

A Successful Intentional Replantation After Failed Regenerative Endodontics Caused by Foreign Body: 4-Year Follow-up

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Dear Editors,

Thin-root walls and divergent open apices of necrotic immature teeth are limiting factors in their endodontic treatment. The traditional treatment of these cases was long-term calcium hydroxide apexification or the placement of mineral trioxide aggregate (MTA). Although these techniques are successful, they cause root growth to stop and teeth become prone to root fractures because the dentin walls remain thin. Regenerative endodontic treatment (RET), in contrast to apexification and artificial apical barrier techniques in necrotic immature teeth, is a biological treatment based on revascularisation by bleeding in the canal and at the same time maintaining mineral deposition to strengthen dentin and grow roots. The outcomes of RET can be a high healing rate of 97% [1]. There are some important steps in RET technique. The root canal is disinfected with sodium hypochlorite (NaOCl) irrigation without mechanical instrumentation and the dried canal is filled with triple antibiotic paste (ciprofloxacin, metronidazole and minocycline). When the symptoms of infection have subsided, the antibiotic paste is removed and a blood clot is produced. Finally, the root canal entrance is sealed with MTA and the coronal restoration is permanently completed. When this technique is successful, root elongation, thickening of the root canal walls, apical closure and periradicular healing can be seen [1].

Intentional replantation (IR) is a treatment approach that consists of planned extraction of a tooth followed by evaluation and endodontic repair of the root surfaces, root resection, and retrograde hermetic sealing with a biocompatible root-end filling material and placement of the tooth back into its original socket [2]. IR is indicated in the following situations: crown-root fractures, external root resorption/perforations, failed non-surgical root canal treatment [3], periodontally compromised teeth, and when the patient refuses more expensive treatments. The contraindications to IR include periodontal involvement with excessive mobility of the tooth, septal bone loss in the labial or buccal region or at the bifurcation [2].

The most important advantage is that it allows direct visualisation of inaccessible areas of the tooth surface. In addition, ankylosis, external root resorption and enlargement of apical



radiolucency are expected complications [4]. IR maximizes the healing potential when performed with the correct indication and by current information and apical microsurgery. In addition, preoperative and intraoperative factors can significantly influence the prognosis [5]. The IR technique has been modified over time; today, atraumatic tooth extractions, root resection, and preparation are performed with piezoelectric systems. In addition, root-end filling is applied with current biomaterials [5].

In a meta-analyzed systematic review, the survival rate of intentionally replanted teeth was reported to be approximately 90% [6]. This case report describes the 4-year follow-up of IR treatment and devital whitening after the failed regeneration of a maxillary central incisor due to a foreign body.

Patient Information

A 10-year-old male patient was applied to our clinic with the complaint of severe pain in the anterior maxillary region. The patient had no systemic disease. The dental history revealed trauma on the right upper maxillary tooth #11 two years before, which resulted, according to his mother's statement in a crown fracture, but they didn't have treatment because there was no pain. Clinical examination revealed an uncomplicated crown fracture of tooth #11 and a black-grey-colored zone in the middle of the fracture line. Periapical radiography showed (Fig 1a.) that the tooth apex was open, a large periradicular lesion. It was decided to perform RET for tooth #11 and informed consent was obtained. A root canal access cavity was opened wide enough to see all the walls after local anesthesia (LA-Maxicaine 4%, VEM Medicine, Ankara, Türkiye). Working length was determined radiographically.

The root canal was gently irrigated with 20 ml of sterile saline and 20 ml of 2.5% NaOCl, provided that it was 1 mm shorter than the canal length, without any instrumentation. After checking the dryness of the canal with paper points, the triple antibiotic paste was placed into the canal with a lentulo spiral. The access cavity was filled with glass ionomer cement on a moist cotton pellet (Kavitan Plus Kerr, USA).

At second appointment 3 weeks later, there was no palpation or percussion pain and intraoral swelling on clinical examination. To apply Platelet-rich fibrin (PRF) for root canal revascularisation; the patient's blood was collected from a vein in the arm, and centrifuged using a PRF kit (Fig 1b). After LA with 3% mepivacaine, the temporary filling was removed. The antibiotic

paste was removed with irrigation with 20 ml of sterile saline and then 20 ml of 17% EDTA solution gently. Then, dried with sterile paper points. After checking that the root canal was dry and clean, a sterile 25 K-File (Dentsply Maillefer, Ballaigues, Switzerland) was passed 3 mm out of the apex and gently irritated the periapical tissues to induce bleeding [1]. While waiting for the blood to fill the root canal, PRF was sent into the canal. Then, a 3 mm thick layer of MTA was then placed in contact with the scaffold to seal the root canal orifice. The tooth access was temporarily sealed with a moist cotton pellet and glass ionomer cement on MTA. Two days later, the tooth was permanently restored with composite resin after the MTA set was confirmed (Fig 1c).

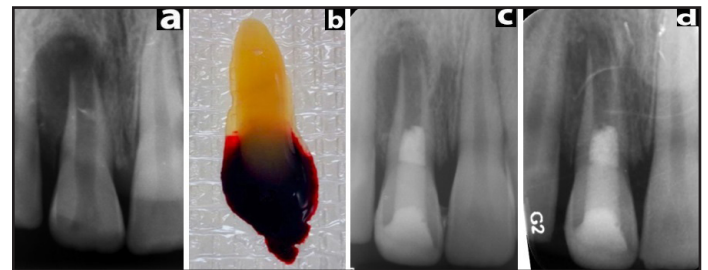


Figure 1.(a) Preoperative radiograph (b) PRF (c) Post-operative radiograph (d) Radiograph taken at 1-year of follow-up showing lesion

One year later, the patient came recall appointment (Fig 1d). The radiograph showed that the periapical lesion was still unhealed. The tooth was asymptomatic but there was discoloration in the crown. Devital bleaching treatment using sodium perborate bleaching agent was performed for 2 weeks. After 15 months treatment, the patient applied to the clinic with sinus tract and pus drainage at tooth #11. Amoxicillin, analgesics, and 0.12% chlorhexidine mouthwash were prescribed for 1 week. At the follow-up visit, the drainage was stopped, and the gingiva had healed. The patient didn't want Cone-beam computed tomography (CBCT) for economic reasons and periapical radiographs were taken. After discussing treatment options (apexification, regenerative endodontic retreatment, IR, removable appliance after extraction), a decision arose to perform an IR of tooth #11, and informed consent was obtained for the treatment plan from the patient's parents.

Two operators worked simultaneously to reduce the extraoral time of the tooth. The tooth #11 was gently extracted with dental forceps without root contact, without the use of a dental elevator after LA.

After tooth extraction (Fig 2a), a mass of granulation tissue and a foreign body were observed in the socket (Fig 2b). When asked, the patient reported that before the treatments he couldn't bear the severe pain and that he had stuck a pencil in his gums for relief and the pencil broke. While one operator prepared the tooth, the other operator prepared the socket for IR. The socket was curetted to clean only the apical lesion site and the whole was gently irrigated with sterile saline (Fig 2c).



Figure 2.(a) Intraoral image immediately after extraction (b) Pencil tip coming out of the socket (c) Cleaned socket (d) After retrograde filling

When performing extraoral procedures, sterile gauze was bitten to prevent contamination of the blood-filled socket [4]. On the other hand, while the tooth was held in forceps from the crown, 2 mm root tip resection was performed using a diamond bur, retrograde preparation and irrigation were performed. The root surface was moistened with sterile saline to prevent drying. After drying, the prepared retrograde cavity was filled with injectable MTA (BIOfactor MTA, Konya, Türkiye) (Fig 2d). The tooth was reinserted into the socket with finger pressure and occlusion was carefully checked [5] (Fig 3a). The extra-oral processing time was 8 minutes. The tooth was semirigid splinted for 4 weeks. When the patient came recall appointment after 1 week, there was no symptom and the gingiva was healthy.



Figure 3.(a) After IR radiograph; (b) Post-operative 6 months periapical radiograph; (c) Post-operative 4 years radiograph

Six months later, at follow-up appointment, there were no symptoms. Radiographic examination showed that the lesion had reduced in size and bone trabeculation had formed (Fig 3b). The patient attended the follow-up appointment every year. At the 4th

year follow-up appointment, the periapical radiograph showed external resorption of the root surface (Fig 3c). However, there were no symptoms. Since the patient stated that he wanted to use his tooth until the indication for extraction, the tooth was kept under follow-up.

Discussion and Conclusion

In this case report, the successful result of IR treatment applied after the RET technique, which failed due to the presence of a foreign body at the root tip of the tooth, although its success rate was high, is presented. Unlike apexification and artificial apical barrier techniques in the treatment of necrotic immature teeth, RET is a biologically based approach that revascularises the canal by causing bleeding in the canal and also continues mineral deposition to strengthen dentin and grow the roots of immature teeth [1]. In addition, in the ways described below, a scaffold or biological procedure is applied to stimulate the formation of vital tissue within the root canal: 1. blood clot revascularization (BCR), 2. platelet-rich plasma (PRP) 3. platelet-rich fibrin (PRF). In a study, stem cell scaffolds were compared and PRP and PRF were found to be more successful than BCR in terms of root apex closure, periapical healing response and root elongation [1]. In our case report, in addition to BCR formation with a K-file passed through the root apex, it was aimed to provide a scaffold by placing PRF. As a chemical irrigant, 2.5% NaOCl and sterile saline were used in the first appointment, and sterile saline and 17% EDTA were used in the second appointment as recommended in the literature. At the 2nd appointment of the RET, only irrigation with EDTA was recommended because EDTA supports the survival of stem cells of the apical papilla (SCAP). [7]. We irrigated the clean canal cavity with EDTA after removing the triple antibiotic paste using sterile saline at the 2nd appointment. SCAP are defined as mesenchymal stem cell populations located in the apical papilla around the root apices of immature permanent teeth and are known as the main cell source. In addition to dental pulp stem cells; periodontal ligament stem cells and bone marrow mesenchymal stem cells may also participate in pulp regeneration. All these cells need to be stimulated to migrate into the root canal space. It is thought that by removing the file from the apex during treatment, BCR is created and stem cells are stimulated for migration [7].

The outcomes of RET show a high survival and cure rate of 97%[1]. All treatment steps were performed following the literature and as recommended in the guideline. The patient's oral hygiene was at an acceptable level. However, RET failed

as the tooth presented with sinus tract and pus drainage at 15 months of follow-up. Unfortunately, the failure, in this case, can be explained by a foreign body reaction due to the broken pencil tip in the affected tooth area and inhibition of biological healing, as was later realized.

The treatment options for failing regenerative endodontic procedures, include apexification, regenerative endodontic retreatment, or IR [1,3]. In tooth #11, apexification or orthograde retreatment was not preferred due to the presence of a persistent periapical lesion involving the apical region and thin-short root walls. In addition, compared to alternative techniques, IR promotes healing by preserving the natural tooth and bone tissue and offers a conservative, cost-effective last resort option compared to tooth extraction and prosthetic rehabilitation.

IR is a procedure by intentionally extracting a tooth atraumatically and replanting it into original socket after the root-end resection is performed extra-orally [2]. According to previous studies, the shorter the extra-oral time and the more atraumatic the extraction, the higher the success rate [8]. Although some studies report that a single operator is more advantageous in that a single operator masters all aspects of the treatment and extraoral times are similar to those using 2 operators, many authors, such as Grossman [2], have recommended 2 operators during intentional replantation: one for tooth extraction and one for endodontic surgical manipulation. In this case report, two operators worked simultaneously to shorten the extraoral time and completed the procedure in 9 minutes.

In the literature, there is a consensus on atraumatic extraction without the use of dental elevators to minimize trauma to periodontal ligament (PDL) cells [5]. In this case report, the authors performed atraumatic extraction without the use of an elevator and with forceps grasping only the crown of the tooth; at the same time, the roots were continuously flushed with saline to prevent drying of the roots. Some studies have reported that curettage of the socket will damage the PDL cells. Therefore, they recommended removing the blood clot and irrigation with saline [4]. However, in this case, since there was a persistent periapical lesion, only the lesioned area of the socket was curetted and then irrigated with saline. To prevent ankylosis, a short-term splint that allows physiological tooth movement should be applied [8]. In this case report, the tooth was placed in the socket with finger pressure, a semirigid splint was applied for 4 weeks. After 4 years of follow-up, the replanted tooth had healed the periapical

lesion, with no percussion/palpation pain. Also, the tooth was aesthetic and functional. External root resorption, which was an expected complication as a result of IR, was present but there was no clinical mobility. Therefore, it can be considered an acceptable success after IR treatment.

Intentional replantation in correctly selected cases, such as in the presence of failed non-surgical root canal treatment, perforations, external root resorption and crown-root fractures, is a unique procedure that provides direct vision to the lesion site and has the potential to promote tooth preservation.

Sincerely yours,

Keywords: Dental Infection Control, Foreign-Body Reaction, Intentional Replantation, Pediatric Dentistry, Regenerative Endodontic Treatment , Tooth Bleaching

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