CASE REPORT

Pulp Revascularization of Non vital Immature Young Permanent Tooth: A case report.

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Abstract

Traumatic injuries to an immature permanent tooth may result in cessation of dentin deposition and root maturation. Novel revascularization endodontic procedure (REP) have been considered as alternative options for treatment of immature teeth with damaged pulp tissue. The continuous development of the root canal has been recognized as a major advantage of these techniques over traditional apexification approach. REP must consist of regenerative approaches in which necrotic pulp tissues are removed and replaced with healthy pulp tissue to revitalize teeth. The biological concept of REPs involves the triad of stem cells, scaffold and signalling molecules. Currently, repair rather than true regeneration of the 'pulp-dentine complex' is achieved and further root maturation is variable. The purpose of this case report is to illusrate the outcome of the revascularization endodontic procedure in non vital immature young permanent central incisor.

Keywords: Non-vital immature teeth, dental pulp stem cells, pulp regeneration, regenerative endodontics, revascularization, revitalization.

INTRODUCTION

REP is a treatment option for cases of immature teeth with pulp necrosis. An alternative approach with organic basis that unlike the technique of artificial apical barrier allows the continuation of root development and recovery of pulp vitality. Root canal preparation for REP consist of passive chemomechanical preparation performed with manual instrument and auxiliary chemical substances with antimicrobial property and low toxicity, antimicrobial medication placement and subsequent bleeding induction.[1]

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Single visit MTAapexification has traditionally been the treatment of choice for necrotic immature teeth. The goal of this treatment is to induce a hard tissue barrier apically to facilitate root canal filling. Nevertheless, this treatment modality does not promote root canal wall thickening or apical closure. This necessitates the need for an alternative treatment protocol conducive to continued root maturation with deposition of hard tissue, thereby strengthening the tooth and protecting against future loss or root fracture.[2]

The first case treated with this approach was published in 2001[1]. The objective of this article is to report the outcome of revascularization procedure in central incisor.

CASE REPORT:

A 9 year old male patient reported to the Department of Pediatric and Preventive Dentistry, Kothiwal Dental College and Research Centre, Moradabad; with the chief complaint of pain in upper front tooth region and he gave a history of trauma three months back.Pain was localized and non - radiatin

, moderate in intensity and dull in nature. His medical history was non-contributory.(Fig-a)Extraorally, no abnormality was detected,Clinical examination revealedEllie's class IV fracture i.r.t-21.

Fig (a)

Radiographic examination revealed that fractured 21 had incomplete root formation (Fig-b).The final diagnosis was chronic irreversible pulpitisirt 21. After evaluating all the other options, the treatment choice was pulp revascularization.

Fig (b)

Under local anesthesia with 2% Lidocaine and 1 : 800,000 epinephrine and rubber dam isolation, an access cavity was prepared i.r.t. – 21. Coronal pulp tissue was removed by using a high-speed sterile long shank round diamond bur under copious water spray. The canal was irrigated with sodium hypochlorite (NaOCl) and normal saline solution, and passively instrumented with manual K-fi les up to the apparent length of the tooth subtracted by 2 mm, and irrigation was done with saline solution. Triple antibiotic paste (Metromidazole + Ciprofloxacin + Minocyclin) was used as intracanal medication, followed by temporary tooth restoration is placed for 21 days.

On the second visit after 21 days the tooth was re-entered & irrigated with 2.5% sodium hypochlorite and rinsed with normal saline. The canal was then dried with paper points. A #40 K-file was used to irritate the apical tissues to induce bleeding into the root canal. The bleeding was allowed to reach the cervical part of the canal. Ten minutes later, after the formation of a blood clot, white MTA was mixed and placed over the clot carefully. A moistened cotton pellet was placed over MTA and the tooth was restored temporarily with Cavit. One day later the treatment was completed with double seal of GIC restoration on MTA for permanent restoration of this tooth.

Patient was recalled 1, 3, 4 and 6 months after the treatment. In clinical examination, the teeth was asymptomatic. In radiographic examinations after 1 month, there was slight thickening of the dentin walls. After 3 months, radiographic evaluation revealedthickening of the dentin wallsand increased root length.(Fig-c) Patient is still under follow up.

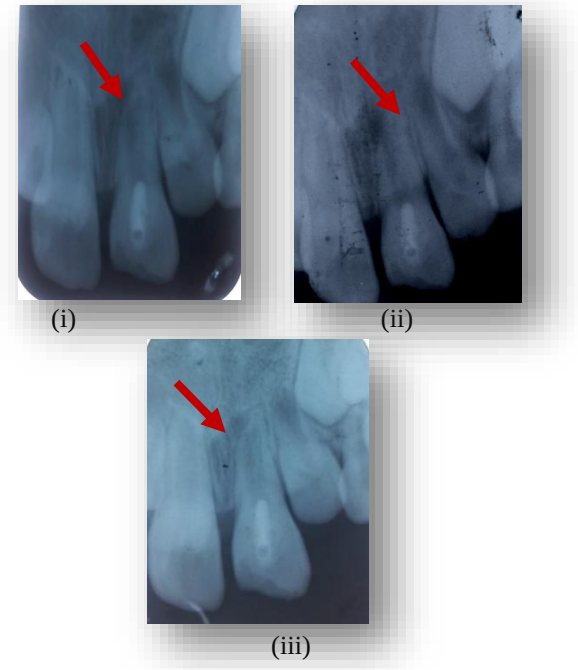

Fig C: (i) 3 months (ii) 4 months (iii) 6 months

Discussion:

A complicated crown fracture will always result in pulp necrosis if left untreated. The common method traditionally used for the treatment of necrotic open apex teeth has been apexification. Furthermore, apexification does not promote continued development of the root, leading to the risk of fracture of a short and weakened root or compromise the crown root ratio.[3]

Revascularization has been considered an alternative treatment modality. If the root canal of a necrotic infected tooth is effectively disinfected, regeneration should occur in the presence of a suitable scaffold.[2]The success of pulp revascularization treatment depends on three elements: root canal disinfection, the presence of a scaffold (blood clot), and hermetic coronary filling. The generation of a functional tissue requires three key elements: stem cells, growth factors, and a scaffold.[4]

Disinfection:

The removal of microorganisms by mechanical instrumentation in immature teeth is limited due to thin dentinal walls. Thus, cleaning these canals is generally achieved through irrigation and intracanal dressing.[2] Most of authors agree to advocate no instrumentation procedure. Using root canal instrument could not only increase fragility of dentin walls but also injure stem cells present in the apical area of these dentin walls.[3]

In cases of pulp revascularization, sodium hypochlorite at concentrations ranging from 2.5 to 6% or chlorhexidine in concentrations of 2% and 0.12% have been used as auxiliary chemical substances, yielding satisfactory clinical results.[1] Lower concentrations of NaOCl are now recommended as higher concentration significantly decreases the survival of stem cells of the apical papilla (SCAP).Furthermore the use of 17% EDTA resulted in increased SCAP survival expression as well as partially reversing the deleterious effects of NaOCl. EDTA demineralises the dentine and expose the dentine matrix which acts to release growth factors from the dentine matrix . EDTA conditioning of dentin promotes the adhesion, migration and differentiation of dental pulp stem cells towards or onto dentin. Exposure of the dentin matrix by EDTA also appeared to increase the adherence of newly formed mineralized tissue to the root walls.

Therefore, a final rinse with EDTA before inducing bleeding is advised.[5] Therefore the use of 1.5% sodium hypochlorite followed by 17% EDTA is currently the recommended irrigation protocol in REP and should be considered in future studies. Wigler et al. 2013[5]

Intracanal medicaments:

Most publications on revitalization report the use of antibiotic pastes as intracanal medicaments.[6]The first report of revascularization in an infected immature tooth in 2001 used a double antibiotic paste of metronidazole and ciprofloxacin[7].

Takushige et al. (2004) recommended that a combination of ciprofloxacin, metronidazole and minocycline efficiently eliminated bacteria commonly found in infected root canal dentine. The combination of these three antibiotics was called triple antibiotic paste (TAP) and has been widely used for revitalization therapies with good success. Due to severe and unfavourable discolorations caused by minocycline, this antibiotic was replaced by cefaclor in a modified mTAP (Thibodeau& Trope 2007). (Kim et al. 2010) which has further reported a similar antimicrobial effect of the tri-antibiotic and bi-antibiotic pastes. Furtherdisadvantages of antibiotic pastes include cytotoxicitydue to excessive concentrations in the described application (Ruparel et al. 2012), the problem of removability (Berkhoff et al. 2014) and the development of resistance and risk of sensitization, which are particularly problematic in young patients.

Thus, recommendations to date tend towards the use of calcium hydroxide, which does not exhibit cytotoxicity in tests with stem cells from the apical papilla (Ruparel et al. 2012) and has been successfully used in a number of case reports and case series (Cotti et al. 2008, Cehreli et al. 2011, Chen et al. 2012).

Concerns have been raised against calcium hydroxide as an intracanal medicament for revitalization procedures due to its property to break the carboxylate and phosphate groups in dentine hydroxyapatite, thus weakening root canal dentine and leading to an increased risk of root fractures (Cvek 1992)[6,8].

Induction of bleeding:

After disinfection of the canal and resolution of symptoms, REP usually involve lacerating the periapical tissues to initiate bleeding with hand file. The bleeding was allowed to reach a level 3 mm below the cementoenamel junction, and a moist cotton pallet was placed over it and tooth was left for 15 minutes so that a blood clot was formed. An important study demonstrated that the evoked-bleeding step in regenerative procedures triggers a significant accumulation of undifferentiated stem cells into the canal space. Contemporary regenerative endodontics follows principles of bioengineering with the foundation dependent on the interaction of stem cells, scaffolds and growth factors[8].

Effective coronal seal:

Once a blood clot or scaffold is in place within the canal, a coronal access is covered with a biocompatible material capable of inducting of mineral formation. MTAshould becarefully placed on top of the blood clotto achieving a hermetic coronal seal followed by glass ionomer cement or composite resin is placed over the MTA to provide double seal, preventing future contamination.

Most commercially available MTA products contain agents used to enhance its radio-opacity, such as bismuth oxide, an agent known to cause discolouration of teeth[6,9]. Biodentine can be used as an alternative to calcium silicate-based cement. Biodentine has the same mechanical characteristics as human dentin. Moreover, upon application of this material in a cavity, it seems to fully expand and fill the space by its plasticity. Another advantage is discoloration caused by grey MTA in the cervical area.

Both MTA and triple antibiotic paste, when used as intracanal medication are effective in assisting the development of the pulp dentin complex.Full root formation of immature teeth with pulp necrosis and periapical lesion is expected after 10 to 13 months after treatment onset.[1]

Mechanism:

Several researchers have tried to explain the mechanism of revascularization. Some have stated that a small amount of vital pulp tissue containing dental pulp stem cells (DPSCs) remains at the apical end of the root canal. These DPSCs retain tissue regeneration potential and can proliferate into the newly formed blood clot matrix and differentiate into odontoblasts, and deposit tertiary or tubular dentin.[8]

Another explanation is the presence of stem cells in the periodontal ligament and bone marrow, when released by over-instrumentation that can proliferate and grow into the apical end and within the root canal, thus depositing hard tissue both at the apical end and on the lateral root walls[10].

The most plausible explanation for the revascularization mechanismis stem cells residing in the apical papilla of incompletely developed teeth (SCAP). Because of its apical location, the apical papilla has collateral circulation that enables it to survive during the process of pulp necrosis. The step of inducing a blood column triggers a significant accumulation of stem cells into the canal space. Moreover, it contributes to the regeneration of pulpal tissues, and under the influence of surviving epithelial cells from Hertwig'sroots heath, can differentiate into primary odontoblasts to continue root formation.[7]

Teeth with incomplete root formation, necrotic pulp and apical periodontitis or abscess may have five different responses to pulp revascularization treatment: Type I, increasing the thickness of root canal dentin walls and continued root development; Type II, nonsignificant root development, but with closure of the apical foramen; Type III, continued root development, but without closingthe apical foramen; Type IV, calcification (obliteration) of the root canal; Type V, hard tissue barrier formed between the cervical MTA plug and the root apex.

Conclusion: It is concluded that pulp revascularization therapy is an appropriate treatment for necrotic immature teeth. Revascularization is a procedure that promotes thickening of the dentinal walls and closure of the apical foramen, thus preventing the tooth from being weakened.

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