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CASE REPORT

Revascularization of Immature Permanent Anterior Tooth using Platelet-rich Plasma

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ABSTRACT

Loss of pulp vitality in an immature permanent tooth will lead to arrested root development, due to which there will be tooth with open apex and weak lateral dentinal walls. Management of such necrotic teeth with immature roots poses several treatment challenges. The documented case report illustrates the use of platelet-rich plasma (PRP) in nonvital, immature anterior teeth for revascularization. Subsequent to chemomechanical preparation, revascularization with PRP was randomly induced in tooth. The cases were followed-up clinically and radiographically at 3, 6, and 12 months. There was a marked difference in periapical healing, apical closure, and dentinal wall thickening of teeth treated by revascularization with PRP.

Keywords: Immature tooth, Platelet-rich plasma, Revascularization.

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INTRODUCTION

In young children, anterior teeth by virtue of their position in the dental arch are prone to trauma. In cases of complicated tooth fracture with the loss of pulp vitality, cessation of root development with an open apex is a serious sequel. Management of such immature, nonvital teeth is a challenge. The treatment modalities for management of immature permanent teeth include apexogenesis with calcium hydroxide, apexification either with calcium hydroxide or mineral trioxide aggregate (MTA), custom-made roll cone technique, and periapical surgery. Recent advances have led to a paradigm shift from conventional replacement procedures to regenerative protocols.

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Two scientific disciplines have made major progress in the recent decade. One is stem cell biology and the other is tissue engineering. These two lines of research have promoted the emergence of regenerative medicine. Although its exact definition is still being discussed in the scientific community, generally regenerative medicine is defined as a process that combines diverse disciplines aiming at creating living, functional tissues to regenerate, repair, or replace tissue or organ function lost due to age, disease, damage, or congenital defects. The diverse disciplines include stem cell biology, cellular and molecular biology, gene therapy, chemical engineering, nanotechnology, tissue engineering, etc. Regenerative medicine provides the elements and designs the replacements for *in vivo* repair, stimulating the body's intrinsic capacities for regeneration. The elements may be growth factors or live cells and the replacement may be engineered tissues established *in vitro* ready for transplantation.[1,2]

Modern concept of medicine emphasizes prevention and reversal of the diseases. Only when these attempts failed, we will take on the unfavorable approaches, i.e., surgical intervention and restoration with artificial prostheses. Utilization of stem cells to regenerate the lost tissues may thereby reverse tissues to their normal state. Regenerative endodontics deals with the healing of impaired dental tissues, including dentin, pulp, cementum, and periodontal tissues. The endodontic community is highly motivated in the promotion of tissue regeneration research and practice.[3]

The following case report represents a revascularization of immature, nonvital, maxillary permanent central incisor using platelet-rich plasma (PRP).

CASE REPORT

A 7-year-old child reported to the Department of Pedodontics and Preventive Dentistry with a chief complaint of broken upper left front tooth. Past dental history revealed that child had a traumatic injury 6 months back. On clinical examination, it was revealed that the fracture line was extending into the pulp of 21. It was sensitive to both palpation and percussion tests. The teeth gave a negative response to both thermal and electric tests. Intraoral periapical radiographic examination revealed an immature root and an open apex with respect to 21 with periapical

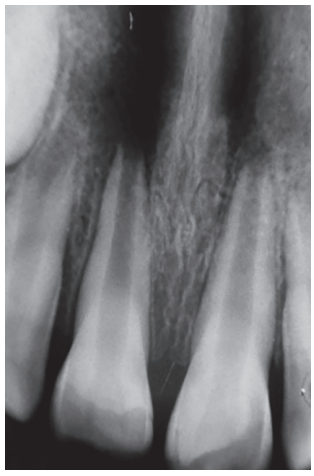

Fig. 1: Preoperative intraoral periapical radiograph showing the open apex with respect to 21

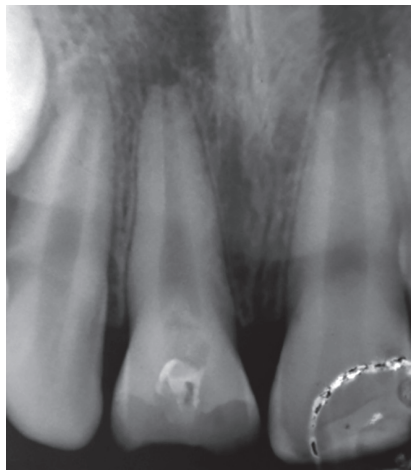

Fig. 2: Six months follow-up

radiolucency. Further radiographic examination of the tooth revealed 3 mm open apex with thin dentinal walls that appears prone to fracture (Fig. 1). A written consent was obtained from the patient's mother.

Under rubber dam isolation, access was gained to the root canal, and contents of the canal were extirpated. Alternate irrigation with saline and 0.2% chlorhexidine solution was done along with minimal filing so as to prevent further weakening of root canal walls. An intracanal-medicated dressing of metronidazole, ciprofloxacin, and minocycline was placed.[4] Following 1 week, the tooth was symptom-free and the canal was found to be dry. The revascularization process was then carried out.[5,6]

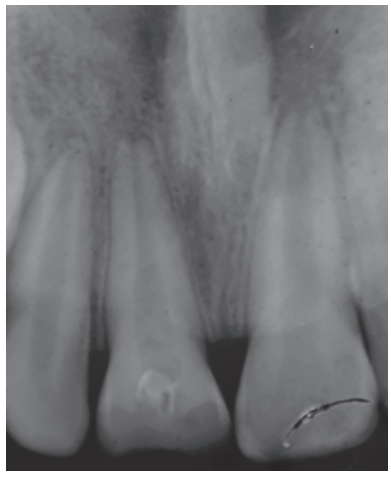

Fig. 3: One-year follow-up

Preparation of Autologous Platelet-rich Plasma[7]

Prior to the surgery, 10 mL of blood was drawn intravenously from the boy and collected in a sterile plastic vacuum tube coated with an anticoagulant, sodium citrate. It was then centrifuged at 1300 rpm for 10 minutes, following which layers were obtained: An upper straw-colored fluid, which was platelet-poor plasma (PPP); a middle buffy coat rich in platelets; and a lower layer rich in red blood cells (RBCs).

The plasma, buffy coat and 1 mL of RBC layer was aspirated into another sterile tube without anticoagulant. It was further centrifuged at 2400 rpm for 10 minutes, in order to separate the PPP from the PRP. The upper layer of PPP was discarded and PRP remained at the bottom of the tube in the form of a red button. For the purpose of activation, 6 mL of calcium chloride and thrombin was added and the resultant PRP gel was placed inside the disinfected root canal. The access opening was sealed with MTA. Clinical and radiographic evaluation was done following 6 months and 1 year (Figs 2 and 3). The tooth was asymptomatic and positively responded to all vitality tests. At the end of 1 year, thickening of dentinal walls of the root canal, root lengthening, regression of periapical lesion, and closure of apical root end were observed.

DISCUSSION

The present case series compared the clinical and radiographic treatment outcome of revascularization with and without PRP in immature, nonvital anterior teeth. Revascularization can be achieved successfully if a suitable matrix is provided in a disinfected root canal for tissue in-growth and a coronal bacteria-tight seal is provided. Mechanical instrumentation of the immature teeth with blunderbuss canal is difficult as it often leads to fracture of thin, lateral dentinal walls.[8] Therefore, minimal mechanical instrumentation is recommended for the disinfection of such teeth.

Regenerative endodontic techniques may enhance continued root development and,[3] therefore, offer an alternative approach to the management of traumatized immature permanent teeth with pulp necrosis and

periradicular infection. Banchs and Trope documented a case report where revascularization of immature permanent teeth with apical periodontitis was made possible by inducing the blood clot into the pulp canal by mechanically irritating the periapical tissues which they attributed to the total disinfection of canal.[9] A growing body of evidence supports the possibility of residual viable pulpal tissue in the wide root canal or apical region of necrotic immature teeth, which may survive the infection and allow continued apical development.[10] Stem cells from the apical papilla may also survive infection, because of their proximity to the periapical tissues. Following proper endodontic disinfection, these cells may differentiate under the influence of surviving epithelial cells of Hertwig's root sheath and initiate continued root development.[11] Once the regenerative process is induced, the presence of a wide apical foramen and root canal enhances the ingrowth of small blood vessels and regenerated tissues. This procedure might cause discomfort to the patient.

Formation of an intracanal blood clot is not always predictable. Bleeding may be reduced when an inter-appointment medication of calcium hydroxide is given, as it can cause periapical coagulation necrosis. Clot formation may be compromised if vasoconstrictor (adrenaline) containing local anesthetic is used. The concentration of growth factors in the blood clot is unpredictable and limited. Furthermore, after clot formation, erythrocytes undergo necrosis, affecting the properties of the matrix.[11]

To overcome these drawbacks and to augment the healing process, use of PRP is highly desirable. It is a first-generation, autologous platelet concentrate containing different growth factors, such as platelet-derived growth factor, transforming growth factors β, insulin-like growth factor, vascular endothelial growth factor, epidermal growth factor, and epithelial cell growth factor. These growth factors are released when platelets are degranulated, which can be carried out by various methods: Addition of thrombin, calcium containing products (e.g., calcium chlorite, calcium sulfate, etc.), or even shaking the platelets.

Platelet-rich plasma works via the degranulation of the alpha granules in platelets, which contain growth factors. The active secretion of these factors is initiated by the clotting process of blood when PRP is activated by thrombin. The secreted growth factors immediately bind to their transmembrane receptors on adult mesenchymal stem cells, osteoblasts, fibroblasts, epithelial cells, and then cause cellular proliferation, matrix formation, osteoid production, and collagen synthesis through cellular message transforming. Platelet-rich plasma also contains three proteins in blood known to act as cell adhesion molecules for osteoconduction and as a matrix for bone and connective tissue. These molecules are fibrinogen, fibronectin, and vitronectin.[12,13]

Apart from the root canal disinfection and use of a suitable scaffold, the quality of the coronal restoration is also very important to achieve success of revascularization treatment. This critical requirement of a bacterial-tight coronal seal can be met with the use of composite, MTA, cavit, glass ionomer, or their combinations. In this present case coronal seal is obtained by MTA.

However, the use of PRP has few disadvantages; need to draw blood in young patients and requirement for special equipment and reagents to prepare PRP. Another limitation is determination of actual contents of the pulp space after revascularization procedures since it is not possible to extract a functional tooth for histopathological analysis. If the attempted revascularization procedure fails, the traditional option of apexification using calcium hydroxide or MTA remains, followed by a conventional root filling.

CONCLUSION

Revascularization is an effective method for inducing maturogenesis in nonvital, immature teeth. Supplementations with PRP can potentially improve and hasten the desired biological outcome of this regenerative technique. However, randomized prospective clinical trials are needed to establish PRP supplements in revascularization cases routinely and its impact on the final outcome.

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