MANDİBULAR ASİMETRİNİN PANOROMİK RADYOGRAFİ İLE BELİRLENMESİ

DETERMINATION OF MANDIBULAR ASYMMETRY WITH PANORAMIC RADIOGRAPHY

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Özet

Bu çalışmanın amacı, sağlıklı bireylerde mandibular asimetrinin ve bunun yaş ve cinsiyetle ilişkisinin değerlendirilmesidir.

Bu çalışma 8 ile 60 yaş arasındaki 499 hastanın panoromik röntgeninin değerlendirilmesi ile yapılmıştır. Hastalar 3 gruba ayrılmıştır. Birinci grubta 8 ila 18 yaş arasında 35 hasta, ikinci grubta 19 ila 30 yaş arasında 155 hasta, üçüncü grubta 31 ila 60 yaş arasında 309 hasta bulunmaktadır. Dijital panoromik radyoğrafi üzerinde uzunluk ve genişlik (kondiler, ramus uzunlukları ve korpus, kondil genişlikleri) her iki mandibula bölgesinde dijital analiz programı ile ölçülmüştür. Pearson korelasyon ve tek değişkenli ANOVA testleri grublar arasında fark olup olmadığını belirlemek amacıyla uygulanmıştır.

Yaş grubları arasında, ölçüm yapılan mandibulanın 4 bölgesindede istatistiki açıdan anlamlı sonuçlar bulunmuştur ($p<0.05$). Grublar arasında yapılan ölçümlerde 8 ila 18 yaş grubu ile diğer grublar arasında anlamlı sonuç vardır.

Bu çalışma sonucunda, mandibular asimetriyi belirlemek amacıyla yapılan vertikal ve horizontal ölçümlerin, 8 ila 18 yaş grubunda anlamlı olduğu sonucuna ulaşılmıştır.

Anahtar kelimeler: yaş, asimetri indeksi, cinsiyet, mandibular asimetri, panoromik.

Abstract

The aim of the present study was to assess mandibular asymmetry and its relation to the age and gender of healthy individuals.

This research was conducted on 499 patients panoramic radiograph who were between the ages of 8 and 60. The patients were divided into three groups. The first group had 35 patients between the ages of 8 and 18, the second group had 155 patients between the ages of 19 and 30, and the third group had 309 patients between the ages of 31 and 60. On digital panoramic radiographies, the heights and width (condylar, ramal heights, and corpusal, condylar widths) on both mandibular sides were measured with a digital analysis program. Pearson correlation test and Univariate ANOVA was applied to determine the relationships among groups.

There was a statistically significant difference was found between age groups in the four mandibular dimensions ($p<0.05$). Among age groups, there was a significant difference in measurements of the 8 to 18 age group compared with the other age groups.

The present study revealed that vertical and horizontal measurements for the determination of mandibular asymmetry in a preadolescent age group were meaningless.

Key words: age, asymmetry index, gender; mandibular asymmetry, panoramic

Introduction

The word symmetry is derived from the Greek word *symmetria,* which means “of like measure.” Symmetry is correspondence in size, shape, and relative position of parts on opposite sides of a dividing line or a median plane. Asymmetry is the lack or absence of symmetry. When applying this to the human face, asymmetry is an imbalance or disproportionality between the right and left sides. A degree of asymmetry is normal and acceptable in the average face and may be caused by a range of factors that affect the underlying skeletal structure or soft tissue drape.[1]

Due to the adaptive response of the mandible to deviations during functioning, which may cause modeling of the condyle and glenoid fossa[2,3] with remodeling and modeling of the mandibular bone[4-6], asymmetries between both sides of the mandible may occur. However, this situation may also lead to dimensional

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differences in sizes between the right and left sides of the mandible.

The etiology of mandibular asymmetry might be a combination of genetic and environmental influences. Common causes include developmental (such as Hemimandibular elongation, Hemifacial microsomia, Achondroplasia, Hemiafacial hypertrophy), pathological (tumours and cysts, infections, joint pathologies such as rheumatoid arthritis), traumatic (Condylar fractures), and functional issues. Much research has been done in relation to mandibular asymmetry and much more remains to be done.[7-17] Several methods such as submento-vertical and posteroanterior radiographs[18,19], photography[20], and panoramic radiography[21,22] have been proposed to determine mandibular asymmetries. The panoramic radiograph offers a method that analyzes the various structures of the mandible separately on the right and left sides.[7,23,24]

Even though panoramic radiography should be used cautiously when making absolute measurements or relative comparisons, it is reliable for determining mandibular asymmetries.[7,21-23,25] In the literature, studies about mandibular asymmetry were made usually involving individuals with the problems of temporomandibular joint[12] and orthodontic anomalies[14,15,26], during the pre-pubertal growth period.[16] To our knowledge, no study has evaluated mandibular asymmetry in different age groups. Therefore, the aim of this study was to investigate the presence of mandibular asymmetry and its relationship to age groups and gender using horizontal and vertical measurements on panoramic radiography.

MATERIAL AND METHODS

The panoramic radiographs of 499 individuals (257 males and 242 females) were obtained from the archives of the Faculty of Dentistry at Mustafa Kemal University and divided into three groups. Group 1 consisted of 35 individuals, 8 to 18 years old; Group II consisted of 155 individuals, 19 to 30 years old; and Group III consisted of 309 individuals, 31 to 60 years old. The panoramic radiographs of all of these patients were taken under standard conditions. On these digital panoramic radiographs, the heights and widths (condylar, ramal heights, corpusal and condylar width) on both mandibular sides were measured by a trained investigator using a digital analysis program (Enil Packs, Eskişehir, Turkey). The condylar, ramal, and corpusal asymmetry indexes were determined according to Habets et al.[7]

The results were obtained as percentages. Based on the asymmetry index (AI) for each measurement on each radiograph, the results were classified into four categories of asymmetry: no significant (NS) asymmetry, when AI was between 0% and 2.99%; light (L), when AI was between 3% and 5%; moderate (M), when the index was greater than 5%, but less than or equal to 10%; and severe (S), when AI was more than 10%.

According to Habets et al.'s method, an A-line was drawn between the most lateral point of the condylar image (O1) and on the ascending ramus image (O2) (Figure 1). To the A-line from the most superior point of condylar image, a perpendicular B-line was drawn. Condylar height was determined by measuring the distance between the O1 point and the B-line. The Ramus height was determined by measuring the distance between the O1 and O2 points.

Statistical Analysis

The effects of the age groups and the gender on the asymmetry indexes were investigated by using the Pearson correlation test. Univariate ANOVA was applied to determine the relationships among age groups, gender, measurements, and sides.

RESULTS

Regarding the severity of the mandibular asymmetry calculated with the AI, a high percentage of the subjects presented no significant asymmetry or light asymmetry. No significant asymmetry was present in a high percentage of subjects in all age groups for the four mandibular dimensions evaluated.

Asymmetry indexes for the four mandibular dimensions according to age group were not statistically significant ($p>0.05$). The effect of gender on the asymmetry index for condyle width was statistically significant ($p<0.05$). The severity of the asymmetry regarding age groups and gender is shown in Table 1. When both sides of the mandible were compared, the difference was not statistically

significant for the mandibular measurements (p>0.05).

		31-60	19-30	8-18	Total	*p*	Male	Female	Total	*p*
Corpus width	NS	133	55	12	200	0.842	102	98	200	0.307
	L	71	38	9	118		69	49	118	
	M	97	37	10	144		71	73	144	
	S	20	10	2	32		12	20	32	
	Total	321	140	33	494		254	240	494	
Ramus height	NS	283	122	29	434	0.364	225	209	434	0.293
	L	29	9	2	40		21	19	40	
	M	2	4	1	7		4	3	7	
	S	7	5	1	13		4	9	13	
	Total	321	140	33	494		254	240	494	
Condyle height	NS	143	74	11	228	0.725	122	106	228	0.112
	L	62	19	10	91		48	43	91	
	M	95	38	11	144		75	69	144	
	S	21	9	1	31		9	22	31	
	Total	321	140	33	494		254	240	494	
Condil width	NS	149	59	16	224	0.558	129	95	224	0.004
	L	61	36	8	105		52	53	105	
	M	83	41	6	130		61	69	130	
	S	28	4	3	35		12	23	35	
	Total	321	140	33	494		254	240	494	

p<0.005 indicates significant difference

Table 1: Distribution of asymmetry index according to age and gender groups

There was a statistically significant difference between the age groups in the four mandibular dimensions (p<0.05). The effect of gender on the four mandibular measurements was statistically significant (p<0.05) (Table 2).

Source	Type III Sum of Squares	df	Mean Square	F	*p*
Age	9000,448	2	4500,224	15,51	0.000
Gender	6101,159	1	6101,159	21,027	0.000
Side	62,268	1	62,268	0,215	0,643
Measurements	3045990,488	3	1015330,163	3499,231	0.000
Age * Gender	349,128	2	174,564	0,602	0,548
Age * Side	320,177	2	160,088	0,552	0,576
Gender * Side	114,518	1	114,518	0,395	0,53
Age * Gender * Side	40,551	2	20,276	0,07	0,933
Age * Measurements	12077,871	6	2012,978	6,938	0.000
Gender * Measurements	9983,237	3	3327,746	11,469	0.000
Age * Gender * Measurements	603,753	6	100,625	0,347	0,912
Side * Measurements	123,249	3	41,083	0,142	0,935
Age * Side * Measurements	934,584	6	155,764	0,537	0,781
Gender * Side * Measurements	159,325	3	53,108	0,183	0,908
Age * Gender * Side * Measurements	220,355	6	36,726	0,127	0,993

p<0.001 indicates significant difference

Table 2: ANOVA test results based on age, gender, side, and measurements

Among the age groups, there was a statistically significant difference in the measurements of the 8-18 age group compared with the other age groups (Table 3). No statistically significant difference was found between both sides of the mandible for the condyle width measurements (Table 4).

Age	8-18	19-30	31-60
8-18		0.00	0.00
19-30			0.43
31-60			

p<0.001 indicates significant difference

Table 3: ANOVA results for age groups

	Corpus W	Ramus H	Condil H	Condil W
Corpus W		0.00	0.00	0.46
Ramus H			0.00	0.00
Condil H				0.00
Condil W				

p<0.001 indicates significant difference

Table 4: ANOVA results for both sides of the mandible for the condyle width measurements

DISCUSSION

The perfect craniofacial symmetry does not exist in nature and asymmetry ranges from clinically undetectable to a gross abnormality. The assessment of dentofacial asymmetries is a fundamental goal of orthodontic treatment to create a balanced and harmonious facial appearance. There are several radiographic techniques to determine the asymmetry such as; submentovertex[27] or postero-anterior cephalometric radiographs[28], computed tomography[29,30], and magnetic resonance imaging[31]. Studies have shown the posterior cephalometric films to have some limitation of methodology and reliability. The submental vertex (SMV) view is capable of significant distortion[33,34], especially in the analysis of mandibular asymmetry, since the mandible is positioned farthest from the film's plane. The most useful and available radiographic technique is panoramic radiography. Since it current standard of care for dental diagnosis, and treatment planning providing significant amount information about the teeth and supporting bone structure. There are several reports related to evaluation of mandibular asymmetry using panoramic radiography in the

literature. Therefore panoramic radiography based on the present study.

Most authors have suggested that small changes in head position can affect the horizontal dimensions, while big changes do not occur in vertical dimensions, thereby allowing the vertical asymmetry measurements to be performed on the panoramic radiographs.[7,23,35] The reported accuracy for vertical measurements in the articles ranged from 6% to 10%. Beyond these percentages, any differences in vertical measurements can be considered a result of an asymmetry rather than an image distortion.[35,36] The previous studies showed that horizontal measurements made on the panoramic radiographs were particularly unreliable and abandoned[37], and the vertical measurements were clinically applicable in quantitative assessments of the alveolar bone height in both jaws.

In a recent study, Kambylafkas et al.[22] showed that panoramic radiographies could be used to assess the vertical posterior mandibular asymmetries. The reproducibility of the vertical and angular measurements on the panoramic radiographies is acceptable if the patient's head is positioned properly in the equipment. Vertical measurements, although more accurate than horizontal or angular measurements, are still not true representations of the real objects.[38] In the present study, while corpus width from the horizontal measurements revealed no statistically significant differences among the gender groups, the measurements of the condylar width between males and females were statistically significant. In addition, neither horizontal measurement showed a statistically significant difference for the age groups. Vertical measurements (ramus and condyle height) also did not show statistically significant differences for the age and gender groups.

Although in the literature several reports exist related to mandibular asymmetry, most of them involved problems such as orthodontic anomalies, pre-pubertal growth disorders, or temporomandibular disorders. The studies on healthy subjects were very limited. In addition, few studies determined the relationship between the presence of mandibular asymmetry in line with gender and age. The previous studies investigated asymmetry between the right and left condyles of the subjects in the normocclusive subgroups and showed a slight asymmetry.[9,11,13,26] In the present study, regarding the severity of the mandibular asymmetry calculated with the asymmetry index, a high percentage of the subjects for four asymmetry indexes did not present significant or light asymmetry.

The method described by Habets et al.[7] has been used for evaluating condylar and ramal asymmetries in TMD patients and in different malocclusions. In the present study, this method was used to assess the condyles, the rami, and the corpus. The reliability of this method was verified.[7,13,39] Because the formula of Habets et al.[7] contains absolute values to measure asymmetry, it was impossible to assess which side was longer or shorter with that formula. It was the hypothesis that this asymmetry index is universal and could be applied not only to vertical dimensions but also to horizontal ones.

In the present study, there was no significant difference between gender for evaluation of condyle and corpus width. Asymmetry indexes for the four mandibular dimensions according to age groups were not statistically significant. On the other hand, the effect of gender on the asymmetry index for condyle width was statistically significant. This difference could be explained by horizontal projection factors. Catic et al.[37] reported that horizontal measurements can be made precisely on a panoramic radiography as long as the distance is only one side of the mandible and does not transverse the midline. In the light of this knowledge and the findings of the present study, it is suggested that the determination of horizontal mandibular asymmetry may not always be accurate in panoramic radiographs.

Most of studies in the literature related to mandibular asymmetry focused on the vertical dimensions. Ramirez-Yanez et al.[16] researched the horizontal asymmetries in the mandible together with the vertical ones. They revealed statistically significant differences between both sides of the mandible for the corpus length measurements on the panoramic radiographs, which were consistent with the findings of the present study.

The present study also evaluated condyle width on the panoramic radiographs for both sides. In contrast to the other three measurements (corpus width, ramus height, condyle height), no statistically significant difference was found between both sides of the

mandible for the condyle width measurement. This condition results from the anatomic structure of the condyle. Because of the movements of the condyle when opening the mouth, the reference point for the measurement on the condyle may change and this results in different measurement values. These differences should be neglected clinically since there were no significant differences according to other three measurements.

Costa examined the relationship between condylar asymmetry with age and gender in Indians living in America, but he did not find a significant difference. He detected that 64.3% of the women's and 54.8% of the men's right condyle height was longer than the left side, but he declared that these findings were not statistically significant.[40] In the same way, Habets et al.[7] reported no association between gender and condylar asymmetry. No relationship between asymmetry indexes for four measurements with genders were found in the present study, so the findings parallel those of other studies, except with regard to condyle width. The effect of gender on the asymmetry index for condyle width was statistically significant.

Asymmetries have been associated with periods of significant growth[41], malocclusions[42-44], asymmetric development in some brain regions[45], and temporomandibular joint internal derangement.[19] Mandibular asymmetries have been reported as a common feature in growing patients.[46,47] In the current study, although there were statistically significant differences in the measurements of the 8-18 age group compared with the other age groups, the asymmetry indexes did not show any statistically differences in this age group.

CONCLUSIONS

The following conclusions can be drawn from the results of the present study:

1. The vertical measurements on the panoramic radiographs showed no differences between the right and left sides.
2. The vertical and horizontal measurements on the panoramic radiographs showed differences between the right and left sides of mandibles in the 8-18 age group.
3. Asymmetry indexes for the four mandibular dimensions were not statistically significant according to age groups.
4. The effect of gender on the asymmetry index for condyle height, ramus height, and corpus width, except for condyle width, was not statistically significant.
5. Regarding the severity of the mandibular asymmetry calculated with the AI, a high percentage of the subjects presented no significant asymmetry or light asymmetry.

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