Class III malocclusion treated with distalization of the mandibular dentition with miniscrew anchorage: A 2-year follow-up

Kun Chena and Yang Caob
ShenZhen, Hong Kong, and Guangzhou, China

This case report describes the orthodontic camouflage treatment for a 16-year-old Chinese girl with a Class III malocclusion. The treatment included extractions of the mandibular second molars, fixed appliance therapy, and miniscrew-aided mandibular arch distalization. Pretreatment, posttreatment, and 2-year follow-up records are shown. The anterior negative overjet and the Class III molar and canine relationships were corrected. The patient’s facial profile was greatly improved. The mandibular third molars erupted into the second molar spaces, with acceptable intercuspation with the maxillary dentition. (Am J Orthod Dentofacial Orthop 2015;148:1043-53)

The treatment options associated with skeletal Class III problems in the late adolescent and adult dentition often involve surgical intervention or orthodontic camouflage treatment. A skeletal Class III malocclusion usually results from mandibular prognathism, maxillary deficiency, or a combination of both.1 Surgical intervention can correct the skeletal discrepancy in the sagittal, vertical, and transverse dimensions.2 In mild and moderate skeletal Class III cases, camouflage treatment can reposition the teeth to disguise the skeletal discrepancy and obtain better occlusion, function, and esthetic results.3

In camouflage treatment, an anterior crossbite is corrected by retroclination of the mandibular incisors and proclination of the maxillary incisors. Usually, the mandibular premolars are extracted to relieve crowding, alleviate mandibular incisor protrusion, and correct the molar relationship.4 Distalization of the mandibular dentition is an alternative to premolar extraction to correct a Class III malocclusion.5 Retraction of the lower lip follows the distalization of the mandibular incisors. Whether the mandibular incisors are tipped back or retracted with bodily movement significantly affects the morphologic change of the labiomental fold.5

It had been difficult to distalize the mandibular dentition before the miniscrew was popularly used in orthodontics. With the help of a miniscrew inserted in the retromolar or premolar region, the mandibular dentition can be successfully distalized to a great extent.6–8

In this case report, miniscrew anchorage was applied to distalize the mandibular dentition to correct the anterior crossbite, establish a Class I molar relationship, and correct the concave profile.

DIAGNOSIS

The patient was a 16-year-old Chinese girl with the chief complaint that her “lower front teeth bite in front of the upper teeth.” By comparing the lateral cephalometric radiographs taken 1 year before and on the day of consultation, no further mandibular growth was expected, and orthodontic treatment was initiated. Her medical and dental histories were noncontributory.

The pretreatment facial photographs showed a mandibular prognathic profile with an acceptable midface convexity and high tension in the labiomental fold. From the front view, no asymmetry was identified. The intraoral photographs showed Class III canine and molar relationships and an anterior crossbite at centric occlusion. Other findings included a deep curve of Spee in the mandibular arch and mild crowding in both arches. The mandible was able to move back slightly with the incisors edge to edge at centric relation (Figs 1–3).
The panoramic radiograph showed a permanent dentition with the maxillary left third molar and mandibular third molars in the forming stage. The mandibular third molars were slightly mesially inclined. The cephalometric analysis showed a skeletal Class III relationship with mandibular prognathism and a slightly decreased mandibular plane angle. The maxillary incisor positions and proclinations were in the normal range in relation to the maxillary palatal plane. The mandibular incisor was slightly retroclined; therefore, the interincisal angle was slightly increased. (Fig 4; Table). The patient was diagnosed with an Angle Class III malocclusion with mild crowding on a Class III skeletal base with mandibular prognathism in the anteroposterior dimension.

TREATMENT OBJECTIVES

The orthodontic treatment aimed to correct the dental crowding, the anterior crossbite, the Class III canine and molar relationships, and the prognathic profile. Retraction of the mandibular incisors would help to form a relaxed labiomental fold and correct the concave profile.

TREATMENT ALTERNATIVES

Several treatment options were proposed to the patient. First, orthognathic surgery was suggested to set back the mandible; this would lead to a harmonized profile. However, the patient refused the surgical plan for financial reasons and the potential risk.

The second option was orthodontic camouflage treatment with extraction of the premolars. This plan could easily resolve the anterior crossbite, but the mandibular incisors would be tipped back even worse after closing the extraction spaces. With the incisors tipped back, the high tension in the labiomental fold would not be improved. Alternatively, orthodontic camouflage treatment can be carried out with extraction of
mandibular molars, usually the third molars. Then the mandibular arch could be distalized with miniscrews to correct the anterior crossbite. In this patient, the mandibular third molars were deeply impacted and close to the inferior alveolar nerve; it would be difficult to surgically remove them. Instead of the third molars, the mandibular second molars could be extracted if the third molars could substitute for the second molars in the long term. The panoramic radiograph showed that the mandibular third molars were forming and slightly mesially inclined. They would possibly erupt into the second molars’ former positions after extraction of the second molars. After discussing this option with the patient, camouflage treatment with extraction of the mandibular second molars was adopted, and consent was obtained from the patient.

Therefore, the treatment plan involved resolving the dental crowding in the maxillary arch by slightly proclining the incisors. In the mandibular arch, the predicted amount of distalization was over 4 mm on both sides.
This would help to resolve the crowding, level the curve of Spee, and correct the anterior crossbite.

**TREATMENT PROGRESS**

After extraction of the mandibular second molars, both arches were bonded and aligned with sequential nickel-titanium wires. Class III elastics (1/4 in, 3.5-oz; Ormco, Orange, Calif) were used for a month on an 0.018-in Australian wire. A miniscrew implant (Orlus 1016108, 1.6 \times 8 mm; Ortholution, Gyeonggi-do, Korea) was inserted in the mandibular buccal shelf region distal to the first molar on each side under local anesthesia. A nickel-titanium coil spring was applied from the miniscrew to distalize the mandibular arch en masse with a continuous force of about 250 g on a 0.0160 × 0.022-in nickel-titanium archwire. The mandibular occlusal plane was rotated counterclockwise because of a moment created by the retraction force (Fig 5). Distalization was discontinued until the molars were overretracted to reach an end-to-end Class II molar
relationship. Vertical elastics (3/16 in, 3.5 oz; Ormco) were applied on both sides to correct the open bite in the molar region and the deep anterior overbite. We suggested that the patient should have the maxillary left third molar extracted to align the second molar, but she refused. Then the maxillary molars were intruded to leave enough vertical space for the mandibular third molars to erupt with the help of miniscrews inserted at the palatal side of the maxillary molars (Orlus 1018309, 1.8 × 9 mm; Ortholution).

The orthodontic treatment lasted for 26 months. At the end of treatment, normal incisor overjet and overbite, and canine and molar Class I relationships were reached. After debonding and removing all miniscrews, we prescribed maxillary wraparound and mandibular Hawley retainers for the patient’s full-day wear for the first 6 months and nighttime wear for the next 18 months. The maxillary wraparound retainer was used to prevent overeruption of the maxillary second molars.

TREATMENT RESULTS

The posttreatment records showed improvement of the lower third of the facial profile. The lower lip was significantly retracted with a deepened labiomental fold. Dental crowding in both arches was alleviated. The anterior crossbite was corrected. The occlusion was improved to achieve Class I molar and canine relationships on both sides (Figs 6-8). Incisal guidance in anterior excursion and canine guidance in lateral movement were achieved (Fig 9).

The transverse dimension was changed slightly after treatment. In the maxillary arch, the intercanine width was constricted from 41.5 to 39 mm, whereas the intermolar width was slightly changed from 57.5 to 57 mm. In the mandibular arch, the intercanine width was constricted from 31 to 29 mm, and the intermolar width was expanded from 49 to 52 mm because of the distalization of the molars (Figs 6 and 7).

The posttreatment panoramic radiograph showed no significant root resorption or other pathologic finding. The mandibular third molars were in the eruption stage. From the cephalometric analysis, the SNB angle was reduced by 1.1°; this helped to increase the ANB angle and the Wits appraisal value. Vertically, the mandibular plane angle was slightly increased by 2.3°. The maxillary incisors were proclined, and the mandibular dentition was retracted. The mandibular incisors and molars showed a slight extrusion and a translational retraction. The retraction of the mandibular incisors led to a 2-mm retraction of the lower lip in relation to the E-line (Figs 8 and 10; Table).

After 2 years of retention, the occlusion was stable. Overjet and overbite, as well as the molar and canine relationships, remained unchanged. The panoramic radiograph showed that the mandibular third molars were in contact with mandibular first molars. The intercuspation...
of mandibular third molars with the maxillary molars was acceptable (Fig 11).

**DISCUSSION**

The patient’s concave profile and anterior crossbite mainly resulted from the mandibular prognathism in the anteroposterior direction. In mild and moderate skeletal Class III patients, both surgical treatment and orthodontic camouflage treatment can have a successful result.2,11 Since this patient’s mandibular prognathism was moderate, together with her preference, orthodontic camouflage treatment was carried out instead of an orthognathic surgical plan.

The camouflage treatment of this Class III malocclusion included distal movement of the mandibular incisors with or without mesial movement of the maxillary incisors.11,12 The patient’s upper lip had a balanced position, so the maxillary incisors could not be overproclined to accommodate the mandibular incisors. Miniscrew anchorage was applied to retract the mandibular dentition to achieve a Class 1 incisor relationship. In addition to the tooth movement, the improvement of the anteroposterior mandibular functional deviation contributed to the correction of the anterior crossbite as well.

Distalization of the mandibular arch with miniscrews to correct a skeletal Class III malocclusion has been reported by several orthodontists.6-8 Miniscrews can be placed in the mandibular premolar region8 or the retromolar region.7 Placement of a miniscrew in the retromolar region enables long-distance distalization of the
mandibular arch, whereas the distance between the roots restricts the amount of tooth movement when miniscrews are placed interdentally. Extraction of the mandibular second molars in this patient provided enough space for the arch distalization, with the retraction force originating from the miniscrews in the retromolar area. The cephalogram showed the retraction of the mandibular incisors, leading to the distal movement of Point B, which in turn helped to deepen the labiamental fold, retract the lower lip, and improve the lower third of the facial profile. This finding was similar to the study of Jacobs et al in that after extraction of the mandibular second molars, the mandibular incisors showed a slight retrusion and a translational retraction. On the contrary, if the patient had been treated with extraction of the premolars, the mandibular incisors would have been lingually tilted to compromise the overjet; the tipping movement would have contributed less to the deepening of the labiamental fold.

To correct the concave profile and the protrusive mandible, the orthodontic treatment plan should increase the anterior facial height and rotate the mandible clockwise; this will make the chin less prominent. However, miniscrew anchorage in the retromolar region to distalize the mandibular dentition will complicate the intrusion of the molars and the rotation of the mandibular occlusal plane. The retraction force applied to the tooth crown was backward and in a gingival direction. Under the traction of the intrusive vector, the posterior teeth might be distalized with tipping and intrusion movements. This explained the molar open bite when the distalization was finished. Using vertical elastics in the molar region in the later stage, the posterior alveolar vertical dimension was slightly increased; this was shown in the superimpositions of the cephalometric tracings. The clockwise rotation of the mandible made the chin look less prominent. The posttreatment maxillary-mandibular plane angle was still within the normal range, showing that the vertical dimension was well controlled.

In the transverse dimension, there is usually an arch width discrepancy between the maxillary and mandibular arches in patients with a Class III malocclusion. To achieve a proper positive overjet in the molar region, the treatment plan should involve maxillary expansion and mandibular constriction. The mandibular first molars were planned to be retracted to the original second molar positions, so the treatment should not expand the arch width at the molar region; otherwise, the first molar would cause a decreased overjet. However, the retraction force applied on the canine brackets tended to expand the arch width in the posterior region. Meanwhile, the intrusion force on the molar buccal surface expressed a crown buccal torque, which also tended to increase the intermolar width. Considering these side effects, the archwires were constricted in the mandibular molar region. The posttreatment records showed a positive molar overjet despite the slight increase in the mandibular intermolar width, proving that the mandibular arch width and molar torque were under control. In the maxillary arch, the molars were buccally inclined before treatment, so maxillary expansion was...
contraindicated, and the intermolar width was maintained. The intercanine width was reduced in both arches after aligning the buccally displaced canines into the arches.

Kim proposed extraction of the mandibular second molars instead of the third molars in patients whose third molars were developing normally. Extraction of the mandibular second molars provides space to retract the mandibular arch. Extraction of the mandibular second molars keeps the dentition whole after the third molars are well aligned, compared with treatment with premolar extractions. The eruption of the mandibular third molars should be carefully monitored and reinforced. Researchers have found that successful eruption of the third molars after extraction of the second molars is quite high (up to 96%) and determined the favorable factors for second molar extraction. In a study reviewing the eruption of 74 mandibular third molars after extraction of the second molars, the authors learned that most mandibular third molars uprighted and replaced the second molars automatically, whereas eruption was unsuccessful in older patients with higher Nolla developmental stages. It was also reported that the increased angle of the mandibular third molar to the mesial tooth’s long axis before removing the second molar was a poor prognosis indicator.

This patient’s pretreatment condition was in favor of second molar extraction. First, she was an adolescent, and her mandibular third molars were in the crown formation stage. Second, the mandibular third molars were slightly mesially inclined and in contact with the second molars. With these favorable factors, the second molars were extracted instead of the third molars to reduce the surgical complexity. Another advantage of extraction of the mandibular second molars rather than the third molars was that it was easier to distalize 12 teeth rather than 14 teeth.

Upon the completion of active orthodontic treatment, the mandibular third molars had not fully erupted. To maintain the vertical space for them, a maxillary wraparound retainer was prescribed to hold the vertical

Fig 8. Posttreatment panoramic radiograph, cephalogram, and tracing.
position of second molars. We proposed that the patient should have the maxillary left third molar extracted to prevent the continuing overeruption and distal tipping of second molar, but she refused.

After 2 years, both mandibular third molars had erupted into the former second molar spaces. The panoramic radiograph shows that the mandibular third molars had contact with the first molars at this stage. Most probably, this will be further improved automatically, as reported in several studies.\textsuperscript{10,17} The intraoral photographs show that the intercuspation of the mandibular third molars to the maxillary second molars was acceptable. Simple uprighting mechanics were proposed for better molar occlusion, but the patient declined.

Fig 9. Posttreatment intraoral photographs showing anterior and lateral functional guidance.

Fig 10. Superimpositions of the cephalometric tracings before and after treatment.
The mandibular functional shift contributed to the anterior crossbite. The functional setback of the mandible during orthodontic treatment also helped to correct the reverse overjet. Although no accurate pre-treatment cephalogram at centric relation was available, the cephalometric superimposition showed that the major contribution to the anterior crossbite correction was the mandibular arch distalization rather than the mandibular setback. The functional shift would play a role in the change of the ANB angle measurement and other parameters related to the esthetic line. However, the recontouring of Point B and the labiomental fold were mainly attributed to the retraction and transitional distalization of the mandibular incisors.

The traction force tends to distalize the mandibular posterior teeth with a tipping movement, which is due to the play between the archwire and the brackets. The tipped mandibular molars are assumed to be a risk factor for posttreatment relapse. Chung et al reported significant relapse after 8 months of retention in a Class III patient treated with distalization of the mandibular dentition because of obvious mandibular molar distal tipping. Therefore, it is important to prevent the tip-back movement of the mandibular molars after distalization for better stability. In our patient, the whole arch distalization was finished when the Class II molar relationship was reached. The molar was intruded temporarily because of the gingivally directed traction force. Thus, vertical elastics from the maxillary arch to the mandibular molars were applied. With this vertical force, the tipped-back mandibular molars were uprighted; then the Class II molar relationship was corrected to a Class I relationship. The occlusion was stable after 2 years of retention, showing that the tipping control of the mandibular molars contributed to the posttreatment stability of the mandibular distalization. Lima and Lima reported the mandibular functional shift contributed to the anterior crossbite.
reported treating a Class III malocclusion with an open bite using directional force from J-hook headgear to intrude and bodily distalize the mandibular molars; the treatment result was stable after 4 years of retention. Our treatment method had a similar effect on the mandibular molars and showed similar posttreatment stability of the mandibular arch distalization.

The anatomy of the mandible at the incisor region places a limitation on the amount of retraction because of the risks of dehiscence and loss of bone support. Over-retraction of the mandibular incisors would lead to loss of alveolar bone integrity and bony support. The cone-beam computed tomography image showed that the mandibular incisors were centralized in the alveolar bone envelope. Normal alveolar height was identified from the periapical radiograph (Fig 11). This evidence showed that the extent of incisor retraction did not exceed the biologic limitation.

**CONCLUSIONS**

This case report demonstrates that in a moderate Class III case, miniscrew anchorage can be used with a fixed appliance to retract the mandibular dentition after extraction of the mandibular second molars. The retraction of the mandibular arch corrected the anterior negative overjet and the Class III molar relationship; moreover, the lower third of the facial profile was greatly improved with retraction of the lower lip and the deepened labiomental fold.

**REFERENCES**
