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Maturogenesis by Pulp Revascularization in an Immature Necrotic Permanent Tooth in a Pediatric Patient: A 15 Month Follow-up Case Report

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ABSTRACT

Endodontic treatment of immature necrotic permanent teeth is clinically challenging and poses a risk of inducing dentin wall fracture or extending gutta-percha into the periapical tissue during root canal filling. Pulp revascularization is a promising alternative for the treatment of such immature necrotic permanent teeth offering 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. Pulp revascularization allows the stimulation of the apical development and the root maturation of immature teeth by physiologically strengthening the canal walls. The present case report describes the case of successful revascularization of the necrotic infected pulp space of an immature permanent maxillary central incisor induced in vivo by stimulation of a blood clot from the periapical tissues into the canal space. Thickening of the canal wall and complete apical closure were confirmed 15 months after the treatment.

KEYWORDS

Immature permanent teeth; Revascularization; Scaffold; Apical closure

INTRODUCTION

The routine endodontic treatment procedures accomplish the chemo-mechanical preparation of root canals in order to eliminate necrotic or infected pulp tissues and microorganisms [1]. However, clinicians are often encountered with cases of immature teeth wherein trauma or infections prevent the root to complete its formation by halting mineral deposition. Adequate obturation in such teeth is often difficult to achieve and often poses a unique challenge to the dentist [2]. Conventionally, the treatment of choice in necrotic immature teeth was multiple-visit apexification with calcium hydroxide aiming at formation of apical hard tissue barrier. Alternatively, Mineral trioxide aggregate (MTA) has been used by placing it in apical portion of the root canal creating an artificial apical barrier that permits the compaction of obturating material and the placement of coronal restoration [3]. The dental literature has reported that both these techniques have high success rate and less number of appointments, but these treatment options do not strengthen the root or foster further root development. Lately, a new technique has been proposed to promote continued hard-tissue formation and root growth i.e. pulp

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revascularization. It is a biological based regenerative treatment approach [4], first attempted by Nygaard Ostby. Intentional over instrumentation was done to evoke bleeding followed by obturation to allow tissue in-growth into the root canal space [5].

The present case report describes a case of successful revascularization in necrotic immature central incisor using MTA with a follow-up period of 15 months.

CASE REPORT

An 8-years old male patient reported to the Department of Paedodontics & Preventive Dentistry at PGIDS, Rohtak with the chief complaint of pain in right front tooth region since past one week. It was throbbing, moderate in intensity, continuous in nature, non-radiating without nocturnal variations. No relevant medical history and allergies were reported. On extra oral examination, no swelling or gross facial asymmetry was detected. On intraoral examination, the right maxillary central incisor tooth had Ellis class 3 fracture with positive tenderness on vertical percussion. It was non-vital. Radiographic examination revealed incomplete root formation with presence of periapical lesion in respect to 11 (Figure 1). The diagnosis of pulp necrosis with chronic periapical abscess was confirmed. After evaluating the options, the treatment of choice was pulp revascularization. The parents were given detailed information regarding the treatment procedure and a written informed consent was obtained.

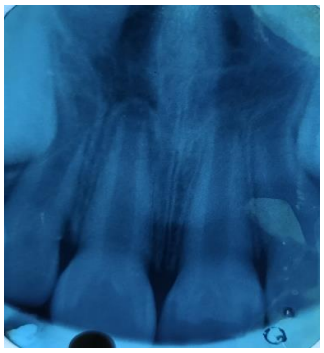

Figure 1: Pre-operative IOPA showing open apex and periapical radiolucency in respect to 11.

After obtaining adequate anesthesia and isolation with rubber dam with respect to permanent right maxillary central incisor, microscopic surgery was performed with high-speed round diamond burs No. 1015 (KG-Sorensen, Barveri, SP) under continuous irrigation with water spray at first sitting. Biomechanical preparation was done using crown-down technique up to the apparent length of the tooth subtracted by 2 mm by K-files #60, #55, #50 and #45 (Figure 2).

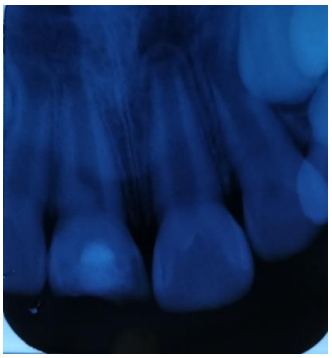

Figure 2: IOPA after access opening and biomechanical preparation.

On second visit after two weeks, root canal was irrigated with 5 ml of 1.5% sodium hypochlorite solution and 5 ml of normal saline. It was dried with sterile absorbent paper points and triple antibiotic medicament was placed using lentulospiral.

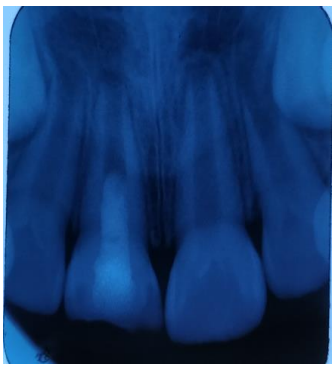

Figure 3: Scaffold formation.

On third visit after four weeks, the medicament was removed by thorough irrigation with normal saline. Root canal was irrigated with 5 ml of 1.5% sodium hypochlorite solution, 5 ml of 17% EDTA and 5 ml of normal saline. Bleeding was induced with a manual K-file #45. After 15 minutes, blood clot was formed and

MTA was placed over the coronal part of scaffold (Figure 3). The tooth was then restored with composite.

RESULTS

Follow-up visits were scheduled after 1 month, 3 months, 6 months, 9 months, 12 months and 15 months wherein radiographic images revealed continual disappearance of the lesion with slight thickening of the dentin walls (Figure 4 - Figure 9).

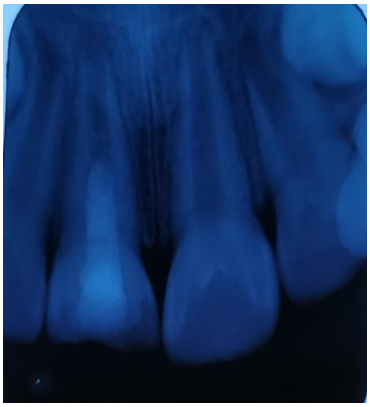

Figure 4: One-month follow-up.

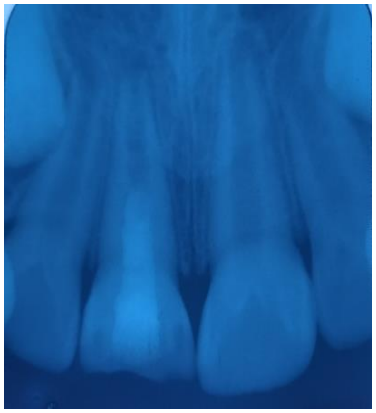

Figure 5: Three-month follow-up. Healing of periapical lesion is evident.

Figure 6: Six-months follow-up.

Figure 7: Nine-months follow-up. Increasing thickness of the dentinal walls i.r.t. 11.

Figure 8: One year follow-up.

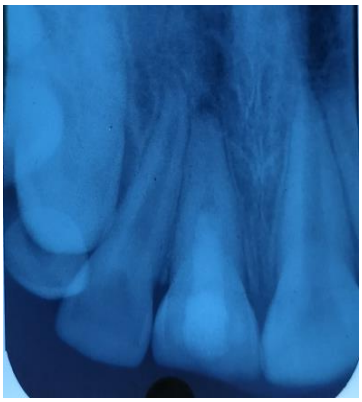

Figure 9: 15 month's follow-up. Closed apex i.r.t. 11.

DISCUSSION

The present era of regenerative endodontics intends to replace damaged, insufficient and missing structures with healthy, newly produced tissues, restoring the shape and function of the pulp-dentin complex. It is viable, easy to perform which allows complete root formation [6]. It works with a prerequisite that the root canal space should be free of contamination associated with a new

stimulated blood supply which can indeed re-establish vascularization, enhancing root completion.

Indications of pulp revascularization are presence of deep caries or trauma, which induce a stop in the development of root canal of an immature tooth. The present case reported met the above stated requirements. Two pulp revascularization techniques are found in the literature: one using calcium dihydroxide and another using a triple antibiotic paste for disinfection of pulp necrosis [2]. In the present case report second one was attempted. It is a two-step procedure. Second step takes place two or three weeks after the first one, only if the tooth is asymptomatic and if there is a visual reduction of the apical lesion. Success depends on root canal disinfection, the presence of a scaffold (blood clot), and hermetic coronary filling [2].

In the present study, irrigation was performed with sodium hypochlorite solution and EDTA. Irrigators play a role of primary disinfection. They should have a maximal bactericidal and bacteriostatic effect while having a minimal cytotoxic effect on stem cells and fibroblasts to allow their survival and ability to proliferate. EDTA-type chelators allow better wettability of the irrigator and removal of the smear layer [2,7].

Rule and winter introduced polyantibiotics into the canals, which resulted in thicker and continued root development as well as an apical barrier formation in pulp less teeth. Henceforth, keeping infection control in mind and considering the conditional role of microorganisms within the root canals, in the present study triple antibiotic paste consisting of metronidazole, ciprofloxacin and minocycline was placed on second visit to help control bacterial infection within the root canal space, more specifically in the periapical location. The pulp cells surviving behind might proliferate under the influence of Hertwig's epithelial root sheath even during the inflammation process; giving rise to odontoblasts that are able to propagate dentin formation at the apical end [8].

In the present study intra-canal bleeding was induced with a file to irritate the apex to bring in situ fibrin, platelets, and growth factors. The fundamental objective is to cause the formation of a blood clot in the canal space, which then serves as a scaffold to enable the three-dimensional in-growth of new tissue. This is in accordance with the authors who induced bleeding to form the clot acting as a scaffold for pulp revascularization [9,10].

The Mineral Trioxide Aggregate was placed over scaffold. It is hydrophilic in nature which makes it compatible with moisture and also challenges to seal communication between the root canal system and oral cavity. About 15 months later, CBCT images showed an increasing thickness of dentinal walls and an apical closure (Figure 10).

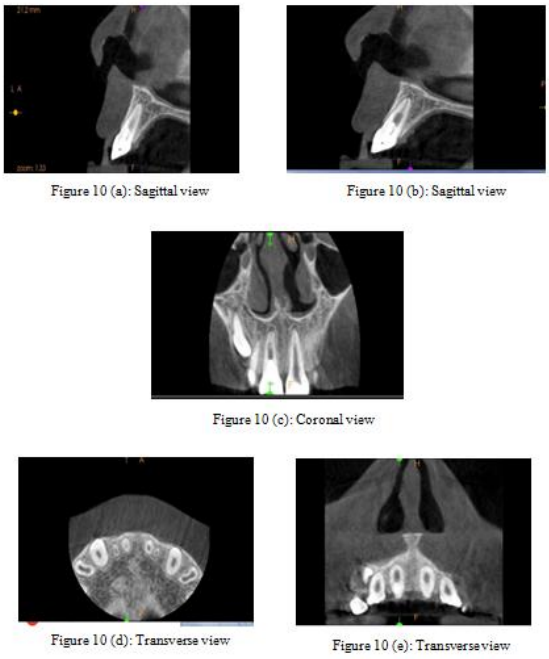

Figure 10: (a) to (e): CBCT sections of tooth #11 at 15-month follow-up showing an increase of root canal length and thickness with complete resolution of the periapical radiolucency and closure of the root apex.

CONCLUSION

The favorable results obtained in this case show that regenerative endodontic treatment of pulpally involved traumatized necrotic immature permanent tooth is a viable alternative.

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