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Original Research Article

Vertical mandibular asymmetry in angle's class II subdivision malocclusion

Shireen siddiqui[1]*, Tripti Tikku[1], Kamna Srivastava[1], Snehlata Verma[1], Rohit Khanna[1]

[1]*Dept. of Orthodontics, Babu Banarasi Das College of Dental Sciences, Lucknow, Uttar Pradesh, India*

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ABSTRACT

Aim and Objective: To evaluate and compare vertical mandibular asymmetry like condylar, ramal and condylar plus ramal mandibular vertical asymmetry using asymmetry indices among subjects with Angle's class II subdivision malocclusion and subjects with Angle's class I malocclusion from Orthopantomogram.
Background: Asymmetries in the lower third of the face are mainly due to mandibular asymmetries because of asymmetry in the height of condyle and ramus. As there is morphological variability in jaw bases in different malocclusion, it is anticipated that there will be variability in mandibular asymmetry. Considering this, it is decided to assess mandibular asymmetry in subjects with Angle's class II subdivision and compare with subjects with Angle's class I malocclusion.
Materials and Methods: A total of 40 subjects coming to the department of orthodontics for fixed orthodontic treatment were equally divided into two groups i.e., Angle's class II subdivision malocclusion group and Angle's class I malocclusion group have selected (clinical examination) to assess type of malocclusion after screening of 80 subjects. Orthopantomogram of these subjects were taken before start of treatment and condylar height (CH), ramal height (RH), total height (RH) and mandibular asymmetry Index by Habet's formula were evaluated. Data was obtained and subjected to statistical analysis.
Result: For group I and group II, CH (L>R), RH (R>L) and TH (L>R) but the difference was statistically significant only for condylar height of group II. Asymmetry indices did not show any significant difference between group I and group II.
Conclusion: As mandibular asymmetry not show any significant difference between group I and group II hence it can be suggested that mandibular asymmetry in subjects with class II subdivision group was dentoalveolar in nature not skeletal.

1. Introduction

Facial symmetry is derived from a Greek word "symmetries" which means of "like measure" where one half of the face is equivalent and same as another half, however true bilateral symmetry is never present naturally.[1] In relation to the face, symmetry and balance can be considered as correspondence in size shape and arrangement of the facial features on both sides of the mid sagittal plane. The bilateral symmetry is rare hence various studies evaluated the same.[1–10] Asymmetry of face is one of the major problems causing structural and functional imbalance in adult patients who seek for orthodontic treatment and wants to improve their facial asthetic. Clinically detectable facial asymmetry can be due to functional, soft tissue, dental and hard tissue asymmetries. Asymmetries in the lower third of the face are mainly because of mandibular asymmetries.[11] Mandibular asymmetries are one of major cause of facial

* *Corresponding author.*
E-mail addresses: dr.vishu0188@gmail.com (S. siddiqui), 0000-0002-3930-9238 (R. Khanna).

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asymmetry. As we all know bone undergoes the continuous process of resorption and deposition known as bone remodelling, mandible is also subjected to remodelling under the influence of occlusal state and function of masticatory muscles.[12] Mandible also shows various morphological changes in its various regions like gonial, antigonial, condylar and ramal region.[13]The asymmetry in the height of condyle and ramus causes mandibular asymmetry. It gives morphologically rotated facial appearance with kinking at the mandibular symphysis, prominent gonial angle, prominence of lower border of mandible and canting of occlusal plane.[14] Various studies investigated the relationship between condylar asymmetries and temporomandibular disorders (TMD) and concluded that condylar asymmetry has been associated with TMD, emphasizing the importance of its evaluation in subjects with clinically obvious facial asymmetry.[15–22] The aetiology of mandibular asymmetry is vast and it has association with environmental and genetic influences. Infections, trauma, myogenic problems, developmental abnormalities, joint pathologies like rheumatoid arthritis and syndromes such as Treacher Collin syndromes or occlusal disturbances can cause asymmetry.[23] The measurement of condylar and ramal height is important to know the impairment of growth. The early assessment of mandibular asymmetry whether subclinical or clinically obvious is important to quantify craniofacial asymmetry and treat the same. As there is morphological variability in jaw bases in different classes of malocclusion, it is anticipated that there will be variability in mandibular asymmetry. The subjects with Angle's class II subdivision malocclusion have dental asymmetry hence it was decided to assess mandibular asymmetry in these subjects and compare with other malocclusion group.

Mandibular asymmetry is better viewed from frontal radiograph like PA ceph, OPG and 3 D imaging like such as CT and MRI. 3D imaging techniques are expensive and cannot be used for routine orthodontic treatment. On the other hand, OPG is reliable tool for determining mandibular asymmetry due to its broad bilateral coverage of facial bone and teeth including TMJ and is taken routinely as essential diagnostic record for all subjects undergoing fixed orthodontic treatment.[24]The study on effectiveness of orthopantomography in vertical mandibular measurements has already been done by Anupriya et al.,.[11] where they concluded that vertical measurements were more accurate as compared to horizontal and angular measurement on panoramic imaging. Kambylafkas et al.,.[25] found validity of panoramic radiograph for measuring Ramal height but for condylar height measurement was unreliable. Facial asymmetry had been assessed in PA cephalogram and photography in various studies but few studies were done to assess mandibular asymmetry on OPG. Sander et al.,.[26] found that the etilogy of class II subdivision is skeletal asymmetry of mandible i.e. the mandible is shorter and posteriorly positioned in middle cranial fossa on class II side. The dental midline and chin point were also deviated towards class II side. Janson et al.[27] mentioned skeletal asymmetries are more likely on mandible. Habet's technique was used to assess vertical mandibular asymmetry. This calculation allows individual difference in sizes and provide values for asymmetry in each individual.

Considering this, the aim of this study was to evaluate and compare vertical mandibular asymmetry like condylar, ramal and condylar plus ramal mandibular vertical asymmetry using asymmetry indices among subjects with Angle's class II subdivision malocclusion and subjects with Angle's class I malocclusion from Orthopantomogram.

2. Materials and Methods

This study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, BBDCODS, BBDU, Lucknow to evaluate mandibular asymmetry in subjects with Angle's class II subdivision malocclusion and comparing with subjects of Angle's class I malocclusion. The sample included orthopantomogram of 40 North Indian population with age range of 18-35 years (mean age 20 + 3 years). These sample were selected after screening of 80 patients who came for fixed orthodontic treatment in the department and OPG was taken as a part of essential diagnostic record. Selected samples was divided into two groups based on the type of malocclusion as seen clinically, The Group I (n=20) - had Angle's class I malocclusion and Group II (n= 20) had Angle's Class II subdivision malocclusion.

2.1. Criteria for sample selection

2.1.1. Inclusion criteria

1. Patients with age range from 18-35 years to ensure complete growth.
2. Patient having Angle's class I molar relation on both the sides (Group I).
3. Patient having class II molar relation on one side and class I on other side (Group II).

2.1.2. Exclusion criteria

1. Patients with history of orthodontic treatment.
2. Patient having history of trauma or surgery of craniofacial region.
3. Patient who had multiple extraction of posterior teeth.
4. History of any systemic illness.
5. Patient having craniofacial deformity or syndrome affecting Mandible.

2.2. Methodology

2.2.1. Method of taking OPG

To obtain Orthopantomogram, patient were positioned in the dental panoramic machine in such a way that the vertical line produced by the machine was aligned with subject's facial midline and horizontal line (Frankfort plane) was parallel to the floor. The patient were asked to bite the biting fork with anterior teeth and the dorsum of the tongue touches against the palate with relaxed lips. The chin of the subject was placed on the chin rest. Lateral head stabilizer was used to support patient head. Patient was explained that the tube moves around the head while taking OPG. All images were made by Planmeca proline XC panoramic machine in the Department of oral medicine and Radiology.

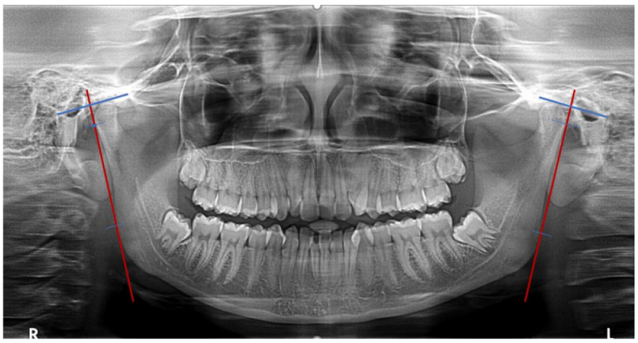

Figure 1: Tracing on an OPG

2.2.2. Tracing of OPG- (Figure 1)

OPGs of selected subjects were traced for the borders of the condyle, neck, ramus and corpus of mandible bilaterally on acetate sheet with the help of Hb pencil.

2.2.3. Landmark used for the study- (Figure 2)

L1: The most lateral point of the condyle on OPG.
L2: the most lateral point of the ascending ramus on OPG.
Line A: A tangent line was drawn to the ramus that contact point L1 and L2.
Line B: A perpendicular is drawn to line A so that it passes through superior most part of condyle.

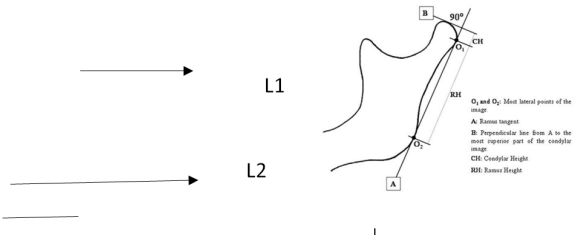

Figure 2: Measuring method accordingto Habet technique

2.3. Parameters used for the study

1. Condylar height (CH -It was measured as the perpendicular distance between L1 and Line B
2. Ramal height (RH - The distance between L1 and L2
3. Total height (TH - CH (Condylar height + RH (Ramal height
4. Condylar Asymmetry Index (CAI = [CH Right-CH Left]/ [CH Right +CH Left] ×100
5. Ramal Asymmetry Index (RAI = [RH Right-RH Left]/ [RH Right+ RH Left] ×100
6. Total Asymmetry Index (TAI) = [(CH+RH) Right - (CH+RH) Left] / [(CH+RH) Right+(CH+RH) Left] ×100

Data obtained for both the groups was tabulated for each side.

2.4. Measurement of reliability

To determine intraoperator measurement reliability, 10 Orthopantomograms of patient were randomly selected and hand tracing was done. Vertical condylar and ramal asymmetry were measured in both group I and group II at 10 days interval. (Table 1) shows Intra-operator Measurement reliability table. The Comparison between first and second reading was done using paired student t- test. It was observed that the mean difference between reading 1 and reading 2 was statistically non-significant. Hence the measurement taken were considered reliable with no discrepancies on the operator side.

3. Results

Hows the mean value of condylar height,ramal height and total height of Group I and Group II. Hows comparison of Condylar height,Ramal height and Total height between right and left side for Group I and Group II.For group I, CH (L>R), RH (R>L) and TH (L>R) but difference was not statistically significant between right and left side for CH, RH and TH.For group II, CH (L>R), RH (R>L) and TH (L>R) and difference was statistically significant between right and left side only for condylar height.

Hows comparison condylar,ramal and total asymmetry index among Group I and Group II. Mean values of condylar asymmetry, ramal asymmetry and total asymmetry Index was higher in Group II (Angle's class II subdivision) than Group I (Angle's class I malocclusion) but no statistically significant difference was found.

4. Discussion

Mandible is one of the most important and only mobile bone of the skull that may be affected by developmental process and environmental disturbances which leads to mandibular asymmetry.[28] In present study the age of all subjects was greater than 18 years so that the growth of mandible was

Table 1: Intra-operator measurement reliability table

Variable	Condylar height(mm+ SD)	Ramal height(mm+ SD)	Total height(mm+ SD)
Reading- 1	6.5000+_1.33	40.3500+_2.69	46.90+_2.96
Reading- 2	6.300+_1.25	40.30+_2.84	46.55+_2.57
p-value	0.104	0.678	0.209

Table 2: Descriptive statistics of condylar height,ramal height and total height of Group I and Group II.

Parameters	Group-I (Class I)		Group- II (Class II subdivision)	
	Right	Left	Right	Left
Condylar height (CH) (in mm)	6.900+_1.569	7.58+_2.054	6.184+_1.314	7.55+_1.480
Ramal height (RH) (in mm)	40.800+_2.637	40.525+_3.548	42.875+_3.797	42.325+_3.617
Total height (TH) (in mm)	47.60+_3.254	48.07+_4.098	48.85+_4.029	49.80+_4.234

Table 3: Comparison of condylar height,ramal height and total height between right and left side for Group I and Group II.

Group	Parameter	side	Mean	Std. Deviation	Std. Error Mean	Mean difference	Std deviation	P value
Group I	Condylar height (CH) (In mm)	Right	6.900	1.5694	.3509	-.6750	1.8011	0.110
		Left	7.58	2.054	.459			
	Ramus height (RH) (In mm)	Right	40.800	2.6378	.5898	.2750	2.6382	0.646
		Left	40.525	3.5484	.7935			
	Total height (TH) (In mm)	Right	47.6000	3.25496	.72783	-.47500	2.68267	0.438
		Left	48.0750	4.09838	.91643			
Group II	Condylar height (CH) (In mm)	Right	6.184	1.3146	.3016	-1.3684	1.5798	0.001*
		Left	7.55	1.480	.340			
	Ramus height (RH) (In mm)	Right	42.875	3.7971	.8491	.5500	3.1452	0.444
		Left	42.325	3.6175	.8089			
	Total height (TH) (In mm)	Right	48.8500	4.02982	.90110	-.95000	3.14099	0.192
		Left	49.8000	4.23457	.94688			

Table 4: Comparison condylar,ramal and total asymmetry index among Group I and Group II

Asymmetry Index	Type of malocclusion	Mean	Std. Deviation	Std. Error Mean	P Value
CAI	Group I	11.3410	8.36457	1.87038	0.505
	Group II	13.1915	8.99389	2.01110	
RAI	Group I	2.5375	2.60572	.58266	0.578
	Group II	2.9815	2.39155	.53477	
TAI	Group I	2.0815	1.58225	.35380	0.480
	Group II	2.5340	2.35807	.52728	

completed and effect of growth was eliminated. OPG as used in present study for measuring mandibular asymmetry was also used in previous studies by C Elslande et al., and Kambylafkas et al.

The result of present study suggested that the mean values of condylar, ramal and total asymmetry indices had higher values in Angle's class II subdivision malocclusion (Group II) but as compared to Angle's class I malocclusion (Group I) but the difference was statistically non-significant.CH had statistically significant difference between right and left side for group II whereas CH, RH and TH had no statistically significant difference between left and right side during intra-group comparison.

On comparing our result to other studies,a study by M Akin et al.[29] showed smilar results, concluded that condylar and ramal asymmetry index values are greater in subjects with class II subdivision group than in normal group but condylar asymmetry index was statistically significant while other two i.e., ramal asymmetry index and Total asymmetry index showed statistically insignificant difference. Also there was significant difference in condylar height, ramal height and total height between right and left in subjects with class II subdivision (p=0.042).In our study none of the asymmetry indices showed statistically significant difference between subjects of group I and group II, only condylar height of subjects with class II subdivision had statistically significant difference (p=0.001) between right

and left side.

A Sundrani et al.[30] used dental cast models for evaluating dental asymmetries which were statistically insignificant between right and left side for positioning of maxillary 1^{st} molar. On OPG, condylar height of left side in class II subdivision group was statistically highly significant ($p<0.005$). Ramal height and asymmetry indices were also significantly higher, as compared from mean values of class I and class II Div. I malalignment groups. According to authors, there is presence of skeletal asymmetry of mandible in class II subdivision group and suggested that aetiology of class II subdivision malocclusion could be due to shorter and posteriorly positioned mandible on class II side.[31–33] Sanders et al.,[8] had similar finding on measuring mandibular asymmetry in class II subdivision group by CBCT.

G Kurt et al.,[34] study shows that condylar, ramal and total height values were significantly higher ($p<0.001$) in class II subdivision group as compared to class I group but the difference was statistically insignificant . This is similar to result of present study.

Kasimoglu et al.,[35] in a study on different occlusion types found that no subjects exhibit significant difference between condylar asymmetry indices between class I, class II and class III malocclusion.

Alavi et al., 1988[36] Rose et al., 1994[37] Azevedo et al., 2006[31] and Janson et al.,2007[32] from their study concluded that class II subdivision malocclusion are generally dentoalveolar in nature not skeletal.

In contrast to present study, Taki et al.[38] investigated impact of different malocclusion types on the vertical mandibular asymmetry in young adult sample. They concluded that condylar asymmetry index value was significantly higher in class II div 1 malocclusion compared to class I ($p<0.001$).No significant difference ($p>0.05$) were found in RAI and TAI which means different occlusal pattern affects condyle that leads to vertical mandibular asymmetry. Syeda et al.[39] evaluated condylar asymmetry in class II div 1 malocclusion patient and concluded that CAI values are higher in class II div 1 malocclusion patients and this malocclusion act as a predisposing factor for asymmetry of condyle if not treated timely.

Sezgin O S et al.[40] study concluded that malocclusion has marked effect on condylar height in comparison to ramal height and class II div 1 malocclusion are more related to condylar asymmetry. No significant difference was present in condylar asymmetry values of class I and class II div I malocclusion.

Saglam AM.[41] studied the aetiology of condylar asymmetry to investigate gender difference and reveals no statistically significant difference.

The difference in variability of results between different studies could be due to the fact that class II subdivision group was not segregated for being skeletal or dental.

With the limitation of present study, it can be suggested that mandibular asymmetry in subjects with class II subdivision group was dentoalveolar in nature not skeletal.

Further studies are needed to verify the accuracy and reliability of conventional OPG with 3-D imaging on a large sample size.

5. Conclusion

Following were the conclusion of present study

1. Asymmetry indices did not show any statistically significant difference between group I and group II. However, the values of CAI, RAI and TAI are higher in group II.
2. There was no statistically significant difference seen in ramal height and total height on right and left sides of group I and group II subjects.
3. Condylar height of class II subdivision subjects showed statistically significant difference between right and left side for group II subjects.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Author's biography

Shireen siddiqui, PG Student https://orcid.org/0009-0006-7413-0811

Tripti Tikku, Professor https://orcid.org/0000-0003-0054-8554

Kamna Srivastava, Reader https://orcid.org/0000-0001-9390-1454

Snehlata Verma, Professor https://orcid.org/0000-0002-9924-9521

Rohit Khanna, Professor and Head

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