Relationship between temporomandibular joint internal derangement and facial asymmetry in women

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Introduction: Internal derangement (ID) of the temporomandibular joint (TMJ) can cause facial asymmetry. The purposes of this study were to analyze the relationship between facial asymmetry and TMJ ID by using posteroanterior cephalometric variables, and to compare the findings with the results of magnetic resonance imaging (MRI).

Methods: The sample consisted of women seeking orthodontic treatment at Seoul National University Dental Hospital who had routine posteroanterior cephalograms and bilateral MRIs of the TMJ. To eliminate the influence of condylar hyperplasia on facial asymmetry, only those with SNB angles less than 78° were selected (n = 63). They were classified into 5 groups according to the results of the MRI: bilateral normal disk position, unilateral normal TMJ and contralateral disk displacement with reduction (DDR), bilateral DDR, unilateral DDR and contralateral disk displacement without reduction (DDNR), and bilateral DDNR. Fourteen variables from posteroanterior cephalograms were analyzed with 1-way ANOVA to evaluate differences among the 5 groups.

Results: Subjects with TMJ ID of greater severity on the unilateral side had shorter ramal height compared with those with bilateral normal or bilateral DDR or bilateral DDNR. In addition, the mandibular midpoint deviated toward the side where the TMJ ID was more advanced.

Conclusions: Subjects with a more degenerated TMJ on the unilateral side might have facial asymmetry that does not come from condylar or hemi-mandibular hyperplasia. (Am J Orthod Dentofacial Orthop 2005;128:583-91)

The relationship between internal derangement (ID) of the temporomandibular joint (TMJ) and dentofacial morphology has been examined by many researchers.1-11 Their studies show that TMJ ID is a contributing factor in the development of dentofacial deformities, and that the degree of joint degeneration is related to the severity of retrognathia and vertical dysplasia. If this is true, people with unilateral ID might have similar features, but only unilaterally; ID of the TMJ can change condylar morphology on the affected side, thus contributing to facial asymmetry. However, most investigators used lateral cephalograms to study changes in dentofacial morphology.2-5,7,11 The lateral cephalogram is useful for analyzing the anteroposterior or vertical displacement of the mandible, but it cannot accurately account for asymmetries because the right and left landmarks are averaged. On the other hand, lateral displacement or asymmetry of the mandible can be recognized in the posteroanterior (PA) cephalogram.

Recently, some investigators suggested that there might be an association between TMJ dysfunction and mandibular asymmetry. Nickerson and Moystad,12 Talents et al,13 and Katzberg et al14 all suggested that degenerative joint disease might be associated with unilateral mandibular asymmetry. A recent study of 100 patients with mandibular asymmetry suggested that disk displacement, ID, or degenerative joint disease could be a main cause of mild and moderate mandibular asymmetry.1 Animal studies have also demonstrated that unilateral disk displacement without reduction can cause facial asymmetry.15,16

However, the relationship between facial asymmetry and unilateral TMJ ID is still not clear,6,13,17 because facial asymmetry can result from other causes, such as trauma with fracture, tumor, and condylar or hemi-mandibular hypertrophy. Apparent unilateral condylar hyperplasia can cause mandibular facial asymmetry without evidence of TMJ ID.13,17 If this condition is excluded, clearer results will be obtained.

In this study, only subjects with SNB angles smaller than 78° were chosen to eliminate the influence of...
condylar or hemi-mandibular hypertrophy on facial asymmetry. The purposes of this study were to analyze the relationship between facial asymmetry and TMJ ID by using PA cephalometric variables and to compare the findings with the results of magnetic resonance imaging (MRI).

**MATERIAL AND METHODS**

The sample for this study comprised female patients over the age of 17 who visited the Department of Orthodontics at Seoul National University Dental Hospital from 1997 to 2003. Men were not included to avoid skewing the cephalometric measurements with sex-related differences. No subject had a history of mandibular or condylar fracture or tumor. Patients with congenital anomalies were also excluded. All subjects had a primary complaint of malocclusion, and routine lateral and PA cephalograms were taken. Irrespective of TMJ status, each subject consented to a bilateral high-resolution MRI in the sagittal (opened and closed) and coronal (closed) planes to evaluate the TMJ. The MRIs were obtained with a Signa Horizon system (GE, Waukesha, Wis) operating at 1.5 T and unilateral 3-in surface receiver coil (GE). Initially, the axial scout images were obtained at the level of the TMJ to identify the long axis of the condyle. Nonorthogonal sagittal sections were obtained perpendicular to the condyles, and non-orthogonal coronal oblique sections were also obtained. Closed mouth images were obtained at maximum dental intercuspation, and open-mouth images were taken at a maximum unassisted vertical mandibular opening by using a Burnett bidirectional TMJ device (Medrad, Pittsburgh, Pa). T1-weighted 600/12 (repetition time [TR] ms/echo time [TE] ms) and proton-density 4000/14 (TR ms/TE ms) pulse sequences were performed in the sagittal plane by using a 3-mm slice thickness, a 10-cm field of view, 2 excitations, and an image matrix of $254 \times 192$ pixels. T1-weighted 500/12 (TR ms/TE ms) pulse sequence was performed in the coronal plane under the same conditions.

A radiologist experienced in interpreting a TMJ MRI and an orthodontist interpreted the images. TMJ disk position was divided into 3 categories: normal disk position (Fig 1), disk displacement with reduction (DDR) (Fig 2), and disk displacement without reduction (DDNR) (Fig 3).

The position and shape of the disk were evaluated carefully, and some ambiguous images were excluded. A total of 102 women were originally selected. The MRIs identified 34 patients with bilateral normal disk position (group 1), 14 with unilateral DDR and normal disk position in the contralateral TMJ (group 2), 20 with bilateral DDR (group 3), 10 with unilateral DDNR in the contralateral TMJ (group 4), and 22 with bilateral DDNR (group 5). Only 2 patients had unilateral DDNR and normal disk position in the other TMJ. Patients with normal and contralateral DDNR were excluded because of their small numbers. Only subjects with SNB angles smaller than 78.0° were included to eliminate the influence of condylar or hemi-mandibular hypertrophy on the facial asymmetry. The final sample consisted of 63 patients (Table I).

PA cephalograms are widely used to evaluate transverse skeletal and dentoalveolar relationships, but they have several limitations, including difficulties in reproducing head posture and identifying landmarks, and concerns about exposure to radiation. One of the most important limitations is the measurement error associated with head rotation and orientation. PA cephalometric radiographs should be taken with a standardized and reproducible head position in relation to the x-ray source and film to minimize this limitation. For this study, all radiographs were taken with an Asahi CX 90X (Asahi Roentgen, Kyoto, Japan), with the patient’s head held in position in the cephalostat. The source-to-film distance was a constant 150 cm, and the distance from the middle of the ear rods to the film was 15 cm. The Frankfort horizontal plane (from the infraorbital margin to the external auditory canal) was determined by a preset light beam parallel to the floor. A standard setting was used for the best quality of radiographs (70-80 kV, 15 mA, and 0.4 sec).

PA cephalometric radiographs were traced on acetate tracing film by 1 investigator (S.J.A.). The tracings were digitized by using a digitizer interfaced with a desktop computer. A line connecting right and left latero-orbitale was used as a horizontal reference line, and a line bisecting and perpendicular to the horizontal reference line was used as a vertical reference line. Four unilateral and 4 bilateral landmarks were digitized on each radiograph (Fig 4), from which 14 cephalometric variables were calculated (Table II, Figs 5 and 6). To calculate asymmetry, the difference between the right and left sides was calculated by subtracting the left value from the right value in the 9 bilateral measurements, because the difference between the right and left sides was reported to be the best method to explain vertical asymmetry in the lower facial region. If the value is positive, the right structure or measurement will be larger than the left one.

To describe the influence of unilateral ID on facial asymmetry, the positive or negative signs of the measurements were adjusted in the subjects of groups 2 and 4. In group 2, the measurements of those with unilateral DDR in the left TMJ and normal TMJ in the right were used as a standard, and the measurements of those with
Fig 1. Sagittal images showing normal TMJ disk position: A, closed mouth; B, open mouth. Intermediate zone of disk (arrow) was interposed between condyle (C) in both mouth positions.

Fig 2. Sagittal images showing disk displacement with reduction: A, closed mouth; B, open mouth. Disk (arrow) was anteriorly displaced relative to posterior slope of articular eminence (E) and head of condyle (C), but disk was reduced on mouth opening.

Fig 3. Sagittal images showing disk displacement without reduction: A, closed mouth; B, open mouth. Disk (arrow) was anteriorly displaced relative to posterior slope of articular eminence (E) and head of condyle (C), but without reduction of disk on mouth opening.
unilateral DDR in the right TMJ and contralateral normal TMJ were used after the signs of the numbers were changed. The measurements of the subjects with unilateral DDNR in the left TMJ and contralateral DDR were used as a standard in group 4, and the measurements of those with unilateral DDNR in the right TMJ and DDR in the left TMJ were used after the signs of the numbers were changed.

One-way analysis of variance (ANOVA) was used to compare the 5 groups with respect to all cephalometric measurements. A difference with a $P$ value less

Table I. Comparison of age and SNB angle by group (mean, SD, range)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age (y)</th>
<th>Range</th>
<th>SNB angle (°)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>23.3 ± 3.9</td>
<td>19.4-32.2</td>
<td>78.3 ± 2.0</td>
<td>70.3-77.6</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>22.5 ± 4.2</td>
<td>17.5-28.7</td>
<td>73.9 ± 2.6</td>
<td>68.9-77.5</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>24.6 ± 4.4</td>
<td>18.2-31.7</td>
<td>75.4 ± 2.7</td>
<td>69.8-77.9</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>22.9 ± 3.8</td>
<td>19.1-30.7</td>
<td>75.5 ± 1.9</td>
<td>72.6-77.7</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>24.6 ± 5.6</td>
<td>18.5-38.9</td>
<td>73.0 ± 2.8</td>
<td>68.2-77.1</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>23.9 ± 4.6</td>
<td>17.5-43.7</td>
<td>74.5 ± 2.6</td>
<td>68.2-77.9</td>
</tr>
</tbody>
</table>

Fig 4. Landmarks used in this study: 1, latero-orbitale: intersection of lateral orbital contour with innominate line (left and right); 2, anterior nasal spine; 3, condylion: most superior point of condylar head (left and right); 4, jugal process: intersection of lateral contour of maxillary alveolar process and lower contour of maxillozygomatic process of maxilla (left and right); 5, antegonion: highest point in antegonial notch (left and right); 6, menton: point on inferior border of symphysis directly inferior to mental protuberance and below center of trigonium mentalis; 7, incision superior frontale: midpoint between maxillary central incisors at level of gingival crest; and 8, incision inferior frontale: midpoint between mandibular central incisors at level of gingival crest.

Fig 5. Linear measurements used in study. Line connecting right and left latero-orbitale was used as horizontal reference; line bisecting and perpendicular to horizontal reference line was used as vertical reference. 1, horizontal distance from vertical reference line to menton (when menton is on left, value is positive; when menton is on right, value is negative); 2, horizontal distance from vertical reference line to antegonion (left and right); 3, horizontal distance from vertical reference line to jugal process (left and right); 4, horizontal distance from vertical reference line to condylion (left and right); 5, vertical distance from horizontal reference line to condylion (left and right); 6, vertical distance from horizontal reference line to jugal process (left and right); 7, vertical distance from horizontal reference line to antegonion (left and right); 8, condylion to antegonion (left and right); 9, antegonion to menton (left and right); 10, condylion to menton (left and right). Bilateral measurements were calculated by subtracting left value from right.
than .05 was considered significant. The Duncan multiple comparisons test was performed to identify the differences between the groups.

To test the magnitude of the measurement error in this study, the PA cephalograms of 15 randomly selected patients were measured again. According to Dahlberg's formula,22 the error ranged from 0.52 to 0.84 mm for the linear measurements and from 0.53° to 0.74° for the angular measurements.

RESULTS

Table II shows the results of the cephalometric differences among the 5 groups. Six measurements of 14 cephalometric variables showed statistically significant differences. Generally, the linear measurements were more significant than the angular measurements. Multiple comparisons showed that the statistical differences were mainly due to the discrepancy between group 2 or 4 and other groups (Table III). Among the statistically significant measurements, the distances from condylion to menton and from condylion to antegonion discriminated the differences more efficiently than the other measurements.

The horizontal and vertical position of the jugal process related to the reference planes was not statistically significant, but the measurements in the mandible, such as the position of antegonion and menton, differed significantly among the 5 groups. This indicates that the amount of asymmetry by TMJ ID might appear mainly in the mandible.

The horizontal distance from vertical reference line to menton showed significant differences between group 2 and group 1, 3, or 5. Although slight differences were shown also between group 4 and group 1, 3, or 5, there was no statistical significance. This indicates that the chin was deviated toward the side where the TMJ ID was more advanced. This is proved by the angular measurement between the vertical reference line to ANS-menton (Tables II and III).

Vertical asymmetry in the lower facial region also appeared in the subjects with TMJ ID of greater severity on the unilateral side. The vertical distance from horizontal reference line to antegonion showed significant differences between group 2 and group 1, 3, or 5. The result showed that the distance from horizontal reference line to antegonion was significantly shorter on the affected side of TMJ than the contralateral side in the subjects in group 2 (Table II). The vertical distances from condylion to antegonion and condylion to menton also showed statistical differences. Condylion to antegonion and condylion to menton discriminated the difference between group 4 and the other groups and between group 2 and the other groups (Table III). The distances from condylion to antegonion and condylion to menton also tended to be shorter in the more degenerated TMJ than in the contralateral TMJ. These results indicate that subjects with unilateral ID or bilateral TMJ ID of greater severity on the unilateral side have vertical facial asymmetry.

DISCUSSION

Facial asymmetry has many causes. Unilateral condylar hyperplasia and TMJ ID are well-defined, asymmetric mandibular malformations in adults. Recent studies reported that both condylar hyperplasia on the long side of the mandible and TMJ ID on the short side can cause mandibular asymmetry.13,17 Therefore, to accurately analyze the influence of TMJ ID on facial asymmetry, subjects with condylar hyperplasia must be excluded. Unilateral condylar hyperplasia, or hemimandibular hypertrophy, is characterized by diffuse enlargement of the condyle, the condylar neck, and the ramus and body of the mandible. A previous study
**Table II. Comparison of cephalometric variables of groups**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group 1 (n=13)</th>
<th>Group 2* (n=8)</th>
<th>Group 3 (n=14)</th>
<th>Group 4† (n=8)</th>
<th>Group 5 (n=19)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear relationships</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Vertical reference line to menton*</td>
<td>1.86 ± 4.34</td>
<td>6.59 ± 6.30</td>
<td>0.85 ± 3.83</td>
<td>3.08 ± 2.79</td>
<td>0.23 ± 4.52</td>
<td>*</td>
</tr>
<tr>
<td>2. Vertical reference line to antegonion*</td>
<td>-0.65 ± 5.85</td>
<td>-2.67 ± 7.47</td>
<td>3.22 ± 6.13</td>
<td>-1.51 ± 5.49</td>
<td>0.88 ± 6.21</td>
<td>NS</td>
</tr>
<tr>
<td>3. Vertical reference line to jugal process*</td>
<td>-0.63 ± 3.40</td>
<td>-0.02 ± 3.45</td>
<td>1.21 ± 2.68</td>
<td>0.31 ± 2.02</td>
<td>0.06 ± 3.57</td>
<td>NS</td>
</tr>
<tr>
<td>4. Vertical reference line to condylion*</td>
<td>-1.69 ± 4.48</td>
<td>1.41 ± 5.14</td>
<td>0.62 ± 2.94</td>
<td>3.86 ± 3.57</td>
<td>-0.87 ± 4.49</td>
<td>*</td>
</tr>
<tr>
<td>5. Horizontal reference line to condylion*</td>
<td>0.33 ± 3.24</td>
<td>1.42 ± 2.24</td>
<td>-0.96 ± 2.48</td>
<td>-1.64 ± 1.65</td>
<td>-1.26 ± 3.63</td>
<td>NS</td>
</tr>
<tr>
<td>6. Horizontal reference line to jugal process*</td>
<td>-0.23 ± 2.35</td>
<td>1.45 ± 1.27</td>
<td>-0.89 ± 1.38</td>
<td>-0.64 ± 1.95</td>
<td>-1.16 ± 3.04</td>
<td>NS</td>
</tr>
<tr>
<td>7. Horizontal reference line to antegonion*</td>
<td>0.96 ± 2.78</td>
<td>5.54 ± 3.95</td>
<td>-0.38 ± 3.59</td>
<td>2.62 ± 4.97</td>
<td>-0.34 ± 4.28</td>
<td>†</td>
</tr>
<tr>
<td>8. Condylion to antegonion*</td>
<td>0.51 ± 2.98</td>
<td>3.83 ± 5.21</td>
<td>0.22 ± 3.38</td>
<td>4.97 ± 4.59</td>
<td>0.83 ± 3.86</td>
<td>*</td>
</tr>
<tr>
<td>9. Antegonion to menton*</td>
<td>1.45 ± 4.24</td>
<td>5.83 ± 5.15</td>
<td>1.16 ± 4.05</td>
<td>1.08 ± 2.59</td>
<td>1.56 ± 5.62</td>
<td>NS</td>
</tr>
<tr>
<td>10. Condylion to menton*</td>
<td>0.29 ± 3.65</td>
<td>5.91 ± 5.11</td>
<td>0.51 ± 3.29</td>
<td>4.33 ± 2.85</td>
<td>1.53 ± 3.61</td>
<td>†</td>
</tr>
<tr>
<td>Angular relationships</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Vertical reference line to ANS-menton</td>
<td>1.12 ± 3.01</td>
<td>4.95 ± 3.98</td>
<td>0.43 ± 2.55</td>
<td>1.99 ± 2.59</td>
<td>0.27 ± 2.56</td>
<td>†</td>
</tr>
<tr>
<td>12. ANS-menton to incision superior</td>
<td>-0.16 ± 14.20</td>
<td>15.95 ± 16.33</td>
<td>-1.95 ± 19.22</td>
<td>-3.33 ± 22.93</td>
<td>5.08 ± 15.46</td>
<td>NS</td>
</tr>
<tr>
<td>13. Vertical reference line to incision superior</td>
<td>-1.09 ± 12.64</td>
<td>10.98 ± 12.72</td>
<td>-2.09 ± 17.68</td>
<td>-4.06 ± 20.77</td>
<td>0.25 ± 18.82</td>
<td>NS</td>
</tr>
<tr>
<td>14. Condylion-antegonion-menton</td>
<td>-0.31 ± 4.74</td>
<td>5.65 ± 5.12</td>
<td>-1.49 ± 5.18</td>
<td>-1.32 ± 5.14</td>
<td>-1.64 ± 4.25</td>
<td>NS</td>
</tr>
</tbody>
</table>

Line connecting right and left latero-orbitale was used as horizontal reference line, and line bisecting and perpendicular to horizontal reference line was used as vertical reference line.

NS, Not significant.

*P < .05; †P < .01.
*aWhen menton is on left, value is positive: when menton is on right, value is negative.
*bBilateral measurements were calculated by subtracting left value from right value.
*cMeasurements of subjects with unilateral DDR in left TMJ and contralateral normal TMJ were used as standard; measurements of those with unilateral DDR in right TMJ and normal in left TMJ were used after positive or negative signs of numbers were changed.
*†Measurements of subjects with unilateral DDNR in left TMJ and contralateral DDR were used as standard; measurements of those with unilateral DDNR in right TMJ and DDR in left TMJ were used after positive or negative signs of numbers were changed.

**Table III. Duncan multiple range test for 5-group comparisons**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Homogeneous subsets with statistically significant difference (P &lt; .05)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear relationships</td>
<td></td>
</tr>
<tr>
<td>Vertical reference line to menton</td>
<td>(1, 3, 5 &lt; 2)</td>
</tr>
<tr>
<td>Vertical reference line to antegonion</td>
<td>(1, 5 &lt; 4)</td>
</tr>
<tr>
<td>Horizontal reference line to antegonion</td>
<td>(1, 3, 5 &lt; 2)</td>
</tr>
<tr>
<td>Condylion to antegonion</td>
<td>(1, 3, 5 &lt; 4), (1, 3 &lt; 2)</td>
</tr>
<tr>
<td>Condylion to menton</td>
<td>(1, 3, 5 &lt; 2), (1, 3 &lt; 4)</td>
</tr>
<tr>
<td>Angular relationships</td>
<td></td>
</tr>
<tr>
<td>Vertical reference line to ANS-menton</td>
<td>(1, 3, 5 &lt; 2)</td>
</tr>
</tbody>
</table>

*Group 1, bilateral normal disk position; group 2, 1 DDR and other joint with normal disk position; group 3, bilateral DDR; group 4, unilateral DDR and DDNR on contralateral side; group 5, bilateral DDNR.

SNB angles under 78° were selected to eliminate the influence of unilateral condylar hyperplasia on facial asymmetry.

Patients with unilateral DDNR were known to show intranidal side differences in ramal height significantly more often than reference subjects.24 The side difference was attributed to mandibular shortening of the disk displacement side as a result of osteoarthrotic degeneration of the condyle. In other studies, flattening, erosion, and external resorption were found in condyles with TMJ ID.17,25 This implies that TMJ ID might have an effect on the degree of mandibular asymmetry secondary to the change of the shape and size of the mandibular condyle. This was also supported by experimentally induced disk displacement in animal studies. Disk displacement caused mandibular asymmetry in rabbits by shortening the mandibular ramus.15,16

In this study, vertical distance from condylion to antegonion (ramal height) was also statistically different among the 5 groups. Multiple comparisons showed that the distance in the more affected TMJ was shorter than that in the contralateral TMJ in group 2 or 4 compared with group 1, 3, or 5 (Tables II and III). This means that women with TMJ ID of greater severity on
the unilateral side showed shorter distances from condylion to antegonion than those with bilateral DDR or DDNR or bilateral normal TMJs. The difference in ramal height might be associated with differences in the vertical position of antegonion related to the horizontal reference line, and differences in the distance from condylion to menton. The distances horizontal reference line to antegonion and condylion to menton showed significant differences between the left and right sides in group 2, but the difference between sides was not significant in the subjects with bilateral DDR or DDNR or normal TMJs. The distance condylion to menton discriminated the difference between group 4 and group 1 or 3 and between group 2 and group 1, 3, or 5.

Vertical asymmetry might affect horizontal asymmetry of mandibular midpoint (menton) related to the vertical reference line. A unilateral shorter ramus might reduce mandibular length on the ipsilateral side and result in a shift of the mandibular midline. As a result, menton tended to deviate toward the more degenerated TMJ in the subjects of group 2, whereas those with bilateral DDR or DDNR or normal TMJs. The distance condylion to menton tended to be longer in patients with the more degenerated TMJ on the unilateral side compared with the contralateral TMJ.

The skeletal features of mandibular asymmetry might be the prominence or fullness of the gonial region and the shift of the chin away from the long side. The gonial angle is usually more acute on the long side. In this study, the condylion-antegonion to antegonion-menton angle also showed a difference between group 2 and the bilateral normal or bilateral TMJ ID groups, although this was not statistically significant. The difference in the angle between the affected and contralateral sides was larger in subjects with unilateral DDR than in those with bilateral normal TMJs or bilateral TMJ ID.

The horizontal position of condylion showed statistical significance between group 4 and group 1 or 5. The subjects in group 4 had a shorter horizontal distance from the vertical reference line to condylion of the affected side than those in group 1 or 5. The mesial movement of condylion in the more degenerated TMJ can be explained by the lateral resorptive change. A higher prevalence of resorption of the middle or lateral portion of the mandibular condyle was reported in joints with ID.26,27 This resorption became increasingly worse as the subjects progressed to DDNR, and the patients with DDNR exhibited evident osseous changes in the condylar head.28 In our study, the change of the horizontal distance from the vertical reference line to condylion was more evident in subjects with unilateral DDR and contralateral DDNR than in those with unilateral DDR and contralateral normal TMJ.

The dental midline related to the vertical reference line showed no statistical significance; this was different from the result of skeletal midline related to the vertical reference line. This means that the apparent asymmetry in the chin and gonial angle does not always reflect as a dental midline discrepancy. This is consistent with a previous study, which showed that patients with facial asymmetry did not always have dental midlines skewed to the short side.13

Trpkova et al6 found that an adolescent girl with bilateral TMJ ID or unilateral TMJ ID might have or develop vertical mandibular discrepancy. Those authors reported that subjects with bilateral ID of similar severity on both sides had significantly greater asymmetry in the vertical position of antegonion than those with unilateral ID. They also reported that transverse asymmetry of chin point did not show a statistically significant difference with regard to TMJ ID. This is consistent with our study, in which unilateral TMJ ID or bilateral TMJ ID of greater severity on the unilateral side showed greater vertical and transverse mandibular asymmetry than bilateral TMJ ID of similar severity on both sides.

This can be explained by differences in sample selection. Our sample consisted mainly of subjects with small and retrognathic mandibles with SNB angles less than 78°, and condylar or hemi-mandibular hyperplasia of the sample was not considered in the previous study. This can also be explained by the fact that the 2 experimental models might reflect TMJ ID in a different status. The TMJ status in our study was divided into normal, DDR, and DDNR according to the progressive stage of the TMJ ID, but the TMJ disk status was classified by a quantitative spectrum ranging from normal to disc displacement with deformation in the sample of the previous study.

The difference might be partly explained by the difference in methodology. Trpkova et al6 used a percentage of differences between the right and left sides according to the formula (R – L)/(R + L) X 200 to calculate asymmetry. The percentage of difference can be influenced by the change of denominator—ie, the sum of the right and left measurements. The percentage difference of the vertical position of antegonion between the right and left sides can be affected significantly in subjects with bilateral DDNR, because both right and left ramal heights decreased significantly more than ramal height in...
subjects with other types of ID. The decrease of ramus height of the right and left sides (R + L; denominator) might increase the relative difference of vertical position of antegonion showed greater asymmetry in subjects with bilateral DDNR in the previous study.

Previous studies document that patients with TMJ ID might be at risk for developing TMJ symptoms during orthodontic treatment or after surgery for skeletal deformities. If this is true, pretreatment diagnosis is important for identifying patients with potential ID. MRI is the best method to discriminate these patients with potential ID. However, MRI is too expensive to use routinely. This study indicated that facial asymmetry due to mandibular asymmetry is a clinical sign in patients with TMJ ID of greater severity on the unilateral side. Recently, some cephalometric characteristics, such as a decrease in the posterior facial height, a decrease in the ramus height, and a backward rotation and retruded position of the mandible, have also been reported to be associated with TMJ ID. It is possible to diagnose initial TMJ ID in orthodontic patients based on the combined evidence from lateral cephalograms, PA cephalograms, and panoramic radiographs and from the patient’s history and physical examination.

CONCLUSIONS

This study was performed to analyze the relationship between TMJ ID and facial asymmetry by using PA cephalograms and MRI. This study suggests that TMJ ID, particularly greater severity on the unilateral side, might affect mandibular symmetry. The amount of asymmetry did not differ significantly among subjects with bilateral normal TMJs or bilateral DDR or bilateral DDNR. The study suggests that TMJ ID, especially when it is more advanced on the unilateral side, can cause mandibular asymmetry.

REFERENCES

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