

ORIGINAL ARTICLE

Comparison of Gonial Angle Determination from Cephalograms and Orthopantomogram of Patients under Orthodontic Treatment

Mansoor Majeed¹, Imtiaz Ahmed²

ABSTRACT:

Objective: To compare and find out the possible application of OPG for gonial angle and compare it with cephalogram in Orthodontic patients of a Public Sector Dental Institute.

Materials and Methods: In this descriptive retrospective study lateral cephalograms and OPG of 103 patients, 27 males and 76 females were analyzed. The gonial angle was determined in panoramic radiographs by two tangents drawn from the condyle's posterior borders and right and left ramus and inferior border of the mandible. Landmarks in the cephalogram were identified and spotted. Cephalometric protractor and calipers were used to mark and measure the angles. Angles and other parameters were rechecked to counter any missed measurement.

Results: In lateral cephalograms the mean value of gonial angle was 121.77° and in panoramic radiographs 122.18°. In females, the difference among the mean gonial angle in both radiographs was 1.20 and in males 1.224 while difference among the two genders was 0.02°. As $P > 0.05$ for all the variables stated above, these differences were not significant.

Conclusion: OPG may be considered to evaluate the gonial angle as correctly as a lateral cephalogram because in the values of gonial angles measured in both radiographs there was non-significant difference. The plus point in OPG is that it is more accurate in evaluating patient's gonial angles without any overlaid images.

Keywords: Gonial angle, Cephalograms, Orthopantomogram, Orthodontic treatment, Dental institute

INTRODUCTION:

In orthodontics to get the information regarding axial inclinations, maturation periods, and surrounding tissues of the teeth panoramic radiograph has been widely used. For cephalometric measurements, another radiograph is considered that is Lateral cephalogram. In orthodontics treatment, planning the Gonial Angle is extensively considered. The gonial angle is the angle between an imaginary tangential line along the inferior border of the mandible and along the posterior border of the mandibular ramus.¹

History, clinical examination and diagnostic records counting radiographs, photographs and dental casts' evaluation are the key sources, from where orthodontic diagnostic records are taken. All the patients undergoing orthodontic treatments have cephalograms and orthopantomogram (OPG). Vertical and Horizontal relationship of five main functional components of face include the cranium and cranial base, skeletal mandible and maxilla, alveolar process and the mandibular dentition.

To get significant data about dentition, their growth phases, neighboring tissues and axial inclinations panoramic radiography is considered in orthodontics. For complete evaluation of dental occlusion, hard tissue correlation and soft tissue proportion radiographs are required. For cephalometry presently, lateral and anteroposterior projections are in practice. Determining individual gonial angles is challenging, in this method, because other images are superimposed in lateral cephalograms. However, in Panoramic imaging this problem does not occur and for jaw investigations and evaluation it is in use on a very high scale. Both the vertical and horizontal relationship of these structures is equally important because the planning of treatment and the result of treatment is affected by pattern of growth of the patient and the vertical relationships.² For the craniofacial complex and craniofacial disorders, diagnosis of the external gonial angle is the significant angle. Gonial angle is one of the vital factors giving a sign about the vertical parameters and symmetry of the facial skeleton.³

In 1961 a Professor from University of Helsinki named Yrjö Paatero introduced panoramic radiography. To get significant data about dentition, their axial inclinations, development stages and adjacent tissues panoramic radiography is regularly recommended in orthodontics. By quality of its ability to take a solitary picture of the entire oral cavity, jaws, sinuses-panoramic, temporomandibular joints, radiography forms an essential orthodontic screening tool. Studies inspecting panoramic radiographs as a source of exploring skeletal patterns are deficient in the orthodontic studies. In OPG the problem of superimposed images are negligible as compared to cephalograms and it can be used for better measurement and evaluation.⁴ The aim of the current research is to compare and find out the possible application of OPG

✉ **Dr. Mansoor Majeed**
Post graduate trainee
Department of Oral Biology
Dow University of Health Sciences
Karachi
E-mail: mmansoormajeed@gmail.com

✉ **Dr. Imtiaz Ahmed**
Professor and Head
Department of Orthodontics
Dow University of Health Sciences
Karachi
Received: 11-01-2016
Revised: 26-02-2016
Accepted: 05-03-2016

for gonial angle and compare it with cephalogram of orthodontic patients in a public sector dental institute of Karachi.

MATERIALS AND METHODS:

Records of Lateral cephalograms and OPG of 103 patients from August 2014 to January 2015 were taken from the Department of Orthodontics, Dow University of Health Sciences. There were 27 males and 76 females. The mean age was 16.24 years with an age range from 11 to 30 years. The standard for assortment of patient's radiographs were as follows: the OPG and Lateral cephalogram should be of superior quality and clear with same X-ray machine used to take all radiographs and in natural head position (NHP). Good quality radiographs were selected and cellulose acetate sheets were used for tracing with a pencil number 2H by a single operator. Landmarks in cephalogram were identified and spotted. Cephalometric protractor and calipers were used to mark and measure the angles. Angles and other parameters were rechecked to counter any missed measurement. The gonial angle was found out in panoramic radiographs from two tangents drawn from the condyle's posterior borders, right and left ramus and inferior border of the mandible. SPSS regression analysis and Student's t test were applied to evaluate statistically significant differences between the

variable. SPSS version 16 was used for statistical analysis and probability level of $P < 0.05$ was considered to be statistically significant.

RESULTS:

In lateral cephalograms the mean value of gonial angle was 121.77° and 4.75 was the STD deviation and in panoramic radiographs 122.18° was the mean value and 4.61 STD deviation of the gonial angle (Table 1). Between the two genders there was no statistically significant difference as in females gonial angle was 122° and gonial angle in males was 124° . In OPG, 122.14° was the mean value of the right gonial angle with 4.77 standard deviation and 122.74° was the mean value of left gonial angle with a 3.55 standard deviation. The difference between the values of gonial angles determined by lateral cephalogram and panoramic radiography was non-significant. Also the difference in right and left gonial angle was non-significant. According to outcomes of the current study, in females the difference among the mean gonial angle in both radiographs was 1.22 and 1.24 in males and the difference among the two genders was 0.02° (Table 2). As $P > 0.05$ for all the variables stated above, these differences were non significant. In linear regression significant association is observed among the means of gonial angle in lateral cephalometry & OPG.

Table: 1
Range, standard deviation and mean of gonial angle in lateral cephalogram and panoramic radiographs (OPG) in degrees

Variables	Range	STD deviation	Mean
Gonial angle in cephalogram	112-130	4.75	121.77
Gonial angle in OPG	110-136	4.61	122.18
Right gonial angle in OPG	110-136	4.77	122.14
Left gonial angle in OPG	110-137	3.55	122.74

Table: 2
Comparison of gonial angle in later cephalogram and OPG

Variable	Mean differences (degree)
Gonial angle in cephalogram and OPG	-0.41
Right and left gonial angle in OPG	0.06
Gonial angle in cephalogram and OPG (males)	1.24
Gonial angle in cephalogram and OPG (females)	1.22
Right gonial angle in cephalogram and OPG	0.02
Left gonial angle in cephalogram and OPG	0.02

DISCUSSION:

In our study, the difference of average measurements of external gonial angle were not significant between lateral cephalogram and panoramic radiographs. A study done by Mattila have stated that there is no such difference between the gonial angle in both radiographs, though the mean gonial angles were 127.8° and 128.6° in panoramic and lateral cephalogram respectively.⁵ Shahabi have equated the external gonial angle taken from panoramic radiographs and lateral cephalograms in Class I malocclusion patients. Established on the

results, they proved that panoramic radiography is as accurate as lateral cephalogram in determining the gonial angle.⁶

Application of OPGs for measurement of vertical and horizontal angular measurement is proved by Jena.⁷ For mandible's linear measurement that is menton-gonion, gonion-condyilion and menton-condyilion, OPG is as trustworthy as a lateral cephalogram and it is an established radiological evaluation of changes in gonial angle.⁸ Fisher-Brandies in his study has observed a difference of 2.2-3.6 degree in the gonial angle between

panoramic and lateral cephalogram and the difference was significant.⁹ This result is totally opposite to the result of our study.

Angle assessment on the left & right panoramic radiographs makes it feasible to precisely assess the variations at the end of orthodontic treatment. In evaluating inclination of mandible and gonial angle, it has been reported that panoramic radiography has a potential. For finding out the gonial angle that is considered to be a decent indicator of mandibular steepness & growth direction, panoramic radiography has been used widely.¹⁰ Fatahi and Babouei have estimated the accuracy of cephalometric measurements when determined from an OPG.¹¹

A comparison of actual measurements from dry skulls and panoramic radiographic measurements showed good association between panoramic and cephalometric radiographs in gonial angle, whereas the minimum correlation was observed in the length of the mandibular body. In different growth patterns, it was seen that gonial angle and ramus height showed highest correlation between the two radiographs. They reported that the capability to determine growth direction from the OPG should be beneficial because most of the dentists demand an OPG for patients during oral examination.¹² As OPG is normally suggested by a dental surgeon during oral checkup. It appears to be a beneficial feature of this modality for determination of direction, so the vertical growth tissues can be easily detected by the dentist. A study done by Larheim also have specified that OPG and lateral cephalograms were precise in defining gonial angle and the difference was not significant among the left and right sides in panoramic radiography. Several researches have established the effectiveness for measuring the gonial angle by panoramic radiography, the right and left gonial angles do not overlap differing with cephalometry.¹³ A study conducted by Al haija have reported the possibility that panoramic radiographs measure mandibular inclination and steepness. Extreme association between the measurements extracted from both radiographs was found. They also reported that for the measurement of gonial angle panoramic radiograph can be a valuable tool.¹⁴ A previous study by Raustia proved that genders have irrelevant influence on gonial angle's size.¹⁵ A variance in gonial angle of left side among the two genders was showed by Gungor.¹⁶ However, research done by Nohadani associated longitudinal vertical facial and dentoalveolar variations using OPGs with measurements on lateral cephalometric radiographs.¹⁷ After using OPG to find out mandibular symmetry in Class II malocclusion patients, by measuring different parameters Kurt has concluded that satisfactory outcomes can be attained with panoramic radiographs.¹⁸ Furthermore the panoramic radiographs are of low cost and chances of radiation exposure are also fairly low.¹⁹ Multiple studies have admitted that panoramic radiography is comparatively better in measuring gonial angle and other important aspects needed to be in focus, that is, there is no overlapping in right and left gonial angles on OPG as compared to Cephalometry.^{1,6,14,15,}

²⁰On the contrary many researchers share the idea that there is a person to person discrepancy in gonial angle distortion and proves that gonial angle differs in different classes of malocclusions in different age groups and among genders as well.^{21, 22, 23,24,25}

CONCLUSION:

Panoramic radiography may be considered to evaluate gonial angle as correctly as a lateral cephalogram because in values of gonial angles measured by cephalogram and OPG there is non-significant difference. The plus point in OPG is that it is far better and more accurate in evaluating patient's gonial angles without any overlaid images because of the anatomical landmarks in lateral cephalogram. OPG may be a superior choice in evaluating gonial angle than lateral cephalogram. Thus current study confirms the opportunity of enhancing the clinical usefulness of panoramic radiograph.

REFERENCES:

1. Ceylan G, Yanikoglu N, Yilmaz AB, Ceylan Y. Changes in the mandibular angle in the dentulous and edentulous states. *J Prosthet Dent* 1998;80(6):680-4
2. Staley RN. Cephalometric analysis. In: *Textbook of orthodontic*, Bishara SE edition 3rd, W. B. Saunders, Philadelphia 1972, p. 113-7
3. Mandeep KB, Amandeep SU, Gulsheen KK, Sanjay C, Anuraj S K. Comparison of gonial angle determination from cephalograms and orthopantomogram. *Indian J Dent* 2014; 5(3): 123-6
4. White SC, Pharoah MJ. *Oral radiology: principles and interpretation*. 4th edition, Mosby, St Louis 2000, 205-6
5. Mattila K, Altonen M, Haavikko K. Determination of gonial angle from the orthopantomogram. *Angle Orthod* 1977;47:107-10
6. Shahabi M, Ramazanzadeh BA, Mokhber N. Comparison between the external gonial angle in panoramic radiographs and lateral cephalograms of adult patients with Class I malocclusion. *J Oral Sci* 2009;51(3):425-9
7. Jena AK, Singh SP, Utreja AK. Effects of sagittal maxillary growth hypoplasia severity on mandibular asymmetry in unilateral cleft lip and palate subjects. *Angle Orthod* 2011;81:872-7
8. Ongkosuwito EM, Dieleman MM, Kuijpers-Jagtman AM, Mulder PG, van Neck JW. Linear mandibular measurements: Comparison Between orthopantomograms and lateral cephalograms. *Cleft Palate Craniofac J* 2009; 46:147-53
9. Fischer-Brandies H, Fischer-Brandies E, Dielert E. The mandibular angle in the orthopantomogram. *Radiologe*. 1984;24(12):547-9
10. Niwa K, Maeda T, Omichi S, Sumikawa Y. Estimation of the gonial angle from the orthopantomogram. *Gifu Shika Gakkai Zasshi* 1990;17(1):7-16
11. Fatahi HR, Babouei EA. Evaluation of the precision of panoramic radiography in dimensional measurements and mandibular steepness in relation to lateral cephalometry. *J Mashhad Dent Sch Fall* 2007;31:223-30
12. Zangouei-Booshehri M, Aghili H-A, Abasi M, Ezoddini-Ardakani F. Agreement Between Panoramic and Lateral Cephalometric Radiographs for Measuring the Gonial Angle. *Iranian Journal of Radiology* 2012;9(4):178-82
13. Larheim TA, Svanaes DB. Reproducibility of rotational

- panoramic radiography: Mandibular linear dimensions and angles. *Am J Orthod Dentofacial Orthop* 1986;90:45-51
14. Alhaija ES. Panoramic radiographs: Determination of mandibular steepness. *J Clin Pediatr Dent* 2005;29:165-6
 15. Raustia AM, Salonen MA. Gonial angles and condylar and ramus height of the mandible in complete denture wearers-a panoramic radiograph study. *J Oral Rehabil* 1997;24(7):512-6
 16. Gungor K, Sagir M, Ozer I. Evaluation of the gonial angle in the Anatolian populations: from past to present. *Coll Antropol* 2007;31(2):375-8
 17. Nohadani N, Ruf S. Assessment of vertical facial and dentoalveolar changes using panoramic radiography. *Eur J Orthod* 2008;30(3):262-8
 18. Kurt G, Uysal T, Sisman Y, Ramoglu SI. Mandibular Asymmetry in Class II Subdivision Malocclusion. *Angle Orthod* 2008;78:32-7
 19. Nikneshan S, Sharafi M, Emadi N. Evaluation of the accuracy of linear and angular measurements on panoramic radiographs taken at different positions. *Imaging Science in Dentistry* 2013;43(3):191-6
 20. Akcam MO, Altioek T, Ozdiler E. Panoramic radiographs: A tool for investigating skeletal pattern. *Am J Orthod Dentofacial Orthop*. 2003;123:175-81
 21. Slagsvold O, Pedersen K. Gonial angle distortion in lateral head films: a methodologic study. *Am J Orthod* 1977;71, 554-64
 22. Altonen M, Haavikko K, Mattila K. Developmental position of lower third molar in relation to gonial angle and lower second molar. *Angle Orthod*.1977;47:249-55
 23. Ohm E, Silness J. Size of the mandibular jaw angle related to age, tooth retention and gender. *J Oral Rehabil* 1999;26:883-91
 24. Ranta R, Altonen M. A comparative study of gonial angle and growth of the lower third molar in cleft lip and palate. An orthopantomographical study. *Scand J Plast Reconstr Surg* 1978;12:273-8
 25. Fish SF. Change in the gonial angle. *J Oral Rehabil*. 1979;6:219-27

