ÖZGÜN ARAŞTIRMA ORIGINAL RESEARCH

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RETROSPECTIVE EVALUATION OF MANDIBULAR ASYMMETRY WITH PANORAMIC RADIOGRAPHY IN ANGLE MALOCCLUSION SAMPLES

ANGLE MALOKLÜZYON ÖRNEKLERİNDE PANORAMİK RADYOGRAFİ İLE MANDİBULAR ASİMETRİNİN RETROSPEKTİF OLARAK DEĞERLENDİRİLMESİ

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Öz

Amaç
Bu çalışmanın amacı çeşitli anatomik noktalarda panoramik radyografi ile farklı oklüzyon tiplerinin mandibular asimetri üzerine etkisini araştırmaktır.

Gereç ve Yöntem
Bu retrospektif çalışmaya, panoramik görüntü ve malokluzyonları hasta veri tabanına kayıtlı 100 hastayı dahil edilmiştir. Asimetri indeksleri, doğrusal ve açısal ölçümler kullanılarak Habets asimetri indeksi formülüne göre değerlendirildi. Malokluzyonlar, yaş ve cinsiyetin asimetri indeksi üzerinde etkisi istatistiksel olarak araştırıldı ve <0.05 p değeri anlamlı kabul edildi.

Bulgular
100 hastanın 51' i (51%) kadın, 49'u (49%) erkekti. Cinsiyet ile sağ korpus uzunluğu, sağ ve sol gonial açı değerleri arasında, malokluzyon ile sağ kondil yüksekliği ile sağ ve sol korpus uzunluğu arasında ilişki tespit edildi.

Sonuç
Bazı parametrelerin değerleri cinsiyet ve maloklüzyon ile değişmekle birlikte, herhangi bir parametre için yaş, cinsiyet ve maloklüzyon ile asimetri indeksi değerleri arasında istatiksel olarak anlamlı bir ilişki bulunmamıştır.

Anahtar Kelimeler: Fasiyal asimetri, Maloklüzyon, Panoramik radyografi

Abstract

Objective
The purpose of this study was to investigate the effect of different types of occlusion on mandibular asymmetry by using panoramic radiography in various anatomical points.

Materials and Methods
This retrospective study included 100 patients whose panoramic images and malocclusions were registered in a patient database. Asymmetry indices were evaluated according to the Habets asymmetry index formula using linear and angular measurements of images. The effects of malocclusions, age and gender on the asymmetry indices were investigated and <0.05 p value was considered significant

Results
Of the total 100 patients 51 (51%) were female and 49 (49%) were male. Associations were found between gender and the right corpus length, right and left gonial angle values, and between malocclusion and the right condylar height and right and left corpus length.

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Conclusion
Although values of some parameters varied with gender and malocclusion, there was no statistically significant relationship found between age, gender and malocclusion and asymmetry index values for any parameter.

Keywords: Facial Asymmetry, Malocclusion, Panoramic Radiography

Introduction

The facial structures of humans play an important role in regard to social relationships. A symmetric facial appearance is a major factor in determining human attractiveness; however, perfect symmetry does not exist. In cases where a distinctive diagnosis is required for dental and skeletal problems, the determination of symmetry of the maxillofacial complex is a very important and basic step (1).

Asymmetric function and activities of the jaws cause different developments in the right and left sides of the mandible (2). Mandibular asymmetry is important because it directly affects facial aesthetics and can cause functional problems due to its stomatognathic role (3). Mandibular asymmetry may originate from morphological disorders, including abnormal growth speed, trauma, tumours, condylar hyperplasia, hemi-mandibular hypertrophy, hemi-mandibular elongation and coronoid hyperplasia. Functional causes such as bruxism, muscle dysfunctions, occlusal malformation and temporomandibular joint dysfunction may also cause mandibular asymmetry (4,5). Furthermore, it has been demonstrated that malocclusions have a significant effect on mandibular condyle morphology (2).

The purpose of this study was to investigate the effect of different types of occlusion on mandibular asymmetry by using panoramic radiography (PR) in various anatomical points.

Material and Methods

Data Collection

PR images of 100 patients who presented for orthodontic treatment to the Akdeniz University Faculty of Dentistry, Oral and Maxillofacial Radiology Department were retrospectively scanned and three linear and one angular measurements were made on images. The anamnesis and malocclusion data of the patients were reached using the Metasoft Dentasist Programme (version 3.0.448, Eskişehir, Turkey). Patients included in the study were divided into three occlusion groups according to Angle: class I, class II and class III, which were each divided into five age groups: 10, 11, 12, 13 and 14 years.

The following inclusion criteria were used for the study: (1) presence of normal anatomic condyle and coronoid processes in radiographic images, (2) existence of mandibular first molar teeth, (3) presence of germs for all teeth (whether third molar germ exists or not), (4) absence of systemic diseases affecting bone structure and (5) absence of trauma affecting bone structure. PR images wherein anatomical points needed to perform linear and angular measurements were not clearly visualised, image quality was poor or had horizontal distortions and wherein temporomandibular joint pathology was suspected were excluded from the study.

PR images were obtained using the same Planmeca ProMax panoramic-cephalometric device (Planmeca Oy, 00880 Helsinki, Finland), in accordance with the manufacturer’s instructions, by the same X-ray technician. Images were evaluated using the same LED monitor by the same investigator who is experts in dental radiology and has five years of experience. Evaluation was made in a reduced-light room with tonal adjustments made on images to maximise the view. Only five panoramic images were evaluated per a day in order to prevent investigator fatigue. The mesiodistal widths of the mandibular first molar teeth were evaluated bilaterally to detect horizontal distortion in the images and images with greather than a size difference of 1 mm were excluded from the study (1).

Mandibular Dimensions

Condyle point (Co), gonion point (Go), menton point (Me), corpus length (CL), gonial angle (GA) were determined according to Agrawal et al.(4) O_1 point, O_2 point, A line, B line, condylar height (CH) and ramal height (RH) were determined according to Habets et al.(6) Figure 1 shows the definition of O_1 point, O_2 point, A line and B line.

Linear and angular measurements taken from the PR images were as follows:
CH: distance between Co and O_1 points
RH: distance between O_1 and O_2 points

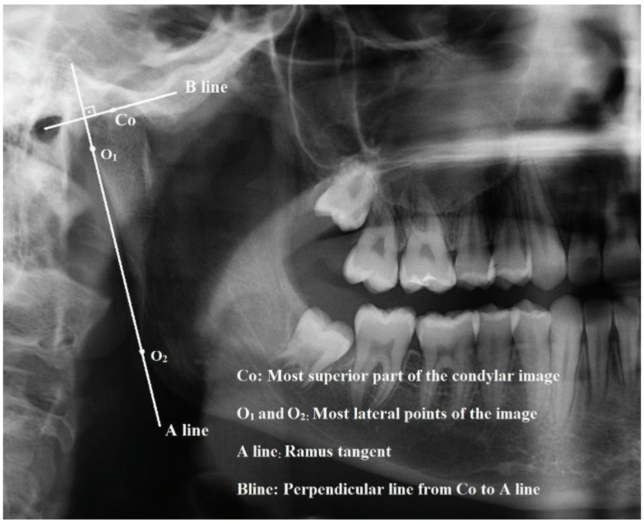

Figure 1: Anatomical points and definitions

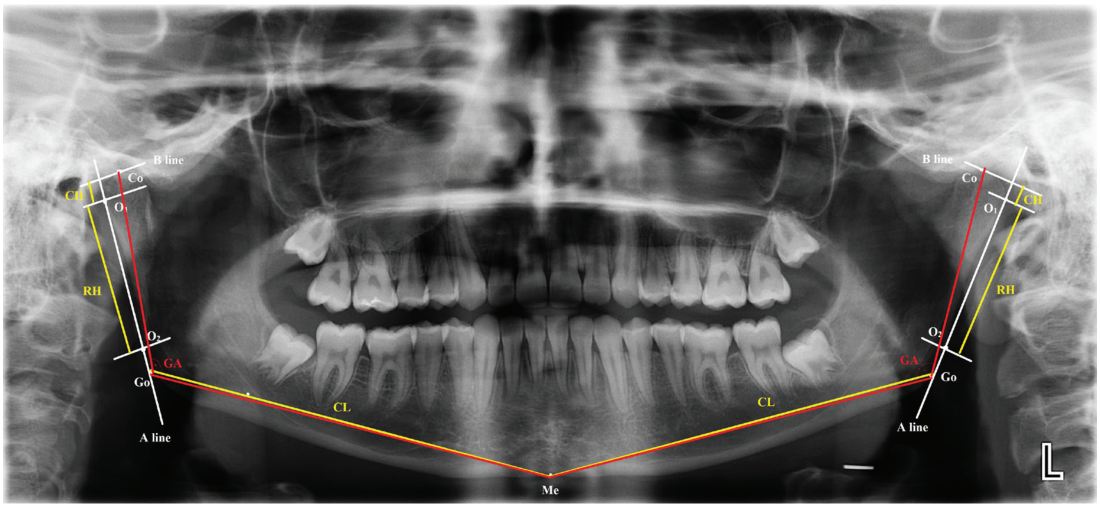

Figure 2: Linear and angular measurements on panoramic image

CL: distance between Go and Me points
GA: angle between Co, Go and Me points (Figure 1).

Measurements were performed on both the right and left sides. The asymmetry indices were determined using the formula developed by Habets et al.(6):

Asymmetry Index (AI) = [(Right − Left)/(Right + Left)] × 100

Measurements were automatically calibrated with the Planmeca Romexis 4.0 software program developed for the Planmeca ProMax device (Planmeca Oy, 00880 Helsinki, Finland) as per the manufacturer's instructions. After 4 weeks, all measurements were repeated in 20 randomly selected patients and inter-observer variability was assessed.

Statistical Analysis

Data were statistically analysed using SPSS (version 23.0, SPSS Chicago, USA). The normality assumption was evaluated using the Kolmogorov–Smirnov method. For analysis of between-group differences, the independent samples t-test was applied for data with a normal distribution and the Mann Whitney U test was used for data not displaying a normal distribution. For dependent variables, the paired t-test was used for data displaying a normal distribution, whereas the Wilcoxon signed rank test was used for data with non-normal distribution. For analysis of differences between data of more than two groups, parametric analysis of variance was used for data with a normal distribution and the non-parametric Kruskal Wallis test was used when data were not normally distributed. Statistical significance was determined using the Scheffe test used for paired comparisons. Relationships between data were evaluated using the non-parametric Spearman correlation test or the parametric Pearson correlation test. A p-value of <0.05 was considered statistically significant.

Results

Three linear and one angular measurements were performed bilaterally on PR images of 100 patients in this study: 51 (51%) were female and 49 (49%) were male. Age of the patients ranged between 10 and 15 years with a mean age of 12.03 ± 1.06 years. Age, type of occlusion and gender of the patients are detailed in Table 1.

When the relationship between gender and the right and left values of the parameters is examined, the right CL, right and left GA values were higher in males than in females (Table 2).

Table 3 shows the comparison of the right and left values according to the type of occlusion.

When the relationship between the type of occlusion and the right and left values of the parameters is

Table 1 Age, type of occlusion and gender of the patients

age	**10**		**11**		**12**		**13**		**14**		**Total**
gender	female	male	female	male	female	male	female	male	female	male	
class I	0	2	1	2	1	3	4	2	5	4	24
class II	2	3	6	2	9	2	5	2	4	2	37
class III	3	7	4	6	3	4	3	6	1	2	39
total	5	12	11	10	13	9	12	10	10	8	100

Table 2 The relationship between gender and the right and left values of the parameters

Parameter	**Gender**	**n**	**mean(mm)**	**SD**	**p value**
right CH	female	51	9.05	2.12	0.408
	male	49	8.69	2.23	
left CH	female	51	9.15	1.83	0.146
	male	49	8.57	2.14	
right RH	female	51	63.58	6.49	0.275
	male	49	65.11	7.42	
left RH	female	51	64.03	6.6	0.395
	male	49	65.2	7.01	
right CL	female	51	135.45	11.85	0.002*
	male	49	141.94	8.43	
left CL	female	51	136.62	10.90	0.114
	male	49	139.90	9.60	
right GA	female	51	118.67	5.96	0.013*
	male	49	121.80	6.47	
left GA	female	51	117.89	5.16	0.014*
	male	49	120.81	6.47	

The independent samples t-test; n: number of patients; mm: millimeter; SD: standart deviation; * p< 0.05

examined, the right CH and right and left CL values demonstrated differences dependent on the type of occlusion and p values are respectively 0.001, <0.001 and <0.001. The type of occlusion responsible for these differences is shown in Table 4.

Table 5 shows the AI values obtained as a result of the AI formula and Table 6 shows the relationships between the AI values and the type of occlusion. When the relationships between the AI values and age, gender and the type of occlusion are examined, none of the parameters demonstrated a statistically significant relationship.

Table 3 The comparison of the right and left values according to the type of occlusion

parameter	right mean± SD	left mean± SD	p value
class I			
CH	9. 03± 2. 29	9. 28± 2. 65	0.476
RH	64. 69± 8.02	65.48± 7.66	0.529
CL	142. 23± 11.49	140. 34± 9.46	0.279
GA	119.16± 5.76	118. 66± 6.60	0.508
class II			
CH	7. 89± 1. 78	8. 2± 1. 48	0.182
RH	63. 69± 5. 61	64. 56± 6 .48	0.231
CL	132.3± 10.74	132.19± 10.53	0.916
GA	119.41± 5.26	118.11± 4.07	0.182
class III			
CH	9.71± 2. 11	9.24± 1. 84	0.14
RH	64. 72± 7. 58	64. 1± 6. 76	0.357
CL	142.43± 7.13	142.64± 7.89	0.885
GA	121.59± 7.51	120.87± 6.87	0.449

the paired t-test for normal distribution and the Wilcoxon signed rank test for non- normal distribution;
SD: standart deviation; * p< 0.05

Table 4 The type of occlusion responsible for the differences

parameter	malocclusion	class I	class II	class III
right CH	class I	----	NS	NS
	class II	NS	----	< 0.001
	class III	NS	< 0.001	----
right CL	class I	----	0.004	NS
	class II	0.004	----	< 0.001
	class III	NS	0.001	----
left CL	class I	----	0.005	NS
	class II	0.005	----	< 0.001
	class III	NS	< 0.001	----

the Scheffe test; NS: Nonsignificant

Table 5 Asymmetry index mean, standart deviation, minimum and maximum values

Parameter	n	mean(%)	SD	min	max
condyle AI	100	6.95	6.66	0.36	33.93
ramus AI	100	2.84	2.15	0.07	10.77
corpus AI	100	2.16	1.88	0	12.51
gonial angle AI	100	3.89	3.21	0.01	15.88

Table 6 The relationships between the asymmetry index values and the type of occlusion

Parametre	malocclussion	n	mean(%)	SD	min	max	p value
condyle AI	class I	24	8.19	6.13	0.36	25.87	
	class II	37	6.26	6.23	0.59	25.15	0.19
	class III	39	6.84	7.39	0.44	33.93	
ramus AI	class I	24	3.4	2.53	0.26	10.77	
	class II	37	2.68	2.26	0.07	8.84	0.246
	class III	39	2.64	1.75	0.08	8.04	
corpus AI	class I	24	2.44	1.7	0	6.83	
	class II	37	1.83	1.35	0.08	5.69	0.358
	class III	39	2.3	2.36	0.07	12.51	
gonial angle AI	class I	24	2.64	2.46	0.14	10.62	
	class II	37	3.9	2.99	0.16	12.26	0.055
	class III	39	4.66	3.62	0.01	15.88	

the independent samples t-test for normal distribution and the Kruskal Wallis test for non-normal distribution
n: number of patients; SD: standart deviation; min: minimum; max: maksimum

Discussion

Mandibular asymmetry is defined as asymmetry in the lower third of the face and is important due to its direct effect on facial appearance (3). Asymmetry is detected radiographically using PR, lateral cephalometric radiography, posterioanterior radiography, 45° oblique radiography of the mandible and submentovertex radiography (7) or by computed tomography (3,8), cone-beam computed tomography (9) and magnetic resonance imaging (3). The use of PR for these measurements is controversial due to the magnification and distortion inherent to the methodology; however, many studies support the use of PR to detect mandibular asymmetry due to such advantages as being a standard, low-cost procedure that exposes the patient to relatively low levels of radiation (7,10,11). In addition to these advantages, PR data were used in this study because it is easy to come by for retrospective analyses. Moreover, evidence suggests that if the patient is accurately positioned, vertical and angular measurements may be accurately performed using PR (2).

The Kjellberg technique (12) and Habets technique (6) are frequently used to examine mandibular asymmetry with PR. In 1987, Habets et al.(13) reported that a 1-cm change in head position in PR caused a 6% vertical size difference. In 1988, when investigating the relationship between temporomandibular joint dysfunction and condylar asymmetry using PR, they developed a formula to evaluate the mandibular condyle and mandibular ramus (6). According to this formula, a 3% index rate may originate from a 1-cm displacement in head position during PR, whereas a >3% difference indicates the existence of asymmetry (2,14).

The Habets technique may be used for patients with temporomandibular joint dysfunction, class II and class III malocclusions and different skeletal and occlusal samples (7). The literature includes studies wherein the Habets AI formula is used in different anatomic points and different types of occlusion to obtain the AI (1-3, 7, 10, 11, 14-17). This study used the Habets technique for the evaluation of AI values of CH, RH, CL and GA in Angle class I, class II and class III occlusal samples.

When the hemi-mandibular dimension is considered, some studies have indicated that the right side is more dominant than the left (18). All parameters did not show a significant difference between values for the right and left sides at the current study. This finding contradicts those of Ramez-Yanez et al.(18) who showed that RH, CL and GA values of the left side were greater than those of the right side.

Among the reference studies, while only the AI values of the parameters are given, the measured values are not given. For this reason, the measured values of the parameters can not be compared at the current study. There was no statistically significant relationship between malocclusions and none of the parameters at the current study. Results of the current study (Table 6) support the findings of Kasımoğlu et al.(2), who also reported no relationship between the type of occlusion and condylar asymmetry in class I, class II and class III patient groups. On the other hand, statistically significant condylar asymmetry was found in the class II patient group compared with the class I patient group by Al Taki et al (16). These findings contradict those of the current study. This may originate from the different inclusion criteria used between studies, the number of patients studied and different age distributions of the patients evaluated.

Miller and Bodner (17) found that the mean condylar asymmetry index values were higher by 3% in the class I and class III occlusion groups, in agreement with the current study (Table 6).

Most studies in the literature have not examined the relationship between asymmetry and gender. There was no statistically significant relationship found between asymmetry and gender in studies that examined relationships of gender with condylar and ramal asymmetries. In the current study, no relationship was found between gender and condylar and ramal asymmetry, similar to the studies by Kasımoğlu et al.(2). Kasımoğlu et al.(2) and Miller and Bodner (17) have examined the relationship between asymmetry and age. They found no relationship was between asymmetry and age, consistent with findings of the current study.

This study was conducted using patient records on the type of occlusion from the database. This may be a limitation of the current study due to the lack of knowledge about the frequency of midline deviation, class II division 1, class II division 2, class II subdivision, unilateral posterior crossbite and bilateral posterior crossbite. On the other hand, Kasımoğlu et al.(2) and Silvestrini-Biavati et al.(1) also performed their studies using the class II patient group, but did not make a distinction between divisions or subdivisions. Moreover, results from our study are largely harmonious with those of other studies in the literature.

Conclusion

While presence of asymmetry is considered normal at some ages, asymmetries should be identified by radiological evaluation and treated at any age. Although values of some parameters varied with gender and malocclusion, there was no statistically significant relationship found between age, gender and malocclusion and asymmetry index values for any parameter.

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