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NOVEL METHOD OF MTA APEXIFICATION – A CASE REPORT

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Abstract:
Apexification using an apical plug of Mineral Trioxide Aggregate (MTA) can be considered a predictable treatment and has been an alternative to the calcium hydroxide apexification since late 1990s. But the major drawback of MTA is its difficulty in manipulation. This case report presents a new technique for orthograde root end placement of MTA. This novel method created superiorly condensed apical plugs. It will resolve the problems faced by conventional technique and produce a better apical seal.
Key words: Mineral Trioxide Aggregate, Manipulation, Calcium hydroxide, Apexification, Apical Plug.

Introduction

Complete root formation and apical closure of a permanent tooth continues for up to 3 years following tooth eruption. Immature teeth have wide dentinal tubules and allow the penetration of bacteria and their irritants.(1) So, any trauma or caries in immature permanent teeth can trigger the loss of pulpal vitality as well as directly have an impact on root development. This results in short roots with very thin walls, thus increasing the risk of fracture. Also, root resorption occurs rapidly after trauma in these teeth.(2)

Root canal treatment (RCT) helps to achieve three dimensional debridement and sealing of root canal space. Obtaining an apical seal is the biggest problem in achieving a successful endodontic treatment.

Apexification is a procedure done for inducing a calcific barrier in the apical zone of an incompletely formed root.(3) Calcium hydroxide [$Ca(OH)_2$] apexification may involve multiple monthly appointments to achieve elimination of the intracanal infection. The placement of $Ca(OH)_2$ stimulates calcification and produces the apical closure. But, it has several disadvantages like alteration of the mechanical properties of dentin making the teeth more susceptible to root fracture. Also, it takes 5 to 20 months to form a calcific barrier.(4) The formed apical plug is not completely impervious due to increased porosities within the barrier.(5)

Thus, the traditional use of $Ca(OH)_2$ to achieve apexification is being gradually replaced by MTA. Since late 1990s, MTA is the most popular material and it is used as an apical plug followed by the root canal obturation. MTA helps in regeneration of root apex by the continuation of root to develop to its length and width.(6) The major demerits of MTA are the difficulty in manipulation and placement of the MTA plug at the apex of an immature tooth. Moreover, MTA also has harmful effects on the periapical tissues, if accidentally extruded.(4)

The aim of this case report is to introduce a new method of MTA placement at the root apex of immature root with large apical foramen. The method described is relatively easy and aid in overcoming the demerits of the conventional practice. Before following this novel method in vivo, we performed an in-vitro study to know the quality of the apical plug through radiographic assessment and microleakage analysis. The results were satisfactory and thus we implemented the technique in this case.

CASE REPORT

A 28- year old male patient had Ellis class III fracture in maxillary right central incisor (tooth 11) with previously initiated root canal treatment and discolouration. The patient had no tenderness on percussion. He had a history of trauma 15 years ago. Radiographically, tooth 11 showed open apex, periodontal space widening and mild periapical radiolucency [Fig 1]. The diagnosis was narrowed to previously initiated therapy with asymptomatic apical periodontitis in 11. The treatment options for open apex were explained to the patient and root canal therapy following MTA apexification was chosen.

During the first visit, rubber dam isolation was done in 11 followed by removal of the temporary restorative material.

Access refining was done using endo Z bur (Dentsply, USA) and the canal was explored with DG 16 (GDC, India).

The root canal orifice was enlarged using gates glidden drills # 4, 3 (Mani Inc., Japan). Working length of the root canal was determined with a K-file (Mani Inc., Japan) ISO number 10 using apex locator and confirmed with a radiograph [(7)] [Fig 2]. Biomechanical preparation was done using hand K-files with intermittent irrigation using 30 G irrigating needles (NaviTip; Ultradent Products, USA). The irrigants used were 5 ml of 3% sodium hypochlorite (Prime dental products Pvt, Ltd., India), 5 ml of 17% EDTA (Prevest DenPro, India) and 5 ml of 0.9% saline (Fresenius Kabi Private Limited, India). Calcium hydroxide (Calplus, Prevest DenPro Limited, India) intra-canal medicament was placed and sealed using a temporary restorative material (Cavitemp, Ammdent, India) for one week to disinfect the root canal.

In the second appointment, the intra-canal medicament was flushed out with saline and ultrasonics. 2% Chlorhexidine (DEOR RC-CHLOR, India) was used as the final irrigant and the canal was dried using paper points (DiaDent, Korea). The root canal impression was taken with gutta-percha sticks (Neelkanth, India) using rolled cone technique [Fig 3a] and apical 4 – 5 mm impression was transferred to addition silicone (Zhermack Elite HD+, Italy) to serve as a mould [Fig 3b]. Temporary restoration was placed on the access cavity and the patient was recalled the next day.

MTA (ANGELUS, Brazil) was then condensed into the mould layered with sterile Teflon tape to get a 5 mm MTA plug [Fig 3c]. During setting, 1 mm diameter of 25 mm long sterile coaxial wire (GDC, India) was inserted into the condensed MTA plug.

The next day, MTA plug was transferred into the prepared root canal with a thin coating of freshly mixed MTA [Fig 3d]. A radiograph was taken to confirm the position of apical plug [Fig 3e]. Once the plug was placed upto the working length, the coaxial wire was removed slowly from the root canal with a mild twisting motion. A sterile cotton pellet moistened with sterile water was placed over the orifice and the access cavity was sealed with a temporary restorative material. Three days later, the set of MTA was confirmed and the root canal was obturated with thermoplasticized gutta-percha (E & Q Master, Meta Biomed, USA) and resin-based root canal sealer (AH plus, Dentsply DeTrey, Germany) [Fig 4] followed by permanent restoration of the access cavity with composite (3M ESPE Filtek Z350, USA) [Fig 5].

DISCUSSION

Apart from insufficient disinfection and debridement of canals, another factor which is responsible for endodontic failure is the improper apical seal.[(8)] Immature root with a necrotic pulp and apical periodontitis presents multiple challenges to the clinicians. The standard protocols for root canal treatment cannot be followed because the open apex provides no barrier to prevent the irrigants or root filling materials from impinging the periodontal tissues. Even when the challenges described above are overcome, the roots of these teeth are thin with a higher susceptibility to fracture.[(9)]

MTA has become a predictable alternative to address the issues of $Ca(OH)_2$ such as porous apical barrier, increased risk of root fracture and long treatment duration. Also, $Ca(OH)_2$ apexification necessitates complete removed of $Ca(OH)_2$ before obturation, whereas, in MTA apexification, MTA remains as a part of obturation itself.

MTA creates an osteoconductive apical barrier. It is a powder containing fine hydrophilic particles of tricalcium silicate, tricalcium oxide and silicate oxide. These particles have the ability to stimulate cells to differentiate into hard tissue, thus producing a hard tissue matrix. The set MTA has a pH similar to $Ca(OH)_2$ i.e. 12.5 pH and this may show some antimicrobial properties. It shows less solubility and its radiopacity is slightly higher than dentin.[(10)] This material has demonstrated good sealability and biocompatibility.[(11)] It has been used in both surgical and non-surgical applications including root end filling, direct pulp capping, perforation repairs and apexification.[(12)] But, most of the dental practitioners encounter difficulty in handling MTA clinically.[(13)] MTA should be confined to the root canal space and should not be extruded beyond the apex. Once extruded, it may not harden and may be associated with continuous periapical irritation. This is because, it gets encapsulated in the mucosa and not surrounded by bony matrix, thus could act as a chronic irritant.[(14)] The above demerits of the conventional method was the actual reason for introducing this novel technique of MTA apical plug placement.

Before the placement of MTA apical barrier, it is recommended to use $Ca(OH)_2$ for one week as an intracanal dressing. This has been considered an essential step in reducing the intracanal microbes. Owing to the detrimental effects of an acidic pH, by the inflammatory reactions of periapical tissues, on the physical properties of MTA, it is mandatory to delay the placement of the MTA plug to a second session. $Ca(OH)_2$ is used as an inter-appointment intracanal medication to achieve thorough disinfection and neutralization of an acidic environment.[(15)] Also, the residual $Ca(OH)_2$ has the potential to promote an initial chemical and mechanical bond between dentin and MTA.[(16)] Thus, $Ca(OH)_2$ was placed as an intracanal medicament for one week in the first visit and the root canal impression was taken in the second visit.

The root canal impression was taken using gutta-percha sticks, because it can be easily moulded and can mimic the actual shape of the canal. During the condensation of MTA in the mould created by elastomeric impression material, teflon tape was used to prevent any undesirable reaction between MTA and impression material. The MTA plug was transferred to the canal using a coaxial wire. The coaxial wire attaches well to the MTA plug and serves in the precise placement at the apex. It is also easy to remove the wire after the placement of MTA plug in the desired position. The prefabricated plug was coated with freshly mixed MTA to ensure close adaptation to the root canal wall.

According to Matt et al in 2004, the two-step technique of MTA apexification showed significantly less leakage than the one-step technique and they pointed out that the additional moisture from a cotton pellet is a crucial factor for MTA to establish its optimum properties.[17] Thus, a moist cotton pellet was placed over the plug and the obturation was done after three days. Thermoplasticized gutta percha obturation was done, since it produces a homogenous root canal filling.[18]

This technique can be adopted for teeth with open apex which has parallel walls and large open apical foramen. Even in incompletely formed root with very wide open apex, this procedure can be adopted to regenerate the apex after it undergoes a $Ca(OH)_2$ apical stop. Once there is narrowing or partial bridging of the open apex, then MTA apical plug can be fabricated by the novel method and placed. Further studies are necessary for implementing this technique in regular clinical practice.

Conclusion:

The novel method of MTA compaction shows superior apical seal and will surely serve as a better technique for the operator to produce a successful treatment outcome.

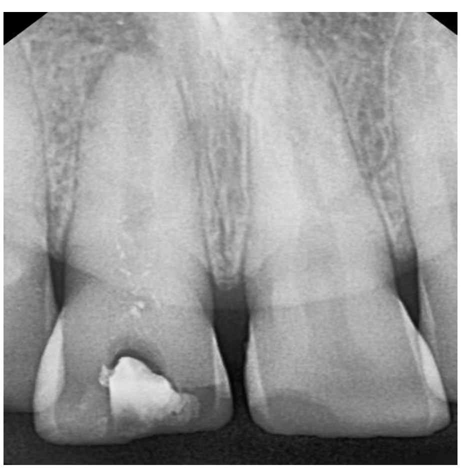

Figure 1: PRE-OPERATIVE RADIOGRAPH

Figure 2: WORKING LENGTH DETERMINATION

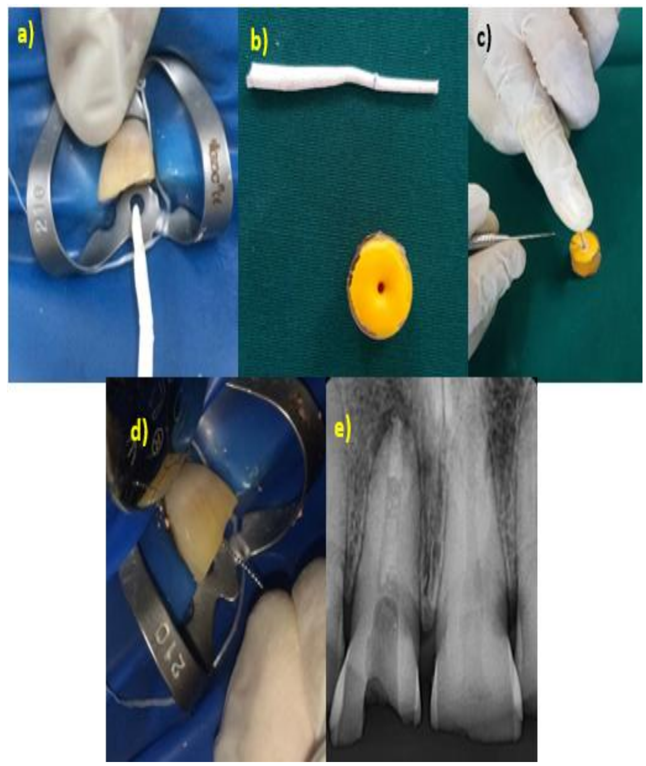

Figure 3: MTA MANIPULATION AND PLACEMENT

a) Intracanal impression with gutta-percha stick

b) Root canal impression transferred to addition silicone to serve as a mould

c) Condensation of MTA into the mould

d) Transfer of MTA plug into root canal with the help of co-axial wire

e) Radiograph confirming the position of MTA plug

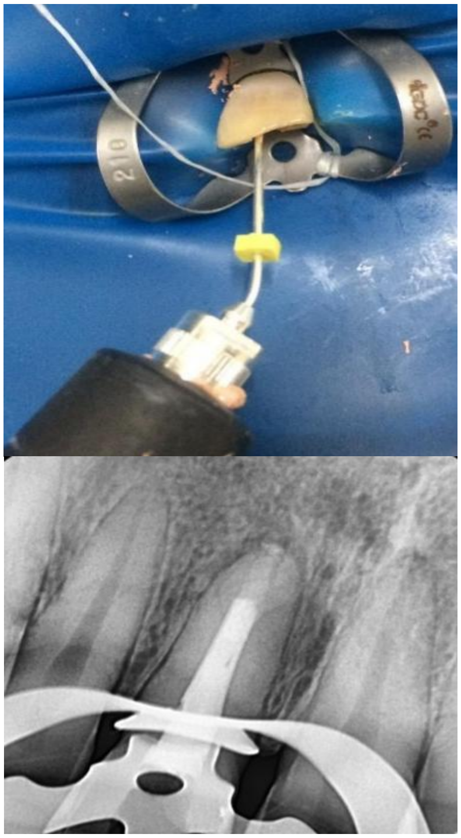

Figure 4: OBTURATION USING THERMOPLASTICED GUTTA PERCHA AND RESIN SEALER

Figure 5: POST – OPERATIVE RADIOGRAPH

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