

Decoronation for the management of an ankylosed young permanent tooth

CASE REPORT

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Accepted 23 March, 2006

Abstract – Replacement resorption rate is a variable process, and is dependent on age, basal metabolic rate, extra-alveolar time, treatment prior to replantation, amount of root dentin, severity of trauma, and extent of periodontal ligament necrosis. In patients 7–16 years old a tooth is lost 3–7 years after the onset of root resorption. The complications that may develop as a consequence of ankylosis of a permanent incisor in children are due to the inevitable early loss of the traumatized tooth and local arrest of alveolar bone development. An ankylosed tooth should be removed before the changes become so pronounced that they compromise future prosthetic treatment. The treatment options may involve: interceptive regenerative treatment, early extraction of the ankylosed tooth, orthodontic space closure, intentional replantation, extraction of the ankylosed tooth followed with immediate ridge augmentation/preservation, auto-transplantation, single tooth dento-osseous osteotomy, and decoronation. The purpose of this article was to review the considerations involved in the decision-making concerning the use of the decoronation technique for the treatment of a permanent incisor diagnosed as ankylosed.

Replacement resorption and ankylosis are common complications of a severe dental trauma of a permanent incisor. It might be diagnosed following avulsion, lateral luxation, intrusion, and root fracture (1, 2). The absence of vital periodontal ligament in substantial areas of root surface may enhance resorption of the cementum and dentin by osteoclasts from the adjacent bone marrow. The resorbed tooth dentin is replaced with alveolar bone by osteoblasts. When the damage to the periodontal ligament is limited, this process may be reversible, and the root surface may repopulate with new periodontal ligament cells. However, when the damage is extensive, the replacement resorption cannot be transient, and progresses until the root substance is totally remodeled to bone (2, 3).

The replacement resorption rate is variable and is dependent on age, basal metabolic rate, extra-alveolar time, treatment to the root surface prior to replantation, amount of root dentin at the time of the trauma, severity of the trauma, and the extent of periodontal ligament necrosis (4, 5).

In patients 7–16 years old the tooth is lost within 3–7 years after the onset of root resorption, while in adults this process is slower and the tooth may survive 20 years or more (5). The first clinical signs may be lack of physiologic tooth mobility and metallic sound during percussion. On radiographic examination, the manifestation of ankylosis may be the disappearance of periodontal ligament width, together with replacement of root dentin with bone. The metallic sound on percussion usually precedes radiographic diagnosis. In young children progressive infraposition gradually develops (1).

The complications that may develop as a consequence of ankylosis of a permanent incisor in children and adolescent are due to the inevitable early loss of the traumatized tooth and local arrest of alveolar bone development. The complications include: inflammatory root resorption, esthetic compromise caused by disharmony of the smile due to a change in position in the arch, orthodontic complications resulting from arch irregularity, lack of mesial drift, tilting of adjacent teeth, and arch length loss. Lack of sufficient alveolar bone may compromise future prosthetic solutions and may necessitate complex regenerative procedures in order to provide sufficient bone and soft tissue to support an esthetic solution with an implant. To avoid such complications an ankylosed tooth should be removed before the changes become so pronounced that they compromise future prosthetic treatment. Preservation of the ankylosed tooth for as long as it provides reasonable function and esthetics, without compromising future rehabilitation, is recommended.

In order to facilitate the recovery of the periodontal ligament interceptive treatment may start with correct handling of the traumatized tooth and socket prior to replantation: careful handling, immediate replantation whenever possible or proper storage media when indicated and possible treatment with doxycycline antibiotic solution and Emdogain (Biora, Malmo, Sweden) may enhance periodontal ligament cell recovery (6).

However, once an ankylosis of a traumatized incisor is diagnosed, the treatment options may involve one or more of the following:

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

Immediate extraction upon diagnosis of irreversible ankylosis is not routinely recommended, because of two main reasons: first, early extraction of an ankylotic tooth might be complicated by damage to the alveolar bone. Second, frequently the tooth may be retained for a few more years providing the patient with an esthetic and functional solution (7).

Orthodontic space closure after the early loss of the traumatized tooth may provide an esthetic solution as well as rehabilitation of the alveolar bone ridge. When a lateral incisor is lost, it may be beneficial to let the canine erupt in the lateral incisor space in order to provide new bone and some intermediate esthetic solution even if an orthodontic distalization and implant therapy is planned in the future (8). In rare cases a lateral incisor can replace a central incisor (9). Unfortunately limitations such as the underlying malocclusion, dental and skeletal age, teeth involved (systemic health, periodontal status, tooth shape and size), the need for compensatory extractions or reshaping of teeth as well as cost and compliance limit this option to well selected cases. Nevertheless this treatment may provide the patient with an excellent long-term solution and bone preservation.

Intentional replantation involves extraction of the ankylosed tooth as soon as the replacement resorption process is diagnosed. The tooth is immersed in Emdogain (Biora) and replanted (10, 11). This technique cannot be recommended on a regular basis as the chance of the replacement resorption process being transient is abandoned, and there is a risk of further damage to the root and alveolar bone when the tooth is extracted. Furthermore, the lack of evidence based on long-term follow-up of the success of this protocol is discouraging (10, 11). Ridge augmentation/preservation should be considered when the tooth is spontaneously lost, or in some cases when the ankylosed tooth must be extracted early due to orthodontic or prosthetic requirements (12).

Auto-transplantation of a premolar may provide a long-lasting physiologic and esthetic solution (13, 14). It is recommended when the premolar root is less than three quarters developed (the first lower premolar is the preferred choice). This solution may not be indicated when the extraction involves additional damage to the alveolar bone site as the success may be compromised. Other contraindications may include orthodontic considerations, systemic health, and teeth shape and size. In adolescents over 12–14 years, tooth transplantation is no longer recommended (15, 16).

Single tooth dento-osseous osteotomy involves the transposition of the ankylotic tooth with the bone to a more coronal position. Even though good occlusal and

periodontal results are provided, this procedure is reserved for adult patients as this technique does not cure the replacement resorption process, which is more accelerated in youngsters (17).

The purpose of this article was to review the considerations involved in decoronation treatment of a permanent incisor diagnosed with replacement resorption. A case report of a child treated with decoronotomy is also presented.

The procedure involves a full thickness flap, and decoronation of the crown beneath the CEJ just 1 mm under the crestal bone margins. All root canal filling or medication should be removed. Bleeding is initiated from the coronal and apical sides to encourage blood coagulum formation inside the canal. The flap is fully sutured to encourage primary healing of the soft tissue and encourage vertical bone apposition (18). The indications for treatment with decoronation are:

- 1 A child or an adolescent diagnosed with an ankylotic permanent incisor, and a future rehabilitation with an implant or a bridge is planned, with no medical, surgical, or orthodontic contraindications.
- 2 The root is not expected to resorb within a year.

The treatment intention is to maintain the alveolar bone ridge width, height, and continuity, and facilitate future rehabilitation with minimal, if at all, ridge augmentation procedures.

Decoronation provides certain advantages: (a) it is reliable in terms of alveolar process width and height preservation; (b) it is a simpler and more economical surgical procedure than ridge augmentation; and (c) vertical bone apposition is possible (18–20).

The disadvantages are its surgical nature, which may be challenging in young children, and the necessity for a long-term esthetic space maintainer.

The chronology of decoronation

The optimal time for performing decoronation is 2 years prior to surgical implant insertion, considering the need for full remodeling of the root prior to implant insertion. Nevertheless, frequently there are indications for performing the procedure earlier. Once ankylosis is diagnosed, a strict follow-up is indicated; usually an immediate intervention is not necessary (11, 18–21).

The timing of the intervention is decided according to the following major variables: the vertical difference between the ankylosed and adjacent teeth, the child's age, growth pattern and other minor variables, the planned future orthodontic or prosthetic treatment, space maintenance, esthetics, adjacent teeth eruption status, behavior management, caries risk assessment, and financial issues.

In the growing child decoronation is recommended when the infra-position of the ankylosed tooth is one-eighth to a quarter of the homologous tooth crown (18, 19).

A relationship was established between infra-position of reimplanted, ankylosed teeth and the age of the patient at the time of the injury (19, 20). The severity depends on the stage of development of both the occlusion and facial growth (19). Progression of infra-position

varies individually; there is a high risk of severe infraposition when ankylosis is diagnosed before the age of 10 or before spurt of growth. Infraposition was more severe in the group aged 6.5–10 and not as severe in the group aged 12–16 (19).

Usually the need for decoronation is expected within 2–3 years from the diagnosis (18). When the ankylosis is diagnosed at age 11–14 the infraocclusion may precede more slowly on average, despite variability resulting from individual growth rate and direction. When the ankylosis is diagnosed in adolescents above 15 years, the progression of the infraposition is usually very slow and may necessitate possible surgical intervention at adulthood (18). Sexual dimorphism may influence intervention, as earlier treatment with implants in girls is possible, as girls reach puberty and facial maturity 2 years earlier than boys on average (12, 22).

Individual growth pattern is by far more accurate than the chronological age. As the accumulative facial growth is well correlated with somatic growth (22), and spurt of growth is correlated with the progression of infraocclusion (22), a follow-up after the individual growth pattern may be more predictive of the timing of surgical intervention. Periodic body height measurements indicating the intensity of skeletal growth are an aid to assessment. A child diagnosed with an ankylotic tooth closer to puberty should be followed more closely (every 3 months), and when the peak growth is recognized, decoronation should be considered. When the ankylosis is diagnosed subsequent to the growth spurt, an annual follow-up of clinical crown height is satisfactory (19).

Cephalometric radiograph analysis may contribute valuable information on the expected growth pattern. Usually the maxilla grows in a downward and forward direction and the ankylotic tooth remains in infraposition; vertical individual growth pattern of the maxilla may require earlier intervention (19).

When an orthodontic space closure is attempted, or when an implant solution is planned earlier than the ankylotic root is expected to remodel, the clinician may prefer extraction and ridge augmentation over decoronation.

Space maintenance and esthetics may encourage early treatment with decoronation, as periodic clinical crown lengthening with composite resin is not always sufficient to disguise positional problems in the horizontal and vertical planes.

In addition, when the clinical crown does not justify further investment because of obnoxious color or deep fractures, early decoronation followed by an esthetic space maintainer may be indicated (23, 24).

Whenever adjacent teeth are in the process of eruption decoronation close to the full eruption of the teeth is justified, as they may bring new bone with them and augment the alveolar bone in that region.

Other considerations may involve behavior management and systemic medical conditions, caries risk assessment, and cost issues, that may defer the procedure.

The space maintainer should provide esthetics and comfort. Caries risk assessment, supporting teeth status, eruption of teeth, and growth might influence the choice of the space maintainer. A Hawley retainer with a tooth at

the place of the lost crown or palatal arch with a resin tooth or a splint with the original or acrylic crown or a Maryland bridge can be considered.

Case report

H.R., a healthy 12-year-old boy, was referred to the author's private pediatric dental clinic. Two years before, the upper right central incisor had sustained avulsion during tonsillectomy performed under general anesthesia. The tooth was replanted approximately 2 h later, after being kept in a dry condition. Shortly after, a root canal therapy was performed. The patient's main complaints were poor appearance of the gray malpositioned tooth.

Intraoral examination revealed (Fig. 1) permanent dentition with enlarged over-jet of 5 mm and Angle Class I dental relations. The upper right central incisor was infraoccluded and in a buccal position when compared with the left central incisor. On percussion a metallic sound was heard without mobility.

The periapical radiograph (Fig. 2) demonstrated severe replacement resorption of the upper right central



Fig. 1. Intraoral view of the severely infrapositioned right maxillary central incisor at the initial examination.

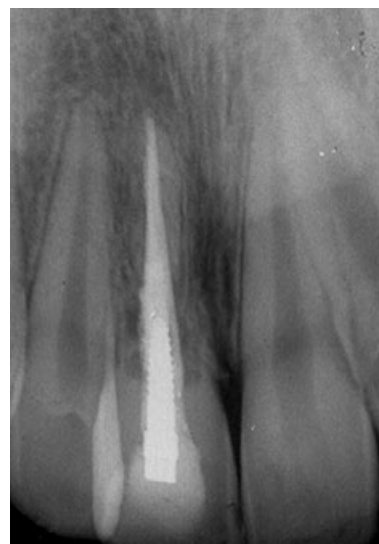


Fig. 2. Periapical radiograph of the ankylosed central incisor at the initial examination.

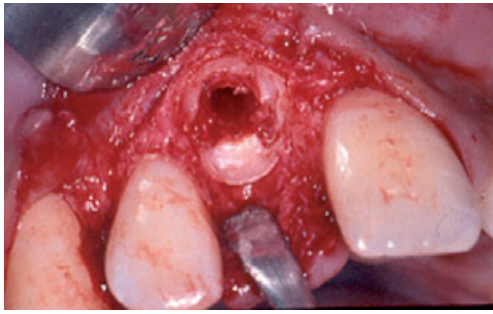


Fig. 3. Intraoral view of the decoronation procedure.



Fig. 4. Intraoral view of the space retainer constructed of a palatal arch and resin tooth.



Fig. 5. Intraoral view of the space retainer constructed of a resin tooth held by elastomeric modules on the orthodontic wire. Notice the preservation of the gingival contour at the site of the decoronation.

incisor, and disappearance of the periodontal space. Ankylosis of the right upper central incisor was diagnosed with advanced replacement resorption.

The immediate treatment consisted of oral hygiene instructions, prophylaxis, and an orthodontic consultation. Decoronation was chosen in the following reasons: an implant was planned in the future, jaw growth was not yet complete, tooth transplantation was orthodontically contraindicated, and the heavily discolored and malpositioned tooth was not esthetically acceptable.



Fig. 6. Periapical radiograph of the alveolar bone ridge at the former site of right maxillary central incisor 4 years after decoronation. Notice the complete remodeling of the root to bone and the preservation of the alveolar ridge.

Under local anesthesia a full buccal mucoperiosteal flap was reflected, the crown of the right maxillary central incisor was removed using diamond burs. The crown was cut 1 mm under the buccal alveolar bone crest and flush with the palatal surface (Fig. 3). Employing rotary titanium files (Profile, Dentsply, Tulsa, OK, USA) and chlorhexidine rinses the gutta-percha was removed from the root canal. As the root canal was filled with a blood coagulum, periosteal releasing incision enabled wound edge approximation without tension. The flap was sutured with 4-0 resorbable sutures using the horizontal matrix technique for primary closure and healing which was reported to enhance vertical bone apposition in decoronation procedures (18). A space retainer constructed of a palatal heavy wire and resin tooth was cemented (Fig. 4). The healing was uneventful. Three years later an orthodontic treatment was initiated and the palatal wire was replaced by an orthodontic arch wire to hold the provisional tooth with elastics providing the patient with reasonable esthetics (Fig. 5).

Radiographically, 4 years later, the decoronated root showed further replacement resorption and an additional apposition of 1 mm of bone coronal to the decoronation level (Fig. 6). Implant restoration is planned in about 2 years when the orthodontic treatment and body growth will be complete.

Conclusions

The present article reviews the options for the treatment of an incisor diagnosed with ankylosis. The clinician should consider all the different options for the management of this complication, and consult other dental professionals as indicated.

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