Treatment of a Class II deepbite with microimplant anchorage

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The goal of this report was to illustrate new treatment mechanics for using microimplants for the treatment of a Class II Division 2 deepbite malocclusion. A 29-year-old woman with a deepbite was treated with the aid of microimplant anchorage. Microimplants placed between the maxillary second premolars and first molars were used as anchorage to apply a distal force to the anterior teeth to correct the Class II canine and molar relationships. A distal force was applied to long hooks that were crimped between the lateral incisors and the canines. By applying a backward force to the long hooks, the maxillary anterior teeth experienced palatal root movement with no change in the vertical and anteroposterior positions of the incisal edges. The distal extrusive movement of the maxillary second molars achieved by disengaging the second molars from the archwire during distal force application and an anterior bite-block bonded on the lingual surface of the maxillary central incisors produced the increase in vertical dimension. The distal force to the long extended hooks from the microimplants was possibly good mechanics for obtaining the palatal root movement and correcting the Class II canine and molar relationships. The anterior bite-block and disengagement of the maxillary second molars during distal force application were effective for increasing the vertical dimension. (Am J Orthod Dentofacial Orthop 2011;139:397-406)

A deepbite is considered a difficult malocclusion to treat. The treatment of deepbite has included orthognathic surgery and orthodontic treatment by intrusion of the anterior teeth or extrusion of the posterior teeth in either or both of the maxillary and mandibular arches.1 A decision for molar extrusion or intrusion of incisors should be based on the causes and the vertical positions of the incisal edges of the maxillary incisors relative to the upper lip.

Distalization of the maxillary posterior teeth is often needed in the treatment of Class II malocclusion when a nonextraction treatment is planned. Many extraoral and intraoral appliances have been developed to distalize the molars.2-5 Extraoral appliances can provide reliable anchorage but only in compliant patients. On the other hand, all intraoral molar distalizing appliances produce adverse side effects such as labial tipping of the maxillary anterior teeth.6,7

With the development of extradental skeletal anchorage such as microimplants, clinicians can now move teeth without anchorage loss to the specific planned goal. The tooth movement can also be precisely controlled with the help of microimplants. Many clinical reports and studies have focused on treating the various types of malocclusions, including bialveolar protrusion requiring maximum retraction of the anterior teeth,8,9 whole arch distal retraction,10,11 intrusion of a tooth or teeth,12,13 and protraction of the molars.14 However, there has been no report to illustrate the treatment mechanics involved with microimplants in skeletal Class II deepbite treatment. In the treatment of a deepbite, the maxillary or mandibular incisors can be intruded by conventional or microimplant-aided mechanics.15 However, in a patient with proper vertically positioned maxillary incisors, their intrusion is not desirable. Lingually tipped maxillary incisors should be uprighted by distal root movement, which requires strong anchorage. The microimplant can be used to provide anchorage for root movement of the maxillary incisors and distal retraction of the whole maxillary dentition to correct Class II relationships.

In this report, we illustrate effective microimplant mechanics for the treatment of Class II deepbite malocclusion by palatal root movement of the maxillary anterior teeth, distal movement of the whole maxillary dentition, and an increase of the vertical dimension.
A 29-year-old woman’s chief concern was a deepbite (Fig 1). She had a decreased vertical dimension, a deep mentolabial fold, and a negative E-line value. The cephalometric analyses showed that she had a Class III skeletal pattern. However, because of peg-shaped lateral incisors and lingually tipped maxillary incisors, the canines and molars showed Class II relationships. The maxilla was slightly retropositioned; the SNA angle was 2° under normal, and the ANB angle was 0.8° (Table). The patient had a severe brachyfacial pattern; the FMA angle was 14.1° and the gonial angle was 107.3°. There was no apparent facial asymmetry or transverse discrepancy.

Intraorally, the patient had a Class II Division 2 deepbite malocclusion (Figs 1 and 2). The maxillary lateral incisors were peg-shaped, and the mandibular central incisors exhibited severe attrition and discoloration from trauma 12 years previously. Overjet and overbite were 2 and 6.5 mm, respectively, and arch-length

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* N-per, Nasion perpendicular line.
discrepancies in the maxilla and the mandible were +2 and −5.8 mm, respectively. If the lateral incisors were built up to normal size with composite resin, the arch-length discrepancy in the maxillary arch would become −3 mm. The vertical position of the maxillary incisors was 1 mm relative to the reposed upper lip. There were no signs and symptoms of temporomandibular joint disorders or root resorption.

**TREATMENT OBJECTIVES**

Six treatment objectives were identified: (1) obtain Class I canine and molar relationships, (2) correct the overbite by extrusion of the posterior teeth (3) obtain proper inclination and position of the maxillary anterior teeth, (4) make space for cosmetic restoration of the maxillary lateral incisors, (5) increase the vertical dimension, and (6) obtain good retention.

**TREATMENT PLAN**

Distalization of the maxillary molars was planned to correct the Class II relationships. The inclination of the lingually tipped maxillary incisors also needed to be corrected. The distal movement of the posterior tooth segment and palatal root movement of the maxillary incisors required strong anchorage. For these reasons, the use of microimplants was proposed in the treatment plan. The initial facial photos showed a favorable profile, and the anteroposterior position of the maxillary incisors was planned not to change. The vertical position of the maxillary incisors relative to the upper lip was 1 mm, and their intrusion was not indicated. Instead, molar extrusion was proposed to open the anterior bite and obtain enhanced vertical facial proportions. This was achieved by bonding an anterior bite-block on the palatal surface of the central incisors and inducing the extrusion of the maxillary second molars by disengaging them from the archwire during distal force application.

**TREATMENT PROGRESS**

The traumatized mandibular central incisors were treated. All teeth in the maxillary arch except the second molars were fitted with fixed preadjusted edgewise
appliances, and a 0.014-in nickel-titanium (NiTi) aligning archwire was ligated. Simultaneously, the microimplants (diameter, 1.2 mm; length, 6 mm; Absoanchor, Dentos, Daegu, Korea) were placed into the buccal alveolar bone between the maxillary second premolar and the first molar on both sides (Fig 3). After 2 months of treatment, an anterior bite-block was bonded on the palatal surfaces of the maxillary central incisors to increase the vertical dimension (Fig 4). The braces were subsequently bonded to all teeth in the mandibular arch. In the maxillary arch, a 0.016 × 0.022-in stainless steel archwire, with crimped 10-mm long hooks between the lateral incisors and the canines, was placed. Distal force was also applied from the microimplants to the hooks with NiTi coil springs. To increase the counterclockwise moment to the maxillary anterior teeth, the long hooks on the archwire were extended gingivally. After 5 months of treatment, there was distal movement of the maxillary posterior teeth. Vertical steps between the maxillary first and second molars resulted from slight intrusion of the first molars, and distal tipping and extrusion of the second molars was observed. The distal force transmitted to the maxillary posterior teeth had caused distal tipping and extrusion of the second molars. The vertical dimension was increased during treatment by 3-point contacts—the anterior bite-block and 2 second molars. To control the axial inclination of the maxillary anterior teeth, a 0.019 × 0.025 beta-titanium alloy archwire with long hooks with a torquing bend between the lateral incisors and the canines was used. The retraction force was applied continuously by the NiTi coil springs from long hooks to the microimplants (Fig 5). After 12 months of treatment, buccal tubes were bonded onto the maxillary second molars, and the archwire...
was switched to 0.016-in NiTi. Up-and-down elastics were used to extrude the maxillary first molars to settle the occlusion (Fig 6). After final arch coordination and minimal occlusal equilibration, all appliances were debonded. The microimplants were removed by unscrewing without anesthesia. The treatment time was 20 months. Lingual fixed retainers were bonded from the left first premolar to the right first premolar in the mandibular arch, and resin was built up on the maxillary lateral incisors. A wrap-around retainer with an anterior bite plate was also used to prevent relapse of the anterior overbite.

**TREATMENT RESULTS**

Class I canine and molar relationships were achieved (Figs 7 and 8). The maxillary posterior teeth had moved distally by 3 mm, and a Class I molar relationship was achieved. The vertical dimension had increased, and masseter muscle weakness was also observed. The cephalometric measurements showed that the FMA angle had increased from 14.1° to 16.7°, and the anterior facial height had increased from 61.5 to 65 mm, along with the backward and downward movement of B-point (Fig 9). The extrusion of the maxillary and mandibular posterior teeth allowed a favorable position for the mandible.

Overbite was improved remarkably from 6.5 to 1 mm. The angle of the maxillary incisor to the Frankfort horizontal plane was corrected from 96.2° to 106.1° after distal movement of the roots. Root resorption was not significant, as observed in a panoramic radiograph. The 12-month follow-up records showed good retention without any obvious relapse (Fig 10). The occlusion was stable, and the good facial harmony had also been retained.

**DISCUSSION**

Factors contributing to the development of an Angle Class II Division 2 deepbite malocclusion include
enhanced dentoalveolar development with overeruption of the anterior teeth, growth of the jaw, and function of the soft tissues. Supraeruption of the anterior teeth, infraocclusion of the posterior teeth, tooth-size discrepancy, maxillary prognathism with or without mandibular retrognathism, underdevelopment of anterior lower facial height, and other factors are generally accepted as the causes of this type of malocclusion.\textsuperscript{1,16,17}

Since the patient had low FMA and gonial angles, she was diagnosed as having a deepbite with a hypodivergent skeletal pattern. Underdevelopment of molar height, normal growth of mandibular length, and counterclockwise rotational growth resulted in the short anterior facial height that led to the deepbite. The anterior deepbite and tooth-size discrepancy between the maxilla and the mandible due to the peg-shaped maxillary lateral incisors caused the Class II canine and molar relationships.
Since the patient was an adult and no further growth was expected, distal movement of the maxillary posterior teeth was considered a reasonable treatment option to correct the Class II canine and molar relationships. The vertical position of the maxillary incisors was normal relative to the upper lip. The short anterior facial height and proper vertical positioning of the maxillary incisors led to a treatment plan of not intruding the incisors but extruding the posterior teeth to correct the deepbite.

There are various conventional methods to correct Class II canine and molar relationships by distal movement of the maxillary molars. Headgear and Class II intermaxillary elastics with the mandibular teeth as anchorage have been used routinely for many years. However, the success of these methods depends greatly on patient cooperation. For this reason, many types of intraoral devices and techniques for molar distalization such as pendulum or distal jet appliances have been developed. These methods are effective, but it is impossible to avoid undesirable movements of teeth, including mesial movement of the anterior teeth and distal tipping of the molar crowns.

With the help of skeletal anchorage, we can now move teeth to the specific goal precisely and reliably. Miniscrews were used to reinforce anchorage to the distalizing appliances. The distal force applied to the first molars might produce distal or mesial tipping of the molars when the force does not pass through their center of resistance. The screw-reinforced molar distalizing appliance can result in distal tipping of the molars. A distal force, when applied to the canines to distalize the entire dentition, could bring about not only distal movement of the molars but also intrusion of the molars. As a result, this can cause a decrease in the vertical dimension. Therefore, for this patient, we chose not to engage the second molars during distalization of the maxillary posterior teeth and bonded an anterior bite-block on the lingual surface of the maxillary central incisors. The distal force transmitted to the maxillary first molars exerts a distal and extrusive force.

Fig 10. Retention records (12 months).
to the second molars. The extrusion of the maxillary second molars and the anterior bite-block resulted in the increase in the vertical dimension. After the retraction was completed, the maxillary second molars were bonded. A light wire was placed, and up-and-down elastics were used to settle the maxillary first molars down to occlusion. Three-point contacts, the maxillary second molars on both sides, and an anterior bite-block can enhance the increase in vertical dimension and minimize trauma from the occlusion. This is also helpful when bonding brackets on teeth in the mandibular arch in the early stages of treatment. We had placed 2 bracket-head microimplants (diameter, 1.5–1.4 mm; length, 7 mm; BH1514-07, Absoanchor, Dentos) to apply extrusion force to the mandibular arch, but mandibular microimplants were not used because the treatment was successful with the maxillary microimplants, and 1 of 2 mandibular microimplants showed mobility during treatment.

A proper inclination of the maxillary anterior teeth was obtained by palatal root movement. In conventional orthodontic treatment, the moment to achieve palatal root torque of the maxillary anterior teeth can be applied by twisting the rectangular archwire, an anterior torquing arch, and helical torsion springs. However, with these mechanics, it is difficult to prevent labial crown tipping and mesial movement of the anchorage posterior teeth. The later distal movement of labially tipped anterior teeth is a round-tripping movement that might cause root resorption. With skeletal anchorage, it is possible to overcome these side effects. There have been successful cases that obtained labial crown tipping and the root palatal torque of the maxillary anterior teeth with intrusive force from microimplants placed below the anterior nasal spine. However, these mechanics cause intrusion of the maxillary anterior teeth, and this was not suitable in this patient with proper vertical positioning of the anterior teeth relative to the upper lip. Therefore, pure root palatal movement of the maxillary anterior teeth without intrusion was 1 goal. Root movement requires strong anchorage and so too does distal movement of the posterior teeth. Therefore, the microimplants placed between the second premolars and the first molars were used as anchorage. To apply palatal root torque, we crimped long hooks on the archwire, and a distal force was applied from the microimplants. The distal force, as applied to the long hooks, could bring about distal movement of posterior teeth as well as palatal root movement of the anterior teeth (Fig 11). To increase the counterclockwise moment to the maxillary anterior teeth, a torquing bend of 3° was applied to the archwire between the lateral incisors and the canines.

External apical root resorption is a common iatrogenic problem associated with orthodontic treatment. Parker and Harris reported that palatal root torque of the maxillary central incisors is strongly correlated with an increase in root resorption. This was also found in other studies. This can be explained by the fact that the torqueing force is concentrated at the apex, which is the most resorption-sensitive area of the tooth. In this patient, the moment produced at the anterior teeth of the maxilla could be high; thereby, root resorption could occur. However, there was no evidence of external apical root resorption posttreatment. It seems that force application with NiTi coil springs from microimplants to long hooks on the archwire produces a more progressive and consistent moment to the anterior teeth than that with a twisted archwire in the bracket slots. According to the finite element study of Jayade et al, third-order moments generated by rectangular twisted archwires were often high and dropped suddenly when tooth movement started. Another reason might be that movement with the microimplants was not round tripping, which tended to increase root resorption. Even so, although mechanics with microimplants produce a continuous moment, clinicians must pay attention so as not to cause root resorption through periodic radiographic reviews.

To increase the horizontal component of force, the heads of the microimplants need to be positioned near
the gingival margin. Microimplants that are placed obliquely to the bone surface can reduce the chance of root contacts. Some authors prefer to place them 30° to 40° to the long axes of adjacent teeth. By inclining the microimplants, clinicians can put the apex of the microimplants at the apical area of roots where the space is wider and position the head of the microimplant gingivally. The apex of the inclined microimplant is sometimes located buccally to the root of the second premolar, and this relationship would not interfere with distal movement of the teeth. The 3-dimensional reconstruction of the computed tomography scan images shows the inclination of the microimplants and their relationships to adjacent roots. The apex of the microimplant was located buccally to the root of the second premolar in this patient. The interradicular space between the maxillary second premolar and the first molar was reported to reach 3.2 mm at midroot level. Also, it increases toward the apex of the roots. According to some authors’ experience, 3.5 mm of distal movement can be performed without a deteriorating effect with buccally placed microimplants. However, if more than 4 mm of distal movement is required, it is better to place the microimplant into the palatal slope where there is more interradicular space. If there is interference with distalization of the teeth, clinicians can place a new microimplant distally and remove the old one.

Several reports have shown the relationship between jaw muscle volume and craniofacial form. The large masseter volumes were associated with brachycephalism. The muscle activities were significantly higher in patients with deepbite than in patients with any other types of malocclusion. Our patient also had a brachyfacial pattern with a large masseter muscle volume. The strong muscular force from the masseter muscle might be a cause of relapse of the extruded molars. By adding the anterior bite-block, the patient experienced weakening of the masseter muscle during treatment. The occlusal force generated from contacts at the anterior teeth is much lighter than that at the posterior teeth. This might be considered the result of disuse atrophy from the decrease in the occlusal force from the anterior bite-block. The contractive capacity of the masseter muscle would be decreased, and this could aid in better treatment results and has advantages for long-

Fig 12. A, Frontal view of a clear model showing the inclination of the microimplant; B, bottom view of a clear model showing the relationship of the apex of the microimplant and the roots; C, buccal view of the 3D image of the CT scans; D, bottom view of the 3D image of CT scan. Arrows indicate the microimplant.
term retention. The use of a retainer with an anterior bite plate appears to be sufficient for maintaining treatment results.

CONCLUSIONS

The distalization of the maxillary posterior teeth and palatal root movement of the maxillary incisors could be effectively achieved by microimplant-aided mechanics. The application of the distal force from the microimplants to long hooks crimped between the lateral incisors and the canines produced the counterclockwise moment to the maxillary incisors and the resultant palatal root movement without labial tipping and distal movement of the posterior teeth. The deepbite was corrected by extrusion of the molars by adding an anterior bite-block and disengagement of the maxillary second molars to the archwire. This brought about the increase in the vertical dimension and the weakening of the masseter muscle.

REFERENCES