Management of a severe Class III malocclusion with extreme dentoalveolar compensations

Karan Nehra, BDS, MDS¹
Vineet Sharma, BDS, MDS²
Rajat Mitra, BDS, MDS²

This case report describes the treatment of a 21-year-old woman with a severe Class III malocclusion, 9-mm anterior crossbite, extremely proclined maxillary anterior incisors associated with decreased buccolingual alveolar width, and a malformed supernumerary tooth. The treatment plan included fixed appliances to align and level the teeth, en masse retraction of maxillary anterior incisors after a labial and palatal corticotomy using temporary anchorage devices, high Le Fort I maxillary osteotomy for maxillary advancement, and bilateral sagittal split osteotomy for mandibular setback. Ideal overjet and overbite relationships were established, and the final esthetic result was pleasing. Occlusal stability was excellent in the 1-year follow-up. ORTHODONTICS (CHIC) 2012;13:e82–e93.

Key words: bimaxillary orthognathic surgery, corticotomy, temporary anchorage units

Class III skeletal deformities are usually a result of mandible prognathism, maxillary hypoplasia, or a combination of the two.¹,² The decision to reposition the mandible posteriorly or the maxilla anteriorly depends upon multiple clinical, cephalometric, and biomechanical considerations.³,⁴ The stability of maxillary and mandibular surgeries is dependent upon a number of factors, the most important being the thorough assessment of the maxillofacial complex in all the three planes of space and meticulous treatment planning. When performed alone, Le Fort maxillary advancement greater than 6 mm and bilateral sagittal split osteotomy mandibular setback greater than 10 mm are often associated with significant relapse.⁵–⁷ The predictability and stability of results increases in cases of combined bimaxillary surgeries.

To mask the underlying Class III skeletal bases, compensation in the dentition is often present in the form of proclination of maxillary incisors and retroclination of mandibular incisors. It is essential to remove these compensations prior to surgery to know the true extent of malocclusion.⁸,⁹ Due to severe compensations, buccolingual alveolar width may often be compromised to perform conventional orthodontic mechanotherapy.¹⁰–¹³ Corticotomy plays a vital role in such situations.¹⁴–¹⁷ In this case report, we demonstrate the usefulness of corticotomy for facilitated orthodontics mechanotherapy along with bimaxillary surgeries in a Class III skeletal deformity.
A 21-year-old woman reported to our dental center with the chief complaint of difficulty in speaking and eating, inability to properly close her mouth, and a forwardly placed mandible. Her family indicated that she was greatly affected by her appearance. She presented with a history of a visit to a local dentist 6 months prior for the extraction of her mandibular left first molar. There was no family history of Class III malocclusion or any other related genetic disorder.

Extraoral examination showed a markedly concave facial profile without asymmetry, an acute nasolabial angle, incompetent lips, and increased mandibular incisal show at rest and smiling (Fig 1).

Intraorally, she had carious teeth, retained primary root stumps, and a Class III molar and canine relationship with complete bilateral crossbite. The patient had a 9-mm anterior crossbite with no incisor overbite, missing mandibular left first molar, and a midline diastema between both the maxillary and mandibular central incisors. She had extremely proclined maxillary anterior incisors, and the roots of her anterior teeth could easily be palpated, indicating a decreased buccolingual alveolar width. The compensatory lingual inclination of the mandibular incisors usually seen in skeletal Class III malocclusions was absent (Figs 2 and 3). The panoramic radiograph showed a supernumerary tooth with incomplete root formation between the mandibular left second premolar and second molar (Fig 4).
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Cephalometric analysis showed severe skeletal Class III deformity (ANB, –13 degrees) contributed by both maxillary hypoplasia (SNA, 77 degrees) and mandibular prognathism (SNB, 90 degrees) (Fig 5). Extreme proclination of maxillary anterior incisors was confirmed cephalometrically (U1-NA, 54 degrees and 19 mm). The mandibular incisors were also significantly proclined (L1-NB, 39 degrees and 12 mm) (Table 1).

To analyze the maxillary anterior buccolingual alveolar width and plan orthodontic mechanotherapy, a contiguous 1.5-mm slice thickness computed tomography (CT) scans were obtained for both the maxillary and mandibular incisors at 120 kV and 175 mA with the window width set at 5,000 and 1,500 HU (Fig 6). The Gantry angle was set parallel to the occlusal plane before CT scanning, and the thickness of the labial and lingual alveolar plates was measured nearest to 0.3 mm. Measurements were taken at the site adjacent to the widest point of the labiolingual root in three slices separated by 3 mm; crestal (L1), midroot (L2), and apical (L3). There was severely compromised buccolingual alveolar thickness at all the three levels (Table 2).
<table>
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Fig 6  Sagittal CT scan through the midst of the central incisors and axial CT scan at the apical level of incisors.
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**Case Reports**

**Treatment objectives**
The treatment objectives included restoration of the carious teeth, extraction of the retained primary root stumps and malformed supernumerary tooth, improvement of the profile, alignment and leveling of the teeth, correction of the posterior crossbite, correction of the molar and canine relationship, and coordination of the arch forms.

**Treatment options and plan**
A joint orthodontic/orthognathic treatment plan was decided upon. Three treatment options were proposed for decompensation of the maxillary anterior incisors after alignment and leveling of teeth. The first option consisted of conventional mechanotherapy for decompensation of maxillary anteriors with retraction of the canines and then the incisors. The second option consisted of en masse retraction of the maxillary anterior incisors using temporary anchorage devices (TADs), and the third treatment option was of en masse retraction of the maxillary anterior incisors using TADs after buccal and palatal corticotomy. Since the buccolingual dimension of the maxillary anterior alveolus was severely decreased, any conventional orthodontic mechanotherapy or en masse retraction without corticotomy would produce detrimental effects such as increased mobility, loss of vitality, root resorption, fenestrations, and dehiscences. It was therefore decided to extract the maxillary first premolars and decompensate the maxillary incisors by en masse retraction of the maxillary anterior incisors with the help of TADs after buccal and palatal corticotomies. This would allow the teeth to be retracted with their surrounding bone as bone blocks.

Bilateral sagittal split ramus osteotomy for mandibular setback would reduce mandibular prognathism, while high Le Fort I osteotomy for maxillary advancement would correct maxillary hypoplasia.

**Treatment progress**
During presurgical orthodontic treatment, preadjusted edgewise 0.022 × 0.028-inch Roth appliances were placed on the maxillary and mandibular
teeth. Bilateral extraction of maxillary first premolars was performed. The supernumerary tooth, along with the third molars, was also extracted because of three reasons: there was incomplete root formation; it could not have occupied the entire space created by extraction of first molar; and it would have resulted in an unstable posttreatment occlusion.

After initial alignment and leveling, TADs (titanium mini-implants, $1.3 \times 8 \text{ mm}$) were placed bilaterally between the first molar and second premolar. Interdental spaces were created between the maxillary anterior incisors to facilitate buccal and palatal corticotomy. A labial corticotomy was carried out, and a palatal corticotomy was performed 2 days after the buccal corticotomy. Next, 0.017 × 0.025-inch archwires with crimpable hooks were placed in the arch, and en masse retraction of anterior incisors was begun on the fifth day after palatal corticotomy with the help of nickel-titanium (Ni-Ti) coil springs attached to the TADs (Fig 7). Each Ni-Ti coil spring applied a retraction force of 250 to 300 g. The proclination of the mandibular incisors and the diastema present between the mandibular central incisors was corrected.

After 10 months of presurgical orthodontic treatment, the sagittal occlusal discrepancy accentuated and the anterior crossbite increased to 14 mm. Complete records were again taken (Figs 8 and 9). Cephalometric and prediction tracing was performed to analyze the outcome. Cast surgery was carried out to fabricate occlusal splints prior to surgery. Bimaxillary orthognathic surgery was performed. Following a high Le Fort I osteotomy, the maxilla was repositioned anteriorly 6 mm with the help of temporary intermaxillary fixation and an occlusal splint. A bilateral sagittal split was done to set the mandible back 10 mm using temporary intermaxillary fixation and a second occlusal splint.

The postoperative course was uneventful. Six months after surgery, healthy periodontal status and vitality of the teeth in all segments was confirmed. Overall facial esthetics were considerably improved, and full interdigitation of the buccal occlusion was achieved.

The complete orthodontic-surgical procedure was completed in 19 months; a wraparound retainer was placed in the maxilla for retention, and a fixed lingual retainer was placed in the mandible between the canines. A band-
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and-loop retainer was placed, and the patient was referred for prosthetic rehabilitation of the missing mandibular left first molar for which a dental implant was placed. However, when complete posttreatment records were taken after 4 months, a panoramic radiograph showed bone resorption around the dental implant. The patient was again referred for further management.

Treatment results
The maxillary hypoplasia and mandibular prognathism was corrected. The SNA angle increased by 6 degrees, and the SNB angle decreased by 6 degrees. The sagittal discrepancy between the maxilla and the mandible was corrected; ANB angle decreased by 12 degrees (Table 1).

Posttreatment records were taken 4 months after treatment. The posttreatment extraoral photographs show remarkable improvement in the facial profile (Fig 10). Class I canine relationship, ideal overjet, and overbite can be seen in posttreatment intraoral photographs (Fig 11). The predebonding panoramic radiograph shows that the root parallelism was achieved (Fig 12). The posttreatment cephalometric radiograph (Fig 13), posttreatment panoramic radiograph (Fig 14), and superimposed tracing (Fig 15) show the changes that were achieved with treatment. Good intercuspalation and interproximal contacts achieved can be appreciated in the posttreatment dental casts photographs (Fig 16). The patient was satisfied with her teeth and profile. Occlusal stability of the treatment result was excellent at 1 year (Fig 17).
Fig 11  Posttreatment intraoral photographs.

Fig 12  Predebonding panoramic radiograph.

Fig 13  Posttreatment cephalometric radiograph.
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Fig 14 Posttreatment panoramic radiograph.

Fig 15 Superimposed cephalometric tracings.

Fig 16 Posttreatment dental casts.
DISCUSSION

Patients with Class III skeletal deformities often present with the features of a severely compensated dentition.\(^2,8,9\) Due to severe compensations, the buccolingual width of the alveolus may be compromised to carry out orthodontic mechanotherapy without producing detrimental effects such as pain and discomfort, increased tooth mobility, loss of vitality, root resorption, fenestrations, and dehiscences.\(^18\)–\(^20\) CT studies have confirmed that lingual movement of the incisors decreases the lingual alveolar bone width in both arches, refuting the conventional concept of alveolar bone remodeling with tooth movement.\(^11\)

CT permits clinicians to visualize the thickness of the buccolingual alveolar bone, as well as the presence of any pathology such as fenestrations and dehiscences prior to the initiation of orthodontic treatment. Since the roots of the anterior teeth in the patient could be palpated prior to initiation of the treatment, it was decided to analyze the buccolingual alveolar bone thickness with the help of a CT scan. The CT scan showed decreased buccolingual alveolar bone thickness in all the three levels of the root in the maxillary and mandibular anterior incisors. The lateral cephalometric radiograph also showed severe proclination of both the maxillary and mandibular anterior incisors (maxillary incisors: NA, 54 degrees and 19 mm [normal, 22 degrees and 4 mm]). To decompensate the dentition after the extraction of the maxillary first premolars, a change in both the inclination and bodily retraction of the maxillary anterior incisors would have been required, whereas no bodily movement was calculated to correct the proclination of mandibular anterior incisors.

Since the patient had decreased buccolingual alveolar bone thickness, along with severe proclination of the maxillary teeth that required bodily retraction after extraction of the first premolars, it was decided to perform maxillary anterior en masse retraction with the help of corticotomy/corticotomy-assisted

Fig 17  Postretention photographs after 1 year (with retention appliance).
orthodontic treatment (CAOT) to prevent unwanted effects of conventional retraction orthodontic mechanotherapy. The incidence of lingual bone deficiency increases after bodily retraction maxillary and mandibular anterior incisors.\textsuperscript{11} Since no bodily movement was required in the mandibular arch, this outgoing surgical procedure was performed only in the maxillary arch.

CAOT may be defined as a linear cutting surgical technique in the cortical plates surrounding the teeth to produce mobilization of the teeth for immediate movement. Köle\textsuperscript{14} introduced this concept and noted that teeth move faster when the resistance exerted by the surrounding cortical bone is reduced via this surgical procedure. Over the years, CAOT has grown manifold and now has varied applications in orthodontic treatment. These applications are to overcome shortcomings of conventional orthodontic treatment and difficulty of producing movement in certain direction. Applications of this minor outgoing surgical procedure include accelerated canine retraction after premolar extraction; resolving crowding and shortening treatment time; facilitating eruption of impacted teeth; controlling movement of teeth surrounded by narrow cortical bone; facilitating slow orthodontic expansion, molar intrusion, and open bite correction; and manipulating of anchorage. Complications of this procedure include interdental bone loss and loss of attached gingiva. Although numerous publications have claimed to decrease the orthodontic treatment time with corticotomy, none have reported its effectiveness in clinical situations such as decreased alveolar bone width.\textsuperscript{14–17}

The retraction of the anterior teeth with sliding mechanics utilizing mini-implant anchorage, where a main archwire slides through the posterior brackets, provides many advantages.\textsuperscript{21–25} Not only does it provide absolute anchorage control, but it also reduces treatment time considerably, which enables the profile change to be achieved in the early stages. As calculated in the treatment planning of the present case, 6 mm of maxillary advancement and 10 mm of mandibular setback were required to correct the midface deficiency and mandibular prognathism, respectively, to achieve a good posttreatment profile and stable occlusion. Any anchorage loss (the dentoalveolar movement of posterior teeth) would have decreased the amount of maxillary surgical advancement/mandibular setback required to achieve a stable occlusion. This would have severely affected the posttreatment profile of the patient and necessitated absolute anchorage.

In the present case, decreased buccolingual alveolar width meant the maxillary anterior incisors needed to be retracted bodily, which was achieved by utilizing three basic principles. First, incisor retraction forces were generated from the Ni-Ti coil springs connected to the TADs so that the retraction forces could pass as close as possible to the center of resistance of the anterior segment. Secondly, mild torquing bend was applied on the anterior segment to counteract the lingual crown tipping force vector. Thirdly, the six anterior teeth were retracted simultaneously with sliding mechanics. The same can be appreciated by comparing the pre- and postcephalometric values (Table 1). However, the complete decompensation of the maxillary anteriors to the normal values was not achieved since it would have increased the amount of presurgical reverse overjet. This would have increased the amount of maxillary surgical advancement and/or mandibular setback, thereby affecting the stability of the surgical procedure and posttreatment functional occlusion. When performed alone, Le Fort maxillary advancement greater than 6 mm and bilateral sagittal split osteotomy mandibular setback greater than 10 mm are often associated with significant amount of relapse.\textsuperscript{5–7} Predictability and stability of the result increases in cases of combined bimaxillary surgeries. In the present case, bimaxillary surgery involving BSSO for mandibular setback of 10 mm was done along with Le Fort I maxillary advancement of 6 mm, which increased the stability of the surgical procedure.
To the best of our knowledge, this is the first report of a two-stage orthognathic procedure consisting of buccal and palatal corticotomy for decreased maxillary anterior alveolar widths followed by a double-jaw procedure with high Le Fort I maxillary osteotomy for maxillary advancement and bilateral sagittal split ramus osteotomy for mandibular setback.

CONCLUSION

This case report describes the combined orthodontic and surgical treatment of a woman with mandibular prognathism, hypoplastic maxilla, and severely proclined maxillary incisors with decreased buccolingual maxillary anterior alveolar width. Ideal overjet, overbite, and interarch relationships were established, and the esthetic results were pleasing.

REFERENCES
