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Comparison of gonial angle with different mandibular planes on panoramic & lateral cephalometric radiographs in class I malocclusion

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ABSTRACT

BACKGROUND & OBJECTIVE: Lateral cephalometric and panoramic radiographs are considered the gold standard in orthodontic diagnosis. Due to superimpositions, artifacts, and hindrances, it becomes problematic to calculate the gonial angle on the lateral cephalogram. Due to the double images of the mandible, it is challenging to perceive and measure the gonial angle with reliability. In contrast, on a panoramic radiograph, we can measure both right and left angles individually. The rationale of this study was to compare the gonial angle with different mandibular planes on panoramic & lateral cephalometric radiographs in a class I malocclusion population.

METHODOLOGY: A cross-sectional study on 50 participants from Fatima Memorial Hospital. The gathered data were logged and examined in SPSS 20. Quantitative variables were expressed as mean and standard deviation. Categorization of gender and age was performed to identify distractors, and an independent t-test was used, with a p-value of ≤ 0.05 considered statistically significant.

RESULTS: The patients in this study are, on average, 18.235 ±4 years old. Out of 50 patients, 19 (38%) were male and 31 (62%) were female. The majority of patients (33 (83.5%)) were between the ages of 15 to 20 years, and 17 patients (16.5%) were between 21 to 25 years of age. Mean value of Tweed's mandibular plane on OPG and lateral cephalogram was 127±8.2497 and 124.820±8.7077, p-value = <0.05). Gender and age showed no statistically significant differences in any other factors.

CONCLUSION: This research concluded that tweed's mandibular plane shows equal reliability on the lateral cephalogram and panoramic radiograph of Pakistani origin.

KEYWORDS: Orthodontics, Mandible, Malocclusion, Radiograph.

INTRODUCTION

Orthodontics, also referred to as dentofacial orthopedics, is a specialized branch of dentistry focused on the supervision, guidance, and correction of both developing and fully formed dentofacial structures. It involves diagnosing and treating conditions that require the movement of teeth, correcting malocclusions, and realigning the structural relationships between the teeth and facial bones. Additionally, orthodontics addresses jaw discrepancies and related skeletal imbalances to improve both function and facial aesthetics [1].

Cephalometric and panoramic X-rays are recognized as some of the most important tools in comprehensive orthodontic diagnosis and are invaluable for treatment planning. Lateral cephalometric and orthopantomogram radiographs are considered the benchmark in orthodontic diagnosis. The gonial angle is a pointer of the mandibular growth divergence, steepness, inclination, and age estimation in forensic dentistry [2-9]. It has been reported that tongue base collapse in pediatric sleep disorders, as well as breathing and airway collapse, are associated with a larger gonial angle [4]. The ratio of ramus height to face height is related to the size of the gonial angle. The size of the gonial angle is associated with the proportion between facial height and ramus height. With a relatively greater facial height, the angle is more obtuse (for example, an open bite); conversely, with a relatively smaller facial height, it is more acute (for example, a deep overbite). The gonial angle exhibits wide

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unpredictability in its measurement, as many authors have employed different measurement methods, but none of these methods appear accurate [2].

Measurement of the gonial angle on a lateral cephalogram becomes difficult due to interferences and superimpositions. Due to the double images of the mandible, it is challenging to perceive and measure the gonial angle with reliability. In contrast, on a panoramic radiograph, we can measure both right and left angles individually. Due to the left and right sides superimposing on one another, the lateral cephalogram's efficacy in measuring the gonial angle is in question. On the other hand, the calculation done on the panoramic radiograph is the same as that measured on dried human mandibles [5]. There were no discernible variations in the gonial angle, body length, and height of the ramus on panoramic and lateral cephalometric radiographs in one investigation that evaluated the gonial angle [6]. Similarly, panoramic radiography yields the same results as lateral radiography in measuring the gonial angle. Therefore, according to these studies, panoramic radiography is a valuable tool for measuring the gonial angle.No such local study could be found in the literature search.

METHODOLOGY

The orthodontic department at the Fatima Memorial Hospital College of Medicine and Dentistry in Lahore conducted a cross-sectional study from December 2020 to July 2021. The sample size was determined to be 50 participants with a 5% level of significance using a 95% confidence level. The study was approved by the FMH College of Medicine & Dentistry Institutional Review & Ethical Board (IRB) FMH-10-2018-IRB-521-M on December 12, 2018. Informed consent will be taken from every patient. Consecutive sampling (a non-probability technique) was used as the sampling method. Subjects were to be from the Pakistani population, aged between 15 and 25 years, presenting in the FMH Lahore outpatient department (OPD), with skeletal class I malocclusion and ANB (0-4) degrees, and good-quality standard panoramic images without any positioning or exposure mistakes.

Good facial symmetry, maxilla-mandibular plane angle (21–29 degrees).A single radiographer who will expose and take Digital lateral cephalograms and panoramic radiographs of all subjects using the same apparatus. The point where the mandibular plane (Go-Me) and ramal plane (Ar-Go) intersect is known as the gonial angle. Two different mandibular planes, as described by Tweed (tangent to the mandibular lower border) and Downs (line joining Menton and the gonion), will be applied to the lateral cephalogram, which is measured with a precision of one degree using a protractor. The gonial angle on the panoramic radiograph will be determined by taking the mandibular plane from the gonion to the menton, and the two tangents from the inferior border of the mandible and the posterior borders of the condyle and ramus on both sides. All the information will be recorded in a specifically designed proforma (Annexure).

The twentieth version of SPSS will be utilized to enter and assess the collected data. Quantitative variables like age, gonial angle with reference to Tweed's and Down's are measured on the lateral cephalogram and panoramic radiograph, and they will be displayed as the standard deviation and mean. Frequencies and percentages will be used to display qualitative data, such as gender. To account for confounding variables, age and gender stratification will be carried out, and the "Independent T test" will be used. A P-value of less than 0.05 is deemed statistically significant.

Inclusion Criteria: Good quality standard panoramic images without any grade of exposure or positioning errors. Maxillo-mandibular angle (25+4).Age 20 + 5 years. Skeletal class I malocclusion ANB (2+2) degrees.

Exclusion Criteria: Medically compromised patients affecting the craniofacial region, Any Previous history of orthodontic or prosthodontics or surgical treatment, History of trauma to the craniofacial region, Patients with craniofacial anomalies and syndromes and Skeletal class II & III malocclusion.

RESULTS

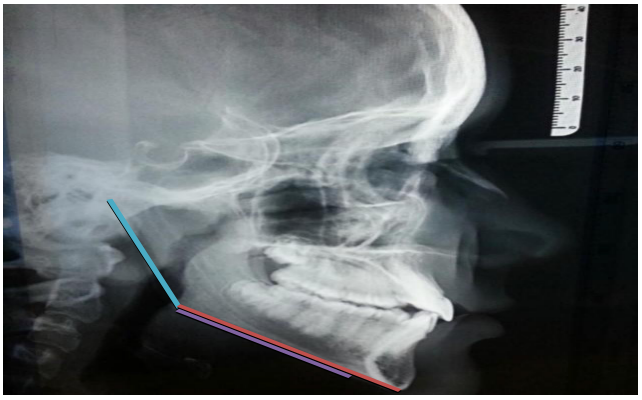
In this study, the age range was 15 to 25 years, with a mean age of 18.381 ± 4.9 years. Most patients, 33 (83.5%), were between 15 and 20 years of age, while 17 patients (16.5%) were between 21 and 25 years of age. Out of 50 patients, 19 (38%) were males and 31 (62%) were females, with a male-to-female ratio of 1.1:2. Stratification with respect to age and gender is shown in Table I. The mean value of the gonial angle on OPG with Down's method was 119±8.5093 and with Tweed's method was 124.820±8.7077. The p-value = (>0.05) in comparison to the mean value on lateral cephalogram with the same methods was 125.740±8.3000 and 127.060±8.2497, respectively. (P-value = <0.05) as shown in Table II. In this study, the age range was 15 to 25 years, with a mean age of 18.381 ± 4.9 years.

A comparison of OPG and lateral cephalograms with different methods and sides is presented in Table III. These values suggest the results obtained for the gonial angle differ considerably from one another. With the Downs method, the p-values for males are 0.008 on the right side and 0.011 on the left, indicating a statistically significant difference in the gonial angle between the two sides within the sample. For females, the p-value is less than 0.001, indicating a very strong statistically significant difference in the gonial angle between the right and left sides. Conversely, using Tweed's method, the p-values are 0.307 for the right side and 0.519 for the left, which suggests no statistically significant difference in the gonial angle measured between the right and left sides for males. Similarly, for females, the p-values of 0.342 and 0.132 indicate no statistically significant difference in the gonial angle between the right and left sides. The gonial angle assessed by Tweed's method on the lateral cephalogram and OPG reveals a clinically insignificant difference, especially on the left side.

Table-I: Age distribution (n=50).

Age (years)	No. of patients n (%) Total (n=50)
15-20	33(83.5)
21-25	17(16.5)
Mean ± SD	18.381 ± 4.9

Fig-I: Gonial angle on lateral cephalogra mandible.



Blue line =Ramus plane (condylion-gonion)
Red =Down's method (gonion-menton)
Purple=Tweed's method (tangent lower border)

Fig-II: Gonial angle on dry.

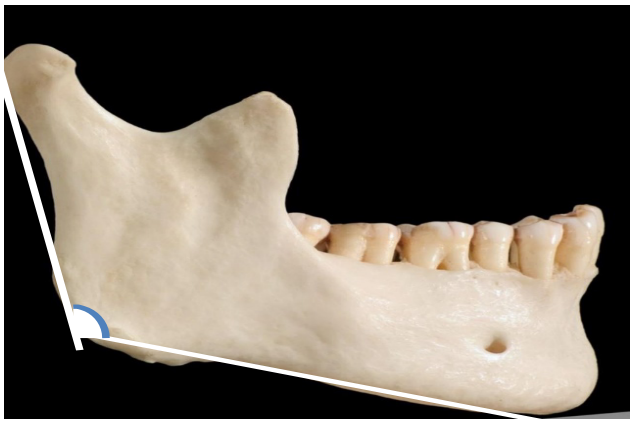
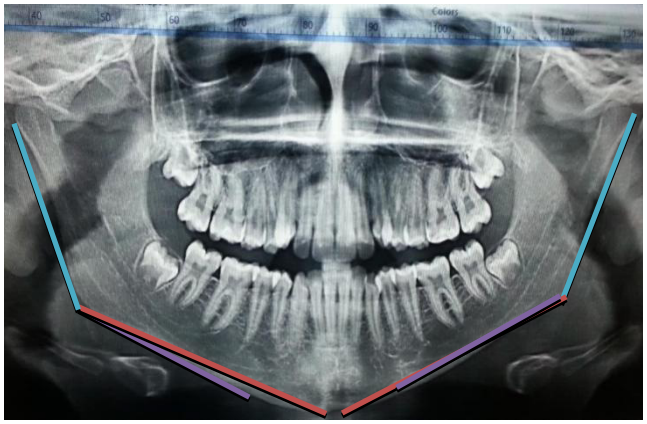


Fig- III: Gonial angle on OPG.



Blue=Ramus plane (condylion to gonion)
Red=Down's method (gonion to menton)
Purple=Tweed's method (tangent to lower border of ramus)

Table-II: Mean values of gonial angle (n=50) .

Variables		Mean±SD	P-value
Down's	Lateral cepahlogram	125.740±8.3000	<0.001
	OPG Right	119.000±8.5093	
	Lateral cephalogram	125.740±8.3000	<0.001
	OPG Left	118.440±7.7858	
Tweed's	Lateral cephalogram	127.060±8.2497	0.190
	OPG Right	124.820±8.7077	
	Lateral cephalogram	127.060±8.2497	0.181
	OPG Left	124.820±8.3926	

Table-III: Comparative values of gonial angle (Independent Sample t-Test).

Variables		Male	Female
Down's	Lateral cepahlogram	123.684±7.7032	127±8.5206
	OPG Right	116±9.0860	120.226±8.0404
	P-value	0.008	<0.001
	Lateral cephalogram	123.684±7.7032	127±8.5206
	OPG Left	116.842±8.0984	119.419±7.5533
	P-value	0.011	<0.001
Tweed's	Lateral cephalogram	125.211±7.4355	128.194±8.6310
	OPG Right	122.526±8.4877	126.548±8.5901
	P-value	0.307	0.342
	Lateral cephalogram	125.211±7.4355	128.194±8.6310
	OPG Left	123.526±8.4877	125.613±8.3733
	P-value	0.519	0.132

DISCUSSION

The quantitative assessment of hard tissue thickness is a vital tool for both developing an orthodontic treatment plan and making a diagnosis. Unless they are altered to fit a particular demographic group, these established standards are not relevant to people of different races because some values may seem good to members of one group while being disagreeable to others.

These values allow orthodontists, maxillofacial surgeons, and plastic surgeons to standardize case planning and predict post-surgical esthetic outcomes following treatment [10-12]. The gonial angle measured with Tweed's mandibular planes on lateral cephalogram and OPG appears insignificantly different. Results showed that the mean value of Tweed's gonial angle on OPG is 124.820 ± 8.7077, and on the lateral cephalogram, it is 127.060 ± 8.2497. OPG is equally reliable for measuring the gonial angle as a lateral cephalogram. Determination of the gonial angle on a lateral cephalogram becomes problematic due to the interferences and superimpositions. Due to the dual images of the mandible, it is challenging to consistently observe and accurately measure the gonial angle. In contrast, a panoramic radiograph allows us to measure both right and left angles individually. Due to the controversy surrounding the accuracy of measuring the gonial angle with a lateral cephalogram, the right and left sides are considered. Values of the gonial angle with different mandibular planes are compared between the lateral cephalogram and OPG, among genders, and on the OPGs.

PV Nadkerny et al conducted a study to evaluate which gonial angle (obtained from Tweed's, Steiner's, or Down's mandibular plane) on a lateral cephalogram has the value closest to that obtained on a panoramic radiograph [2]. The mean gonial angle determined using the three techniques on the lateral cephalogram is statistically insignificant. The differences between gonial angle measurements in lateral cephalograms by using Tweeds, Steiner's, and Down's mandibular planes were statistically insignificant ($P > 0.05$) in Class I and Class III patients when compared with those in the panoramic radiographs. However, the difference in the gonial angle measurements in Class II patients using the Steiners and Downs mandibular plane was statistically significant ($P = 0.049$ and $P = 0.003$, respectively, where $P < 0.05$), but using Tweed's mandibular plane it was statistically insignificant ($P = 0.242$, where $P > 0.05$), compared to that obtained in the panoramic radiograph. This study is in agreement with our study, which explains the same finding [13-15].

Thijeel AT conducted research on malocclusion classes I, II, and III to ascertain their gonial angle. The study's findings advocated that a panoramic radiograph can be used to specifically calculate the gonial angle. Larheim TA agreed with their findings; he recommended using panoramic radiographs instead of lateral cephalograms to determine the gonial angle in Class I patients. The two radiography methods did not show appreciable differences in our results. [16-18].

Numerous researchers have examined and contrasted the two primary radiographs to measure the gonial angle [19-22]. Memon S. et al. conducted a study to examine three vertical facial groups (high, low, and normal) and three techniques of gonial angle construction using a cephalogram with an orthopantomogram technique. When compared to the three methods (Tweed's, Steiner's, and Downs) of gonial angle determination on a lateral cephalogram, the value of gonial angle determination on an orthopantomogram was shown to differ. For this reason, orthopantomograms in different vertical face groups of orthodontic patients cannot be utilized as a substitute for gonial angle determination. Additionally, it cannot replace a lateral cephalogram in terms of the information it contains [23].

Kaya D, use software to see if the gonial angle values obtained from digital lateral cephalograms and OPG differ from one another. The Total Ceph software was employed in this study. All the measurements were taken digitally using Total Ceph software. The measured gonial angles did not differ significantly. When measuring the gonial angle, there was a good degree of agreement between the lateral cephalogram and the OPG. On the OPGs, the mean gonial angle values for the right and left sides were 123.25 ° ± 7.04 ° and 123.44 ° ± 6.54 °, respectively. The difference between these measured angles was also not statistically significant. The OPGs were as reliable because the lateral cephalograms for measuring the gonial angle employed a software [24].

The aforementioned variations make it clear that average values must always be applied for a particular demographic group and that variances must always be considered. This research will enable orthodontists to accurately determine the gonial angle using only OPG, thereby reducing patients' exposure to excessive radiation. It is recommended that further studies include a larger sample size.

The New advances, such as software (Total Ceph, WEB Ceph, The Planmeca Romexis, cephX, Dolphin Imaging, Invivo6, Surgicase CMF, 3DMD Vultus), in dentistry for digital cephalometric tracing, are novel and deserve more importance as they have immense potential to generate results [25,26]. They are time-saving technologies with a minimum chance of error. Their cost and clinical availability should be considered to ensure optimal results.

CONCLUSION

This study established panoramic gonial angle mean values for a Pakistani population presenting in a tertiary care hospital, Tweed's mandibular plane angle for the measurement of gonial on OPG is equally reliable as cephalometric radiograph. Down's method have significant differences on OPG and lateral cephalogram. Among the sides on OPG when compared with lateral cephalogram (with Tweed's method) the left side is more closely associated. Indiscriminative of the method used the values for gonial angle with the same method appear similar on OPG.

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Authors Contributions:

Muhammad Fayyaz Nafees: Designed , concept the study, and collected the data.

Naseer Ahmad Chaudhry: Conception the design of work, critical revision and final approval of the version to be published.

Muhammad Imran Rahbar : Data collection and interpretation of data for the work.

Anum Aziz: Analysis of data for the work.

Kashif Haroon: Critical revision of the article.

Saad Saud Farooqui: Drafting the work.

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