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Original Research Article

Comparative analysis of the gonial angle on lateral cephalogram and panoramic radiography in a normal-occlusion population

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Abstract

Background: The gonial angle is an important parameter in diagnosis and prognosis in orthodontics, human identification, and anthropology. Lateral cephalogram is the examination of choice. It can also be studied on a panoramic radiograph. This study aimed to compare the value of the gonial angle on panoramic radiography and profile teleradiography in a Senegalese population.
Materials and Methods. This was a cross-sectional study of 60 patients managed by the orthodontic department with class I skeletal angle. The gonial angle was studied using panoramic radiography and lateral cephalogram. Radiographic examinations were carried out by a dental X-ray technician. An analysis of variance was performed to compare the mean values of the gonia angles. The significance level was set at p less than 0.05.
Results: The mean values of the gonial angle were 119±6.8º on lateral cephalogram. On panoramic radiography they were 119±7.17º on the right side and 120±7.19º on the left side. No statistically significant difference was found for gender (p=0.9). The analysis of variance showed no statistically significant difference between the two methods.
Conclusion: In summary, it is possible to use panoramic radiography to measure the gonial angle with the same accuracy as lateral cephalogram. Although lateral teleradiography is considered more accurate for estimating the gonial angle, panoramic radiography can also provide useful information.

Keywords: Normal occlusion, Gonial angle, Panoramic X-ray; Lateral cephalogram.

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1. Introduction

The gonial angle is an important parameter in orthodontic diagnosis and prognosis. It is also used in age estimation, human identification, ethnic differentiation and anthropology.[1,2] It is formed by the angle created by the intersection of the tangent line of the posterior edge of the mandible and that of the basilar rim. It can be studied on a dry skull, but most often on an x-ray. Lateral cephalometric radiography is the examination of choice for studying the gonial angle. Together with panoramic radiography, these are the essential examinations in clinical orthodontic assessment.[3] Lateral cephalogram provides an image without any change in dimensions. This gives it its role in radiomorphometric study, cephalometry. The two sides of the mandible are superimposed, allowing the gonial angle to be calculated. Lateral cephalometry is much more than just an X-ray; it is the central diagnostic and decision-making tool in orthodontics. It allows us to move from simple clinical observation to scientific and predictive analysis of dysmorphoses, enabling us to develop a precise treatment plan, predict its effects and aim for a result that is both functional and aesthetic. However, this superimposition of structures often makes it difficult to recognise the anatomical landmarks that allow the gonial angle to be studied properly.[4] Panoramic radiography is the most commonly prescribed examination in odontology. It allows the dental and maxillofacial structures that extend from one mandibular

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condyle to the other to be examined. Among other structures, it allows both the right and left gonial angles to be studied on the same X-ray image.[3] Several studies have focused on the dilemma of whether there is a difference in the value of the gonial angle between panoramic radiography and lateral cephalogram.[5-7] To date, no studies have been conducted on this issue in a sub-Saharan African adult population with normal occlusion. Therefore, the objective of this study was to compare the gonial angle values on panoramic radiographs and lateral cephalogram in a Senegalese population with normal occlusion.

2. Materials and Methods

This is a cross-sectional study of 60 patients treated by the orthodontics department of the Institute of Odontology and Stomatology of the Faculty of Medicine, Pharmacy, and Odontology in Dakar.

This study included:

1. Over 16 years of age
2. Be in class I skeletal angle in normocclusion
3. Have a digital panoramic radiograph and a digital lateral cephalogram. Panoramic radiographs and lateral teleradiography s with artifacts incompatible with morphometric analysis were not retained.

The variables studied were age, sex, and goniacal angle values in degrees.

Age was calculated as the difference between the date of consultation and the patient's date of birth. Sex was recorded in the patient's file.

The gonial angle was studied on panoramic radiography and on lateral cephalogram. The radiographic examinations were carried out by an experienced dental X-ray technician using a machine. Carestream CS 9600 (Atlanta, Georgia).

The radiographs were analyzed by a dental surgeon specializing in dento-maxillo-facial radiology. The images were scanned using Carestream's CS Imaging 8 software.

The gonia angle was measured on both the right and left panoramic radiographs (**Figure 1**) and the lateral cephalogram (**Figure 2**) of the same patient and expressed in degrees. It is formed by the tangent to the posterior edge of the mandibular ramus and the lower edge of the mandibular body.

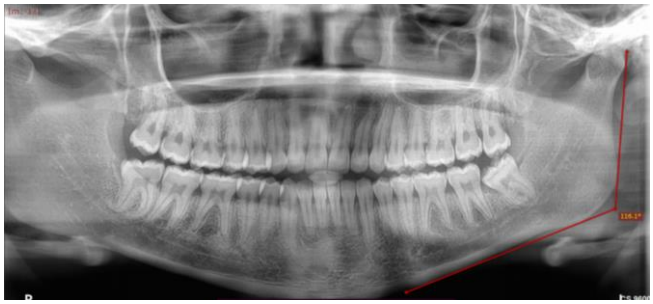

Figure 1: The left gonial angle measured on digital panoramic radiograph

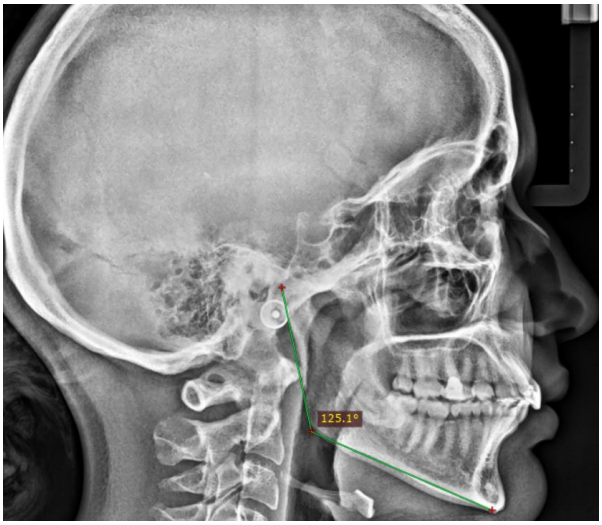

Figure 2: The gonial angle measured on the lateral cephalogram

2.1. Statistical analysis

The data were collected and processed using Jamovi. Results were expressed as a percentage and number of patients. A one-way analysis of variance (ANOVA) was performed to compare the mean values of the goniac angles. The significance level was set at p less than 0.05.

3. Results

A total of 60 cases were selected, 51.7% (n=31) of which were girls and 48.3% (n=29) boys. The mean age was 24.6 ±0.6 years. The mean gonial angle was 119±6.8 degrees on lateral cephalogram. On panoramic radiography, they were 119±7.17 degrees on the right side and 120±7.19 degrees on the left side. Depending on the radiographic technique used, the mean value of the gonial angle showed no statistically significant difference (**Table 1**). No statistically significant difference was found for gender (p=0.9) (**Table 2**). The mean value of the gonial angle was 119±7.6 degrees in girls and 119±5.5 degrees in boys. The ANOVA analysis of variance showed that the mean values of the goniac angle did not differ in any statically significant way according to the radiographic technique used (p>0.05), with mean values between 119 degrees and 121 degrees (**Table 3**).

Table 1: Means values for gonial angles on lateral cephalogram and panoramic radiography

	n	Means±SD
GA right	60	119±7.17
GA LC	60	119±6.68
GA left	60	119±7.19

p>0,05
GA LC: gonial angle on lateral cephalogram
GA right: gonial angle right on panoramic radiograph
GA left: gonial angle left on panoramic radiograph

Table 2: Mean value of the gonial angle according to sex

Group	N	Means± SD	p
F	31	119±7,69	0.918
M	29	119±5,54	

Table 3: Analysis of covariance of the value of the gonial angle according to sex and radiographic technique

	Sex	N	Means	SD	p
GA LC	F	31	119	7.69	0.9
	M	29	119	5.54	
GA right	F	31	119	7.93	0.8
	M	29	119	6.39	
GA left	F	31	120	7.57	0.5
	M	29	121	6.86	

F: Female, M: Man

4. Discussion

This study involved 60 adult Senegalese subjects in normocclusion. The results showed that there were no statistically significant differences between the gonial angle values measured on lateral teleradiography and panoramic radiography.

The mean values of the gonial angle were 119±6.8° on profile teleradiography. On panoramic radiography, they were 119±7.17° on the right side and 120° on the left. This value was higher in a population of 28 normal-divergent Pakistani subjects with 123.66°±5.50.[6] In 50 normal-occlusion Indians, the angle was 122.7±1 with no difference between panoramic radiography and lateral cephalogram.[7] Mattila et al.[5] conducted a comprehensive comparison of gonial angle measurements across three modalities: lateral cephalogram, panoramic radiograph, and dry skull specimens. Their findings demonstrated that panoramic radiography provided measurements that closely matched those obtained from direct dry skull measurements, suggesting superior accuracy compared to lateral cephalogram. These conclusions are reinforced by subsequent studies. Larheim and Svanaes[4] confirmed the reliability of panoramic radiography for angular measurements. Akcam et al. supported these methodological findings.[9] Alhaija et al. specifically validated panoramic radiographs for assessing mandibular tilt, noting strong intermodal correlation coefficients.[10] The collective evidence from these studies establishes panoramic radiography as a clinically valid alternative for precise gonial angle measurement in both research and diagnostic applications. Fatahi and Babouei conducted a reliability assessment of cephalometric measurements derived from panoramic radiography.[11] Their analysis demonstrated no statistically significant difference between gonial angle measurements obtained from lateral cephalogram and panoramic radiography (right side), strong correlation between panoramic radiographic measurements and direct dry skull measurements, comparable accuracy between panoramic radiography and lateral cephalogram for gonial angle evaluation. Kurt et al. further substantiated these findings, confirming the clinical validity of panoramic radiography for gonial angle assessment. Notably, they highlighted three key advantages of panoramic radiography no invasive naturen, favorable cost-benefit ratio, reduced radiation exposure compared to alternative methods.[12]

Shahabi et al. compared the external gonial angle determined from lateral cephalogram and panoramic radiographs in class I patients.[13] Based on the results obtained, they concluded that panoramic radiography can be used to determine the gonial angle as accurately as cephalometry. These results corroborate those of several authors.[13-15] However, goniac angle measurements are routinely performed on lateral cephalogram rather than panoramic radiography. The results of the present study show that panoramic radiography can be used to perform these measurements as well as lateral cephalogram. Araki et al on dry skulls showed that the gonial angle is smaller on panoramic radiography than lateral cephalogram with a statistically significant difference.[6]

5. Conclusion

In short, it is possible to use panoramic radiography to measure the goniac angle with the same precision as lateral cephalogram. Instead, it may be desirable to perform gonial angle measurements on the panoramic radiograph as the right and left goniac angles can be visualized separately and clearly. Although lateral cephalogram is considered to be more accurate for measuring the goniac angle, panoramic radiography can also provide useful information on this angle.

6. Ethical Committee Approval

Yes.

7. Source of Funding

None.

8. Conflict of Interest

No.

9. Acknowledgement

None.

References

1. Xiao D, Gao H, Ren Y. Craniofacial morphological characteristics of Chinese adults with normal occlusion and different skeletal divergence. *Eur J Orthod*. 2011;33(2):198–204. https://doi.org/10.1093/ejo/cjq064.
2. Upadhyay RB, Upadhyay J, Agrawal P, Rao NN. Analysis of gonial angle in relation to age, gender, and dentition status by radiological and anthropometric methods. *J Forensic Dent Sci*. 2012;4(1):29–33. https://doi.org/10.4103/0975-1475.99160.
3. Foucart J-M, Felizardo R, Pizelle C, Bourriau J. Indications for radiography in orthodontics and dentofacial orthopedics. *Orthod Fr*. 2012;83(1):59–72. https://doi.org/10.1051/orthodfr/2012001.
4. Larheim TA, Svanaes DB. Reproducibility of rotational panoramic radiography: mandibular linear dimensions and angles. *Am J Orthod Dentofacial Orthop*. 1986;90(1):45–51. https://doi.org/10.1016/0889-5406(86)90026-0.
5. Mattila M, Könönen M, Mattila K. Vertical asymmetry of the mandibular ramus and condylar heights measured with a new method from dental panoramic radiographs in patients with psoriatic arthritis. *J Oral Rehabil*. 1995;22(10):741–5. https://doi.org/10.1111/j.1365-2842.1995.tb00217.x.
6. Araki M, Kiyosaki T, Sato M, Kohinata K, Matsumoto K, Honda K. Comparative analysis of the gonial angle on lateral cephalometric radiographs and panoramic radiographs. *J Oral Sci*. 2015;57(4):373–8. https://doi.org/10.2334/josnusd.57.373.
7. Radhakrishnan PD, Varma NKS, Ajith VV. Dilemma of gonial angle measurement: panoramic radiograph or lateral cephalogram. *Imaging Sci Dent*. 2017;47(2):93–7. https://doi.org/10.5624/isd.2017.47.2.93.
8. Rehman SA, Rizwan S, Faisal SS, Hussain SS. Association of gonial angle on panoramic radiograph with the facial divergence on lateral cephalogram. *J Coll Physicians Surg Pak*. 2020;30(4):355–8. https://doi.org/10.29271/jcpsp.2020.04.355.
9. Akcam MO, Altiok T, Ozdiler E. Panoramic radiographs: a tool for investigating skeletal pattern. *Am J Orthod Dentofacial Orthop*. 2003;123(2):175–81. https://doi.org/10.1067/mod.2003.3.
10. Abu Alhaija ESJ. Panoramic radiographs: determination of mandibular steepness. *J Clin Pediatr Dent*. 2005;29(2):165–6.
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*. 2007;31:223–30. https://doi.org/10.22038/jmds.2007.1392.
12. Kurt G, Uysal T, Sisman Y, Ramoglu SI. Mandibular asymmetry in Class II subdivision malocclusion. *Angle Orthod*. 2008;78(1):32–7. https://doi.org/10.2319/021507-73.1.
13. Shahabi M, Ramazanzadeh B-A, 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. https://doi.org/10.2334/josnusd.51.425.
14. Bhullar MK, Uppal AS, Kochhar GK, Chachra S, Kochhar AS. Comparison of gonial angle determination from cephalograms and orthopantomogram. *Indian J Dent*. 2014;5(3):123–6. https://doi.org/10.4103/0975-962X.140820.
15. Kumar SS, Thailavathy V, Srinivasan D, Loganathan D, Yamini J. Comparison of orthopantomogram and lateral cephalogram for mandibular measurements. *J Pharm Bioallied Sci*. 2017;9(Suppl 1):S92–5. https://doi.org/10.4103/jpbs.JPBS_98_17.

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