Journal of Dentomaxillofacial Radiology, Pathology and Surgery

Winter2019, Volume8, Number 1

Research Paper: Comparative analysis of the gonial angle on panoramic and lateral cephalometric radiographs

Pedram Javidi[1], **Farzane Ostovarrad**[2], **Seyedeh Ayeh Shekarbaghani**[3*]

[1]*Assistant professor, Departments of Orthodontics, School of Dentistry, Anzali International Campus, Guilan University of Medical Sciences, Rasht, Iran*

[2]*Assistant professor, Departments of Radiology, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran*

[3] *Dentist*

Use your device to scan and read the article online

Citation: Javidi P, Ostovarrad F, Shekarbaghani SA. Comparative analysis of the gonial angle on panoramic and lateral cephalometric radiographs . Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2019; 8(1):31-36. http://dx.doi.org/10.32598/3dj.7.4.145

http://3dj.gums.ac.ir

Article info:
Received: 2019/02/26
Accepted: 2019/03/10

Keywords:
Radiography, Panoramic
Malocclusion
Radiography

ABSTRACT

Introduction: Gonial angle (GA) is one of the essential angles that is used in orthodontic treatment plans. It is often evaluated by lateral cephalometry, but because of its overlap of right and left structures, a lack of different magnifications on two sides, and strength of panoramic radiography in angular measurements, it was decided to compare panoramic radiography and lateral cephalometry for determining GA in patients referring to dental clinic of Guilan University of Medical Sciences (GUMS) in 2017 and 2018.

Materials and Methods: The study samples included Lateral cephalograms and panoramic radiographs of 391 patients (215 females and 176 males) with an age range of 6-40 years. In both methods, GA was determined based on two tangents drawn from the inferior border of the mandible and posterior borders of condyle and ramus of both sides. The values of the studied parameters were compared using paired t-test.

Results: The mean value of the GA in lateral cephalogram was 119.07°±7.88° and the mean value of GA in panoramic radiography was 116.36°±8.20°. The difference of GA measurement between the two methods was statistically significant. Moreover, a similar significance was observed in the measured GA with respect to gender and skeletal classifications.

Conclusion: The difference of GA measurements obtained from lateral cephalograms and panoramic radiographs were found to be statistically significant. Thus, panoramic radiography would not be an alternative for lateral cephalometry in determining GA and it is suggested to be used only for the preliminary diagnosis.

*** Corresponding Author:**
Seyedeh Ayeh Shekarbaghani.
Address: School of Dentistry, Anzali International Campus, Guilan University of Medical Sciences, Rasht, Iran.
Tel: +981344553183
E-mail: aye.shekarbaghani@yahoo.com

Journal of Dentomaxillofacial Radiology, Pathology and Surgery

Introduction

Diagnosis and treatment planning in the field of orthodontics is defined as a body of data obtained from three sources of: history, clinical examination, and evaluation of diagnostic records. The purpose of cephalometric analysis is to evaluate the horizontal and vertical relation of five major functional components of the face. One of the angles to be assessed in cephalometric analysis is the gonial angle.(1, 2)

The gonial angle is one of the major angles for predicting a patient's growth pattern and mandibular rotation, which is often evaluated through lateral cephalometry. Gonial angle is obtained from the intersection of two lines, one tangent to the inferior border of mandible and, the other tangent to the posterior border of ramus.(2, 3)

Lateral cephalometry provides precise information about skeletal, dental and growth patterns for the dentist. The difference between angle of ramus and the divergence of the mandibular base and the magnification difference between the distant and near areas in images, results in an image distortion with no method for determining its extent.(1, 4) Studies have shown that due to an overlap between the right and left structures in lateral cephalometry, the precision of measurements such as that of gonial angle is low.(1)

Panoramic radiography provides information on the teeth, dental arches, skeletal structures, temporomandibular joint, lesions of the jaws, and changes in anatomic landmarks such as the ramus width and mandibular angle. It is also widely used in the diagnosis and orthodontic treatment planning.(1,5) Different magnifications in linear dimensions and geometric abnormalities may cause distortion in the image; or patient's displacement and their tilted heads can result in errors. However, this method of imaging possesses advantages like having no overlap of two sides and acceptable accuracy in angular measurements.(1, 5, 6)

The results of the study by Park et al.[5] showed that panoramic radiographs, with an accuracy equal to that of lateral cephalometry, can be used for determining gonial angle. On the contrary, Ul-haq(7) concluded that panoramic radiography could not be used as an alternative to lateral cephalometry.

Due to important role of gonial angle in orthodontic treatment and different finding about correlation between lateral cephalometry and panoramic, we decided to compare panoramic and lateral cephalometric radiography for determining gonial angle in patients referring to the dental clinic of Guilan University of Medical Sciences (GUMS), Anzali international branch, in 2017 and 2018.

Method and material

Lateral cephalograms and panoramic radiographs of 391 patients were gathered, of whom, 215 were females and 176 males, with a mean age of 18.52±7.02 years and an age range of 6-40 years. The samples were collected from the dental clinic of GUMS, Anzali International Campus in 2017 and 2018. Panoramic and cephalometric images were acquired with a Cranex D digital X-ray unit, (CRANEX D™, SOREDEX®, TUSUULA, FINLAND). Radiographs were taken with appropriate exposure conditions for each patient. Later, code of ethics IR.GUMS.REC.1398.257 was obtained from Ethical committee of Guilan University of Medical Sciences.

Exclusion criteria were defined as follows: a gap of more than 6 months between lateral cephalometry and panoramic radiography(5); radiographs showing unclear and cropped image; patients with a systemic disease or syndrome affecting the jaws; patient positioning error; orthodontic or orthognathic interventions between two images; and history of trauma or surgery.

Cephalometric data including ANB (A point, Nasion, B point), and Wits analysis of selected patients, were measured by Scanora version 5.1.2 (SOREDEX™, TUSUULA, Finland) software programs, to confirm the angle classification. In lateral cephalograms and panoramic radiographs, the gonial angle was determined

Javidi P, et al. Comparative analysis of the gonial angle on panoramic and lateral cephalometric radiographs . Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2019; 8(1):31-36. http://dx.doi.org/

from two tangent lines which were drawn from the inferior border of the mandible and posterior borders of condyle and ramus of both sides (Figure 1, 2) and were measured by SCANORA® version 5.1.2 (SOREDEX™, TUSUULA, FINLAND) software programs. In lateral cephalomety, If there is not overlap on the right and left side, the interface between two lines on the two sides is considered.

Legends of figures and tables

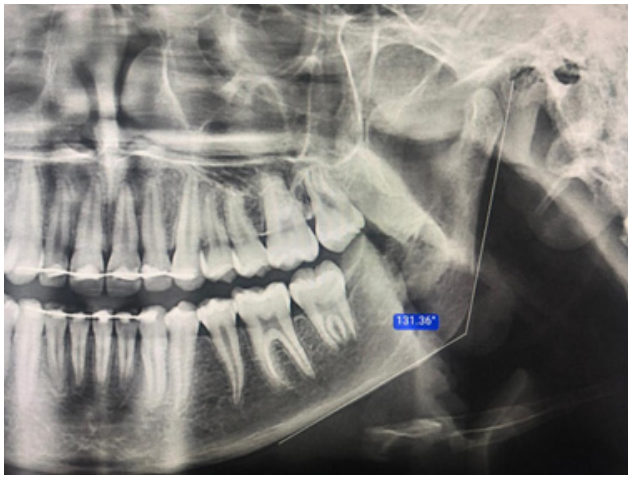

Fig. 1. Measurment of the gonial angle in panoramic radiographs.

Fig. 2. Measurment of the gonial angle in lateral cephalograms.

For eliminating inter examiner's errors, all analyses were made by a qualified observer, and regarding the intra examiner, the measurments were repeated by the same observer after 10 days.

The normality of the studied parameters was checked using the Kolmogorov-Smirnov test, and because all data displayed a standard distribution, statistical analysis were based on parametric tests. The values of the studied parameters were compared by paired sample t-test. The analyses were performed using SPSS version 21 (SPSS Inc., Chicago, Illinois, USA); a P-value of less than 0.05 was considered to indicate statistical significance.

Results

The study samples consisted of lateral cephalograms and panoramic radiographs of 391 patients of which 215 were females and 176 males; with a mean age of 18.52±7.02 years and an age range of 6-40 years and with various skeletal classifications.

Table 1 shows the data of gonial angle values of panoramic radiographs and lateral cephalograms. T-test demonstrated significant differences between the values of gonial angles determined by lateral cephalograms and panoramic radiographs (P=0.000).

In Table 2, there were significant differences between all values of gonial angles determined by panoramic radiographs and lateral cephalograms Based on genders (P=0.000).

The mean and standard error values according to the skeletal classification type were presented in Table 3. statistically significant difference was observed in the measured gonial angle with respect to skeletal classification type (P<0.005).

Table 1: Differences between the values of gonial angle using lateral cephalogram and panoramic radiographs

Radiography type	Number	Mean	Standard	Significance
Lateral cephalometry	391	119.07	7.88	0.000***
Panoramic radiography	391	116.36	8.20	0.000***

***Paired T-test, significance level: p< 0.005

Table 2: Difference in the gonial angle measurement using lateral cephalograms and panoramic radiography with respect to gender

Gender	N	Lateral Cephalometry		Panoramic		P value
		Mean	Std. Deviation	Mean	Std. Deviation	
Male	176	117.53	13.311	115.4338	8.84375	0.000***
Female	215	119.40	7.696	116.8626	7.77161	0.000***

***Paired T-test, significance level: p< 0.005

Table 3: Difference in the gonial angle measured using lateral cephalograms and panoramic radiographs with respect to skeletal classification

Skeletal classification	Number	Lateral cephalometry		Panoramic radiography		P value	95% Confidence Interval of the Difference	
		Mean	Standard	Mean	Standard		Lower	Upper
Class I	179	119.47	7.79	116.57	7.82	0.000***	2.314	3.4744
Class II	182	118.52	7.76	115.72	8.53	0.000***	2.1142	3.4791
Class III	30	120.06	9.09	117.10	9.56	0.01***	1.6980	4.2019

***Paired T-test, significance level: p< 0.005

Discussion

The gonial angle describes the shape and the form of the mandible and plays an important role in forecasting the growth pattern of an individual and an is a critical parameter for evaluating the symmetry of the facial skeleton. (2, 3) Panoramic radiograph is considered as the current standard of care for dental diagnosis and treatment planning. It offers a comprehensive overview of the patient's bone and dental features, but it also includes a drawback: image distortion.(1, 5) Lateral cephalogram is a valuable method for evaluating the skeletal relations, growth pattern, dentition, and alveolar process. However, the interference by superimposed images is always present (1), thus, both radiography methods have their own strengths and weaknesses. Hence, the aim of the present study was to evaluate the accuracy of panoramic imaging in measuring the right and left gonial angles by comparing the mentioned angles with the assessments achieved through lateral cephalograms in patients with different skeletal classifications. That was done with the goal of enhancing the application of panoramic radiographs in clinical practice for the determination of the gonial angle.

The mean values of the gonial angle measured using the panoramic radiographs and the lateral cephalograms were 116.36° and 119.07°, respectively. Further, statistically significant differences were observed in the gonial angle measured using these two diagnostic tools (P=0.000).

The results of this study were in accordance with the findings of Baig et al,(8) who reported such discrepancy of similar results using lateral cephalograms and panoramic radiographs.

Fisher-Brandies (9) in his study observed a difference of 2.2 to 3.6 degree in gonial angle between panoramic and lateral cephalogram and the difference was significant. Araki et al.(10) also reported that the gonial angle measuements on the panoramic radiographs were slightly smaller than on the lateral cephalometric radiographs and the results of the present study are in agreement with the above-mentioned studies. A research done by Majeed et al.(3) did not state such a difference between the gonial angle in both radiography methods, although the mean gonial angles were 122.18° and 121.77° in panoramic and lateral cephalograms, respectively. This is totally opposite to the findings of the research at hand. Bhullar et al.(2) equated the external gonial angle taken from lateral cephalogram and panoramic radiographs. Established on their results, they proved that the difference of average measurements of external gonial angle were not significant between lateral cephalogram and panoramic radiographs. This discrepancy may have been due to the small sample size of their study.

In the present survey, statistically significant differences were observed in the gonial angle with respect to gender. The results were in accordance with the findings of Ghosh et al., Bhardwaj et al., Huumonen et al., and Xie and Ainamo (11-14) who reported women had a larger gonial angle. The difference between men and women could be explained by the gender differences affecting the bone metabolism and the variation of action of muscular masses attached to this region. Radhakrishnan et al.(1) did not observe any gender-based difference in the gonial angles, similarly, Park et al.,(5) excluded sex as a determining factor for variation of gonial angles.

This study's statistically significant difference was observed between mean gonial angle in different age groups. This too, was established in the study conducted by Park et al.(5) While this research considered a sample age of 8 to 40 years, they focused on children (ages 4 to 12). This is disagreeing with the study by Ghosh et al.(11) who found out that the mean gonial angle increased with age in patients, this change was not statistically significant however. Ageing causes changes in masticatory muscles and mandibular base and creates decreased contractile power.

In the study at hand, a statistically significant difference was found in the gonial angle measured by lateral cephalogram and panoramic radiographs in three different types of skeletal classification. Zangouei et al.(15) claimed that the type of malocclusion had an insignificant impact on the size of gonial angle. Nadkerny et al.,(16) in their study, concluded there were statistically insignificant differences in gonial angle between the Tweed's mandibular plane on lateral cephalogram and panoramic radiograph in Class I, Class II and Class III patients. The results of the present study are in contrast with the results of Zangouei et al. and Nadkerny et al.(15, 16) who reported that there were statistically insignificant differences in gonial angle on lateral cephalogram and panoramic radiograph in three type of skeletal malocclusion and the variation of results could be due to selection of different number from three malocclusion type, different age range, and a sample size which were not specified in the above-mentioned studies.

Conclusion

In the present study, statistically significant differences were observed between the gonial angles measured using lateral cephalograms and panoramic radiographs. Therefore, gonial angle cannot be measured on panoramic radiograph as precisely as it can be by lateral cephalometry radiograph.

Therefore, although panoramic radiography provides satisfactory results at the preliminary

diagnosis, but lateral cephalometry with its higher accuracy is suggested for measuring gonial angle.

Ethical Considerations

Compliance with ethical guidelines

There is no ethical principle to be considered doing this research.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

Authors contribution's

All authors contributed in preparing this article.

Conflict of interest

The authors declared no conflict of interest.

References

1. Radhakrishnan, P.D., N.K. Sapna Varma, and V.V. Ajith, Dilemma of gonial angle measurement: Panoramic radiograph or lateral cephalogram. Imaging Sci Dent, 2017. 47(2): p. 93-97.https://doi.org/10.5624/isd.2017.47.2.93

2. Bhullar, M.K., et al., Comparison of gonial angle determination from cephalograms and orthopantomogram. Indian J Dent, 2014. 5(3): p. 123-6.https://doi.org/10.4103/0975-962X.140820

3. Majeed M, A.I., Comparison of Gonial Angle Determination from Cephalograms and Orthopantomogram of Patients under Orthodontic Treatment. J Bahria Uni Med Dental Coll, 2016: p. 88.

4. Slagsvold O, P.K., Gonial angle distortion in lateral head films: a methodologic study. American Journal of Orthodontics and Dentofacial Orthopedics, 1977. 71(5): p. 554-64.https://doi.org/10.1016/0002-9416(77)90005-7

5. Park, S.-H., et al., The Simple Regression Model of Gonial Angles : Comparison between Panoramic Radiographs and Lateral Cephalograms. The Journal of the Korean Academy of Pedtatric Dentistry, 2017. 44(2): p. 129-137. https://doi.org/10.5933/JKAPD.2017.44.2.129

6. McKee, I.W., et al., The effect of vertical and horizontal head positioning in panoramic radiography on mesiodistal tooth angulations. Angle Orthod, 2001. 71(6): p. 442-51.

7. Hammad ul-Haq, M., S. Memon, and D. Agha, Comparison Between Three Methods of Gonial Angle Formation on Lateral Cephalogram and Orthopantomogram. Journal of The Pakistan Dental Association, 2018. 27(2): p. 57-61. https://doi.org/10.25301/JPDA.272.57

8. Baig, M., Reliability of panoramic radiography in assessin gonial angle compared to lateral cephalogram. Pakistan Oral & Dental Journal, 2018. 38(3): p. 320-3.

9. Fischer-Brandies, H., E. Fischer-Brandies, and E. Dielert, [The mandibular angle in the orthopantomogram]. Radiologe, 1984. 24(12): p. 547-9.https://doi.org/10.1016/S0301-0503(84)80222-2

10. . Araki, M., et al., Comparative analysis of the gonial angle on lateral cephalometric radiographs and panoramic radiographs. J Oral Sci, 2015. 57(4): p. 373-8https://doi.org/10.2334/josnusd.57.373

11. Ghosh, S., M. Vengal, and K.M. Pai, Remodeling of the human mandible in the gonial angle region: a panoramic, radiographic, cross-sectional study. Oral Radiology, 2009. 25(1): p. 2-5.https://doi.org/10.1007/s11282-009-0002-4

12. Bhardwaj, D., J.S. Kumar, and V. Mohan, Radiographic evaluation of mandible to predict the gender and age. J Clin Diagn Res, 2014. 8(10): p. ZC66-9.https://doi.org/10.7860/JCDR/2014/9497.5045

13. Huumonen, S., et al., Influence of edentulousness on gonial angle, ramus and condylar height. J Oral Rehabil, 2010. 37(1): p. 34-8.https://doi.org/10.1111/j.1365-2842.2009.02022.x

14. Xie, Q.-F. and A. Ainamo, Correlation of gonial angle size with cortical thickness, height of the mandibular residual body, and duration of edentulism. The Journal of Prosthetic Dentistry, 2004. 91(5): p. 477-482. https://doi.org/10.1016/j.prosdent.2004.02.020

15. Zangouei-Booshehri, M., et al., Agreement between panoramic and lateral cephalometric radiographs for measuring the gonial angle. Iran J Radiol, 2012. 9(4): p. 178-82.https://doi.org/10.5812/iranjradiol.8444

16.

17. Nadkerny, V., et al., Assessing reliability of mandibular planes in determining gonial angle on lateral cephalogram and panoramic radiograph. Journal of Orthodontic Research, 2015. 3(1): p. 45.https://doi.org/10.4103/2321-3825.146358