Case Report

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# Regenerative endodontic procedure of permanent teeth with incomplete root development after application of a devitalizing agent – a case report

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## Abstract

*In the recent years, there is a common belief that regenerative endodontics can provide high success rate in the treatment of permanent teeth with incomplete root development and in general to improve their long-term prognosis. New protocols are constantly being explored to improve the chances of a successful healing process. This case report demonstrates the effectiveness of the protocol in the treatment of fractured maxillary central incisors with incomplete root development and necrotic pulp and previous treatment of the pulp with devitalizing agent. It uses 2.5% hypochlorite, EDTA and saline for irrigation. The most distinctive feature is the use of minimal mechanical preparation of the channel walls with XP-Endo Finisher for 1 min. Clinical follow-up at 24 months showed fully functional asymptomatic teeth with completely formed root walls and closure of the apex.*

***Keywords: regenerative endodontic procedure, XP- Endo Finisher, immature permanent teeth***

## Introduction

Trauma is common in children in the period of mixed dentition. The riskiest age is 8 - 10 years, and in 97% of cases the incisors are affected, often with pulp exposure [1]. In a clinical situation like this pulp necrosis may occurs if proper and timely treatment is not carried out [2]. During this period the root development of the maxillary permanent incisors is not complete, which makes the treatment of complicated fractures difficult and unpredictable [3]. It is important to have continuation of root development and closure of the apex of the tooth, without which the endodontic treatment would not have long lasting success.
In recent years, regenerative endodontic procedures (REP) have become increasingly popular in the treatment of immature permanent teeth with necrotic pulp. They have a higher chance of increasing the length and thickness of the root walls than apexification with calcium hydroxide or MTA [4].
Regenerative endodontics includes biologically based procedures designed to physiologically replace damaged tooth structures such as root dentin and pulp - dentin complex [5]. It uses three main elements - stem cells, growth factors and biomaterials [6]. Survival of stem cells from apical papilla (SCAP) is crucial for inducing regeneration or repair in REP [7]. This task becomes more complicated after the use of devitalizing pastes. Although contraindicated in teeth with incomplete root development, they are still used by some dentists [8]. A review of the specialized literature did not show any successful regenerative endodontic procedures in immature permanent teeth after application of devitalizing paste.

## Case Report

A seven-year-old girl without any general diseases was referred to the Department of Pediatric Dentistry. The parents reported fall injury during playtime with fracture of both maxillary central incisors (Figure 1a).


**Figure 1. Condition immediately after the injury (a), after first visit in the dental office (b), intraoral view (c), remnants from the pulp after application of devitalizing agent (d).**

They visited the family dentist one hour after the injury where devitalizing paste was applied on both teeth. In the next visit a week later, an attempt was made to extirpate the pulp. Due to the presence of pain, the devitalizing paste was reapplied. This step was repeated once more without extirpation of the root pulp. On the fourth visit, an eugenol based medication was placed in the pulp chamber, and in the next - calcium

hydroxide with iodoform without any attempts for pulp extirpation. After the last visit, there was constant severe pain, which rarely responded to analgesics. In this event of an emergency, one month after the injury, the parents sought help in the Department of Pediatric Dentistry.

**Clinical examination**

Extraoral status

No facial asymmetry was found. Enlarged lymph nodes were not palpated.

Intraoral status

A horizontal crown fracture of tooth 11 and oblique crown fracture of tooth 21 were observed. There was visible endodontic access in both teeth, sealed with temporary filling (Figure 1b, c). The cold test was negative. Teeth were sensitive on percussion and palpation with first degree of mobility. The patient's oral hygiene was neglected.

**Radiographic status**

The X-ray showed presence of radiolucency in the periapical area of teeth 11 and 21. The teeth were immature with wide open apices. The presence of intracanal medication in the coronal third of the root canals was also visible.

**Diagnosis and treatment plan**

Teeth 11 and 21 were diagnosed with symptomatic apical periodontitis based on the symptoms and the data from the clinical examination: the presence of spontaneous pain, unresponsive to nonsteroidal anti-inflammatory drugs, pain on percussion and palpation of the periapical area, presence of mobility and negative cold test. After discussing the treatment options (apexification or REP), the possible risks and benefits, informed parental consent was obtained. It was decided to treat the teeth with REP.

**Treatment**

First stage

The clinical symptoms and the condition of the teeth necessitated emergency treatment. Infiltration anesthesia without epinephrine was used to increase patient comfort. The teeth were isolated with a rubber dam and the working area was disinfected with povidone iodine for 1 minute. This was followed by removal of the temporary filling and careful irrigation with 2.0% solution of sodium hypochlorite (NaOCl, Chloraxid 2.0% / Cerkamed, Stalowa Wola, Poland). The preliminary working length was determined using an apexlocator (Raypex® 6 Apex Locator, VDW GmbH, Munich, Germany), and then the root canal walls were gently scraped with a hand K-file. During this manipulation no bleeding from the root canal was detected, which confirmed the pulp necrosis (Figure 1d).

The canals were then prepared with XP-endo Finisher (FKG Dentaire SA, La Chaux de Fonds, Switzerland) for 1 minute, irrigated with sodium hypochlorite, EDTA 17% (ENDO-Solution, Cerkamed) and saline, and dried with sterile paper points. A triple antibiotic paste of clindamycin, metronidazole and ciprofloxacin, made ex tempore in a macrogol vehicle, was inserted as a canal dressing. The access was sealed with glass-ionomer cement as temporary filling (GC Fuji IX GP, GC Corporation, Tokyo, Japan).

Second stage

The patient visited the office again after 4 weeks. At this stage, there was no pain on palpation and percussion, and the mobility of the teeth was normal. The lack of symptoms and the results from the clinical examination allowed us to proceed with REP. Infiltration anesthesia without epinephrine (mepivacaine

Septodont, CEDEX, Saint-Maur-des-fosses, France) was administered and the teeth were isolated with a rubber dam. Both teeth were treated with the same protocol. The root canals were irrigated with NaOCl and EDTA and prepared for 1 min with XP-Endo Finisher. Final irrigation with 5 ml of saline followed. The liquid in the canal was dried with sterile paper points. Bleeding was provoked in the root canal with a sterile needle, by carrying it 1-2 mm outside the apical foramen. After the formation of the blood clot, a small piece of hemostatic sponge (Surgispon, Actavis, Bulgaria) was placed and bioactive cement (Biodentine, Septodont, CEDEX, Saint-Maur-des-fosses, France) was condensed over it with thickness of 3 mm. The teeth were closed with temporary filling.

Third stage

The hardness of the cement was checked and the teeth were restored with resin composite (Figure 2).

**Figure 2. Direct restoration of the fractured teeth**

Control X-ray at 6 and 24 months showed healing of the periapical lesions and increase in the thickness and length of the root walls with apical root closure (Figure 3).

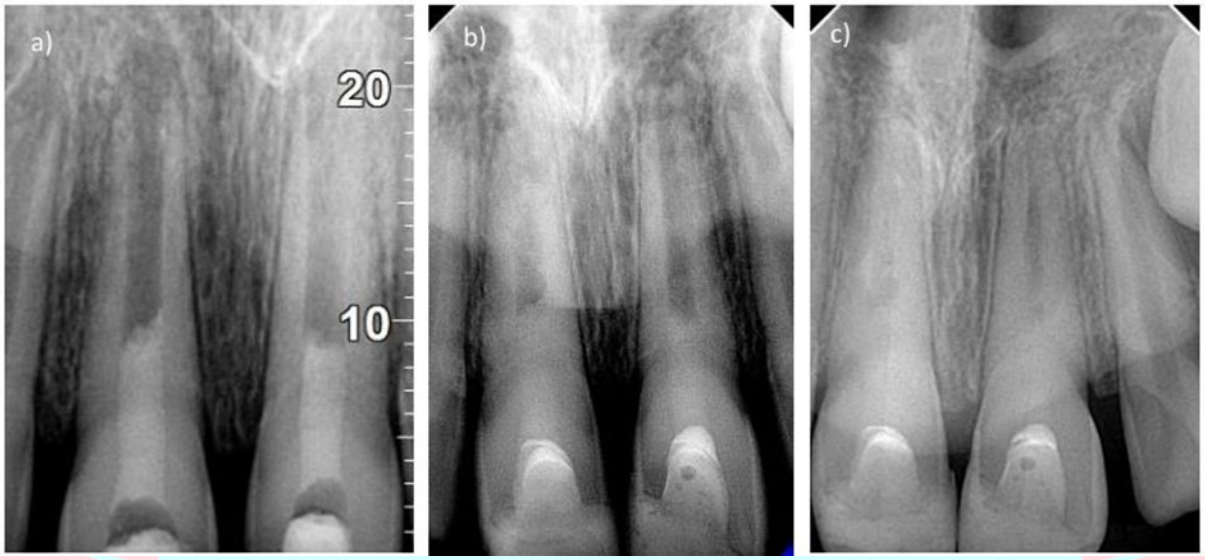


**Figure 3. Control X-ray immediately after REP (a) and follow-up X-rays after 6 (b) and 24 (c) months.**

## Discussion

This clinical case presents a successful REP in the treatment of immature permanent teeth after application of a devitalizing paste. Permanent teeth with incomplete root development are a clinical challenge as incorrect clinical decisions can lead to their loss and related consequences such as disturbances in jaw development, chewing, speech and aesthetics [9, 10]. Apexification technique is often preferred in immature teeth, but when the root walls are too short and thin, REP should be the treatment method of choice as it provides a better long-term prognosis of the tooth [10]. The purpose of this procedure is to increase the length and thickness of the root canal walls, and lead to apical closure [11]. Certain conditions are required to achieve this goal: the presence of stem cells, scaffold and growth factors [11]. The vitality, proliferation and differentiation of stem cells from apical papilla (SCAP) have been shown to be easily affected by inflammation, irrigants and medications in culture [12, 13]. The use of devitalizing paste in presented case might have caused harmful adverse effects on these cells. Despite these concerns a successful REP was achieved with full completion of root development.

Complete decontamination of the root canal is required in order to achieve success in REP. Most protocols use irrigantion with 5.25% sodium hypochlorite. However, studies have shown that high concentrations have a toxic effect on SCAP [14]. Therefore, in this case we used lower concentration of 2 % in the root canal.

It was crucial in the presented case to remove all remnants from the pulp that were necrotic or infiltrated by a devitalizing agent. Immature permanent teeth have larger root canals and the dental pulp is with extensive vascular supply. These factors allow faster and easier penetration of devitalizing agent to the periapical tissues, thus leading to negative impact on the stem cells located in the growth zone [15]. Therefore, in addition to the root canal irrigation we used minimal mechanical preparation of the canal walls with XP-endo Finisher for 1 min. It has been proven that combining XP-endo Finisher with EDTA solution improves the removal of smear layer and intracanal dressings and reduces the microbial load, thus limiting the need to

use higher concentration sodium hypochlorite [16-18]. At the same time, XP-endo Finisher leads to minimal loss of root dentin in immature permanent teeth [19].

## Conclusion

In the presented case, regenerative endodontics allowed successful treatment of immature permanent teeth with necrotic pulp due to the use of devitalizing agent.

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