Abstract

Intentional replantation has been practised for many years as a treatment modality for pulpless teeth. Although the success ratio for intentional replantation is far below that for routine or surgical endodontics, this procedure should be considered an alternative to tooth extraction. A case of mandibular second molars treated with intentional replantation and retrograde fillings is reported in this article. At the eight-year recall visit, radiographs showed no evidence of pathological changes.

Introduction

Intentional replantation (IR) is the extraction of a tooth to perform extra-oral root-canal therapy, curettage of an apical lesion when present and its replacement in its socket. Grossman in 1982 defined it as follows: “A purposeful removal of a tooth and its reinsertion into the socket almost immediately after sealing the apical foramina.” He also stated that it is “the act of deliberately removing a tooth and following examination, diagnosis, endodontic manipulation, and repair, returning the tooth to its original socket to correct an apparent clinical or radiographic endodontic failure.” It is a one-stage treatment that will maintain the natural tooth aesthetics if successful.

This method was first reported nearly a thousand years ago. In the eleventh century AD, Abulcasis gave the first account of replantation and use of ligatures to splint the replanted tooth. Fauchard, in 1712, reported an IR performed 15 minutes after extraction. In 1768, Berdmore reported IR of mature and immature teeth. In 1783, Woofendale reported IR of diseased teeth. In 1778, Hunter believed that boiling the extracted tooth prior to replantation might help to remove the tooth disease.

In 1890, Scheff addressed the role of the periodontal ligament (PDL) in the prognosis of replanted teeth. In 1955, Hammer described the importance of leaving an intact PDL on intentionally replanted teeth. He believed that a healthy PDL is essential for reattachment and retention of replanted teeth. He stated “an average 10 years life span could be expected when replantation was accomplished in a technically flawless manner.” In 1961, Loe and Waerhaug tried to replant teeth immediately to keep the PDL vital. Consequently, ankylosis was not seen; however, all teeth showed resorption repaired with cementum. These results were confirmed by Deeb in 1965 and Edwards in 1966. In 1968, Sherman showed that normal PDL could be kept vital.
Intentional replantation is specifically indicated when all other endodontic non-surgical and surgical treatments have failed or are deemed impossible to perform; when the patient is not able to open his or her mouth fully, preventing the performance of non-surgical or peri-radicular surgical endodontic procedures; in the case of root-canal obstructions; and when there are restorative or perforation root defects in areas that are not accessible via the usual surgical approach without excessive loss of root length or alveolar bone.

Contra-indications may include long, curved roots; advanced periodontal diseases that have resulted in poor periodontal support and tooth mobility; multi-rooted teeth with diverging roots that make extraction and replantation impossible; and teeth with non-restorable caries.

In order to provide the best long-term prognosis for a tooth that is to be replanted intentionally, the tooth must be kept out of the socket for the shortest period possible, and the extraction of the tooth should be atraumatic to minimise damage to the cementum and the PDL. The PDL attached to the root surface be kept moist in saline solution, Hanks’ balanced salt solution, Viaspan or a doxycycline solution for the entire time the tooth is outside the socket.

We have documented three clinical cases to exemplify the potential of IR as a viable treatment option in select endodontic cases. The purpose of this article is to report a case of successful IR as an alternative to extraction.

Case report

A 48-year-old woman was referred for evaluation and treatment of a painful mandibular left second molar. The patient described recent severe throbbing pain associated with the left second molar area, extending to the left ear, of three days’ duration. The patient stated that she had had a cavity in tooth 37 (Fig. 1) and her dentist had performed root-canal therapy a few months before her presentation. Upon examination, tenderness to percussion and palpation were noted and sulcus depths around tooth 37 did not exceed 3 mm. Radiographic examination revealed an endodontic failure associated with a periradicular radiolucency (Fig. 2).

The patient was anaesthetised, and tooth 37 was extracted and received in a sterile gauze sponge saturated with saline solution. The wound was packed with sterile gauze and the patient asked to close her teeth together to immobilise the pack. Resection of both the mesial and distal roots was performed by bevelling the root tip with a #702 bur in a straight handpiece. Retro-preparation of the mesial root was accomplished using a #1/2 round bur in a contra-angle handpiece with copious irrigation. An MTA retrograde filling was placed in the root canals (Fig. 3). Once the extra-oral procedure had been completed the socket was irrigated gently with a normal saline solution to remove the clot and the tooth was replanted. No splint was needed.

Six weeks later, the patient was asymptomatic and the replanted tooth was firm in its socket. At the time, the patient was advised to proceed with the final restoration on the replanted molar (Figs. 4–8).

After one year (Fig. 9), three years (Fig. 10), four years (Fig. 11) and eight years (Fig. 12), the patient attended for evaluation and radiographs were taken of the tooth. The radiographs showed no evidence of resorption and the patient was asymptomatic.
### Discussion

Intentional replantation is an accepted endodontic procedure in cases in which intra-canal and surgical endodontic treatments are not recommended. Although not frequently used, IR is a treatment option that dentists should consider under these conditions. If the standard protocols during IR are not followed, root resorption and ankylosis may be observed within one month and one to two months, respectively. Most resorptive processes are diagnosed within the first two to three years. However, although rare, new resorptive processes could occur even after five or ten years.

As various investigators report varying success rates, it is difficult to predict the outcome for IR. Bender and Rossmann evaluated 31 cases with an overall success rate of 80.6% (six recorded failures). Replanted teeth survived from one day to 22 years. A second mandibular molar that failed after three weeks was replanted successfully a second time with no signs of failure after 46 months of follow-up.

Majorana et al. followed 45 cases of dental trauma for five years, recording complications and responses to treatment. Root resorption was observed in 45 cases (17.24%). Of these, nine were associated with luxation injury (20%) and 36 (80%) with avulsion. The authors identified 30 cases of inflammatory root resorption (18 transient and 12 progressive) and 15 cases of ankylosis and osseous replacement.

Aqrabawi evaluated two cases of IR and retrograde filling of mandibular second molars. At the five-year recall visit, radiographs showed no evidence of pathological changes.

Nuzzolese et al. state that the success rate of IR at five years reported in the literature ranges from 70 to 91%.

Al-Hezaimi et al. treated a radicular groove that predisposed a 15-year-old girl to a severe periodontal defect with a combination of endodontic, IR and Emdogain (Straumann) therapy. At the one-year follow-up, the patient was comfortable and active healing was evident.

Demiralp et al. evaluated the clinical and radiographic results of IR of periodontally involved teeth after conditioning root surfaces with tetracycline hydrochloride. Thirteen patients (seven women and six men; age range: 35–52 years) with 15 periodontally involved non-salvageable teeth were included in this study. During the replantation procedure, the affected teeth were gently extracted and the granulation tissue, calculus, remaining PDL and necrotic cementum on the root surfaces were removed. Tetracycline hydrochloride, at a concentration of 100 mg/ml, was applied to the root surfaces for 5 minutes. The teeth were then replaced in their sockets and splinted. After six months, no root resorption or ankylosis was observed radiographically. Although the period of evaluation was short, the authors suggest that IR may be an alternative approach to extraction in cases in which advanced periodontal destruction is present and no other treatment can be considered.

Araujo et al. demonstrated that root resorption, ankylosis and new attachment formation, among other processes, characterised healing of a replanted root that had been extracted and deprived of vital cementoblasts. It was also demonstrated that Emdogain therapy, that is, conditioning with EDTA and placement of enamel matrix proteins on the detached root surface, did not interfere with the healing process.
Peer\textsuperscript{25} reviewed nine cases of IR that illustrated the feasibility of the procedure for a variety of indications. Only one case of replantation showed evidence of pathosis, reflected by root resorption or ankylosis. His report suggests that IR is a reliable and predictable procedure, and should be considered more often as a treatment method to maintain the natural dentition.

Yu et al.\textsuperscript{26} reported a case in which a combined endodontic–periodontic lesion on a mandibular first molar was treated by IR and application of hydroxyapatite. Four months after the surgery, a porcelain–metal full-crown restoration was completed. At the 15-month follow-up examination, the tooth was clinically and radiographically healthy and functioned well.

Shintani et al.\textsuperscript{27} performed an IR of an immature mandibular incisor that had a refractory periapical lesion. The incisor was extracted and the periapical lesion was removed by curettage. The root canal of the tooth was then rapidly irrigated, and filled with a calcium hydroxide and iodoform paste, after which the tooth was secured with an archwire splint. Five years later, no clinical or radiographic abnormalities were found, and the root apex was obturated by an apical bridge formation.

Kaufman\textsuperscript{28} reported successful results of a maxillary molar tooth treated with IR after a four-year follow-up period. A mandibular first molar, which was replanted, by Czonstkowski and Wallace\textsuperscript{29} showed no signs of resorption and ankylosis after six months.\textsuperscript{14} Different investigators reported success rates varying from 52 to 95\% with follow-ups of between one to 22 years in posterior teeth.\textsuperscript{2,15–17}

Bender and Rossman\textsuperscript{19} reported a success rate of 77.8\% in molars. Among 14 mandibular molars, the success rate in first molars was 85.7\%, and 71.4\% in second molars. Of the four maxillary molars, three first molars and one second molar, one maxillary first molar failed, resulting in a 66.7\% success rate in first molars.\textsuperscript{2}

Raghoebar and Vissink\textsuperscript{30} replanted 29 teeth, consisting of two mandibular first molars, 17 mandibular second molars, one mandibular third molar and nine maxillary second molars, and followed them for an average of 62 months. The success rate was 72\% and 25 of them were still in function.\textsuperscript{18}

_**Conclusion**_

For extraction and replantation to be successful, the following criteria must be met:

- Informed consent must be obtained from the patient.

Intentional replantation is a treatment alternative that should not be underrated, especially when conventional endodontic or surgical treatment is not possible. This is an excellent treatment with a predictable result. I have performed approximately 30 replantations, and have lost only one tooth to date.

In order to be successful with extraction and replantation cases, the practitioner must have the right patient and the right rapport with that patient. The practitioner must also be able to assess the tooth and be confident that it can be extracted without breakage. Additionally, the practitioner must be able to recognise tooth morphologies that may lead to extraction problems. This is a skill that is perfected through experience. Replantation is a predictable and acceptable method of treatment in my office when patients present with root canals that require retreatment due to failure or those that cannot be completed owing to sclerosing of the canals.

(Editorial note: A complete list of references is available from the publisher.)

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