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Intrusion of Overerupted Molars by Corticotomy and Orthodontic Skeletal Anchorage

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ABSTRACT

This article describes the orthodontic treatment of a 26-year-old female patient with overerupted left maxillary molar teeth. Her chief complaint was that the maxillary left first and the second molar intruded into the space required for the mandibular left first and the second molars, preventing prosthodontic treatment. The authors performed a corticotomy and used orthodontic skeletal anchorage with a miniplate and orthodontic miniscrews with a head modified to provide a specially designed hook. With this approach, they were able to achieve a sufficient amount of molar intrusion without discomfort, root resorption, or extrusion of the adjacent teeth. The first molar was intruded 3.0 mm and second molar was intruded 3.5 mm during 2 months of treatment. These results have been maintained for 11 months.

KEY WORDS: Intrusion, Orthodontic skeletal anchorage system, Specially designed hook.

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Patients who have overerupted molars due to the loss of antagonists are a common clinical finding. To provide prosthodontic treatment of the missing teeth, these overerupted teeth need to be intruded, but molar intrusion is difficult in adults.^{1,2} Correcting these overerupted teeth with fixed appliances can be frustrating because the reciprocal extrusion of the adjacent teeth will usually be more evident than the intrusion of the overerupted teeth.

Sufficient anchorage for molar intrusion requires that the appliance be rigid and include as many teeth as possible. However, most appliances require a complex and bulky design, so the overerupted teeth are often reduced by grinding the crown.³ Grinding the overerupted tooth is quick and easy, but in severe cases, the teeth need to be treated endodontically.⁴

Teeth can be moved quickly with a corticotomy.⁵ With an orthodontic skeletal anchorage system (OSAS) such as miniscrews,^{6,7} miniplates,⁸ onplants,⁹ or zygomatic wires,¹⁰ teeth can be moved without patient compliance.^{11,12}

This case report demonstrates successful molar intrusion with a corticotomy and two types of OSAS. One was titanium miniplate, and

the other was orthodontic miniscrews, in which the head was attached to a specially designed hook.

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Corticotomy Procedure

The surgical procedure was performed with local anesthesia. Mucogingival flaps were elevated on both the palatal and buccal sides of the overerupted molars to expose the cortical bone completely beyond the apex. Then vertical bone cuts were made with a fissure bur (#701) extending from 3 to 4 mm above the alveolar crest between the second premolar and the first molar to 3.0 mm beyond the apices. The cant of these vertical bone cuts should coincide with the desired direction of intrusion of the posterior segment. A horizontal bone cut was made 3.0 mm above the apices of the teeth to the maxillary tuberosity with a round bur (#4), and the pterygomaxillary junction was separated with an osteotome. This resection was 3 to 4 mm wide to facilitate molar intrusion ([Figure 1](#)). The depth of the bone cuts should be limited to the cortical bone, barely reaching the medullary bone. After completing the corticotomy, the incisions were closed by sutures. Antibiotics and anti-inflammatory drugs were prescribed for 3 days after the surgery.

OSAS Implant Procedure

An L-shaped miniplate (Meditech Co, Boston, Mass) was fixed in the buccal vestibule using two bone screws with the short arm exposed to the oral cavity from the incised wound ([Figures 2a,b](#)). Two orthodontic miniscrews (Jeil Medical Co, Seoul, Korea), 1.6 mm in diameter and 8 mm in length, were implanted in the palatal area. One was 3.0 mm and the other was 8.0 mm from the midpalatal area ([Figure 2c](#)). The miniplate was fixed during the corticotomy procedure, and the orthodontic miniscrews were implanted 2 weeks after the corticotomy.¹³

Hook Fabrication

Just after insertion of the screw type OSAS, an impression was obtained to make a hook. For the working model, two orthodontic miniscrews (analogous to an implant) were put inside the impression material and poured with yellow stone ([Figure 3a](#)). The hook was made with 0.7-mm stainless steel wire, and the force direction that allows suitable intrusion of overerupted molars was considered ([Figure 3b,c](#)). Orthodontic miniscrews and the hook were attached using a metal primer, bonding agent, and resin after each was sandblasted ([Figure 3d](#)).

Treatment Progress and Results

The same day the screw type OSAS was inserted, a specially designed hook was bonded on the palatal side. After that, brackets were bonded on the center of the buccal and lingual faces of the molar, and elastics were used to apply a force of 100 to 150 g on each side ([Figure 4a](#)). In this case, the amount of intrusion of the first and second molars should be different, so we used a different force between the two teeth. One month after the application of elastic force, considerable intrusion had occurred. The mesial marginal ridge of the maxillary left first molar was level with the distal marginal ridge of the maxillary left second premolar. However, for correction of the curve of Spee, we continued the force on the maxillary left second molar and reduced the force on the maxillary left first molar tooth ([Figure 4b](#)).

Two months after surgery, the molars were adequately intruded, and a suitable curve of Spee was present. The overerupted molars were successfully intruded without movement of the adjacent teeth, and the intruded teeth remained vital ([Figure 5](#)). The patient experienced minimum discomfort and a slight soft tissue inflammation around the hook on the palatal side. The miniplate and one of the two orthodontic miniscrews were used as a retainer ([Figure 5c,d](#)). During retention, oral hygiene education was given to the patients, and no complications occurred.

Seven months into retention, implant treatment for prosthetic replacements started. After 1 month of prosthodontic treatment, we stopped the retention and removed the miniplate and miniscrew. Three months after stopping the retention, the patient had a satisfactory occlusion ([Figure 5e](#)).

Cephalometric superimposition showed that the maxillary left first molar had intruded 3.0 mm and the second molar had intruded 3.5 mm ([Figure 6](#); [Table 1](#)). The teeth were tipped about 1° to 3°. The posttreatment radiograph demonstrated that the overerupted molars were successfully intruded without root resorption ([Figures 7](#) and [8](#)).

DISCUSSION [Return to TOC](#)

It is often difficult to perform prosthodontic treatment for missing molars because of the overeruption of antagonists. The traditional treatment has been to reduce the antagonist's crown length by grinding,⁴ subapical osteotomy,¹⁵ orthodontic treatment, or extraction, but most patients refuse the extraction approach.

There are many orthodontic intrusion methods.¹⁶⁻¹⁹ However, intrusion by conventional orthodontic methods usually extrudes the adjacent teeth because of the action and reaction rule. In addition, such extrusion can cause a clockwise rotation of the mandible, creating an anterior open bite. Hwang and Lee²⁰ reported a magnetic appliance for prevention of adjacent tooth extrusion, but these removable appliances^{17,20} require patient compliance.

Corticotomy before orthodontic force application was suggested for overcoming this limitation.^{2,5,21,22} Corticotomy does not require general anesthesia or hospitalization and has no possibility of devitalizing the affected teeth. Orthodontic treatment combined with corticotomy has some advantages, such as reduced possibility of root resorption and shortened treatment time.^{2,5,21,22}

The optimal force for molar intrusion has not been established. Umemorie et al⁸ recommended 500 g of force, Park et al²³ used 200 to 300 g of force in aged patients, and Kalra et al²⁴ used 90 g of force in growing patients.

In the corticotomy case, the optimal force also has not been established.²⁰ However, with corticotomies, heavier forces and more frequent reactivation is needed as compared with conventional orthodontic treatment.^{2,15} Hwang and Lee²⁰ applied more than 90 g of force for molar tooth intrusion in young adult corticotomy patients. We used 200 to 300 g of intrusion force on the bone block and teeth. Hwang and Lee²⁰ intruded a single tooth and bone block, but our case consisted of two teeth and a bone block, so we used heavier forces than Hwang and Lee. We obtained about 3 mm of intrusion during 2 months without root resorption or any vitality problem or discomfort, but further research is needed to determine an optimal force for corticotomy cases.


To obtain an intrusion force, we used an orthodontic skeletal anchorage system. Sugawara et al¹¹ and Umemori et al⁸ used a miniplate for molar intrusion. This type of orthodontic skeletal anchorage system has many advantages. No preparation is necessary to obtain a location for implantation; a stable rigid anchorage is ensured; during intrusion, it is possible to make a force parallel with the intrusion direction; and tooth movement is possible shortly after implantation.⁸

However, insertion and removal is not easy, so only an experienced surgeon should perform these procedures.²³ For insertion and removal, a flap operation is needed. This can be painful and requires medication, so many patients do not want to use this appliance. Kanomi¹² and Costa et al²⁵ have introduced the use of orthodontic miniscrews as orthodontic anchorage, and there are many case reports of treatment with orthodontic skeletal anchorage using orthodontic miniscrews.^{23,26-28}

Orthodontic miniscrews have many advantages. They are small enough in size to place in any area of alveolar bone, have an ease of implantation and removal,²⁵ are low cost, do not require medication,²⁵ and tooth movement is possible shortly after implantation.²⁷ However, when orthodontic miniscrews are implanted on movable mucosa below the mucogingival junction, soft tissue commonly covers the orthodontic miniscrew head, making it difficult to access.²⁹ In addition, the orthodontic miniscrew is commonly inserted between roots, and a parallel force in a translatory direction may be impossible to attain.

Because of the corticotomy, the orthodontic anchorage should be placed below the mucogingival junction since we need an intrusion force that is parallel with the tooth's long axis. Therefore, we decided to use a miniplate on the buccal side. On the palatal side, we also needed an intrusion force that was parallel with the tooth's long axis, but it was impossible to get this force with orthodontic miniscrews, and it is not comfortable for the patient to have a miniplate implanted on the palatal side. Therefore, we decided to implant two orthodontic miniscrews and attach a hook for getting an intrusive force vector parallel with the tooth's long axis. It is the same anchor unit as a plate type OSAS but very easy to insert and remove as well as more comfortable for the patient.

The midpalatal suture area has a sufficient amount of bone^{29,30} for miniscrews to acquire excellent stability easily and rarely damage important adjacent anatomy. However, the force direction at that area is not parallel with the tooth's long axis. Our implants allowed a more favorable force direction than those in the midpalatal suture area, but research concerning bone thickness is rare, so there is no guide to decide on the orthodontic miniscrew's length for that area. This needs further research.

We attached a specially designed hook to the orthodontic miniscrews with light-curing resin to obtain a force parallel with the long axis of the tooth. With this method, we achieved 3.0 mm intrusion with a mere 1° to 3° tipping. However, because of the resin, the bonding area was bulky, and it was not easy to maintain oral hygiene. Although we ordered 0.12% chlorhexidine and careful managed oral hygiene, the patient suffered inflammation around the miniscrews and the hook (Figure 4b ).

Lindhe et al³¹ reported that plaque around the implant neck caused inflammation. Park^{26,27} also reported minor inflammation around orthodontic miniscrews. The inflammation around the orthodontic miniscrew is one of the causes of orthodontic miniscrew dislodgement.^{28,32} In this case, when we removed the hook that was used for intrusion, one of the two miniscrews became loose, so we removed the loose one and replaced it with another for retention.

To solve such problems, it is necessary to take care to use minimal amounts of bonding resin in the attachment of the hook and to maintain a clean state in the attachment process. In addition, it is recommended that patients be continuously educated on the maintenance of oral hygiene.

We achieved a sufficient amount of maxillary molar intrusion with a corticotomy and an orthodontic skeletal anchorage system. With the use of the hook supported by orthodontic miniscrews on the palatal side, we very easily created a force parallel with the tooth's long axis, and with this force, we effectively controlled the direction of the tooth movement. There was no root resorption, no patient compliance was needed, and only 2 months was needed for 3.0 mm of intrusion.

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Table 1. Comparison of Cephalometric Analysis

	Initial	Final	Retention
Gonial angle (118.60)	119.46	120.85	120.55
SNA (81.60)	84.30	84.27	84.29
SNB (79.10)	75.63	75.61	75.60
ANB difference (2.40)	8.68	7.69	7.71
PFH/AFH (66.80)	58.11	58.85	58.77
Mn plane angle (33.40)	44.92	45.58	45.51
U1 to SN (107.00)	101.26	101.08	101.11
6/ANS-PNS, ° ^a	92.5	89.0	89.5
6/SN, ° ^b	80.0	76.7	77.0
7/ANS-PNS, °	84.5	82.7	83.0
7/SN, °	72.1	71.1	71.4

^a ANS-PNS indicates the angle between the first permanent maxillary molar and the palatal plane.

^b 6/SN indicates the angle between the first permanent maxillary molar and the anterior cranial base.¹⁴

FIGURES [Return to TOC](#)



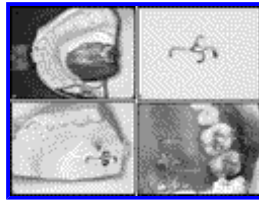
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Figure 1. A fissure was formed on cortical bone surface in an L shape by using a fissure bur and osteotome



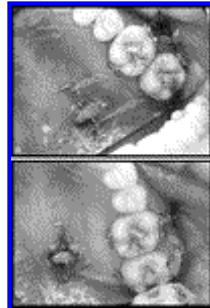
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Figure 2. Orthodontic skeletal anchorage system implants. (a, b) On the buccal side, an L-shaped miniplate was fixed by bone screws, with the short arm exposed to the oral cavity. (c) Two orthodontic miniscrews, 1.6 mm in diameter and 8.0 mm in length, were implanted on the palatal area 2 weeks after the corticotomy



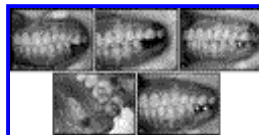
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Figure 3. Hook fabrication and attachment. (a) An impression was taken, and two orthodontic miniscrews were put inside the impression material for the working model. (b, c) The specially designed hook for this patient with 0.7-mm stainless steel wire. (d) The hook was attached by using metal primer, bonding agent, and resin



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Figure 4. (a) Elastics were used to apply a force of 100 to 150 g to each side. (b) For the correction of the curve of Spee, the force of the maxillary left second molar was continued more, and the force of the maxillary left first molar tooth was reduced

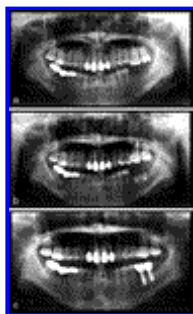


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Figure 5. Intraoral photographs of the patient. (a) Pretreatment. (b) Posttreatment. (c, d) The miniplate and one of two orthodontic miniscrews were used as a retainer during the retention period. (e) After retainer removal

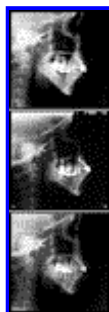


Figure 6. Superimposition cephalometric tracing of maxilla



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Figure 7. Panoramic evaluation of patient. (a) Pretreatment of intrusion. (b) Posttreatment of intrusion. (c) Postretention of intrusion



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Figure 8. Cephalometric evaluation of patient. (a) Pretreatment. (b) Posttreatment. (c) Postretention

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