Elaboration of transverse dental compensation is critical for treatment of patients with severe facial asymmetry

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This case report describes the importance of eliminating transverse dental compensation during preoperative orthodontic treatment for a patient with severe facial asymmetry. The patient, a 17-year-old Japanese woman, had severe facial asymmetry involving the maxilla and the mandible, and extreme transverse dental compensation of the anterior and posterior teeth in both arches. Therefore, the main treatment objectives were elimination of the transverse dental compensation by orthodontic treatment and correction of the morphology of the maxilla and the mandible by orthognathic surgery. The preoperative orthodontic treatment resulted in sufficient elimination of the transverse dental compensation and movement of the teeth into their proper positions so that basal bone firmly supported them. LeFort I osteotomy and sagittal split ramus osteotomy were performed to correct the skeletal morphology. Facial asymmetry was dramatically improved, and a favorable occlusion was obtained. At 1 year 8 months after the surgical orthodontic treatment, the facial symmetry and occlusion remained favorable. The results suggest that sufficient elimination of transverse dental compensation in the maxillary and mandibular arches during preoperative orthodontic treatment is requisite for successful treatment of severe facial asymmetry. (Am J Orthod Dentofacial Orthop 2010;137:552-62)

Facial asymmetry is highly visible, can degrade quality of life, and is often a chief complaint of orthodontic patients.1-3 Patients with severe facial asymmetry are generally treated with a combination of orthodontic and orthognathic surgical therapies, not only to improve their occlusion, but also to improve their facial esthetics.4,6 With such treatment, it is difficult to develop a plan to improve facial esthetics, because patients with severe facial asymmetry also often have extreme transverse dental compensation.5-12 The maxillary incisors and posterior teeth are usually inclined to the deviated side, and the mandibular incisors and posterior teeth are inclined to the contralateral side to maintain normal interarch positioning under transverse jaw relationships.4,11-14 In such cases, it is critical to eliminate the extreme transverse dental compensation of the maxillary and mandibular teeth6,7 and move them back to the proper positions for basal bones to firmly support them.7,10 If this is inadequately done, it will be impossible to obtain sufficient correction of the asymmetry and the occlusion.6,7

We treated a patient with severe facial asymmetry, using orthodontic and orthognathic approaches, and improved her quality of life.

DIAGNOSIS AND ETIOLOGY

The patient was a 17-year-old Japanese woman. Her chief complaint was facial asymmetry. According to the interview, the facial asymmetry was pointed out by her family doctor and first became obvious when she was about 11 years old. Because there was no history of injury to her head or the jaw, and no relevant family history, the cause of her facial asymmetry was unknown. In the frontal view, severe facial asymmetry was obvious; the mandible was deviated to the left. In the lateral view, a convex facial profile was noted (Fig 1).

The midline of the maxillary arch was deviated about 1 mm to the right from the facial midline, whereas the midline of the mandibular arch was deviated 3 mm to the left (Fig 2). The maxillary incisors were inclined to the left, and the mandibular incisors were inclined to the right. Overbite and overjet were 4.5 and 4.0 mm, respectively. The maxillary right canine was blocked labially, and a scissors-bite was observed between the
maxillary and mandibular right first premolars. The molar relationships were Class I on the right and Class II on the left. The mandibular arch was asymmetric, with severe lingual inclination of the mandibular left molars and premolars. In contrast, the maxillary right molars had an extreme palatal inclination. There was moderate crowding in both arches, and the maxillary and mandibular arch-length discrepancies were –9 and –6 mm, respectively.

The patient had no temporomandibular joint (TMJ) disorder symptoms at the examination, although she had a history of occasional clicking sounds in the left TMJ. Magnetic resonance imaging showed anterior articular disc displacement without reduction, and computed tomography (CT) showed osteoarthrosis in the left TMJ.

A panoramic radiograph showed that the maxillary central incisors had short roots. No pathologic lesions of the alveolar bone were observed (Fig 3). Lateral cephalometric evaluation showed a skeletal Class II jaw relationship (ANB, 8.1°) with mandibular retrognathia (SNB, 72.3°). The mandibular plane angle was steep, and the ramus was retroclined. The maxillary and mandibular central incisors were inclined lingually (Table). Both the maxilla and the mandible exhibited severe deviation on the frontal cephalogram and the 3D CT image (Fig 3). Menton was deviated to the left 12 mm from the midsagittal plane (facial midline). The difference in height between the left and right molars was 5 mm, and the cant of the occlusal plane was 4.5°. The patient was diagnosed with a transverse jaw deformity of the maxilla and mandible with skeletal Class II jaw relationship.

**TREATMENT OBJECTIVES**

The following treatment objectives were established: (1) correct the jaw deformities of the maxilla and the mandible; (2) eliminate the transverse dental compensation; (3) coordinate the skeletal and dental midlines; (4) correct and coordinate the maxillary and
Fig 2. Pretreatment dental casts.

Fig 3. Pretreatment radiographs.
mandibular arch forms; (5) correct the irregularity of the teeth (eliminate the arch-length discrepancy); and (7) improve the facial asymmetry.

**TREATMENT ALTERNATIVES**

Several treatment options were considered. The first was extraction of the maxillary and mandibular first premolars during preoperative orthodontic treatment. This option would make it easy to coordinate the maxillary and mandibular arch forms. But coordinating the dental midline with the skeletal midline of the mandible would be difficult. In this option, facial asymmetry would be difficult to correct during the orthognathic surgery. The second option was extraction of the maxillary first premolars and the mandibular left first premolar. Although this option might cause a Class II molar relationship on the right side, it would be beneficial for

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**Table.** Cephalometric measurements

<table>
<thead>
<tr>
<th>Angular (°)</th>
<th>Norm (SD)</th>
<th>Pretreatment (17 y 3 mo)</th>
<th>Posttreatment (20 y 7 mo)</th>
<th>Postretention (22 y 3 mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>81.3 (3.0)</td>
<td>80.4</td>
<td>80.0</td>
<td>79.8</td>
</tr>
<tr>
<td>SNB</td>
<td>79.2 (3.0)</td>
<td>72.3</td>
<td>74.0</td>
<td>73.9</td>
</tr>
<tr>
<td>ANB</td>
<td>2.1 (2.1)</td>
<td>8.1</td>
<td>6.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Facial angle</td>
<td>87.5 (3.1)</td>
<td>80.5</td>
<td>82.0</td>
<td>81.9</td>
</tr>
<tr>
<td>FMA</td>
<td>27.1 (5.2)</td>
<td>39.8</td>
<td>40.0</td>
<td>39.8</td>
</tr>
<tr>
<td>U1-SN</td>
<td>104.3 (5.8)</td>
<td>83.8</td>
<td>94.0</td>
<td>94.8</td>
</tr>
<tr>
<td>FMIA</td>
<td>58.0 (6.0)</td>
<td>51.9</td>
<td>51.5</td>
<td>52.5</td>
</tr>
<tr>
<td>IMPA</td>
<td>93.0 (6.2)</td>
<td>88.3</td>
<td>87.5</td>
<td>88.0</td>
</tr>
<tr>
<td>Linear (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A'-Ptm'</td>
<td>50.1 (3.2)</td>
<td>46.7</td>
<td>46.2</td>
<td>46.0</td>
</tr>
<tr>
<td>Gn-Cd</td>
<td>120.8 (5.2)</td>
<td>105.9</td>
<td>109.3</td>
<td>109.3</td>
</tr>
<tr>
<td>Pog'-Go</td>
<td>80.0 (4.7)</td>
<td>70.5</td>
<td>71.7</td>
<td>71.6</td>
</tr>
<tr>
<td>Cd-Go</td>
<td>61.2 (4.3)</td>
<td>49.9</td>
<td>52.1</td>
<td>52.0</td>
</tr>
</tbody>
</table>


S, Sella; N, nasion; A, A-point; B, B-point; SN, sella-nasion plane; Facial angle, angle between FH plane and nasion-pogonion plane; FMA, angle between FH plane and mandibular plane; U1, axial inclination of maxillary central incisor; FMIA, angle between FH plane and axial inclination of mandibular central incisor; IMPA, angle between axial inclination of mandibular central incisor and mandibular plane; Gn, gnathion; Cd, condylion; Pog', perpendicular from pogonion to mandibular plane; Go, gonion.

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**Fig 4.** Presurgical intraoral photographs. The transverse dental compensation of the anterior and posterior teeth was eliminated, and the left buccal segments showed lateral crossbite.
eliminating the transverse dental compensation of mandibular incisors and coordinating the dental midline with the skeletal midline of mandible.

The first surgical option was a mandibular osteotomy only. The second option was 2-jaw surgery: Le Fort I and mandibular osteotomies. The first option would not sufficiently improve the facial asymmetry, although the surgical intervention was limited to the mandible. On the other hand, 2-jaw surgery would be much more effective for improving the facial symmetry of the maxilla and the mandible.

**TREATMENT PLAN**

In the consultation, the patient and her parents selected the following treatment plan.

1. Preoperative orthodontic treatment to include extraction of the maxillary first premolars and the mandibular left first premolar, elimination of the arch length discrepancy, alignment and decompensation of the maxillary and mandibular teeth, arch coordination, and coordination of the dental midlines with the midlines of the jaws.
2. Orthognathic surgery to include Le Fort I osteotomy to correct the asymmetry of the maxilla with iliac bone grafting and bilateral sagittal split ramus osteotomy (SSRO) to correct the mandibular deviation.
3. Postoperative orthodontic treatment to include fine adjustment of the occlusion and muscle training.
4. Retention.

**TREATMENT PROGRESS**

When the patient was 17 years old, the maxillary first premolars and mandibular left first premolar were
Fig 6. Posttreatment dental casts.

Fig 7. Posttreatment radiographs.
extracted, and 0.018 × 0.025-in standard edgewise appliances were placed in both arches. The arches were leveled and aligned, with several replacements of archwires. The maxillary incisors were moved slightly to the left. The mandibular incisors were also moved to the left to eliminate the transverse dental compensation and coordinate the dental midline with the midline of the mandible. As a result, the dental midline was moved until it was approximately 11 mm to the left of the facial midline.

Furthermore, the dental compensation of the buccal segments of the maxillary and mandibular arches was eliminated. A set of 0.017 × 0.025-in stainless steel archwires with third-order bends was used to eliminate the transverse dental compensation.

At the end of this treatment, the left buccal segments exhibited a lateral crossbite, and the teeth in both arches were moved to positions where the basal bone firmly supported them, making it possible for surgical correction of the maxilla and the mandible (Fig 4).

When the patient was 20 years 3 months old, the Le Fort I osteotomy and bilateral SSRO with titanium miniplate fixation were performed to correct the jaw deformities. The maxilla was rotated clockwise to correct the canted occlusal plane of the maxillary arch, and iliac bone was grafted onto the left disjunction region. The left maxillary alveolar bone was repositioned 5 mm inferiorly. The body of the mandible was moved 10.5 mm to the undeviated side, with

**Fig 8.** Dental casts cut off at the maxillary and mandibular first molars. A, Pretreatment casts show extreme transverse dental compensation of the maxilla and mandible; B, posttreatment casts show that the transverse dental compensation of the maxillary and mandibular first molars was eliminated, and symmetry of molar inclination was obtained. Solid line, axis of the first molars.

**Fig 9.** Tracings of the frontal cephalograms. Skeletal symmetry was obtained with improvement of the canted occlusal plane and correction of the mandibular deviation.
a 6.5-mm advancement on the left side and a 7.5-mm setback on the right side.

Maxillomandibular fixation was maintained for 10 days, with neuromuscular and occlusal rehabilitation for 1 month. Then, arch coordination and interdigitation were adjusted for 4 months, the edgewise appliances were removed, and circumferential retainers were used for retention.

**TREATMENT RESULTS**

The posttreatment photographs and dental casts showed successful results (Figs 5-7). The frontal view was dramatically improved, and the profile was also slightly improved, with forward movement of the chin and reduction of upper lip protrusion. Overbite and overjet were 3.0 mm and 2.0 mm, respectively. Favorable interdigitation and a Class I canine relationship between the maxillary and mandibular teeth were obtained, although the molar relationships were Class I on the left and full-cusp Class II on the right. The preoperative orthodontic treatment sufficiently eliminated the transverse dental compensation of the mandibular left molars and maxillary right molars. In both arches, symmetry of buccolingual molar inclinations was obtained, and basal bone firmly supported the molars (Fig 8).

The frontal cephalogram and the 3D CT images showed that the cant of the maxillary occlusal plane was eliminated by the LeFort I osteotomy, and the deviation of the mandible was eliminated by the SSRO. Consequently, the midlines of the maxilla and mandible were coordinated with the facial midline (Figs 7 and 9). The maxillary incisors showed slight root resorption. There was no sign of TMJ disorder during the treatment.

Superimposition of the pretreatment and posttreatment lateral cephalograms showed a slight forward movement of the mandible (Fig 10). Cephalometric analysis indicated that the ANB angle had decreased from 8.5° to 6.5° because of a slight increase in the SNB angle. The occlusal plane angle had decreased to approximately 5°, and the U-1 to SN angle had increased (Table). Radiographic examination showed slight root resorption of the maxillary incisors (Fig 7). There was no sign of a temporomandibular disorder during the treatment.

After 1 year 8 months of retention (ending 2 years after orthognathic surgery), the facial symmetry and occlusion were well maintained, and the patient was satisfied with the treatment results (Figs 11 and 12, Table).

**DISCUSSION**

It is important to understand the components of facial asymmetry for diagnosing and planning surgical orthodontic treatment.20 Facial asymmetry is generally classified into 3 patterns, depending on the area affected: craniofacial skeleton, both maxilla and mandible, and mandible only. In this patient, the frontal cephalometric analysis indicated that the facial asymmetry extended over the maxilla and the mandible with transverse and vertical skeletal asymmetry. In such cases of facial asymmetry, transverse dental compensation is frequently observed to maintain the dental occlusion.5-12 The magnitude of transverse dental compensation generally varies to the same extent as the patient’s skeletal deformity,5 and many studies of skeletal asymmetry have shown that transverse dental compensation is statistically correlated with transverse skeletal asymmetry.12-14,20 Our patient had extreme transverse dental compensation of the anterior and posterior teeth as a consequence of the severe skeletal asymmetry. The maxillary incisors and molars were inclined to the deviated side, and the mandibular incisors and molars were inclined to the contralateral side. The mandibular left posterior segment was extremely inclined to the right; this prevented the formation of a crossbite, despite the severe lateral deformities of the maxilla and the mandible. Furthermore, the mandibular incisors were also inclined to the right, and the mandibular right lateral incisor was pushed out from the arch. This seemed to be a reaction of the body to maintain normal interarch positioning even with a distorted jaw relationship.

The primary goal of preoperative orthodontic treatment is to eliminate the transverse dental compensation for the skeletal deformity.5,7 If the transverse dental
compensation is left during preoperative orthodontic treatment, the facial asymmetry will remain, even though the surgery produces satisfactory occlusion. Therefore, it is critical to eliminate the dental compensation orthodontically and to move the teeth to their proper positions so that basal bone supports them. This makes it possible to move the maxilla and the mandible into their proper positions during orthognathic surgery.

The preoperative orthodontic treatment included elimination of transverse dental compensation and coordination of the dental and skeletal midlines. In the maxillary arch, the elimination of the transverse dental compensation and the correction of the dental midline involved extraction of both maxillary first premolars. In the mandibular arch, the treatment was somewhat complicated. It was necessary to move the dental midline 7 to 8 mm to the left to make the dental midline coincident with that of the mandible; therefore, only the mandibular left premolar was extracted. The dental midlines of the maxillary and mandibular arches were coordinated with the midlines of the maxilla and mandible, respectively. Asymmetric extraction is an effective approach to correct transverse decompensation so that the incisors can be retracted more on one side than on the other, and the midline can be shifted in the desired direction. The transverse dental compensation of the posterior teeth was completely eliminated by torque control, and coordination of both arches was obtained. The posterior teeth were seated firmly on the basal bone of the maxilla and the mandible, making it easier to position them during the orthognathic surgery. The preoperative orthodontic treatment enabled sufficient correction of the jaw deformities during the orthognathic surgery and dramatically improved the facial asymmetry. This indicates that elimination of transverse dental compensation during preoperative orthodontic treatment is a requisite for successful correction of severe facial asymmetry.
The combination of Le Fort I osteotomy and SSRO is an effective method for correcting facial asymmetry extending over the maxilla and the mandible.\textsuperscript{5,18,19} The Le Fort I osteotomy with iliac bone grafting to eliminate the canted occlusal plane made it possible to correct the maxillary asymmetry. This procedure made it easier to reposition of the mandible during the SSRO.

For our patient, the postoperative treatment took only 4 months—a very short period—suggesting that the likelihood of skeletal relapse was small, despite the great skeletal changes. The preoperative elimination of transverse dental compensation appears to have contributed to the stability of facial symmetry and occlusion after treatment. Early muscle training after the orthognathic surgery could also have contributed to the stability.

**CONCLUSIONS**

This case suggests that sufficient elimination of extreme transverse dental compensation of the anterior and posterior teeth in both arches during preoperative orthodontic treatment is a requisite for the successful treatment of severe facial asymmetry and stabilization of the occlusion after orthognathic surgery.

**REFERENCES**