Nonextraction treatment with temporary skeletal anchorage devices to correct a Class II Division 2 malocclusion with excessive gingival display

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The patient was a 22-year-old Japanese woman who complained of a gummy smile. She had several other orthodontic problems, including crowding of the maxillary anterior teeth, retroclination of the maxillary central incisors, excessive maxillary incisor display, a deep overbite, Class II dental relationships, a Class II profile, and a long face. Two options for the correction of these problems were proposed. The first option was to extract the maxillary first premolars to correct the Class II relationship and implant a miniscrew to correct the gingival display; the second option was to place 2 miniplates for distalization of the maxillary molars and a miniscrew to correct the gingival smile without premolar extractions. The patient chose the second option. After placing a preadjusted bracketed system, 2 miniplates were placed in the zygomatic buttresses bilaterally with monocortical screws, and 1 miniscrew was fixed between the root apices of the maxillary central incisors. Distalization and intrusion of the maxillary molars and intrusion of the maxillary incisors were simultaneously started with those temporary skeletal anchorage devices functioning as absolute orthodontic anchors. The total treatment period was approximately 22 months. Her orthodontic problems were corrected. According to the cephalometric evaluation, the entire maxillary dentition was significantly distalized, and her maxillary incisors were successfully intruded, with the mandible showing a slight counterclockwise rotation. Thanks to the temporary anchorage devices combined with miniplates and a miniscrew, we were able to predictably achieve her treatment goals without premolar extractions, orthognathic surgery, and the need for patient compliance. (Am J Orthod Dentofacial Orthop 2014;145:85-94)

The prevalence of Angle Class II Division 2 malocclusion is relatively low in comparison with other malocclusions. 1-3 This malocclusion is generally characterized by retroclination of the maxillary incisors, a deepbite, and an obtuse interincisal angle. 4-5 In the treatment of a Class II Division 2 malocclusion, the improvement of a deepbite with a gummy smile is a challenging treatment objective. Conventional orthodontic methods, such as an intrusive arch, have been used to reduce overbite, often resulting in undesirable extrusion and flaring of the posterior teeth. 6-7 The clock-wise rotation of the mandible caused by the extrusion of the posterior teeth worsens the Class II convex profile in many patients and also leads to an increase in the incidence of relapse for adults. 8-10 Extraoral appliances to reduce overbite, such as the J-hook, are effective in controlling the anchorage, but it is difficult to predict the final result in uncooperative patients. 11 There is a clear need for a procedure for patients with deepbite and excessive gingival display resulting a gummy smile that effectively intrudes the maxillary incisors without undesirable side effects and without their cooperation.

The successful use of temporary skeletal anchorage devices (TSADs) as absolute anchorage to reduce overbite in nongrowing patients has been reported. 12,13 However, no case report has detailed the simultaneous intrusion of the anterior teeth to correct a gummy smile and distalization of the maxillary posterior teeth to correct molar relationships.

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In this case report, we present the nonextraction treatment of an adult with a Class II Division 2 malocclusion whose deep overbite and gummy smile were predictably corrected using TSADs combined with miniplates and a miniscrew on the basis of a goal-oriented approach.

**DIAGNOSIS AND ETIOLOGY**

The patient, a 22-year-old Japanese woman, had a convex profile, a Class II malocclusion, and excessive display of her maxillary incisors (Fig 1). Her chief complaint was a gummy smile. A short upper lip and hyperactivity of the elevator muscles of the upper lip were found in the clinical examination and are clearly shown in her pretreatment smiling photograph. Intraorally, she had Class II molar relationships bilaterally, a deep overbite, retroclination of the maxillary incisors, a high canine on the left hand side, and anterior crowding in the maxilla (Fig 2).

The initial lateral cephalometric radiograph was taken in natural head position with relaxed lip posture and at centric relation (Fig 3). The cephalometric template analysis (Fig 4) and the cephalometric measurements (Table) clearly indicated that she had a skeletal Class II profile, retroclination of the maxillary central incisors, and excessive eruption of the maxillary incisors. The panoramic radiograph showed her bilateral mandibular third molars. The level of alveolar bone crest was within the normal range, and she had healthy periodontal tissues (Fig 5).

**TREATMENT OBJECTIVES**

The principal treatment objectives were to achieve optimal overjet and overbite, improve her gummy smile, and establish Class I canine and molar relationships. Figure 6 shows her treatment goal on the basis of the cephalometric prediction. According to her treatment goal, the maxillary central incisors and first molars needed to be intruded by 4.0 and 1.0 mm, respectively. The intrusion of the entire maxillary dentition was expected to induce a counterclockwise rotation of the mandible, in effect improving her Class II profile and significantly...
reducing her large interlabial gap. In addition, a 4.0-mm average bilateral distalization of the maxillary molars was needed to correct her Class II dentition.

TREATMENT ALTERNATIVES

The development of TSADs has made it possible to correct a gummy smile successfully without surgery. Orthognathic surgery is no longer the first option for the correction of a gummy smile. The patient was given 2 nonsurgical alternatives: the first option was to extract the maxillary first premolars for Class II correction and implant a miniscrew for gummy simile correction, and the second option was to place 2 miniplates for distalization of the maxillary molars and a mini-screw for gummy smile correction without premolar extractions.

Since she was reluctant to have her 2 maxillary premolars extracted, she decided on the second option.

TREATMENT PROGRESS

Before starting the orthodontic treatment, the bilateral mandibular third molars were extracted. Subsequently, 0.022-in preadjusted brackets were bonded at the maxillary posterior teeth, nickel-titanium archwires were engaged for leveling and aligning segmentally, and titanium miniplates (Dentsply Sankin, Tokyo, Japan) were implanted at the zygomatic buttresses bilaterally under local anesthesia by an oral surgeon. A 0.032 × 0.032-in transpalatal arch was placed to prevent buccal expansion of the first premolars after distalization of the maxillary posterior teeth and buccal flaring of the molars during intrusion of the maxillary molars.
Three weeks after the implantation surgery, distalization of the maxillary posterior segments was started with elastic chain modules. The magnitude of orthodontic force for distalization was 250 g per side. During distalization of the maxillary posterior segments, the buccal archwires were ligated to the transpalatal arch at the maxillary first premolar to prevent expansion of the first premolar (Figs 7, A, 8, A, and 9, A).

Four months later, brackets were bonded at the maxillary anterior dentition, and a miniscrew was fixed between the root apices of the maxillary central incisors. Thereafter, leveling and aligning of the entire maxillary dentition and intrusion of the maxillary incisors were started by applying an elastic thread tied from the head of the miniscrew to the archwire between the maxillary central incisors (Figs 7, B; and 8, B). Then, after engaging a rigid rectangular wire (0.0175 × 0.025-in stainless steel), distalization of the entire maxillary dentition was started. Orthodontic force was delivered from the miniplates to the power arms that were placed between the maxillary canines and first premolars (Figs 7, C, 8, C, and 9, B).

Ten months later, brackets were bonded on the entire mandibular dentition, and leveling and aligning were initiated with a nickel-titanium archwire. The intrusion of the entire maxillary arch started with the application

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Table. Cephalometric analysis

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pretreatment</th>
<th>Posttreatment</th>
<th>Retention</th>
<th>Norm</th>
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<td>SNA (°)</td>
<td>76</td>
<td>75</td>
<td>75</td>
<td>82</td>
</tr>
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<td>SNB (°)</td>
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<td>69</td>
<td>69</td>
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<td>6</td>
<td>6</td>
<td>1.5</td>
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<td>3</td>
<td>4</td>
<td>-</td>
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<tr>
<td>U1 to SN (°)</td>
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<td>94</td>
<td>90.5</td>
<td>107.5</td>
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<td>Upper lip (mm)</td>
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<td>Lower lip (mm)</td>
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<td>0</td>
<td>-0.5</td>
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Fig 4. Craniofacial drawing standards analysis.

Fig 5. Pretreatment panoramic radiograph.

Fig 6. Treatment goal.
of specific mechanics. The maxillary incisors were intruded using a miniscrew, and the canines and premolars were intruded by intrusion cantilevers. Those levers were inserted into the buccal tubes bonded on the head portion of the miniplates. In addition, another intrusive force was bilaterally applied with elastic threads.
Fig 10. Posttreatment facial and intraoral photographs.

Fig 11. Posttreatment dental models.
from the miniplates to the maxillary first molars at the same time (Figs 7, D, 8, D, and 9, C).

After intrusion of the maxillary dentition, distalization of the entire maxillary dentition was carried out to correct the molar relationships and overjet (Figs 7, E, and 8, E). Through the finishing and detailing stage, a functional occlusion with proper anterior guidance and rigid posterior support was established (Figs 7, F, and 8, F). Since the clinical crown length of the maxillary incisors was reduced by the intrusion, electrical cautery was used to modify the gingival margins of the maxillary incisors once the intrusion was completed.

After 22 months of active orthodontic treatment, the multibracketed system and all the TSADs were removed. Immediately after debonding, a wraparound type of retainer in the maxillary dentition and a lingual bonded retainer from canine to canine in the mandibular dentition were placed.

TREATMENT RESULTS

Thanks to the application of the 2 types of TSADs, the patient’s orthodontic problems dramatically improved. She obtained a balanced profile, and her gummy smile and deepbite were dramatically corrected. The canine and molar relationships were normalized from Class II to Class I. A functional occlusion with stable posterior support and proper anterior guidance was established (Figs 10 and 11).

The cephalometric superimposition before and after treatment showed that her treatment goals were predictably achieved (Figs 12 and 13). Particularly worthy of note is the accuracy of the results of the maxillary incisors and molar positions: these were almost exactly the same as the treatment goals. The maxillary first molars were intruded about 1.5 mm and distalized by 4.0 mm. The maxillary central incisors were intruded by 3.5 mm. The amount of counterclockwise rotation of the mandible was less than predicted. The panoramic radiograph taken at debonding showed that her maxillary and mandibular dentitions had proper root parallelism (Fig 14). A stable occlusion and a balanced profile have been maintained during the 2-year follow-up period (Figs 15 and 16).
DISCUSSION

A gummy smile is the result of a combination of factors, including excessive eruption of the maxillary incisors, vertical maxillary excess including a posterior gummy smile, a short upper lip, and hyperactivity of the elevator muscles of the upper lip.\textsuperscript{14,15} The principal factor in this patient seemed to be the excessive eruption of the maxillary incisors (central incisors to stomion, 8.0 mm). Thus, we believed that if the extruded maxillary incisors were intruded, the gummy smile would be improved after the remodeling of the alveolar bone and the gingivae of the incisors.

Creekmore and Eklund\textsuperscript{12} were the first to report intrusion of the maxillary incisors with a TSAD when they used a surgical vitallium bone screw. Ohnishi et al\textsuperscript{13} reported maxillary incisor intrusion using a miniscrew. Clearly, TSADs can intrude the maxillary incisors without side effects: ie, without extrusion of the maxillary molars or the undesirable clockwise rotation of the mandible. Recently, Lin et al\textsuperscript{16} reported simultaneous reduction in the vertical dimension and improvement of a gummy smile using miniscrews. Especially in nongrowing patients, intrusion mechanics with TSADs are the most effective and useful method available to us at this time and compare favorably with conventional orthodontic therapies.

In our patient, the maxillary incisors were successfully intruded by 3.5 mm, and the gummy smile improved without side effects. The maxillary molars were intruded by 1.5 mm. In addition, the intruded incisors and molars showed no relapse at the 2-year...
follow-up. Riedel\textsuperscript{17} suggested that a large interincisal angle at the end of treatment was associated with relapse of a deepbite. The patient’s interincisal angle was reduced by 21.5° during orthodontic treatment. According to the literature to date, the relapse rates after maxillary molar intrusion and maxillary incisor intrusion range from 10% to 30%\textsuperscript{18-20} and 20% to 60%\textsuperscript{21-26} respectively. These authors also reported that intruded molars are less stable than are mesiodistal movement and rotation because no effective method for retention has been developed. It has been suggested that intrusion should be performed slowly to allow for neuromuscular adaptation, overcorrection, and active retention, and that this strategy will assist in stabilizing the intrusive molars.\textsuperscript{17,20}

After distalization of the maxillary molars, the Class II molar relationship was successfully corrected in this patient. It has been reported that the average amount of distalization of the maxillary first molars with miniplates is 3.8 mm at the crown level.\textsuperscript{27} In this patient, distalization of the maxillary first molar was 4.0 mm. The maxillary molars were predictably distalized in accordance with the treatment goals established before the orthodontic treatment. The biomechanics of the skeletal anchorage system with miniplates for distalization are simpler than those for miniscrews because miniplates are fixed outside the dentition. Since miniplates do not disturb tooth movement in any way, the skeletal anchorage system makes simultaneous 3-dimensional control of the maxillary and mandibular teeth possible. Since the miniplate is one of the most reliable TSADs, the treatment goal can be predictably achieved, with little difference between the objectives established before treatment and the outcome of treatment.

For the bodily distalization of the posterior teeth, lever arms were extended from the main arch to bring the line of force closer to the center of resistance, in effect limiting the length of the lever arm because of the soft-tissue impingement. In this patient, the line of orthodontic force was expected to be below the center of resistance of the whole maxillary dentition. As a result, it was expected that extrusion of the anterior teeth and intrusion of the posterior teeth would induce clockwise rotation of the occlusal plane. Extrusion of the anterior teeth was considered particularly undesirable because it would only worsen the gummy smile. The miniscrew implanted between the root apices of the maxillary central incisors and the intruding lever arm were required for prevention of undesirable side effects that are sometimes associated with distalization of the posterior teeth and correction of a gummy smile. Because the surgical intervention required for the insertion of a miniscrew is relatively minor and because it is possible to intrude the anterior teeth without undesirable side effects with a miniscrew, a miniscrew is considered to provide the most effective mechanism to predictably intrude the anterior teeth.

In an orthodontic treatment that requires distalization to correct the molar relationships and intrusion to correct a gummy smile, it is possible to predictably achieve treatment goals using a combination of TSADs: miniplates and a miniscrew.

**CONCLUSIONS**

Thanks to a combination of TSADs, miniplates, and a miniscrew, the correction of this patient’s Class II Division 2 malocclusion with a gummy smile was successfully achieved without premolar extractions, orthognathic surgery, and the need for patient compliance.

**REFERENCES**