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Comparison Of Orthopantomogram and Lateral Cephalogram for Gonial Angle, Mandibular Ramus Height And Body Length

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Abstract

Objective: This study aims to compare orthopantogram and lateral cephalogram for gonial angle and mandibular linear measurements (ramus height and body length).

Methods: A cross-sectional study was conducted at Islamic International Dental Hospital. A total of 195 patients, both genders, ages 16 to 35 years who were citizens of Pakistan and had clear radiographs, lateral cephalograms, and OPG available, were included. Patients with craniofacial malformations and facial asymmetry were excluded. The following variables were measured. (a) body length (Go-Me) (b) ramus height (Co-Go) and (c) gonial angle on both sides. An independent sample t-test was applied to compare mandibular measurements between two radiographs (OPG and lateral cephalograms).

Results: The mean age of the participants was 24.24±5.39 years. The females were 111 (56.92%) and males were 84(43.08%). Measurements on the cephalogram and OPG on the right and left sides were almost similar. The mean value of ramus height on OPG (60.93±5.39mm) was higher than on cephalogram (58.69±6.15mm) statistically significant on the right side ($p<0.001$). Similar statistically significant results($p<0.001$) were found for ramus height being increased in the OPG on the left side(60.92±5.39mm), and body length on both sides(109.41±6.08mm). However, the gonial angle on both radiographs and both sides was insignificant ($p=0.058$ for the right; $p=0.062$ for the left).

Conclusion: For angular measures of the mandible, panoramic radiographs are equally accurate as lateral cephalograms, but physicians should use caution when assuming vertical and horizontal measurements from OPGs.

Keywords: Mandibular ridge, Ramus, Orthopantomography

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1. Introduction

A detailed analysis of dental occlusion, relationships between hard and soft tissues, and soft tissue proportions is necessary for orthodontic diagnosis and treatment planning.[1] The three main sources used to create the orthodontic diagnosis database are as follows: the inspection of diagnostic documents, including dental casts, radiographs, and pictures, and the taking of medical history.[2,3] For every orthodontic patient, routine cephalograms and orthopantomograms (OPGs) are performed.4 Cephalometry is one of the most important tools in Orthodontics for assessment of treatment response, growth prediction, diagnosis of dental as well as skeletal malocclusions and research purposes.[5] It is a very versatile radiograph used throughout the world of Orthodontics. It was first introduced by Broadbent in 1931.[6]

Lateral cephalograms cannot be used to measure both sides of the face, especially the mandible because of overlapping structures superimposition.[7] Conditions like hemifacial microsomia and unilateral condylar hyperplasia involve asymmetry and to diagnose and plan any form of surgery or distraction osteogenesis, these patients require exact measurements of the structures on either side.[8] These types of asymmetries are difficult to assess by lateral cephalograms. Orthopantomograms (OPGs) do not experience this problem.[9] By employing OPG, it is simple to see the right and left side structures separately, avoiding any overlap or superimposition that might be present on the lateral cephalogram. Yet, significant methodological flaws have raised doubts about measures taken from panoramic radiography.[10]

Kumar et al.[7] conducted a study on 100 patients and compared various mandibular parameters from both OPGs and lateral cephalograms. The mean ramus height on the lateral cephalogram was 57.27±6.54 mm and on OPG was 60.63±6.47mm for the left side. The mean body length on the lateral cephalogram was 74.17±5.45mm and on OPG was 108.10±6.54mm for the left side. The gonial angle was 127±6.68 degrees on the lateral cephalogram and 126.10±7.034 degrees on OPG.

In some situations, it is not feasible to obtain both radiographs (OPG and lateral cephalogram), so this study will provide statistics on how these radiographs will provide agreement in mandibular measurements. The objective of this study is to compare

orthopantogram and lateral cephalogram for gonial angle, mandibular ramus height and body length.

2. Materials & Methods

It was a cross-sectional study which was conducted in Islamic International Dental Hospital, Islamabad. The study was conducted from 1st September 2022 to 28th February 2023. The sample size determined by the WHO sample size calculator was 195. There was a 95% confidence level, a population mean of 126.107, and a population standard deviation of 7.034 with absolute accuracy. A simple consecutive non-probability sampling method was used to select patients fulfilling the inclusion criteria. The study comprised patients who ranged in age from 16 to 35 years, had Pakistani nationality determined by "Form B" or CNIC, were male or female, had high-clarity radiographs, and needed both lateral cephalograms and OPG as part of orthodontic therapy. Craniofacial malformations (was assessed clinically) and facial asymmetry (was assessed clinically) were excluded from the study.

Approval was taken from the hospital ethical committee (attached). All patients included in the study were explained the study's objectives, methods, risks, and advantages. Their willingness to engage in the study and informed consent was guaranteed. They received guarantees that the personal information and other information gleaned from their records would be kept private. When in use, the hard copies of the data were kept in lockers and were kept in good condition. Age and gender were recorded. The radiographs (OPG and lateral cephalograms) of the chosen participant were drawn, landmarks were found, lines and angles were made, and the subsequent variables were recorded. (a) body length (Go-Me) (b) ramus height (Co-Go) and (c) gonial angle on both sides (operational definitions). For cephalograms right and left sides have similar values as we excluded asymmetric cases and mandible borders are superimposed in all cases.

The information listed above was entered into a pre-made proforma. (see Annex II).

Bias and confounders in the study were controlled by strictly following the inclusion/exclusion criteria.

Data was analyzed using SPSS (statistical package for social sciences) version 22.0. Mean and standard deviation were calculated for numerical variables like age and mandibular measurements (ramus height, body length and gonial angle) on both sides and both radiographs. Frequency and percentage were calculated for qualitative variables like gender. An Independent sample t-test was applied to compare mandibular measurements between two radiographs (OPG and lateral cephalograms). An Independent sample t-test was applied. $P \leq 0.05$ was considered as significant.

3. Results

The mean age of the participants was 24.24±5.39 years. The females were 111 (56.92%) and males were 84(43.08%). Most of the participants belonged to age group 16-25 years having 115 (58.97%).

Measurements on cephalogram on right and left side were almost similar. The mean ramus height, body length, and gonial angle on right side was 58.69±6.15mm, 72.56±6.13mm, and 129.96±6.40^0 respectively. (Table 1)

Table 1: Mean measurements of Ramus height, body length and gonial angle on cephalogram

Variable	Mean ±SD on cephalogram	Mean ±SD on OPG
Right Ramus height (mm)	58.69 ± 6.15	60.93 ± 5.39
Left Ramus height (mm)	58.68 ± 6.15	60.92 ± 5.39
Right body length (mm)	72.56 ± 6.13	109.41 ± 6.08
Left body length (mm)	72.56 ± 6.13	109.42 ± 6.08
Right gonial angle (^{0})	129.98 ± 6.40	128.61 ± 7.78
Left gonial angle (^{0})	129.96 ± 6.40	128.62 ± 7.78

Measurements on OPG on right and left side were almost similar. The mean ramus height, body length, and gonial angle on right side was 60.93±5.39mm, 109.41±6.08mm, and 128.61±7.78^0 respectively. (Table 2)

The mean value of ramus height on OPG (60.93±5.39mm) was higher than on cephalogram (58.69±6.15mm) statistically on right side ($p<0.001$). Similar results were found for ramus height on left side, body length on both sides. However, gonial angle on both radiographs and both sides were not different ($p=0.058$ for right; $p=0.062$ for left). (Table 2)

For both genders the ramus height and body length was different on OPG and cephalogram on both sides ($p<0.001$). In both genders the gonial angle was not different on ceph and OPG ($p>0.05$). (Table 3 & Fig 1)

Among age group 16-25 years the difference for all mandibular measurements were statistically different on OPG and cephalogram ($p<0.05$). In age group 26-35 years only gonial angle was not statistically significant on both radiographs. (Table 4 and fig 2)

Table 2: Comparison of measurements on cephalogram and OPG

Characteristic	Cephalogram Mean±SD	OPG Mean±SD	P-value*
Right Ramus height (mm)	58.69±6.15	60.93±5.39	<0.001
Left Ramus height (mm)	58.68 ± 6.15	60.92 ± 5.39	<0.001
Right body length (mm)	72.56 ± 6.13	109.41 ± 6.08	<0.001
Left body length (mm)	72.56 ± 6.13	109.42 ± 6.08	<0.001
Right gonial angle (^{0})	129.98 ± 6.40	128.61 ± 7.78	0.058
Left gonial angle (^{0})	129.96 ± 6.40	128.62 ± 7.78	0.062

Table 3: Comparison of measurements on cephalogram and OPG stratified by gender

Gender	Characteristic	Cephalogram Mean±SD	OPG Mean±SD	P-value*
Male	Right Ramus height (mm)	58.73 ± 6.16	60.98 ± 5.25	0.012
	Left Ramus height (mm)	58.73 ± 6.16	60.96 ± 5.27	0.012
	Right body length (mm)	72.64 ± 5.98	109.42 ± 5.90	<0.001
	Left body length (mm)	72.64 ± 5.97	109.43 ± 5.86	<0.001
	Right gonial angle (^{0})	129.88 ± 6.28	128.73 ± 7.63	0.29
	Left gonial angle (^{0})	129.88 ± 6.28	128.70 ± 7.62	0.28
Female	Right Ramus height (mm)	58.67 ± 6.17	60.89 ± 5.52	0.005
	Left Ramus height (mm)	58.65 ± 6.16	60.89 ± 5.51	0.005
	Right body length (mm)	72.50 ± 6.27	109.40 ± 6.24	<0.001
	Left body length (mm)	72.50 ± 6.27	109.41 ± 6.26	<0.001
	Right gonial angle (^{0})	130.05 ± 6.53	128.51 ± 7.92	0.12
	Left gonial angle (^{0})	130.03 ± 6.52	128.55 ± 7.94	0.13

* Independent t test with level of significance set at p-value 0.05

This study aimed to determine mean mandibular measurements (ramus height, body length and gonial angle) from panoramic radiographs and lateral cephalograms. Our findings showed that ramus height and body length statistically differ on OPG and cephalograms however the gonial angle was not statistically significant.

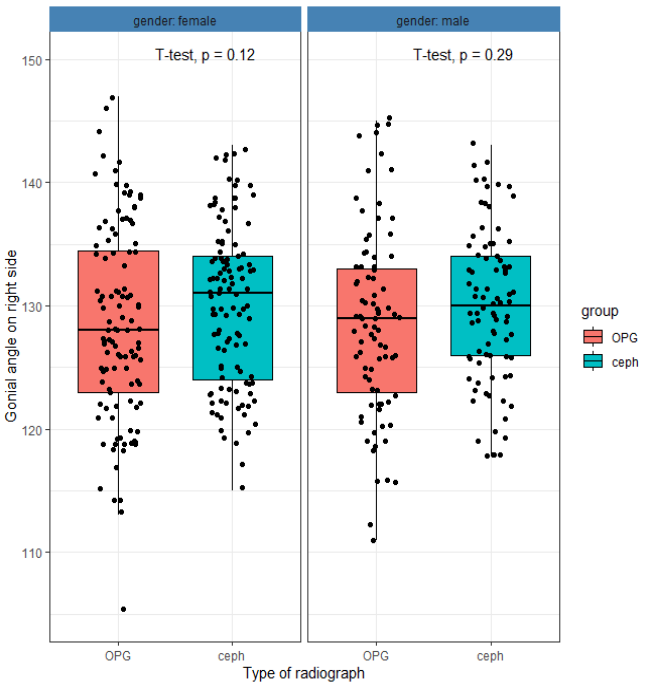

Fig 1: Comparison of gonial angle on ceph and OPG in both genders

Table 4: Comparison of measurements on ceph and OPG stratified by age groups

Age group	Characteristic	Cephalogram Mean±SD	OPG Mean±SD	P-value*
16-25	Right Ramus height (mm)	58.38 ± 5.96	60.69 ± 5.34	0.002
	Left Ramus height (mm)	58.37 ± 5.96	60.69 ± 5.35	0.002
	Right body length (mm)	72.28 ± 6.08	109.07 ± 6.10	<0.001
	Left body length (mm)	72.28 ± 6.08	109.10 ± 6.10	<0.001
	Right gonial angle (^{0})	130.42 ± 6.35	128.20 ± 7.55	0.017
	Left gonial angle (^{0})	130.37 ± 6.37	128.21 ± 7.56	0.02
26-35	Right Ramus height (mm)	59.14 ± 6.42	61.27 ± 5.47	0.025
	Left Ramus height (mm)	59.14 ± 6.42	61.26 ± 5.47	0.026
	Right body length (mm)	72.96 ± 6.21	109.89 ± 6.05	<0.001
	Left body length (mm)	72.96 ± 6.21	109.89 ± 6.05	<0.001
	Right gonial angle (^{0})	129.35 ± 6.47	129.19 ± 8.10	0.89
	Left gonial angle (^{0})	129.38 ± 6.44	129.20 ± 8.10	0.88

Independent t test with level of significance set at p-value 0.05

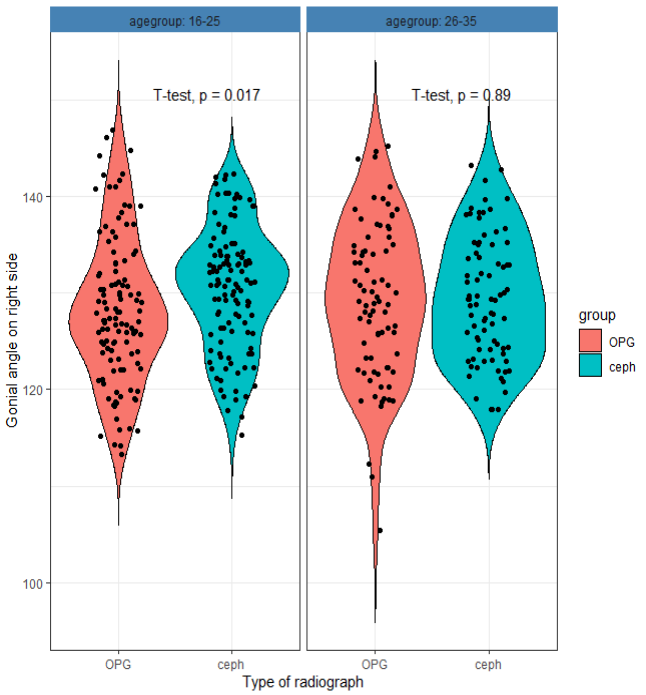

Figure 2: Comparison of gonial angle on ceph and OPG in both age groups

4. Discussion

In this investigation, samples were chosen at random, and in OPG and lateral cephalogram mandibular linear and angular measures were analyzed. Although numerous researches are comparing the measurements of the gonial angle between the OPG and the lateral cephalogram, there are relatively couple of documented researches contrasting the measurements of the linear mandible between the OPG and the lateral cephalogram. For linear measurements of the mandible, an OPG is as trustworthy as a lateral cephalogram, with vertical measurement having a better correlation than horizontal, according to research by Ongkosuwito et al.[11] on the dry skull. Their study's sample size, however, was modest.

The lateral cephalometric radiograph is better for establishing the gonial angle, according to Fischer-Brandies et al.[12] Larheim and Svanaes [13] pointed out that lateral cephalograms could not reliably register the gonial angle, and the overlapping images made it difficult to identify and measure the various angles. In contrast, the gonial angle determined from a panoramic film was nearly identical to the angle determined on the dried mandible. In Class I patients, Shahabi et al.[14] compared the external gonial angle calculated from lateral cephalograms and panoramic radiographs. They decided that panoramic radiography could be utilized to accurately identify the gonial angle just like a lateral cephalogram based on the obtained results. The measurements of the gonial angle were found by Araki et al.[15] to be slightly smaller on panoramic radiographs than on lateral cephalometric radiographs throughout their examination.

When calculated using an OPG, the cephalometric measurements' accuracy was assessed by Fatahi and Babouei.[16] The length of the mandibular body showed the lowest connection between actual measurements made from dry skulls and measurements obtained through panoramic radiography, whereas the gonial angle had the highest correlation. Nohadani and Ruff state that although panoramic radiographs (OPG) approximate the scenario depicted on a lateral cephalogram rather well, they should not be used to assess changes in vertical facial parameters over time.[17] They compared data on lateral cephalometric radiographs with longitudinal vertical facial and dentoalveolar alterations obtained from panoramic radiographs.

Kurt et al.[18] measured the condylar, Ramal, condylar and Ramal asymmetry index values, as well as the gonial angle, to assess the mandibular asymmetry in patients with Class II subdivision malocclusion. They found that using panoramic radiography can yield respectable outcomes. In their mathematical analysis of the precision of panoramic measures, according to Tronje et al.[19] if the patient is appropriately positioned, it is possible, within specific parameters, to use the panoramic film for clinical practice vertical measurements. Also, they found that the horizontal dimension is inconsistent.

According to our study's findings, the gonial angle on an OPG and lateral cephalogram are statistically equivalent. Nonetheless, there is a ramus and body length difference between OPG and lateral ceph that is statistically significant. In other studies, OPG can be used to measure the gonial angle and vertical measures separately on sides right and left, but it may not be dependable for horizontal measurements. [11, 13]

The nonlinear fluctuation in the magnification at various object depths has been proven to make horizontal and vertical measurements particularly unreliable. The focus of the horizontal projection in panoramic radiography is different from the vertical projection. The functional focus is on the rotating centre in the horizontal dimension, and the X-ray source in the vertical dimension. The vertical distortion of radiography

pictures in terms of size and shape depends on the projection variables. Object to X-ray source alignment, object to X-ray source distances, and film to X-ray source distances are a few examples of what they include. The vertical dimension is unaffected by the movement of the beam in the horizontal plane since the X-ray source acts as the functional focus. Yet, in the horizontal dimension, size and shape distortion are influenced by both projection and motion factors.

5. Conclusion

A panoramic radiograph is as accurate as a lateral cephalogram for angular measurements; however, it is not a reliable tool for the measurement of mandibular ramus height and body length. Lateral cephalogram gives more accurate linear measurements.

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