Class III occlusion with missing maxillary first molars and facial asymmetry treated with intraoral vertical ramus osteotomy: 7-year follow-up

Jae Hyun Park, DMD, MSD, MS, PhD1
Kiyoshi Tai, DDS, PhD2
Hitoshi Hotokezaka, DDS, PhD3
Yoshinobu Yanagi, DDS, PhD4
Kazuhisa Ikeda, DDS5

A 17-year-old girl with a Class III occlusion and facial asymmetry was treated with orthodontics and intraoral vertical ramus osteotomy (IVRO). She had a severe skeletal Class III relationship (Wits, –17 mm). Even though she had a prognathic mandible, she showed a straight rather than concave profile because of severe mandibular dental compensation. The patient also had severe mandibular deviation. After 17 months of presurgical orthodontic treatment, IVRO was performed. Total active treatment time was 26 months. Both occlusion and facial appearance were significantly improved by the surgical-orthodontic treatment. There were no functional problems during or after treatment. Posttreatment records after 7 years showed excellent results with good, stable occlusion; facial balance and harmony; and long-term stability. ORTHODONTICS (CHIC) 2012;13:110–121.

Key words: Class III malocclusion, facial symmetry, intraoral vertical ramus osteotomy

Severe Class III malocclusion in adults can be treated by orthodontic camouflage or in combination with orthognathic surgery to reposition the mandible or maxilla. Camouflage treatment is an option, but orthognathic surgery is preferred when patients have a severe Class III occlusion caused by mandibular protrusion. Combining surgery and orthodontic treatment can actually provide significant skeletal improvement for patients with facial asymmetry. Facial esthetics and occlusion will be improved more than with orthodontic camouflage treatment alone.

For orthognathic surgery of the mandible, two methods are commonly used. One is sagittal split ramus osteotomy (SSRO), while the other is intraoral vertical ramus osteotomy (IVRO). SSRO is commonly performed in the mandible for setback or advancement. Because of rigid fixation, this method usually provides stable treatment results.1–4 IVRO is most frequently used to set back the mandible.5–7

Patients with internal derangements of the temporomandibular joint (TMJ) are more likely to have facial asymmetry.8 Mandibular asymmetries are often corrected with SSRO or IVRO. IVRO is an easier procedure because it does not require
fixation with screws and can therefore be completed in less time with a lower incidence of nerve injury and bleeding\(^9,10\) and a higher probability of improvement of temporomandibular disorder (TMD) symptoms than with SSRO.\(^11-13\)

This case report presents a patient who had a skeletal Class III jaw relationship due to mandibular protrusion; in addition, she had skeletal mandibular deviation to the left, missing maxillary first molars, and TMD symptoms. Her treatment included mandibular osteotomy (IVRO) combined with orthodontic therapy.

**CASE HISTORY**

A 17-year-old girl was referred to the orthodontist. She was very healthy without any specific medical problems. Her chief complaint was the unesthetic appearance of her maxillary anterior teeth and facial asymmetry. She did not have a history of injury to her head or jaw.

**Diagnosis and etiology**

The patient presented a straight profile with an acute nasolabial angle. Her frontal facial photograph showed facial asymmetry with mandibular deviation to the left (Figs 1 and 2).

During the TMJ evaluation, a unilateral clicking sound was detected and the patient had a tenderness of the TMJ and surrounding muscles with palpation. Her maxillary arch showed approximately 6 mm of spacing while her mandibular arch showed approximately 3.5 mm of crowding. Her maxillary first molars were missing, but she could not recall ever having had them extracted. It may be assumed that they were missing congenitally or that she did not remember the extraction procedure. Because of the missing maxillary first molars, the maxillary second molars were severely rotated mesiolingually. She also showed an anterior crossbite on the maxillary left lateral incisor and canine. The maxillary right lateral incisor showed an edge-to-edge bite. She had a Class III canine relationship on both sides. The molar relationship was not applicable due to missing maxillary first molars. She had a 10% overbite and 2 mm overjet. The dental midline was almost coincidental with the maxillary midline, but the mandibular skeletal midline was shifted 3 mm to the left. When the mandible was guided
in centric relation, a functional shift of the mandible 2 mm to the left side was observed because of the presence of an anterior crossbite (Figs 1 and 2).

In the posteroanterior cephalogram, an occlusal plane cant was not revealed, but the patient’s chin was deviated 3 mm to the left of the facial midline. Her nasal septum was also deviated to the left (Fig 3a). Lateral cephalometric analysis indicated a skeletal Class III relationship (ANB, −4 degrees; Wits, −17 mm) with a hyperdivergent growth pattern (SN-MP, 34.8 degrees). The maxillary incisors were severely proclined (U1 to SN, 112 degrees), and the mandibular incisors showed severe retroclination (IMPA, 71 degrees) (Fig 3b and Table 1). The panoramic radiograph revealed the missing maxillary first molars and developing third molars (Fig 3c).

The etiology of the skeletal Class III occlusion was considered to be a combination of heredity (a family history of asymmetry and Class III skeletal pattern) and environmental factors.

**Treatment objectives**
The treatment objectives were to obtain a normal overjet and overbite, establish a Class I canine relationship, close the spacing on the maxillary arch, relieve the crowding on the mandibular arch, provide a stable and functional occlusion, reduce TMD symptoms, and improve facial esthetics and asymmetry.
Treatment alternatives
Several potential procedures were considered for achieving an ideal overjet and overbite. Making room for the maxillary first molars was considered by protracting the entire maxillary dentition forward and performing interproximal reduction (IPR) in the mandibular anterior dentition. This treatment plan would
require two maxillary first molar implants after orthodontic treatment and procline the maxillary incisors even more. It would not, however, correct the skeletal disharmony (prognathic mandible and facial asymmetry). For these reasons, the surgical-orthodontic treatment option was selected.

**Treatment plan**

To improve the patient's facial asymmetry, single- or double-jaw surgery was an option. After a comprehensive assessment of diagnostic records, it was determined that a mandibular osteotomy alone would sufficiently improve the patient's facial asymmetry because she did not show any significant vertical maxillary height and occlusal plane cant. A combination of orthodontic treatment and orthognathic surgery was used to substitute the maxillary third molars for the maxillary second molars.
Treatment progress

Before orthodontic treatment, the patient was referred to a specialist to evaluate the existing periodontal conditions, especially the thin attached gingiva in the mandibular anterior dentition and an unesthetic gingival contour of the maxillary central incisors. The patient was referred to an oral surgeon to determine whether mandibular third molar extraction was necessary.

A stabilizing splint was used for 3 months to alleviate pain in the muscles and TMJ. Full-fixed 0.018-inch edgewise brackets (3M Unitek) were bonded to both arches when the patient was 17 years 4 months old. To contour the esthetic gingival margin on the maxillary anterior teeth, brackets were bonded at different heights. The maxillary and mandibular arches were leveled with continuous archwires, starting with 0.014-inch nickel-titanium and working up to 0.017 × 0.025-inch beta-titanium, to decompensate the maxillary and mandibular anterior teeth. All the maxillary spaces were closed. After proper labiolingual inclination of the anterior teeth had been achieved, 0.017 × 0.025-inch stainless steel archwires were applied prior to surgery, shifting her mandibular dental midline to the left approximately 3 mm to coincide with the mandibular skeletal midline (Figs 4 to 6). IVRO was performed when the patient was 18 years 9 months old. The mandible was repositioned 4 mm to the right and 1 mm posteriorly on the left side without rigid fixation. The mandibular third molars were extracted during the surgery. Maxillomandibular fixation was maintained for 1 week. After the fixation was released, neuromuscular and occlusal rehabilitation was performed for 3 months with elastics and an occlusal splint. The force vectors for the elastics were vertical or light Class II. Three months of rehabilitation was enough to stabilize the mandibular position after IVRO. During the postoperative edgewise treatment, the occlusion was detailed with adjustable archwires and elastics. The edgewise appliances were removed at age 19 years 6 months. Following treatment, a 0.0175-inch twistflex wire was bonded lingually from lateral incisor to lateral incisor on the maxillary and mandibular arch.

Treatment results

Posttreatment records indicate that the treatment objectives were achieved. Facial photographs show improved profile esthetics (Fig 7). A Class I canine relationship was established with canine-protected occlusion. Dental midlines were aligned with the facial midline, an ideal overbite and overjet were achieved, and the TMD symptoms were improved (Fig 8).
A posttreatment posteroanterior cephalometric radiograph shows that mandibular symmetry was achieved (Fig 9a). Posttreatment lateral cephalometric analysis and superimposition reveals significant skeletal changes with backward movement of the mandible (ANB, 1.6 degrees; Wits, −7.6 mm) and an increase in the mandibular plane angle (SN-MP, 44.5 degrees). The maxillary incisors (U1-SN, 100 degrees) were slightly retroclined. The inclination of the mandibular incisors was slightly retroclined (IMPA, 80 degrees) (Fig 9b and Table 1). A posttreatment panoramic radiograph shows proper space and acceptable root parallelism with no signs of bone or root resorption (Fig 9c). The maxillary third molars successfully erupted in the second molar position.

Condylar asymmetry, ramal asymmetry, and condylar-plus-ramal asymmetry in vertical heights were determined14 (Fig 10). When posttreatment measurements were compared with the pretreatment measurements, a significant reduction of asymmetry was apparent (Table 2).
The patient’s facial profile was improved, and facial symmetry was achieved. Furthermore, the esthetic plane was improved primarily by decreasing the nasolabial angle (Figs 7 and 11). At the 7-year follow-up, the patient had a stable occlusion and the results of the surgical orthodontic treatment were maintained (Figs 12 and 13). Radiographic examination confirmed fairly stable results (Figs 14 and 15 and Table 3).

Table 2  Comparison of pretreatment asymmetry and posttreatment symmetry in vertical height and asymmetry index measurements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pretreatment</th>
<th>Posttreatment</th>
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<tr>
<td></td>
<td>Right</td>
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</tr>
<tr>
<td>CH (mm)</td>
<td>7.0</td>
<td>7.2</td>
</tr>
<tr>
<td>RH (mm)</td>
<td>54.1</td>
<td>47.3</td>
</tr>
<tr>
<td>CH+RH (mm)</td>
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<td>54.5</td>
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<td>Condylar asymmetry index</td>
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</tr>
<tr>
<td>Asymmetry index</td>
<td>5.7</td>
<td>0.6</td>
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CH, condylar height; RH, ramal height; CH + RH, condylar + ramal height.
Condylar asymmetry index = [(CHright – CHleft) / (CHright + CHleft)] × 100%
Asymmetry index = [(right – left) / (right + left)] × 100%
Class III occlusion treated with intraoral vertical ramus osteotomy

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Fig 11  Superimposition of cephalometric tracings: pretreatment (black) and post-treatment (red).

Fig 12  Postretention facial photographs after 7 years.

Fig 13  Postretention intraoral photographs after 7 years.
Fig 14  Postretention 3D images after 7 years. (a) Maxillary height; (b) ramal length (1), mandibular body length (2); (c) chin height; (d) mandibular midline to gonion; (e) ramal inclination (lateral view); (f) ramal inclination (rear view).

Fig 15  Postretention radiographic views after 7 years. (a and b) posteroanterior and lateral and maximum intensity projection (MIP) images, (c) panoramic rendering.

Table 3  Postretention 3D image analysis of facial symmetry after 7 years

<table>
<thead>
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<th>Measurement</th>
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<th>Difference</th>
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<tr>
<td>Maxillary height (mm)</td>
<td>48.0</td>
<td>47.4</td>
<td>0.6</td>
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<tr>
<td>Ramal length (mm)</td>
<td>53.2</td>
<td>52.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Mandibular body length (mm)</td>
<td>53.3</td>
<td>52.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Chin height (mm)</td>
<td>41.5</td>
<td>41.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Mandibular midline to gonion (mm)</td>
<td>74.1</td>
<td>73.8</td>
<td>0.3</td>
</tr>
<tr>
<td>Ramal inclination (lateral view) (degrees)</td>
<td>15.9</td>
<td>14.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Ramal inclination (Rear view) (degrees)</td>
<td>18.5</td>
<td>17.9</td>
<td>0.6</td>
</tr>
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</table>
DISCUSSION

The surgical correction of a dentofacial anomaly is generally done after completion of growth. The final decision regarding whether to use single- or double-jaw surgery for the surgical correction of a dentofacial anomaly is made after preoperative orthodontic treatment has been completed and is based on an evaluation of morphology, esthetics, and cephalometry. As a rule, it should be fairly clear from the start of orthodontic treatment what type of surgery will most likely be necessary; however, in some cases, preoperative orthodontic treatment may result in changes that, within certain limits, will alter the planned surgery.

Facial asymmetry often exists in orthodontic patients. The treatment of severe facial asymmetry involves surgically repositioning the maxilla and mandible. Maxillary osteotomy is required if the patient has problems in the maxilla such as a canted occlusal plane, retrognathic maxilla, labial incompetence, or a gummy smile. In such cases, a LeFort I osteotomy is performed along with mandibular surgery. Although these procedures can improve both esthetic and functional problems, the disadvantages of a treatment that requires two-jaw surgery include a lengthy surgical procedure, increased medical expenses, and severe postoperative discomfort for patients.

Surgical prediction tracing is usually conducted twice during orthognathic treatment planning. The first prediction is performed as part of the initial treatment plan. The second surgical prediction tracing is done at the immediate preoperative stage. On this cephalometric prediction, the magnitude of surgical movement is accurately measured, correlated with the model surgery and recorded. It helps to assess the impact of planned surgical movements on hard and soft tissue structures. In this case study, we used Quick Ceph (Orthodontic Processing) to perform surgical prediction tracing immediately before surgery. The mandible was moved 6.8 mm horizontally and 2.2 mm vertically. This visual estimate provided a reasonably accurate method of prediction considering the actual outcome (Figs 6 and 7).

The choice of surgical procedure to correct Class III malocclusions should essentially be based on an esthetic evaluation in the three planes of space: sagittal, vertical, and transverse. It must determined which would be more appropriate: mandibular osteotomy, maxillary osteotomy, or double-jaw surgery. Cephalometric analysis of skeletal structures should come after the esthetic considerations. If skeletal values are in agreement with a surgical approach selected on esthetic grounds, so much the better; but if not, the esthetic evaluation should always dominate.

From the lateral cephalometric radiographs, it appears that the posterior surgical repositioning of the mandible performed in this case significantly reduced the pharyngeal airway space at the levels of the second through fourth cervical vertebrae (Figs 3b and 9b). However, after 7 years, the pharyngeal airway morphology gradually relapsed because of a reflex alternation in the pharyngeal muscular mechanism and the biomechanical conditions of the supra- and infrahyoid muscles (Fig 15b).

Surgical correction of Class III malocclusions should be postponed whenever possible. Some patients, however, experience severe psychosocial stresses and difficulties, so it is inappropriate to delay surgery in these instances. One study found that younger Class III patients (females younger than 18 and males younger than 20) who show little or no mandibular growth from serial cephalometric radiographs have the same prognosis for long-term clinical success as older patients in whom less growth might be expected. Serial cephalograms should be used to provide evidence that growth is complete in a younger patient because surgical correction that is performed too early can easily lead to a relapse due to residual mandibular growth.
CONCLUSION

Orthodontic treatment can be combined with orthognathic surgery to achieve acceptable results. After treatment, the skeletal disharmony and malocclusion both improved significantly. Generalized esthetics and function were still stable after 7 years of retention.

REFERENCES


