattern of an individual, rotation of the mandible and the extraction pattern in class II patients. Lateral cephalogram makes it difficult to reliably measure the gonial angle in an individual instead of using lateral cephalogram for measuring gonial angle, panoramic radiography can be used for determining the gonial angle more accurately. **Objective:** The aim of this present study was to evaluate the accuracy of panoramic imaging and lateral cephalometrics with respect to the measurement of the right and left gonial angles by comparing the measured angles. **Materials and methodology:** The study was conducted using the Lateral Cephalograms and Orthopantomograms of 90 patients (30 males and 60 females) were obtained Cephalometric landmarks were located, identified, and marked on the selected radiograph using a 2H pencil. On both radiographs, ramal angle was constructed. **Results:** The study sample consisted of lateral cephalograms and panoramic radiographs of 90 patients (30 females and 60 males; mean age, 23±3.5 years) with skeletal class I malocclusion. The mean value of the gonial angle measured using the lateral cephalograms was 123.12, and that of the gonial angle measured using the panoramic radiographs was 122.75°. No statistically significant difference was found between the gonial angle measured using lateral cephalograms and that using panoramic radiographs ((p=0.1). **Conclusion:** The present study concludes that there seems to be no significant difference in gonial angle between two radiographs. There seems to be a difference in gonial angle with gender groups, but not significant and definitively reliable. As per present study Panoramic radiography can be used to determine the gonial angle as accurately as a lateral cephalogram as there are no significant differences in the gonial angle values as measured on cephalogram and OPG

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INTRODUCTION

Orthodontic treatment planning is complex and requires the ability to simultaneously analyze multiple data obtained from different orthodontic diagnostic records¹. Appropriate diagnosis and treatment planning depend on data derived from diagnostic aids such as clinical examinations, study models, and the relevant radiographs. Among which Lateral cephalography and panoramic radiography are important tools for treatment planning and are often recommended to orthodontic patients.

As cephalometrics has been the foundation of orthodontic diagnosis for many years it can be used for evaluating the skeletal relationship, growth pattern, dentition, and alveolar process² which includes to evaluate the horizontal and vertical relationship of five major functional components of the face: The cranium and cranial base, skeletal maxilla, skeletal mandible, the maxillary dentition and alveolar process and the mandibular dentition and alveolar process.³ The gonial angle is an important parameter for determining the growth pattern of an individual, assessing the growth pattern of an individual, rotation of the mandible and the extraction pattern in class II patients,⁴ making decisions regarding whether to perform

surgery in class III skeletal base patients,⁵ and estimating age in forensic medicine along with for evaluating the symmetry of the facial skeleton.⁶ Usually, gonial angle is measured using a lateral cephalogram. Lateral cephalogram makes it difficult to reliably measure the gonial angle in an individual. However, according to Larheim and Svanaes, the accuracy of measurements of the gonial angle using lateral cephalograms is questionable because of the superimposition of the right and the left angles.⁷ Instead of using lateral cephalogram for measuring gonial angle, According to Mattila *et al.*, panoramic radiography can be used for determining the gonial angle more accurately than lateral cephalography, as the right and left gonial angles can be measured individually without any superimposition.⁸

AIM AND OBJECTIVE: The aim of this present study was to evaluate the accuracy of panoramic imaging and lateral cephalometrics with respect to the measurement of the right and left gonial angles by comparing the measured angles.

MATERIALS AND METHODOLOGY

The present study was approved by the Ethics Committee of Himachal dental college. Patients were informed about the study in detail and written informed consent forms were obtained from the patients who agreed to take part in the study. The study was conducted using the Lateral Cephalograms and Orthopantomograms of 90 patients (30 males and 60 females) were obtained from the Department of Orthodontics, Himachal Dental College, Sundernagar (H.P). All radiographs were viewed and evaluated, and only high quality radiographs were included in the study. An X-ray energy of 85 kVp for the panoramic radiography and an energy of 73 kVp for the lateral cephalometric radiography were used. An exposure time of 14.1 seconds was selected for panoramic radiography and 9.4 seconds was selected for lateral cephalography. Only radiographs obtained between August 2017 and December 2018 were included in this study. The inclusion criteria for the radiographs were that the radiographs had to be of high quality and sharpness; all radiographs had to be taken using the same apparatus. The exclusion criteria were history of trauma, previous facial/mandibular surgery, syndromes affecting the face/ jaw, and facial asymmetry.

Cephalometric landmarks were located, identified, and marked on the selected radiograph using a 2H pencil. On both radiographs, lines tangential to the mandibular lower border (mandibular plane) and those tangential to the posterior border of the ramus and condyle (ramal plane) were drawn. On the OPGs, the GoAng was measured for both left and right sides. The gonial angle at the intersection of these planes was traced on a piece of tracing paper and measured using a protractor. (Fig 1 and 2) Gonial angle measurement was done twice, with an interval of 1 month, to determine any errors in measurement.

STATISTICAL ANALYSIS: The Statistical Package for Social Sciences version 22.0 software was used for data analysis. As data for angles were quantitative data, these were estimated using mean and standard deviation. In order to evaluate the difference between the GoAngs measured on the Lat Ceph and OPGs, a paired t-test was used. Analysis of variance (ANOVA) was applied to compare the mean values of the size of the gonial angle in the groups.

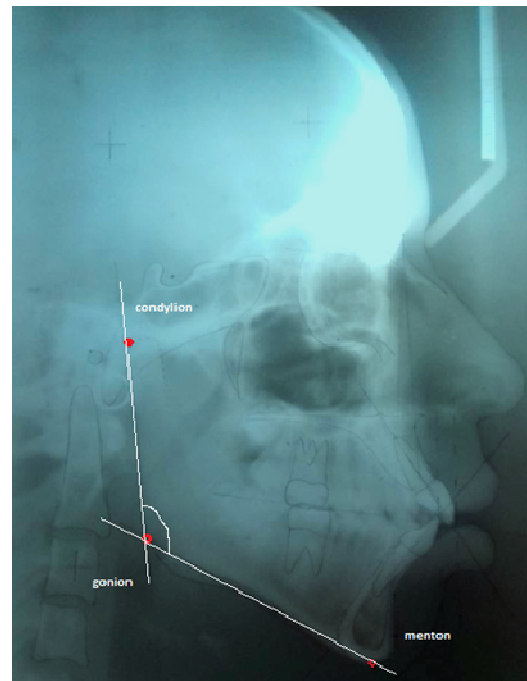


Figure 1. Gonial angle on cephalogram

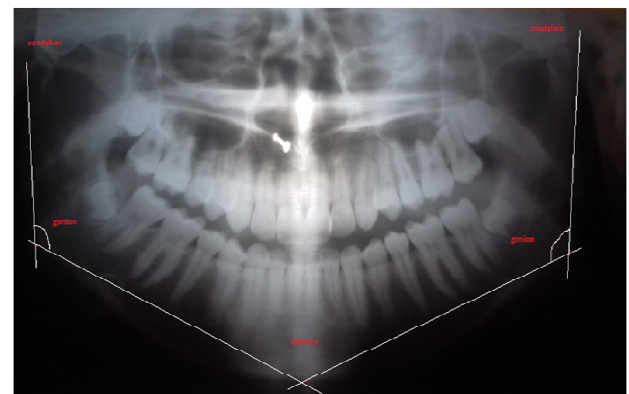


Figure 2. Gonial angle on opg

Independent t-test for samples was used to test the difference between genders in the total sample size. The level of statistical significance was set at <math><0.5\%</math>. To compare the two techniques (Lat Ceph and OPG) in terms of GoAng measurement, Bland-Altman analysis was used.

RESULTS

The study sample consisted of lateral cephalograms and panoramic radiographs of 90 patients (30 females and 60 males; mean age, 23 ± 3.5 years) with skeletal class I malocclusion. The mean value of the gonial angle measured using the lateral cephalograms was 123.12° , and that of the gonial angle measured using the panoramic radiographs was 122.75° . No statistically significant difference was found between the gonial angle measured using lateral cephalograms and that using panoramic radiographs ($p=0.1$) Table 1). The mean value of the gonial angle measured using the lateral cephalograms in females was 123.94° , and in males, which was statistically non-significant. Further, the mean value of the gonial angle measured using the panoramic radiographs in females was 122.69° , and in males, it was 122.98° ; which was also not statistically significant (Table 2).

Table 1. Showing gonial angle values from cephalogram and opg

	N	MEAN	STANDARD DEVIATION	STANDARD ERROR
Cephalometric gonial angle	90	123.12	6.714	1.036
Gonial angle OPG right	90	122.60	6.808	1.050
Gonial angle OPG left		122.90	6.778	1.046
Gonial angle OPG total		122.7500	6.75373	1.04212
ANOVA	F	SIG.		
Cephalometric gonial angle	0.226	0.798		
Gonial angle OPG right	0.376	0.688		
Gonial angle OPG left	0.086	0.917		
Gonial angle OPG total	0.113	0.893		

Table 2. Showing gonial angle value comparison in between males and females

GENDER	N	MEAN	STANDARD DEVIATION	STANDARD ERROR OF MEAN
Cephalometric gonial angle. Male	60	123.23	6.153	0.928
Female	30	123.94	7.337	0.998
Gonial angle OPG right	60	122.66	6.232	0.939
Male				
Female	30	123.50	7.192	0.979
Gonial angle OPG left	60	123.32	6.003	0.905
Male				
Female	30	121.89	13.885	1.889
Gonial angle OPG total male	60	122.98	6.070	0.915
Female				
	30	122.69	8.62	1.173

Thus, no statistically significant difference was observed in the measured gonial angle with respect to both the patient's gender and the diagnostic tool used.

DISCUSSION

Orthodontic measures and procedures require thorough radiographic investigation.⁹ The radiographic procedures generally employed are OPG and lateral cephalometrics.¹⁰ This study was performed to assess and compare the measurement of gonial angle from panoramic radiograph and lateral cephalograms in adult patients with mean age group of 23±3.5 years with skeletal class I malocclusion. Although there is lack of evidence on the value of lateral cephalometric radiographs in orthodontic treatment planning, but their routine use is widely accepted. Conflicting results have been published regarding whether there is a difference between these radiographs. Some authors have reported that OPGs are more accurate than Lateral Cephalograms, whereas others have reported no statistically significant difference. According to Mattila *et al.*¹¹ and Dahan *et al.*,¹² the size of the gonial angle depends on the method of measurement used. The measurement could either involve the horizontal side of the gonial angle formed by the tangent to the lower border of the mandible or be based on a line passing through the gnathion. On a lateral cephalogram, both planes can be easily determined, but on a panoramic radiograph, the determination of the gnathion could be difficult and might result in an inaccurate measurement of the gonial angle. Thus, in this study, to avoid any inaccuracies in measurement, the horizontal plane of the gonial angle in both the panoramic radiograph and the lateral cephalogram was formed by a line drawn tangentially to the lower border of the mandible. The mean values of the external gonial angle measured using the panoramic radiographs and the lateral cephalograms were 123.25° and 123.71°, respectively. Further, no statistically significant difference was observed in the gonial angle measured using these 2 diagnostic tools ($P=0.1$).

The results of our study were in accordance with the findings of Larheim *et al.*⁷ and Bhullar *et al.*,¹³ who reported no statistically significant differences in the gonial angle measured using lateral cephalograms and panoramic radiographs. Also similar to our study Shahabi *et al.*¹⁴ compared the external gonial angle determined using lateral cephalograms and panoramic radiographs of class I patients and concluded that panoramic radiography could be used for determining the gonial angle as accurately as a lateral cephalogram. According to Nohadani and Ruf,¹⁵ angular values from panoramic radiographs are more reliable, whereas Fischer-Brandies *et al.*¹⁶ preferred only lateral cephalograms for determining the gonial angle. The goal of this study was to enhance the panoramic radiograph's clinical use by determining its potential for evaluating craniofacial specifications. Even though there are a number of published articles on magnification and image distortion in panoramic radiographs, there are only a few studies involving the use of panoramic radiographs in evaluating dentoskeletal specifications and gonial angle measurements. The results of the study demonstrate that there are no statistically significant differences in the values of gonial angle measured on cephalogram and OPG. Therefore, it is possible to use OPG for measuring the gonial angle with equal accuracy as cephalogram. Jena *et al.*¹⁷ concluded that OPGs can be used for vertical and angular measurements as well as evaluation of side to side mandibular asymmetry. Ongkosuwito *et al.* (2009)¹⁸ concluded that an OPG is as reliable as a lateral cephalogram for linear measurements of the mandible, i.e., condylion-gonion, gonion-menton and condylion-menton. In our study there was no statistical difference between right and left gonial angle in panoramic radiographs which coincides with previous studies and hence failed to find any gender difference in gonial angle from two different radiographs which was in agreement with the result reported by study of Altonen. Ohm claimed that gender had little effect on the size of the gonial angle. In this study, the mean values of the right and left GoAngs measured on digital OPGs were slightly smaller than those reported by Shahabi *et al.*, who used the

same mandibular and ramal planes for GoAng measurements as were used in this study.¹⁴ and Radhakrishnan *et al.*¹⁹ Araki *et al.*²⁰ had results similar to those in this study, although they used different mandibular and ramal planes. Moreover, it has been demonstrated in previous studies that the correlation between measured GoAngs on Lat Ceph and OPG is high. However, the present study showed no correlation between genders with gonial angle, and this is in agreement with Raustia AM and Salonen mam²¹ and Ceylan *et al.*²² Wafa Al-Faleh²³ could not establish any significant difference between sexes and gonial angle, further supporting the findings of our study. They concluded that panoramic radiographs and lateral ceph. are a useful tool for the measurement of gonial angle, which is an indicator of mandibular steepness and, subsequently, mandibular growth direction. Thus, This present study demonstrates that the size of the gonial angle can be determined from the OPG with the same accuracy as from the generally used lateral cephalogram

CONCLUSION

The present study concludes that there seems to be no significant difference in gonial angle between two radiographs. There seems to be a difference in gonial angle with gender groups, but not significant and definitively reliable. As per present study Panoramic radiography can be used to determine the gonial angle as accurately as a lateral cephalogram as there are no significant differences in the gonial angle values as measured on cephalogram and OPG. In addition, OPG forms an additional tool for easier and more accurate determination of both right and left gonial angles of a patient without interferences due to superimposed images of anatomical structures in a lateral cephalogram. For determination of the gonial angle, an OPG may be a better choice than a lateral cephalogram. Thus, the present study substantiates the possibility of enhancing the clinical versatility of the panoramic radiograph and lateral ceph. both are indispensable tool for dental diagnosis.

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