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Treatment of replacement resorption by intentional replantation, resection of the ankylosed sites, and Emdogain® – results of a 6-year survey

Filippi A, Pohl Y, von Arx T. Treatment of replacement resorption by intentional replantation, resection of the ankylosed sites, and Emdogain® – results of a 6-year survey. © Blackwell Munksgaard, 2006.

Abstract – The present clinical study investigated the outcome of intentional replantation using resection of the ankylosed sites of the root, extraoral endodontic treatment using titanium posts and Emdogain® for periodontal healing following trauma-related ankylosis. During an evaluation period of 6 years, 16 ankylosed teeth affected by replacement resorption were treated as described. Evaluation parameters before treatment and during the follow-up period included Periotest® scores, percussion sound and periapical radiographs. All findings were compared to those of the adjacent teeth. In a second accident, one tooth was lost after 7 months and was excluded as a dropout. Ankylosis did not recur in seven replanted teeth, which were observed for an average of 52.3 months (range 24–68 months). Ankylosis recurred in eight teeth after an average period of 12 months (range: 4–26 months). An infraocclusion, normal or only slightly reduced Periotest® scores and normal percussion sound were preoperatively found in six of seven successfully replanted teeth, which corresponded to a relatively small area of ankylosis. The majority of the teeth showing recurrent ankylosis preoperatively presented with normal position, negative Periotest® scores and a high percussion sound which corresponded to an extended area of ankylosis. Statistically significant relationship between preoperative findings and the treatment outcome ($P = 0.031$) have become apparent. The results indicate that the treatment of minor areas of ankylosis by intentional replantation, resection of the ankylosed sites and Emdogain® appeared to prevent or delay the recurrence of ankylosis in 7 of 15 teeth.

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Key words: replacement resorption; ankylosis; intentional replantation; Emdogain

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Severe tooth trauma or non-physiologic extraoral storage of avulsed teeth may lead to irreversible damage of periodontal ligament cells (1–3) causing ankylosis and replacement resorption (1, 4–7). Cementum and root dentin are resorbed by osteoclasts with subsequent replacement by alveolar bone deposited by osteoblasts. Such teeth are usually lost within three to 7 years after the initiation of root resorption (8).

Ankylosis and replacement resorption can be diagnosed by means of the Periotest® examination at an early stage (Gulden, Bensheim, Germany).

The Periotest® scores are clearly reduced compared to an unaffected neighbouring tooth (9, 10). A further clinical finding of an initial ankylosis in a growing jawbone is the increasing infraposition with yet positive Periotest® scores. An altered percussion sound is a late indication for an advanced ankylosis with replacement resorption: Approximately 20% of the root surface is affected (6, 11). The sound is typically high and metallic (4, 6). Another late phenomenon is the observation that the periodontal ligament space cannot be discerned and that the contour of the root disappears gradually (4).

Following completion of jaw growth, an ankylosed tooth can be readily replaced with a fixed restoration or with an implant. In children and adolescents, i.e. in the growing jaw, root resorption takes place at a much higher rate compared to adults, thereby affecting the growth of the alveolar bone (4, 8, 12). While the maxilla is developing in a downward and forward direction, the ankylotic tooth remains more or less in infraocclusion depending on the age at the time of injury and the individual growth pattern. This leads to poor esthetics and functional loss. After tooth loss, a large bone deficiency may be present – particularly in a vertical direction – which later requires an augmentation procedure. Therefore, ankylosed teeth should be removed early while the jaw is still growing (4, 13). Treatment options are the transplantation of a premolar (14) or of a primary canine (15). Intentional replantation has been reported as an alternative therapy (16, 17). A combination of different therapies had been performed after the removal of the ankylosed tooth. Up to 50% of the root length was removed, an extraoral root canal filling with a retrograde approach using a titanium post was performed and the tooth was replanted using Emdogain® (Straumann, Basel, Switzerland) (18–21). Preliminary data and results after a mean follow-up period of 15 months showed promising results (16, 17). A similar study, however with a different design, reported only failures (22). The present 6-year survey was supposed to determine parameters of success and failure.

Material and methods

During an evaluation period of 6 years, ankylosis at an early stage or affecting only a circumscribed area of the root (the latter characterized by normal Periotest® scores but infraocclusion) was diagnosed in 16 patients (mean age: 14.4 years; range: 7–23 years). The trauma of nine teeth had only occurred a few months before and the teeth were in a normal vertical position compared to the adjacent teeth. However, Periotest® scores were clearly reduced and six of these teeth had a high percussion tone. The trauma of seven teeth had occurred more than 1 year before retreatment. They presented with an infraocclusion of up to 7 mm (Fig. 1). Periotest® scores were almost normal or only slightly reduced. Orthodontic movement of

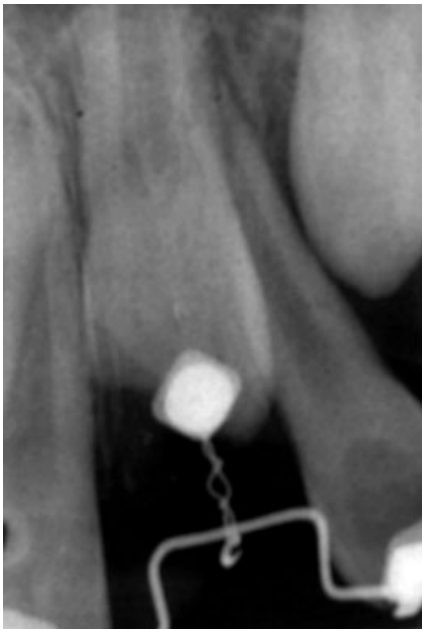

Fig. 1. Infraposition of the ankylosed tooth 21 during unsuccessful orthodontic alignment (Periotest score: +2; percussion sound: normal).

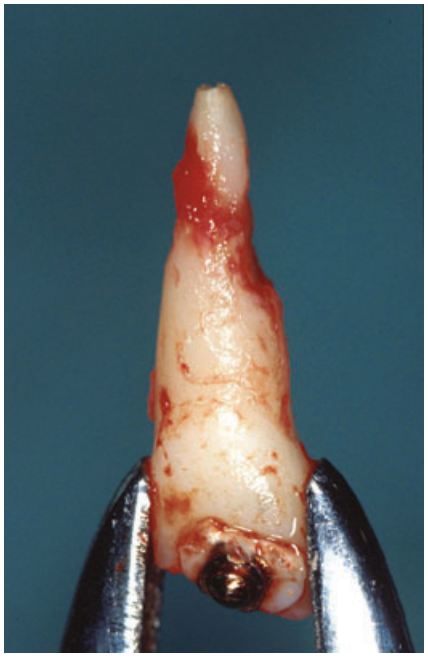

Fig. 2. Visible external root resorption following tooth removal in the apical and middle area of the root.

these seven teeth was not possible. The type of tooth trauma leading to ankylosis, the radiological findings as well as the condition of the pulp has already been discussed in a previous paper (17).

In all 16 patients, the ankylosed tooth was removed under local anesthesia (Fig. 2). After resection of the root apex (20–50% of the entire root length) using a standard drill (Retropost®, Brasseler-Komet, Lemgo, Germany), the pulp including adjacent dentin was removed extending the retrograde preparation into the crown (Fig. 3). After drying the enlarged canal, a cylindrical titanium post was inserted with cement (Figs 4 and 5). The overall length of the post-root-complex was supposed to mimic the root length of the adjacent tooth. Finally, the root surface was carefully dried with sterile gauzes, and Emdogain® was directly applied to the root surface without any conditioning, and it was also placed into the alveolar socket. The tooth was then gently replanted. If infraocclusion occurred, the tooth was repositioned for correct vertical alignment. The replanted tooth was stabilized for 10–14 days using a non-rigid splint (17, 23). Postoperatively, the tooth was examined after one and 2 weeks, respectively, with additional follow ups each month during the first postoperative year. Subsequently, the teeth were examined every 6 months (Fig. 6). Evaluation parameters included Periotest® scores, percussion sound and periapical radiographs. All findings were compared to those of the adjacent teeth. The data was analysed by Fisher's exact test using SAS 6.12 (Cary, NC, USA). The significance level was determined at $P < 0.05$.

Fig. 3. Situation following extraoral resection of the visible areas of resorption.

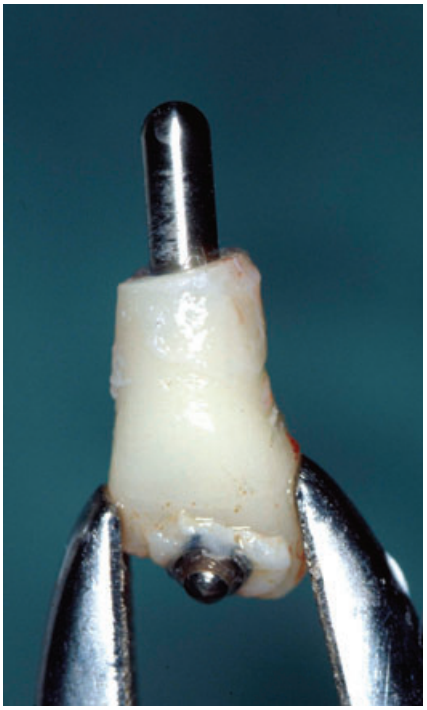

Fig. 4. Situation following extraoral root canal filling using the Retropost system (from a buccal point of view).

Results

Over a period of 6 years, seven replanted teeth without recurrence of ankylosis (no signs of infraposition, normal Periotest® scores and a normal percussion sound) were observed for an average period of 52.3 months (range: 24–68 months). One tooth was lost after 7 months in a new trauma. It was excluded for further examination. Eight teeth presented with a recurrent ankylosis (negative Periotest® scores and/or altered percussion sound) after an average follow up of 12 months (range: 4–26 months). After this recurrence the observation period was terminated, the tooth removed and an alternative treatment initiated.

Of the seven replanted teeth without recurrence of ankylosis six teeth preoperatively presented with an infraocclusion, normal or only slightly reduced Periotest® scores and with normal percussion sound. These findings are in favour of a limited, minor area ankylosis. Of the nine replanted teeth with recurrence of ankylosis five teeth preoperatively presented with normal position, negative Periotest® scores and a high percussion sound. These findings are in favour of a major area ankylosis. Statistically significant relationship between preoperative findings and the treatment outcome ($P = 0.031$) have become apparent.

Fig. 5. Situation following extraoral root canal filling using the Retropost system (from a lateral point of view).

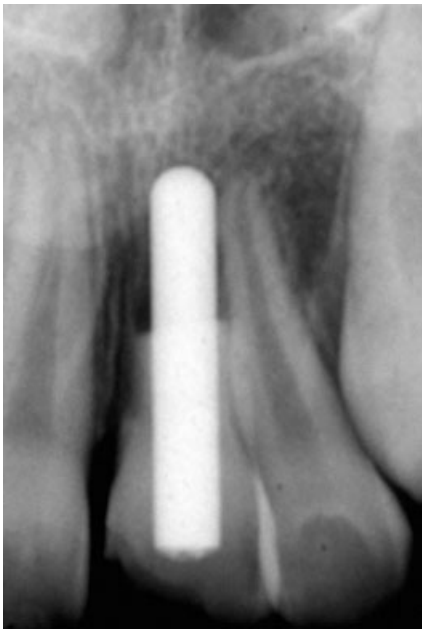

Fig. 6. Radiograph 7 months following replantation (Periotest score: +12; percussion sound: normal).

Discussion

The described combination of intentional replantation, resection of 20–50% of the root apex according to clinically visible resorption lacunae, extraoral retrograde post insertion as a root canal filling, and the application of Emdogain® did not result in recurrence of ankylosis in 7 of 15 teeth after an average of 52.3 months. Six of these seven cases preoperatively showed a minor area of ankylosis. The same is defined by positive Periotest® scores and normal percussion sound but a clearly progressive infraposition, which cannot be rectified by orthodontic means. Failures predominantly included teeth with high percussion sound and negative Periotest® scores in the sense of extended area of ankylosis. One has to assume that at least 20% of the root surface is ankylosed (6, 11). This corresponds to the negative results of another study group, which intentionally replanted only teeth with high percussion sound, and probably including only teeth with extensive ankylosis (22).

Ankylosed areas in extracted teeth cannot be optically evaluated or defined. Clearly visible resorptions in the apical or centre third of the root was, therefore, completely resected in the present survey. Cleaning of resorption lacunae with a scalpel (22) presumably does not change the defect prognostically; recurrence of ankylosis after replantation appeared to be inevitable. However, if the resorbed areas are completely removed by resection and if the remaining root sections do not show any ankylosis, normal periodontal healing can be expected similar to the healing process after intentional replantation as an alternative to apicectomy (24). According to the present data, this seems to be particularly promising in case of minor area of ankylosis.

The present study did not evaluate an isolated effect of Emdogain® but the overall treatment concept. This has proven itself only in localized ankylosis as is typically seen after less severe trauma (avulsions with physiological storage, moderate intrusions or palatal dislocations). Extended defects of the root surface cannot be treated with Emdogain® to allow for periodontal regeneration (17, 22).

After resection of 20–50% of the root and the application of Emdogain®, recurrence of ankylosis occurred not earlier than four months after replantation. This is later than expected (6, 14, 22). Most of the failures comprized of teeth with previous extended areas of ankylosis. The resection of large parts of the ankylosed areas in combination with Emdogain® application appeared to have been the reason for the longer period prior to recurrence. The influence of both factors can, however, not is separated due to the design of the present study.

The extraoral root canal treatment with resection of the root tip and insertion of posts has several advantages (24–26). The ankylosed sites were mainly located in the apical region and were removed. Even higher resection is possible; a length of 2–3 mm of remaining root attachment is usually sufficient (25). The post extends the root to its original length. The

fulcrum is shifted more apically and enhances tooth stabilization. The polished titanium posts are integrated into connective tissue, do not osseointegrate, and thereby do not provoke any ankylosis (26–29). The posts do not have any negative effect on periodontal healing and do not hinder orthodontic movement. This is confirmed by the Periotest®, which shows values comparable to these of the adjacent teeth (28). This type of extraoral root canal treatment reliably prevents infection-related resorption (27). In addition, periodontal lesions are avoided since endodontic irrigation and calcium hydroxide may cause local irritation or interfere with Emdogain® when escaping from the root canal via the apical foramen or dentin tubules (30).

Intentional replantation with the application of Emdogain® is a possible treatment approach to preserve teeth with small areas of ankylosis. However, according to the present and other data (22), this treatment concept should not be taken into consideration for cases with advanced ankylosis with an already increased percussion sound. Depending on jaw growth and the age of the patient the use of alternative therapies, such as transplantation of primary canines (15) or premolars or decoronation (12, 31) must be considered.

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