Movement of Ankylosed Permanent Teeth with a Distraction Device

YAN RAZDOLSKY, DDS, BSD
TAREK H. EL-BIALY, BDS, MS, PHD
STUART DESSNER, DMD
JOHN E. BUHLER, JR., DDS

An ankylosed permanent tooth, one of the most challenging problems in dentistry, almost always has a poor prognosis.[1-5] Treatment usually requires block surgery, repetitive luxation, or extraction of the involved tooth to avoid pathological side effects. An alternative approach has been developed, however, to save the ankylosed tooth with acceptable esthetic and functional results, while avoiding the need for extensive prosthetic work.

The technique involves a segmental osteotomy, followed by distraction osteogenesis to reposition both the ankylosed tooth and the adjacent alveolar bone. Schierle and colleagues presented the case of a 16-year-old patient who suffered a sports accident at age 7, leading to ankylosis of the upper central incisors and subsequent underdevelopment of the frontal alveolar process.[6] An osteotomy of the upper anterior tooth-bearing segment was performed, and the segment was attached to a custom-made distraction device. Bone lengthening was started on the seventh day after surgery at a rate of .5mm per day. On the 22nd day, after the open bite was closed, the segment was fixed with an orthodontic archwire, and the distraction device was removed. The results were retained for six weeks. The authors reported a stable situation 18 months after treatment, with good consolidation of the bone fragments and a physiologically shaped gingivobuccal sulcus. They concluded that lengthening the alveolar process by vertical distraction osteogenesis with a toothborne device may be appropriate in certain cases to avoid a second surgery and reduce the risk of root laceration from fixation screws.

Isaacson and colleagues reported the case of a 12-year-old female with a central incisor that had been replanted five years earlier, became ankylosed, and was out of the occlusal plane after normal vertical growth of the alveolar process.[7] When the patient's growth was nearly complete, a combination of orthodontics, surgical block osteotomy, and distraction osteogenesis was used to reposition the tooth in the arch. Two weeks after surgery, distraction was initiated by placing a 1mm vertical extrusion bend in the archwire. This activation was repeated two weeks later, and after two more weeks, extrusion was complete. The passive archwire was left in place for six weeks to allow bone segment healing. The authors noted that this approach had the advantage of bringing both the incisal edge and the gingival margin of the clinical crown to the proper

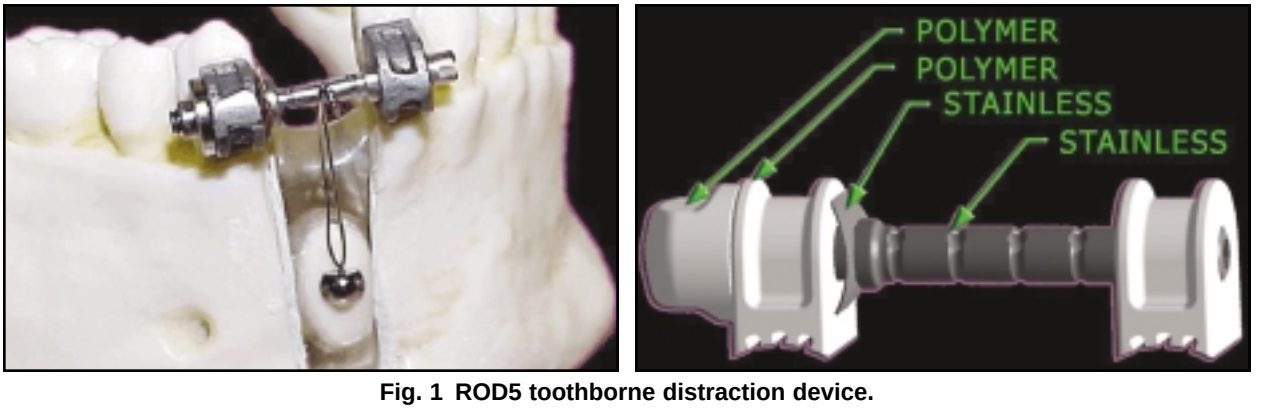


Fig. 1 ROD5 toothborne distraction device.

Dr. Razdolsky is in the private practice of orthodontics at 600 Lake Cook Road, Suite 150, Buffalo Grove, IL 60089; e-mail: yan@razdolsky.com. He has a financial interest in the appliance described in this article. Dr. El-Bialy is a Lecturer, Department of Orthodontics, College of Dentistry, Tanta University, Egypt. Drs. Dessner and Buhler are in the private practice of oral and maxillofacial surgery in Schaumburg, IL, and Fort Wayne, IN, respectively.


Dr. Razdolsky


Dr. El-Bialy


Dr. Dessner


Dr. Buhler

heights relative to the neighboring teeth. A two-week latency period, however, may be too long for an adolescent patient, who may experience early bone healing and premature consolidation. Also, the relatively low stiffness of the archwire could compromise the treatment outcome, since the quality of bone depends on the rigidity of the distraction device.

ROD5 Appliance

Five ROD* appliances have been developed for various preprogrammed vectors of distraction. The new ROD5 is designed to perform vertical distraction of an ankylosed tooth, along with its alveolar bone, to create a proper foundation for implant placement in an atrophic alveolar ridge[8] (Fig. 1).

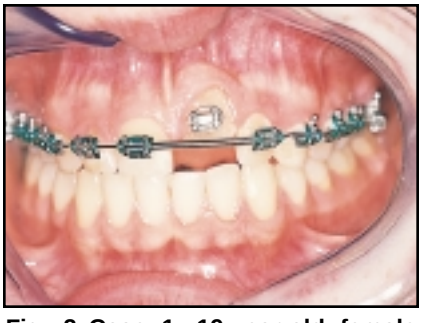
The ROD5 consists of a stainless steel rod supported by polyurethane attachments with notched bases for adhesion to the tooth surfaces. The rod comes in various lengths, with one end threaded to accommodate a spring-loaded detent hub, and the other drilled to accept a standard hex wrench. The detent spring yields 16 clicks per revolution of the shaft, with each click representing about .5mm of linear movement when an .025" surgical wire is used.

*Trademark of Oral Distraction, LP, 600 Lake Cook Road, Suite 150, Buffalo Grove, IL 60089.

Case 1

A 19-year-old female presented with a maxillary left central incisor that had failed to erupt (Fig. 2). She had no history of trauma. Several luxations were performed, but the tooth re-ankylosed each time. Three years of orthodontic forced eruption of the tooth resulted only in intrusion of the adjacent teeth.

The patient had a Class I molar and canine occlusion with an edge-to-edge incisal relationship. Percussion of the involved incisor produced a dull sound that could be felt by the patient in the frontal bone area. Periapical and occlusal radiographs revealed that the maxillary left cen-



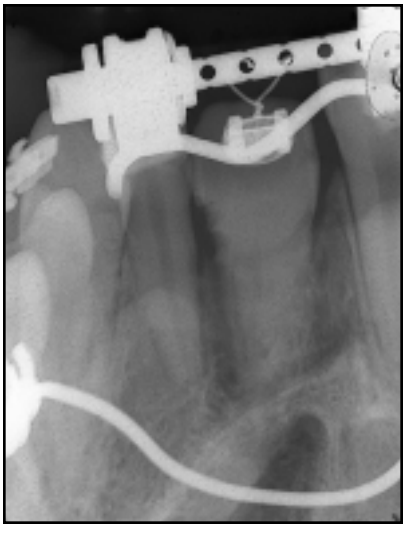


Fig. 2 Case 1. 19-year-old female with ankylosed maxillary left central incisor. Attempts at orthodontic forced eruption of incisor had led to intrusion of other upper anterior teeth. Radiograph shows infraocclusion of left central incisor and obliteration of periodontal ligament.

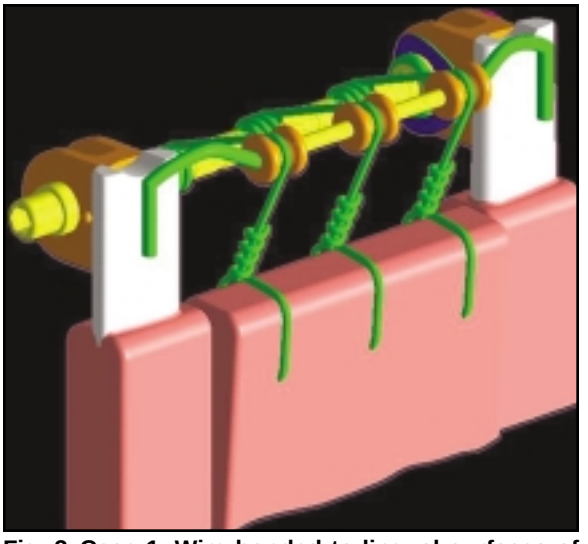


Fig. 3 Case 1. Wire bonded to lingual surfaces of adjacent teeth to act as pulley for surgical wire attached to ankylosed tooth, directing distraction force incisally rather than buccally.

tral incisor was ankylosed, as indicated by its infraocclusion and by the obliteration of the periodontal ligament, particularly at the mesial surface of the root.

After a discussion of the potential risks and unpredictable long-term prognosis of the ankylosed tooth, the patient and parent agreed to osteodistraction treatment that involved moving the ankylosed tooth with its alveolar bone into normal position.

An open-coil spring between the maxillary right central and left lateral incisors was used to gain more interproximal space for the ankylosed tooth. Distal root tip was placed with an .016" × .022" Blue Elgiloy** wire to create more space between the roots of the left lateral incisor and right central incisor, so that the osteotomy could be performed without risk of damage to any of the roots.

The size of the ROD5 distractor was based on the mesiodistal distance between the midpoints of the clinical crowns of the right central incisor and left lateral incisor. The ROD polyurethane attachments designed to fit these two incisors were bonded with Transbond XT.*** An .045" stainless steel wire was bonded to the lingual surfaces of the same teeth to act as a pulley for the surgical wire attached to the ankylosed tooth (Fig. 3). This arrangement would produce a more vertical vector of the distraction force.

Under general and local anesthesia, a horizontal incision was made above the junction of the attached and unattached gingivae, extending one tooth beyond the ankylosed tooth in both directions (Fig. 4). A subperiosteal flap was elevated in a crestal direction, leaving tissue

**Registered trademark of RMO Inc., P.O. Box 17085, Denver, CO 80217.

***Trademark of 3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016.

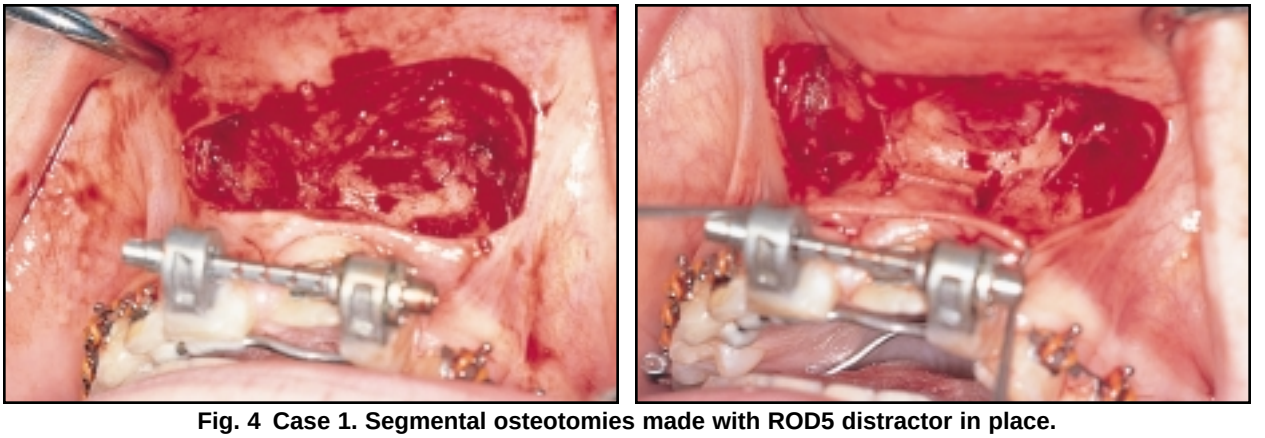


Fig. 4 Case 1. Segmental osteotomies made with ROD5 distractor in place.

attached to the labial bone overlying the ankylosed incisor. Two vertical osteotomies were made with a No. 700 fissure bur, stopping short of the alveolar crest and tapering slightly toward the apex of the tooth. The resulting bone segment was slightly wider at the crest than at the apex. A horizontal osteotomy was then made to connect the two vertical osteotomies, and a thin, straight chisel was used to complete the osteotomies at the crest, freeing the segment. The tooth was attached to the ROD5 appliance with a 28-gauge stainless steel wire. The appliance was activated temporarily to ensure that free movement of the segment had been achieved. The surgical site was then irrigated and sutured.

After five days of healing, the ankylosed tooth was bonded with an orthodontic bracket, which was tied to the ROD5 across the lingual pulley wire with an .016" stainless steel ligature wire (Fig. 5).

Following a five-day latency period, distraction was begun at a rate of 1mm/day by having the patient turn the screw 180° three times a day (Fig. 6). This continued for two weeks, until a slight overcorrection of the tooth had been achieved (Fig. 7). The overeruption would allow maximum bone formation at the apex on the osteotomy side and account for any tissue shrinkage and relapse.

The tooth was bracketed and ligated to an .016" × .022" Blue Elgiloy archwire for stability, and the ROD5 distractor was removed (Fig. 8). Clinical examination confirmed that the vector of distraction was vertical without labial movement.

Three months later, periapical radiographs and computed tomographs indicated that the

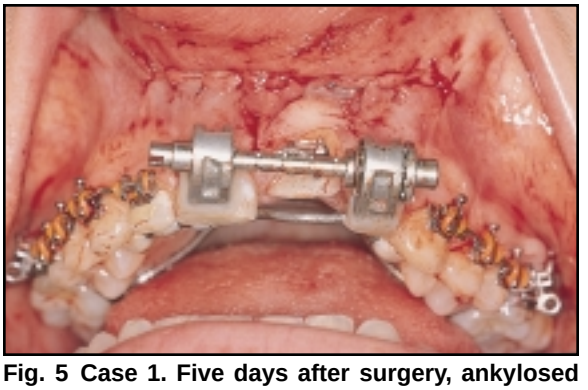


Fig. 5 Case 1. Five days after surgery, ankylosed incisor-bone block connected to distractor across lingual pulley.

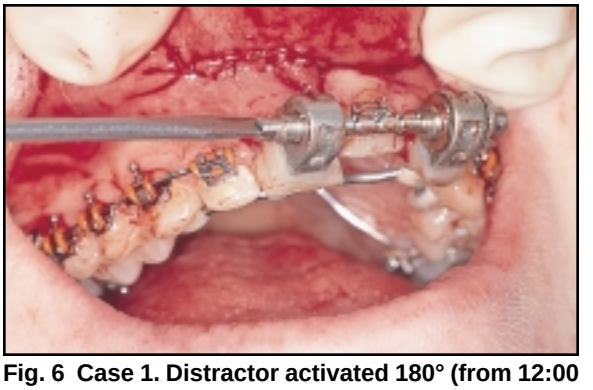


Fig. 6 Case 1. Distractor activated 180° (from 12:00 to 6:00) by patient three times per day with hex wrench.

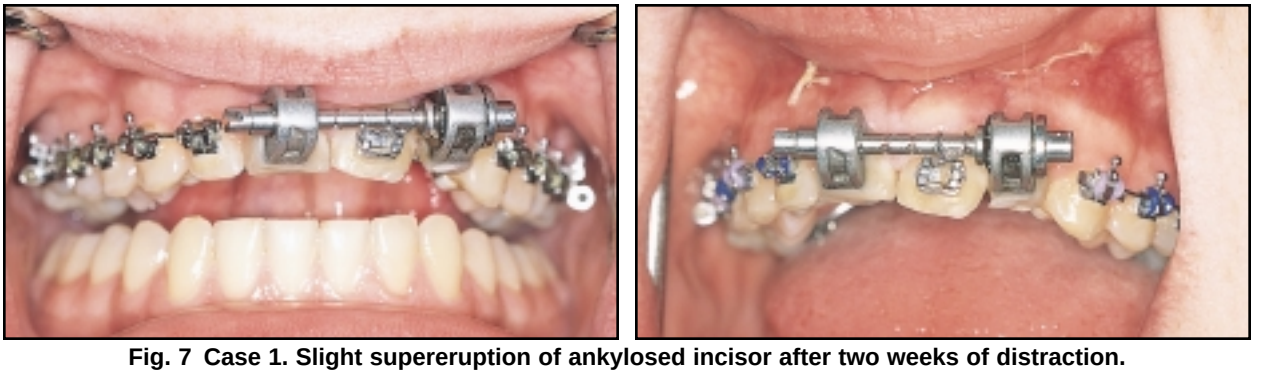


Fig. 7 Case 1. Slight supereruption of ankylosed incisor after two weeks of distraction.

Fig. 8 Case 1. Fixed appliances placed to stabilize incisor after removal of distractor.

Fig. 9 Case 1. Periapical x-rays taken during and after distraction confirm preservation of tooth structure.

Fig. 10 Case 1. Patient after removal of fixed appliances.

ankylosed incisor had been moved into a proper position in the arch, with no damage to any tooth structures (Fig. 9). The fixed appliances were removed (Fig. 10), and an upper 2-2 fixed retainer was bonded.

Case 2

A 16-year-old male presented with a maxillary left first permanent molar that had failed to erupt (Fig. 11). The patient reported no history of trauma. He had a porcelain crown on the maxillary left second molar following root-canal treatment.

Clinical evaluation showed a mesocephalic facial pattern and an orthognathic profile. The patient had a Class I molar and canine relationship with spacing in the anterior maxillary region.

Percussion of the involved molar and the adjacent teeth with a blunt metal instrument produced the same results as in Case 1. Periapical and occlusal radiographs revealed that the maxillary left first permanent molar was ankylosed, as indicated by its infraocclusion and by the obliteration of the periodontal ligament.

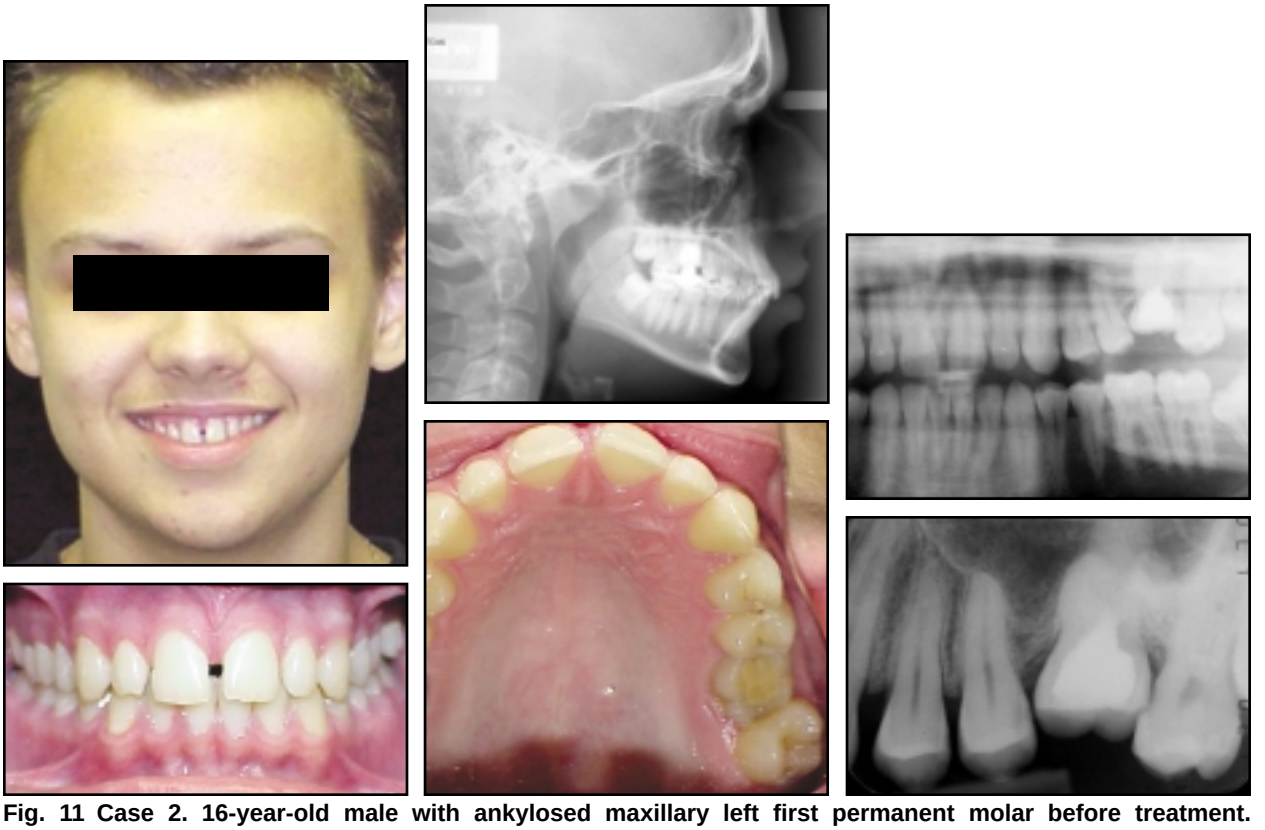


Fig. 11 Case 2. 16-year-old male with ankylosed maxillary left first permanent molar before treatment. Radiographs show infraocclusion of molar and obliteration of periodontal ligament.

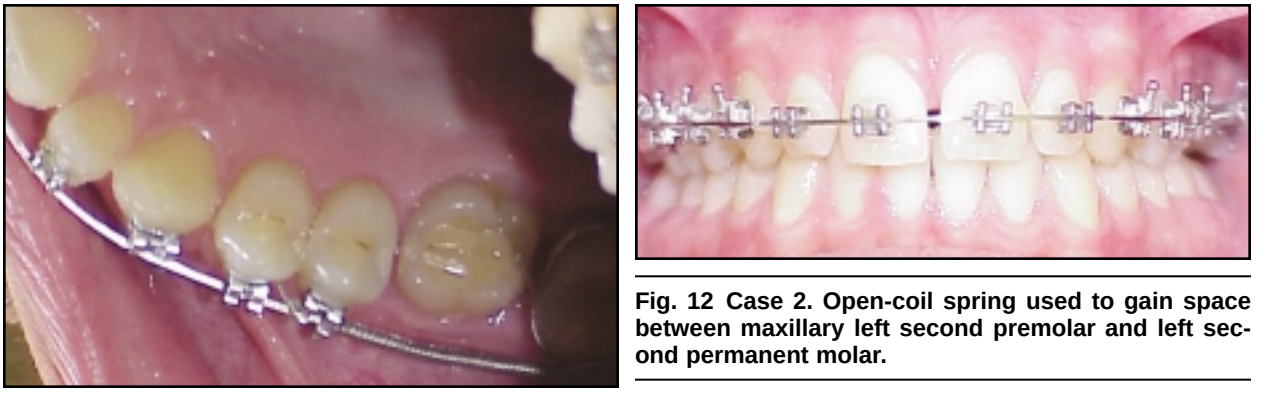


Fig. 12 Case 2. Open-coil spring used to gain space between maxillary left second premolar and left second permanent molar.

After discussion of the potential risks and long-term prognosis of the ankylosed tooth, the patient and parent consented to moving the affected molar with its alveolar bone into normal position using the osteodistraction technique.

The maxillary arch was bonded with an .018" × .025" preadjusted appliance, and an open-coil spring was placed between the maxillary left second premolar and left second permanent molar to gain more space for the ankylosed tooth (Fig. 12).

The size of the ROD5 distractor was based

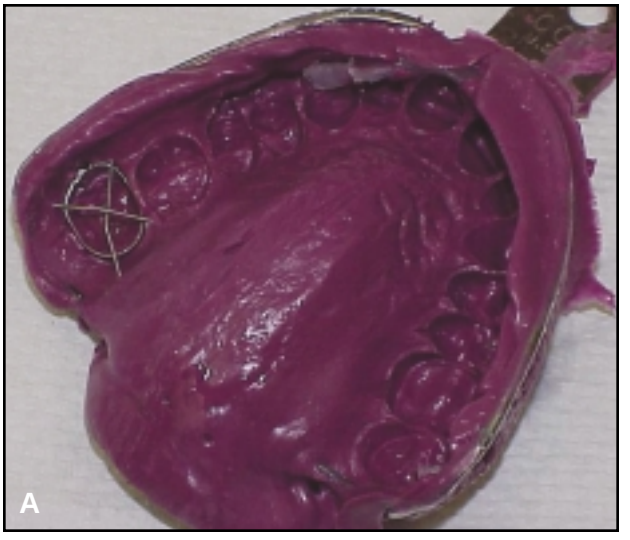


Fig. 13 Case 2. A. Impression taken with maxillary left second molar band in place. B. ROD5 distractor welded to band.

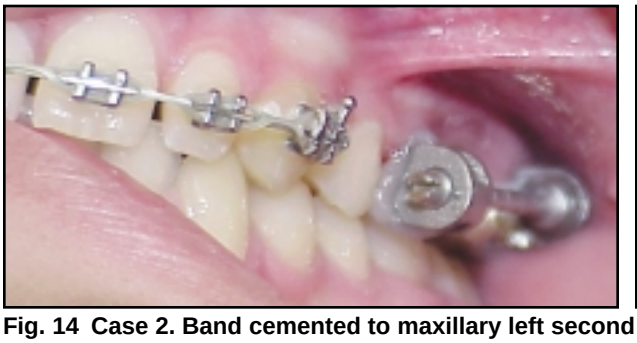


Fig. 14 Case 2. Band cemented to maxillary left second molar, and distractor bonded to left second premolar.

on the mesiodistal distance between the midpoints of the clinical crowns of the teeth adjacent to the ankylosed molar. A preformed band was fitted to the maxillary left second molar, and an impression was taken with the band in place (Fig. 13). The ROD5 attachment was then soldered to the band. The band was cemented to the maxillary left second molar with Transbond Plus Light Cure Band Adhesive,*** and the other ROD5 attachment was bonded to the maxillary left second premolar with Fuji Ortho LC† glass ionomer cement (Fig. 14). An .045" stainless steel wire was bonded to the palatal surfaces of the adjacent second premolar and second molar to act as a pulley and to direct the vector of distraction vertically.

The surgical procedure was performed as described in Case 1. Lingual and labial buttons were bonded to the ankylosed molar and tied to the ROD5 appliance over the lingual pulley with

***Trademark of 3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016.

†Trademark of GC America, Inc., 3737 W. 127th St., Alsip, IL 60803.

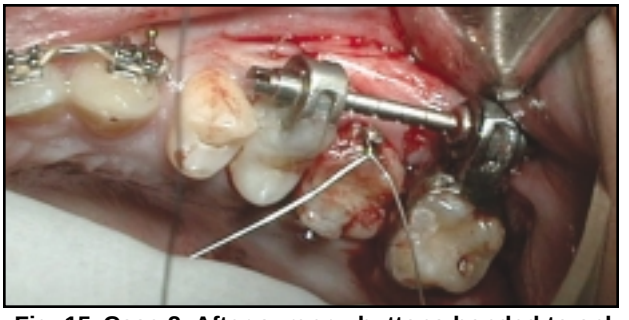



Fig. 15 Case 2. After surgery, buttons bonded to ankylosed molar and tied to distractor over lingual pulley.

Fig. 16 Case 2. Occlusal vector of distraction.

.020" stainless steel surgical wires (Fig. 15).

After a five-day latency period, distraction was begun at a rate of 1mm/day (Fig. 16). Ten days later, the ankylosed molar was in normal occlusion and was stabilized with an .030" stainless steel lingual wire (Fig. 17).

The distractor was removed, and an .016" × .022" Blue Elgiloy archwire was placed, with the first molar used as an anchor for anterior space closure (Fig. 18). After two more months of treatment, all brackets were debonded, and a


Fig. 17 Case 2. After 10 days of distraction, ankylosed molar stabilized by .030" stainless steel lingual wire.

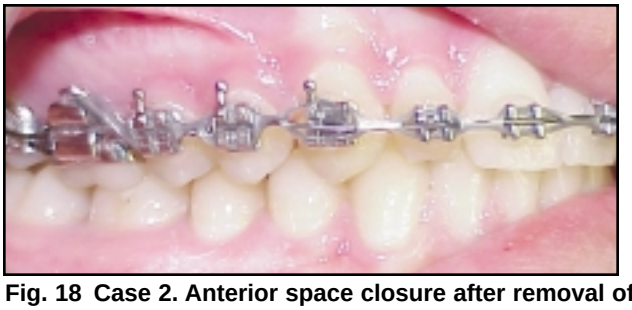



Fig. 18 Case 2. Anterior space closure after removal of distractor, with ankylosed molar used for anchorage.

Fig. 19 Case 2. Patient after removal of fixed appliances.

lower lingual 3-3 retainer was placed (Fig. 19).

Discussion

Any maxillary surgery that approximates the sinus must be handled with caution. Because oral surgeons are experienced at working in this area, however, a surgical intrusion into a healthy sinus through properly designed incisions is not likely to cause complications or compromise the blood flow to the osteotomies. Surgery should not be undertaken if the patient has active sinusitis or if a local infection has not been treated.

Care must also be taken to avoid damaging the important anatomical structures of the maxilla, such as the teeth, periodontia, trigeminal nerve, and attached gingivae. The dental artery, nerve, and vein are transected during a segmental osteotomy, but are known to repair within three to six months.

Conclusion

In the two cases presented here, ankylosed teeth were moved into the arch with the combination of a simple surgical procedure and distraction of the tooth-bone block. The distraction appliance stayed in the mouth for only about three weeks in each case. Post-treatment computed tomography revealed complete bone growth, healing, and maturation, and considerable expansion of the soft tissues was noted clinically.

This promising procedure eliminates the need for extraction of ankylosed teeth and future bone grafts. A smaller ROD5 alveolar distractor, made of tooth-colored, autoclavable plastic, is currently being developed.

ACKNOWLEDGMENT: Dr. Razdolsky thanks Patrick Driscoll, PE, for his countless hours perfecting the ROD5 design.

REFERENCES

1. Owen, T.L.: Ankylosis of teeth, J. Mich. St. Dent. Assoc. 47:347-350, 1965.
2. Biederman, W.: Etiology and treatment of tooth ankylosis, Am. J. Orthod. 48:670-684, 1962.
3. Noyes, F.B.: Case report (submerged tooth), Angle Orthod. 13:62-68, 1943.
4. Medeiros, P.J. and Bezerra, A.R.: Treatment of an ankylosed central incisor by single-tooth dento-osseous osteotomy, Am. J. Orthod. 112:496-501, 1997.
5. Jacobs, S.G.: Ankylosis of permanent teeth: A case report and literature review, Aust. Orthod. J. 11:38-44, 1989.
6. Schierle, H.P.; Mauck, C.; and Schliephake, H.: Vertical distraction osteogenesis of the alveolar process using a tooth-borne device, Mund. Kiefer. Gesichtschir. 4:50-52, 2000.
7. Isaacson, R.J.; Strauss, R.A.; Bridges-Poquis, A.; Peluso, A.R.; and Lindauer, S.J.: Moving an ankylosed central incisor using orthodontics, surgery and distraction osteogenesis, Angle Orthod. 71:411-418, 2001.
8. Razdolsky, Y.; Dessner, S.; and El-Bialy, T.: Correction of alveolar ridge deficiency using the ROD-5 distraction device: A case report, in *Craniofacial Distraction Osteogenesis*, ed. M. Samchukov, J. Cope, and A. Cherkashin, Mosby, St. Louis, 2001, chapter 52.