Case Report

Orthodontic and Orthognathic Surgical Correction of a Skeletal Class III Malocclusion

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Abstract: We report here a case of skeletal Class III malocclusion with mandibular prognathism treated with a combination of orthodontic and orthognathic surgery. A 28-year-old woman presented with a cross bite and the inability to incise food; she had no history of trauma or serious illness. She was diagnosed with a skeletal Class III malocclusion and crowded teeth. The left mandibular first molar showing an inappropriate root canal treatment was extracted and the left mandibular third molar was implanted into the first molar extraction space. She was treated with conventional fixed edgewise appliance therapy combined with orthognathic surgery (sagittal split ramus osteotomy). The mandibular prognathism was eliminated. The transplanted tooth remains stable more than 5 years after the procedure.

Key words: Class III malocclusion, orthodontic treatment, orthognathic surgery, autotransplantation.

Orthognathic surgery is always considered for treatment of a skeletal Class III malocclusion if the orthodontist and patient desire complete correction of the skeletal discrepancy. In addition to any tooth-size/jaw-size discrepancy that may be present, the orthodontist must decide if the patient has a skeletal problem requiring surgery on both jaws, and if so, where the jaws should be positioned to give the patient the best possible occlusion, functional recovery, and facial-esthetic result.

There has been a recent and marked increase in the number of adults presenting for treatment. Orthodontic and orthognathic surgical procedures are important adjuncts to the provision of optimum restorative and periodontal care. With adequate combined orthognathic-orthodontic treatment, it is possible to re-establish a healthy and well-functioning dentition. This article reports an interdisciplinary approach (orthognathic, orthodontic, and restorative with autotransplantation) for the treatment of a skeletal Class III malocclusion with crowded teeth.

History and Etiological Factors

A 28-year-old woman presented for treatment with no history of trauma or serious illness. Her chief complaints were a cross bite and the inability to incise food. She also had esthetic concerns about her large lower jaw (Fig. 1). The patient had received regular dental care and had undergone minimal restorative dentistry. No familial history was reported. The presenting patient had no symptoms of a temporomandibular disorder. The left mandibular first molar was subjected to a root canal treatment several years ago.

Diagnosis

The patient had a skeletal Class III malocclusion

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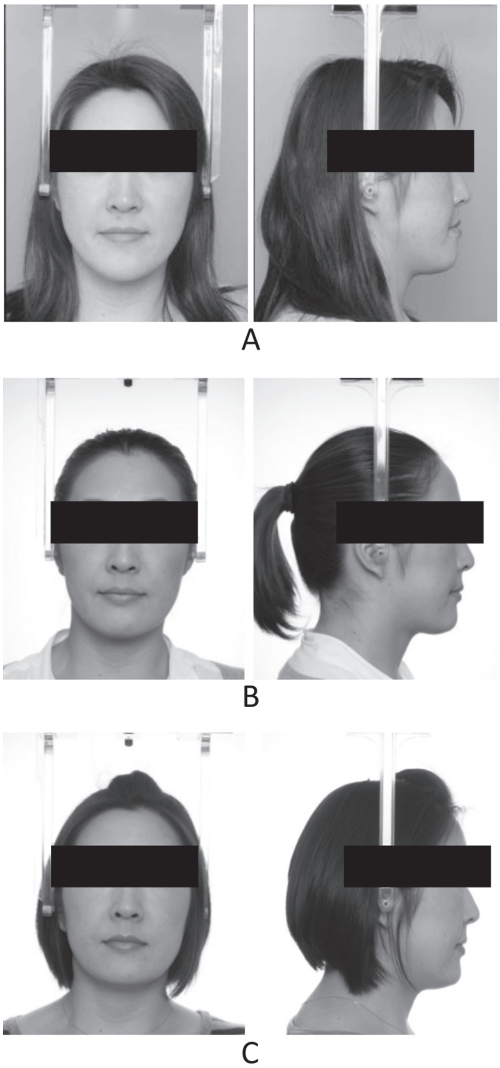


Fig. 1 Facial photographs. A: Pre-treatment (28Y3M). B: Post-treatment (31Y9M). C: Post-retention (34Y3M).

with mandibular overgrowth (SNB 82.6°, ANB −2.9°) and a wide gonial angle (131.8°) (Table 1). The Class III occlusion had a negative overjet of 3.5 mm (Fig. 2), with severe crowding of the maxillary arch (Fig. 2). The entire mandibular arch was in linguoversion, the upper dental midline was displaced 3.5 mm from the facial midline, and the mandibular left first molar required extraction due to an apical lesion (Fig. 3).

Specific Treatment Objectives

1. Eliminate mandibular prognathism
2. Establish a Class II molar relationship due to extractions of the upper first-premolar tooth on both sides.
3. Obtain a proper interdigitation and a Class I canine relationship, with an ideal overbite and overjet.
4. Reduce lower-facial height, improve lower-lip support, and improve lip competence.
5. Autotransplant the third molar to replace the mandibular left first molar that was extracted due to an apical lesion.

Treatment alternatives

Several treatment plans were considered. A non-surgical approach would not have sufficiently improved the protruding mandible and this was the patient’s chief complaint. In addition, the patient had no facial asymmetry of the maxilla. Therefore, a mandibular osteotomy only was applied. Extraction of the mandibular premolars during the preoperative orthodontic treatment was not needed because there was no dental-midline deviation from the skeletal midline of the mandible. Although the planned extraction of the maxillary first premolars could lead to a Class II molar relationship, it was the best strategy for eliminating the transverse dental compensation of mandibular incisors and coordinating the dental midline with the skeletal midline of maxilla.

Treatment Plan

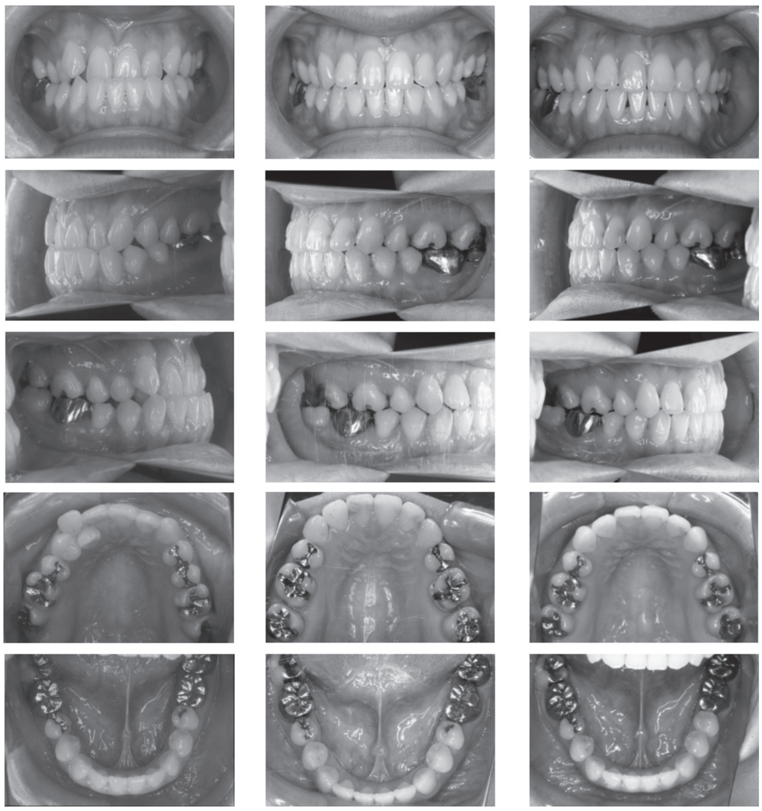
1. Pre-orthodontic treatment: Extract the maxillary left and right first premolars, and the left and right third molars, and then autotransplant the third molar to replace the missing mandibular left first molar due to the apical lesion.
2. Pre-surgical orthodontic treatment: Orthodontic leveling and alignment of the teeth in both arches.
3. Surgery: Bilateral sagittal split osteotomies (BSSO) setback to achieve anteroposterior occlusal correction.
4. Post-surgical orthodontics.
5. Retention.

Appliance Plan

1. Nance’s holding arch in upper arch.
2. Combination banded and bonded 0.018-inch edgewise appliance.
3. Archwire sequence in presurgical orthodontic

Table 1 Cephalometric analysis.

	Norm	Pre-treatment 28Y3M	Pre-surgery 30Y3M	Post-treatment 31Y9M	Post-retention 34Y3M
Angular (°)					
SNA	82.3	79.7	79.6	78.9	81.2
SNB	78.9	82.6	82.1	78.3	79.3
ANB	3.4	−2.9	−2.4	0.2	1.9
Gonial angle	121.2	131.8	130.4	129.2	131.6
Ramus inclination	87.1	80.4	81.4	83.7	81.9
Occlusal plane angle	11.4	8.3	7.8	6.3	7.1
U-1 FH plane angle	111.1	112.8	111.9	111.1	108.2
FMA	28.8	32.2	31.7	32.9	33.4
IMPA	96.3	78.7	81.4	86.5	87.0
FMIA	54.6	69.1	66.8	60.6	59.6
Linear (mm)					
A'-Ptm'	48.3	48.4	47.9	47.2	48.5
Gn-Cd	119.3	131.8	133.4	124.5	125.3
Pog'-Go	77.2	82.8	83.6	79.9	78.5
Cd-Go	62.4	64.3	64.7	60.3	61.7



(A) (B) (C)

Fig. 2 Intra-oral photographs. A: Pre-treatment (28Y3M). B: Post-treatment (31Y9M). C: Post-retention (34Y3M).

treatment: upper; 0.014 nickel-titanium (NiTi), 0.016 NiTi, 0.016 ss, 0.016 × 0.022 ss; and, lower; 0.014 NiTi, 0.016 NiTi, 0.016 × 0.022 NiTi, 0.016 × 0.022 ss.

4. Archwire sequence in post-surgical orthodontic treatment: upper; 0.016 × 0.022 ss; and lower; 0.016 × 0.022 ss.
5. Removal of maxillary and mandibular retainers.

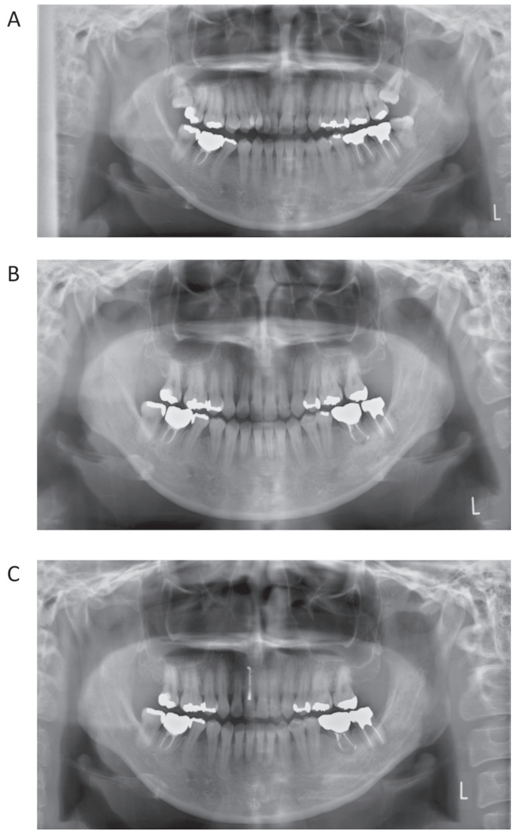


Fig. 3 Panoramic radiographs. A: Pre-treatment (28Y3M). B: Post-treatment (31Y9M). C: Post-retention (34Y3M).

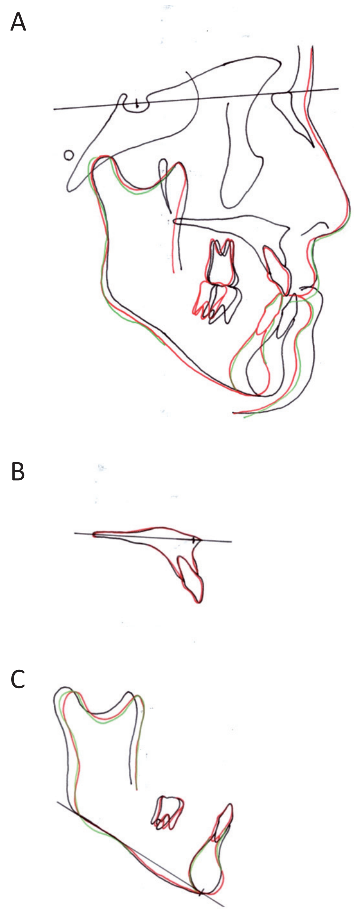


Fig. 4 Cephalometric superimposition. (A: S-N at S, B: Palatal at A', C: Mandibular at Me). Black line (Pre-treatment, 28Y3M), green line (Post-treatment, 31Y9M) and red line (Post-retention, 34Y3M).

Surgical Plan

The pretreatment facial photographs show the underlying skeletal relationships (Fig. 1). The presurgical phase of the treatment achieved good decompensation of the mandibular-incisor inclination and alignment of the teeth in both arches, with IMPA improved from 78.7° to 81.4° and the U-1 FH plane angle improved from 112.8° to 111.9° (Table 1). The distal segment was set back 6 mm with care taken not to disturb the presurgical position of the proximal segment. BSSO was performed using semirigid fixation.

Treatment Progress

Initially, the Class III occlusion had a negative overjet of 3.5 mm, and an overbite of 2.5 mm. The mandibular left third molar and left first molar were extracted, and the mandibular left third molar was transplanted to the region of the extracted mandibular left first molar. The upper first premolars were extracted. The upper teeth were then fitted with conventional fixed appliances using edgewise arch brackets, 0.014 NiTi (August 2003). After ten months (July 2004), the lower teeth were also fitted with conventional fixed appliances using edgewise arch brackets, 0.016 NiTi. Subsequent presurgical orthodontic treatment was required after 1 year and 10 months. In May 2006, stainless steel surgical spurs were silver-soldered to the archwire in preparation for the mandibular BSSO, which was subsequently performed by a maxillofacial surgeon. After 1 week of intermaxillary fixation, the orthodontic treatment was resumed. Final arch coordination and minor occlusion equilibrations were accomplished during the subsequent 15 months. The overbite of 2.0 mm and overjet of 2.0 mm was established. All fixed appliances were then removed, and the patient was fitted with removal maxillary and mandibular retainers (September 2006). Post-surgical orthodontic treatment was required after a further 1 year and 3 months. Post-treatment follow-up occurred at 30 months after removal of the fixed appliances (March 2009).

Treatment Results

The patient's overall facial esthetics was improved significantly due mainly to the lower-jaw size reduction (Fig. 1). The repositioning of the mandibular incisor provided better lower-lip support (Fig. 1). The occlusion was corrected with a Class I canine relationship. The Class II molar relationship was maintained on both sides due to the upper first-premolar tooth extractions (Fig. 2). The overbite and overjet relationships were optimized and the occlusal result was excellent (Fig. 2). Two years after retention, an acceptable occlusion was maintained, indicating long-term stability of the treated jaw (Fig. 2). The maxillary and mandibular dental midlines were coincident with the facial midline. Panoramic radiograph showed no or less root resorption, and the autotransplanted teeth were stable (Fig. 3). The mandible was moved posteriorly 6 mm compared to the pretreatment position (Fig. 4). Cephalometric changes included an increase in ANB angle from −2.9° to 1.9°, an increase in mandibular plane angle from 32.2° to 33.4°, a decrease in N-Me from 134.1° to 133.4°, and a decrease in ANS-ME from 76.3° to 74.8° (Table 1).

The left mandibular first molar with inappropriate root canal treatment was extracted and the left mandibular third molar was implanted into the first molar extraction space. The transplanted tooth remains stable more than 5 years after the surgery.

Discussion

BSSO is an effective, relatively safe, and simple method for correcting the lower facial profile to attain a satisfactory esthetic facial contour. It can also be combined with any facial bone surgery for treating more complex deformity.[1)]

A combined orthodontic and surgical approach is often chosen to treat dentofacial deformities because certain orthognathic procedures have a tendency to relapse. The main factors that influence stability are the direction and magnitude of movement, the surgical technique employed, and the type of fixation used.[2)] Severt and Proffit[3)] demonstrated a hierarchy of stability for orthognathic procedures for correcting severe facial asymmetries. The long-term stability of BSSO seems to depend on successfully controlling the position of the proximal condylar segments and maintaining the mandibular ramus inclination. In this patient, the occlusion was corrected by establishing a Class I canine relationship, although the Class II molar relationship was maintained on both sides due to the upper first-premolar tooth extractions. Two years after retention, an acceptable occlusion was maintained, indicating long-term stability of the treated jaw. The result in the presented case has been stable in the long term, with no detectable surgical relapse.

Mandibular setback is considered one of the least stable surgical procedures because it usually results in the ramus being pushed to a more vertical inclination, which stretches the soft tissues and creates tension on the mandibular musculature.[2,4)] When masticatory function resumes, the ramus tends to return to its original inclination, which carries the chin forward again. Also, excellent stability requires neuromuscular adaption,[2)] particularly after a combined orthodontic and surgical approach. The assessment of masticatory muscle activity is therefore important when evaluating the outcome of orthognathic surgery performed to improve occlusion and mastication. Electromyography is a well-established method for assessing the function of masticatory muscles.[5)] Unfortunately, the current patient was not assessed sufficiently with respect to masticatory muscle function.

Treatment plans such as the one described herein are often developed with consideration of the site and number of missing teeth, thus tooth extraction may be needed in some cases. In such patients, autotransplantation of the tooth extracted for orthodontic treatment prevents an increase in the number of missing teeth and minimizes tooth movement. Such an approach is thus considered effective for obtaining a satisfactory prognosis, and autotransplantation is now a standard treatment with similar validity to dental implants.[6] Several studies have also suggested autotransplantation of immature teeth, with only a few cases involving combined orthodontic treatment and autotransplantation of mature teeth reported to last more than 10 years after active orthodontic treatment.[7] The present case demonstrated successful autotransplantation of a third molar as a mature tooth in a patient with a missing mandibular left first molar due to apical lesion. Good results have been maintained for over 2 years after completion of the active orthodontic treatment. These results confirmed the validity of autotransplantation of teeth as an effective treatment option, particularly when combined with successful orthodontic therapy. Placement of dental implants is another option, although we would recommend autotransplantation before using dental implants if a donor tooth is available.

The symptoms of temporomandibular joint (TMJ) disorder are largely unpredictable after orthognathic surgery for skeletal Class III malocclusions.[8] The presented patient had no such symptoms before or after treatment; however, the effect of combined orthodontic and orthognathic treatment on the TMJ remains a consideration for clinicians and surgeons.[9]

This case was diagnosed using only two-dimensional data obtained from cephalometric radiographs in combination with clinical examination and model surgery, as is common for traditional orthognathic surgery planning. The introduction of three-dimensional computerized tomographic reconstruction technology provides the clinician with accurate three-dimensional images of the facial skeleton.[10] Advances in maxillofacial surgery has also allowed increased surgical manipulation of facial skeleton components, in concert or independently, also aided by the three-dimensional data. The increasingly standardized application of these computer-derived images will enable preoperative manipulation of the various facial components and analysis of the resulting changes in facial harmony to ensure improved patient outcomes.[11〜13]

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