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NON SURGICAL ENDODONTIC MANAGEMENT OF OPEN APEX USING BIOMATRIX AND MTA: A CASE REPORT

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ABSTRACT

A root with an open apex is often used to describe an exceptionally wide apical foramen, in which preparation of an apical stop is difficult, if not impossible to achieve. In an open apex, it is imperative to limit the MTA placement within the confines of root canal for predictable healing. The placement of an internal matrix may limit the extrusion of MTA to some extent. Enhancement of the regenerative process of human body by utilizing the patient's own blood is a unique concept in dentistry. Platelet rich fibrin (PRF) is coming up as a biological revolution in dental field. Platelet-rich fibrin (PRF) a matrix of autologous fibrin, embedded with a large quantity of platelet and leukocyte cytokines can be used as an apical membrane. The PRF scaffold acts as an excellent biomatrix incorporating proteins responsible for healing. MTA has wider range of clinical applications of which, apexification is one among them. It has additional advantages like biocompatibility and good sealing ability. Present case report showing a successful nonsurgical endodontic management of open apex by using Combination of PRF membrane and MTA.

INTRODUCTION

An open apex is found as a developmental stage in the permanent and primary dentition, as a sequel to pulp death following trauma or caries, or as a result of pathological or physiological resorption of primary teeth due to eruption of the permanent successor (Gutmann and Heaton 1981). These immature teeth usually have thin, fragile walls making it difficult to sufficiently clean and to attain the required apical seal (Shabahang, 2013). Hertwigs epithelial root sheath responsible for determining the shape of the root surrounds the apical opening to the pulp and eventually becomes the apical foramens. At the time of tooth eruption root development is only 62-80% i.e., 2/3rd of the root is formed[5]. Apical closure occurs approximately 3 years after eruption. Traumatic injuries to young permanent teeth before complete root formation is commonly occur in children. Clinical case assessment and precise pulpal diagnosis is significant in the treatment of immature teeth with pulpal injury. Clinical assessment of pulpal status requires a comprehensive history of subjective symptoms, thorough clinical and radiographic examination and carrying out diagnostic tests (Klein, 1978; Rafter, 2005).

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It is not possible to confine MTA within the apical third of the root in case of Cvek stage 1, 2 and 3 of root development wherein, it has to be complemented with the membrane. According to the width of the apical foramen and the length of the root, Cvek has classified 5 stages of root development.

Stage 1 Teeth with wide divergent apical opening and a root length estimated to less than half of the final root length.
Stage 2 Teeth with wide divergent apical opening and a root length estimated to half of the final root length.
Stage 3 Teeth with wide divergent apical opening and a root length estimated to two thirds of the final root length.
Stage 4 Teeth with wide open apical foramen and nearly completed root length.
Stage 5 Teeth with closed apical foramen and completed root development (Kandos, 1996).

An immature tooth with pulpal necrosis and periapical pathology imposes a great difficulty to the endodontist. MTA has an ability to facilitate periradicular healing by inducing hard-tissue formation. But in some cases with wide open apices, adequate condensation of MTA is difficult to achieve as the material may get extruded beyond the apex.

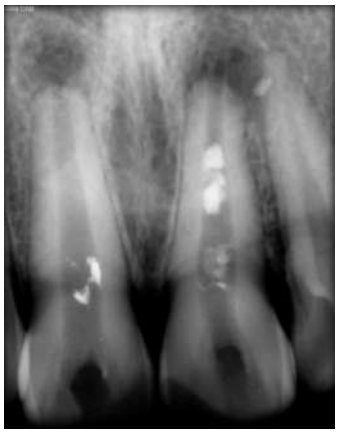

Fig. 1.Preoperative radiograph

Fig. 2. After collection of the PRF itself

Fig. 3. PRF clot

Fig. 4.PRF membrane

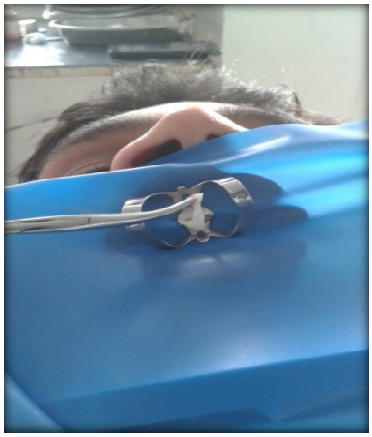

Fig. 5.Carrying PRF membrane

Fig. 6 Packing of PRF in the canal to form matrix membrane

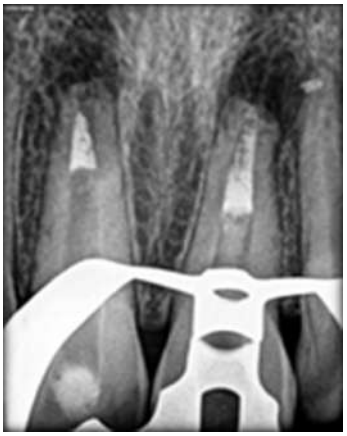

Fig. 7. MTA plug

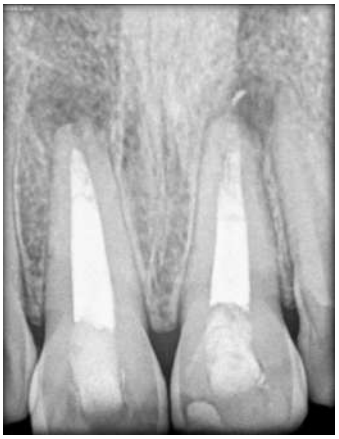

Fig. 8. 6-month follow- up

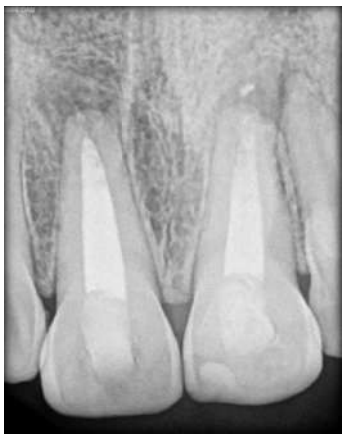

Fig. 9. 9-month follow- up

Therefore an apical matrix is used for the controlled placement of MTA to a desired level. PRF is a matrix of autologous fibrin, in which are embedded a large quantity of platelet and leukocyte cytokines during centrifugation (Dohan *et al.,* 2006). The PRF scaffold acts as an excellent biomatrix incorporating proteins responsible for healing [Autologous biomatrices Platelet-rich plasma (PRP) Platelet-rich fibrin (PRF)] (Kim *et al.,* 2014). The intrinsic incorporation of cytokines within the fibrin mesh allows for their progressive release over time (7-11 days), as the network of fibrin disintegrates. The easily applied PRF membrane acts much like a fibrin bandage serving as a matrix to accelerate the healing of wound edges (Toffler *et al.,* 2009).

In 1974, platelets regenerative potentiality was introduced, and Ross *et al*. were first to describe a growth factor from platelets. After activation of the platelets which are trapped within fibrin matrix, growth factors released and stimulate the mitogenic response in the bone periosteum during normal wound healing for repair of the bone.

CASE REPORT

A 20-year-old male patient was referred to the Department of Conservative Dentistry and Endodontics, Carrier Post Graduate Institute of Dental Sciences and Hospital, Lucknow with a chief complaint of discolored right and left central incisor in the upper anterior tooth region. History revealed that

the patient had suffered trauma at the age of 9 years, following which the patient claimed that he had undergone dental treatment for the same. Medical history was non contributry. Intraoral examination revealed discoloured maxillary right and left central incisor with temprory restoration in access cavity. Radiographic examination revealed an immature tooth with a wide open apex and a radiolucent area in proximity of the apex of the tooth (Fig.1**)**. The root canal was cleaned with hand file under irrigation with 2.5% NaOCl. The rootcanal was then dried with sterile paper points. Triple antibiotic paste was placed in the root canal, and the patient was recalled after one week. One week later, the tooth was isolated under rubber dam. Patient's own blood was drawn into 10 ml glass coated plastic tubes using PRF collection kit without anticoagulant and immediately centrifuged in centrifugal machine at 3000 rpm for 10 minutes.

Three layers got formed in the tube: a base of RBCs, at the bottom, acellular plasma on the surface, and PRF clot in the middle. The fibrin clot was easily separated from the lower part of the centrifuged blood. The PRF clot was gently pressed into a membrane **(**Fig. 4) with a sterile dry gauge . The membrane was packed against the bone and was pushed **(**Fig.6) beyond the apex into the bony space formed due to the periapical lesion to form a matrix for the placement of MTA. A thick mixture of MTA was then prepared and applied to the apical portion of the canal using MTA carrier and a small plugger and the butt end of sterile paper points **(**Fig.7). Moistened gauze was placed in the remainder of the canal and the access cavity sealed using glass ionomer cement (Fuji, *GC* Corporation, Tokyo, Japan). The patient was asymptomatic at 1-week recall visit. Therefore, remaining canal was obturated using thermo plasticized gutta percha (Obtura II, J. Morita Corporation, Japan) (Fig. 8), and the access cavity was sealed using composite resin. The same procedures was followed for the other tooth i.e. 21 . 6-month follow- up revealed complete periapical healing and bone formation **(**Fig.8). The clinical follow-up at 9-month showed complete healing of the periapical radiolucency **(**Fig.9), regeneration of the periradicular tissues and the patient functioning well with no reportable clinical symptoms.

DISCUSSION

According to Simonpieri *et al* (2009*)*, the use of this platelet and immune concentrate offers the following 4 advantages: First, the fibrin clot plays an important mechanical role, with the PRF membrane maintaining and protecting the grafted biomaterials and PRF fragments serving as biological connectors between bone particles. Second, the integration of this fibrin network into the regenerative site facilitates cellular migration, particularly for endothelial cells necessary for the neo-angiogenesis, vascularization and survival of the graft[13]. Third, the platelet cytokines (PDGF, TGF- beta, IGF-1) are gradually released as the fibrin matrix is resorbed, thus creating a perpetual process of healing (Mazor *et al.,* 2004). Lastly, the presence of leukocytes and cytokines in the fibrin network can play a significant role in the self-regulation of inflammatory and infectious phenomena within the grafted material (Dohan *et al.,* 2006). Mineral trioxide aggregate (MTA) was developed in the 1990s initially for use as a root-end filling material due to its ability to set in the presence of moisture (Torabinejad *et al.,* 1993). Whilst its chemistry was based on that of ordinary Portland cement, significant differences preclude use of the latter as a clinical substitute. MTA has been shown capable of inducing mineralised tissue formation at a variety of oral and dental tissue sites and subsequently its potential applications within dentistry have expanded. It is a mixture of dicalcium silicate, tricalcium silicate, tricalcium aluminate, gypsum, tetracalcium aluminoferrite and bismuth oxide. Calcium hydroxide is the main compound released by MTA in water. The calcium hydroxide is biocompatible with tissue. The initial pH of MTA is 10.2 with an increase to12.5, 3 hours after mixing. MTA offers a biologically active substrate for bone cells and stimulates interleukin production because of its alkaline pH and calcium ion release.

The most characteristic tissue reaction of MTA is the presence of connective tissue after the first postoperative week and with a longer duration MTA which allows the overgrowth of cementum and formation of bone which facilitates the regeneration of periodontal ligament[11]. Setting time of grey MTA differs with manufacturers, for ProRoot MTA it was reported to be 2 h and 45 min (± 5 min) and MTA-Angelus it was10 min[9]. MTA showed low solubility and a radiopacity that was little higher than that of dentin. It also demonstrated an excellent biocompatibility and sealing ability. Antimicrobial properties of MTA was related to its pH, it has a pH of 12.5 comparable to that of calcium hydroxide. Bates et al found MTA superior to the other traditional root-end filling materials. MTA expands during setting which may be the reason for its excellent sealing ability (Arathi Rao, 2009). Torabinejad *et al.* 1995, Xavier *et al.* 2005 suggested that mineral trioxide aggregate is most biocompatible and bacteriostatic material with good sealing property, which stimulates cell growth, adhesion and proliferation (Kogan *et al.,* 2006).

Conclusion

The combination of PRF membrane as a matrix and MTA can prove to be an effective alternative for creating artificial root-end barriers and to induce faster periapical healing with large periapical lesions. Recently by showing good promising results with use of Combination of PRF membrane and MTA, it has proved to have a good prospect for its use as healing aid in various aspects of the dentistry. Using platelet-rich fibrin, or PRF, is a way to accelerate and enhance the body's natural wound-healing mechanisms.

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