ORIGINAL RESEARCH

Comparative Evaluation of Prevention of Apical Extrusion of MTA Apical Plug with Different Internal Matrices: A Clinical Study

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ABSTRACT

Introduction: Apexification is a process of induction of an calcified barrier for root end closure. The aim of this study is to evaluate the efficacy of different internal matrices for prevention of mineral trioxide aggregate extrusion in apexification cases. **Methods:** Twelve apexification cases with nonvital Ellis class 4 fractures are selected for this study. The subjects were divided in to three groups. In group 1 cologide is used as an internal matrix. In group 2 calcium hydroxide powder is used as an internal matrix. In group 3 PRF membrane is used as an matrix. MTA apical plug of about 4mm was placed up on these matrices. The handling of internal matrices, prevention of mineral trioxide aggregate plug extrusion and periapical healing was observed for this cases radiographically. **Results:** The results of this study revealed that the placement of internal matrix prevented the extrusion of mineral trioxide aggregate in almost half of cases. No statistically significant differences were seen with-in the groups in prevention of MTA extrusion. Periapical healing was evident in all patients with no clinical symptoms. The handling and placement of PRF membranes is comparatively difficult with other matrices. **Conclusions:** This study advocates the usage of internal matrices as a protocol. The proper choice of matrix and its proper compaction enables the placement of mineral trioxide aggregate very easily with out periapical extrusion in apexification cases. Periapical extrusion of mineral trioxide aggregate is never recommended as it impairs with the healing of periapical tissues. The extrusion of MTA can be prevented by careful placement and condensation of MTA along with using an internal matrix as an apical stop.

KEYWORDS: MTA, Apexification, Matrices, PRF membranes, Periapical Extrusion

INTRODUCTION

Apexification therapy is indicated in cases with immature root apices with clinical and radiological evidence of pulpal necrosis. This apexification or root-end-closure, had been advocated by Seltzer in 1988. Apexification can be defined as a method to induce a calcified barrier in a root with an open apex or the continued apical development of teeth with incomplete roots and a necrotic pulp(American Association of Endodontists 2003). The first choice of root end closure material was calcium hydroxide (Rafter 2005) but the unpredictability of treatment, patient compliance and lengthy schedule and chances of reinfection with temporary restorative material has paid the way for the newer materials. Mineral trioxide aggregate was proposed as an alternative repair material by Mahmoud Torabinejad in 1993. Long term studies on MTA favor the biocompatibility, reparative and regenerative properties of this material.

MTA apexification technique significantly reduces the treatment time in cases with blunderbuss canals. The mechanical properties of root dentine remain unaltered in these cases and induction of cemental repair and root lengthening is possible because of the biomimetic properties of this material.[1] The multiple applications of MTA include the root end closure, perforation repairs, vital pulp capping and retrograde filling of surgical endodontic therapy. However prevention of apical extrusion of MTA is very challenging during the apexification procedure due to reverse architecture of the apical root area in these cases. The purpose of this study is to evaluate the efficacy of internal matrices to prevent the apical extrusion of MTA. The rationale of introducing internal matrices to limit extrusion of MTA is because of the persistence of the inflammatory process which may complicate and prevent the repair of tissues.[3]

MATERIALS AND METHODS

Twelve patients aged between 12 to 17 years with a chief complaint of discolored anterior teeth were selected for this study. All the patients in this study had a history of trauma that occurred at approximately 4-8 years back. Clinical examination of all the patients revealed fractures of upper central incisors. Periapical radiographs demonstrated incompletely formed apices and periapical

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radiolucencies of central incisors. Negative responses were elicited with thermal and electric pulp testing. So the diagnosis of Ellis class IV was done in all the cases and apexification was planned in all the cases.

Procedure: With rubber dam in place, access cavities are done and working lengths were established 1m short of apex. Cleaning and shaping was performed with stainless steel k files. Copious irrigation with 1% sodium hypochlorite and 17% EDTA was done carefully and canals were subsequently dried with paper points. Since disinfection of necrotic canals is not possible in same visit calcium hydroxide paste(rc-cal) was placed in the root canals for two weeks and all the access cavities were sealed with cavit(3M ESPE). Patients were recalled after two weeks and calcium hydroxide was removed using sodium hypochlorite irrigation and hand files. Randomly four patients were assigned in each group. The placement and handling of different matrices was done by one researcher to prevent any operator errors.

In group 1: Cologide sterile collagen membranes were cut in to desirable pieces and pushed apically with endodontic pluggers to form a mechanical barrier upon which MTA can be condensed. (Fig 4, 5) MTA (MTA ANGELUS) was mixed to an sandy consistency according to manufacturers instructions and an apical plug of 4mm thick was placed. (Fig 6)

Fig 1: Collagen membrane

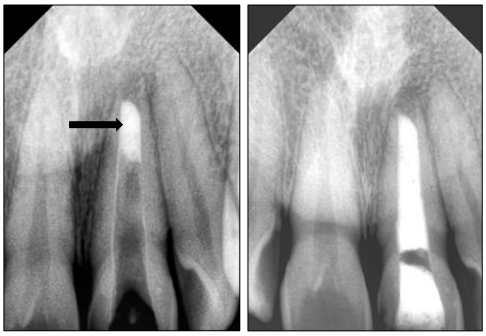

Fig 2: MTA plug with collagen matrix. Fig 3: Backfill with lateral condensation

In group 2: After drying the canals a 1mm plug of dry sterile CH powder was placed as an internal matrix with an amalgam carrier. Powder was pushed apically with endodontic pluggers.MTA plug of approximately 4-5mm was placed incrementally with radiographic evaluation simultaneously. (Fig 8)

Fig 4: MTA apexification with CH powder matrix

In group 3: Platelet rich fibrin membranes were prepared for patients. For this procedure about 8ml of blood was drawn by venipuncture of the anticubital vein from patients. This blood was collected in sterile glass tube without anticoagulant and was centrifuged immediately at 3000 revolutions/min (rpm) for 10 min. (Fig 1) Three layers are obtained. Top-most layer consists of a cellular plasma, PRF clot in the middle and red corpuscle base at the bottom. PRF clot was placed in an compression box to obtain an PRF membrane. (Fig 2,3) .The PRF was then

Fig 5: Blood sample collection

Fig 6: PRF compression box

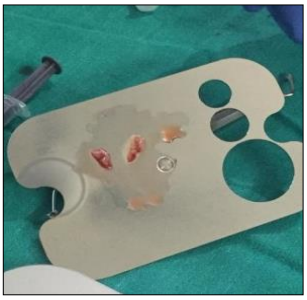

Fig 7: PRF membrane

carried with sterile cotton pliers inside the canal and was condensed gradually using the controlled pressure with the help of endodontic pluggers placed with a rubber stopper .MTA was placed as previously discussed. (Fig 7)

Fig 8: MTA with PRF matrix

In all these cases a sterile moist cotton pellet was placed over the MTA and temporary restoration was done with cavitemp. (Ammdent). The hardness of the apical barrier was checked after one day. Backfill was performed with lateral condensation technique using Apexit plus sealer. The access cavity was sealed with composite restoration for all these patients. Post endodontic restorations were planned. The ease of placement of matrix, the periapical extrusion of material as well as the periapical healing of the lesion was assessed qualitatively for all the cases .The presence/ absence of periapical extrusion of MTA inspite of barrier placement was checked radiographically. (Table 1)

Groups	Handling And Placement Of Matrix	Periapical Extrusion Of Mta	Periapical Healing 3month Recall
Cologide	Easy	Present	Optimal
Ch Powder	Easy	Present	Optimal
Prf	Technique Sensitive	Present	Optimal

Table 1: Depicting the qualitative data between different groups

RESULTS

Statistical analysis was done using chi- square test to determine the apical extent of MTA plug. The extrusion of apical plug of MTA was seen in 3 (25%) cases. 33% of MTA apical fillings were underfilled and 42% are flush with apex in all the cases.(Table 2) The handling and fabrication of PRF membrane was technically challenging when compared to collagen membrane and CH powder as internal barriers. Difficulty in compaction was seen with patients with PRF membrane as matrix. MTA placed with collagen membranes and calcium hydroxide were flush with the apex in 33% of cases. No discrepancies were seen with the periapical healing in all these cases. No statistically significant differences were seen with in the groups with level of significance set at 0.05.

Groups	Overfilled	Under Filled	Flush With Apex
Collagen Membrane	1 (1.00) [0.00]	1 (1.33) [0.08]	2 (1.67) [0.07]
Ch Powder	1 (1.00) [0.00]	1 (1.33) [0.08]	2 (1.67) [0.07]
Prf	1 (1.00) [0.00]	2 (1.33) [0.33]	1 (1.67) [0.27]

Table 2: Chi- square test for evaluation of MTA apical filling
* The chi- square statistic is 0.9. The p value is 0.924. The result is not significant at p< 0.05

DISCUSSION

MTA is considered as a boon to the endodontist due to its multiple applications. MTA is the material of choice for placement as an root end barrier in open apices cases. In addition to biocompatibility the other desirable properties of MTA are fibroblast stimulation, antimicrobial activity, sealing capability and ability to set in an moist environment.[4]

In teeth with open apices, irregular walls and divergent root apices makes the compaction of MTA difficult and extrusion of MTA plug may occur. The lack of an apical step or seat also contributes to the apical extrusion of the material.[2] So to prevent extrusion of MTA in to the periapical tissues matrices are advocated. Lemon in 1992 advocated the use of a matrix when the perforation diameter is larger than 1 mm to avoid extrusion of the sealing material.[5] 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. Collagen plugs, calcium sulphate based materials, CH powder, Platelet rich fibrin, Hydroxyapatite based materials, recently absorbable sutures like Vicryl are being advocated for use as an internal matrix for MTA apexification.[6] CH, calcium sulphate and collagen are recommended as most suitable matrix barriers as they aid in bone formation.

In this present study the efficacy of the internal matrices to prevent extrusion of MTA was evaluated. Qualitative analysis was done in all the cases regarding the handling of matrix and periapical extrusion of MTA. Sterile Collagen membrane (cologide) is used as a matrix in this study as collagen membrane has good tissue integration, fast vascularization, biodegradation without foreign-body reaction, chemotactic action for fibroblasts, hemostatic property, weak immunogenicity, osteoblastic adhesion and their proven biocompatibility and capability of promoting wound healing.[7] However this method seems to be technique- sensitive requiring a high level of accuracy in positioning and placement of these membranes.[8,9]

In this study CH powder was selected because of its easy of availability and predictability for inducing peiapical healing. Biomimetic materials like calcium sulfate hemihydrate and de-mineralised bone particles (Type-I collagen) in powdered form (Osseomold) was used in the formation of the artificial barrier in earlier study done by roheet khatavkar and vivek s hedge and yielded same results.[10]

PRF was first used in 2001 by Choukroun et al specifically in oral and maxillofacial surgery, and is currently considered as a new generation of platelet concentrate. It consists of a matrix of autologous fibrin.[11] PRF consists of an autologous leukocyte-platelet-rich fibrin matrix composed of a tetra molecular structure,

with cytokines, platelets, cytokines, and stem cells within it which acts as a biodegradable scaffold that favors the development of microvascularization and is able to guide epithelial cell migration to its surface . Also, PRF may serve as a vehicle in carrying cells involved in tissue regeneration and seems to have a sustained release of growth factors in a period between 1 and 4 weeks, stimulating the environment for wound healing in a significant amount of time. Quick handling is the key to achieve a clinically usable PRF clot. The protocol given by Dohan is followed in this study and PRF is obtained. However it should be noted that the success of the PRF protocol depends directly on the handling, mainly related to blood collection time and its transference for the centrifuge. This is main limitation of this membranes.[12,13,14.]

This study revealed that there are no statistical differences between the groups in prevention of MTA extrusion with different apical matrices. MTA flush with apex was noted in half of cases with the presence of matrices. It should be noted that placement of matrices as an apical stopper definitely limits the extrusion of MTA. Underfilling was observed in patients with PRF membranes as apical matrix. This might be due to improper compaction force used. The handling of PRF matrices was challenging because of its fragile nature. In patients with cologide as a matrix the placement of matrix was easy and a mechanical barrier was felt while placing MTA plug.

There is still an enigma regarding the periapical healing associated with MTA extrusion .Long term evaluation of mineral trioxide aggregate extrusion into the periapical lesion by Seok-Woo Chang etal showed that favorable healing around this material was observed.[15] Studies done by Tahan E, Celik D, Er K, Taşdemir T. were also consistent with these findings. This study showed that complete periapical healing is possible despite the extrusion of the MTA.[16] Low cytotoxicity and the induction of mineralization are two desirable properties of MTA that may explain the bioregenerative and biocompatibility of this biomaterial according to Mente et al 2010, Samiee et al.2009, Eghbal et al 2009, Tabarsi et al 2010, Ng and Messer 2008,Asgary et al.[17]

On contrary to this a case report by Nosrat A, Nekoofar MH, Bolhari B, Dummer PM in 2012 on extrusion of MTA revealed that extruded MTA may not harden and may be associated with ongoing periapical irritation. The authors postulated that extruded set MTA when encapsulated in the mucosa and not surrounded by bony matrix may act as a mechanical irritant on palpation. Conclusions of the study were that Mineral trioxide aggregate should be confined to the root canal system. Teeth where MTA has been extruded beyond the foramen should be followed-up to monitor the outcome.[18]

All these studies advocate the confinement of MTA with in the canal system. To prevent the extrusion of MTA an internal matrix system should be used as a protocol. The condensation pressure is required to be considerably reduced in order to prevent MTA from being pushed beyond the apex.[19] Periapical healing of all the cases was satisfactory in this study and patients were absolutely free of symptoms after three month recall .More number of cases and long term follow up of patients is required to fabricate a proper protocol for using an internal matrix.

CONCLUSION

The clinical findings of these cases reveals that periapical healing of MTA is uneventful if it is confined within the root canal. No statistically significant differences were found among different groups with internal matrices. MTA apical plugs were flush with apex when used with matrices in almost half of cases.Intentional overfilling of MTA is not recommended. The proper choice of matrix significantly eases the placement of apical plug even in an novel operator.

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