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# Miniscrew-anchored alveolar distraction for the treatment of the ankylosed maxillary central incisor

### CASE REPORT

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When ankylosis of a maxillary incisor that has been replanted after avulsion occurs in a growing patient, the ankylosed tooth fails to move along with the remaining alveolar process during vertical growth (1). Therefore, the ankylosed tooth is gradually infraoccluded and often becomes esthetically problematic. A patient with an ankylosed tooth often requires several reconstructive procedures to correct the local osseous and soft tissue deficiencies. Various conventional orthodontic treatment methods for ankylosed teeth have been reported, but all suffer limitations (2).

Recently, distraction osteogenesis using alveolar distraction devices has became one of the most predictable treatment methods for ankylosed teeth (1, 3–7). The use of miniscrews to obtain temporary skeletal anchorage has also become popular in clinical orthodontics (8). In this article, we present the case of a 20-year-old female patient with an ankylosed maxillary incisor. The patient was successfully treated with a new alveolar distraction device, anchored with miniscrews, via single tooth dentoosseous osteotomy.

#### Case report

A 20-year-old woman was referred to the Division of Orthodontics in the Department of Dentistry at the

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Hanyang University Hospital, Seoul, South Korea, with a primary complaint of an unaesthetic smile resulting from the impaction and the gingival level discrepancy of the maxillary left central incisor (Fig. 1). She had experienced facial trauma at the age of 10, and the injury had resulted in the avulsion of the maxillary left central incisor, which was later replanted. As the patient grew, the infraoccluded state of the maxillary left central incisor worsened, with discoloration because of accompanying root resorption (Fig. 2).

The treatment plan focused on repositioning the osseous and gingival margins of the ankylosed maxillary central incisor tooth to the ideal level by distraction osteogenesis. A distraction device was designed using miniscrews for absolute anchorage based on recent experiences demonstrating that miniscrews can be used for simple and effective minor tooth movement.

Four miniscrews (Orlus, Ortholution, Korea) were inserted in the mesial and distal portions of the right maxillary lateral incisor and the mesial and distal portions of the left maxillary canine under local anesthesia. Because of the relatively long root lengths and small spaces between the roots in the anterior maxilla, miniscrews were installed with great care not to damage the tooth roots, with progress monitored during the procedure through step by step X-ray analysis. After a



*Fig. 1.* Pre-treatment intraoral photograph showing the ankylosis of the maxillary left central incisor.

direct impression was taken, a distraction device anchored from miniscrews was designed and fabricated (Fig. 3).

Surgery was carried out in an outpatient clinic while the patient was deeply sedated with an intravenous infusion of midazolam and propofol. After local anesthesia, a full-thickness incision was made horizontally from the right maxillary central incisor to the left maxillary canine. The mucoperiosteal flap was reflected to expose the anterior maxilla. Subperiosteal tunneling was carefully performed in both interdental areas, and



*Fig. 2.* Pre-treatment periapical radiograph showing the root resorption of the maxillary left central incisor.



*Fig. 3.* Fabrication of a miniscrew-anchored alveolar distraction device on dental cast by direct impression after the insertion of miniscrews.

interdental osteotomies were performed by a piezoelectric surgical device (Piezosurgery, Mectron, Italy). Horizontal osteotomy, connected with vertical interdental osteotomies, was also performed with piezosurgery. The distraction device was applied and bonded to the ankylosed tooth. To prevent contact interferences during the distraction process, the mesial and distal sides of the ankylosed tooth were minimally prepared prior to surgery. The maximum mobilization of the dentoosseous segment was confirmed by full activation of the expansion screw (Fig. 4). After copious irrigation, the wound was closed.

After a latency period of 1 week, distraction of the dento-osseous segment began. The rate of distraction was 0.5 mm a day and the frequency of distraction was two activations a day for 12 days. Therefore, the total distraction distance, which was overcorrected by 1.0 mm, was 6.0 mm (Fig. 5). The distraction device and miniscrews were removed under local anesthesia and the final position was maintained with a  $0.019 \times 0.025$  inch stainless steel archwire by anterior passive bracketing for 2 months (Fig. 6). The entire procedure resulted in uneventful healing with no complications associated with alveolar distraction. Before definitive prosthetic



*Fig. 4.* Clinical aspect confirming the passive vertical mobilization of the segment according to the full activation of the expansion screw of the miniscrew-anchored alveolar distraction device during the single tooth dento-osseous osteotomy using piezoelectric surgical device.



Fig. 5. Intraoral photograph during the distraction period.

treatment, resin was temporarily built up on the crown of the distracted tooth (Figs 7 and 8).

#### Discussion

Ankylosis of the tooth to the alveolar bone is the most commonly reported periodontal ligament complication following replantation (9). In primary dentition, ankylosis is usually treated through simple procedures such as prosthetic build-ups or extractions (6). However, ankylosis of a permanent tooth requires a more complex treatment plan with treatment options that may involve one or more of the following (10):

- 1 early extraction of the ankylosed tooth and aesthetic solution until more conclusive treatment is provided in the future;
- 2 orthodontic space closure;
- 3 intentional replantation;
- 4 extraction of the ankylosed tooth followed by immediate ridge augmentation/preservation;
- 5 auto-transplantation;
- 6 single tooth dento-osseous osteotomy;
- 7 decoronation and esthetic space maintenance until more definitive treatment is provided.



*Fig.* 6. Intraoral photograph during the consolidation period maintained with  $0.019 \times 0.025$  inch stainless steel archwire by anterior passive bracketing after the removal of miniscrews.



*Fig.* 7. Post-treatment intraoral photograph showing temporary resin build-up before the definitive prosthetic treatment.

Distraction osteogenesis with single tooth dentoosseous osteotomy has been reported to result in better blood supply, gingival reshaping, and aesthetics than other techniques (1, 3–7). Many devices for alveolar distraction have been described in the literature. Toothborne distraction devices are usually bulky (1) and require full arch bracketing (6, 7). Bone-borne distraction devices are useful as they usually result in good patient compliance, however, ready-made alveolar



Fig. 8. Post-treatment periapical radiograph.

distractors are expensive and require a second surgery to remove the device (4).

Recently, miniscrews have become more and more popular for temporary skeletal anchorage in orthodontics (8). Many treatments, where optimal results were difficult to achieve with conventional orthodontics, have been successful with the use of miniscrews. By minimizing the number of brackets required, miniscrews make various minor tooth movements very manageable by not having to consider the intrusive forces and moments on adjacent teeth (11). Our distraction device, which utilized four miniscrews as an anchorage unit, is small, efficient, easy to apply and remove, and better tolerated by patients than previous tooth-borne distraction devices. In addition, the device is inexpensive and requires only a minor second operation to remove the miniscrews without reflection of full-thickness mucoperiosteal flaps, unlike ready-made bone-borne distraction devices

Osteotomies are usually performed by a fissure bur or a microsaw (6). In the present case, a piezoelectric surgical device was used to minimize the bone loss, especially on interdental areas, and the risk of damaging the roots of the adjacent teeth, while maintaining the integrity of the palatal mucosa (12). A short healing period was expected with few postoperative complications as the osteotomies were performed with fine, thin cuts and no foreign bodies, such as bone-borne distraction devices, were left beneath the mucosa.

Our distraction rate was slower than those of previously reported alveolar distractions (1, 4). Augmentation rates of more than 0.5 mm a day are related to insufficient bone formation and evidence of complications (13). As the mean relapse in such cases was reported to be almost 20% (14, 15), we decided to perform an overcorrection of 1.0 mm followed by a consolidation period of 2 months. In addition, the patient was given a permanent anterior palatal retaining wire to prevent the predicted relapse. Our distraction protocol proved to be optimal to achieve functional and aesthetic outcomes with no complications, considering the small bony segment and the long distraction distance.

Even if the root of the ankylosed tooth is progressively resorbed, our treatment could be an excellent way to prepare the site for a later implant treatment because the greatest advantage with alveolar distraction is that all tissues, including bone and soft tissue, are moved in an inferior direction ideally. However, as most alveolar distraction procedures are in the aesthetic zone and clinical outcomes must be predictable (15), further studies are needed to monitor the short-term and longterm stability of generated tissue after the use of miniscrew-anchored alveolar distraction devices.

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