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Apexification - Management of Open Apex Using Mineral Trioxide Aggregate (MTA) and Platelet Rich Fibrin (PRF): Case Reports

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Abstract

Apexification is an endodontic procedure to manage immature teeth with non-vital pulp and open apex. It promotes the formation of a calcific barrier at the root apex. These case reports highlight the successful apexification of a maxillary central incisor using mineral trioxide aggregate (MTA) and platelet-rich fibrin (PRF). MTA was used as an apical barrier material which have excellent biocompatibility and sealing properties. while PRF, is used as a biocompatible scaffold that enhanced healing and regeneration. The combined approach ensured predictable outcomes, including apical closure, periapical healing, and preservation of tooth structure. This method demonstrates the efficacy of MTA and PRF as synergistic materials in apexification, offering improved prognosis in challenging cases.

Keywords: Apexification, Modified Apexification, Mineral Trioxide Aggregate (MTA), Open Apex, Platelet Rich Fibrin (PRF).

Introduction

Dental trauma accounts for 4%–5% of all injuries to human body. Due to their position in the oral cavity, maxillary central and lateral incisors are more prone to trauma and are particularly common among young

children [1]. This leads to tooth displacement, fracture, or avulsion. Fractures that involve enamel (74.8%) or enamel with dentin without pulp exposure (11.7%) are characterized as simple fractures and can be treated with various restorative procedures. However, in cases of complicated tooth fractures including pulpal tissue, root canal therapy must be undertaken [1,2].

Necrotic immature permanent teeth caused either by caries or trauma, offer an inconsistent prognosis due to thin dentinal walls that are prone to fracture and difficulty to seal open apices. Such treatment requires special attention as we will be dealing with a large root canal with thin and fragile walls, and a divergent apical architecture [3,4]. These characteristics complicates canal instrumentation and the creation of an adequate apical stop. The greatest challenge in the endodontic treatment of teeth with an open apex is to achieve complete debridement and disinfection, and optimum sealing of the root canal system specially at apical third [5].

Apexification is defined as 'a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp'. The formation of an apical barrier is necessary in order to obturate the root canal system without the risk of overfilling. In this sense, apexification with MTA offers an alternative to conventional treatment with calcium hydroxide [6]. Mineral trioxide aggregate (MTA) has been proposed for immediate sealing of the apical foramen without having to wait for the natural healing process [6-8].

These case reports aims to describe a reliable and predictable alternative to conventional apexification with calcium hydroxide in permanent teeth with an open apex associated to apical periodontitis and arrested root development. In both the cases MTA was used as a novel material for creation of apical barrier [6-8].

Case Report I

13 Year old female patient reported to the department with the chief complaint of pain in upper front region of jaw.

Patient gave history of trauma due to hitting of object 5 years back and history of initiation endodontic treatment with 11 and 12.

On clinical examination there was temporary restoration with 11 and tenderness on percussion with 11 and 12. There was mobility with 11 and 12.

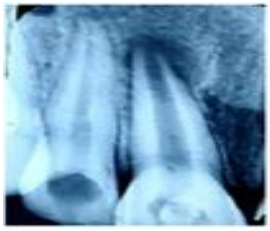
Radiographic examination revealed open apex and periapical radiolucency with 11.

The clinical diagnosis of tooth 11and 12 was previously initiated endodontic treatment and symptomatic apical periodontitis. Apexification treatment was explained to the patient's parents, and we decided to proceed with apexification with 11 and endodontic treatment with 12.

Management

The Apexification procedure was carried out as follows:

- After rubber dam isolation, access preparation was done and working length was determined with 11 and 12
- Canals were copiously irrigated with 2.5% sodium hypochlorite, and minimal instrumentation was done to prevent further weakening of the dentinal walls
- Calcium hydroxide was placed as an intracanal medicament in the dried canals, and the coronal access was sealed with intermediate restorative material for 4



Pre-operative radiograph showing open apex and periapical lesion with 11

Working length determination with 11 and 12

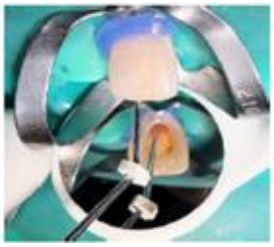
Intracanal calcium hydroxide dressing given with 11 and 12

During second visit after 4 weeks, calcium hydroxide was removed from the canal using irrigation with 2.5% sodium hypochlorite and saline.

Platelet rich fibrin (PRF) preparation

- Platelet rich fibrin membrane was prepared using the procedure described by Dohan et al., 8.5 ml blood was drawn by venipuncture of patients anticubital vein
- This blood was collected in a 10 ml sterile glass tube without anticoagulant, and was centrifuged immediately at 3000 revolutions/min for 10 min
- After the centrifugation, glass tube consisted of the layer of acellular platelet poor plasma at top, PRF clot in the middle and red blood cells at the bottom
- PRF membrane was obtained by squeezing the PRF clot in a piece of sterile gauze. The PRF membrane was cut into pieces to reduce the size of the membrane

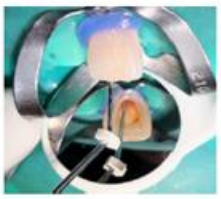
Preparation of PRF



PRF membrane inserted into the canal beyond the apex of 11.

- PRF membrane was introduced into the canal and was gently compacted using hand pluggers of appropriate sizes to form an apical barrier at the level of apex
- MTA (Angelus) was mixed according to the manufacturer's instructions and was placed in the apical portion of canal against the PRF matrix. Subsequent increments were condensed with hand pluggers till a thickness of 4 mm is achieved.
- A wet cotton pellet over the MTA plug, access cavity was sealed with intermediate restorative material.
- After 1 week the patient was asymptomatic, the tooth was isolated with rubber dam, temporary restoration and cotton pellet was removed. An endodontic hand plugger was used confirm the setting of MTA by tapping over MTA barrier.

The remaining portion of the canal was obturated using AH plus sealer and injectable thermoplasticized gutta-percha.




Placement of Apical MTA plug with 11 and root Canal treatment done with 12

Immediate postobturation radiograph showing Obturation with 11 using thermoplasticized gutta percha

Pre-operative Radiograph

12 Months follow up radiograph showing complete healing of periapical lesion

Case Report II

14 Year old male patient reported to the department with the chief complaint of pain in upper front region of jaw.

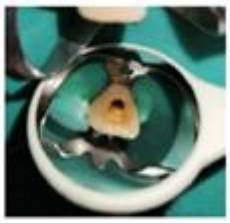
Patient gave history of trauma due to hitting of object 6 years back and history of initiation of endodontic treatment with 11.

On clinical examination there was temporary restoration with 11 and tenderness on percussion with 11. There was no mobility with 11.

Radiographic examination reveals open apex and periapical radiolucency with 11.

The clinical diagnosis of 11 was previously initiated endodontic treatment and symptomatic apical periodontitis with open apex. The modified apexification treatment was explained to the patient's parents, and we decided to proceed with modified apexification with 11.

Pre-operative radiograph showing open apex and periapical lesion with 11



Access cavity modification with 11

Working length determination with 11

Intracanal calcium hydroxide dressing given with 11

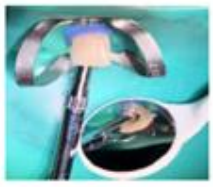

Preparation of PRF membrane

In this case, modified apexification was done which varies from case report I in that, PRF membrane (2-3 mm thick layer) was inserted in the apical part of the canal, 1–2 mm coronal from the end of the open apex.

MTA plug of 4 mm was inserted over this PRF membrane which acts as a scaffold.

Obturation was done using thermoplasticized gutta percha and AH plus sealer over set MTA plug.

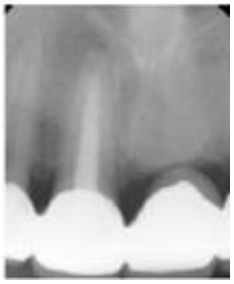
PRF membrane inserted into the canal leaving 1-2 mm apical space.




Placement of MTA plug with 11 over PRF scaffold

Immediate post obturation radiograph showing Obturation with 11 using thermoplasticized gutta percha

Pre-operative radiograph



12 months follow up

Discussion

Apexification aims at formation of an apical barrier to prevent the percolation of bacterias and their toxins from the root canal into periapical tissues. This apical barrier is necessary to allow compaction of root canal filling material and to confine the obturating material into the root canal preventing an overfill [2,6,8,9].

The mineral trioxide aggregate (MTA) is material of choice to induce the formation of the apical barrier because of its superior sealing properties and excellent biocompatibility. Mahmoud Torabinejad et al. (2010) compared the sealing ability of MTA with other materials in root-end fillings and showed that MTA leaked significantly less than the other materials. MTA is a bioactive material with capacity to induce the formation of new cementum and periodontal ligament, which makes this material biologically acceptable for closing a root canal with an open apex. MTA induces apical hard tissue formation with significantly greater consistency than Calcium hydroxide [7-10].

The major problem in formation of an artificial barrier at the apex, is the need to limit the material to the apex,

preventing overextrusion, which may complicate tissue healing and repair. Using a matrix will restrict the barrier material at the apex and prevent the extrusion of this material like MTA into the periodontal tissues. Various materials used as a matrix are hydroxyapatite, resorbable collagen, calcium sulfate, platelet rich fibrin, etc [8-10].

PRF is an immune platelet concentrate which has been used as a matrix. In the present cases, Choukroun's technique for making PRF was used. The advantages of Choukroun's technique and PRF in general are: It Contains growth factors including transforming growth factor beta, vascular endothelial growth factor, and platelet-derived growth factor.

Platelet rich fibrin stimulates osteoblasts, fibroblasts and periodontal ligament cells proliferation as a mitogen, it does not dissolve quickly after application, it is completely autologous and biocompatible, it has low cost and greater ease of the procedure [10-12]..

Modified apexification procedure with MTA is simpler to perform than the traditional apexification technique because it avoids the need to place a MTA apical plug in proximity to the open apex, which could cause direct harm to the apical papilla cells and HERS cells due to the high pH (12.5) and its extrusion[5,6,10-12].

Conclusion

The combination of PRF as a matrix and MTA as an apical barrier can be considered as a good option for apexification procedure to treat cases with open apices. This innovative procedure is more predictable and less time consuming with a high success rate and good patient compliance.

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