Root Maturation in Teeth Treated by Unsuccessful Revitalization: 2 Case Reports

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Abstract

This article deals with the unusual course of failed revascularization/revitalization cases. Up to this date the evidence of success and failure rates of revascularization/revitalization treatment is scarce. These case reports present "unsuccessful" revascularization/revitalization treatment of permanent immature teeth with apical periodontitis. Although the teeth were treated by protocol suggested by the American Association of Endodontists and the symptoms disappeared, maturation of teeth continued, and periapical lesion was reduced, the teeth went symptomatic during the follow-up. Subsequently, regular root canal treatment was performed. Despite chronic infection that was probably left inside the root canal after a disinfection protocol, the secondary aims of the treatment were achieved even when the primary ones were not. The possible causes of failures of revascularization/revitalization treatment and their prevention are discussed. *(J Endod 2016;42:724–729)*

Key Words

Apical periodontitis, immature tooth, revascularization, revitalization, root maturation

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The first case report of modern regenerative endodontics that used principles of tissue engineering was published in 2001 (1). From the beginning of the performance of the revascularization/revitalization procedure, great emphasis has been placed on root canal disinfection. It had been assumed that in the absence of bacteria and necrotic tissue and if scaffold with stem cells or growth factors are present, regeneration of dental pulp would be feasible (2). The first revascularization cases used high concentrations of hypochlorite and a multiple interim medication mixture of antibiotics to control bacterial infection (3). The concentration of antibiotics in these mixtures reached 1 g/mL, which was subsequently found to be cytotoxic for stem cells of apical papilla (SCAP) (4), and lower concentrations of 1 mg/mL or the usage of $Ca(OH)_2$ were proposed (5). Later the conditioning of dentin with high concentrations of hypochlorite was shown to have a profound negative effect on the survival and differentiation of SCAP (6) and prevented stem cell attachment to the dentin surface (7). In addition, a high concentration of hypochlorite was discovered to be toxic to SCAP (8).

In 2007, the American Association of Endodontists in agreement with the American Academy of Pediatric Dentistry suggested the first treatment protocol for regenerative endodontic therapy and has revisited it since then. This treatment protocol follows laboratory procedures rather than clinical experience described in case reports and series. It consists of short time usage of a low concentration of hypochlorite, interim medication with low concentration of triple antibiotic paste or $Ca(OH)_2$, and prolonged usage of EDTA. Experiments showed that residual bacteria persisted in noninstrumented recesses of root canals and in isthmi, and that it was impossible to remove them by hypochlorite (9) or by 2-visit treatment protocols (10). Consequently, reaching the goal of achieving a microbe-free canal by the root canal treatment is currently unattainable (11).

Until now, many complications of regenerative endodontic procedures have been described. The first was the discoloration of the clinical crown caused by minocycline or mineral trioxide aggregate (MTA). This esthetic complication does not impede the success of the treatment itself. Currently, it is possible to use other calcium silicate cements that are discoloration-free, bond access cavity (12), or use antibiotic pastes without minocycline. Another complication of the revascularization/revitalization treatment was the inability to induce bleeding from the apical papilla. This complication can be solved by the injection of platelet-rich plasma (13). Animal histologic studies suggest that although there is no difference between blood clot and platelet-rich plasma, there is a significant difference if there is no matrix inside the root canal system (14). Furthermore, the collapse of MTA on top of the blood clot was described (15). It can be reduced with the use of atelocollagen or oxidized cellulose. Another problem leading to poor clinical outcome is a lack of root maturation or the deposition of hard tissue (16, 17). On the other hand, the formation of a root apex is possible without regeneration of pulp (18). The information about failure is very scarce in the literature (19). It is related to limited deposition of mineralized tissue or development of tooth rather than to recurrent bacterial infection. No evidence has appeared to date in the literature about symptomatic revascularization/revitalization where maturation of root or hard tissue deposition had occurred and subsequently went symptomatic.

Figure 1. Case 1: diagnostic X-ray.

Figure 2. Case 1: 9-month follow-up.

Case Report 1

An 8-year-old girl was admitted to the pediatric emergency department at the Dental Clinic of Palacky University, Olomouc, Czech Republic for the evaluation and treatment of a maxillary anterior swelling associated with her permanent maxillary left incisor (Fig. 1). The tooth was slightly discolored, and an access cavity that was previously performed showed it filled with food debris. Responses to percussion and probing pocket depth were all within normal limits. A scar was apparent in the mucosa resulting from a previous incision. Palpation was mildly painful. A diagnostic x-ray showed that the tooth was in the third stage of root development and encircled by large radiolucency. The tooth was diagnosed as acute exacerbation of chronic apical periodontitis. The dental history disclosed that the patient was treated a week earlier as a dental emergency patient where the access cavity and incision for drainage were performed. The dental history also disclosed the patient had suffered dental trauma nearly 6 months earlier, sustaining a noncomplicated crown fracture of her permanent maxillary left incisor. No treatment was offered since then. After an interview with her parents, an informed consent for revascularization treatment was obtained.

The treatment was accomplished according to the clinical protocol recommended by the American Association of Endodontists. During the first appointment, local anesthesia 4% articaine with 1:200,000 epinephrine (Supracain 4%; Zentiva a.s., Prague, Czech Republic) and a rubber dam were applied, and the access cavity was redesigned. After that, the orientation working length was established by an electronic apex locator and verified by measuring x-ray. The root canal system was rinsed with 1.5% hypochlorite for 5 minutes and subsequently with 5 mL saline and then dried. Calcium hydroxide was injected into the coronal third of the root canal and covered with sterile Teflon tape, temporarily restoring the access cavity with glass ionomer cement.

After 3 weeks, the patient was completely free of symptoms when she returned for further treatment. In local anesthesia, 4% mepivacaine (Mepivastesin; 3M ESPE, St Paul, MN), a rubber dam was applied, and a temporary glass ionomer restoration with Teflon tape was removed. The root canal system was irrigated for 20 minutes with 17% EDTA with a final rinse of 5 mL saline. Afterwards, bleeding from apical papilla was induced with the help of sterile ISO 25 K-file, with the tip bent by 30°. Ten minutes were allowed for the blood clot to reach a level of around 2 mm under the cementoenamel junction. White MTA (ProRoot MTA; Dentsply Tulsa Dental, Johnson City, TN) was mixed with sterile water and applied over the blood clot together with sterile paper points. Then the access cavity was cleaned, and a thin layer of self-adhering composite (Vertise Flow; Kerr Corporation, Orange, CA) was placed atop the MTA to prevent the displacement of MTA. The tooth was then adhesively restored with composite material.

During the follow-up 3, 6, and 9 months later, the patient was completely asymptomatic. Compared with her adjacent and contralateral teeth, her central left incisor was within normal