RESEARCH ARTICLE

Comparison of ramal heights in individuals with clinically symmetrical and asymmetrical faces

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Abstract

Objective: To compare the mandibular ramal height differences between clinically symmetrical and asymmetrical face individuals.

Method: The comparative cross-sectional study was conducted from May 2020 to July 2021 at the Armed Forces Institute of Dentistry, Rawalpindi, Pakistan, and comprised subjects regardless of age and gender who were divided into two equal groups. Those with a clinically symmetrical face were in Group-I, and those with a clinically asymmetrical face were in Group-II. Mandibular ramal height of both sides of all subjects was measured, and asymmetry index. Differences of both right and left ramal heights of each group were measured and compared. Data was analysed using SPSS 26.

Results: Of the 78 subjects, 40(51%) were males and 38(49%) were females. The overall mean age was 18±5.78 years, with 44(56%) aged 16-25 years, 28(36%) <15 years and 6(8%) >26 years. There was high but non-significant correlation between the right and left sides of both the groups (p>0.05). Inter-group differences were significant with respect to ramal height (p=0.000), whereas difference in terms of asymmetry index was not significant (p>0.05).

Conclusion: There were significant differences in the mean ramal height between clinically symmetrical and asymmetrical face individuals.

Keywords: Facial asymmetry, Mandibular condyle, Radiography, Panoramic.

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Introduction

The perfectly bilateral face is primarily an impractical and unrealistic concept, whereas asymmetry is the norm.[1,2] The vertical proportions of the human face may always show some degree of variance, called the normal asymmetry.[2] This balance between normal asymmetry and ideal symmetry of the human face is a crucial determinant of facial attractiveness.[3] Asymmetry in the facial dimensions may be defined as the presence of any disparity when the face is divided into vertical thirds and horizontal fifths proportions during the frontal examination of the patient field.[2] The presence of this asymmetry may be the patient's or parent's concern, and it can easily be quantified by the clinicians based on their own or patients' perception and subjective evaluation of facial asymmetry.[1] There may be many causative factors of facial asymmetry, including genetic problems, trauma, oral parafunctional habits, malocclusion, environmental factors, etc.[1,4] that can be divided into three broad categories; congenital, developmental, and acquired.

Facial asymmetry can lead to developmental and functional problems, such as increased likelihood of temporomandibular disorders, uneven masticatory forces leading to traumatic temporomandibular joint and muscular overloading, dental attrition, etc.[3,5,6] Moreover, the facial asymmetry can have an impact on the quality of the life by impacting the social and mental wellbeing of patient.[4] Hence, modern orthodontics is not limited to recreation of an optimal occlusion, but also symmetrical and well-aligned dentofacial structures that will contribute to patient's self-confidence, solve their problems, and improve their psychosocial wellbeing.[3,4]

Despite the undeniable significance and consequences of aesthetically pleasing facial symmetry, there is lack of consensus on a standard method for the determination of asymmetry. The methods of determination of facial asymmetry vary depending on use of technique, for example, clinical examination, photography, or radiography.[7] This in-turn highlights the discrepancy between soft tissue and skeletal-dental profile, based on radiographic assessment. Literature lacks studies assessing the correlation between the perception of facial asymmetry and the panoramic measurements.[1] Nonetheless, patients rely on clinical picture and, hence, soft tissue parameters take precedence over skeletal-dental parameters. Therefore, one popular method of assessment of facial asymmetry is by measuring the

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distance between the mid-point of the chin and the facial midline, and a deviation of 2mm or more defines the asymmetry.[6]

Another unexplored dimension of this biological imperfection of facial disharmony is the characteristics associated with it. There are very few epidemiological studies in literature evaluating and quantifying the underlying skeletal features of this disharmony to assess their impact. The method by Habets et al.[8] is the most reliable and most frequently used method[7] to determine underlying asymmetries between vertical heights of the mandibular right and left rami. This has also been an acceptable method for diagnosis and treatment planning in malocclusion and temporomandibular-disorder patients.[3,6,9,10] The current study was planned to compare mandibular ramal heights in individuals with clinically symmetrical and asymmetrical faces.

Subjects and Methods

The comparative prospective cross-sectional study was conducted from May 2020 to July 2021 at the Department of Orthodontics, Armed Forces Institute of Dentistry (AFID), Rawalpindi, Pakistan. After approval from the institutional ethics review committee, the sample size was calculated using OpenEpi software, keeping hypothetical values in line with a previous study,[11] significance level (1-α) 95% and power (1-β) 85% using Fleiss with continuity correction (CC) formula.[12] Those included were individuals regardless of age and gender who were equally divided into Group-I and Group-II. The inclusion criteria for Group-I were clinically symmetrical face with no or minimal chin point (soft tissue Menton, Men') deviation of <3mm from the facial midline. Group-II had individuals with clinically asymmetrical faces with chin point (soft tissue Menton, Men') deviation >3mm, but <5mm from the facial midline. Individuals with any temporomandibular pathology or craniofacial abnormality, crossbite, history of previous orthodontic or orthognathic treatment, any restorations, or missing teeth were excluded. The radiographs of patients based on the inclusion criteria were analysed for mandibular asymmetry.

For the assessment of facial asymmetry, all the patients were seated upright with the face oriented with the natural head position parallel to the floor. Mandibular ramal height was evaluated according to Habets' technique[8] (Figure) and the Ramal Asymmetry Index (RAI) was calculated using the following formula[8]:

$$RAI = RH_{(right)} - RH_{(left)} / RH_{(right)} + RH_{(left)} \times 100\%.$$

Data was analysed using SPSS 26.[13] Data was expressed as frequencies and percentages or mean with standard deviations, as appropriate. Shapiro-Wilk test was used to assess normality of data distribution, which showed no evidence of non-normality for all variables. To determine ramal height differences between left and right sides of each patient, paired-sample t-test was used. To determine statistical differences between the two groups and to compare them across the variables of gender, age and skeletal class for ramal heights and RAI measurements, independent sample t-test was used. P<0.05 was considered statistically significant.

Results

Of the 78 subjects, 40(51%) were males and 38(49%) were females. The overall mean age was 18±5.78 years, with 44(56%) aged 16-25 years, 28(36%) <15 years and 6(8%) >26 years. In terms of skeletal class, skeletal class 36(46%) subjects had class I, 31(40%) class II and 11(14%) class III.

Both the groups had 39(50%) subjects each. Group-I had 19(49%) males and 20(51%) females with mean age 18.04±7.02 years. Group-II had 21(54%) males and 18(46%) females with mean age 17.74±4.27 years. Regarding skeletal class distribution, Group-I had 22(56.3%) patients with Class I, 13(33.3%) Class II and 4(10.3%) class III, whereas Group-II had 14(35.9%) Class I, 18(46.1%) Class II, and 7(17.9%) Class III patients.

There was high but non-significant correlation between the right and left sides of both the groups (p>0.05) (Table-1). Inter-group differences were significant with respect to ramal height (p=0.000), whereas RAI difference was not significant (p>0.05) (Table-2).

With respect to severity of asymmetry, 32(41%) subjects

Table-1: Intra-group comparison of ramal heights (right and left) using paired T-test and Pearson correlation in clinically symmetrical and asymmetrical groups.

Parameters	Comparison Groups	Mean (mm)	SD	Pearson Correlation		Paired T-test	
				r value	p-value	T test value	p-value
Symmetrical	Right ramal Length	60.64	4.99	0.845	0.000*	-0.227	0.821
	Left ramal Length	60.74	5.12				
Asymmetrical	Right ramal Length	54.36	7.20	0.755	0.000*	1.406	0.168
	Left ramal Length	53.25	6.75				

*Statistically significant at p<0.05.

Figure: Orthopantomagram (OPG) tracing showing tracing and landmarks labelled Cor (Coronoid), Co (Condyle), Go (Gonion) with vertical measurements, i.e., right ramal height (1) and left ramal height (2).

Table-2: Inter-group comparison of ramal heights (right and left) and RAI using independent T-test.

Parameters	Comparison Groups	Mean (mm)	SD	p-value
Right ramal Length	Symmetrical	60.64	4.99	0.000*
	Asymmetrical	54.36	7.20	
Left ramal Length	Symmetrical	60.74	5.12	0.000*
	Asymmetrical	53.25	6.75	
RAI	Symmetrical	-0.07	2.38	0.21
	Asymmetrical	0.97	4.66	

RAI: Ramal asymmetry index, *Statistically significant at $p<0.05$.

had RAI value <0%, 28(35.9%) ranged 0-2.99%, 9(11.5%) ranged 3-5% and 9(11.5%) ranged 5-$\leq$10%.

Discussion

The current study is the first to analyse the mandibular ramal asymmetry measured using Habet et al.'s method[8] on orthopantomogram (OPG) radiographs in individuals with clinically symmetric or asymmetric faces. The study is also the first to provide ground-level data on the frequency distribution of mandibular ramal asymmetry across gender, age and skeletal classification in Pakistani population.

Facial asymmetry is a norm rather than the exception, as every human being is a combination of minor asymmetrical components.[1,11] These minor asymmetries in the seemingly bilaterally symmetrical structures are also referred to as fluctuating asymmetries.[13] With the exceeding interest in facial aesthetics, it is becoming necessary for orthodontists to pay due attention to symmetries and have the required knowledge and skills to establish the most suitable diagnosis and treatment plan for their patients.[14,15]

Panoramic radiograph is a reliable and recommended two-dimensional (2D) screening tool for assessing dental and craniofacial disorders. It also effectively measures mandibular ramal height differences of both right and left sides.[1,8,11] A few studies have been conducted measuring condylar and ramal heights using Habet et al.[8] methods, but the current study measured the ramal sizes in both clinically symmetrical and asymmetrical individuals using this method on panoramic radiographs, which has not been done previously. The concern with using panoramic radiographs is the magnification of image, which is why Habets et al.[8] defined 6% asymmetry (3% each) threshold, and the current study also followed same criteria.

Facial asymmetry, owing to mandibular asymmetry, may be skeletal, dental, soft tissue, and functional, and it is necessary to determine the underlying cause of facial asymmetry before establishing its treatment plan.[16] Limited evidence is available to support the skeletal outcome of these facial, dentoalveolar and muscle asymmetries.[17] Asymmetry of the soft tissue structures is usually detected in the central one-third of the face during pre-adolescence. Later in post-adolescence, it becomes more visible in the lower one-third of the face as the mandibular growth continues till 16 years of age.[18] Studies have also explored the role of gender and age in affecting the rate of average mandibular growth.[19] In the current study, the ramal heights of the right and left sides for both genders were measured, and no statistically significant difference was found. This result is consistent with the studies done previously.[8,11,18,20]

Data regarding the ramal height measurements of the right and left sides in asymmetrical faces is controversial. A few studies correlated clinical asymmetry with skeletal asymmetry.[1] While other studies claimed that some degree of asymmetry exists even in symmetric faces, no significant correlation was found in such individuals.[21] These findings were established on the spatial position of condyle within the glenoid fossa, and were carried out using a 2D radiographic modality. As such, this data is not an accurate representation of true skeletal asymmetry.

The current study reported mean ramal height of 57.5mm; 61mm in symmetrical faces and 54mm in asymmetrical faces. The mean ramal heights reported in other studies varied from 34mm[9] to 43mm[3,7,19] and from 66mm[1] to 81mm[11] in different studies. The differences could be attributed to varying magnification of panoramic radiograph. The current study also reported difference in right and left ramal heights to be statistically non-significant (p=0.82). These results were consistent with some studies,[1,3,7,9] while contrasting results have been reported by others.[11]

Despite having a strict criterion of including only individuals with <5mm chin point deviation, the current study found statistically significant (p=0.001) ramal height difference between the two groups.[8] Based on thorough literature search, no other study compared ramal heights between such groups. Only one study[14] compared the two groups using cone-beam computed tomography (CBCT) for condylar parameters. Some other studies compared ramal heights among skeletal classifications,[7,10,15,20] cross-bites,[3,9,18] and mandibular impactions.[19] The current study did not assess cross-bite and mandibular impaction, but results related to skeletal classification were not statistically significant.

The mean value of RAI in the current study was 0.45±3.7; -0.07 for symmetrical faces, and 0.97 for asymmetrical faces. RAI values reported in literature are -0.01,[7] 0.37,[3] 1.97,[1] 2.12[20] and 2.52.[9] RAI between differences between clinically symmetrical and asymmetrical faces were statistically non-significant (p=0.21). No other study conducted this comparison for RAI.

Values related to the severity of asymmetry in the study were similar to those reported earlier.[1]

The limitations of the current study include its cross-sectional design. Longitudinal research is required to understand growth effects, development and skeletal maturation in mandibular asymmetry. However, it seems idealistic to follow a group of individuals with certain malocclusions without performing any treatment. Secondly, patients were mainly young adults (mean age 18), so the results may not be generalisable to older adults. Thirdly, only panoramic radiographs were used for assessment, which, although acceptable, reliable and non-invasive, provide a 2D image with magnification errors. Hence, future research needs to employ 3D imaging technology to obtain more accurate findings.

Conclusion

A statistically non-significant difference in RAI values between clinically symmetrical and asymmetrical faces was found. However, ramal height differences between the groups were statistically significant, indicating that certain degree of asymmetry existed in all subjects.

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