ORTHOPANTOMOGRAPHIC ANALYSIS FOR ASSESSMENT OF MANDIBULAR ASYMMETRY AND RELIABILITY OF GONIAL ANGLE IN VARYING GROWTH TRENDS AMONG CHENNAI POPULATION.

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Abstract

Aim: The aim of this study was to introduce a simplified analysis for diagnosing mandibular asymmetry using digital OPG and to find out average gonial angle in horizontal and vertical growers.

Methodology: Improvement in the beauty and harmony of facial appearance has been the main intention of orthodontic treatment since the beginning of orthodontic practice. Asymmetry in the lower third of the face is referred to as "mandibular asymmetry", this causes Aesthetic and functional problems. Condylar asymmetry is the disproportion of vertical condyle between left and right mandibular condyles. Condylar asymmetries are thought to be one of the most important causes of mandibulofacial asymmetries. Mandibular asymmetry has been diagnosed by a combination of tools. These include clinical examination followed by extraoral photographs of frontal and side views. Radiographic aids included two‐dimensional (2D) radiographs such as lateral and posteroanterior cephalograms and also oblique radiographs of the mandible taken at 45 degrees and panoramic radiographs.

100 Digital OPG samples were collected (50 Horizontal and 50 Vertical) , analysis for accessing mandibular asymmetry was carried out, digital OPG for diagnosing mandibular asymmetry had favourable cost benefit, low radiation exposure, significantly simplified analysis, reduces diagnosing duration, and quick tool for diagnosing.

The analysis described gives a gross assessment for diagnosing mandibular asymmetries. Particularly helpful in diagnosing condylar hyperplasia, hemimandibular hypertrophy, hemimandibular elongation, coronoid hyperplasias, etc.

Keywords: Orthopantomograph, mandible, asymmetry, condyle, length, simplified analysis.

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INTRODUCTION

Mandibular asymmetries are most common asymmetric trait among orthodontic patients.[1] Traditionally, mandibular asymmetry is diagnosed by different tools which include a thorough clinical examination, photographic analysis, routine radiographs such as lateral cephalogram, panoramic radiograph, additional radiographs like posteroanterior cephalogram, submentovertex view, CT, stereometry with or without implants, Technitium-99 scintigraphy etc.[2-4] However, additional radiographs not only involve increased radiation exposure but also additional expenses, which sometimes become unfeasible to the patients.

Panoramic radiograph is commonly used in daily clinical routine and offers an acceptable cost-benefit ratio due to the minimum radiation exposure.[5] This radiograph allows a bilateral view and adequate information on vertical measurements.[5] Studies on panoramic radiography have shown that horizontal measurements tend to be particularly unreliable because of nonlinear variation in magnification at different object depths,[5] whereas vertical and angular measurements are acceptable provided the patient's head is positioned properly in the equipment.[6]

Diagnosing mandibular asymmetries with particular emphasis on differential diagnosis of condylar hyperplasia (CH), hemimandibular hypertrophy (HH), hemimandibular elongation (HE), coronoid Hyperplasia can be simplified if it is made possible with the help of OPGs.

Dental compensations like altered axial inclination of teeth can also be evaluated to some extent. Condylar hyperplasia or condylar hyperactivity named by Obwegeser7 is a pathological overgrowth condition at the condylar process, which leads to variable abnormal mandibular/ facial asymmetry. Two different forms of condylar hyperplasia have been differentiated based on the clinical and radiological findings: HH and HE.[8] HH is characterized by a three dimensional enlargement of one side of the mandible, i.e. the enlargement of the condyle, the condylar neck and the mandibular ramus and corpus.[9] Mandibular midline is in general not shifted.[8,10] A double contour is noticeable on a lateral cephalograms.

Orthopantomogram (OPG) reveals increased size of the affected mandibular corpus and ramus and increased distance between the tooth root apices and the inferior mandibular border.[9] The more common condylar hyperplasia type HE, differs in its clinical and radiological view from HH.

HE is characterized by a horizontal elongation of the affected hemimandible and may affect the condylar neck, the mandibular ramus and corpus.8 Condylar head does not seem to be enlarged in HE. A flattening of the gonial angle on the affected side is observed but the mandibular corpus remains on the same level on both sides, which means that no double contour on lateral cephalogram can be seen.[11] Unlike in HH, HE patients do not have an increased height between the tooth root apices and the inferior mandibular border in an OPG examination. Lower dental midline is displaced to the healthy side and the facial asymmetry is very noticeable. A crossbite is noticed commonly on the unaffected side.

Coronoid hyperplasia is a rare condition which is macroscopically characterized by an increase in the dimensions of the coronoid process resulting from an abnormal bony elongation of histologically normal bone.[12] Measuring the coronoid length may be helpful in diagnosing Jacob's disease in which there is bilateral enlargement of coronoid process which if not assessed may be misdiagnosed as TMJ disorder.

Gonial angle is the angle formed by the intersection of the tangent drawn to lower border of mandible and tangent drawn to ramus. Both the linear and angular measurements were assessed in OPGs. Mean and standard deviation were calculated for all the parameters from OPG. The purpose of this study was to derive an analysis to determine mandibular asymmetries from OPGs and to access the variation in gonial angle among horizontal and vertical growers.

METHODOLOGY

100 Digital OPGs taken from a single source were used for analysis – 50 of horizontal growers and 50 of vertical growers. Digital measurements was carried out using Carestream dental software.

Landmarks

1. Anterior nasal spine (ANS): Tip of bony anterior nasal spine

2. Condylion (Co): Most superior point on head of mandibular condyle

3. Coronoid point (Cor): Most superior point on coronoid process

4. **Sigmoid notch point (Snp)**: Deepest point on sigmoid/ mandibular notch

5. Gonion (Go): Most posteroinferior point at the angle of mandible

6. Antegonion (Ag): Highest point of the notch or concavity of the lower border of the ramus where it joins the body ofthe mandible

7. Mandibular midpoint (M): Located by projecting the mental spine on the lower mandibular border parallel to ANS vertical plane.

Following measurements are made:

1. Length of condyle: Measured from the Co to sigmoid notch plane along the long axis of condylar process

2. Length of coronoid: Measured from the Cor to sigmoid notch plane along the long axis of condylar process

3. Length of ramus: Measured from point Snp to point Ag

4. Length of corpus: Measured from point Ag to point M

5. Height of corpus: Distance between the distal root apex of mandibular first molar and inferior mandibular border,

6. Gonial angle:

a. Upper Gonial angle – angle formed between Co-Ag-ANS

b. Lower Gonial angle – angle formed betweem ANS-Ag-Co

RESULT

Fig : Figure depicts measurements done using carestream dental radiograph software.

Linear and angular measurements were used to access the mandibular assymmentry.

- Length of Coronoid,
- Length of Condyle,
- Length of Ramus,
- Length of Corpus,
- Height of Corpus, were measured.

Comparing these measurements of one side to the other side mandibular asymmetry was accessed. The samples were categorised based on their growth pattern as either horizontal grower or as vertical grower. However irrespective of their growth pattern the results revealed that the samples were apparently symmetrical with a difference of less than 1 mm on an average for all the measured linear measurements.

Table 1 depicts the angular measurements of the gonial angle among horizontal growers and vertical growers. Gonial angle was further divided into upper and lower gonial angle. Upper gonial angle was formed by joining condylon, point Ag, ANS ; lower gonial angle was measured by the angle formed by ANS, Ag and point M.

HORIZONTAL		
Rt. Average gonial angle	118.2°	± 2.33
Rt. Average upper gonial angle	67.97°	± 2.02
Rt. Average lower gonial angle	50.23°	± 1.33
Left Average gonial angle in horizontal	116°	± 2.35
Left Average upper gonial angle	69.63°	± 2.12
Left Average lower gonial angle	46.37°	± 1.92
AVERAGE GONIAL ANGLE	116°-118°	
VERTICAL		
Rt. Average gonial angle	122.16°	± 2.5
Rt. Average upper gonial angle	67.9°	± 2.35
Rt. Average lower gonial angle	54.26°	± 2.77
Left Average gonial angle in horizontal	119.43°	± 3.11
Left Average upper gonial angle	70.43°	± 1.2
Left Average lower gonial angle	49°	± 3.33
AVERAGE GONIAL ANGLE	120°-122°	

RESULTS	
Horizontal	116°-118°
Average	118°-120°
Vertical	120°-122°

Table 1 : Gonial angle measurement among left and right side in horizontal and vertically growing individuals.

Results from table 1 concludes that apparently symmetrical right and left Gonial angles were seen irrespective of growth pattern, however there was variation seen in the average range. How so ever there was significant difference in gonial angle between horizontal and vertical growers. Vertical growers on an average had increased gonial angle than horizontal growers which resulted in subsequent increase in upper and lower gonial angle of the vertical growers.

Dependent Variable			**Mean Difference**	**Std. Error**
Length of condyle	Horizontal right	Horizontal left	0.1382	0.09378
		Verticle right	0.2240	0.09378
		Verticle left	.2986*	0.09378
	Horizontal left	Horizontal right	-0.1382	0.09378
		Verticle right	0.0858	0.09378
		Verticle left	0.1604	0.09378
	Verticle right	Horizontal right	-0.2240	0.09378
		Horizontal left	-0.0858	0.09378
		Verticle left	0.0746	0.09378
	Verticle left	Horizontal right	-.2986*	0.09378
		Horizontal left	-0.1604	0.09378
		Verticle right	-0.0746	0.09378
Length of coronoid	Horizontal right	Horizontal left	-0.0740	0.06094
		Verticle right	0.1108	0.06094
		Verticle left	0.0562	0.06094
	Horizontal left	Horizontal right	0.0740	0.06094
		Verticle right	.1848*	0.06094
		Verticle left	0.1302	0.06094
	Verticle right	Horizontal right	-0.1108	0.06094
		Horizontal left	-.1848*	0.06094
		Verticle left	-0.0546	0.06094
	Verticle left	Horizontal right	-0.0562	0.06094
		Horizontal left	-0.1302	0.06094
		Verticle right	0.0546	0.06094
Length of ramus	Horizontal right	Horizontal left	-0.0930	0.16407
		Verticle right	0.4124	0.16407
		Verticle left	0.2854	0.16407
	Horizontal left	Horizontal right	0.0930	0.16407
		Verticle right	.5054*	0.16407
		Verticle left	0.3784	0.16407
	Verticle right	Horizontal right	-0.4124	0.16407
		Horizontal left	-.5054*	0.16407
		Verticle left	-0.1270	0.16407
	Verticle left	Horizontal right	-0.2854	0.16407
		Horizontal left	-0.3784	0.16407
		Verticle right	0.1270	0.16407
Length of corpus	Horizontal right	Horizontal left	-0.4282	0.29507
		Verticle right	0.2768	0.29507
		Verticle left	-0.1756	0.29507
	Horizontal left	Horizontal right	0.4282	0.29507
		Verticle right	0.7050	0.29507
		Verticle left	0.2526	0.29507
	Verticle right	Horizontal right	-0.2768	0.29507
		Horizontal left	-0.7050	0.29507
		Verticle left	-0.4524	0.29507
	Verticle left	Horizontal right	0.1756	0.29507
		Horizontal left	-0.2526	0.29507

		Verticle right	0.4524	0.29507
Heigth of corpus	Horizontal right	Horizontal left	-0.1188	0.35776
		Verticle right	0.0364	0.35776
		Verticle left	-0.0576	0.35776
	Horizontal left	Horizontal right	0.1188	0.35776
		Verticle right	0.1552	0.35776
		Verticle left	0.0612	0.35776
	Verticle right	Horizontal right	-0.0364	0.35776
		Horizontal left	-0.1552	0.35776
		Verticle left	-0.0940	0.35776
	Verticle left	Horizontal right	0.0576	0.35776
		Horizontal left	-0.0612	0.35776
		Verticle right	0.0940	0.35776

Table 2 : Comparitive linear measurement of left and right side in horizontal and vertical growers.

Table 2 compares each parameter to its counterpart not only among individuals with same growth pattern but also it shows comparison between horizontal and vertical growing individuals also. It reveals that there is not much significant difference between left and right and between horizontal and vertical. Hence we can infer that from the observed samples, the samples were linearly apparently symmetrical with mean difference of less than 1cm.

DISCUSSION

Diagnosing of mandibular asymmetry is of great importance and is a complex procedure. Mandibular asymmetry may be caused by a number of factors like CH, HH, HE, coronoid hyperplasia, TMJ disorders, etc. Though the precise differentiation of these conditions may be confusing, clinical environment requires radiographic impressions at first hand before any other data are available.[13]

OPG is relatively accessible and provides a bilateral view of the mandible and vertical measurements can be constructed.[14] A series of reports on the panoramic technique[15-17] suggested that panoramic radiographs yield acceptable results, non-invasive and have a favourable cost-benefit relationship, and expose subjects to relatively low doses of radiation. The shortcomings include distortion and magnification errors especially in horizontal dimension. However, it is important to realize, as suggested by some authors,[6,18] reproducibility of measurements can be acceptable provided patient's head is positioned properly in the equipment.

This study reveals that there is not much discrepancy among right and left side, and OPG can itself serve as a tool in determining mandibular Assymmetry. OPGs can serve as a tool during comparing the left and right side, hence ratios can be accessed. Gonial angle also reveals that, opg is also significant in identifying horizontal and vertical growers as the mandibular border is clearly seen without any overlap or double image as seen from lateral cephalogram. The result from this study shows that there is no significant difference between left and right side. Hence we can conclude that OPGs are better choice for determining gonial angles as they eliminate disturbing influence of superimposed images.

Another important factor for consideration is the need to compare the apparent mesiodistal dimension of the mandibular first molar bilaterally to evaluate any sort of distortion, and if distortion is present, the OPG should be repeated.[19] Although the vertical and angular measurements on an OPG are reproducible[18] and give us an insight into the possible asymmetry present, it is mandatory to use ratios to compare the right and left side.[20] For example, the ratio of distance Co-M and Ag-M on the right and left sides compared. This would eliminate drawbacks of direct measurements. The basic aim of this article is to provide the reader with a preliminary screening tool in diagnosing mandibular asymmetries utilizing a digital OPG.

However, Larheim and Svanaes 1986[21] indicated that lateral cephalograms did not permit reliable registration of the gonial angle, and the superimposed images created difficulties in recognition and measurement of the individual angles, whereas the gonial angle assessed from a panoramic film was almost identical to that measured on the dried mandible. Hence we can take opg as reliable source for determining gonial angles.

Kurt *et al.* 2008[22] concluded panoramic radiographs gives acceptable results rather than exposing the patient to lateral cephalogram. They

evaluated condylar and ramal mamndibular asymmetry in a group of patients with class II subdivision malocclusion to identify possible gender differences between male and female subjects.

Ongkosuwito *et al*. 2009[23] based on findings from dry skulls, concluded that an OPG is as reliable as a lateral cephalogram for linear measurements of the mandible, with vertical measurement having a better correlation than horizontal.

Katti G *et al.* 2016[24] studied to investigate whether OPGs can be used as an alternative to lateral cephalogram for measuring the gonial angle. They concluded that panoramic radiography can be used to determine the gonial angle as accurately as lateral cephalogram. In addition, it is easy to determine the right and left gonial angles of a patient in an OPG without interferences due to superimposed images of anatomical structures in lateral cephalogram

CONCLUSION

The analysis performed and studied gives a gross assessment for diagnosing mandibular asymmetries. Particularly it is helpful in diagnosing condylar hyperplasia, HH, HE, coronoid hyperplasias, etc. This method is particularly advantageous as it reduces the need of additional radiograph in some instances. Thus, minimizing radiation exposure and added cost of additional radiograph to the patient. Standardized positioning of head during panoramic radiography and use of ratios for comparing right and left sides during OPG analysis can overcome the measurement errors due to magnification and distortion to some extent

Panoramic radiographs may not always be accurate in measuring the angular and vertical measurements, but they do have the advantage of giving a higher diagnostic yield on a single film when compared to lateral cephalogram. They showed an increased coverage of the dental arches with reduced radiation exposure to the patients. Furthermore, 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. Though panoramic radiographs are as reliable as a lateral cephalogram for vertical and angular measurements of the mandible, clinicians should be vigilant when predicting horizontal measurement from OPGs. It was concluded that vertical growers had comparatively greater gonial angle than the horizontal growers when measured with OPGs, which is the results which have been previously found with lateral cephalogram. Hence we can conclude that OPGs serve the purpose of detecting mandibular asymmetry along with growth pattern.

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