Retreatment Of Endodontically Failed Tooth With Open Apex Using A Matrix Concept - Case Reports

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Abstract: An immature tooth with non-vital pulp and periapical pathology imposes a great difficulty to the endodontist. The primary reason for endodontic failure is the persistence of re growth of bacteria within the root canal system and such cases requires retreatment. Endodontic treatment options for such teeth consist of retreatment with conventional apexification procedure with and without apical barriers with the objective of eliminating bacteria from the root canal system with minimum irritation to the periapical tissues and induction of apical closure to produce favourable conditions and to confine the root canal fillings within the canal space. Traditionally, multiple dressings of calcium hydroxide medicament were placed to induce apical barrier formation. This case series describes two clinical cases with open apex and poorly treated root canals which were subjected to apexification procedure using different materials and techniques. The materials used here varied from Biodentine with platelet-rich fibrin (matrix) and mineral trioxide aggregate (MTA) with hydroxyapatite (matrix). Conclusion: Both the cases were successful regarding the resolution of symptoms and periapical healing. No matter what barrier is used or matrix is placed or not, healing takes place if the procedure is followed carefully using recommended protocols. [Kubavat R Natl J Integr Res Med, 2019; 10(6):88-93]

Key Words: Apexification, Apical barrier, Biodentine, Hydroxyapatite, Mineral trioxide aggregate, Matrix, Open apex, Periapical pathology, PRF, Retreatment.

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Introduction: Injury to anterior teeth is a common event. Injury to a tooth with immature apex requires a treatment approach that assures a tight seal at apex, which ensures complete biological and functional restoration of the tooth involved[2]. The immature root with a necrotic pulp and apical periodontitis presents multiple challenges to successful treatment.

- The infected root canal space cannot be disinfected with the standard root canal protocol with the aggressive use of endodontic files.
- Once the microbial phase of the treatment is complete, filling the root canal is difficult because the open apex provides no barrier for stopping the root filling material before impinging on the periodontal tissues.
- Even when the challenges described earlier are overcome, the roots of these teeth are thin with a higher susceptibility to fracture.

These problems are overcome by using a disinfection protocol that does not include aggressive root canal instrumentation, stimulating the formation of a hard tissue barrier or rather focus on providing an artificial apical barrier to allow for optimal filling of the canal, and reinforcing the weakened root against fracture during and after an apical stop is provided[8].

Apexification is the process of induction of calcific barrier across the open apex or the continued development in the apical region in an immature tooth with necrotic pulp. Traditional approach of apexification procedure involves the induction of formation of an apical barrier while, in the recent times, an artificial apical barrier is formed by the placement of various materials which included tricalcium phosphate, freeze-dried bone, freeze-dried dentin, and mineral trioxide aggregate (MTA).However, these materials tend to extrude beyond the apex impinging on the periodontal tissue. The placement of an artificial barrier or a matrix provides an apical stop against which sealing material can be placed and packed. Several materials proposed to create a matrix include calcium hydroxide, absorbable collagen, hydroxyapatite, and autologous platelet-rich fibrin (PRF) membrane[3].

In recent times, MTA has gained considerable attention for single-visit apexification. Nevertheless, MTA remains subject to some concerns such as its long setting time, poor handling characteristics, and possibility of staining of tooth structure. Recently, a new calcium silicate-based material, Biodentine

(Septodont, France), has been introduced which was designed as a "dentin replacement" material with properties similar to MTA without its disadvantages. It has biocompatibility similar to MTA. Compared to MTA, Biodentine handles easily and needs much less time for setting[3, 6].

The aim of the present article is to report the successful closure of root apex in a pulpless permanent maxillary central incisor with wide-open apex using Biodentine or MTA in combination with a matrix.

Case Reports:

Case Report 1(PRF + Biodentine) [Figure 1a-1n]:

A 20-year-old male patient reported with a chief complaint of discolored and broken tooth in upper front left tooth region. Patient gave a history of trauma 6 years back. Intraoral clinical examination revealed discoloration and Ellis Class III fracture with relation to #21 [Figure 1a]. The patient gave no history of swelling or pus discharge. No other significant medical history was found. Dental history showed previously endodontically treated teeth. Radiographic examination revealed an under obturated root canal filling with thin dentinal walls and open apex with associated periapical radiolucency i.r.t 21, suggestive of non-healing chronic lesion [Figure 1b]. Tooth was not tender to palpation and percussion.

Fig 1a: Preoperative Clinical Photograph

Fig 1b: Preoperative Radiograph

The decision was made to retreat the same tooth with apexification procedure. After explaining the procedure to the patient and obtaining his consent, treatment was initiated. Following rubber dam placement [Figure 1c], old post endodontic restoration was removed gaining access. All previous root canal filling was removed using #50 no. H files in circumferential motion with copious irrigation with 0.5% sodium hypochlorite (NaOCl) and Normal Saline. Than the radiograph was taken to confirm complete removal of old filling and showed immature open apex [Figure 1d].

Fig 1c: Complete Isolation With Rubber Dam

Fig 1d: After Old GP Removal

Then, the working length was determined using apex locator and confirmed radiographically 1 mm short of radiographic apex [Figure 1e]. Minimum instrumentation was performed and circumferential filing was done with the largest file that bind with the canal i.e., 80 K file. Copious irrigation was performed with 0.5% sodium hypochlorite and normal saline using side-vented irrigation needle. Care was taken so that irrigant should not extrude through open apex. Root canal was then dried with sterile paper points. Calcium hydroxide intracanal medicament was placed in the root canal, and the access cavity was sealed with cotton pellet and Cavit G (3M ESPE,Germany)[Figure 1f]. It was replaced every 7 days for 2 times.

Fig 1e: Working Length Radiograph

Fig 1f: Intracanal Medicament Placed

After 2 weeks in the subsequent appointment, using rubber dam and under isolation, calcium hydroxide dressing was removed by H files and irrigating with alternating solutions of 0.5% NaOCl and 17% EDTA. A final irrigation with sterile saline was done. Then, the length of the hand plugger to be kept in the root canal was confirmed using a radiograph [Figure 1g]. The root canal was then dried with sterile paper points.

Fig 1g: Radiograph Showing The Plugger Fit

Simultaneously, PRF membrane was prepared according to protocol developed by Choukroun et al. [Figure 1h]. A 10 ml sample of patient's whole blood was drawn and transferred into a 10 ml sterile glass test tube without anticoagulant and was immediately centrifuged at 3000 rpm for 10 min. The resultant product consisted of three layers: topmost layer consisting of acellular platelet poor plasma, PRF clot in the middle, and red blood cells at the bottom [Figure 1i]. The freshly prepared PRF membrane was placed into the root canal and gently compacted using hand plugger to achieve a matrix at the level of the apex [Figure 1j].

Fig 1h: PRF In Test Tube

Fig 1i: Clinical Photograph Of PRF Membrane

Fig 1j: PRF Placement With Plugger

Biodentine was mixed as per the manufacturer's instructions and was carried into the canal with the help of amalgam carrier and was condensed against the PRF matrix using hand pluggers. The entire canal was than filled with Biodentine due to the thin walls present surrounding it. After 12 min, the hardness of the Biodentine was checked using a plugger to confirm its set. The access cavity of the tooth was than restored with a composite restoration (Tetric N-Ceram, Ivoclar Vivadent) and postoperative radiograph taken [Figure 1k].

Fig 1k: Postoperative Radiograph Showing Root Canal Filled With Biodentine

One month follow up radiograph was taken [Figure 1l] and in subsequent visits, metal ceramic crown was placed [Figure 1m]. Six-month follow-up revealed the patient remained asymptomatic with completely healed periapical lesion and restored esthetics and functions [Figure 1n].

Fig 1l: Follow Up After 1 Month

Fig 1m: After Crown Placement

Fig 1n: Follow Up After 6 Months

Case 2 (Hydroxyapatite + MTA) [Figure 2a-2g]: A 32-year-old male patient reported with a chief complaint of pain in relation to upper right front tooth region since 15 days. A detailed case history revealed that he had experienced trauma in the same tooth around 18-19 years back. Radiographic examination revealed poor obturated root canal, and periapical radiolucent lesion. The apexification treatment with MTA was planned with the informed consent of patient. A similar protocol of treatment as in previous case was adapted with proper sterilization in this case, and apexification was done with MTA over hydroxyapatite matrix while remainder of the canal was entirely filled with MTA [Figure 2a-2g].

Fig 2a: Pre Operative Radiograph

Fig 2b: Working Length Radiograph

Fig 2c: Intra Canal Medicament

Fig 2d: Radiograph Showing Plugger Fit

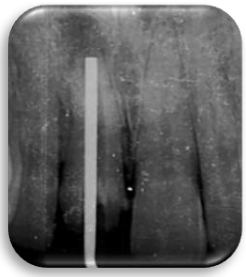

Fig 2e: Hydroxyapatite Crystals Placed

Fig 2f: Postoperative Radiograph Showing Root Canal Filled With MTA

Fig 2g: After Crown Placement

Discussion: Immature necrotic permanent teeth pose difficulty during endodontic treatment because of the wide-open root apex and thin dentin walls and periapical tissues may be traumatized due to overextended root canal fillings. Induction of apical closure may take more than 3–4 months requiring multiple appointments[3].

MTA has the ability to induce cementum like hard tissue when used adjacent to the periradicular tissues. MTA is a promising material as a result of its superior sealing property, its ability to set in the presence of blood and its biocompatibility[11, 13].

In 1997, Shabahang et al. compared MTA, osteogenic protein-1, and calcium hydroxide for apexification in dogs and found that MTA has maximum ability to form an apical barrier. He also concluded that it reduces root fracture. However, there are few concerns regarding MTA such as its long-setting time, poor handling characteristics, low resistance to washout before setting, possibility of staining tooth structure, presence and release of arsenic, and its high cost. These disadvantages necessitate more ideal restorative materials[6, 11].

Biodentine was introduced in 2010 which is similar to MTA in its basic composition with the addition of setting accelerators which is calcium chloride; it not only results in fast setting but also improves handling properties and strength. Biodentine is superior to MTA in that its consistency is better suited to clinical use, ensures better handling and safety, does not require a two-step obturation as setting time is faster around 10-12 min, there is a lower risk of bacterial contamination. Biodentine induces mineralization by expressing markers of odontoblasts and increases transforming growth factor beta 1 secretion from pulpal cells[3, 13].

To eliminate the number of steps and innovate modalities of managing such cases, Case 1 and Case 2 were obturated with Biodentine and MTA alone without gutta-percha respectively. The lesions responded well in these cases too. The major problem in cases of a wide open apex is the need to limit the material, thus avoiding the extrusion of a large amount of material into the periodontal tissue. Using a matrix avoids the extrusion of the material into the periodontal tissues, reduces leakage in the sealing material and allows favorable response of the periodontal tissues. The apical barrier technique utilizing calcium sulfate or a combination of calcium sulfate and collagen in a powdered form has been performed in the past. Various materials have been used for formation of apical barrier during apexification.

PRF, a second generation platelet concentrate first described by Choukroun et al., is a matrix of autologous fibrin, composed of a tetramolecular structure with cytokines, platelets, and stem cells within it which acts as a biodegradable scaffold that guides epithelial cell to migrate to its surface. The cells involved in tissue regeneration may be carried by PRF and release growth factors in a period between 1 and 4 weeks. The easily applied PRF membrane acts much like a fibrin bandage serving as a matrix to accelerate the healing of wound edges[2, 3, 9, 13].

Hydroxyapatite (a calcium phosphate complex) is the basic mineral ingredient of bone, and has a radiodensity comparable to bone. It has been explored extensively for bone grafting applications because of its osteoconductive effect. It provides scaffolding for bone regeneration and augmentation for osseous tissue ingrowths. The porosity (100–500 microns) with interconnectivity (>100 microns) is the most essential prerequisite, so as to allow vascularisation and bone growth inside[12].

Conclusion: Thus, it can be concluded that despite the different types of material used in various cases, the success in all the cases could be attributed to as follows:

- Proper disinfection of the canal.
- Limiting the barrier and obturation within the canal.
- Fluid-tight seal with void less obturation.
- Healthy response to the patient's body.

Novel biocompatible materials such as MTA and Biodentine are a boon in effective management of teeth with open apices. In cases, where hydroxyapatite or PRF barrier was first created as a large periapical radiolucency necessitated its use to avoid expulsion of materials beyond the root apex, although these materials can be limited with precise knowledge and experience[13]. It was noted that in both the cases periapical bone healing was appreciable and the patient was symptom-free during follow-ups. The healing

could be attributed to following recommended protocols and response of the patient's body. However, more comparative longer follow-ups and large-scale studies are needed to be conducted to devise the exact material and technique which could give 100% results.

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