

RELIABILITY OF ORTHOPANTOMOGRAM IN DETERMINATION OF GONIAL ANGLE

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ABSTRACT

The aim of this study was to assess the values of gonial angle on orthopantomogram (OPG) and correlate them with the respective values on lateral cephalogram in order to determine the diagnostic capability of OPG for vertical facial pattern.

The study was conducted as a cross-sectional study at the Department of Orthodontics and Dentofacial Orthopedics, Khyber College of Dentistry by using 100 radiographs of the patients in the form of OPG and lateral head films. The sample included 35 male subjects with mean age of 18.00 ± 5.167 years and 65 female subjects with mean age of 18.66 ± 4.874 years. The gonial angle was determined by tracing a tangent to the lower border of the mandible and another tangent to the posterior ramus of the mandible both on OPG and lateral cephalogram manually and measured with the help of protractor.

The mean value for gonial angle on right and left side of the mandible on OPG was $124.62 \pm 7.54^\circ$ and $124.31 \pm 8.37^\circ$ respectively. The value was $124.65 \pm 7.99^\circ$ on lateral cephalograms. The Pearson correlation showed statistically significant correlation between cephalometric and OPG gonial angle (p value $< .01$). One way ANOVA revealed no significant difference between the values.

The results revealed a significant correlation between the cephalometric and panoramic values which concludes that panoramic radiography is as reliable as lateral cephalogram in predicting vertical facial pattern as determined by gonial angle. OPG can be used as an alternative to lateral cephalogram in determining gonial angle which shows its versatility as a diagnostic tool.

Key Words: orthopantomogram, gonial angle, lateral cephalogram, mandible, vertical pattern.

INTRODUCTION

In routine dental practice, radiographs are frequently used as a diagnostic tool for a number of pathological and developmental problems. In orthodontics, the treatment planning is based on a detailed problem list which is derived from history, clinical examination and evaluation of diagnostic records including dental casts, radiographs and photographs.¹ Orthopantomograms and lateral cephalograms are commonly advised in diagnosing dental and skeletal disharmony.

Panoramic radiography was first introduced by Professor Yrjö Paatero in 1961.² It provides invaluable information regarding teeth, their axial inclinations and stages of maturation and surrounding structures

(e.g. TMJ).³⁻⁶ The introduction of radiographic cephalometrics in 1934 by Hofrath in Germany and Broadbent in the US provided both a research and clinical tool for the study of malocclusion and underlying skeletal discrepancy.¹

The mandible is a key anatomical structure from both functional and aesthetic perspective.⁷ Implant studies on jaw rotations carried out in 1960 primarily by Bjork and coworkers revealed that mandibular rotation during growth results in individuals with various facial types including normal, short and long face.⁸ One of the most important cephalometric parameter giving an indication about the vertical growth pattern and symmetry of facial skeleton is gonial angle.⁹

Gonial angle on lateral cephalogram is measured by the intersection of tangent to the lower border of the mandible and posterior ramus.^{10,11} Due to double images of the lower border of mandible in lateral cephalogram, it is difficult to recognize and measure the gonial angle. Lateral cephalograms produce distorted image of the gonial angle and do not permit reliable measurement of the individual angle and is measured as an intermediate angle between right and left gonial angles.¹² In orthopantomogram both borders of the mandible can be easily discerned without any superimposition and

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has been shown to be as accurate as lateral head films in measuring gonial angle.¹¹

Several investigators compared the accuracy of OPG in determining the gonial angle and found that OPG is as reliable as lateral cephalogram in determining gonial angle.^{9,11,13,14} On the other hand, other studies proposed that OPG can provide information on the vertical aspect of craniofacial structure but they are not reliable enough to provide acceptably accurate additional information compared with lateral cephalograms.^{6,15} The aim of this study was to determine the reliability of orthopantomogram in evaluating gonial angle relative to lateral cephalogram. This will provide a novel approach in the utility of orthopantomogram and valuable information about the applicability of OPG in orthodontic practice for determination of vertical pattern using gonial angle as a parameter.

METHODOLOGY

This cross sectional study was carried out at the Department of Orthodontics, Khyber College of Dentistry, Peshawar from September to November 2016. The record of 100 patients in the form of lateral cephalograms and orthopantomogram was selected on the basis of following inclusion criteria:

- 1 Age range (12-30 years)
- 2 Fully erupted permanent dentition
- 3 Lateral cephalograms and OPG of high quality
- 4 Patients of either gender.

The subjects with previous history of trauma to the mandible, orthodontic treatment, pathological jaw lesions and low quality radiographs were not included in the study. Ethical approval was obtained from the hospital research committee for the study.

Pretreatment lateral cephalograms of patients were obtained by using Kodac - 9000 C machine with film size of 11×14". Measurements were made by two operators after tracing the landmarks manually using illuminator. The panoramic radiographs were taken from the same machine with the film size of 10×12". On panoramic radiograph gonial angle was traced for both right and left sides Fig 1. Gonial angle was traced as a tangent to the lower border of mandible and another tangent to the posterior ramus and condyle Fig 2. The point of intersection was measured as gonial angle. The measurements were recorded in data collection form for each patient.

STATISTICAL ANALYSIS

The statistical analysis of the data was carried out with SPSS software for windows (IBM; SPSS, version 20.0). Descriptive data for numerical variables like age and gonial angle was calculated. The mean gonial angle on lateral cephalogram and on OPG (right and left sides) with standard deviations according to gender was calculated.

Pearson product-moment correlation was used to measure the degree of correlation between right and left gonial angles on OPG and on lateral cephalogram.

One way analysis of variance (ANOVA) was applied for differences in gonial angle between the groups. For inter-observer reliability, measurements were repeated after two weeks with randomly selected radiographs and paired t-test was performed. The statistical significance was set at $\leq .05$ (p-value).

RESULTS

The means and standard deviations of the sample by age and gender are given in Table 1. The mean age of the sample studied was 18.43 ± 4.96 years, of which 35 were male and 65 were female patients.

Mean values of gonial angle on OPG and lateral cephalogram are presented in Table 2 with respective gender. The values of gonial angle on right and left side of OPG shows no significant difference. The mean value of gonial angle on lateral cephalogram was $124.65 \pm 7.99^\circ$ while on OPG right and left gonial angles were $124.62 \pm 7.54^\circ$ and $124.31 \pm 8.37^\circ$ respectively.

Pearson correlation co-efficient values for right and left gonial angles on OPG and lateral cephalogram revealed striking correlation with $r = .898$ between left

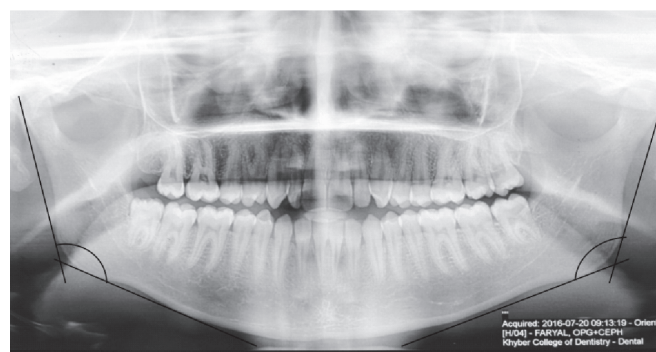


Fig 1: Measurement of gonial angle on OPG as tangent to the lower border of the mandible and tangent to the posterior ramus

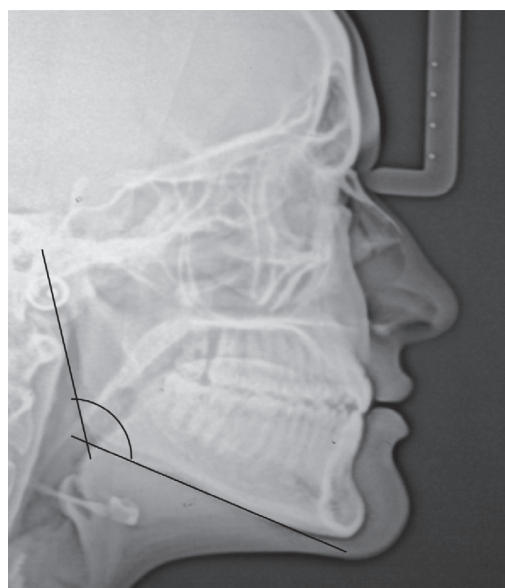


Fig 2: Measurement of gonial angle on lateral cephalogram

TABLE 1: AGE DISTRIBUTION ACCORDING TO GENDER

Gender	n	Mean age (years)±SD
Male	35	18.00 ± 5.167
Female	65	18.66±4.874
Total (n)	100	

convenient and accurate measurement of the GA.¹¹

Gonial angle is an important radiographic parameter for vertical growth pattern and has been investigated for age and gender differences in studies.¹⁶ It has been reported to serve as an adjuvant forensic parameter and scientific growth scale.¹⁷ There are only a few studies on the use of panoramic radiographs for dentoskeletal features and focus mainly on intercondylar asymme-

TABLE 2: MEAN VALUES OF GONIAL ANGLE ON OPG AND LATERAL CEPHALOGRAM WITH GENDER

Group	Right gonial angle (Mean ±SD)	Left gonial angle (Mean ±SD)	Cephalometric gonial angle (Mean±SD)
Male	124.07±8.60	123.98±8.87	123.50±9.07
Female	124.92±6.96	124.49±8.15	125.26±7.35
Total	124.62±7.54	124.31±8.37	124.65±7.99

TABLE 3: PEARSON CORRELATION BETWEEN GONIAL ANGLE ON OPG AND LATERAL CEPHALOGRAM

	Right Gonial Angle	Left Gonial Angle	Ceph Gonial Angle
Rt Gonial Angle	1	0.860**	0.894**
Left Gonial Angle	0.860**	1	0.898**
Cephalometric	0.894**	0.898**	1
Gonial Angle	100	100	100

**Correlation is significant at the 0.01 level (2-tailed)

TABLE 4: COMPARISON OF RIGHT AND LEFT GONIAL ANGLES ON OPG AND LATERAL CEPHALOGRAM (ANOVA)

	Mean square	F	Sig.
Right gonial angle	16.501	0.287	0.593
Left gonial angle	5.838	0.083	0.775
Cephalometric gonial angle	71.212	1.115	0.294

gonial angle on OPG and lateral cephalogram as shown (Table 3). One way ANOVA was applied for differences in values of gonial angle which shows the difference to be insignificant. (Table 4). The paired sample t-test was used for inter-observer reliability which gave the result of .887 excluding errors in the study measurements.

DISCUSSION

The purpose of this study was to determine the diagnostic potential of orthopantomogram (OPG) in assessment of vertical facial parameter i.e gonial angle (GA) in comparison to lateral cephalogram.

Gonial angle is measured as an intersection between two tangents i.e one tangent to the lower border of the mandible and another tangent to the posterior ramus.^{10,11} Lateral head films show superimposition of the image of the lower border of lower jaw which makes accurate measurement of the angle difficult.¹² On the other hand, OPG provides a clearer image of the right and left sides of the mandible, hence providing

tries and gonial angle measurements.^{14,20} Larheim and Svanaes¹⁴ found that horizontal measurements are not reliable with panoramic films; therefore only angular measurements were assessed in this study.

In routine orthodontic practice, lateral head films and panoramic x-rays are advised as an adjunct to diagnostic procedure, therefore the record of the studied sample was readily available without additional radiation exposure. Panoramic radiographs have been shown the potential to measure mandibular inclination and steepness and are useful for the measurement of gonial angle.¹⁸

In our study, gonial angle on lateral cephalogram and OPG was assessed which revealed striking correlation between the measurements on both radiographs. Pearson correlation coefficient of 0.894 and 0.898 was found for right and left gonial angles with lateral cephalogram respectively. Similarly no significant difference between GA of male and female patients was found. Our findings are in agreement with those

of Mattila et al¹¹ who concluded that GA can be determined using OPG as accurately as from lateral head films and are a more obvious choice for determination of GA. Similarly other studies comparing external gonial angle on OPG with lateral cephalograms found an accurate assessment of the GA from OPG further substantiating our results.^{6,9,13,14} Fisher –Brandies¹⁹ observed a significant difference in the gonial angle obtained by the two different radiographs which is in contrast to our findings.

Orthopantomograms have been shown to evaluate mandibular asymmetry^{14,20-22}, mandibular rotations^{6,20}, an accurate measurement of the right and left gonial angles¹⁴ and a low radiation exposure thus providing clinical versatility. It has been reported that OPG can provide information on the vertical dimensions of the craniofacial structures but they are not reliable enough to give acceptably accurate additional information when compared to lateral cephalogram.⁶

This cross sectional study provides valuable information on the utility and versatility of panoramic radiographs other than its routine dental use. Our study results are comparable to the findings of other researchers which strengthens our observation. No studies are available on this population regarding applicability of OPG for vertical growth pattern; our study fills a knowledge gap in this regard.

OPG is an important diagnostic tool and this study confirms its reliability as an alternative to lateral cephalogram for determining GA however, it cannot substitute lateral cephalogram in the information contained in it.

CONCLUSION

The conclusion of this study is:

- 1 Panoramic radiographs can be used to determine the vertical facial pattern with the same degree of accuracy as lateral head films.
- 2 There is a significant correlation between the values of gonial angle obtained from OPG and lateral cephalograms.
- 3 There is no difference between gonial angle of male and female subjects.

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