

Case Report

Orthodontic Treatment of an Ankylosed Maxillary Central Incisor through Osteogenic Distraction

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ABSTRACT Tooth ankylosis is one of the various problems in dentistry and requires special treatment approaches for satisfactory results. In the orthodontic treatment of an ankylosed tooth, different treatment modalities have been put into practice including both orthodontic and orthodontic-surgical approaches. For favorable results, gingival margin esthetics must be considered as much as leveling the ankylosed tooth in the arch. Distraction osteogenesis accompanied by orthodontic mechanics is a sensible way of achieving this goal. However, devices used in the distraction protocol are high in price and bulky in shape, causing functional and esthetic problems for the patient. This report describes treatment of an infrapositioned ankylosed incisor with continuous distraction forces produced by conventional orthodontic mechanics. In conclusion, the ankylosed tooth was leveled in the upper arch successfully with a harmonic gingival margin. (*Angle Orthod* 2010;80:391–395.)

KEY WORDS: Tooth ankylosis; Distraction osteogenesis; Continuous forces; Gingival esthetic

INTRODUCTION

Tooth ankylosis is the fusion of mineralized root surface to the surrounding alveolar bone with obliteration of the periodontal ligament. The causes of ankylosis are reported as local metabolic changes, genetic predisposition, dental trauma, luxation injuries, periapical infections, replantation of a tooth after avulsion, chemical or thermal irritation, and previous surgical procedures.^{1–5}

The diagnosis of ankylosis can be made by both clinical and radiologic evaluations. Clinically, typical metallic sounds upon percussion, lack of tooth mobility, and dental infraocclusion with a higher gingival margin may be observed.⁶ Ankylosis should be visible as an interruption of the periodontal membrane space on a radiograph.⁷ However, the

most important evidence of an ankylosed tooth is the inability of movement during orthodontic force applications.^{6,7}

Treatment methods of ankylosed teeth include extraction and replacement with a prosthetic tooth, surgical luxation, corticotomy, or block osteotomy.^{7,8} Another contemporary treatment modality is distraction osteogenesis, and it is a promising technique in bringing an ankylosed tooth to the occlusal plane.^{7–11}

Ankylosed teeth and their gingival margin remain infrapositioned relative to neighboring teeth. This appears as a clear esthetic problem, especially in the anterior region of the arch. Distraction osteogenesis provides expansion of soft tissues together with alveolar bone simultaneously and may be an ideal technique to overcome this esthetic problem. Furthermore, adequate blood supply can be provided for an ankylosed tooth and the supporting bone process. This article presents leveling of an infraocclusion ankylosed incisor via orthodontic treatment combined with continuous distraction osteogenesis process.

CASE REPORT

The patient was a 35-year-old woman seeking orthodontic treatment due to esthetic problems caused by an infrapositioned upper right central incisor. Upon clinical evaluation, a skeletal and dental Class I relationship with an intrusive upper right central incisor was present (Figure 1). The examination was focused on this incisor and the dull sound obtained during

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Accepted: June 2009. Submitted: March 2009.

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Figure 1. Initial intraoral frontal view of dentition.

percussion and obliteration of the periodontal ligament on radiographs was supporting evidence for ankylosis (Figure 2). However, since the diagnosis of tooth ankylosis can be confirmed by the inability of tooth movement during orthodontic force applications, the treatment plan was established as beginning with conventional orthodontic mechanics and proceeding with alveolar distraction in case of tooth movement failure.

The patient received full orthodontic appliances, and a 0.014-inch NiTi archwire was placed for leveling. Tooth movement could not be observed in the upper



Figure 2. Initial periapical radiograph of ankylosed incisor.



Figure 3. Segmental osteotomy line.

right central incisor during treatment, and a diagnosis of ankylosis was confirmed. Then, the distraction procedure was started.

Before surgical intervention, the upper dental arch was stabilized by means of a 0.016- × 0.022-inch SS archwire. This stabilization arch wire was cut at the ankylosed tooth region to prevent movement of the ankylosed tooth during vertical elongation. The stabilization wire was to enhance the anchorage of the right and left segments near the ankylosed tooth.

Under local anesthesia, a vestibular sulcular incision and mucoperiosteal flap elevation were made. An osteotomy line was constructed 4 mm above the central incisor apex and interdently using a fine round bur. Osteotomy was completed with osteotomes (Figure 3). After mobilization of the dentoalveolar segment, the wound was closed primarily.

Two days after the surgical procedure, an overlay 0.014-inch NiTi archwire was engaged on to the 0.016- × 0.022-inch SS wire sections for the distraction



Figure 4. Application of 0.014-inch NiTi archwire for leveling the ankylosed incisor.



Figure 5. Application of 0.016-inch NiTi archwire after approximation of ankylosed incisor to occlusal level.

protocol (Figure 4). With the aid of this superelastic wire, light and continuous forces were applied to the ankylosed tooth. At the end of the second week, the ankylosed tooth had moved approximately to the occlusal level. The distraction process was continued with a round 0.016-inch NiTi archwire, which continued applying light and continuous forces (Figure 5). When the ankylosed tooth reached the occlusal plane, the 0.016-inch NiTi archwire and SS wires were removed. A 0.016- × 0.022-inch HANT archwire was inserted (Figure 6) and 0.1875 inch intraoral anterior box elastics were used to apply 80 g of force between the upper and lower incisors (Figure 7). After 4 weeks, the final 0.016- × 0.022-inch SS archwire was inserted. Leveling was completed with this arch and fixed appliances were removed (Figures 8 and 9). A lingual retainer was applied for fixed retention.

DISCUSSION

Ankylosed permanent teeth are one of the most challenging problems in dentistry, and for acceptable esthetic and functional results, special combined



Figure 6. Leveling with 0.016- × 0.022-inch HANT archwire.



Figure 7. Utilization of box elastics in anterior region.

treatment approaches including both orthodontics and surgery are required.

An infrapositioned incisor may be a part of an orthodontic malocclusion, and the probability of ankylosis must be considered in these cases. If the tooth does not move during orthodontic force applications, an ankylosis diagnosis will be confirmed. In this case, the treatment plan should be modified to consider the ankylosed tooth.

Until now, several different treatment protocols have been performed for ankylosed teeth. In these cases, surgical luxation can be performed, but this treatment modality may result in reankylosis and, during force application, adjacent teeth may intrude.^{8,10} The tooth may be extracted and reimplanted into the socket created in place of the extracted tooth. However, this usually results in external root resorption.⁴

Another treatment alternative is extraction of the ankylosed tooth and restoration of the space with prosthetics or implants. However, in the presence of an ankylosed tooth an alveolar defect is often observed. If the ankylosed tooth is extracted and the



Figure 8. Final intraoral frontal view of dentition.



Figure 9. Final periapical radiograph of ankylosed incisor.

space is restored with prosthetics, the results may not be esthetically acceptable. Besides, implants can be used, but due to inadequate bone and soft tissue levels, the outcome will not be satisfying esthetically. To avoid this problem, additional surgical applications such as ridge augmentation or onlay bone grafts may be required.⁷

Another treatment alternative is the mobilization of the ankylosed teeth with surrounding bone by interdental osteotomies and repositioning of the tooth-bone segment to its proper position followed by fixation with archwires or acrylic splints.¹² Surgical reposition is one of the best treatment alternatives. Furthermore, total mobilization of the segment and separation of the palatal mucosa may risk the blood supply of the segment. Also, the proliferation of gingival tissues may not follow the movement of the tooth-bone segment, resulting in gingival recessions and differences in the gingival margin level.⁹ Distraction osteogenesis provides expansion and regeneration of soft tissues simultaneously with the bone process, so it has become a promising technique in moving the ankylosed tooth to the occlusal plane. When compared to other treatment modalities, the most important advantage of distraction osteogenesis is carrying clinic crown, incisal edge, and gingival margin to their appropriate position with neighboring teeth.^{1,7,8} Management of ankylosed teeth with distraction osteogen-

esis can be performed by leveling with orthodontic tooth-borne distractors,⁸⁻¹⁰ leveling with internal bone supported screw distractors,^{13,14} or leveling with arch wires.⁷

Intraoral bone-borne distraction appliances provide unidirectional movement, and this makes three-dimensional alignment of transport segment difficult. Kinzinger et al¹³ used a bone-borne distraction device in a study and, although they obtained sufficient vertical adjustment, a marked palatal deviation occurred. In order to move the ankylosed tooth into the desired position, they reduced the consolidation phase and continued the treatment using a floating bone effect. Similarly, Huck et al¹¹ modified the classic distraction protocol and applied distraction osteogenesis accompanied by the bone floating concept.

Tooth-borne appliances were also used in treatment of ankylosed teeth. Razdolsky et al⁸ used a tooth-borne device in their study to produce a more vertical vector of the distraction force. They bonded a stainless steel wire to the lingual surfaces of adjacent teeth and moved the ankylosed tooth into normal position. Alcan⁹ used a miniature tooth-borne distractor named MTD, a device using both the tooth and the archwire as anchorage units for the alignment of ankylosed teeth. He suggested that the mobilized bone segment could be adjusted in three dimensions by creating bends in the stainless steel archwire. Although elimination of additional surgery for device removing is an important advantage of tooth-borne appliances, intrusive forces and moments developing on adjacent teeth must be considered as disadvantages of the technique.

Isaacson et al⁷ used a repositioning method and mobilized the ankylosed tooth with surrounding alveolar bone, but due to the limitations of the stretch of the attached soft tissue, they could not move the segment to the desired position. They continued the distraction process with 1-mm extrusion bends placed in the arch, and repeated this step at a 2-week interval to bring the segment to the occlusal level.

Although distraction osteogenesis is the most efficient technique in positioning ankylosed teeth, it has also some drawbacks. The distractors used are bulky, high in price, and difficult to place in dental region, and they require a second surgery for removal.

In the present case report, the ankylosed incisor was aligned with continuous distraction forces produced by conventional orthodontic treatment mechanics instead of additional devices. This approach eliminated the esthetic and functional problems resulting from bulky distraction devices and provided a low-priced treatment. The successful result in this case may be achieved due to the short distance between the ankylosed tooth and occlusal level. However, the success of the technique must be evaluated in

ankylosed teeth that require movement over a long distance to the occlusal plane.

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