

SINGLE VISIT APEXIFICATION USING THREE DIFFERENT APICAL MATRICES FOR OPEN APEX – A CASE SERIES

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ABSTRACT

In immature teeth with necrotic pulp caused by trauma, caries, and other insults, there absence of a natural constriction in the apex of the root canal can produce difficulties of apical obturation and the root-filling procedure.¹There is an innovative technique and rationale for placing apical matrices prior to placement of barrier in apexification in the management of non-vital teeth with open apices. Over the years, there have been numerous methods for managing non-vital open apices; the oldest and first to be used was calcium hydroxide, but bioceramics are currently very popular in single visit apexification. Open apices are present in the vicinity of bone loss, So, before placing bioceramics, a variety of materials can be employed as a matrix. By placing a matrix, the biomaterial remains confined within the canal and cannot leach beyond the apex. In this case series three cases are discussed of single visit apexification using MTA as apical barrier and PRF, absorbable suture and absorbable collagen material as internal apical matrix.

KEYWORDS: Internal matrix, mineral trioxide aggregate, single visit apexification, open apex, platelet rich fibrin, absorbable collagen, absorbable suture material.

INTRODUCTION

In endodontic therapy, managing open apex cases poses a challenge, especially when working with young teeth that have necrotic pulps. A calcific barrier is induced at the root apex in traditional apexification approaches, however more recent methods that include biological materials like demonstrated encouraging outcomes in fostering apical closure and tissue regeneration.

In order to prevent the sealing substance from extruding, Lemon recommended using a matrix when the perforation diameter was greater than 1 mm, because it offers a foundation for packing the sealing material—particularly MTA—into the perforation where bone damage has occurred.^[2] The modified internal matrix Concept by Bargholz C uses, collagen as a completely resorbable barrier material and MTA for sealing of the perforation. This not only results in repair of the defect, but also promotes healing of the periodontal ligament.^[3] Both of these concepts are applied in managing cases with open apices.

Several materials have been recommended to create a matrix, in cases of teeth with incomplete formation of apex; including Calcium Hydroxide(CH), Hydroxyapatite(HA), Platelet rich fibrin (PRF), Resorbable Collagen, Absorbable Suture Material,

Calcium Sulphate Cement (CSC), Calcium Phosphate Cement(CPC) and Demineralized freeze-dried bone allograft (DFDBA), Amnion membrane. In this case series three cases are discussed of single visit apexification using different apical matrices absorbable collagen, PRF and absorbable suture material as apical matrix.

CASE I – PRF AS MATRIX

A 17 years old male reported to the Dept. of Conservative Dentistry and Endodontics, with the chief complaint of poor aesthetics due to fractured tooth. On history taking patient had traumatic incidence with same tooth long back. On clinical Examination Elli's class IV fracture and discoloration with 11 was noted. Radiographic Examination showed open apex with 11. In the first visit access cavity was done, minimal instrumentation (circumferential filling) was done with #80 K file (MANI.inc) to remove intracanal debris & necrotic tissue, after working length determination the canal was irrigated with copious 2.5% NaOCl (PRIME Dental Products) followed by PUI (Ultra X, Eighteenth) to enhance the removal of debris and bacteria from the canal. Interim irrigation is done with saline to rinse the canal and remove any debris or irrigant residue.17% EDTA to remove the smear layer and open up the dentinal tubules. Final irrigation is done with 2.5 %

NaOCl to ensure thorough cleaning and disinfection. Finally, rinse the canal with saline to remove any remaining residue. Followed by placement of Calcium hydroxide (CalciCure, SafeEndo) in paste consistency was introduced till the CEJ level and the access cavity was sealed with temporary sealing material. It was placed for the period of 7 days for canal disinfection.

At recall visit, under rubber dam isolation the tooth 11 was reopened and the calcium hydroxide was removed with copious saline irrigation and light instrumentation. The canal was dried with paper points. A plugger was selected & adjusted short of the working length. After explaining the procedure to the patient & taking informed consent, 5ml of venous blood was withdrawn under all aseptic measures from Rt. forearm using 22 G sterile needle & syringe. The blood was immediately transferred to 5ml collection tube without any anticoagulants added to it & immediately centrifuged to obtain PRF. Multiple small pieces of PRF were done with the help of sterile scissors, minute amount of MTA (MTA Angelus) powder was sprinkled on the fibrin pieces to provide radiopacity for visualizing the placement of PRF. The PRF was then carried with tweezers and plugger inside the canal and was condensed gradually under radiographic guidance, using the controlled pressure with the help of pre-adjusted plugger. MTA Angelus was then mixed with sterile water and placed over PRF matrix with the help of endodontic pluggers. 4 to 5 mm of apical plug of MTA was achieved over PRF.

CASE II – ABSORBABLE SUTURE MATERIAL AS MATRIX

A 23-year-old male patient reported to the Department with a chief complaint of fractured tooth in upper front teeth region. On clinical examination, it was found that the left central incisor # 21, revealed an Ellis class IV fracture. The patient reported a history of trauma long back. Radiograph in relation to 21 showed a wide-open apex along with an area of periapical rarefaction. It was decided to carry out single visit apexification using MTA. Under rubber dam isolation, access was opened, minimal instrumentation was done with #80 K file (MANI.inc) the canal was debrided using copious irrigation with 2.5% sodium hypochlorite (PRIME Dental Products). Irrigation protocol was followed as done in first case. Calcium hydroxide (Calci Cure, SafeEndo) in paste consistency was introduced till the CEJ level. It was placed for the period of 7 days for canal disinfection, and a temporary coronal seal was established with Cavit.

At recall visit, under rubber dam isolation the tooth 21 was reopened and the calcium hydroxide was removed with copious saline irrigation and light instrumentation. the canal was dried using sterile paper points. Braided coated polyglactin-based, 3- 0 absorbable suture material VICRYL (Johnson and Johnson Ltd., Aurangabad, India) was used for the formation of apical matrix. The suture was tied to form a knot and was tied 2 more times to

form a thicker knot. The thickness of the knot can be approximately determined by gauging the apex with a large size file. This knot would serve as an apical matrix and the free end of the suture material can be used to adjust its length. The suture material was placed in an iopamidol solution (61%) (ISOVUE-300, Bracco Diagnostics) for 15 minutes to make it radiopaque. The “matrix” was then placed in the canal and was pushed to position it at the apex using preselected hand pluggers 2-4 mm short of working length. The position of the matrix was confirmed radiographically. Once the matrix was in position, MTA was mixed according to the manufacturer’s instructions to a thick creamy consistency and placed in the canal using an MTA carrier. MTA was condensed with the butt end of sterile damp paper points to form an MTA plug. After this, free end of the suture was cut with a hot ball burnisher as close as possible to the MTA plug and another 1mm MTA plug was packed.

CASE III – ABSORBABLE COLLAGEN AS MATRIX

A 17 years old male reported to the with the chief complaint of a discoloured maxillary anterior tooth. Clinical examination revealed fracture in the upper right incisor. The patient had a history of trauma that occurred long back. A periapical radiograph demonstrated incompletely formed root apex. Ellis Class III fracture in the upper right central incisor. A decision was made to perform apexification with 11. With a rubber dam in place and after access to the pulp chamber was gained, a working length radiograph of the upper right central incisor was taken. Cleaning and shaping were carefully performed using stainless- steel 80 no. K files (MANI.inc). Copious irrigation with 2.5 % sodium hypochlorite (PRIME DENTAL PRODUCTS Pvt Ltd.) cleaning and shaping procedure. Irrigation protocol was followed as done in first two cases. Calcium hydroxide paste (CalciCure, SafeEndo) was placed in the root canal system for 7, days and a temporary coronal seal was established with Cavit. Calcium hydroxide was used to disinfect the root canal system in order to reduce root canal infection.

At recall visit, under rubber dam isolation the tooth 11 was reopened and the calcium hydroxide was removed with copious saline irrigation and light instrumentation. Small pieces of Collagen plug ColoPlug® (ColoGenesis Healthcare Pvt. Ltd) a synthetic collagen material, were gently compacted using hand pluggers to produce a barrier at the level of the apex. MTA (MTA Angelus) plug was placed in the canal with a carrier and pluggers to form an apical plug approximately 4-mm thick. Placement of MTA was confirmed radiograph.

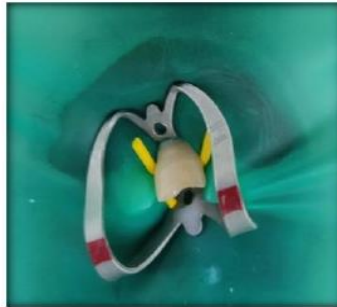
After formation of apical plug in all the three cases a sterile moist cotton pellet was placed over the MTA, and the access was sealed with Cavit. The patient was recalled after one-week for obturation of remainder space canal with the help of Backfill thermoplastic obturation

system. Finally, the access cavity was restored with resin composite.

1A



1B



1C



1D



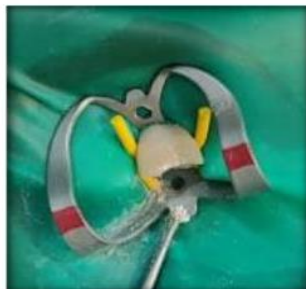
1E



1F



1G



1H



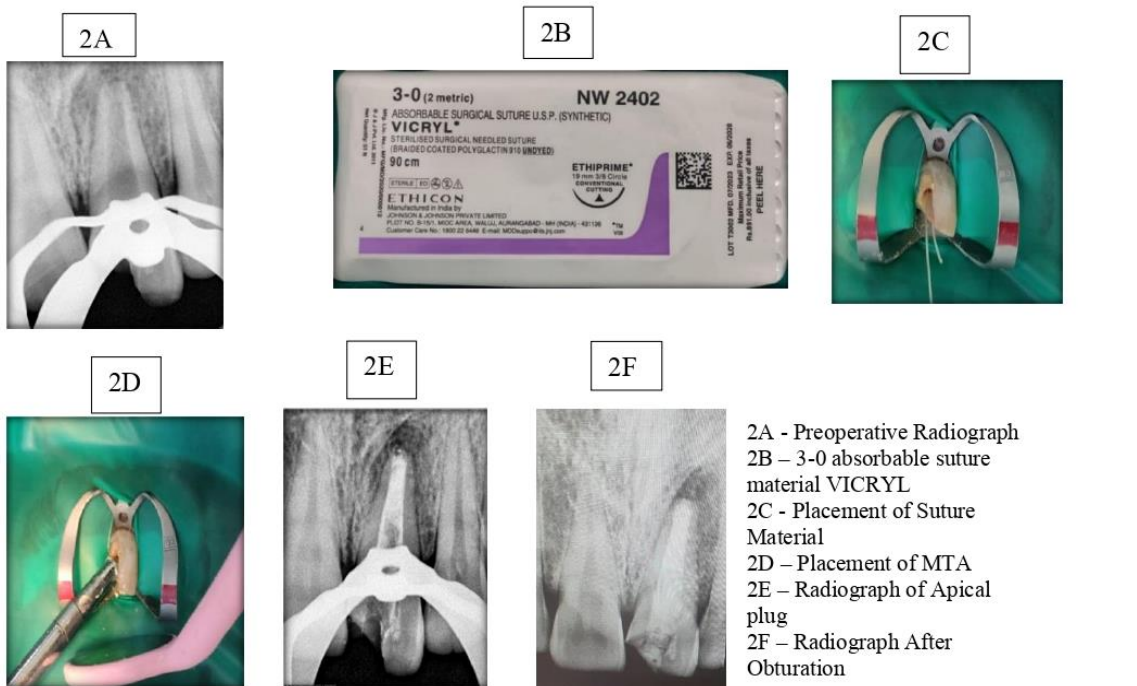
1I



1J



- 1A - Pre-operative radiograph
- 1B - Pre-operative photograph
- 1C - Access opening
- 1D - PRF preparation
- 1E - Piece of PRF prepared from patient's own blood
- 1F - MTA sprinkled in PRF
- 1G - Placement of PRF
- 1H - Placement of MTA
- 1I - Radiograph of apical plug
- 1J - Radiograph after obturation



DISCUSSION

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”.^[4] Traumatic dental injuries

play a significant role in causing the pulp necrosis and subsequent infection of the root canal system in immature permanent teeth (most common maxillary central incisor).^[1] There are many methods recommended to induce a barrier in root with open apex.

Calcium hydroxide was considered material of choice in past. Recently MTA has also been emerged strongly as artificial root end closure material in open apices. Both materials were found to stimulate the formation of mineralized tissue, thereby providing an adequate seal in the apical region. MTA, a bio-compatible material, can be used to create a physical barrier that also helps in formation of bone and periodontium around its interface.^[5] Formation calcific bridge with bioceramics have shown favourable outcomes and can be achieved in much shorter time compared to that of calcium hydroxide with average of 12.6 months.^[6]

In first case PRF was used as matrix which is an immune platelet concentrate that aids in wound healing and repair and can be employed as a matrix. PRF comprises of growth factors such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), transforming growth factor beta (TGF- β , including β -1 and β -2 isomers) and insulin like growth factor (IGF -1). PRF is absolutely biocompatible and autologous. It does not disintegrate right away after using. All-natural, chemical- free, Economical and more convenient to use. PRF membrane has a soft consistency and it inherently contains some amount of moisture, still it serves as a good matrix material for placement of MTA. PRF is an effective barrier when combined with MTA.

In second case absorbable suture material was used as matrix a synthetic absorbable sterile surgical suture composed of a copolymer made from 90% glycolide and 10% L-lactide.^[6] This approach has certain benefits over others, including easy matrix "fabrication," simple insertion using pluggers, easy accessibility of absorbable sutures, and affordability. It is non antigenic and pyrogenic. Absorption of coated VICRYL suture is complete between 56 and 70 days by hydrolysis.^[6]

In third case absorbable collagen was used as matrix as Collagen is the most abundant protein in the human body, a molecular structure that is characterized by a high diamino dicarboxylic amino acid content and carbohydrate moieties. By functioning as a scaffold, resorbable collagen sponges support platelet aggregation, stabilize clots, facilitate recovery by attracting fibroblasts to the wound area, and enable increased vascularization in the recovering tissue.^[1] The malleability, adaptability, and ease of manipulation of absorbable collagen membranes may prove beneficial in condensation in open apex cases. Benefits include natural enzymatic breakdown, chemotactic capability for attracting fibroblasts, haemostatic function, semi- permeability as it permits nutrient flow, and biocompatibility. It requires 2-4 weeks to totally resorb.

Orthograde placement of MTA as an apexification material also represents an attempt to strengthen immature tooth roots. Though MTA is not bonded to dentin, interaction of the released calcium and hydroxyl ions of MTA with a phosphate- containing synthetic

body fluid results in the formation like interfacial deposits. These deposits fill any gaps induced during the material shrinkage phase and improve the frictional resistance of MTA to the root canal walls, which accounts for the seal of MTA in orthograde obturation.^[7] Taking into consideration all these advantages of PRF, absorbable suture and absorbable collagen, we have used these materials as an apical barrier matrix over which MTA, a well-known root end filling material was placed proving success of this cases.

CONCLUSION

Using internal matrix of PRF, absorbable suture and absorbable collagen have given a good result in single visit apexification. The placement of MTA has become predictable with controlled condensation which has reduced duration and frequency of visits. Long-term clinical trials and investigations are further required.

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