Comparison between Panoramic Radiograph and Lateral Cephalogram in Determining Gonial Angle in Western UP Orthodontic Patients

By Rashi Chaturvedi

Abstract - Introduction: Gonial angle is an important determinant of mandibular morphology and a salient parameter in the evaluation of vertical growth dysplasia as well as facial skeletal asymmetry. It also has got important application in age estimation in forensic sciences, formulating camouflage and ortho surgical treatment plan for skeletal malocclusion, as well.

Aim: The study aims to check whether there is any significant difference between the assessment of gonial angle from panoramic radiograph and lateral cephalogram in western UP orthodontic patients and establishing the reliability of panoramic radiograph as an essential diagnostic aid in orthodontics.

Keywords: gonial angle, OPG, lateral cephalogram, growth pattern.

GJMR-J Classification: DDC Code: 617 LCC Code: RK1

Strictly as per the compliance and regulations of:

© 2022, Rashi Chaturvedi. This research/review article is distributed under the terms of the Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0). You must give appropriate credit to authors and reference this article if parts of the article are reproduced in any manner. Applicable licensing terms are at https://creativecommons.org/licenses/by-nc-nd/4.0/.
Comparison between Panoramic Radiograph and Lateral Cephalogram in Determining Gonial Angle in Western UP Orthodontic Patients

Rashi Chaturvedi

Abstract: Introduction: Gonial angle is an important determinant of mandibular morphology and a salient parameter in the evaluation of vertical growth dysplasia as well as facial skeletal asymmetry. It also has got important application in age estimation in forensic sciences, formulating camouflage and ortho surgical treatment plan for skeletal malocclusion, as well.

Aim: The study aims to check whether there is any significant difference between the assessment of gonial angle from panoramic radiograph and lateral cephalogram in western UP orthodontic patients and establishing the reliability of panoramic radiograph as an essential diagnostic aid in orthodontics.

Materials and Methods: A total of 60 panoramic and cephalometric radiographs of patients (24 males, 36 females) ranging from age 12-24 years were used in this study. 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 panoramic radiograph and lateral cephalogram manually and measured with the help of protractor. Pearson correlation was applied to check for correlation between cephalometric and panoramic gonial angle value.

Results: High correlation between cephalometric and panoramic gonial angle values was seen using pearson correlation coefficient.

Conclusion: Panoramic radiograph can be used as an effective, reliable, alternative to lateral cephalogram in determining gonial angle which shows versatility of panoramic radiograph as a diagnostic tool.

Keywords: gonial angle, OPG, lateral cephalogram, growth pattern.

I. INTRODUCTION

In orthodontics, the treatment planning is based of enumeration of problem list, clinical examination and evaluation of diagnostic records i.e. dental casts, radiographs and photographs.

Orthopantomogram is considered as an essential diagnostic aid for gross assessment of dental and skeletal framework.

In 1961 Prof. Yrjo Paatero introduced panoramic radiography. It provides a bird’s eye view of the entire dentition, information about teeth and their axial inclinations, stages of maturation, surrounding structures and supporting bone. In 1934 Hofrath and Broadbent introduced cephalometrics as a research and a clinical tool.

Gonial angle on lateral cephalogram is measured by the intersection of tangent to the lower border of the mandible and posterior ramus. In hyperdivergent or high angle cases the gonial angle is found obtuse, which interprets downward and backward rotation of the mandible. In hypodivergent or low angle individuals gonial angle values are acute, and interprets upward and forward rotation of the mandible. Recent studies have shown that OPG can also be used to determine gonial angle which is an important parameter in cephalometric diagnosis. Larheim & Svanaes observed inaccuracy and difficulty in measuring gonial angle using lateral cephalogram because of the superimposition of right and left images. Also the gonial angle values measured from OPG was same as measured from dried human mandibles. Mattila et. al (1977) also concluded that gonial angle measurement from OPG were the same as from lateral cephalogram.

Several investigators determined gonial angle using OPG and lateral cephalogram and found OPG as a reliable and accurate tool in determining the gonial angle. On the other hand, other studies proposed that the interpretation of the vertical aspect of craniofacial structures can be reliably obtained via OPG but other diagnostic informations are more reliably achieved via lateral cephalogram. The aim of the study was to check whether there is any significant difference between the assessment of gonial angle from OPG and cephalogram in western UP orthodontic patients. Application of orthopantomogram also gives an important information regarding vertical jaw dysplasia in routine orthodontic practice.

II. MATERIALS AND METHODS

A total of 60 panoramic and cephalometric radiographs of patients (24 males and 36 females, age 12-24 years) who were enrolled for treatment at Department of Orthodontics and Dentofacial Orthopedics, Kalka Dental College, Meerut were used in this study.

The inclusion criteria for the radiographs were as follows: The radiograph had to be of high quality and sharpness; all radiographs had to be taken using the same apparatus.
The exclusion criteria for the radiographs were: dento-facial trauma, history of any facial/mandibular surgery, syndromes in relation to face/jaw and asymmetric facial appearance.

Lines tangent to the lower border of mandible and distal border of ascending ramus and condyle on both sides were drawn to mark gonial angle in OPG. (Fig. 1).

The point of convergence of plane tangential to lower border of mandible and that tangential to distal border of ascending ramus and condyle were drawn to mark gonial angle in lateral cephalogram (Fig. 2).

**Statistical Analysis:** As the data for angles were quantitative data, these were estimated using mean and standard deviation. Correlation between the radiograph techniques was made by applying pearson correlation. The level of significance \( \alpha =0.05 \) was set for the two-sided statistical tests.

**III. Results**

The study sample consisted of panoramic radiographs and lateral cephalograms of 60 patients (36 females and 24 males; age range 12-24 yrs. The subjects were divided based on gender into males and females and compared for the value of gonial angle on OPG or cephalogram.
Table 1: Mean, Standard deviation and Standard error of panoramic and lateral cephalometric gonial angle values in subjects distributed on the bases of gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean(degrees)</th>
<th>Std.deviation</th>
<th>Std.error mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cephalometric gonial angle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>122.5</td>
<td>7.47</td>
<td>1.529</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>123.5</td>
<td>7.44</td>
<td>1.241</td>
</tr>
<tr>
<td><strong>Gonial angle OPG right</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>121.23</td>
<td>6.94</td>
<td>1.419</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>120.13</td>
<td>7.65</td>
<td>1.275</td>
</tr>
<tr>
<td><strong>Gonial angle OPG left</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>120.75</td>
<td>6.12</td>
<td>1.25</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>121.58</td>
<td>7.46</td>
<td>1.244</td>
</tr>
<tr>
<td><strong>Gonial angle OPG total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>120.66</td>
<td>6.51</td>
<td>1.33</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>120.86</td>
<td>7.29</td>
<td>1.216</td>
</tr>
</tbody>
</table>

Correlation between values of cephalometric and OPG gonial angle was checked by applying pearson correlation coefficient. The level of significance was set at $p \leq 0.05$.

Table 2: Pearson's correlation of cephalometric gonial angle, gonial angle OPG right, gonial angle OPG left, and gonial angle OPG total

<table>
<thead>
<tr>
<th></th>
<th>Ceph. gonial angle</th>
<th>OPG rt</th>
<th>OPG lt</th>
<th>OPG total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceph. gonial angle Pearson correlation Sig. (2-tailed)</td>
<td>1</td>
<td>0.82</td>
<td>0.80</td>
<td>0.85</td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>OPG right</td>
<td>Pearson correlation Sig. (2-tailed)</td>
<td>0.82</td>
<td>1</td>
<td>0.83</td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>OPG left</td>
<td>Pearson correlation Sig. (2-tailed)</td>
<td>0.80</td>
<td>0.83</td>
<td>1</td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>OPG total</td>
<td>Pearson correlation Sig. (2-tailed)</td>
<td>0.85</td>
<td>0.96</td>
<td>0.95</td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 2 shows a high correlation between the values taken on both the radiographs.
IV. Discussion

The goal of this study was to diversify the clinical application of panoramic radiographs by exploring its ability to evaluate craniofacial structures. Even though there are a number of published articles on disadvantages of using panoramic radiographs because of its image distortion and magnification, there are only a few studies involving the use of panoramic radiographs in evaluating dentoskeletal structures and gonial angle measurements.

The results of the above study showed that there are no statistically significant differences in the values of gonial angle measured on cephalogram and panoramic radiograph. Therefore, it is possible to use panoramic radiograph for measuring the gonial angle with equal accuracy as cephalogram. Right and left gonial angles can be clearly and separately viewed using orthopantomogram. Mattila et al. (1977) 8 showed that measurements on OPG for right and left gonial angles conform to the angles measured on dry skulls and the measurements made on OPG are more accurate than measurements made on cephalogram. The present study shows the same results. But, still, lateral cephalogram is considered routinely for measuring the gonial angle rather than OPG. The results of the present study demonstrate that panoramic radiographs can be used to make these measurements as often as lateral cephalograms, especially in cases of asymmetries before taking PA cephalogram and where the right and left sides are not clearly visible.

Anderson and Popovich (1989) 12 analysed samples of 227 children from Burlington growth centre records. They made cephalometric measurements of anterior cranial base, posterior medial and lateral cranial base length, mandibular ramus height, mandibular body length and angles of Class I and II groups. They found a strong correlation between lateral and medial cranial base angles in Class II malocclusion groups as compared to Class I group malocclusions.

Gungor, Sagir and Ozer (2007) 13 compared gonial angle symmetry and sexual dimorphism in ancient Anatolian population. They concluded that there is no asymmetrical difference between right and left gonial angle degree of individuals belonging to the same sex.

Oksayan et al. (2012) 14 assessed gonial angle by comparing panoramic and lateral cephalogram radiograph on 49 patients with an age range of 12-29 years. They studied subjects retrospectively under groups i.e. skeletal and dental Class I, II and III malocclusion group. The results showed no significant differences between group values of gonial angles determined by lateral cephalometric radiograph and panoramic radiograph.

Adil et al. (2015) 15 conducted a hospital based survey on 80 departmental Class I malocclusion patients. They checked the accuracy of measurement of gonial angle values traced through OPG and Lateral cephalogram. They concluded that the gonial angle of both right and left side OPG is reliable but a significant difference was observed when measured from lateral cephalogram.

Katti et al. (2016) 16 studied 100 OPG and lateral cephalogram radiographs of patients with Angle’s Class I malocclusion with age ranging from 15 to 30 years. They concluded that there was no statistical difference between the measured gonial angles on panoramic and cephalometric radiographs.

Radhakrishnan, Varma and Ajith (2017) 17 evaluated the accuracy of measurement of gonial angle of Class I malocclusion patients using both lateral cephalogram and panoramic radiographs. They found no statistical significant difference between gonial angle measurements using OPG or lateral cephalometric radiographs.

Bibi, Rasool and Khan (2017) 18 studied 100 radiographs of patients with the mean age of 18 years. Their result showed a significant correlation between OPG and lateral cephalometric values. They also concluded that OPG is a reliable and versatile tool as lateral cephalogram for assessing vertical facial pattern.

Ul-Haq, Memon and Agha (2018) 19 compared three methods to determine gonial angle on cephalogram and orthopantomogram among three groups i.e. hypodivergent, normodivergent and hyperdivergent of 178 radiographs. They concluded that OPG cannot be an alternative choice for gonial angle.
determination and lateral cephalogram cannot be replaced by OPG.

Lone and Mushtaq (2018) carried out a cross sectional study on 90 subjects divided into three groups i.e Class I, Class II, Class III. They concluded that measurement of gonial angle in OPG was as reliable as found in lateral cephalogram. 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 0.820 and 0.803 was found for right and left gonial angles with lateral cephalogram respectively. There was no statistically significant difference between the values of the total gonial angle wrt OPG and lateral cephalogram.

Our study clearly showed the reliability and versatility of panoramic radiographs other than its routine dental use. Also the results are comparable to the findings of other researchers which strengthens our conclusion. No studies are available on western UP orthodontic population regarding the reliable applicability of OPG for vertical growth pattern. Our study fills a knowledge gap in this regards. OPG is an important diagnostic tool and this study confirms its reliability as an alternative diagnostic tool to lateral cephalogram for determining gonial angle however, it cannot substitute lateral cephalogram in the information contained in it.

V. Conclusion

Gonial angle can be measured accurately by using panoramic radiography or lateral cephalogram. Furthermore, in panoramic radiography, the right and left gonial angles can be measured easily without superimposition of anatomic landmarks, which occurs frequently in lateral cephalogram. For determination of the gonial angle, an OPG may be a better choice than a lateral cephalogram as it is an essential diagnostic tool, also radiation dose is low as compared to lateral cephalogram, and is cost effective. As a result, the aim of this study was to improve the clinical flexibility of the panoramic radiography, which is a critical tool for dental diagnosis.

Source of Funding

No financial support was received for the work within this manuscript.

References Références Referencias