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Mandibular Asymmetry in Orthodontic Patients with Different Malocclusion Patterns an Orthopantomographic Evaluation

Omair Majeed, Tabassum Ahsan Qadeer, Maria Habib, Ayesha Ashraf

ABSTRACT:

Objectives: To investigate the variation in mandibular asymmetry on right and left sides for different malocclusions.

Study design and setting: It was a cross sectional study carried out in Orthodontic Department at Bahria University Dental College. OPG's of 171 orthodontic patients were collected. The sample was divided into class I, II and III malocclusions.

Methodology: The OPG was traced for condylar and ramal heights for both right and left sides. From these readings, the asymmetry index (AI) was calculated for each side. The significance of height variations between the right and left sides, for each malocclusion was calculated using independent sample t-test. Pearson correlation was used to find the association of asymmetry between the two sides when comparing each malocclusion with the other. One-way ANOVA was used to find the significance of differences in asymmetry index of both sides between different malocclusions.

Results: The ramal heights were significantly different for each malocclusion with p values of 0.00 and 0.02 for right and left side, the p value of the variations in condylar heights was however 0.66 and 0.12 for the two sides. There was a strong positive correlation of the condylar and ramal height on both sides between all three malocclusions. The p value for condylar AI was 0.97 and 0.15 for ramal AI.

Conclusion: The ramus height showed a significant variation in asymmetry while the asymmetry index variations were insignificant between different malocclusion groups.

Keywords: Asymmetry, Asymmetry index, Malocclusion, Condylar height, Ramal height

How to cite this Article:
Majeed O, Qadeer TA, Habib M, Ashraf A. Mandibular Asymmetry in Orthodontic Patients with Different Malocclusion Patterns an Orthopantomographic Evaluation. J Bahria Uni Med Dental Coll. 2023;13(4):291-5 DOI: https://doi.org/10.51985/JBUMDC202162

INTRODUCTION:

Symmetry or proportion refers to equality and resemblance in shape, size and location of facial landmarks on either sides of the median sagittal plane.[1] The facial structures of humans play an important role in regard to social relationships. A balanced and symmetric facial appearance plays a major role in influencing human attractiveness and desirability. However, perfect symmetry is a myth and does not exist. Many faces that appear symmetric and proportional on clinical examination show varying degrees of craniofacial asymmetry on cephalometric studies.[2]

Asymmetry becomes significant when it influences esthetics or social appearance of an individual.[3] Mild asymmetry of the orofacial region is a common finding in a general population however the incidence of clinically apparent facial asymmetry has been reported to be 34–38.6% in patients with dentofacial deformities and 23% in the orthodontic population. Facial asymmetry is more frequently found in patients of skeletal Class III, with an incidence of 40– 80%, possibly due to excessive mandibular growth in the case of mandibular prognathism and can be a risk factor for unbalanced development on both sides of the mandible. Therefore, thorough clinical and radiological evaluation for facial asymmetry is particularly important in skeletal Class III patients.[4]

Asymmetry of the mandible is a craniofacial feature occurring in all types of sagittal malocclusion.[5] It is significant because of its direct effect on facial appearance both in terms of esthetics as well as function.[1,6] Proffit[7] reported that 75% of facial asymmetry patients showed chin deviation, 36% had middle-third asymmetry while asymmetry of the upper face was seen in only 5% patients.[3,8]

The etiology of mandibular asymmetry can be attributed to environmental, genetic or functional factors.[9] It is important

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Received: 14-09-2021
Accepted: 12-09-2023

to determine the aetiological factor and to identify the site of the asymmetry in order to achieve a balanced and harmonious facial appearance following orthodontic or surgical treatment. Asymmetry may originate from morphological disorders including abnormal growth, tumors, trauma, condylar hyperplasia, hemi- mandibular hypertrophy and elongation as well as hyperplasia of the coronoid process. Functional causes such as muscle dysfunctions, bruxism and temporomandibular joint dysfunction may also cause mandibular asymmetry. Malocclusions also have a significant effect on mandibular condyle morphology.[2] One of the main determinants of mandibular growth are the primary and secondary cartilages of the mandible that appear at different times of growth. Growth of the mandibular condyle contributes not only to increased mandible size, but also to anteroinferior displacement (transposition) of the mandible. Condylar growth direction is closely related to the displacement (transposition) direction of the mandible and vertical jaw deviations. The condylar cartilage is one such cartilage that has the highest growth potential and aberrations in the growth of this cartilage due to trauma, congenital diseases or infection can lead to condylar asymmetries rendering them the most common reason for mandibulofacial asymmetries.[10]

Although correlation of mandibular asymmetry and Angle's malocclusion has been studied, however we failed to find local studies on it. Therefore the aim of this study was to investigate the relationship between the occlusal patterns and mandibular asymmetry in our population.

METHODOLOGY:

Ethical approval of the study was obtained from ERC of BUMDC with ref. no. ERC24/2021. It was a retrospective cross sectional study, conducted on the records of patients attending the Orthodontic OPD at BUMDC, who were between 18-30 years of age.

The sample size of 171 subjects was determined by using software G Power version 3.1.9.2 by taking 5% margin of error and 95% confidence interval. The sample was divided into three subgroups according to the malocclusion type. The number of subjects in each subgroup was 58 for Class I, 56 for class II and 57 for class III.

The inclusion criteria was dental class I II and III patients who did not present with any anterior or posterior cross bites or mandibular deviations during opening and closure. Patients who had a history of orthodontic treatment or occlusal and TMJ trauma or TMJ disorders were excluded from the study.

Care was taken in selection of radiographs and only clear ones that captured the entire mandible and presented with no artifacts were used. Panoramic radiographs were traced on an acetate paper, by a single calibrated examiner for all the patients, using a digital caliper with 0.01mm sensitivity. Figure 1 shows the method given by Habets et al who developed a method to quantify condylar asymmetry on panoramic radiographs using linear measurements of both condyles and ramii and comparing the difference between the right and left condylar and ramal heights.[11,12,13] The readings were taken for both the right and left sides. A line connecting the most lateral point of the condyle (O1) and the ascending ramus (O2) was drawn and mentioned as 'A'. Ramus height was the distance between the points O1 and O2, and called 'RH'. Line 'B' was drawn perpendicular to line 'A', touching the most superior part of the condyle. The vertical distance from this line till O1 was measured and named the condylar height, 'CH'. To reduce intra operator bias, 5 cases were randomly retraced to calculate the readings, the Kappa Statistics was found to be 0.8 indicating good agreement.

Asymmetry indices were then calculated for both the condyle (Condylar height right and left) and ramus (Ramus height right and left) using the following formula:

$$\text{Assymetry Index (AI)} = \frac{\text{Right} - \text{Left}}{\text{Right} + \text{Left}} \times 100$$

Statistical analysis was performed using SPSS version 23.0. All continuous variables were calculated as Mean± SD. Normality of data was checked by using Shapiro-Wilk test. Data was found to be Normal (Symmetric). Inferential statistics was performed to find out the height differences between the right and left sides for each malocclusion using independent sample t-test. Pearson correlation was used to find the association of asymmetry between the two sides when comparing each malocclusion with the other. One-way ANOVA was used to find the significance of differences in asymmetry index of both sides between different malocclusions. A p-value = 0.05 considered to be statistically significant.

RESULTS:

Table 1 shows the values of condylar and ramal height with comparison of each side, between different malocclusions, it was found to be statistically insignificant. The condylar height showed minimal difference between different malocclusions whereas the ramal height was most increased in the sample with class III malocclusions.

Pearson correlation showed significant associations in condylar and ramal heights between different malocclusions as shown in Table 2.

DISCUSSION:

There is a state of equilibrium between the two sides of the face in shape, size and form of the structures, however there is usually a dimensional difference between the two sides.[14] Mandibular asymmetry has important esthetic implications due to its direct effect on facial appearance. Various methods have been used to assess facial asymmetry including frontal cephalograms, postero-anterior radiographs, panoramic views, submentovertex views, CT, MRI as well as CBCT.[15,16]

Table 1: Comparison of Condylar and Ramal height values in mm for different groups

	Group	N	Mean ± SD	Min	Max	p value
Condyle	Class I	58	Rt = 8 ± 2.5	7.6	8.9	0.13
			lft = 7.6 ± 2.3	6.9	8.2	
	Class II	56	Rt = 7.9 ± 2.3	7.2	8.5	0.11
			lft = 7 ± 2.3	6.5	7.8	
	Class III	57	Rt = 8 ± 2.5	7.5	8.8	0.89
			lft = 8 ± 2.5	7.4	8.8	
Ramus	Class I	58	Rt = 42.5 ± 5	41.2	43.9	0.39
			lft = 43 ± 6	41.8	45	
	Class II	56	Rt = 43.6 ± 5.4	42.2	45.1	0.51
			lft = 44 ± 5.9	42.7	45.9	
	Class III	57	Rt = 47 ± 6.2	45.3	48.6	0.64
			lft = 46.5 ± 6	44.8	48.1	

p<0.05, SD= Standard Deviation, p value calculated using independent sample t-test

Table 2: Association between right and left side when comparing different malocclusions

	Class I and II		class I and III		class II and III	
	r-value	p- value	r-value	p- value	r-value	p- value
Condyle	0.4*	0.00*	0.3*	0.00*	0.3*	0.00*
Ramus	0.7*	0.00*	0.8*	0.00*	0.79*	0.00*

Data presented as correlation 'r' , p-value
correlation is significant at <0.05 level
calculated using Pearson Correlation

Table 3: Comparison of Asymmetry Index values in % for Condyle and Ramus between different groupS

CAI				
	Mean ± SD	**Min**	**Max**	**p value**
Class I	4.74 ± 16.7	-25	45	0.97
Class II	5.02 ± 17.4	-31	51.5	
Class III	4.36 ±16.07	-33	48.1	
RAI				
	Mean ± SD	**Min**	**Max**	**p value**
Class I	-0.92 ± 4.6	-11.5	8.7	0.15
Class II	-0.74 ± 5.1	-11.3	9.09	
Class III	0.56 ± 3.5	-7.5	10.1	

P<0.05 p value calculated using One-way ANOVA

Orthopantomograms however are the most commonly used imaging technique because it is possible to image the dentition, joints and the entire lower jaw in a single low radiation dose exposure making them a routine diagnostic investigations prior to commencement of orthodontic treatment.

Computed tomography is more accurate and reliable but the cost and increased radiation dosage does not make it a viable option for the majority of the population. Radiographic (OPG) measurements do have the disadvantage of distortion due to magnifications and the methodology used, but studies have been supportive in their use due to advantages like a low cost, relatively low levels of radiation exposure and in third world countries they are also readily available for retrospective studies.[2,9] It has also been suggested that with correct methodology and accurate patient positioning, vertical and angular measurements can be accurately calculated and can be believed to be reliable too.[17] Also the differences between the two sides would likely have the same magnification errors so comparative studies can be adequately performed. Studies have also shown that if the head position is stabilized, the vertical measurements are accurately reproducible.[4]

Habets technique is quite popular for calculation of mandibular symmetry in studies done on radiographs. He reported that if the head position changes by 1cm there would be a 6% change in the vertical dimension.[11,18] The formula for calculating the asymmetry index was developed in 1988 and it gives a 3% index rate from a 1 cm head shift, anything more suggests mandibular asymmetry. In our study the mean condylar asymmetry index was >3% for all malocclusions. This was in accordance to many studies including those of Saglam[19] and Miller[20] who calculated the AI in different malocclusion and found the values in the entire sample to be >3%.

Our study showed no significant variation of the AI values of condyle or ramus, between the three malocclusion groups. Thiesen et al[21] in their study showed that little difference was found, when comparing the same intensities of asymmetry in the different sagittal jaw relationships. This was also similar to the study of Kurt et al[22] who compared the mandibular asymmetry between class II and normal occlusion and did not find any statistical difference in the values between the two groups. A study conducted by Al Taki et al[23] however was the only study that we found which showed a statistically significant condylar asymmetry in class II group that they compared with class I malocclusion. Our sample showed that despite there being no significant variation of condylar AI between different malocclusions, the value shown by the class II sample was the highest. Along with that between the ramus and condylar asymmetry index, only the condylar showed a higher value for class II malocclusion similar to the results of Akin et al.[16] The AI of ramal heights was found to be highest in class III malocclusion in our study, despite having minimum variations.

When comparing the two sides of the mandible, some studies have shown the right side to be dominant or greater in certain dimensions, while some studies show that the larger readings were observed on the left side[2]. For our study we did not find any such relationship with both sides showing random greater and smaller readings with the differences being statistically insignificant as shown in Table 1.

While using Habets method for asymmetry calculation, it is recommended that AI values of >3% is taken into consideration. Our study found the CAI in all the malocclusions to be above 3%, however the RAI value was below that. This is in accordance to the study by Al TaKi et al[23] who found the RAI to be below the benchmark whereas the CAI was more than the prescribed 3%. Another study by Syeda and Roohi showed that CAI in normal occlusion and class II Div I malocclusion (males and females) were found above 3% indicating the presence of asymmetry.[24] Their CAI values, in contrast to many other studies were however much higher, being 9.13, 14.9 and 4.55 for class I II and III, as compared to our sample which was 4.74, 5.02 and 4.36 for the three malocclusion groups given in Table 3. Miller and Bodner, who compared the condylar asymmetry of class I and III, found the values to be 4.42% and 4.14%.[25] The reason that best explains this contrast in results could be the normal variation for different populations, as there was no major difference in the inclusion criteria's of these studies from our study. The age group of the sample by Al Taki et al was 19-28 years while ours was 18 years and above, so late growth resulting in asymmetry can be ruled out to major extent.[23] Convenience sampling was utilized for most studies from the orthodontic records of the patients visiting the OPD. A cohort sample in future studies can may help throw better light on this variation.

Limitations of our study included not dividing the class II sample into division 1 and 2.

CONCLUSION:

Our study showed that there was no significant variation in the mandibular asymmetry between the two sides for any type of malocclusion. The ramus height showed a significant variation in asymmetry between different malocclusions.

Authors Contribution:
Omair Majeed: FRC, ERC, Data compilation, Introduction writing
Tabassum Ahsan Qadeer: Writing Results, discussion and conclusion, Table making
Maria Habib: Data collection
Ayesha Ashraf: Data collection

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