International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Platelet Rich Fibrin Aided Revascularization of an Immature, Non-Vital Permanent Incisor: A Case Report

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Abstract: ***Traumatic dental injuries TDI in pediatric patients pose a significant challenge, often resulting in non-vital teeth with thin dentinal walls and open apices. Traditional treatment options, including single visit MTA apexification, may have limitations in promoting root growth and preventing fractures. This article presents a case report of an 11-year-old boy with a non-vital immature tooth treated with platelet-rich fibrin PRF as a scaffold material to induce revascularization, with 6 months follow up. This case report discusses the clinical and radiographical outcomes, demonstrating successful closure of the apex, thickening of root dentinal walls. PRF emerges as a promising biological approach for the revascularization of immature permanent teeth, although further histological studies are needed to confirm its mechanism.***

Keywords: Traumatic dental injuries, regenerative endodontic treatment, platelet-rich fibrin, immature non-vital tooth, revascularization, PRF

1. Introduction

Traumatic dental Injuries (TDI) are very common in pediatric population with their prevalence ranging from 15% (males, 15%; females, 16%) in children ≤6 years of age and 12% (males, 13%; females, 8%)in children for >6 years of age[1]. Traumatic dental injuries can cause fracture of tooth and pulpal irritation. Sequelae of it can be pulp necrosis, infection and arrested root development. Cessation of root development results in roots with thin dentinal walls, open apex, poor crown root ratio with increased risk of root fracture, difficult instrumentation and sealing of the canal.

The treatment options for this condition are conventional non-surgical endodontic treatment, apical surgery and single visit apexification.[2,3] Single visit MTA apexification has gained popularity in endodontic field but some authors suggest MTA apexification does not lead to further root growth and risk of root fractures are high due to thin dentinal walls.[3] This demands more biological approach of regenerative endodontic procedures. For regeneration to occur, stem cell, growth factors and physical scaffold are necessary to induce growth of new tissues from apical region. In revascularization various biomaterials such as collagen, platelet rich plasma (PRP) can be used as a scaffold in addition to blood clot.[4] PRF, a second generation platelet concentrate was developed by Choukron *et al* in France.[5] PRF has been proved to induce both hard and soft tissue re-growth in various studies.[5,6] The aim of present paper is to describe both clinical and radiological outcome of the case with immature non-vital tooth, in that PRF was used as scaffold material to induce revascularization of the root.

2. Case Report

An 11-year-old boy reported to the Department of Pediatric and Preventive Dentistry, KVG Dental college,Sullia, D.K, Karnataka, India seeking treatment for the fractured upper front tooth due to trauma. There was a history of trauma to the upper front region three month back due to fall. The medical status was non-contributory. On intraoral examination, the right maxillary central incisor had Ellis and Davey's class IV fracture (fracture involving enamel, dentine with pulp exposure leading to non-vital tooth). Clinically the crown exhibited discoloration depicting non-vitality and necrosis of the tooth (Figure 1). The tooth was tender to percussion test and did not respond to cold and electric pulp test and periodontal probing depth was within normal limits.

Figure 1

On intra oral peri-apical radiographic examination, the tooth showed an incompletely formed root, thin dentinal walls with wide open apex. Based on clinical and radiographic findings, the case was diagnosed as pulp necrosis with symptomatic apical periodontitis and we decided to perform a regenerative endodontic treatment using PRF as a scaffold material. The detailed treatment protocol was narrated to the parents and written informed consent was taken.

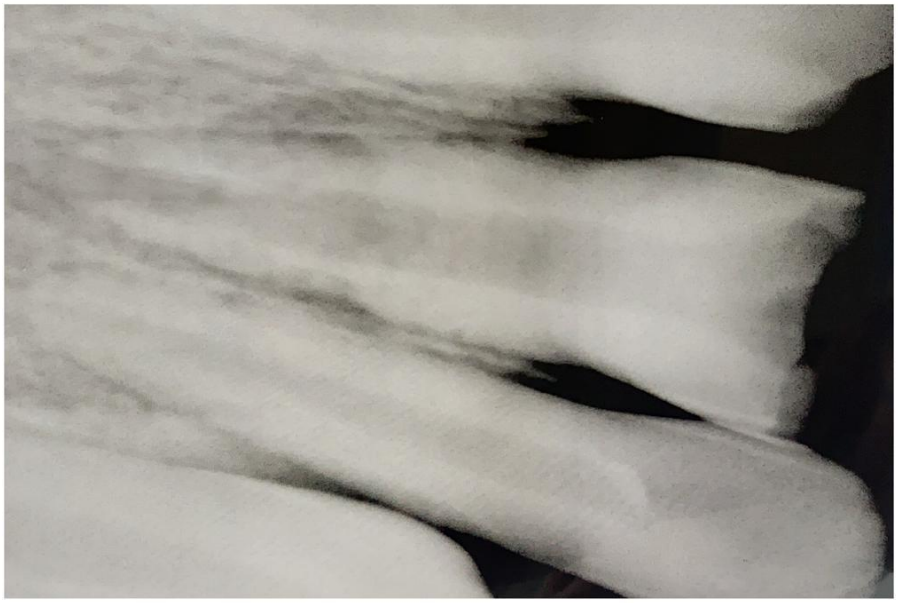

Figure 2

Local anesthesia was given using two percent Lidocaine with 1:100000 Epinephrine and rubber dam application was done for isolation. Proper access cavity was prepared using a round bur. After access opening pulp was completely removed and found to be necrotic and there was no bleeding from the canal. The necrotic pulp was completely removed and the canal was thoroughly irrigated using five ml of 5.25 percent of sodium hypochlorite solution. Next, working length was determined by keeping an 80 size k file 1 mm short of the apex and confirmed on periapical radiograph. After this the canal was completely dried using paper points. Under rubber dam isolation and the canal was copiously irrigated using saline. Finally the canal was dried with paper points.

Figure 3: A-F

Next, for preparation of PRF, five ml of blood was drawn intravenously from the forearm (antecubital vein) of the patient using an 18 gauge needle and collected in a sterile plastic vaccutube without adding any anticoagulants. Immediately after this the tube was centrifuged (Remi Model, Mumbai, Maharashtra, India) under 3000 revolutions per minute (RPM) for 15 minutes. After centrifugation three layers were formed in the whole blood. They are:

1. Top layer - Platelet Poor Plasma (PPP) - acellular straw colored fluid
2. A middle layer - Platelet-rich fibrin clot
3. A bottom layer - Red Blood Cells (RBCs) (Figure 3,A)

Figure 4: A PRF PLACED

Figure 4: B PRF SEALED WITH MTA

A sterile tweezer was inserted into the test tube to remove the PRF clot (Figure 3,B). The PRF gel was pressed between the sterile dry gauze to squeeze out fluid which resulted in a membrane. The membrane was cut into small fragments using scalpel blade and placed incrementally inside the canal using an endodontic hand plugger(Figure 4,A). Then white MTA was placed directly over the PRF membrane and a wet cotton pellet was placed over the MTA (Figure 4,B) and restored with Cavit. The patient was recalled after one day to remove cotton and confirm the setting of MTA. Finally the access opening was restored using Glass Ionomer Cement . The patient was kept under observation and recalled every one, three, six months to evaluate the clinical and radiographical changes. During each follow-up examination the clinical findings exhibited normal findings like no sensitivity to percussion, and palpation tests and with normal pocket probing depths. There was a positive response to cold and electric pulp test fairly similar to adjacent teeth after 3 months onwards. On radiographic examination compared to preoperative radiograph in Figure 2, (showing open apex, discontinuity in the lamina dura, and periapical radiolucency) in subsequent follow ups (Figure 6) we could appreciate the closure of the apex, continuity in lamina dura with normal periapical architecture. At 6 months follow up (Figure 6) obliteration in the root canal space from middle to apical third of root was evident which was absent in Figure 2.

Figure 5: Core Build Up

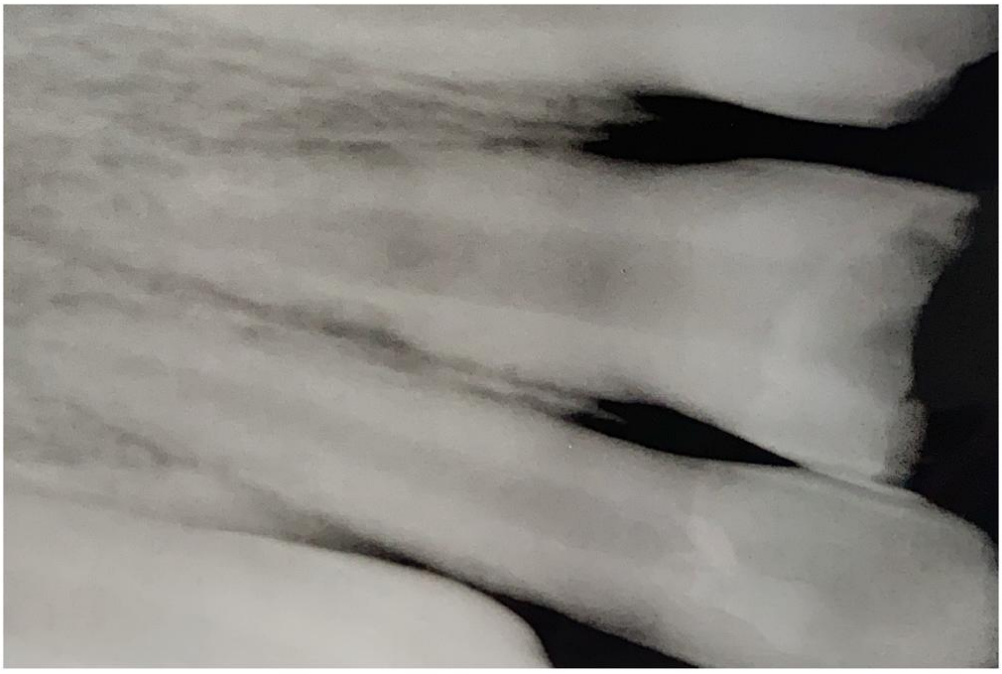

Figure 6: 6 Months follow up shows apex closure

Figure 7: Porcelain fused to metal crown on 11

3. Discussion

Revascularization of non-vital immature teeth with a wide, open apex is a novel treatment modality to re-establish the repair, vitality and regeneration of tissues resulting in further growth of the underdeveloped root and thickening of fragile dentin walls.[7] The primary step in the revascularization therapy includes creating an aseptic environment so that in-growth of new tissues can take place inside the canal space which further leads to completion of root development and periapical closure.

Research shows that three critical components are highly essential for the successful outcome of this procedure.[8]The first component is the stem cells which help in differentiation and supports the root development. The second factor is growth factors which induce cellular proliferation and differentiation and last component is the physical matrix or scaffold. According to Hargreaves et al [9] use of appropriate scaffold is very essential to initiate differentiation and growth of new cells as an empty canal will not lead to in-growth of tissues from the periapical area. Apart from natural blood clot various authors have used different scaffolds like collagen and Platelet-Rich-Plasma for the revascularization process. However, each material is associated with various disadvantages, demerits, and contradictory issues. Therefore, we used PRF in this patient for revascularization of immature necrotic permanent tooth which is a new biologically based scaffold matrix developed to overcome the limitations associated with both conventional blood clot and new matrices like PRP, collagen etc., Compared to PRF, the traditional method of natural blood clot induced revascularization procedures has various draw backs like inducing bleeding to obtain fresh blood clot is extremely difficult and more painful procedure especially in pediatric patients. Petrino et al[10] has stated that several attempts were made to induce bleeding in one of the patient of their case series. Moreover, maintenance of blood clot

within the canal and placement of MTA over this blood clot is still a technically difficult procedure. In addition, condensation of MTA results in apical displacement of the material. All these factors lead to the generation of a novel biologic approach like PRF for the maturogenesis treatment.[10] However, PRF has few disadvantages like difficult handling due to its jelly consistency and requirement of a specialized equipment for its processing. PRF, an autologous healing biomaterial contains platelets, leukocytes, growth factors and key healing proteins (cytokines) in a dense fibrin matrix.[11] On radiographic evaluation the tooth treated with PRF showed continued root growth, thickening of the root dentinal walls, narrowing of root canal space and closure of the root apex after 6 months. On clinical examination, the tooth exhibited negative response to palpation and percussion tests, positive responses to electric and cold pulp tests similar to adjacent normal teeth. This finding was found similar to previous PRF induced revascularization cases.[12-15] The most plausible explanation for this success could be attributed to Huang et al [16] hypothesis who stated that PRF causes proliferation of human dental pulp cells and increase the protein synthesis and alkaline phosphatase activity. So the human dental pulp cells present in the apical papilla remain vital and may differentiate into odontoblasts like cells under the influence of hertwig´s epithelial root sheath (HERS) thereby enhancing the development of both hard and new tissue within the empty canal space.[8,16] However, more human histologic studies are highly essential to evaluate whether the revascularization procedure truly replicate the pulp–dentin complex.

4. Conclusion

PRF can be used successfully for revascularisation of young immature permanent teeth. Further studies are required to analyse the histologic changes taking place.

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