COMPARISON OF ACCURACY OF PANORAMIC RADIOGRAPH AND LATERAL CEPHALOGRAM IN DETERMINING LINEAR MANDIBULAR MEASUREMENTS AMONG ORTHODONTIC PATIENTS IN TERTIARY DENTAL CARE CENTER IN KATHMANDU

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ABSTRACT

Mandibular dimensions are one of the key parameters for planning the treatment by an Orthodontist. Lateral cephalograms are usually used to evaluate the skeletal relationship. However, due to the superimposition of both the sides, lateral cephalogram may not be reliable in measuring the right and left sides of the cranial landmarks. Panoramic radiography delivers a wide-ranging view of maxillofacial structures with comparatively lesser radiation exposure than other tools and superimposition of structures is less compared to lateral cephalogram image. OPG and lateral cephalograms of all the patients of age group 16-35 years attending Department of Orthodontics in Nepal Medical College from September 2022 to February 2023, having Angle's Class I Molar relationship with minimum crowding was taken. Linear measurements (ramus height, total mandibular length and mandibular body length) were measured on OPG and Lateral cephalogram. The data was processed in SPSS version 17 for further analysis. There was no statistically significant difference in mean linear measurements between right and left sides on OPG (p-value 0.77, 0.49 and 0.59 respectively). But there was a statistically significant difference in mean linear measurements between both sides on OPG and lateral cephalograms (p-value <0.001). OPG can be used reliably to measure the mandibular length and ramus height of right and left side but comparison of mandibular length and ramus height between lateral cephalogram and OPG may not be reliable.

KEYWORDS

Linear, mandibular, orthopantomogram

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INTRODUCTION

Mandibular dimensions, which include ramal height (Condylion-Gonion), mandibular body length (Gonion- Menton) and total mandibular length (Condylion-menton) are one of the key parameters for planning the treatment by an Orthodontist.[1]

Various diagnostic aids used in orthodontics for treatment planning include clinical examinations, model analysis, photographs, and various radiographs.[2] Cephalograms and orthopanomograms (OPG) are routinely taken in orthodontic patients.[3] Cephalograms are one of the important diagnostic tools for assessment of jaw relationship in all three planes: sagittal, vertical and transverse.[4]

Cephalometric analysis is done to evaluate horizontal and vertical relationship of major components of face. Horizontal and vertical relationship of these structures is equally important for treatment planning and its outcome.[5] The OPG is commonly used in daily clinical routine. This radiograph allows a bilateral view and adequate information on vertical measurements.[6,7]

Studies on panoramic radiography have shown that vertical and angular measurements seem to be more acceptable than horizontal measurements provided the patient's head is positioned properly.[8,9]

Lateral cephalogram proposed in 1931 by Broadbent in United States and Hofrath in Germany provided both a clinical and a research tool to assess the underlying skeletal disproportions. Since then lateral cephalograms have been used to diagnose dentofacial deformities.[10]

However, due to the overlapping of right and left sides of craniofacial structures and superimposed images on the radiographs, lateral cephalograms are not considered much reliable in measuring those structures mostly in asymmetric cases.[10] On an OPG, certain landmarks can be better identified than on a lateral cephalogram as there are no overlapping of landmarks for left and right side. [11]

Conventional cephalometry is an inexpensive and well-established method for evaluating patients with dentofacial deformities by measuring the lengths and angles defined by craniofacial reference points. Lateral cephalometry has proven valuable for the evaluation of patients with dentofacial deformities. In combination with frontal cephalometry, these methods are also applicable in patients with mild craniofacial asymmetries.[12]

Facial asymmetry is a common phenomenon in craniofacial complex of human being.[13] However, there are wide variations in the facial asymmetry of patients who need orthodontic treatment—from cases in which occlusion can be improved by orthodontics alone to cases of severe asymmetry where orthognathic surgery is needed to improve occlusion and/or facial features.[14]

The validity of cephalometric measurements when determined on an OPG is still a question to be investigated. Thus, the aim of this study is to compare accuracy of panoramic radiograph and lateral cephalogram in determining linear mandibular measurements among orthodontic patients in tertiary dental care center in Kathmandu.

MATERIALS AND METHODS

OPG and lateral cephalograms of all the patients of age group 16-35 years attending Department of Orthodontics in Nepal Medical College from September 2022 to February 2023, having clinically harmonious and symmetrical face, full complement of dentition except third molar, Angle's Class I Molar relationship with minimum crowding were taken. Each patient selected for the study was explained about the study and each patient was instructed to sign written consent form. Ethical clearance was taken from Institutional Review Committee, Nepal Medical College. Complete enumeration (census) sampling was done.

All the radiographs were taken with Natural Head Position (NHP) with high quality and sharpness were selected and taken with same apparatus (Villa Sistemi Medicali, 00kV-6.00mA-13.80s, Italy) and standard exposure conditions. The selected radiographs were traced, landmarks were located, and lines were drawn and measured with single investigator. To improve the measurement accuracy, a vernier caliper was used to measure and record the readings. Linear measurements included ramus height from Condylion (Co) to Gonion (Go), and total mandibular length from Condylion (Co) to Menton (Me) and mandibular body length from Gonion (Go) to Menton (Me). The patient with craniofacial malformations and facial asymmetries were excluded. The data was processed using SPSS-17. Mean and standard deviation were calculated for all the parameters. Independent t-test was done to find the difference in mean body length and

mean ramus height between right and left OPG. Paired t-test was performed for comparison of mean body length and mean ramus height between OPG and lateral cephalograms. Level of significance was set at p-value <0.05.

RESULTS

A total of 50 study participants were included in the study of which 27 (54%) were males and 23 (46%) were females. The age of the study participants ranged from 16 to 35 years with mean age 19.68±4.35 years.

Average mandibular body length (ML), Ramal Height (RH), and total mandibular length (TML) were traced on OPG with the mean and standard deviation 106.52±9.37, 65.56±6.01, 142.56±8.91 respectively. Whereas for the lateral cephalogram ML, RH, and TML were 77.74±7.65, 64.12±5.67 and 114.72±8.22, respectively (Table 1).

Mean values and standard deviation of OPG right and OPG left were tabulated for all the three parameters. ML mean and SD for the right and left half was 107.16±9.38 and 105.88±9.41 respectively. RH mean and SD for the right and left was 65.74±5.92 and 65.38±6.17 respectively. TML mean and SD for the right and left was 143.04±8.92 and 142.08±8.96 respectively. There was no statistically significant difference in mean ramus height, mean body length and mean total mandibular length between right and left OPG (p-value 0.77, 0.49 and 0.59 respectively) (Table 2).

Mean values and standard deviation of OPG right and lateral cephalogram were recorded. ML mean and SD for the right OPG and lateral cephalogram were 107.16±9.38 and 77.74±7.65,

Table 1: Descriptive statistics of the study parameters				
Study parameters (in mm)		Mean±SD	Minimum	Maximum
OPG Right	Ramus height	65.74±5.92	50.00	82.00
	Body length	107.16±9.38	83.00	135.00
	Total mandibular length	143.04±8.92	122.00	162.00
OPG Left	Ramus height	65.38±6.17	51.00	84.00
	Body length	105.88±9.41	80.00	133.00
	Total mandibular length	142.08±8.96	120.00	159.00
OPG average	Ramus height	65.56±6.01	50.50	83.00
	Body length	106.52±9.37	81.50	134.00
	Total mandibular length	142.56±8.91	121.00	160.50
Lateral cephalogram	Ramus height	64.12±5.67	51.00	81.00
	Body length	77.74±7.65	60.00	92.00
	Total mandibular length	114.72±8.22	98.00	131.00

Table 2: Comparison of study parameters between right and left OPG			
Study parameters (in mm)	OPG Right (Mean±SD)	OPG Left (Mean±SD)	p-value
Ramus height	65.74±5.92	65.38±6.17	0.77
Body length	107.16±9.38	105.88±9.41	0.49
Total mandibular length	143.04±8.92	142.08±8.96	0.59

Independent t test, p-value<0.05 statistically significant

Table 3: Comparison of study parameters between lateral cephalogram and OPG Right			
Study parameters (in mm)	OPG Right (Mean±SD)	Lateral ceph (Mean±SD)	p-value
Ramus height	65.74±5.92	64.12±5.67	<0.001*
Body length	107.16±9.38	77.74±7.65	<0.001*
Total mandibular length	143.04±8.92	114.72±8.22	<0.001*

Paired t test, p-value<0.05 statistically significant

Table 4: Comparison of study parameters between lateral cephalogram and OPG Left			
Study parameters (in mm)	OPG Left (Mean±SD)	Lateral Ceph (Mean±SD)	p-value
Ramus height	65.38±6.17	64.12±5.67	<0.001*
Body length	105.88±9.41	77.74±7.65	<0.001*
Total mandibular length	142.08±8.96	114.72±8.22	<0.001*

Paired t test, p-value<0.05 statistically significant

Table 5: Comparison of study parameters between lateral cephalogram and average OPG			
Study parameters (in mm)	OPG Average (Mean±SD)	Lateral Ceph (Mean±SD)	p-value
Ramus height	65.56±6.01	64.12±5.67	<0.001*
Body length	106.52±9.37	77.74±7.65	<0.001*
Total mandibular length	142.56±8.91	114.72±8.22	<0.001*

respectively. RH mean and SD for the right OPG and lateral cephalogram were 65.74±5.92 and 64.12±5.67 respectively. TML mean and SD were 143.04±8.92 and 114.72±8.22 respectively. There was a statistically significant difference in mean ramus height, mean body length and mean total mandibular length between right OPG and Lateral cephalogram (p-value <0.001) (Table 3).

For left side OPG and lateral cephalogram, ML mean and SD were 105.88±9.41 and 77.74±7.65 respectively. RH mean and SD were 65.38±6.17 and 64.12±5.67 respectively. TML mean and SD were 142.08±8.96 and 114.72±8.22 respectively. There was a statistically significant difference in mean ramus height, mean body length and mean total mandibular length between left OPG and Lateral cephalogram (p-value <0.001) (Table 4).

ML mean and SD for average OPG and lateral cephalogram were 106.52±9.37 and 77.74±7.65 respectively. RH mean and SD for average OPG and lateral cephalogram were 65.56±6.01 and 64.12±5.67 respectively. TML mean and SD for average OPG and lateral cephalogram were 142.56±8.91 and 114.72±8.22 respectively. There was a statistically significant difference in mean ramus height, mean body length and mean total mandibular length between average OPG and Lateral cephalogram (p-value<0.001) (Table 5).

DISCUSSION

The results of the current study show that there was statistically significant difference in ramus height, mandibular body length and total mandibular length between OPG and lateral cephalogram. This difference may be due to overlapping of right and left condyle in the lateral cephalogram, which affects measurements involving the condyle.[11] Horizontal measurements have been documented as undependable because of the non-linear variation in the magnification at different object depths; while vertical measurements have been presented as relatively reliable.[1,29] Contrary to these studies, in the present study horizontal as well as vertical measurements were statistically significant.

Even though there are a number of published articles on magnification and image distortion in panoramic radiographs, there are only a few studies involving the use of panoramic radiographs in evaluating dentoskeletal specifications, and they focus mainly on intercondylar asymmetries and gonial angle measurements.[3,5,12,14,23-25]

Tronje et al[30] concluded the unreliability of the horizontal variables despite using correct head positioner and the same radiographer, because the distortion effect is influenced not only by a projection factor but also by a 'motion' factor.

One of the disadvantages of OPG is unequal magnification and geometric distortion. The vertical dimension in contrast to the horizontal dimension is little altered. These distortions result from the horizontal movement of the film and x-ray source. The mean magnification of angular measurements was more reliable than linear measurements.[28]

Most studies have reported that patient positioning (anterior or posterior to the middle of the focal trough) influences horizontal dimension more than vertical dimension. Because of horizontal rotation of the x-ray

source vertical dimension is more reliable.[1,10] In the present study there was significant differences in vertical and horizontal measurements between OPG and lateral cephalograms but there was no statistically significant differences between measurements of right and left sides in OPG.

The reliability of vertical measurements provides evidence to support the previous study on tooth length assessments, and observations on distortion effects studied mathematically and experimentally in panoramic radiography.[26,30] It was suggested that the method might be used for vertical measurements provided the patient is correctly positioned in the machine during the exposure.[1] However, in the present study, not just horizontal measurements but even vertical measurements were found to be unreliable while comparing the measurements in OPG and lateral cephalograms. This could be due to overlapping and distortion of images.

The results of the present study showed that there is statistically significant difference in ramus height, mandibular body length and total mandibular length when compared between OPG and lateral cephalogram which is different from the study done by Kumar *et al.*[31] in which there was no statistically significant difference in ramus height but there was statistically significant differences in mandibular body length and total body length.

Vertical measurements appear to be more accurate than horizontal or angular measurements. However, vertical measurements are prone to misrepresenting the anatomical truth. The lateral cephalogram, in contrast with the 3D imaging techniques, is a classical 2D radiograph in which the 3D structures are projected onto a 2D plane, which makes it difficult to distinguish between sides and complicates landmark definitions due to overprotecting structures.[32]

Comparison of panoramic radiograph and lateral cephalogram in determining linear mandibular measurements may not yield accurate results, yet panoramic radiographs do have the advantage of giving a higher diagnostic yield on a single film when compared to lateral cephalogram. OPG may not always have pinpoint accuracy in measuring the angular and vertical measurements, OPG being an easier tool for measuring the right and left side of the patient without any interference due to superimposed structures it may be a better choice, especially in asymmetry cases.

Further studies with a larger sample size are required to strengthen the findings of the present study. With less exposure for panoramic coverage of the dental arches and ease to measure the right and left side with less superimposition, the clinicians, especially in cases with skeletal asymmetry, should not ignore the importance of OPG as a diagnostic aid.

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