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Comparison of gonial angle in lateral cephalogram and panoramic radiograph among adult patients with Class I and II skeletal pattern

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Abstract

Introduction: The gonial angle is an important parameter in orthodontics for diagnosis and treatment planning. Lateral cephalograms and panoramic radiographs are commonly used for determination. The purpose of this study was to compare the gonial angle on right and left sides of panoramic imaging and lateral cephalogram.

Method: This descriptive cross-sectional study was conducted at Chitwan Medical College, Nepal, from Nov 2021 to May 2023 after ethical clearance. Patients visiting for orthodontic treatment who required a lateral cephalogram and an orthopantomogram were included. Patients were categorised into Class I and II skeletal patterns based on ANB (A-Point-Nasion-B-Point) angle. Gonial angle on right and left sides of panoramic imaging was compared with lateral cephalogram. Data was checked for normality, measures of central tendency (mean, median). Gonial angle was compared (t-test for normally distributed data) between two radiograph findings and between genders, and SPSS 20 was used for analysis, with a $p \leq 0.05$ considered significant.

Result: The mean gonial angle in lateral cephalogram, right and left orthopantomogram was 124.19o±6.85o, 123.43o±7.3° and 123.48o±7.3° respectively. There was a statistically significant difference in the gonial angle in cephalogram and left gonial angle in orthopantomogram among Class II skeletal patterns. On gender-based comparison, there was a statistically significant difference in all parameters.

Conclusion: Orthopantomogram can be used as an alternative for gonial angle measurement in Class I skeletal patterns and only right-sided orthopantomogram among Class II skeletal patterns. The gender-based comparison showed that the gonial angle is larger in females than in males in both radiographs.

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Introduction

The word "gonion" is a point located by bisecting the angle formed by lines tangent to the inferior and posterior borders of the jaw bone.[1] It is most posteroinferior angle of the jaw, an important reference point to determine growth patterns, vertical parameters, facial symmetry and a forensic tool for identifying human remains.[2]

The mean gonial angle value is 128±7°.[3] It varies with age, sex, ethnicity and in almost all cases between right and left side.[4] Lateral cephalograms and panoramic radiographs are frequently utilized for measurements, among options like anthropometric measurement, photogrammetry and cone beam computed tomography. Orthopantomogram (OPG) is favoured over a lateral cephalogram, because it has advantage of decreased superimposition of anatomical structure and allows measurement of both right and left sides.[5,6]

Studies showed statistically significant differences between gonial angles on panoramic and lateral cephalogram.[7-9] Some studies concluded that panoramic radiograph is reliable.[10,11] A study showed gonial angle in lateral cephalogram was greater than OPG.[11] Study has demonstrated that only right-sided OPG can be used accurately as lateral cephalogram in Nepalese population.[5]

This study focuses on comparison of gonial angle in cephalometric radiograph with right and left side of panoramic radiograph among skeletal Class I and II adult patients.

Method

This descriptive cross-sectional study conducted from Nov 2021 to May 2023 in the Department of Orthodontics and Dentofacial Orthopaedics, Chitwan Medical College- School of Dental Sciences (CMC-SODS). Ethical clearance was obtained from the Institutional Review Committee of Chitwan Medical College (Ref: CMC-IRC/078/079-176). The study included the patient who visited the Department for orthodontic treatment requiring lateral cephalogram and panoramic radiograph as diagnostic aid. Inclusion criteria were adults (18 -32 years), skeletal pattern Class I and II, patient with complete diagnostic records, availability of good quality radiographs. Age range of 18-32 years was taken considering that most growth of the craniofacial area is complete after the age of 18 years such that it reduces growth variations due to dental attrition and aging changes.[12,13] Exclusion criteria were gross facial asymmetry on extraoral examination, history of craniofacial trauma, craniofacial syndrome, and congenital disease.

Lateral cephalogram and panoramic radiograph exposure was done using the same device, the Planmeca ProMax 3D Classic unit (Planmeca Oy, Helsinki, Finland). Radiographs were obtained using Planmeca Romexis® imaging software by the same operator under standardized conditions for the natural head position.[14] All radiographs were traced manually on matte acetate paper with a 2H sharp pencil over the view box using transilluminated light by a single observer. The radiographic landmarks were identified and marked. The records were first categorized as skeletal Class I and Class II patterns to be included in the study based on ANB (A-Point-Nasion-B-Point) angle which is considered valid and reliable indicator in all sagittal groups.[15] The ANB angle measures the anteroposterior relationship of the jaw bases, and categorizes in Class I skeletal pattern for ANB angle between 2° and 4°, and Class II for >4°.

A non-probability purposive sampling method was employed. The sample size was based on a correlation study (Bivariate study) calculated by G Power 3.1 software, estimating the minimum sample requirement of 101 samples.[16] However, the final sample consisted of 106 adult patients.

The gonial angle was measured using a geometric protractor on both lateral cephalograms and panoramic radiograph. The angle was matched at the point of intersection of the plane tangential to the lower border of the mandible and another line tangent to the distal border of the ascending ramus and condyle, Figure 1 and 2.[17]

The statistical analyses were performed using IBM SPSS v-20. Intraclass correlation coefficient (ICC) was used to assess the intraobserver

reliability. The Kolmogorov-Smirnov test was done to determine the normality of the data. Descriptive analysis (frequency, mean, standard deviation, maximum minimum value) was performed. For normally distributed data, paired sample t-test was used to compare the gonial angle in lateral cephalogram and panoramic radiograph as both measurements were taken from the same sample record. An unpaired sample t-test was done for comparison of angle based on gender.

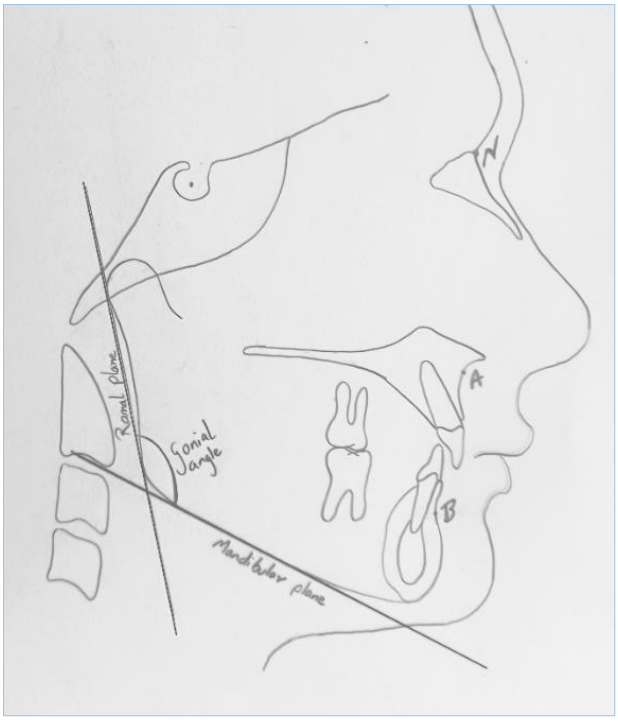

Figure 1. Measurement of gonial angle in lateral cephalogram

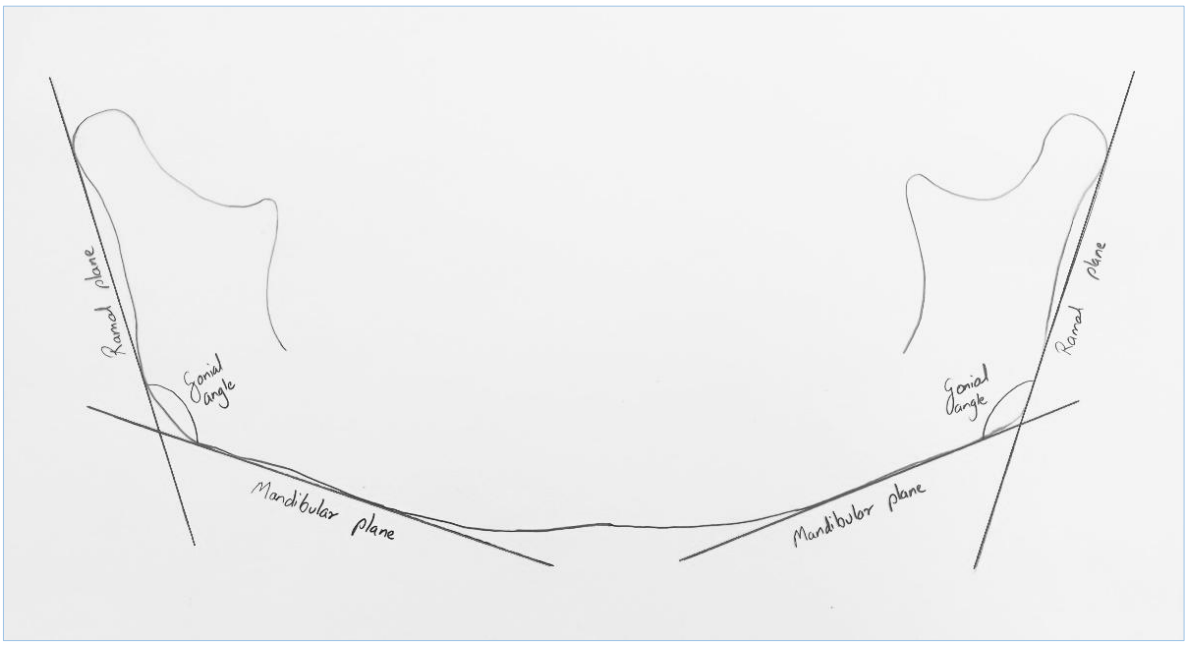

Figure 2. Measurement of gonial angle in right and left side of orthopantomogram

Result

A total of 106 cases were obtained during a study period (42 males and 64 females). The mean age was 22.38±3.59 years, ranging 18 to 32 years. The 66 cases had skeletal Class I pattern and 40 with skeletal Class II pattern.

The mean gonial angle in lateral cephalogram was 124.19°±6.85°. Likewise, mean gonial angle on right OPG was 123.43°±7.3° and on left OPG was 123.48°±7.3°.

Among skeletal Class I pattern cases, the mean gonial angle was observed to be 123.65°±7.15° in lateral cephalogram, 123°±7.18° in right OPG and 123.36°±7.61° in left OPG, Table 1.

Similarly, among skeletal Class II pattern cases, the mean gonial angle was found to be 125.08°±6.32° in lateral cephalogram, 124.15°±7.54° in right OPG and 123.68°±6.84° in left OPG, Table 1.

There was statistically significant difference in gonial angle in cephalogram and left gonial angle measured in OPG in Class II skeletal patterns (p=0.003). Whereas, all the other comparison showed no statistically significant difference (p>0.05), Table1.

On the basis of gender, the gonial angle among male in lateral cephalogram was 121.93°±7.39°, right OPG was 120.83°±8.40° and left OPG was 121.48°±7.57°, Figure 3.

Likewise, among female the gonial angle in lateral cephalogram was 125.67°±6.09°, right OPG was 125.14°±5.96° and left OPG was 124.80°±6.86°, Figure 3. There was statistically significant difference in all parameters between male and female (p<0.05).

Table 1. Comparison of gonial angle in lateral cephalogram and OPG for skeletal Class I and II pattern, n=106

Skeletal pattern	Degree of gonial angle Mean±SD		p-value paired t- test
Class I	Go Ceph	Go OPG R	0.112
	123.65±7.15	123.0±7.18	
	Go Ceph	Go OPG L	0.497
	123.65±7.15	123.36±7.61	
	Go OPG R	Go OPG L	0.410
	123.0±7.18	123.36±7.61	
Class II	Go Ceph	Go OPG R	0.084
	125.08±6.32	124.15±7.54	
	Go Ceph	Go OPG L	**0.003**
	125.08±6.32	123.68±6.8	
	Go OPG R	Go OPG L	0.445
	124.15±7.54	123.68±6.8	

Note: Gonial angle in lateral cephalogram (Go Ceph); Gonial angle in right side orthopantomogram (Go OPG R); Gonial angle in left side orthopantomogram (Go OPG L)

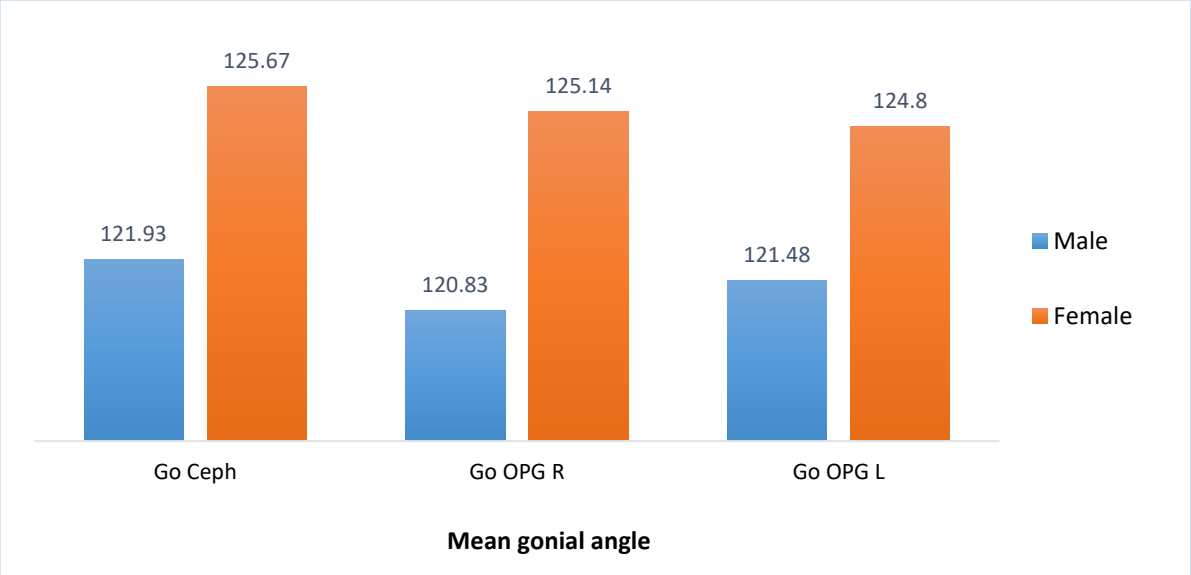

Figure 3. Gender-wise mean gonial angle on lateral cephalogram and OPG right and left, n=106

Discussion

Out of 106 cases, 42 males and 64 females with a mean age of 22.38±3.59 years (range 18-32), 66 had skeletal Class I pattern and 40 Class II. There was statistically significant difference in gonial angle in cephalogram and left gonial angle measured in OPG in Class II skeletal patterns ($p=0.003$). There was statistically significant difference in all parameters between male and female ($p<0.05$).

The present study included pretreatment lateral cephalogram and panoramic radiographs of 106 adult patients with age range 18-32 years considering that most growth of the craniofacial area is complete after the age of 18 years such that it reduces growth variations due to dental attrition and aging changes.[12,13]

Gonial angle is a significant parameter in orthodontics for diagnosis and treatment planning determined by several methods, most common of which are radiographs, particularly lateral cephalogram and OPG. Because lateral cephalograms are not suggested for all patients unless they are planning to undergo orthodontic treatment, this study was undertaken with the primary goal of comparing the gonial angle in lateral cephalogram to the right and left sides of OPG.[6]

The sample included in this study was first categorized into two sagittal jaw relation based on ANB angle as it is considered to be the most valid and reliable indicator.[15,18] For mandibular plane, in the present study we have taken Tweeds mandibular plane for comparison between the two radiographs based on the finding of statistically insignificant difference in gonial angle between the Tweeds mandibular plane on lateral cephalogram and panoramic radiograph.[19]

The mean values of gonial angle measured from lateral cephalogram and both side of OPG ($124.19^{o}\pm6.85^{o}$, $123.43^{o}\pm7.3^{o}$ and $123.36^{o}\pm7.61^{o}$) in the present study were found to be higher than that of the values observed in another study among Nepalese population.[11] This difference may be contributed due to ethnic and geographical variation between study sample. Furthermore, as in the present study, the gonial angle in left OPG was found to be smaller than in the cephalogram similar to another study.[16]

In the present study, paired sample t-test on parameters among Class I skeletal pattern showed no statistically significant difference between lateral cephalogram and right and left side of OPG. This finding was similar to other studies which reported that panoramic

radiography could be used for determining the gonial angle among Class I skeletal pattern.[17,20,21]

The gonial angle in both radiographs among Class II skeletal patterns in the present study showed no statistically significant difference except between gonial angle in the lateral cephalogram and left OPG. This is contradictory to other studies which showed no statistically significant difference in all parameters among sagittal skeletal patterns, with measured angle being highest in skeletal Class II, moderate in Class III, and the lowest in skeletal Class I.[20,21] This result corroborates to the current study that shows higher gonial angle in skeletal Class II compared to Class I in both radiographs.

The mean gonial angle in the present study in the lateral cephalogram, right OPG and left OPG based on gender have comparable descriptive statistic to another study done in Nepalese population.[5] In the present study, there was a statistically significant difference in gonial angle values among gender in all parameters where females showed higher gonial angle value as compared to male which is similarly reported by other studies.[22–24] In contrast, some of the studies have stated that the gonial angle did not differ statistically according to gender.[12,25,26] The gender-based difference may be due to significant biomechanical stresses and development subjected to mandible throughout a lifetime resulting in downward and backward mandibular rotation in females, whereas forward rotation and increased chin prominence in males.[13]

The limitation of our study includes a purposive hospital based small sample size, focusing Class I and Class II skeletal patterns, lack of gender matching, and the vertical jaw relationship that influences gonial angle value has not been taken into account. However, the data are of value and add to the gap in this area by comparing compare gonial angle on right and left sides of panoramic imaging and lateral cephalogram, which showed that OPG can be used as an alternative for gonial angle measurement in Class I skeletal pattern, where as in Class II only right sided OPG can accurately determine gonial angle like lateral cephalogram and gonial angle is larger in female than in male in both radiographs. These findings are helpful in treatment plan. Studies with bigger sample size in varied population may be necessary.

Conclusion

The present study shows that orthopantomogram can be used as an alternative for gonial angle measurement in Class I skeletal pattern. However, in Class II pattern only right sided orthopantomogram can accurately determine gonial angle similar to lateral cephalogram. Our study showed gonial angle is generally larger in female than in male in both radiographs.

Author contribution

Conception, design: All; Data acquisition: All; Data analysis, interpretation: All; Drafting: AB, BKS, MPS; Revision: AB, BKS, RS; Final approval of the version to be published: AB, BKS, MPS, RS; Agreement to be accountable for all aspects of the work: All

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Conflict of interest

None

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Supplementary material

The data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

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