Mandibular Asymmetry in Different Occlusion Patterns
A Radiological Evaluation
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ABSTRACT
Objective: To investigate the effects of different occlusion types on the mandibular asymmetry in young individuals.
Materials and Methods: Mandibular asymmetry measurements were performed on the panoramic radiographs of 189 subjects (104 females and 85 males; age range, 11–15 years), with different occlusion patterns. The subjects were divided into five groups according to the occlusion types, namely, Angle Class I (Cl I), Class II division 1 (Cl II/1), Class II division 2 (Cl II/2), Class III (Cl III), and normal occlusions. The Kruskal-Wallis test was used to determine the possible statistically significant differences between the groups for condyle, ramus, and condyle-plus-ramus asymmetry index measurements. Identified differences between groups were further analyzed using the Mann-Whitney U-test at the 95% confidence interval (P < .05).
Results: There were no statistically significant differences between male and female subjects. The Kruskal-Wallis test showed that the occlusion type had a significant effect on the condylar asymmetry. In Cl II/1 cases, condylar asymmetry values were significantly different from the values of Cl II/2 and Cl III malocclusion and normal occlusion types. The normal occlusion control group was significantly different from those of Cl II/1 and the Cl I malocclusion groups.
Conclusion: Cl II/1 malocclusion has a significant effect on the condylar asymmetry index when compared to Cl II/2 and Cl III malocclusion and normal occlusion types. However, the mean condylar asymmetry index value in Cl II/1 malocclusion was not different from Cl I malocclusion.
KEY WORDS: Mandibular asymmetry; Condylar asymmetry; Asymmetry indexes; Panoramic radiography; Angle malocclusion

INTRODUCTION
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.1

The mandibular asymmetry, also known as the lower third of the face, is important because of its direct effect on facial appearance. Asymmetries of the mandible may cause not only esthetic but also functional problems because of its role in the stomatognathic system. The regions that have the highest growth potential on the mandible are the condylar cartilages. Injuries occurring in these areas during the growth period can disturb the mandibles’ down-and-forward 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.2–4

The relationships between the condylar asymmetries and craniomandibular disorders were investigated by Habets and his coworkers.5 Kjellberg et al6 developed and used a new method of quantitatively measuring the effects of condylar heights on panoramic radiographs.

Condylar asymmetries have also been evaluated in patients with Class II division 2 (Cl II/2)7 and Class III (Cl III)8 malocclusion without any temporomandibular disorder (TMD). There is no published study, however, that has investigated mandibular asymmetry in all occlusion types (Angle Class [Cl I], Class II division 1 [Cl II/1], Cl II/2, Cl III, and normal occlusion). The aim of
this study was therefore to investigate the effect of different occlusion patterns on mandibular asymmetry in adolescents with no clinical signs or symptoms of TMD.

MATERIALS AND METHODS

A total of 189 patients (104 female, 85 male; age range, 11–15 years) who attended our clinic for various reasons participated in this study. The following inclusion criteria were used for subject participation in the study: (1) skeletally and dentally Cl I, II/1, II/2, and III relationship (and normal occlusion for the control group); (2) absence of posterior crossbites (unilateral or bilateral), mandibular deviation during closure, and any history of jaw trauma; (3) no symptoms of occlusal trauma, masticatory disharmony, pain during jaw movements, or clinically diagnosed temporomandibular joint disorders; and (4) no recent history of occlusal adjustment or orthodontic treatment. The subjects were skeletally classified by evaluating cephalometric norms, particularly ANB angle, on the lateral cephalograms in the sagittal plane. In Class II malocclusion cases, the patients with retroclined upper incisors and deep anterior overbites were classified as Cl II/2 malocclusion group.

The study group consisted of 163 subjects with various malocclusions and was divided into four subgroups according to the malocclusion type. The subgroups were as follows: Cl I, 39 subjects (18 female, 21 male); Cl II/1, 43 subjects (24 female, 19 male); Cl II/2, 39 subjects (23 female, 16 male); and Cl III, 42 subjects (25 female, 17 male). The control group consisted of 26 subjects (14 female, 12 male) with normal occlusion.

After classification of the occlusion by the use of Angle standards in clinical examination, the panoramic radiographs of all the patients were taken under standardized conditions (Planmeca proline cc, Helsinki, Finland) and processed (Dent-X 810, Elmsford, NY). The condylar asymmetry, ramus asymmetry, and condyle-plus-ramus asymmetry in vertical heights were determined according to the method suggested by Habets et al (Figure 1). The outlines of the condyle and ascending ramus of both sides on the panoramic radiographies were traced on acetate paper. A line (A) was drawn connecting the most lateral points of the condylar image (O1) and the ascending ramus image (O2). The distance between O1 and O2 was called the ramus height (RH). To the A line (ramus tangent) from the most superior point of the condylar image, a perpendicular line (B) was drawn. For condylar height (CH), the vertical distance from this line on the A line to the O1 point was measured (Figure 1). Asymmetry indexes were estimated using the following formula:

\[
\text{Condylar Asymmetry Index (AI)} = \frac{(|CH_{\text{right}} - CH_{\text{left}}| / (CH_{\text{right}} + CH_{\text{left}}))}{100}.
\]

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

All measurements were performed by one investigator on the panoramic radiographs of the subjects using a digital caliper with a 0.01-mm sensitivity.

Statistical Analysis

The error of the method was assessed by statistically analyzing the difference between double determinations made 2 weeks apart on the panoramic radiographs of 20 subjects selected at random. A paired-sample t-test at the 95% confidence level showed that the difference between the first and second measurements of the 20 patients was insignificant. Correlation analysis applied to the same measurements showed the highest r value (.98) for condylar asymmetry index measurements and the lowest r value (.96) for condyle-plus-ramus index measurements.

Considering the number of groups and the independence of subjects, the Kruskal-Wallis test was used to determine the possible statistically significant differences between the groups. Differences between groups were further analyzed by the Mann-Whitney U test. All statistical tests were set at the 95% confidence level (P < .05).
DISCUSSION

In the literature, the assessment of dentofacial asymmetries has been performed by using submen-
and increase the tissue thickness at the articular surfaces. Thus, the condylar asymmetry index value could increase, and this process might continue as the adaptive capacity of the joint surfaces would permit. In various studies investigating the relationship between TMD and condylar asymmetry, increased condylar asymmetry indexes have been reported in TMD groups.\(^5,6,22\) In this study, TMD was considered to be a factor causing condylar asymmetry, and thus the panoramic radiographs of subjects with no clinical signs or symptoms of TMD were used.

Miller and Smith\(^7\) have reported on the relationship between condylar asymmetry and malocclusions of subjects with Cl I occlusion (11–18 years) and Cl II/2 malocclusion with deep overbite and no signs of TMD. Miller and Bodner\(^8\) investigated the differences in condylar asymmetry indexes between Cl I occlusion and Cl III malocclusion groups. In both studies, no statistically significant differences could be shown between groups. Our study revealed similar values in the comparisons of the control group with the Cl II/2 and Cl III experimental groups.

Sağlam\(^15\) investigated the effect of ANB angle on condylar asymmetry in 72 subjects (36 male, 36 female) aged 12 to 16 years. It was concluded that the condyle-plus-ramus index measurements were affected by the change of ANB angle, while the condylar index and ramus index had no influence on the change of ANB angle. In our study, there were no statistically significant differences between the ramus and ramus-plus-condyle indexes of the groups.

Studies of the etiology of condylar asymmetries in which sexual differences have been investigated also revealed no statistically significant differences.\(^5,15\) In this study, the results of the Student's t-test that was used to compare male and female groups matched those of previous studies.

**CONCLUSIONS**

- Malocclusions have a marked effect on condylar height in comparison with ramal height.
- Angle Cl II/1 malocclusion cases seem to be more related to condylar asymmetries.
- The Cl II/1 malocclusion group had significantly higher condylar asymmetry values than the Cl II/2, Cl III, and normal occlusion control groups.
- The condylar asymmetry value was also significantly different between Cl I malocclusions and normal occlusions.
- No significant difference was detected between the condylar asymmetry values of Cl I and Cl II/1 malocclusions.

**REFERENCES**

20. Miller VJ, Myers SL, Zeltser CH, Yoeli Z. The relation of age
