ORIGINAL RESEARCH

Management of Open Apex: A Case Series

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ABSTRACT

Introduction: An immature tooth that develops pulpal or periapical disease presents special problems. Because the apex has not completely formed, conventional root canal treatment procedure would be unpredictable. The treatment of choice for necrotic teeth is apexification, which is induction of apical closure to produce more favourable conditions for conventional root canal filling. The most commonly advocated medicament is calcium hydroxide, although recently considerable interest has been expressed in the use of mineral trioxide aggregate.
Case report: This paper discusses two case reports where Mineral trioxide aggregate (MTA) has been used successfully to treat immature teeth for apical closure.
Conclusion: MTA showed clinical and radiographic success as a material used to induce apical closure in necrotic immature permanent teeth. MTA is a suitable replacement for $Ca(OH)_2$ for the apexification procedure.

Key words: Apexification, Calcium hydroxide, Mineral trioxide aggregate, Single visit.

How to cite this article: Patil PP, Lotika D, Karan B, Kunal B. Management of Open Apex: A Case Series Int J Cont Med Res. 2015;2(1):110-115

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Source of Support: Nil

Conflict of Interest: None

INTRODUCTION

Traumatic injuries of immature teeth are difficult situations to face with psychological, physical and esthetic considerations. Devitalization of the pulp with arrest in the further development of the immature roots of the involved teeth is one of the sequel of traumatic injuries of young permanent teeth.[1] When immature teeth suffer pulp pathology, the formation of dentin stops and ceases the root development. So the canal remains large, with thin and fragile dentin walls and apex remains open. This makes the instrumentation of canal difficult and hinder the formation of an adequate apical stop.[2] In these situations apexification is the option. Apexification is the formation of mineralised tissue in the apical portion of incompletely formed tooth.[3]
Root development occurs due to continuous deposition of dentin and cementum. It occurs by stimulation and differentiation of Hertwig’s Epithelial Root Sheath (HERS) and surroundingundifferentiated progenitor cells. HERS consists of epithelial cells, which separates the pulp from the dental follicle. It consists of an inner layer of cuboidal cells and an outer layer of more flattened cells. It completely encloses the dental papilla and has an opening in its base, the primary apical foramen. Odontoblastic differentiation takes place adjacent to the basal aspect of HERS and deposition of mantle dentin occurs. As mantle dentin is formed, the innermost layer of cells in the root sheath secretes an intermediate material which combines with the mantle dentin to form intermediate cementum layer. HERS disintegrates after odontoblastic differentiation and formation of intermediate cementum, and these epithelial cells migrate away from the root surface to form the epithelial cell rests of Malassez. At the same time, cells from the dental follicle migrate towards the root surface and become cementoblasts. Interruption of this process by trauma or infection leads to open apex and incomplete root development.[3]
Calcium hydroxide is the material of choice for apexification and it is widely studied and reported

for apexification. A success rate of 74-100% is reported by Sheehy and Roberts. But this traditional material has disadvantages such as its prolonged treatment time, theneed for multiple visits and radiographs, root fracture.[3] So over the last few years, Mineral Trioxide Aggregate (MTA)has been researched extensively and reported as a material of choice for the open apex cases. MTA has a good biocompatibility, better sealing ability, No tunnel defect as compared to other material for apexification. This paper discusses two case reports where MTA has been used successfully to treat immature teeth for apical closure.

CASE REPORTS

Case 1

A 32 year old male patient reported to the department of Conservative Dentistry and Endodontics, Dr D.Y. Patil Dental College and Hospital, Pimpri with a chief complaint of mild mobility of a tooth in lower left back region since 1 month. Patient gave history of trauma at the age of 12 yrs. Patient gave history of pus discharge through gingival sulcus of lower left premolar 2 months back, but there was no history of pain and swelling.

On clinical examination, there was grade I mobility with 35 and pain on percussion. 35 did not show any response to heat, cold and electric pulp tests. Radiographic examination revealed an immature root apex in relation to 35 and widening of periodontal ligament space was seen in periapical area. (fig no.1)

Tooth 35 was diagnosed with chronic periapical abscess with an open apex. Endodontic treatment with MTA root apexification followed by obturation with Thermoplasticized Gutta Percha was planned with 35.

Access opening was done under rubber dam. Necrotic Pulp tissue was extirpated completely, working length was calculated with no. 90 K-file.Circumferential filling was done with no.90 K-file. Cleaning was performed using 1.5% Sodium hypochlorite and 17% Ethylene Diamine tetra acetic acid gel as irrigants then aqueous calcium hydroxide was placed for 7days for disinfection of the canal. After 7 days, temporary restoration andaqueous calcium hydroxide were removed. Final irrigation was performed with saline and canal was dried with paper points.

PLACEMENT OF APICAL PLUG

- Hand plugger was selected for condensation of MTA (angelus) at the root apex. Rubber stopper was adjusted on the plugger, 4mm short of working length. MTA was mixed according to manufacturer's recommendation and mixed MTA was carried with amalgam carrier and pushed towards the apical foramen with a hand plugger.
- The apical plug of 4 mm thickness was made and this was checked radio graphically (Fig no.2).
- A moist cotton pellet was placed in the canal and the tooth was temporarily restored. After 24hrs, after ensuring setting of MTA the remaining canal was obturated with thermoplasticised gutta percha using E & Q system using back fill technique.(Fig no.3)
- Permanent restoration was done and crown was placed. Fig-4 shows 6 months follow up radiograph.

Case 2

A 36 year old male patient reported to the department of Conservative Dentistry and Endodontics, Dr D.Y. Patil Dental College and Hospital, Pimpri with a chief complaint of fractured and discoloured upper front tooth. Patient gave history of trauma with upper front teeth in childhood.

On clinical examination, 11 showed brownish discoloration. Ellis class III fracture and tooth was asymptomatic. 11 did not show any response to heat and cold tests. Radiographic examination revealed an open root apex with 11(Fig no.5). Tooth 11 was diagnosed as nonvital tooth with open apex.

In the 1st appointment access opening was done under rubber dam and circumferential filling was done. Cleaning was performed using 1.5% sodium hypochlorite (NaOCl) and 17% ethylene diaminetetraacetic acid (EDTA) gel as irrigants then aqueous calcium hydroxide was placed for 7 days for disinfection of the canal. In secoand appointment, 4-5mm MTA plug was made using hand plugger (Fig no.6). After single visit

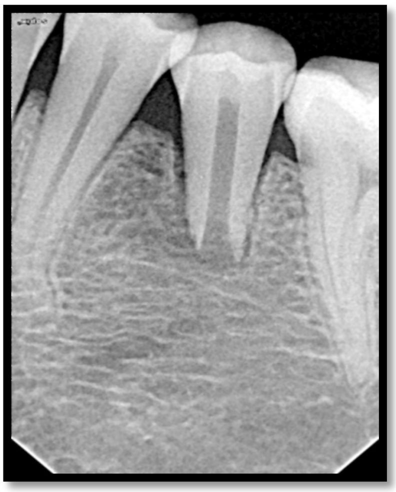

Figure -1: Preoperative radiograph

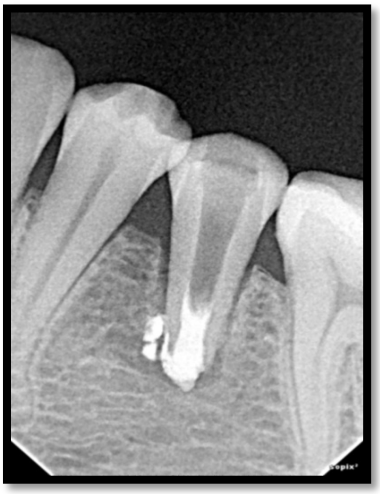

Figure-2: 4mm MTA plug

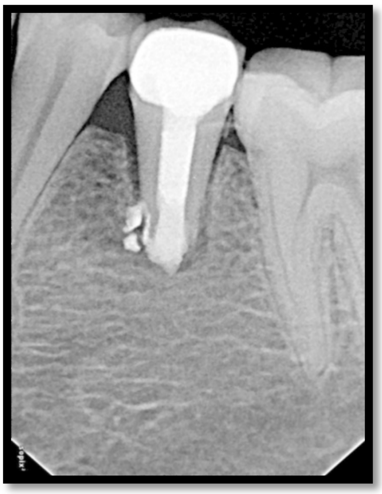

Figure-3: Thermoplasticised Obturation followed by crown

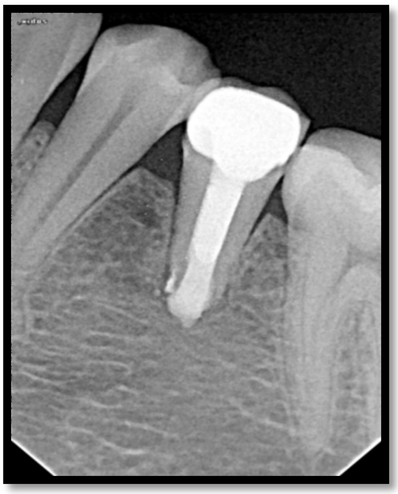

Figure-4: 6 months follow up

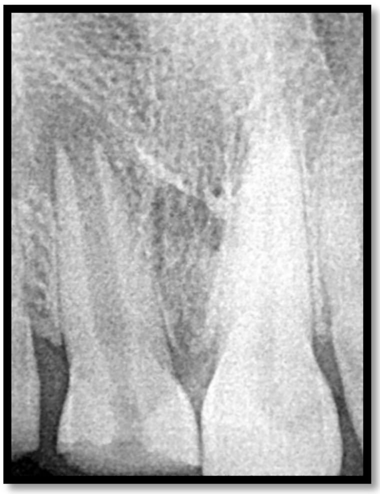

Figure - 5: Preoperative radiograph

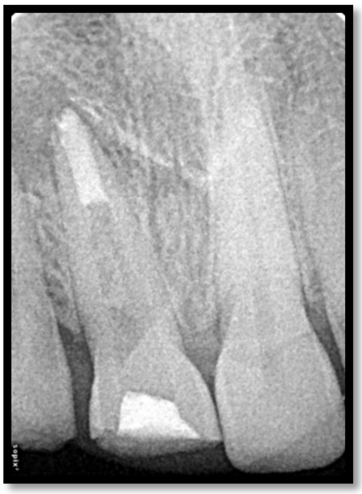

Figure -6: MTA plug

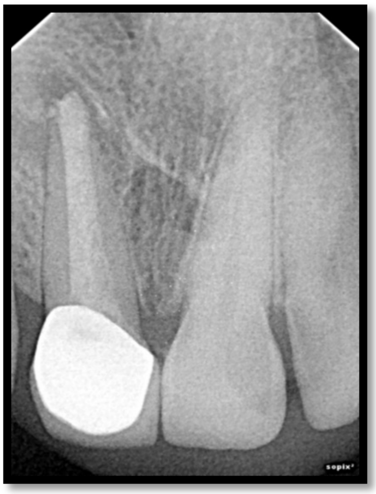

Figure -7: Root reinforcement using interlig followed by crown

apexification, remaining canal was restored with Polyethylene fiber (interlig by angelus), followed by permanent restoration and crown.(Fig no.7)

DISCUSSION

In 1990, Morse et al.[4] have explained three techniques to obturate an immature tooth, which involved the use of a root-filling material without the induction of the apical closure:

- Placement of a large or customized gutta-percha cone with sealer at the apex;
- Placement of gutta-percha with sealer or zinc-oxide/ eugenol short of the apex;
- Peri-apical surgery.

Since there was no physical apical barrier to facilitate obturation, these techniques did not gain popularity. However, Morse et al. also reported two techniques, which aimed to provide the formation of an apical barrier:

- Placement of calcium hydroxide to induce a mineralized apical barrier;
- Placement of a biocompatible material such as dentin chips against which a root-filling could be placed.

The traditional approach to the treatment of non-vital teeth with incompletely developed roots is apexification by inducing the formation of mineralised tissue in the apical portion of incompletely formed apex. The barrier facilitates the placement of root-filling which reduces the possibility of the sealer or root-filling extruding into apical tissues [3,5]. The aim of apexification is production of mineralized apical tissue and to limit the bacterial infection inimmature anterior tooth [7].

Many materials are recommended for apexification, Calcium hydroxide is most widely used and readily available material for apexification [8].

APEXIFICATION WITH CALCIUM HYDROXIDE

Calcium hydroxide is used with great success to form an apical hard tissue barrier in immature open apices, since many years.The use of $Ca(OH)_2$ apical barriers is associated with unpredictable apical closure, more no of appointments, extended time for barrier formation, risk of reinfection resulting from the difficulty in creating long-term seals with provisional restorations and susceptibility to root fractures due to thin roots or prolonged exposure of the root dentine to $Ca(OH)_2$. [7] Thus, the one-visit apexification technique is becoming popular. Torneck et al [8]. found that when apical closure takes place with $Ca(OH)_2$, there is incomplete bridging of the apex histologically. Periapical inflammation remains around the apices of many teeth because necrotic tissue can exist in the corners and crevices of the bridge.[7]

Complete formation of barrier with calcium hydroxide can require 3-18 months. So long period is needed for treatment. Multiple visits and multiple radiographs are needed. In some cases, root resorption possibly caused by trauma and increased risk of root fracture due to dressing the root canal foran extended time with calcium hydroxide are reported.[3]

Considering the disadvantages of $Ca(OH)_2$, another material recommended for apexification is MTA [9]. In the above cases we have used MTA for apexification procedure as Calcium hydroxide has a number of disadvantages.

One-visit apexification is defined as the non-surgical condensation of a biocompatible materials like $Ca(OH)_2$, MTA into the apical end of a root canal, as an apical stop that enables the root canal to be filled immediately. [7-9]

In 1993, MTA was first described in dental scientific literature and was given approval for endodontic use by the US Food and Drug Administration in 1998. Initially, only one MTA material, consisting of grey-coloured powder,was available and then white MTA was introduced. The ingredients in MTA are tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide with some other mineral oxides that were responsible for the chemical and physical properties of aggregate. The white and grey MTA differs mainly in their content of iron, aluminium and magnesium oxides. Asgary et al claim that these oxides are present in less quantity in white MTA while others claim total absence of these oxides in white MTA.[10] The inadequacy of $Ca(OH)_2$ apexification led to the use of MTA, which forms a barrier and prevents microleakage.[7] MTA facilitates the formation of dentinal bridges and cementum and regeneration of the periodontal ligament. It is biocompatible.It has anability to stimulate cytokine release from the bone cells, which actively promotes hardtissue formation .[7]

In the above cases after doing the access opening, only the circumferential filling was performed, in order to prevent the thinning of the root dentin and fracture of tooth. Cleaning was performed with 1.5% NaOCl and 17% EDTA gel. Lower concentration of NaOCl was used, in order to prevent damage to periapical area due to extrusion of irrigant in the periapical area. Calcium hydroxide was placed in the canal to disinfect. The apical plug of MTA (fast setting) should be at least 3-4 mm thick to provide a good seal.[10] A moist cotton pellet was placed over the MTA, which is needed for the setting of MTA as it is hydrophilic.[10] In the next appointment after confirming the setting of MTA, remaining canals were filled with thermoplasticised guttapercha (in case 1) and interlig (Braided glass fiber impregnated with light-cured composite resin) (in case 2) respectively, followed by permanent restoration and crown.

In case 2, the dentin thickness of radicular walls was less, clinically 40% crown structure was remaining so in order to reinforce the tooth and to increase the fracture resistance of tooth interlig was placed in the root canal.

MTA in association with a matrix of calcium sulfate hemihydrate and de-mineralized bone particles [11](Type-I collagen), Bone Morphogenic Proteins, Hydroxyapatite, collagen etc. are tried with varying levels of success. These materials are placed periapically against which the MTA is packed at the apex. MTA is the most upcoming material for apexification.

MTA is capable of activation of cementoblasts and produces cementum.[11] It allows for the overgrowth of cementum and facilitates regeneration of the periodontal ligament. MTA allows bone healing and eliminates clinical symptoms in many cases. [12]

MTA has the ability to induce cementum like hard tissue when used adjacent to the periradicular tissues. MTA is non-cytotoxic and stimulates cementogenesis. This material generates a highly alkaline aqueous environment by release of calcium and hydroxyl ions, making it bioactive by forming hydroxyapatite in the presence of phosphate containing fluids.[3]

MTA is a promising material because of its superior sealing property, its ability to set in the presence of blood and its biocompatibility. Moisture contamination at the apex of tooth before barrier formation is a problem with other materials used in apexification such as Calcium hydroxide. As a result of its hydrophilic property, the presence of moisture does not affect its sealing ability. Despite its good physical and biologic properties, retrieval of material, setting time are main disadvantages.[4,13] Other material such as Biodentin can be preferred over the MTA which shows improved properties.

CONCLUSION

MTA showed clinical and radiographic success as a material used to induce apical closure in necrotic immature permanent teeth. MTA is a suitable replacement for $Ca(OH)_2$ for the apexification procedure. Modifications can be made in the MTA to improve the setting time and retrievability of material. MTA offers the option of a two-visit apexification procedure, which must have the benefit of better compliance and reduced number of radiographs over the multiple visit calciumhydroxide apexification, particularly in younger patients.

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