ABSTRACT

Objective: To investigate whether patients with bilateral posterior crossbite have asymmetrically developed condyles.

Materials and Methods: The study group consisted of 75 patients with bilateral posterior crossbite, and a control group of 75 subjects with normal occlusion. Condylar, ramal, and condylar plus ramal asymmetry values were computed for all of the subjects on orthopantomograms. Data were analyzed statistically by means of paired t-test and Student’s t-test.

Results: The patients with bilateral posterior crossbite had more asymmetrical condyles relative to the controls. However, there were no statistically significant differences in condylar, ramal, or condylar plus ramal heights between left and right sides in both the control and crossbite groups.

Conclusion: Patients with bilateral posterior crossbite can have asymmetrical condyles and might be at risk for the development of future skeletal mandibular asymmetries.

KEY WORDS: Condylar asymmetry; Crossbite; Posterior crossbite; Orthopantomograph
In the subjects with normal occlusion, patient selection criteria were as follows:

1. Skeletal and dental class I relationship, which was determined by ANB angle, convexity angle, Wits appraisal, and molar occlusion;
2. Mesofacial growth pattern;
3. Excellent posterior interdigitation with normal overjet and overbite and harmonious dental midline;
4. No remarkable facial or occlusal asymmetry;
5. No developmental or acquired craniofacial or neuromuscular deformities;
6. No systemic disease;
7. No history of orthodontic treatment;
8. No signs or symptoms of TMD;
9. No missing teeth, excluding third molars;
10. No carious lesions, extensive restorations, or pathologic periodontal status.

The last seven criteria (4–10) were also valid for the study group. Patients having at least two teeth in reverse occlusion on both left and right sides were taken as the study group. The subjects in the control and crossbite groups were all 11–17 years of age.

Plaster models were used to verify the posterior occlusion and panoramic radiographs were used to determine the condyle and ramus heights. Distorted films on which the contours of the condyles and rami were not easily detectable were excluded.

The panoramic radiographs were scanned (Epson Expression 1860 Pro, Seiko Epson Corp, Naoano-Ken, Japan) under a magnification of 100% and the images were saved on a computer. The outlines of the left and right condyle and ascending ramus on the panoramic radiographs were traced using Quick Ceph 2000 (Quick Ceph Systems, San Diego, Calif).

On both the left and right sides, the most lateral points of the condyle and ramus were marked as X and Y, respectively. On each side a line (ramus tangent) was drawn passing through points X and Y and termed the A-line. Another line was drawn from the most superior points of the condylar images perpendicular to the A-line and termed the B-line. The intersection of the A and B lines was named point Z (Figure 1).

The distances between points X and Z were measured and recorded as condylar height (CH). Similarly, the distances between points X and Y and between points Z and Y were measured and recorded as ramus height (RH) and condylar plus ramus heights (CH + RH), respectively (Figure 1).

Asymmetry index: $\frac{\text{Right} - \text{Left}}{\text{Right} + \text{Left}} \times 100\%$

**Statistical Analysis**

All measurements of the 30 subjects were taken again 2 weeks later to determine the measurement error. A paired t-test was applied to the first and second measurements and no error associated with the radiographic tracings and measurements was found.

A Student’s t-test was applied to determine whether there was any difference between the asymmetry indices of the groups. This test was also used to determine the sex differences regarding the asymmetry indices. A paired t-test was used to determine the differences in condylar, ramal, and condylar plus ramal heights between the left and right sides of the subjects.
RESULTS

Table 5. Means and Standard Deviations of Asymmetry Indices in Each Group and P Values Found by Student's t-Test

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control Group (n = 75)</th>
<th>Crossbite Group (n = 75)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condylar index</td>
<td>3.81 ± 2.90</td>
<td>6.77 ± 6.08</td>
<td>0.000</td>
</tr>
<tr>
<td>Ramal index</td>
<td>1.80 ± 1.35</td>
<td>1.53 ± 1.22</td>
<td>0.201</td>
</tr>
<tr>
<td>Condylar + ramal index</td>
<td>1.69 ± 1.13</td>
<td>1.60 ± 1.37</td>
<td>0.701</td>
</tr>
</tbody>
</table>

Comparing the measurements of the left and right sides in control and bilateral crossbite groups are presented in Tables 3 and 4, respectively. There was no statistically significant difference between the right and left sides in the CH, RH, or CH + RH measurements of the control group (Table 3). The same measurements were not statistically different in the crossbite group (Table 4). Comparisons of the asymmetry indices between the groups are shown in Table 5. A statistically significant difference was found only for the condylar index.

DISCUSSION

The orthopantomograph used in this study gives sharply defined images of the structures within the pre-selected plane by the blurring out of other images. There is magnification of the radiographic images of the structures in both vertical and horizontal directions. According to Graber, the magnification on the orthopantomograph is uniform and should not materially affect diagnostic decisions.

In the vertical plane, magnification is dependent on projection factors alone. The distance between the focal point of the x-ray tube and the film is always the
same. In a recent study, Kambylafkas et al stated that panoramic radiographs could be used to evaluate vertical posterior mandibular asymmetries. Many authors suggest that the reproducibility of vertical and angular measurements is acceptable provided that the patient’s head is positioned properly in the equipment. In the present study, special attention was given to the positioning of the subjects during exposure, and the films with distorted and/or poor quality were excluded.

In this study, we aimed to determine whether there was a condylar asymmetry in bilateral crossbite patients. Because computerized digitizing has some advantages, such as accurate determination of the contours of bony structures by enlarging the image and changing the contrast when needed, the asymmetry evaluation method of Habets et al was used with the aid of a computer software program.

According to Habets et al, a 3% index ratio may result from a 1-cm change in head position while the orthopantomograph is being taken, and thus asymmetry index values greater than 3% should be considered as vertical asymmetry.

A slight asymmetry between the right and left condyles of the subjects was observed in the control group of this study (condylar asymmetry index: 3.81 ± 2.90). This finding is similar to that of the normal groups in the studies of Miller and Smith and Miller and Bodner. On the other hand, it is not coincident with the findings of other studies. This difference could be explained by patient selection criteria and age groups.

The results of this study revealed that bilateral crossbite patients had asymmetrical mandibular condyles (condylar asymmetry index: 6.77 ± 6.08). There are a lot of studies concerning mandibular morphological and functional asymmetries in unilateral crossbite patients but no study was encountered in the literature regarding the vertical morphology of the mandible and its components in bilateral crossbite patients.

Thus, we could not compare our findings with those of any other study.

Condylar heights, ramus heights and condyle plus ramus heights in the control group were very similar on the right and left sides (Table 3). In the crossbite group, the differences between the right and left sides were greater than those of the subjects with normal occlusion. However, no statistically significant differences between the right and left sides were observed in either group.

Condylar asymmetry index values in bilateral crossbite patients were significantly higher than those in the normal occlusion individuals. One possible explanation of this finding may be the presence of interdigital disharmony in bilateral crossbite patients.

Hypothesized that the continuous condylar displacement in the glenoid fossa during the growth period, derived from occlusal problems, induced differential growth of the left and right condyles.

The condyle is one of the most sensitive structures to occlusal changes and it is generally affected by transverse anomalies in growing individuals. Therefore, a posterior crossbite may be a potential factor in the development of condylar asymmetry. In addition, the asymmetrical constriction of the palatal vault may account for this situation. Hayashi et al demonstrated a significant correlation between asymmetry in the mandible and the right-left difference in the radius of the palatal curvature in the molar region. In a recent study, Kusayama et al reported that there was a high correlation between transverse dental anomalies and skeletal asymmetry. In autopsy material from young adults, Solberg et al found that variation in the form of condyle was associated with malocclusions such as crossbite.

According to Graber, ‘‘. . . prolonged crossbite conditions also accentuate individual tooth malpositions so that asymmetry of the arch results. In the initial stages, however, the upper arch can be quite symmetrical despite the crossbite. The belief is widespread that unless these crossbites are eliminated, they lead to asymmetry of the dental arches as well as an actual facial asymmetry in the adult. Obviously, crossbites should be eliminated whenever possible.’’ As emphasized by Graber, to avoid future skeletal asymmetries, it should be remembered that the early correction of posterior crossbite is of major importance.

CONCLUSIONS

- A higher degree of condylar asymmetry was found in crossbite patients as compared to normal-occlusion controls.
- The condylar, ramal, and condylar plus ramal heights were not statistically different between the right and left sides of the subjects in either group.
- Asymmetry indices were similar in both sexes.

REFERENCES

3. Kurol J, Berglund L. Longitudinal study and cost-benefit analysis of the effect of early treatment of posterior cross-