

Regenerative Endodontics in Traumatized Young Permanent Tooth

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Abstract

Introduction: Revascularization is new treatment modality and is very valuable treatment option for immature necrotic teeth with open apex.

Methods: An 8-year-old boy with traumatized upper right central incisor. The clinical and radiographical examinations revealed uncomplicated crown fracture, tenderness and periapical radiolucency with immature root. Revascularization was planned to treat the tooth. The tooth root canal was irrigated 2.5% NaOCl, followed by 2 weeks of triple antibiotic (metronidazole, ciprofloxacin and minocycline) paste. Then antibiotic paste was removed, bleeding was induced, and cavity was sealed with MTA.

Results: In clinical and radiographical examinations in follow up visits the tooth was asymptomatic and functional, periapical radiolucency was healed, and root continued to develop with apical foramen became narrower.

Conclusion: Revascularization is an effective treatment for immature necrotic teeth. In addition, triple antibiotic paste provides sterile environment for regeneration.

Keywords: Revascularization; Regeneration; Triple antibiotic paste; Immature tooth; Maturation

Introduction

Management of anterior tooth trauma related with loss of tooth vitality becomes complex when present in an immature tooth. It frequently leads to termination of root development with an open apex [1]. Generally, it was treated with apexification, which apart from being unpredictable, is also time consuming. Treatment modalities have taken a paradigm shift in the treatment of such teeth, where most of the cases are now being treated with revascularization [2]. In 1966, Rule and Winter documented root development and apical barrier formation in cases of pulpal necrosis in children. Ostby in year 1967 introduced the concept of revascularization. Hoshino et al. in 1996 used triple antibiotic dressing using ciprofloxacin, metronidazole and minocycline [3,4].

Revascularization is defined as replacement of damaged tissue by cells identical to the lost tissue, leading to the complete reestablishment of biological function [5]. Revascularization promotes the normal pulp physiological functions and helps in healing of apical periodontitis, root development, and restoring normal sensation [6]. Disinfection of root canals for revascularization has been documented by two methods in the literature: one using calcium dihydroxide and second using triple antibiotic paste both are two step procedures [7].

This article presents a case of revascularization of traumatized anterior tooth based on the procedures of providing an environment suitable for root maturation through disinfection of root canal using triple antibiotic mixture as an intracanal medicament and inducing blood clot for revascularization.

Case Report

A healthy 8-year-old boy reported to the Department of Pedodontics and Preventive dentistry, with sharp, continuous pain in upper right tooth. He gave the history of trauma to the maxillary central incisors one week before. On intraoral examination, an uncomplicated crown fracture was observed in the maxillary right central incisor involving the pulp. The tooth was tenderness on percussion, and slight mobile.



Figure 1: A radiolucent periapical lesion.

The associated gingival tissue and vestibular region seemed normal. The left central incisor had only enamel fracture and was completely asymptomatic. A diagnostic intra oral periapical radiograph was taken

which showed fractured crown exposing the pulp chamber in 11. The root apex was incompletely formed along with a radiolucent periapical lesion (Figure 1).

The pulp tested non-vital and thus a diagnosis of apical periodontitis was made. Revascularisation for the traumatized tooth was planned and parental consent was obtained for the same after explaining the procedure to the parents. Access was gained into the pulp chamber under local anesthesia and rubber dam. The pulp was completely extirpated from the pulp chamber using a spoon excavator and from the canal with a barbed broach. Instrumentation was not carried out in the canal and copious irrigation was done using 2.5% sodium hypochlorite and saline.

A consistency of creamy paste was made by mixing equal proportion of metronidazole (Flagyl, Piramal healthcare), ciprofloxacin (Northstar Rx LLC, Memphis) and Minocycline (Ranbaxy laboratory limited) with sterile water. After drying the canal with paper points, this triple antibiotic paste was condensed into the canal space using a blunt end of sterile paper points. Access cavity was sealed off using temporary filling material and the patient was given an appointment two weeks later. On the second visit, the tooth was completely asymptomatic, rubber dam was applied, temporary filling was removed, and canal was irrigated with 2.5% sodium hypochlorite and saline to remove the entire medicament.



Figure 2: Periapical lesion sealed with glass ionomer cement.

Then, a sterile K-file was used to induce intracanal bleeding by inserting file 2 mm beyond the apical end of the canal. Approximately 15 minutes were allowed for clot to reach cemento-enamel junction and after which the clot was stable. MTA was mixed and applied over the clot. Further it was sealed with glass ionomer cement (Figure 2). At the end of 1 month follow up, the patient was asymptomatic with no pain or tenderness. Diffuse radiopacities within the confines of the canal space was seen on the radiographic evaluation (Figure 3). After 6 months, the radiographic evaluation showed significant apical development of the tooth as well as closure of the apex with narrowing of the canal space (Figure 4).

In the case of 21, initially only enamel fracture was suspected, and so composite restoration was preferred. But after one month, the tooth showed abscess. Similar procedure for revascularization was undertaken but the tooth did not heal and became tender. Eventually, it was endodontically treated.



Figure 3: Radiographic evaluation of Diffuse radiopacities within the confines of the canal space.



Figure 4: Radiographic evaluation of the tooth as well as closure of the apex with narrowing of the canal space.

Discussion

According to tissue engineering principles, stem cells, scaffolds and growth factors are three necessary elements for regeneration: periapical tissues and blood form the main sources of stem cells,

whereas the growth factors and scaffolds can come from the intracanal blood clot.

Pulp revascularization is dependent on the ability of residual pulp and apical and periodontal stem cells to differentiate. These cells have the capacity to generate a highly vascularized and a conjunctive rich living tissue. This one is able to colonize the available pulp space and subsequently, these stem cells will differentiate into newly formed odontoblasts that will induce an apposition of hard tissue [7].

Hertwig's sheath if survives in cases of apical periodontitis or abscess, determines the continued root development in revascularization. It may also be involved in the regulation of the differentiation of periodontal ligament stem cells with the formation of cementum [8].

Case selection also plays an important role in this type of treatment plan. An apical opening greater than 1 mm in a mesiodistal dimension radiographically has higher success rate as it allows ingrowth of vital tissue [9]. According to Kling an apical opening greater than 1 mm mesiodistally was associated with successful revascularization of avulsed permanent teeth, while no revascularization was seen in teeth with smaller apical opening [10].

Instrumentation was not done as it may damage the fragile dentinal walls and can also cause injury to the stem cells present in the apical area of these dentin walls. Apical area also harbors growth factors which along with other cells are essential for the regeneration process which might be eliminated due to instrumentation. The odontoblasts and epithelial cells of Hertwig's Sheath are present in large quantity in the apical area of immature teeth and are capable to resist inflammation. These cells are able to differentiate into secondary odontoblasts that generate dentin on root canal walls and thus allow root maturation [7].

The canal was copiously irrigated with 2.5% sodium hypochlorite. The concentration of 2.5% is considered as best compromise between efficiency and lack of toxicity [7]. Cunningham showed that elevation of the temperature at 37°C of the 2.5% sodium hypochlorite solution potentiates its solvent power and its efficiency as well [11].

Hoshino stated that that each antibiotic used alone is ineffective against bacteria present in pulp, dentine, and apical lesions, while the trio of antibiotics allows complete sterilization of canals [12,13]. In the present case the triple antibiotic paste consisted of metronidazole (spectrum of anaerobic bacteria and protozoa), minocycline (spectrum of gram+ and gram-), ciprofloxacin (spectrum of gram+ and gram-), thus covering the whole spectrum of microbes. Metronidazole and ciprofloxacin may have the potential to induce the formation of fibroblasts [14]. Bose documented that the use of triple antibiotic paste shows the maximum percentage increase in thickness of the dentinal canal walls when compared calcium dihydroxide and formocresol [15]. Triple antibiotic paste is very efficient against bacteria often present in apical lesion and minocycline seems to be its most active component [7]. A bacteria free canal is a prerequisite for tissue regeneration but there will be no tissue growth in an empty space. So, induction of blood clot is of utmost importance, as its constituent's growth and differentiation factors from periapical tissue may acts as scaffold which will further promote the growth of new tissue in the disinfected necrotic immature tooth [9].

Lastly the coronal seal consisted of MTA followed by glass ionomer cement that provided a bacterial-tight seal.

Conclusion

Revascularization after sterilization via blood clot formation in immature traumatized teeth is a very simple, practical and promising approach that leads to apical hard tissue deposition. It also reduces possibilities of immune rejection and contamination as the canal is filled with patients own blood. The triple antibiotic paste seems to be the most suitable in order to avoid problems associated with calcium dihydroxide which include weakening dentinal walls, inducing tissue necrosis, and decreasing effectiveness by infectious exudates. The three antibiotics cover provides sterile root canals and also show minimum stem cells cytotoxicity when used in adequate concentration.

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