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Original Article

Linear and Angular Mandibular Measurements: Comparison between Panoramic Radiography (Orthopentomogram) and Lateral Cephalogram

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ABSTRACT

Invention of lateral cephalogram by Hofrath in Germany and Broadbent in United States provided a clinical tool for assessment of skeletal disparities. But lateral cephalogram is not effective in measuring bilateral cranial structures independently. In orthodontic practice, panoramic radiographs are frequently obtained for information about maturation period of teeth with surrounding tissues and their axial inclination. **Objective:** To determine the use of orthopantomogram, whether it's a substitute of lateral cephalogram for the linear and angular measurement of mandible. **Methods:** This was a Prospective Cohort study. Study was conducted at Nishtar Institute of Dentistry, Multan form January 2021 to December 2021 in one year duration. A total of 75 patients were found to be eligible for the study. Gonial angle of patients with malocclusion type I was measured with lateral cephalogram and orthopantomogram. In orthopantomogram, measurement of gonial angle was made by drawing a tangent line to the lower border of mandible and other tangent line to the distal border of ramus and both sides of condyle. In lateral cephalogram it was measured at intersection point of mandibular plane and ramus plane. **Results:** Overall, 75 patients were included in our study. The average age of the patients was 16.43±4.06 years. The mean difference between cephalogram and OPG was statistically significant, ($p<0.001$). **Conclusions:** Gonial angle can be measured on OPG as accurately as on lateral cephalogram but linear measurements are taken accurately by the help of orthopentomogram.

INTRODUCTION

Invention of lateral cephalogram by Hofrath in Germany and Broadbent in United States provided a clinical tool for assessment of skeletal disparities [1]. But lateral cephalogram is not effective in measuring sides (right or left) of cranial structures independently because of superimposed images and overlapping of sides[2]. Usually linear measurements were taken as body length-condylion-gonion in centimeters and secondly through ramus height-gonion menton in centimeters [3]. In craniofacial complex, gonial angle is an essential measurement which is significant in diagnosis of craniofacial problems[1]. It is that important measurement which indicate symmetry of facial skeleton. It can be measured by taking tangent to the lower border of mandible from posterior border of ramus. Gonial angle describes the shape and form of the mandible. In orthodontic practice radiographs of panoramic view are frequently obtained for information about maturation period of teeth with surrounding tissues and their axial inclination [4]. Panoramic technology in radiography is common and widely used in routine measure bilateral structures of mandible [5]. Through panoramic X-rays, both right and left sides of craniofacial structure can be visualized by producing exact and predictable image of teeth and relevant structures in limited time and minimum exposure to radiations to radiographer and patients [6]. Cephalometric assessment through radiographic measurement are used, most probably anteroposterior

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and lateral projections are in practice [7]. During the planning of jaw surgery interference of superimposed imaging for reliable measurement of gonial angle on lateral cephalogram are very difficult [8]. Such type of disadvantages cannot be compensated in orthopantomography where this examination is commonly used in examination of jaw. Gonial angle measured from panoramic radiograph (OPG) is found to be more reliable than lateral cephalometric radiograph. It is difficult to measure gonial angle accurately on the cephalometric radiograph as there is superimposition of the left and right sides angle [9]. Angular measurement varies person to person; it may differ with type of malocclusion and age of person. Average mandibular size remains unchanged after adulthood till 70 years except few people with extensive tooth extraction [10]. Limited studies were conducted on comparison of mandibular measurements from two different radiographs lateral cephalograms and orthopantogram [11]. This study was planned to identify appropriate radiography for mandibular measurement and to determine whether panoramic view is an alternate of lateral cephalogram.

METHODS

Study was started after ethical approval from departmental ethical review committee of Nishtar Institute of Dentistry, Multan form January 2021 to December 2021 in one year duration. It was a Prospective Cohort study. The sample size was 75 as it was adopted from already published parent article [12, 13]. Written informed consent was taken from patients. Non probability consecutive sampling technique was used. Patients of class I malocclusion, radiographs of high quality and well organized sharpness and natural head position were included in the study. Patients of class II, III malocclusion, any syndrome affecting jaw and face and previous history of facial surgery were excluded from the study. Radiographs of all patients were taken on same digital panoramic system. Gonial angle was measured by taking a tangent to the lower border of mandible and posterior border of ramus and the condyle on both panoramic and cephalometric radiographs. SPSS version 24.0 was used for data entry and analysis after initial composing in Microsoft excel sheet. Mean and standard deviations SD were calculated for numerical data and frequency percentages were calculated for categorical data, independent t-test for numerical outcomes and chi square test for categorical outcomes was applied. p-value less than or equal to 0.05 was taken as significant.

RESULTS

Overall, 75 patients were included in our study. The average age of the patients was 16.43±4.06 years. Majority of the patients were females, 50(66.7%)(Table 1).

Table 1: Demographic and gonial angle in lateral cephalogram and OPG

Characteristic		Mean ± SD	N (%)
Age (years)		16.43±4.06	
Gender	Male		25 (33.3)
	Female		50 (66.7)
CH OPG		5.42±1.32	
CoMe OPG		139.25±12.19	
CoGo OPG		62.73±13.18	
GoMe OPG		100.81±18.31	
Right Go OPG		122.01±7.31	
Left Go OPG		121.78±7.69	
CH cephalogram		4.33±1.03	
CoMe cephalogram		96.21±7.46	
CoGo cephalogram		46.01±5.22	
GoMe cephalogram		62.13±5.89	
Go cephalogram		124.71±6.72	

Mean CH OPG was 5.42±1.32, CoMe OPG was 139.25±12.19, CoGo OPG was 62.73±13.18, right Go OPG was 122.01±7.31, left Go OPG was 121.78±7.69, CH cephalogram was 4.33±1.03, CoMe cephalogram was 96.21±7.46, CoGo cephalogram was 46.01±5.22, GoMe cephalogram was 62.13±5.89 and Go cephalogram was 124.71±6.72. The comparison of cephalogram and OPG is shown in Table 2. The mean differences between gonial angle in lateral cephalogram and OPG were statistically significant, ($p<0.001$) (Table 2).

Table 2: Comparison of linear and angular measurements in lateral CEPH and OPG

Comparison	Mean ± S.D	Mean difference	t	p-value
CH OPG with CH cephalogram	5.42±1.32 with 4.33±1.03	1.09±0.19	5.56	<0.001
Co Me OPG with Co Me cephalogram	139.25±12.19 with 96.21±7.46	43.05±13.97	26.68	<0.001
Co Go OPG with Co Go cephalogram	62.73±13.18 with 46.01±5.22	16.73±12.84	11.28	<0.001
Go Me OPG with Go Me cephalogram	100.81±18.31 with 62.13±5.89	75.78±10.08	65.07	<0.001
R. Go with Go cephalogram	122.01±7.31 with 124.71± 6.72	-2.69±4.68	-4.98	<0.001

DISCUSSION

In this study mandibular linear measurements and mandibular angular measurements on lateral cephalogram were compared with mandibular linear measurements and mandibular angular measurements on OPG. There are number of studies on comparison of gonial angle measurements between OPG and lateral cephalogram but limited data available on comparison of linear and angular measurements between two. Gonial angle has special

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effects on profile changes, growth and anterior teeth conditions in lower jaw [14]. In our study mean difference between gonial angle in cephalogram and gonial angle in OPG was statistically significant p=0.001 showing the measurements taken on these two different radiographs are significantly different whereas the mean differences between the linear measurements on lateral cephalometric and linear measurements on OPG were also found to be significant which means linear measurements are taken accurately only on OPG . Ongkosuwito *et al., conducted a study to assess the reliability of OPG for linear measurements and reported that OPG is as reliable as lateral cephalogram for linear measurements of mandible [15].* Katti *et al.*, conducted a study on gonial angle measurement and compared panoramic view of radiography and lateral cephalogram and reported that panoramic radiography can be used accurately to determine the value of gonial angle in place of cephalogram [16]. According to a study conducted by Baig, Significant differences were found when gonial angle values obtained from OPG right and left sides were compared with that of lateral cephalogram [9]. Therefore gonial angle cannot be measured on OPG as precisely as lateral cephalometric radiograph. A study was conducted by Mattila *et al.,* and reported gonial angle measurement with panoramic radiography has 2.2 to 3.6º less measurement as compare to lateral cephalogram [17]. In another study by Larheim *et al.,* reported that gonial angle measurement and measurement on dried mandible was compared and reported that measurement of gonial angle from panoramic film are almost exact as measured from dried skull and accuracy of dried skull from 5 dried skulls was reported up to 25% [18]. Contrast findings were reported by Fischer–Brandies *et al.,* in a study in 1984 and reported that there was significant difference in gonial angle when measured with two different radiographs. This disparity in findings may be due to difference in age difference of patients or occlusion type [19]. Furthermore, there was a difference in measurements of gonial angle from right and left side of mandible on OPG in our study. Similar findings were reported by Altonen *et al.,* that clinicians should be attentive and vigilant while predicting cephalometric measurement from panoramic radiographs [20]. In a study by Akcam *et al.,* angular measurements were compared on OPG and cephalogram and it was concluded that OPG can be used for angular measurement of craniofacial structures but its reliability is not comparable with lateral cephalogram [21]. Another study by Radhakrishnan *et al.,* concluded that there was no statistical difference in gonial angle measurement on panoramic radiography and lateral cephalogram when there was no interference of superimposed images [22]. In a study conducted by Turp *et al.,* and compared linear measurements on ramus form lateral cephalogram and OPGs, at the end of study no correlation was observed between both techniques [23]. In another study by Kambylafkas *et al.,* panoramic radiography or OPG was used for measurements of total ramal height and some underdiagnosis were reported [24].

CONCLUSIONS

Gonial angle can be measured on OPG as accurately as on lateral cephalogram without superimposed radiological images that are common in lateral cephalogram but linear measurements are taken accurately by the help of orthopentomogram. Furthermore, panoramic radiography is inexpensive, simple and easily available technique. Most of patients in our study belong to remote areas of Pakistan, because of religious ethics they didn't allow to share images. Second limitation of our study is small sample size and single center study. Studies with larger sample size and multicenter are recommended.

Authors Contribution

Conceptualization: R
Methodology: SU
Formal analysis: SU, AUK
Writing-review and editing: SU, AUK, JK, SA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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