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Novel use of platelet-rich fibrin matrix and MTA as an apical barrier in the management of a failed revascularization case

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Abstract – *Method*: We report management of a failed revascularization/revitalization case, which could be due to inadequate removal of biofilm and bacteria in dentinal tubules. The use of an apical matrix barrier in form of a platelet-rich fibrin (PRF) membrane for stabilization of MTA in root end apexification procedure is described. The canal was cleansed of old MTA present in the cervical third using H files, irrigated using saline and finally irrigated with 2.5% NaOCl and saline. To obtain canal disinfection, calcium hydroxide paste was temporized in the canal. In subsequent appointments, PRF was placed at the root tip followed by 5-mm apical plug with mineral trioxide aggregate. One week later, the root canal was obturated with thermoplasticized gutta-percha. A 6-month and a 2-year follow ups showed reduction of periapical radiolucency and adequately functional tooth. *Results*: One-visit apexification techniques provide an alternative treatment for failed revascularization cases. Follow up confirmed complete healing periradicularly. *Conclusion*: Apexification in one step using an apical barrier of PRF and a plug of MTA can be considered a predictable treatment and may be an alternative to long-term revascularization failures.

When teeth with incomplete root formation undergo pulp necrosis, the root development stops and then, apical closure cannot be achieved. Root canal treatment at this time is a significant challenge, because of the size of the canal, the thin and fragile dentine walls and the large open apex. Because of the lack of an apical constriction, an alternative to standard root canal treatment, revascularization/revitalization or apexification has been advocated (1).

Revascularization (root end closure) is an accepted treatment protocol for management of immature, nonvital, infected teeth. Root canal disinfection in regenerative endodontic treatments is a challenge. Irrigation protocols and intracanal dressings have the potential to affect stem cell survival adjacent to the walls of the root canal system and those residing in the periapical tissues, possibly by direct and indirect mechanisms (2). The outcome of revascularization procedures remains somewhat unpredictable, and the clinical management of these teeth is challenging.

Apexification can be defined as a method to induce a calcific barrier in a root with an open apex or continued apical development of teeth with incomplete roots and a necrotic pulp (3). Calcium hydroxide has been the first choice of material for apexification (4) with repeated changes over the course of 5–20 months to induce the formation of calcific barrier (5). Induction of apical healing, regardless of material used, takes at least 4–6 months requiring multiple appointments to change the medicament. Poor patient compliance in keeping up the recall appointments and failure of the temporary seal may result in reinfection. For these reasons, one-visit apexification has been advocated.

The one-step apexification can be described as the non-surgical compaction of a biocompatible material into the apical end of the root canal, thus creating an artificial apical stop and enabling immediate filling of the root canal (6). Because of MTA's excellent biological properties and ability to create a good seal, it has been recommended for creating an artificial barrier in the apical area of teeth with open apices, thus compressing treatment time to 1 or 2 visits (7). Mineral trioxide aggregate (MTA) appears to offer a biological active substrate that stimulates periodontal cell production (8). It is composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide, and silicate oxide, and in a

moist environment, its setting time is approximately 4 h. Apexification using MTA provides an alternative treatment modality in immature pulpless teeth, as it requires significantly less time. MTA has superior biocompatibility and sealing ability and is less cytotoxic than other materials currently used in pulpal therapy. Apical plugging with MTA is a simple and rapid technique that eliminates the need of successive intracanal dressing changes (9, 10). 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. Therefore, an apical matrix is used for the controlled placement of MTA to a desired level. A number of materials have been proposed for this purpose including tricalcium phosphate, calcium hydroxide, freeze-dried bone, freeze-dried dentin, collagen calcium phosphate, Proplast (a polytetrafluoroethylene and carbon felt-like porous material) (8).

Choukroun's PRF is defined as an autologous leukocyte and platelet-rich fibrin biomaterial. This is prepared by collection of patient's blood in specialized glass test tubes with no anticoagulants, and then, it is subjected to gentle centrifugation at 320g for 10 min resulting in division of blood sample in three layers: a base of red cells at the bottom, acellular plasma on the top, and a clot of PRF in the middle. PRF has the characteristic of polymerizing naturally and slowly during centrifugation. This high-density fibrin clot serves as a biological matrix by supporting cell migration and cytokine release. Leucocytes in PRF act as anti-inflammatory agent and play key role in immune regulation (11).

Therefore, present case report highlights the non-surgical management of symptomatic revascularization-attempted tooth with immature apex using PRF membrane matrix and MTA to promote periapical healing.

Case report

An 18-year-old female reported discoloration (Fig. 1) and pain in upper front region since 2 months. The right maxillary central incisor was tender to percussion (vertical and lateral), showed Grade I mobility and no response to sensibility tests (i.e. heat, cold and electric pulp test), which was diagnosed as symptomatic apical periodontitis. Radiographic examination revealed an open apex and presence of MTA in cervical third indicating an attempt for revascularization (Fig. 2) and a radiolucent lesion in the periapical area. Patient had a previous history of dental treatment for the same tooth 2 years back.

Fig. 1. Preoperative view.

Fig. 2. Preoperative radiograph of the upper right central incisor.

So, a clinical decision of placing an apical matrix barrier in form of a platelet-rich fibrin membrane followed by MTA apical plug formation was decided. A written informed consent was obtained from the patient. Access was prepared, and cervical MTA was removed using H files (Dentsply Maillefer, Tulsa, OK,

Fig. 3. Periapical radiograph of root canal length determination with a size 60 K-file.

Fig. 4. Radiograph of the upper right central incisor filled with mineral trioxide aggregate.

Fig. 6. Radiograph of the upper right central incisor after final obturation with Guttaflow.

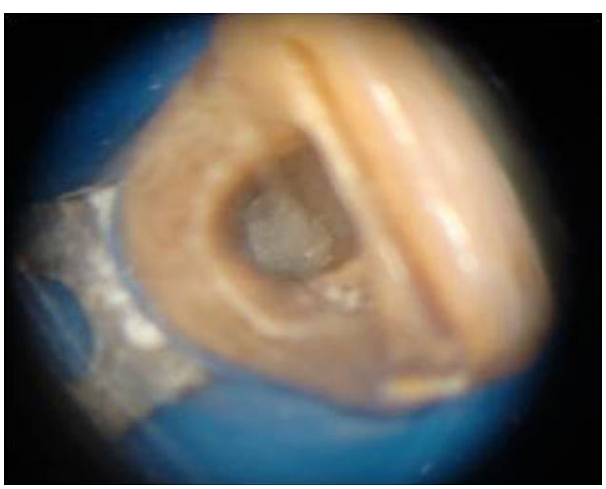

Fig. 5. MTA apical plug.

Fig. 7. Radiograph of the upper right central incisor 24 months after final filling showing reduction in periapical lesion.

USA) under rubberdam isolation followed by working length determination (Fig. 3). Biomechanical preparation was done using # 80 K-file, and root canal was irrigated alternately with 1.25% NaOCl and saline. The canal was dried with sterile paper points, Calcium hydroxide (Ultracal XS, Ultradent, South Jordan, and UT, USA) was placed as an intracanal medicament, and the access cavity was temporized with Cavit G (3M Espe GmbH, Seefeld, Germany). The patient was recalled after 1 week. The medicament was removed from the canal by irrigation with 1.25% sodium hypochlorite. For chair-side preparation of PRF, 12 ml of whole blood was drawn from the patient's right antecubital vein and centrifuged (REMI Model R-8c with 12 × 15 ml swing out head) under 400 g for 10 min to obtain the PRF which was jellylike in consistency. This was retrieved with sterile cotton pliers and placed on a glass Petri dish. After the removal of calcium hydroxide, canal was dried with paper points. This PRF clot was pressed in between two gauge pieces to form a strong membrane. Then, the apical matrix was created by pushing PRF through the canal using finger pluggers (Dentsply Maillefer, Ballaigues, Switzerland) and packing it in periapical area.

MTA was mixed according to manufacturer's guidelines to a thick creamy consistency, and 5 mm of MTA

(White Pro-Root MTA; Dentsply Maillefer) was placed directly over the PRF clot (Figs 4 and 5). A moist cotton pellet was placed inside the access cavity and sealed with temporary cement (3M Espe GmbH, Seefeld, Germany) (Fig. 4). The setting of MTA was confirmed 3 days later, the remaining canal was obturated with Guttaflow (Fig. 6), and access cavity sealed with composite (Ceram-x Duo, Dentsply, De-Trey, Konstanz, Germany). The tooth was later crowned to mask the discoloration (Fig. 7). The patient was examined clinically and radiographically at 1, 3, 6, 9, 18 and 24 months.

Discussion

The major problem with open apex cases is the extrusion of the obturation materials beyond the apex. Using a matrix avoids the extrusion of material into periodontal tissues, reduces leakage in sealing material, and allows favorable response of periodontal tissues.

PRF was used as apical matrix below MTA in this case as it has several advantages including ease of preparation and lack of biochemical handling of blood, which makes this preparation strictly autologous. PRF is also associated with slow and continuous increase in cytokine levels. Leucocytes in PRF clot act as anti-inflammatory, anti-infectious agent, immune response regulator and provide vasculoendothelial growth factor to promote angiogenesis (12).

An apical plug of MTA in the last 5 mm of the canal was used in the present case as it avoids the risk of fracture during traditional calcium hydroxide apexification (13–15). In the above case report, the protocol for apexification with MTA was followed by obturation with thermoplasticized gutta-percha as it does not cause excessive compaction forces on the thin dentinal walls of an immature tooth. Obturation of the root canal system and immediate placement of a coronal restoration are thus possible and are regarded as key elements for long-term conservation. (16, 17).

Clinically and radiographically, the apexification of the present case was successful because of the absence of signs and symptoms and the reduction of periapical lesion (Fig. 7) after 2 years.

It requires further study with long-term follow up on more number of teeth with standardized protocols, and objective assessment of its efficacy needs to be conducted.

Conclusion

These results show that apexification in one visit by placing an apical plug of PRF and MTA is a predictable and reproducible clinical procedure.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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