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CASE STUDY

REVITALIZATION-A NOVEL TREATMENT PROTOCOL FOR AN IMMATURE PERMANENT TOOTH WITH CHRONIC APICAL ABSCESS

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ABSTRACT

A growing body of evidence is demonstrating the possibility for regeneration of tissues within the pulp space and continued root development in teeth with necrotic pulps and open apexes. The immature root with a necrotic pulp and apical periodontitis presents multiple challenges to successful treatment. The purpose of this case report is to present the case of a patient wherein revascularization of the necrotic infected pulp space of an immature permanent maxillary central incisor tooth was induced in vivo by stimulation of a blood clot from the periapical tissues into the canal space. This was achieved after disinfection of the canal space with a topical antibiotic paste followed by a blood clot scaffold induced from the periapical tissues. This treatment approach offers clinicians great potential to avoid the need for traditional apexification with calcium hydroxide or the need to achieve an artificial apical barrier with mineral trioxide aggregate. Furthermore, this treatment approach can help rescue infected immature teeth by physiologically strengthening the root walls.

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INTRODUCTION

During the process of tooth development, Hertwig's epithelial root sheath is the main component playing important role in root formation. It is formed by the cervical loop which results from fusion of the inner and outer dental epithelium1. The healthy pulp is utmost necessary for development of root and apical closure. If dental pulp injury occurs prior to complete root formation and apical closure, normal root development is halted. This condition produces several complications. Firstly, the apical diameter of the canal is often larger than the coronal diameter, so debridement is difficult. Secondly, the lack of an apical stop makes the obturation in all dimensions virtually impossible. And finally, the thin walls of the root canal are prone to fracture, so that surgical treatment is generally not a viable option. There are number protocols to manage non-vital open-apex teeth such as apexification, apical barrier technique (one-visit apexification), orthograde root filling using MTA, triple antibiotic paste, and tissue engineering concept 2-5. Hargreaves et al have identified 3 components contributing to the success of this procedure. They include stem cells that are capable of hard tissue formation, signaling molecules for cellular stimulation, proliferation, and differentiation, and finally, a 3-dimensional physical scaffold that can support cell growth and differentiation6. Various combinations of topical antibiotics have been successfully used to treat and disinfect infected root canals. One of combination that is effective against the infected root canal pathogens is the use of: (1) ciprofloxacin; (2) metronidazole; and (3) cefaclor 7. A sterile root canal system is a require for tissue regeneration, but tissue will not grow into an empty space. Rather, a scaffold is mandatory to help in growth of new tissue into the canal space. Inducing blood clot containing growth and differentiation factors from the periapical tissues, can serve as a scaffold for the in growth of new tissue in the disinfected necrotic immature tooth. The blood clot consists of cross-linked fibrin that may provide pathway for the migration of macrophages and fibro-blasts from the periapical area. Granulation tissue provides osteogenic cells important for bone formation. In the present case report, we describe the use of this protocol to stimulate the continued root development in a case of trauma-induced necrosis and sinus tract of an immature permanent central incisor.

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Case report

A 9 year-old boy reported within the chief complaint of fractured front tooth with a swelling associated with it (Figure 1). The patient was accompanied by his father, who reported that his son had suffered a traumatic injury to the maxillary central incisors about 3 month earlier.

Figure 1. Preoperative clinical photograph illustrates Elli's class IV fracture and a labial draining sinus tract

There were no symptoms immediately after this trauma. But he subsequently developed sensitivity to mastication subsequently he develop buccal swelling in same tooth region. Medical history was non-contributory. The clinical examination revealed the Elli's class IV fracture in the left maxillary central incisor. In addition, a sinus tract was present in the labial mucosa, roughly corresponding to the apical third of the root. The patient was asymptomatic, and sensitivity testing with cold elicited a negative response from the upper left central incisor and a positive response from the right central incisor. Radiographic examination showed that both the roots were immature with open apices measuring 2 mm in diameter with a periradicular rarefaction approximately 5x5 mm in size, extending on the apex of tooth 21(Figure 2).

Figure 2. Showing presence of immature open apex with periapical radiolucency

A pulpal diagnosis of necrotic pulp and a periapical diagnosis of chronic periapical abscess were made. The father of the patient was informed that this treatment was an attempt to initiate further root development, and that the proposed treatment might not be successful. A written informed consent was obtained from the patient's father. The tracing of the labial sinus tract was done with 35 number gutta percha cone (Figure 3). The tooth was isolated and a coronal access cavity was prepared on tooth 21.

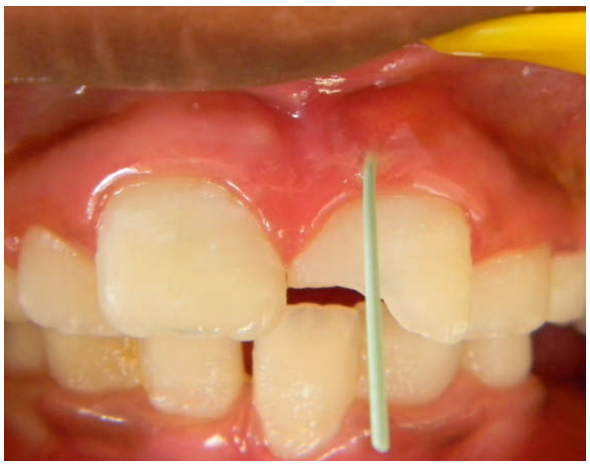

Figure 3. Tracing of sinus tract with 35 no. Gutta-percha cone

Figure 4. Access openning in left central incisor -After controlling the haemorrhage, viable tissue was observed in the canal

A size 10 K-file (Kerr, Romulus, MI, USA) was inserted into the canal and the patient reported discomfort, potentially indicating the survival of residual vital pulp tissue. The clinical diagnosis was revised from total pulpal necrosis to partial necrosis. The working length was determined by placing a large file in the canal and taking a periapical radiograph. A non instrumentation technique was used. For disinfection of root canal it was irrigated with approximately 10 mL of 5.25% NaOCl and dried with paper points. Equal proportions of ciprofloxacin (Bayer, Leverkusen, Germany), metronidazole (Shionogi and Co, Ltd, Osaka, Japan), and cefaclor (Shionogi and Co, Ltd) were ground and mixed with distilled water to a thick paste consistency and placed in the canal up to a depth of 8 mm in to the canal. This antibiotic mixture was placed in the canal using an amalgam carrier and packed with large endodontic pluggers. The access cavity was sealed with Cavit (ESPE, Chergy Pontoise, France). The patient returned to the endodontic clinic 22 days later. The patient was asymptomatic and reporting with no postoperative pain. The sinus tract was not present, and some reduction in the radiolucency was already evident. The access was opened and the canal again

flushed with 10 ml of 5.25% NaOCl. The canal appeared clean and dry, with no signs of inflammatory exudate. A 15 number sterilized K-file was introduced into the canal until vital tissue was felt at a depth of 15 mm into the canal space. File was used to irritate the tissue gently to create some bleeding into the canal. The bleeding was stopped at a level of 6 mm below the level of the CEJ and left for 15 min so that the blood would clot at that level. After 15 min, the presence of the blood clot to approximately 3 mm apical of the CEJ was confirmed (Figure 4). Mineral trioxide aggregate (MTA; Densply Tulsa Dental, Tulsa, OK) was carefully placed over the blood clot, followed by a wet cotton pellet and Cavit.

Two weeks later, the patient returned, asymptomatic, and the Cavit and cotton pellet were replaced with a bonded resin restoration. The patient was scheduled for recall examination and advised to call if he was in pain or if swelling or a recurrence of the sinus tract developed. At the 4-month follow-up evaluation, the patient was asymptomatic. Compared with his adjacent and contralateral teeth, his left central incisor was within normal limits regarding: (1) percussion; (2) palpation; and (3) pocket probing depths. The radiograph showed complete resolution of the radiolucency. The patient returned for another follow-up assessment 8 months from the time of the blood clot induction. He remained asymptomatic, with normal responses to: (1) percussion; (2) palpation; (3) pocket probing depths; and (4) mobility. The tooth remained nonresponsive to cold test. Radiographic evaluation disclosed significant apical development of the tooth. One year from the time of blood clot induction, the tooth remained asymptomatic—with normal responses to percussion and palpation and normal periodontal probing depths and mobility, but no response to CO2 or EPT. Radiographs revealed normal periapical structures with continued root development (Figure 5,6,7).

Figure 5. Post-op radiographs show MTA placement with a composite restoration

DISCUSSION

An immature tooth with early irreversible pulp involvement presents with thin divergent or parallel dentinal walls. This situation creates clinical challenges in disinfection, and as a result, affects the long-term outcome of the treatment. Traditionally, calcium hydroxide has been used as the intra-canal medicament in apexification procedures. However, because of its high pH it will cause necrosis of tissues that can potentially differentiate into new pulp. Moreover, even if rendered successful, apexification procedures will leave a short root with thin dentinal walls with a high risk of root fracture. Components needed for successful regenerative endodontics include absence of intracanal infection, coronal seal to prevent reinfection, a physical scaffold to promote cell growth and differentiation, as well as signaling molecules for the growth of stem cells.

Figure 6. Follow up radiograph after 4, 8 and 12 months

In the present case, we obtained disinfection of the root canals with the use of 5.25% NaOCl and triple antibiotics as suggested by other investigators. Revitalization of a pulp-like tissue for dentine deposition will allow further development of the root and dentinal structure with a better long-term

prognosis. This approach is technically simple and can be completed by using currently available instruments and medicaments. The regeneration of tissue in root canal system by patient's own blood cells avoids the possibility of immune rejection. Some variations on the original tri-antibiotic paste mixture have been used with good success8. These variations were tried because of the staining of the dentin by the antibiotic minocycline 9.

Figure 7. Postoperative Photograph after composite restoration

Either the minocycline is left out thus using a bi-antibiotic paste or cefaclor is used as a substitute for the minocycline. In the present case cefaclor is used instead of minocyclin to avoid the discoloration of coronal portion of tooth. In addition, the use of white MTA instead of grey MTA should also be considered. The modified protocol described in the present article is an attempt to avoid the undesired crown discoloration. Case selection is important in this treatment protocol. It should be encouraged and promoted for clinicians faced with pulp necrosis with an immature apex that is open greater than 1 mm in a mesiodistal dimension radiographically. The size of the apical opening must be sufficient to allow ingrowth of vital tissue. Kling10 suggested that an apical opening greater than 1 mm mesiodistally was associated with successful revitalization of avulsed permanent teeth, while no revitalization occurred in teeth with a smaller apical opening. If the attempted revitalization procedure fails, the traditional options of treatment remain, including long-term Ca (OH)2 apexification or MTA apexification followed by a conventional root filling. There are only a few limitations of revitalization. Long-term clinical results are as yet not available. It is possible that the entire canal might be calcified, compromising esthetics and potentially increasing the difficulty in future endodontic procedures if required. In case post and core are the final restorative treatment plan, revascularization is not the right treatment option because the vital tissue in apical two thirds of the canal cannot be violated for post placement.

Conclusion

Although the healing potential and defense mechanism of pulp have been long recognized, the intensity and the nature of the virulence of infection are still the determining factors for the outcome of pulp recovery. Immature teeth, by having a large and young pulp tissue and an open apex to allow good blood supply, remarkable healing potential has been observed in conditions that would not have been possible for mature teeth. The discovery and understanding of pulp stem cells provide us a better insight into the healing potential of the immature teeth. Along with an improved regimen of canal disinfection, it seems to be the right time to establish a new protocol for a paradigm shift in treating these infected immature teeth.

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