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Revascularization of Necrotic Immature Upper Central Incisors with Opex Apex In 8-Year-Old Patient Using Platelet Rich Fibrin: A Case Report

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Introduction

Conventionally, treatment of necrotic immature young permanent teeth was achieved by long term application of multiple calcium hydroxide dressings or use of Mineral trioxide aggregate (MTA) to bring about apexification. Although, with time, the adverse effects of calcium hydroxide on multipotent stem cells (dental pulp stem cells, stem cells from apical papilla, etc.) were perceived leading to unpredicted failures.

Over the last few years, tissue engineering has gained importance in dentistry and is serving many treatment protocols efficiently. The concept of differentiation using viable stem cells from apical papilla and dental pulp tissue comprehended the clinical approach of regenerative endodontics.

According to American Academy of Pediatric Dentistry "Regenerative endodontics is defined as biologically based procedures designed to physiologically replace damaged tooth structure, including dentin and root structures, as well as the pulp-dentin complex" [1].

The goals of regenerative endodontics include elimination of clinical and radiographical signs/symptoms, apical healing, thickening of dentinal walls and continued root formation in necrotic immature young permanent teeth with open apex [1]. Literature holds evidence that even though pulp is necrotic but stem cells from apical papilla (SCAP), dental pulp stem cells (DPSC), periodontal ligament stem cells (PDLSC) and other residual stem cells usually survive which migrate, proliferate and differentiate towards angiogenesis, neurogenesis and mineralization [2]. To achieve the same, proper disinfection and minimal instrumentation is required which permit the multipotent stem cells to differentiate productively.

Triple antibiotic paste (TAP) as an intracanal medicament has been attaining significance in revascularization cases because of its several advantages over other medicaments (for e.g. Calcium hydroxide) in achieving periapical healing and root formation. Following the disinfection protocol and periapical healing, bleeding is induced in periapical region to form a blood clot which acts like a scaffold and further stimulates stem cells and growth factors. Other techniques are use of Platelet rich plasma (PRP) or platelet rich fibrin (PRF) which act as a scaffold and constitutes additional growth factors within it yielding better postoperative results. Majorly, MTA plug is formed at the orifice of root canal after revascularization protocol for effective seal to avoid any cross contamination. Succeeding to the clinical procedure, the success is defined both clinically and radiographically at follow up visits after a month.

Reviewing the principles and importance of revascularization for necrotic young permanent teeth with open apex in pediatric dentistry, the aim of this case report was to present clinical case records summarizing clinical and radiographic findings with appropriate evidence in justice.

Case Report

An 8-years-old male patient reported to the department of pediatric and preventive dentistry at I.T.S dental college and hospital, Murad Nagar, Ghaziabad with the chief complaint of dull, continuous, non-radiating pain in upper front teeth region for 1 week. Patient was asymptomatic until encountered trauma resulting in tooth fracture involving enamel, dentin and pulp with minimal loss of tooth structure (Figure 1 – A). No abscess or bleeding was observed.

On clinical examination, electric pulp testing was done in relation to 11 and 12 (upper central incisors) and the test in consequence was negative indicative of necrotic pulp (Ellis class IV fracture)

To evaluate radiographically, cone beam computed tomography (CBCT) small FOV scan of upper anterior teeth region was done along with IOPAR investigation. CBCT report commented the presence of

periapical lesion in relation to 11 and 21 with open apices (Cvek's classification III). After culminating the clinical and radiographic findings, the final diagnosis was declared as necrotic immature teeth with open apices in relation to 11 and 21. Following the diagnosis, revascularization of 11 and 21 was planned as the therapeutic option.

Priorly, the teeth were anesthetized with local anesthesia and isolated using rubber dam application. The access cavity was prepared to access the pulp chamber followed by irrigation of canal using 5.25% NaOCL solution. Working length was determined with 15 no. K-file, being mindful of the fact of minimal instrumentation. Consequently, canals were dried with paper points and triple antibiotic paste/3-mix paste (metronidazole, ciprofloxacin and minocycline in the ratio of 1:1:1) was made using glycol. 3-mix paste was then administered in the canals of 11 and 21, subsequently chamber was temporarily sealed with Cavit G (Figure 2 – B). Patient was kept on follow up of every 2 weeks and triple antibiotic dressings were changed every 2 weeks until resolution of periapical lesion was achieved. After 6 weeks, periapical healing was observed radiographically and patient was asymptomatic clinically as well. The paste was removed with copious irrigation of 5.25% NaOCL solution and the canals were dried with paper points again.

5 ml blood was drawn from patient's body after his consent and hand overed to pathology lab for centrifugation of blood to form platelet rich fibrin (PRF) (Figure 3). Thereafter, PRF in a sterilized manner was delivered to the canals and propelled till the open apex correlating it with working length taken. The orifices were sealed by an MTA plug of approximately 2 mm followed by composite restoration (Figure 2 – C). Patient was kept on periodic follow up of every 2 months.

At 24 months follow up, complete root formation and closed apex was appreciated radiographically (Figure 2 - D and E). Also, post-operative CBCT report summarized the findings of root apex formation and closed apex in relation to 11 and 21 with complete periapical healing (Figure 4 – C and D) Fortunately, the vitality of 11 and 21 was again examined by Electric Pulp test and the results were positive, indicative of vital pulp tissue.

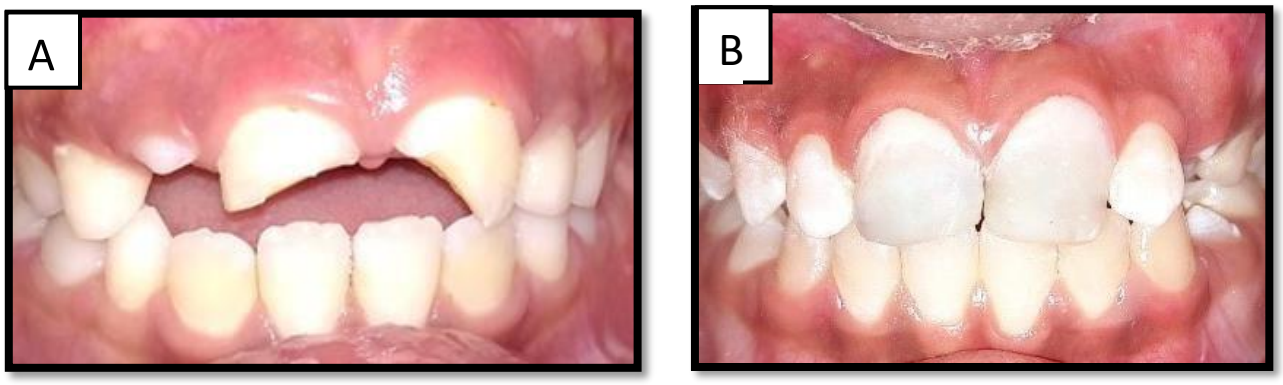

Figure 1: A) Pre-operative clinical picture B) Post-operative clinical picture

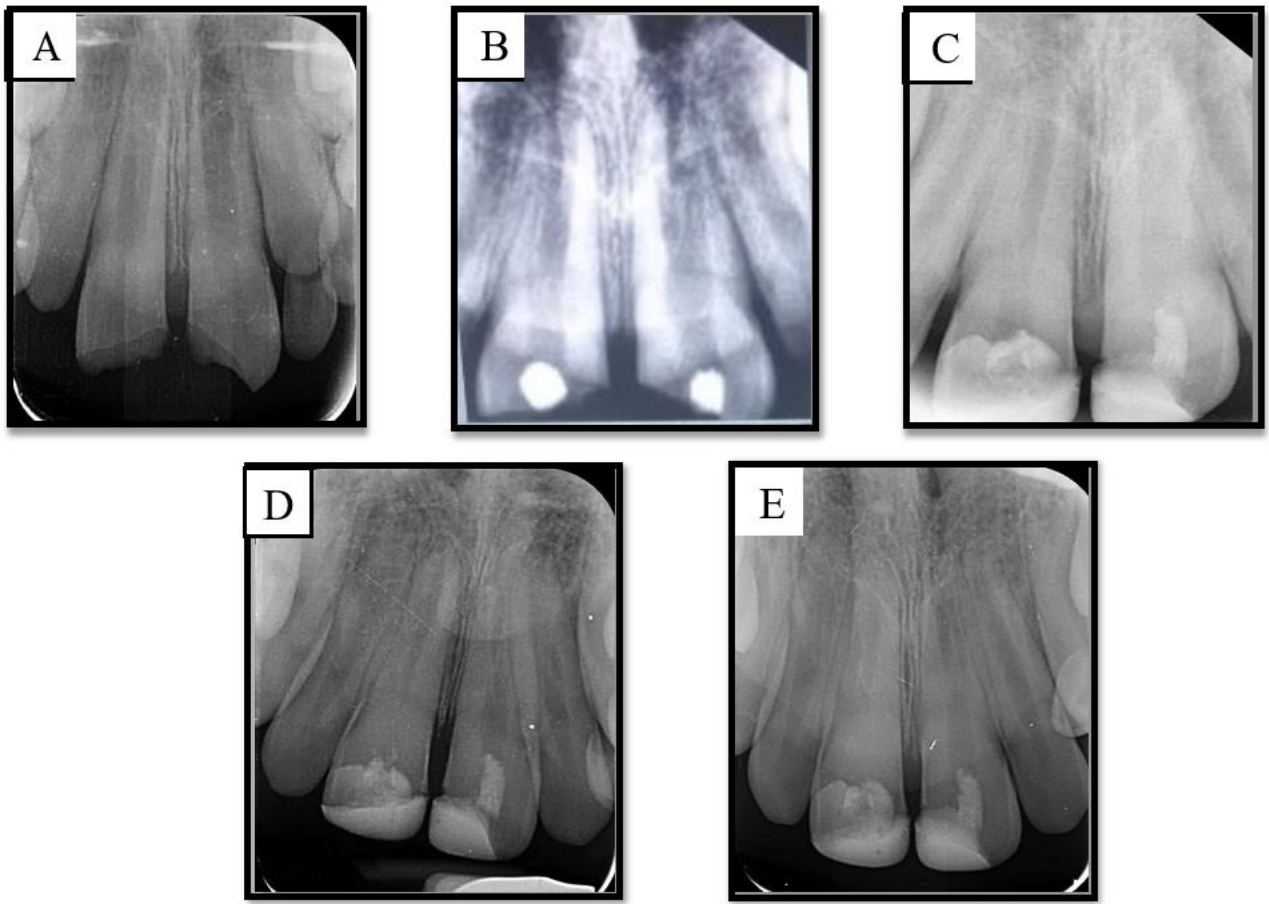

Figure 2: A) Preoperative radiograph depicting periapical lesion and open apices in relation to 11 and 21. **B)** Triple antibiotic paste was placed followed by temporary restoration. **C)** After 6 weeks, Revascularization with PRF was performed followed by MTA plug. **D)** and **E)** At 24 month follow up, root formation was observed

Figure 3: Photograph showing Platelet rich Fibrin

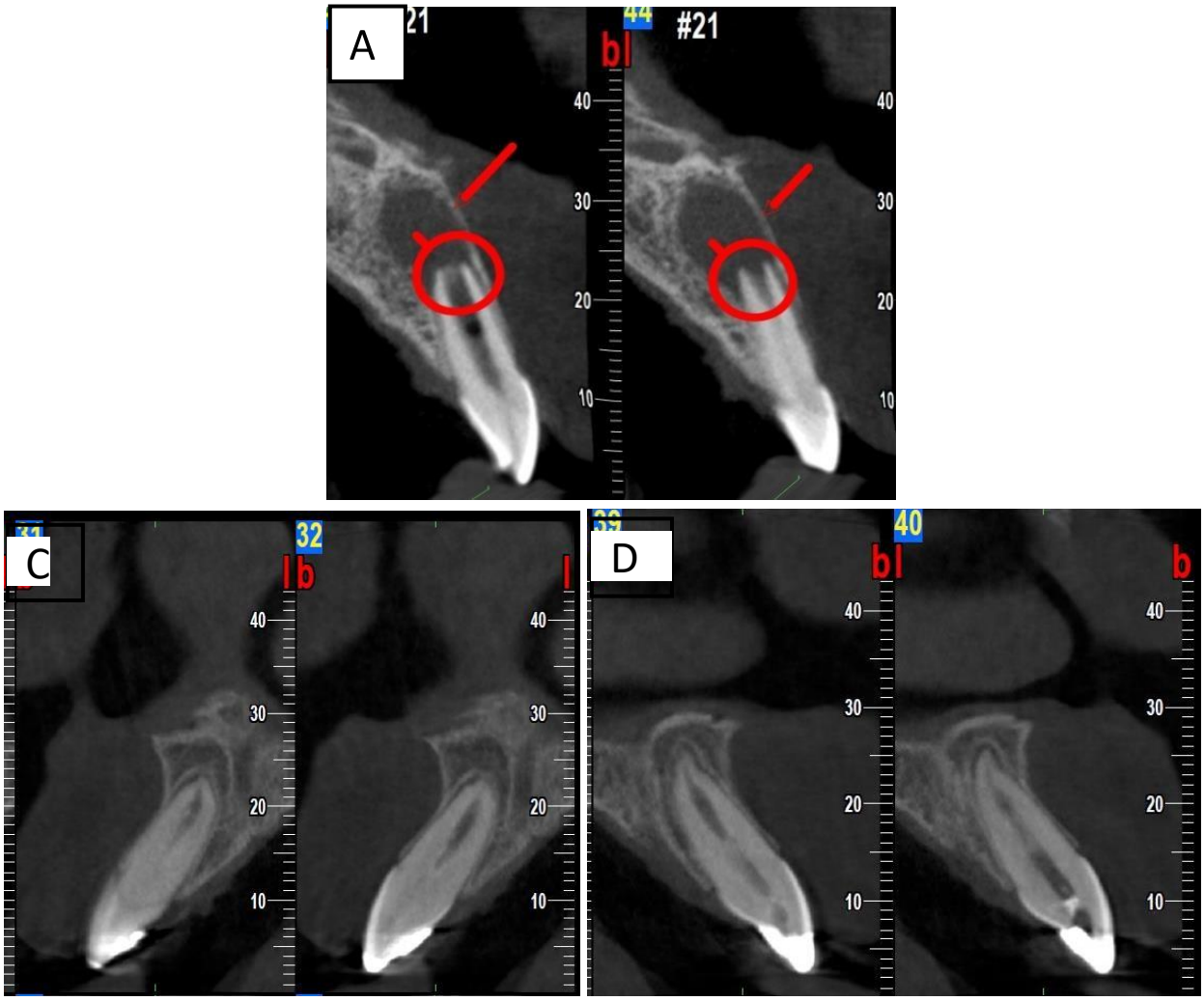

Figure 4: A) Pre-operative CBCT records showing open apices in relation to 21. **B)** and **C)** Poat-operative CBCT record with evident root formation, closed apex and periapical healing in relation to 11 and 21 respectively

Discussion

In the pediatric population, the prevalence of necrotic immature young permanent teeth with open apices are majorly due to trauma or dental caries with the prevailing age group of 6-12 years [3]. International Association of Dental Traumatology (2020) reported that 1 out of every 2 children sustains a dental injury and the most often age group is 8-12 years. Therefore, with advancements in dentistry, regenerative endodontics as a treatment protocol for young permanent teeth with open apices was introduced and tested clinically.

American Academy of Pediatric Dentistry recommended, "an apical opening greater than 1 mm in a mesiodistal dimension radiographically has a higher success rate of revascularization as it allows ingrowth of vital tissue." [4]. Authors believed that the rich blood supply through the wide- open apex is more potent in defending infection and promoting healing due to the presence of multipotent stem cells which on stimulation has greater potential to rebuild the lost pulp tissue and continue with root formation [5]. To achieve suitable intracanal conditions, minimal instrumentation for avoiding damage to fragile dentinal walls and stem cells is required. Adequate irrigation and intracanal medicament placement are also advantageous for the stem cells to project and proliferate effectively. Formerly, calcium hydroxide as a medicament was in use but gradually authors investigated and inferred its disadvantages and its lethal effects to stem cells. There is a significant release of hydroxyl ions from long-term use of calcium hydroxide which can necrose the periapical tissues, destroy potentially differentiating stem cells, weaken the dentin walls and thus increase the risk of tooth fracture. To overcome the side-effects, triple antibiotic paste (mixture of ciprofloxacin, metronidazole, and minocycline in 1:1:1 ratio) as an intracanal medicament was instituted in the regenerative endodontics treatment protocol [6].

There is an amalgamation of different species of aerobic, anaerobic and facultative microbes in the root canals which are sometimes difficult to eliminate. The triple antibiotic paste is an assembly of three drugs working on targeted microbes. Metronidazole binds to bacterial DNA and acts against gram-positive and gram-negative anaerobes whereas, ciprofloxacin inhibits DNA gyrase and act against gram-negative organisms. In addition, Minocycline, inhibits protein synthesis, collagenases, matrix metalloproteinase and acts against gram-positive, gram-negative and Spirochetes. Previously, authors commented on the medicament's efficacy of eliminating pathogenic microorganisms including E. faecalis and concluded that calcium hydroxide and triple antibiotic paste can eliminate bacteria to the dentinal depth of 200 um and 400 um respectively [6]. Besides, triple antibiotic paste exhibits a longer half-life (12-14 days) when compared to calcium hydroxide (6-7 days) [6]. Pulp revascularization therapy with TAP is successful due to evident periapical healing, presence of apical closure, increase in root length and root thickness as well. For that reason, Triple antibiotic paste as one convenient dose is delivered locally to the root canals. American Academy of Endodontics (AEE, 2018) recommended the use of TAP in low concentrations of 1-5 mg/ml to circumvent the downside effects of higher con of TAP.

After culminating the shreds of evidence from literature, in the present case, the triple antibiotic paste was used as an intracanal medicament and eventually periapical healing was appreciated after 6 weeks. Selection and placement of Platelet Rich Fibrin (PRF) as a scaffold was done because it holds additive growth factors like Platelet-derived epidermal growth factor (PDEGF), TGF-β, insulin growth factor (IGF)-1, Epidermal growth factor (EGF) and Epithelial cell growth factor (ECGF), besides of primary growth factors from dentin matrix [7]. Revascularization with PRF is a step ahead in the field of regenerative endodontics which boosts periapical healing and root formation [8]

In the present case, an MTA plug was formed and the patient was kept on periodic follow-up. MTA is a biocompatible material that prevents microleakage and promotes regeneration of the original tissues when placed in direct contact with the dental pulp tissue [9]. After 24 months of follow up, apical closure was observed along with thickening of dentinal walls. Consequently, the pulp vitality was also restored which is following the dynamics developing between stem cells, growth factors and scaffold known as cell homing. The continuous communication between cells and growth factors via signalling molecules induce multipotent cells to proliferate and differentiate into dental tissues (dentin, pulp and cementum) [10] [11] [12] [13].

To conclude, revascularization in a necrotic immature young permanent tooth with open apices is a contemporary treatment approach and is favourable for the pediatric patient as well. Appropriate case selection and treatment protocol are necessary for the success of revascularization. Results from the present study inferred that the triple antibiotic paste as an intracanal medicament, PRF as a scaffold and MTA as a coronal plug could be beneficial and effective with appropriate case selection.

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