



Intentional Replantation: A Procedure as a Last Resort

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ABSTRACT

Aim: To address the indications, contraindications, surgical procedure, complications following treatment, factors influencing the results and success rate of intentional replantation procedure.

Background: Intentional replantation is extraction of a tooth to do extraoral root canal therapy, curettage of apical lesion when present, and its replacement in its socket. It has been proposed as an alternative to routine extraction; however, it should be considered a last resort because the root may be fractured during extraction.

Results: The success rate of intentional replantation is far below than routine endodontic treatment or apical surgery. Difficulty of tooth extraction, the possibility of fracture during extraction and the risk of external resorption are some limitations of this treatment. The most common causes of failure in intentionally replanted teeth are external inflammatory resorption or replacement resorption and ankylosis caused by periodontal ligament damage.

Conclusion: The success rate up to 95% with an average retention of 3 to 5 years, has been reported.

Clinical significance: In some cases, endodontic retreatment or apical surgery is impossible or impractical. In these situations, intentional replantation may be considered as a last resort for preserving the tooth, so all clinicians should know about its indications/contraindications, surgical procedure and complications following treatment.

Keywords: Intentional replantation, Endodontics, Apical surgery, Review article.

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INTRODUCTION

The term 'Replantation' or 'Reimplantation' means reinsertion of a tooth in its special socket after its complete avulsion due to trauma or some other etiologies.¹ Intentional

replantation (IR) is extraction of a tooth to do extraoral root canal therapy (RCT), curettage of apical lesion when present and its replacement in its socket.² Historically, this method of surgery has been reported near a thousand years ago. Grossman³ in 1982 defined it as follows: 'a purposeful removal of a teeth 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.'⁴ It is a one-stage treatment that would maintain the natural tooth esthetics if successful.⁵

At the eleventh century AD, Abulcasis described the first account of replantation and use of ligatures to splint the replanted tooth.⁶ Pierre Fauchard,⁷ in 1712, reported an IR, fifteen minutes after extraction. In 1768, Thomas Berdmore⁸ reported IR for mature and immature teeth. In 1783, Woofendale⁹ reported IR of diseased teeth. In 1778, John Hunter¹⁰ believed that boiling the extracted tooth prior to replantation may help to remove the tooth disease.

In 1890, Scheff¹¹ addressed the periodontal ligament (PDL) role in prognosis of replanted teeth. In 1955, Hammer¹² 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 Waerhaug¹³ tried to replant teeth immediately to keep the PDL vital. Resultantly, ankylosis was not seen; however, all teeth showed resorption repaired with cementum. These results have been confirmed by Deeb in 1965¹⁴ and Edwards in 1966.¹⁵ In 1968, Sherman¹⁶ showed that normal PDL could be reestablished following IR.

In Grossman's publications,³ IR has been introduced as a procedure of last resort. IR may have some advantages

over surgery, including easier procedure, less time consuming and less invasive.^{17,18} In contrast with these claims, Weine¹⁹ rejects IR as a viable treatment alternative. He feels 'it has one of the poorest prognoses of any dental procedure that can be attempted.' Hence, this review will address the indications, contraindications, surgical procedure, complications following treatment, factors influencing the results and success rate of IR.

IR has been proposed as an alternative to routine extraction by many researchers; however, it should be considered a last resort because the root may be fractured during extraction.^{2,3,20-22} It should not be suggested for routine use because its success rate is far below than routine RCT or apical surgery.^{14,19,21,23-27} Some indications have been proposed for IR, including as follows:

1. When routine RCT is impossible or impractical, as with some patients who cannot keep their mouth open for the necessary time.^{19,28}
2. When a previous RCT has been failed but orthograde retreatment or apical surgery is impractical.^{14,16,19,27-32}
3. When there is an obstruction of the canal, such as a broken file or canal calcification.^{1,2,19,27,29}
4. In situations surgical access would be inadequate, such as a shallow buccal vestibule or short roots.^{28,33}
5. Where blunderbuss molar roots or open apices exist, apexification has been failed, and the canal walls are divergent.²⁸
6. When an iatrogenic perforation or a perforating internal or external resorption is present, but surgery is impractical.^{1,5,19,34-36}
7. When a foreign body is present in periapical (PA) tissues or PDL, but surgery is impractical.^{1,19}
8. When a PA radiolucency exists but routine surgery is impractical.^{1,2,19,27,29}
9. If PA radiographs show a large region of rarefaction or a large cyst.^{1,2,27}
10. When the root canal is furcated as it approaches the apex.^{1,2,27,29}
11. For RCT of immature teeth.^{17,37}
12. For primary teeth, as an alternative to extraction and placement of a space maintainer.³
13. Management of vertical root fractures by reconstructing with dentin bonding agents³⁸⁻⁴² or management of complicated crown-root fractures.^{40,43}
14. For RCT of teeth with certain anatomical malformations such as radicular groove or double teeth.⁴⁴⁻⁴⁶
15. Maintenance of the alveolar bone.^{17,47}
16. Progressive destruction of periodontal tissues and management of teeth with advanced endodontic-periodontal lesions.^{31,36,40,48-50}
17. Management of maxillary sinusitis.²⁴

IR is not recommended in the following situations:

1. Patient's medical history may prevent PA surgery or extraction.²⁸
2. Extensive caries or nonrestorability of the tooth.^{3,14,17,21,36,51}
3. Severe periodontal disease of the involved tooth.^{1,3,14,17,18,28,49,51,52}
4. Curved root^{17,18,28} or the possibility of fracture during extraction¹ or during the replantation.²⁸
5. Broken teeth.¹⁸
6. When labial/buccal plate has been destroyed¹ and gingival inflammation and the involvement of furcation exist.⁵¹
7. In ankylosed teeth, IR may be indicated only when the ankylosis is diagnosed at the early stages.⁵³⁻⁵⁵

RESULTS

For reducing the operation time, it is better to perform the IR by a team of at least two dentists.^{2,56} This team work can eliminate the problem of operation time because the extracted tooth can be returned to its socket even within a few minutes.^{17,22,56}

If any pain and/or swelling are present before IR, premedication with antibiotics may be indicated.¹⁸ It can also be effective to prevent secondary infection which may result in root resorption. These antibiotics include penicillin,²⁷ ampicillin,⁵⁶ amoxicillin,⁵⁷ doxycycline,³⁶ augmentin,²⁴ tetracycline,^{16,49,58} and cefuroxime.⁴⁶ Also, premedication of patients with NSAIDs is recommended.^{21,24,27}

The first step in IR is careful tooth extraction in an atraumatic manner which should save the buccal/lingual cortical plates intact. For prevention of the damage to the cementum, elevators should not be used.^{22,49} Also, forceps should be kept off the cementum above the cemento-enamel junction (CEJ).^{17,21} Convex surfaces of the root receive the largest amount of trauma during extraction are the resorption-prone regions.⁵⁹

During the IR procedure, the tooth should be held by the crown area to avoid any contact with the root surface.^{17,21,22,49,60} It is recommended to cover the socket with sterile gauze to prevent contamination with saliva.³² To keep the tooth moisture, constant irrigation or immersion of the tooth in sterile water has been advocated.^{1,2,22,24}

It has been stated that the socket walls must not be curetted, because some parts of the PDL is still attached to these walls which can help in healing.^{3,17,36,49,61} However, some researchers recommend thoroughly curettage of the socket to remove inflammatory tissues and blood clots.^{1,2,22,24,27,62}

The roots should examine for some defects such as cracks or perforations. Usage of loops, magnification lenses

and taking radiographs can be helpful for diagnosis of these defects.^{2,21}

In some cases, it is needed to resect 2 to 3 mm of the root end with a high speed diamond bur and then, a retrograde cavity can be prepared.^{2,21,22,30,49,63,64} The depth of the cavity should not be more than 3 to 5 mm. However, Sherman¹⁶ recommended not removing apices because it may lead to root resorption. Various root end filling materials has been recommended. These materials are Super-EBA cement,² IRM,²¹ ZOE,¹⁷ Zinc-free^{28,49} or spherical amalgam,^{22,27,64} dentin bonding agent,^{38,65,66} and gutta-percha.²²

After replacement of the tooth in its original socket, it is recommended to take a PA radiograph to confirm the true position.^{2,43} True complete seating would be enhanced by requesting the patient to bite on a cotton roll or a tongue blade with firm gentle pressure.²¹

A very important concern in this procedure is the extra-oral time which should be reduced as much as possible. Many researchers believe that 20 to 30 minutes may be considered as the maximum length of time that should elapse between extraction and replacement.^{2,30,40,49,51,58,67-69} There is also no agreement about the time of RCT. Some authors believe that RCT should be completed extra-alveolar;⁷⁰ however, others believe that RCT should be performed before^{1,22,49,71} or after the replantation.^{53,57,58,72}

Occlusal adjustment is another part of this kind of treatment that should be done after replantation procedure.^{21,24,28,30,36,57,62,64,73} However, Koenig et al⁷⁴ stated that replanted teeth do not need to be out of occlusion.

Also, the patient should be informed about the importance of plaque control by using toothbrush and chemical methods such as chlorhexidine,^{2,21,24} povidone iodine,⁴⁰ Kasdenol solution⁴⁹ and salt water.²²

The final step in this appointment is stabilization of the replanted tooth.^{1,75} Splinting may be necessary to eliminate the excessive mobility of the tooth and to help the initial healing of PDL. For this purpose, flexible splinting is more advantageous than rigid splints because a little amount of mobility is necessary to aid periodontal healing.^{20,56} However, some researchers believe that splinting is not mandatory and only should be done if necessary, such as in short roots or lack of interseptal bone.^{17,18,74,76,77} Arens²¹ believes that splinting is required when the tooth mobility is excessive following replacement. It should be stated that semirigid splinting can allow physiologic mobility of the tooth and so can result in functional arrangement of the PDL fibers. Against this, tight splinting may result in ankylosis.^{49,78}

Various methods have been used for splinting: using 0.7 mm orthodontic wire with composite to stabilize the tooth,⁷⁹ with 3-0 silk suture crossing the occlusal surface

of the tooth,²⁴ by an interproximal wire ligature splint,³¹ acrylic splint,⁸⁰ soft wire and light-cured composite,⁵⁶ a soft periodontal packing,^{30,64} the acrylic resin splint with orthodontic wire over the periodontal packing,⁴⁹ placing a composite material interproximally and over lingual surfaces,^{36,73} monofilament and composite resin,⁴³ 7 nylon thread and light cured resin,⁵⁷ sutures with cusp wire and Super Bond C and B,⁴⁰ or nylon line attached to the tooth.²¹ The length of time for removing the splint differs between various researchers, i.e. 7 to 14 days,^{18,21,40,43,49,56,57} 6 months,³⁶ or 4 weeks.³¹ It has also been claimed that placement of a special periodontal pack over the epithelial attachment can reduce the invasion of bacteria through the gingival attachment.⁷⁸

In some studies, Emdogain has been used to the root surface and into the socket before replantation to reduce the possibility of root resorption.^{43,46,53} Emdogain facilitates migration and differentiation of progenitor cells on the root surface.⁸¹ In absence of Emdogain, osteoclasts may attack the root surface in 7 to 10 days.⁵³ Iqbal and Bamass⁵⁴ and Hoshino⁸² reported increased healing of PDL in teeth replanted with Emdogain. Filippi et al⁸³ showed that IR by using Emdogain may delay or even prevent ankylosis of replanted teeth.

Clinical and radiographic examinations following IR are mandatory. In some other studies, PRP gel was prepared from blood of the patient and was inserted into the socket before replantation, because it may facilitate the wound healing, decreases bleeding and accelerate bone formation.^{71,73}

DISCUSSION

In intentionally replanted teeth, the most common causes of failure are external inflammatory resorption or replacement resorption and ankylosis caused by PDL damage and further necrosis of the PDL and cementum.^{17,49,52,84-88} These complications are related to the degree of PDL damage.^{4,6,21,22,49,69,89}

The replacement resorption is influenced by the extra-alveolar time while the inflammatory resorption is caused by infection after an improper RCT.⁹⁰⁻⁹² Also, ankylosis may be due to the removal of pericementum⁹³ the splinting⁹⁴ and a long extra-alveolar period.⁴⁹

It should be stated that resorptive process may occur even after 10 years.⁹⁵ Prevalence for resorption without visible contamination after 2 years is 57%.⁹⁶

The success or failure of the IR depends on vitality of PDL cells.¹⁶ These cells can be kept vital while the tooth is out of the socket but kept moist, for at least 15 to 20 minutes. Resultantly, moistening the PDL with solutions such as saline solution, seems to prolong the vitality of PDL cells.^{14,16}

Some factors may influence the periodontal healing, including:

1. *The extra-alveolar time:* This is probably the most important factor that should be considered.¹³ Thirty minutes appears to be the maximum time limit^{69,97-99} The amount of time more than 30 minutes can increase the possibility of root resorption.^{15,52,69,85,100,101}
2. The root surface should be bathed with normal saline solution.⁵²
3. *Presence of preoperative radiolucency:* Teeth with radiolucency are more inclined to healing without root resorption, which may be due to the facility of the extraction of teeth with apical radiolucency which results in less damage of the root.¹⁰²
4. *Patient's age:* Inflammatory resorption is more frequent in the age 10 to 30 years than in older age patients,^{86,102} which may be due to the wider dentinal tubules in younger patients.¹⁰²
5. *Root end filling:* Replantation of teeth sealed by a filling material seems to be more successful than replantation without root canal filling.^{14,22,100,103} Moodnik et al¹⁰⁴ and Oynick¹⁰⁵ do not agree with the use of amalgam. However, one research showed that the sealing quality of amalgam has been found to be superior to polycarboxylate cement.^{106,107}
6. Care should be taken to minimally manipulate the root surfaces.²⁸ Replanting teeth with the original PDL attached encourages periodontal remodeling and inhibits ankylosis and root resorption.^{1,13-16,57} After two weeks, the PDL has two-thirds of its original adhesion.⁵⁷
7. *Kind of the tooth:* Multi-rooted teeth have less success rate than that of single-rooted teeth.^{14,108}

A major problem in interpreting the success rate of intentionally replanted teeth is determining the retention of the tooth in question whether PA pathosis is present or not so it is difficult to compare the success rate of IR with conventional RCT.² Several success and failure studies have been performed in the area of IR. The success rate ranges from 50%²⁶ to 95%⁵² with an average retention of 3 to 5 years. Some studies reported the tooth surviving up to 20 years^{28,33,109} or even in rare cases up to 41 years.¹¹⁰

In 1968, at the 4th International conference on endodontics, Grossman and Chacker¹¹¹ hypothesized a 3 years survival rate as suitable criteria for IR success. They believed that if resorption is going to occur, it would be seen 1 to 2 years following the IR. However, the histologic studies showed that more than 4 years is needed for assessment of success or failure of IR.⁵⁸ Overall, intentionally replanted teeth should be named successful if generalized resorption has not been occurred, if no

rarefaction is present and if the tooth has normally functioned and had no symptom for at least 5 years.¹

In another view, successful IR should satisfy clinical and radiographic criteria. The clinical criteria include normal function, normal mobility and healthy periodontium. Also, the PA radiograph should reveal no apical radiolucency or resorption.⁸⁴

Nosonowitz and Stanley²⁸ proposed 10 years minimum retention period as a criterion for success.

CONCLUSION

The success rate of IR is far below than routine RCT or apical surgery. The most common causes of failure in intentionally replanted teeth are external inflammatory resorption or replacement resorption and ankylosis caused by periodontal ligament damage.

CLINICAL SIGNIFICANCE

In some cases, RCT or apical surgery is impossible or impractical. In these situations, IR may be considered as a last resort for preserving the tooth, so all clinicians should know about its indications/contraindications, surgical procedure, and complications following treatment.

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