Long-term stability of maxillary group distalization with interradicular miniscrews in a patient with a Class II Division 2 malocclusion

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We successfully treated a Class II Division 2 patient with maxillary group distalization using interradicular miniscrews. A woman, aged 28 years 11 months, had a convex profile and an excessive overjet caused by a skeletal Class II jaw-base relationship. After leveling and alignment, titanium miniscrews were obliquely implanted between the maxillary second premolar and first molar. To distalize the maxillary dentition, nickel-titanium closing coil springs with a 2-N load were placed between the screws and the hooks on the archwire. After 28 months of active orthodontic treatment, a proper facial profile and an acceptable occlusion were achieved with a 4-mm distalization of the maxillary dentition. The resultant occlusion was stable throughout a 5-year retention period. Interradicular miniscrews were useful to distalize the maxillary dentition for correcting a Class II malocclusion. This new strategy, group distalization with miniscrews, can make the treatment simpler with greater predictability. (Am J Orthod Dentofacial Orthop 2016;149:912-22)

In the treatment of a Class II malocclusion, tooth extraction or nonextraction is a subject of much debate.1–3 In growing patients, growth modification is often tried to improve their anteroposterior jaw discrepancies without extractions.4 If a nongrowing patient has excessive overjet or a severe arch length discrepancy, orthodontists are likely to choose extraction treatment.5 However, most patients desire nonextraction treatment, if possible, and some do not accept extractions.

In such patients, orthodontists must seek other treatment options. Molar distalization can be an alternative to correct a Class II malocclusion. However, it is not easy to distalize the maxillary dentition completely with traditional orthodontic mechanics.6 Various types of molar distalizers have been developed and clinically used, but they cannot prevent counteractions: e.g., flaring of the maxillary incisors.6,7 In addition, a group distalization of the maxillary dentition was almost impossible in most patients.

Recently, implant-anchored orthodontics has been shown to be effective in treating a wide variety of malocclusions.8–13 In particular, miniscrews have gained acceptance because they can provide stable anchorage for various types of tooth movement despite their small diameter and short length.12 Miniscrew anchorage can provide maxillary molar distalization without patient compliance and undesirable counteractions; therefore, now they are well regarded as a new treatment strategy for Class II correction.14–17 However, their long-term stability is still unknown.

In this case report, we demonstrate the 5-year retention of a group distalization of the maxillary dentition with interradicular miniscrews in an adult patient with a Class II Division 2 malocclusion.

DIAGNOSIS AND ETIOLOGY

A woman, aged 28 years 11 months, had a chief complaint of esthetic problems of her maxillary incisors. Her facial profile was convex, and the frontal
Fig 1. Pretreatment facial and intraoral photographs.

The molar relationships were Angle Class II on both sides. Overjet and overbite were 5.0 and 0.0 mm, respectively. The maxillary and mandibular dental midline almost coincided with the facial midline. In the panoramic radiograph, the maxillary left central and right lateral incisors and the mandibular first molars were nonvital. Periapical lesions were observed in the mandibular first molars. The maxillary third molars had already been extracted, but the mandibular third molars were impacted.

The cephalometric analysis, when compared with the Japanese norm, showed a skeletal Class II jaw-base relationship (ANB, 9.0° (Table). The mandibular plane was steep (mandibular plane-SN, 49.0°) and the maxillary incisors were lingually inclined (U1-SN, 90.0°) but the mandibular incisors showed an average inclination (L1-mandibular plane, 93.5°). As the result, the interincisal angle was increased (134.0°).

**TREATMENT OBJECTIVES**

The patient was diagnosed as having an Angle Class II Division 2 malocclusion with a skeletal Class II jaw-base relationship. An excessive overjet and a reduced overbite were also shown. The treatment objectives were to achieve (1) an acceptable occlusion with a good functional Class I occlusion and (2) an attractive smile and balanced facial profile.

To achieve a functional Class I occlusion, distalization of the maxillary dentition was necessary. Then, placement of intra-radicular miniscrews was planned in the posterior maxilla. The mandibular first molars would be extracted, and mesialization of the second and third molars was proposed to reduce the spaces for restorations.

**TREATMENT ALTERNATIVES**

Several procedures were explored to achieve an acceptable occlusion. Extraction of the maxillary...
Fig 2. Pretreatment dental casts.

Fig 3. Pretreatment lateral cephalogram, cephalometric tracing, and panoramic radiograph.
premolars was considered to reduce the excessive overjet. However, the maxillary third molars had already been extracted, and 2 maxillary incisors were nonvital. Therefore, premolar extractions should be avoided to retain as many intact teeth as possible.

As for the mandibular first molars, prosthetic restorations without orthodontic treatment might shorten the total treatment period. However, this requires pulpectomy of the proximal teeth when bridge restorations are chosen. Moreover, dental implants are expensive.

Table. Cephalometric summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>Japanese norm*</th>
<th>SD</th>
<th>Pretreatment</th>
<th>Posttreatment</th>
<th>Postretention</th>
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<tr>
<td>ANB (°)</td>
<td>2.8</td>
<td>2.4</td>
<td>9.0</td>
<td>8.0</td>
<td>8.0</td>
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<tr>
<td>SNA (°)</td>
<td>80.8</td>
<td>3.6</td>
<td>85.0</td>
<td>84.0</td>
<td>84.0</td>
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<tr>
<td>SNB (°)</td>
<td>77.9</td>
<td>4.5</td>
<td>76.0</td>
<td>76.0</td>
<td>76.0</td>
</tr>
<tr>
<td>Mandibular plane-SN (°)</td>
<td>37.1</td>
<td>4.6</td>
<td>44.0</td>
<td>44.0</td>
<td>44.0</td>
</tr>
<tr>
<td>U1-SN (°)</td>
<td>105.9</td>
<td>8.8</td>
<td>90.0</td>
<td>88.5</td>
<td>88.5</td>
</tr>
<tr>
<td>L1-mandibular plane (°)</td>
<td>93.4</td>
<td>6.8</td>
<td>93.5</td>
<td>90.0</td>
<td>90.0</td>
</tr>
<tr>
<td>Interincisal angle (°)</td>
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<td>10.6</td>
<td>134.0</td>
<td>137.0</td>
<td>137.0</td>
</tr>
<tr>
<td>Overjet (mm)</td>
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<td>1.1</td>
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<td>3.0</td>
</tr>
<tr>
<td>Overbite (mm)</td>
<td>3.3</td>
<td>1.9</td>
<td>0.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Wada et al,1981.

Fig 4. Treatment progress: A, 3 months after the start of treatment; after leveling and alignment, mini-screws were implanted at the mesial alveolus of the maxillary first premolar, and molar distalization was started with 200-g nickel-titanium closed-coil springs; in the mandible, the second molar mesialization was started. B, 12 months later, the mandibular second molars were completely mesialized, and uprighting of the right third molar was started. C, 18 months later, the mandibular third molars were completely uprighted.
and cause considerable surgical invasion, and their longevity is still unclear. Therefore, molar mesialization was planned to reduce the spaces for prosthetic restorations and to reconstruct the whole mandibular dentition with vital teeth.

TREATMENT PROGRESS

The mandibular first molars were extracted, and 0.022-in slot preadjusted edgewise appliances were placed on both arches. After leveling and alignment with nickel-titanium archwires, the mesialization of the mandibular second molars was started with closing-loop mechanics and a stainless steel archwire (Fig 4, A).

Two months after the start of treatment, miniscrews (diameter, 1.3 mm; length, 7 mm; Absoanchor; Dentos, Daegu, South Korea) were implanted at the distal alveolus of the maxillary second premolars (Fig 5, A and C). They were inserted obliquely in the surface of the cortical bone with the self-tapping method. After the 1-month latency period, distal movement of the

Fig 5. A and C, Distal movement of the maxillary molars: miniscrews are shown at the mesial alveolus of the first molars before distalization, but in B and D, the miniscrews are observed beside the second premolar after distalization, which meant a 4-mm distalization of the maxillary dentition. A and C, 2 months after the start of treatment; B and D, 24 months later; A and B, right side; C and D, left side.
maxillary dentition was started with a 2-N load of the nickel-titanium closed-coil springs (Sentalloy; Tomy, Tokyo, Japan) (Fig 4, A).

At 12 months of treatment, a molar tube was bonded on the erupting mandibular right third molar (Fig 4, B). After leveling with the nickel-titanium wires, uprighting of the mandibular right third molar was initiated (Fig 4, C).

After removal of the edgewise appliances, a wraparound type of retainer was placed on the maxillary arch, and a lingual bonded retainer was set on the mandibular anterior teeth. The total active orthodontic treatment time was 28 months. During the retention period, tooth whitening was performed on both dentitions, and the maxillary incisors were restored with zirconia crowns.

**TREATMENT RESULTS**

On the posttreatment facial photographs, a balanced facial profile was achieved (Fig 6). The occlusion was much more stable, and an acceptable intercuspation of the teeth was achieved with Class I canine and molar relationships (Fig 7). The mandibular second molars were completely mesialized to the position of the first molars.

In the panoramic radiograph, proper root parallelism is shown, and the impacted mandibular third molars were uprighted and mesialized (Fig 8). The posttreatment cephalometric evaluation still showed a Class II jaw-base relationship (SNA, 84.0; ANB, 8.0). The maxillary molars were bilaterally distalized for 5.0 mm, but the mandibular plane angle was stable (mandibular plane-SN, 44.0) (Table). Both the maxillary and
Fig 7. Posttreatment dental casts.

Fig 8. Posttreatment lateral cephalogram, cephalometric tracing, and panoramic radiograph.
mandibular incisors were lingually inclined (U1-SN, 88.5; L1-mandibular plane, 90.) but the acceptable interincisal relationship was maintained. No symptoms or the screws of temporomandibular disorder were observed throughout active orthodontic treatment.

At the 5-year postretention checkup, the occlusion was stable, and the good facial profile was also retained (Fig 9). The panoramic radiograph and cephalometric analysis showed little change (Fig 10 and 11; Table).

DISCUSSION

In this patient, distal movement of the maxillary incisors was required to treat the excessive overjet. Premotion of the dentition because the screws would come late extractions were avoided because 2 maxillary incisors in contact with the surrounding root during tooth were nonvital, and there was enough bone at the post movement. Actually, interradicular miniscrews may not interfere with tooth movement when they are

Fig 9. Five-year postretention facial and intraoral photographs.

For group distalization of the maxillary dentition, it might be believed that temporary anchorage devices at midpalate or miniplates at the zygomatic process. However, miniplates require surgery at both placement and removal, and these procedures cause considerable pain and discomfort for patients. Palatal screws need some kind of bulky appliance to connect the screw and the archwire, and these palatal devices are also unpleasant for patients. In contrast, interradicular screws are relatively comfortable. Nevertheless, most orthodontists still
obliquely inserted in the alveolar bone with adequate buccolingual thickness.\textsuperscript{16}

In this patient, the interradicular screws were placed at the mesial alveolus of the maxillary first premolars but are shown at the middle part of the second premolar after treatment (Fig 5, B and D). This means that the root of the maxillary second premolars could pass through the lingual side of the obliquely inserted miniscrews. Of course, such a tooth movement is not feasible in all patients. Analyses of the alveolar bone thickness with radiographs, and 3-dimensional computed tomography if possible, are essential before planning the treatment. Additionally, dental cast analysis measuring the buccolingual thickness of the alveolar basal bone is also useful for prediction.

In distal movements of the maxillary molars, the maxillary sinus is a major concern because tooth movement through bone-deficient areas is considered challenging and might reduce the alveolar bone height or the root length.\textsuperscript{22-24} Lindskog-Stokland et al\textsuperscript{23} in a dog experiment and Wehrbein et al\textsuperscript{24} in a human biopsy study described that root resorption and loss of osseous supporting tissue occurred in the basal cortical bone of the nasal sinus after translatory tooth movements. They suggested that differentiation of osteoblasts is required for compensatory subperiosteal bone apposition. However, the molar roots seemed to move into the maxillary sinus without any serious root resorption, even though the sinus seemed to be between the molar roots in our patient. Several clinical reports also demonstrated the possibility of tooth movement into the sinus.\textsuperscript{25,26} A recent study provided histologic evidence that the sinus wall is a dynamic structure that responds favorably to mechanical stress, such as tooth movement.\textsuperscript{27} Therefore, the possibility of tooth movement into the sinus under suitable and safe conditions should ultimately contribute to expanding the limits of orthodontic treatment.

\textbf{Fig 10.} Lateral cephalogram, cephalometric tracing, and panoramic radiograph at the 5-year postretention checkup.
Maxillary group distalization improved the horizontal open bite and provided adequate anterior guidance. Extraction of the pathologic mandibular first molars and succeeding molar mesialization could make the mandibular dentition intact, avoiding any prosthetic restorations. Moreover, the maxillary left central and right lateral incisors were restored with zirconia jacket crowns after tooth whitening. This interdisciplinary approach, a combination of orthodontic and restorative treatment, significantly improved the patient’s dental esthetics and function, contributing to the increase of her quality of life.

In this patient, the occlusion was stable, and little relapse occurred during the 5-year retention period, even though a large amount of molar distalization was achieved with miniscrew anchorage. A recent longitudinal study with pendulum appliances for distalization showed that first molars were distalized for 4 mm with 10° of tipping, but almost half of the patients experienced relapse during the succeeding multibracket treatment. In our patient, the distalized molars were initially tipped back but controlled well during the finishing and detailing phase. Control of distal tipping after molar distalization might be an important key for the stability of the distalized dentition. In addition, the mandibular plane angle did not increase during active orthodontic treatment and was also stable during the retention period. With these simple molar distalizing mechanics with inerradicular screws, the distalized maxillary molars can be slightly intruded. As a result, the mandibular plane angle can be stabilized even though the molars are extremely distalized. The strict vertical control might also be important to prevent relapses. However, no authors have evaluated the long-term stability of molar distalization with interradicular miniscrews. Further studies are required to confirm their retention and stability.

**CONCLUSIONS**

Interradicular miniscrews are useful to distalize the maxillary dentition for correcting a Class II malocclusion. With this new strategy, group distalization with miniscrews can make the treatment simpler with greater predictability.

**REFERENCES**

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