Evaluation of condylar asymmetry in class II division 1 malocclusion patients a comparative radiographic study

Arshiya Ara Syeda[1], Uzma Roohi[2,*]

[1]Professor, [2]PG Student, Department of Oral Medicine & Radiology, Al- Badar Rural Dental College & Hospital, Karnataka

***Corresponding Author:**
Email: drarshiyazaka@gmail.com

Abstract

Background & Objective: *The objective of this study was to investigate condylar asymmetry in a group of untreated Class II malocclusions and compare them with a control group of normal Class I malocclusion using Habets et al technique.*

Materials & Methods: *The study group consisted of 100 patients with class II Div 1 malocclusion (50males and 50 females), and a control group of 100 subjects with normal class I occlusion (50males and 50 females). Condylar, ramal, and condylar plus ramal asymmetry values were computed for all of the subjects on orthopantomograms. Data were analyzed statistically by means of Z-test to compare between normal occlusion and class II div 1 malocclusion for each male and female group.*

Results & Interpretation: *Significant difference was observed in condylar height, combined height and condylar asymmetrical ratio respectively when compared between normal classes I occlusion and class II div I malocclusion. Similarly significant differences was observed between condylar height, combined height and condylar asymmetrical ratio in males. However, all other asymmetrical ratios were insignificant. Similarly for females, condylar height, combined height and asymmetrical ratios were all insignificant.*

Conclusion: *Our study shows CAI value was significantly higher in Class II/1 malocclusion males when compared with normal Class I malocclusion. This malocclusion could act as a predisposing factor for having asymmetric condyles if left untreated.*

Keywords: *Mandibular asymmetry, Condylar asymmetry index, Ramal asymmetry index, Class II subdivision 1 malocclusion, Orthopantogram*

Introduction

Asymmetry in the face and dentition is defined as a naturally occurring phenomenon[1]. Literature shows that symmetry, when applied to facial morphology, refers to the correspondence in size, shape, and location of facial landmarks on the opposite sides of the median sagittal plane[2]. The mandibular asymmetry, the lower third of the face, is important because of its direct effect on facial appearance. Asymmetries in the mandible may cause not only esthetic but also functional problems because of its role in the stomatognathic system. Condylar cartilages shows the highest growth potential on the mandible. Hence Injuries occurring in these areas during the growth period can disturb the mandible's growth potential, resulting in the displacement of the mandible toward the affected side. Thus, condylar asymmetries are thought to be one of the most important causes of mandibulofacial asymmetries.[3-5]

Various studies have shown that malocclusions have a remarkable effect on mandibular condyle morphology[6].

Therefore esthetic evaluation of the craniofacial region as well as malocclusions evaluation is important in symmetry assesstment.[7]

The relationship between the condylar asymmetries and craniomandibular disorders were investigated by Habets and his co-workers. Habets et al introduced a method utilizing panoramic radiographs for evaluating mandibular asymmetry. This method compared the vertical heights of the mandibular right and left condyles and rami.[8]

The panoramic radiography is the most commonly used and beneficial for examination in dentistry.[9] It is relatively accessible, cheap and allows bilateral view of mandible in one exposure. The aim of this study was to evaluate the condylar asymmetry in Class II subdivision I malocclusion patients and its comparison with normal occlusion group in males and females.

Materials and Methods

A total of 200 patients (100 females, 100 males) of age group of above 18years who attended the Department for various reasons participated in this study. The study examined panoramic radiographs of these patients. The patients were divided into two groups: 100 class II Division 1 malocclusion subjects (50males, 50 females) and 100 normal class I malocclusion (50males and 50 females).

The Inclusion Criteria for normal class I malocclusion were as follows: Class I canine and molar relationship with minor or no crowding; normal growth and development; well aligned upper and lower dental arches; No missing teeth, excluding the third molars; No history of orthodontic treatment or facial trauma.

The inclusion criteria for class II subdivision 1 were as follows: A Class II molar relationship on any of the other side; No facial symmetry determined clinically; No significant medical history; No history of trauma, or any previous orthodontic, prosthodontic treatment. No signs or symptoms of temporomandibular disorder (TMD).

The panoramic radiographs of all the patients were taken under standardised manner using a Kodak 8000C panoramic machine according to the manufacturer's reference guide.

The condylar asymmetry, ramus asymmetry, and condyle-plus-ramus asymmetry in vertical heights were determined according to the method suggested by Habets et al[8].

The height of the condyle and ascending ramus of both sides on the panoramic radiographs were measured by a digital radiograph.

A line (A) was drawn connecting the most lateral points of the condyle (O2) and the ascending ramus(O1). The distance between O1 and O2 was called the ramus height (RH). To the A line (ramus tangent) a perpendicular line (B) was drawn such that it passed through the most superior point of the condyle. The perpendicular distance between O2 and Line B was called the condylar height. (Fig. 1)

Asymmetry indexes were estimated using the following formula:

Condylar Asymmetry Index (AI) =

$$\frac{\text{CH right} - \text{CH left}}{\text{CH right} + \text{CH left}} \times 100$$

Ramus and condyle-plus-ramus asymmetries were also evaluated using the same formula.

All measurements were performed by one investigator on the digital panoramic radiographs of the patients using a digital ruler with a magnification factor of 1.24.

Four weeks after the first measurements, 40 randomly selected OPGs from normal class I group and study group were re measured by the same investigator. A Student samples *t*-test was applied to the measurements. The difference between the first and second measurements of the 40 radiograms was insignificant. Correlation analysis yielded the highest *r* value, 0.97, for right ramus height measurement and the lowest *r* value 0.69, for left condylar height measurements.

Independent sample z-test was done to compare between the normal class I malocclusion and class II div I malocclusion and between normal class I malocclusion and class II div I malocclusion for each male and female groups. The results were regarded as statistically significant at $P < 0.05$.

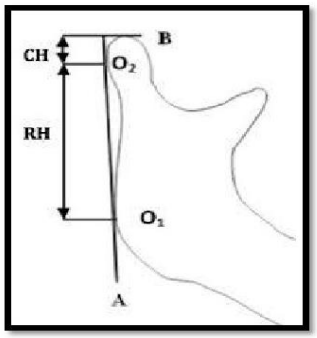

Figure 1: Measurements of mandibular asymmetry index according to Habet's et al

Fig. 1: The perpendicular distance between O2 and Line B was called the condylar height

Results

The statistical data and results of z-test comparing the asymmetry indices between the normal class I malocclusion and class II div I malocclusion is shown in Table 1. Results have shown that Condylar asymmetry index (CAI) values was significantly higher in class II div I malocclusion. However there were no statistically significant differences between the groups for Ramus asymmetry index (RAI) values (P = 0.189) and Condylar plus ramus asymmetry index (CRAI) values (P = 0.059). Z-test was also performed to compare asymmetry indices between the groups for each male and female shown in Table 2 and Table 3. Result shows that there is a significant difference in values between condylar height (right and left), ramus height (right and left), combined height (right and left) and condylar asymmetry ratio (p= 0.00001, p =0.00001, p=0.00001, p=0.00001, p= 0.00001, p= 0.00001, p=0.00001, p= 0.0055) respectively in males. However other asymmetrical ratios were insignificant (Table 2). Similarly, for females condylar height (right and left), ramus height (right and left), combined height (right and left) and all asymmetrical ratios were all insignificant (p=0.211, p= 0.374, p=0.405, p=0.4522, p=0.385, p=0.484, p=0.149, p=0.059, p=0.117) respectively (Table 3).

Table 1: The statistical data and results of z-test comparing the asymmetry indices between the normal class I malocclusion and class II div I malocclusion

Table 1 : Comparison Of Mandibular Asymmetry Indices Between Normal Occlusion And Class II Div1 Malocclusion

Normal Occlusion	Normal Occlusion		Class II Div 1 Occlusion		Z VALUE	P VALUE
	MEAN	SD	MEAN	SD		
Condylar Asymmetrical Ratio	6.03	5.17	7.74	5.02	2.23	**0.0129**
Ramus Asymmetrical Ratio	2.83	2.13	3.13	2.76	0.88	0.1894
Combined Asymmetrical Ratio	2.87	1.69	3.34	2.34	1.56	0.0594

Table 2, 3: Z-test was also performed to compare asymmetry indices between the groups for each male and female

Table 2 - Comparison Of Condylar Asymmetry Indices Between Normal Occlusion And Class II Div1 Malocclusion Males

Normal Occlusion	Normal Occlusion		Class II Div 1 Occlusion		Z VALUE	P VALUE
	MEAN	SD	MEAN	SD		
Right Condylar Height	7.26	1.09	6.38	0.93	4.35	**0.00001**
Left Condylar Height	6.41	0.94	5.36	0.73	6.29	**0.00001**
Right Ramus Height	43.28	4.49	36.3	5.01	7.34	**0.00001**
Left Ramus Height	40.64	3.81	34.5	4.48	7.38	**0.00001**
Right Combined Height	49.52	5.38	42.34	5.14	6.81	**0.00001**
Left Combined Height	49.09	7.12	40.2	4.6	7.41	**0.00001**
Condylar Asymmetrical Ratio	6.16	3.76	8.36	4.7	2.59	**0.0055**
Ramus Asymmetrical Ratio	3.09	1.85	2.89	2.66	0.45	0.3264
Combined Asymmetrical Ratio	2.71	1.55	3.08	2.07	1.01	0.1562

Table 3 - Comparison Of Condylar Asymmetry Indices Between Normal Occlusion And Class II Div1 Malocclusion Females

Normal Occlusion	Normal Occlusion		Class II Div 1 Occlusion		Z VALUE	P VALUE
	MEAN	SD	MEAN	SD		
Right Condylar Height	6.49	1.16	6.68	1.28	0.80	0.2119
Left Condylar Height	5.78	1.13	5.85	0.99	0.32	0.3745
Right Ramus Height	37.10	3.34	37.25	3.01	0.24	0.4052
Left Ramus Height	35.22	3.00	35.14	3.47	0.12	0.4522
Right Combined Height	43.57	3.77	43.78	3.54	0.29	0.3859
Left Combined Height	40.98	3.50	40.95	3.77	0.04	0.4840
Condylar Asymmetrical Ratio	5.91	6.31	7.12	5.29	1.04	0.1492
Ramus Asymmetrical Ratio	2.55	2.37	3.37	2.86	1.56	0.0594
Combined Asymmetrical Ratio	3.04	2.19	3.61	2.57	1.19	0.1170

Discussion

Assessment of mandibular asymmetry has been performed using submentovertex,[9] postero-anterior cephalometric[10] radiographs and computed tomography.[11]

Panoramic radiographs are the most commonly used technique because it is possible to image joints, teeth, and other parts of the jaws in one exposure.[7]

Many authors suggest that panoramic radiographs are known to provide a reproducible vertical and angular measurements if the patient's head is positioned properly in the equipment.[12 -13]

According to Graber, the magnification on the orthopantomograph is said to be uniform and do not affect the diagnostic decisions.[14]

Thus in the present study, orthopantomograph were used for evaluation of mandibular asymmetry. We used a computer software program as computerized digitizing has advantages[15-17] like accurate determination of the contours of bony structures by enlarging the image and changing the contrast whenever needed.

The method described by Habets et al[8] has been used for evaluating condylar and ramal asymmetries in TMD patients and in various malocclusions. According to Habets et al a 3% index ratio can result from a 1-cm change in head position while the panoramic radiograph is being taken, and thus AI values (CAI, RAI, and CRAI) >3% should be considered as mandibular posterior vertical asymmetry.

In this study, CAI in normal occlusion, class II Div I malocclusion (males and females) were found above 3% (6.03 ± 5.17%, 8.36 ± 4.7%, 7.12± 5.29% respectively) indicating the presence of asymmetry.

The results in Table 1 comparison of mandibular asymmetry index between normal occlusion & class II div I malocclusion reveals significant higher mean values (7.74 ±5.02, p=0.012) for CAI. No significant differences were found for RAI & CRAI.

This result was in accordance with the study done by **Taki et al[7] and Segzin et al[18]** where class II div I malocclusion continued to show condylar asymmetry.

Other Studies evaluating condylar asymmetry with this method in different malocclusions and in TMD patients also found asymmetry values >3% both in study and CGs.[18-21]

The results in Table 2 shows significant difference in mean values for CAI (8.36 ± 4.7) but not for RAI & CRAI when compared between normal occlusion and Class II div I malocclusion group of males, which indicates that malocclusion can act as a predisposing factor for having asymmetric condyles. A muscular compensatory mechanism may have been responsible for more symmetrical ramus height on both the sides of the subject with malocclusion[10].

The results in Table 3 shows no significant difference in values for CAI (p=0.149), RAI (p=0.059) and CRAI (0.117) when compared with normal occlusion and class II Div I malocclusion for females.

Our results contradicted with the study done by **Bajracharya et al[22]** who found significant difference in values for CAI in females. The geographical distribution may be the factor for differences seen.

The study done by Yanez-vico et al,[23] using 3D-CT to find the association between condylar asymmetry and TMD found that condylar width, height and length were asymmetrical and was a common feature of TMD.

In literature, studies that compared condylar asymmetry index with other occlusion types showed different results.

Miller et al[24] compared CAI between Class I & Class II Div2 malocclusion and between Class I & Class III malocclusion and found no significant difference between the groups.

Similarly, Velli et al[25] compared CAI between unilateral and bilateral cross bites and found to be significantly higher.

Hence the present study shows that class II Div I malocclusion group have revealed higher CAI values, which may act as a predisposing factor for TMD.

Conclusion

- Angles class II div I malocclusion cases seems to be more related to condylar asymmetry
- Condylar asymmetry was significantly higher in class II div I malocclusion group when compared with normal occlusion
- Condylar asymmetry was significantly higher in class II div I males subjects when compared with normal occlusion males

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