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Open Apex with Mineral Trioxide Aggregate- Case Report

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Abstract : *The permanent teeth with open apex and large periapical lesion are diffcult to treat as a traditional root canal procedure, therefore calcium hydroxide place an important role in reducing the periapical infl ammation. Management of open apex can be done using mineral trioxide aggregate (MTA) which can be placed in apical 3-4 mm. The aim of This case report describes the use of mineral trioxide aggregate (MTA) for management of a periapically compromised immature tooth.*

Keywords: *Intra canal rehabilitation, mineral trioxide aggregate, open apex*

I. Introduction

The maxillary anterior teeth tend to undergo many impact injuries because of its position in the jaw. The apical 3-4 mm is most signifi cant in endodontic practice. When the enamel and dentin reaches the cemento-enamel junction, there is formation of cervical loop from where the root development starts.[1] At the time of tooth eruption, root development is only 62-80% i.e. 2/3rd of the root is formed. If due to trauma or caries exposure occurs, the pulp undergoes necrosis, dentin formation ceases and root growth is arrested.[2] Thorough disinfection of the root canal with proper hermetic seal is important for the success of endodontics. In case of a blunderbuss, canal maintaining the proper apical barrier with the three dimensional seal becomes difficult.[3] Calcium hydroxide was the material of choice to induce hard tissue formation at the apical end before placing the obturating material. However, calcium hydroxide shows certain limitations like the length of time needed to form apical barrier, the number of dressings needed for complete closure of apex, the role of infection caused in the canal in between the appointments and the fracture resistance of the tooth.[4]

Mineral trioxide aggregate (MTA) was developed at the Loma Linda University, California, USA, as a root-end filling material in surgical endodontic treatment . Over the years, further research on the material has resulted in MTA being applied in various clinical situations in addition to its use as a suitable root-end filling material. The diverse application of MTA in the practice of paediatric dentistry is evident in its use as an apical barrier in immature non-vital teeth and in the coronal fragment of fractured roots, as a pulpotomy medicament in primary and permanent teeth, a pulpcapping agent in young permanent teeth, and as a repair material for perforation and resorptive defects.[5-10]**Fig.1**

MTA is a modified preparation of Portland cement .They contain a mixture of a refined Portland cement and bismuth oxide, and are reported to contain trace amounts of SiO2, CaO, MgO, K2SO4, and Na2SO4 . The major component, Portland cement, is a mixture of dicalcium silicate, tricalcium silicate, tricalcium aluminate, gypsum, and tetracalcium aluminoferrite ·Gypsum is an important determinant of setting time, as is tetracalcium aluminoferrate,although to a lesser extent [6]. Currently, two different preparations of MTA are available: the original preparation is grey-colored (GMTA); whereas, a white preparation (WMTA) was recently introduced to address esthetic concerns. The d major difference between GMTA and WMTA is in the concentrations of of its contents .[7,8,9,10]

Fig.1; Mta

The ability of MTA to induce reparative dentinogenesis or dentin bridge formation has been consistently demonstrated in which direct pulp capping was performed in mechanically exposed pulps . These studies have also shown that MTA causes limited pulp tissue necrosis shortly after its application. Thus, MTA seems less causative compared with calcium hydroxide, which is known to cause the formation of a necrotic layer along the material-pulp interface . Compared with calcium hydroxide, MTA induces reparative dentin formation at a greater rate and a superior structural integrity.[5-10]

On the other hand, the cellular and molecular events involved in MTA-induced reparative dentinogenesis have been addressed in a limited number of in vivo studies . In one study, early pulpal cell response after capping with MTA was examined in mechanically exposed dog pulps . MTA initially induced the formation of a zone of crystalline structure and an arrangement of pulp cells with themorphological features of increased biosynthetic activity, for example, nuclear and cytoplasmic polarization and developed cytoplasmic organization. Then, the deposition of fibrodentin, followed by reparative dentin formation, which was characterized by the presence of polarized odontoblast-like cells and a tubular dentin-like matrix, was seen. Thus, the stereotypic pulp defense mechanism by which fibrodentin triggers the expression of the odontoblastic potential of pulp cells may be involved in MTA-induced reparative dentinogenesis[10]. In another study, the reparative process of mechanically exposed rat molar pulps capped with MTA was investigated by immunohistochemistry.[11-15]

The reparative process involved initial deposition of osteopontin in the superficial layer of the pulpal matrix followed by increased cell proliferation and the appearance of nestin-immunoreactive newly differentiated odontoblast-like cells. Thus, the reparative dentinogenesis that occurs following MTA capping is primarily governed by the natural healing process of exposed pulps, which involves the proliferation and migration of progenitors followed by their differentiation into odontoblast-like cells. Osteopontin could play a triggering role in the initiation of this process. The expression of dentin sialoprotein, a noncollagenous protein expressed exclusively by odontoblasts, has been detected in newly differentiated odontoblast-like cells after direct pulp capping of human teeth with MTA . Stronger dentin sialoprotein expression was observed in MTA-capped teeth than in Dycal-capped teeth, suggesting a superior dentinogenic effect of MTA.[7,9,10,11,13,15]
Fig.2

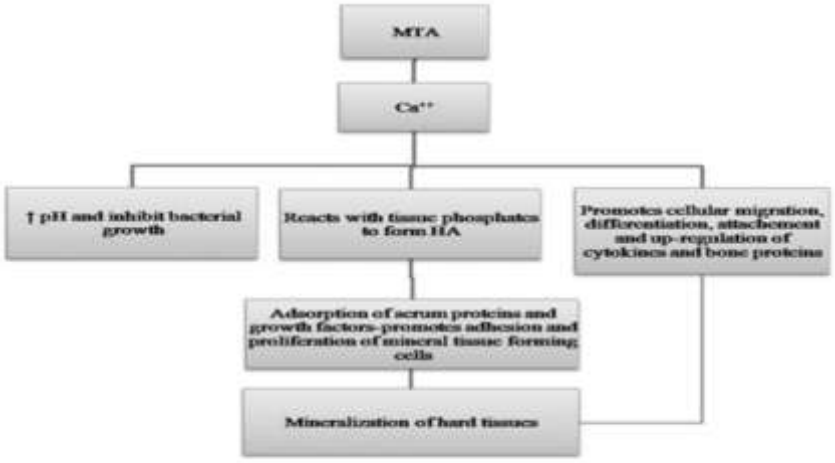

Fig. 2: Mechanism of action of MTA.

The handling properties of MTA are recognized to be less than ideal, since the working time is limited to a few minutes, even though this slow-setting material requires approximately three hours for initial setting and the cement mixture is somewhat grainy and sandy. Thus, attempts were made to improve these drawbacks by using additives to accelerate setting. Calcium chloride (2% to 15%) has been widely studied as a setting accelerator: it reduces the setting time ,increases the sealing ability and maintains a high pH . Moreover, the addition of calcium chloride did not affect the formation of dentin bridges following pulpotomies in, and thus maynot deteriorate the biologic properties of MTA. However, calcium chloride reduces the compressive strength of set MTA . One study recommended an admix of 1% methylcellulose and 2% calcium chloride because it improved the handling properties of MTA without reducing its compressive strength . also reduces the setting time while maintaining biocompatibility in vitro.[1,2,3,13,14,15]

The aim of this This case report describes the use of mineral trioxide aggregate (MTA) for management of a periapically compromised immature tooth.

II. Case Report

A girl aged 12 years reported to the our dental clinic, with the complaint of pain and swelling in her upper left front tooth. She gave a history of a traumatic injury, about 1 year prior to the time of reporting. She mentioned that she had consulted a dentist after having a traumatic episode, and she was told that she needed to undergo a root canal treatment after the closure of the root end. She however, failed to report back to the dentist and did not pursue the treatment until the tooth begun to pain. She had a noncontributory medical history. She expressed her concerns that she will not be able to pursue treatment for multiple appointments. Examination revealed a sinus tract in the labial vestibule of the maxillary left central incisor. Radiographic examination revealed radiolucency in the periradicular area of the upper left central incisor . Clinical and radiological examination indicated pulp necrosis with acute exacerbation of chronic apical abscess in relation to the upper left central incisor. The patient was given a detailed explanation concerning the treatment and prognosis. Considering her inability to make frequent appointments, apexification with MTA was considered after the disinfection of the periradicular area.. **Fig.3**

In the first appointment, the already existing access cavity was refined with a safe-end tapered bur under rubber dam isolation. The root canal was irrigated with a 5.25% sodium hypochlorite solution and the final irrigation was done with a normal saline solution. **Fig.4** After drying, the root canal was filled with a mixture of calcium hydroxide powder and saline. The access cavity was sealed with IRM, analgesics and antibiotics were prescribed, and the patient was recalled in 1 week . One week later, the access cavity was reopened and the canal was thoroughly irrigated with the 5.25% sodium hypochlorite solution and the canal was refilled with calcium hydroxide which was changed once within the interval of 1 week. At the third appointment, 1 week later, the sinus tract had resolved and the tooth was asymptomatic. Biomechanical preparation of the root canal was done using standard hand instruments and the canal was enlarged up to a size of instrument number 70. **Fig. 5**

All appointments were carried under rubber dam isolation. The canal was dried with paper points and MTA was dispensed and mixed according to the manufacturer's instructions. The canal was filled up to half its length with MTA and condensed with hand plugger and back-end of a paper point. The thickness of the MTA plug was almost twice that of the recommended 3–4 mm as the tooth was compromised with acute exacerbation. A moist cotton pellet was inserted into the canal to aid in setting and was left undisturbed for 15 min according to the manufacturer's instructions . with gutta-percha and zinc oxide eugenol sealer. The access cavity was restored with glass ionomer cement . **Fig.6** A follow-up radiograph after 6 months showed that the lesion had begun to resolve . The patient was given a composite resin crown to show improved esthetics which will be replaced by a ceramic crown later. The preoperative and postoperative appraisal is evident from the clinical picture . **Fig.7**

Fig . 3: Radiograph of 21 revealing an incomplete endodontic procedure with calcium hydroxide powder dressing and deteriorated interim restoration of the access cavity

III. DISCUSSION

Regeneration is the ideal desirable outcome for any restorative procedure. The last decade has seen a quest for a material that can regenerate odontogenic tissue successfully, both from a periodontal and endodontic aspect. 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 calcium hydroxide apexification, particularly in younger patients. With the limitations of materials which have been routinely used as retrograde filling materials, MTA has been used over the last 10 years as a suitable alternative to achieve a peri-radicular

seal. There have been no randomised controlled trial comparing MTA and the other commonly used materials, however there are short-term studies indicating favourable success rates with MTA .[1,2,16,17,18,19,20]

Fig . 4: Root canal of 21 was instrumented beyond the apex with the intention of disrupting the epithelium/granulation tissue

The response to trauma can be varied. Some pulps remain apparently normal with no adverse effects, whereas others become necrotic. When treating nonvital teeth, a main issue is eliminating bacteria from the root canal system. As instruments cannot be used properly in teeth with open apices, cleaning and disinfection of the root canal system rely on the chemical action of NaOCl as an irrigant and calcium hydroxide as an intracanal dressing[7-8]. In the case, 5.25% NaOCl was used 2mm short of apex to prevent extrusion of irrigant beyond apex. A 17% EDTA rinse was carried out before placement of the intracanal dressing to remove the smear layer and facilitate diffusion of calcium. hydroxide through the dentin and before obturation to ensure better removal of calcium hydroxide. Final irrigation was done with 0.12% chlorohexidine[1,2,3,8].

With the MTA apical plug technique, a onestep obturation after short canal disinfection with calcium hydroxide could be performed. In agreement with other studies, MTA appeared to show good sealing ability good marginal adaptation, a high degree of biocompatibility and a reasonable setting time. From a practical point of view, MTA can be used in the presence of moisture in the root canal. This property is important in teeth with necrotic pulps and inflamed periapical lesions because one of the problems found in these cases is the presence of exudate at the apex of the root[1,2,3,9,11,12, 16,17,18]

Fig .5: MTA plug with double the recommended thickness in place after the working length

Fig . 6; Immediate postoperative radiograph showing the MTA plug with gutta-percha obturation of the coronal radicular pulp space

Fig .7: 6 months postoperative radiograph indicating the resolution of the apical infection and rarefaction of the periapical area suggestive of bone healing

Many authors [10–18] confirm effectiveness of MTAused in various dental procedures, also in apexification. According to Shabahang et al. MTA, stimulates creating of bone and cementum, additionally these authors observed less inflammation after its use than other tested materials.[19]

In researches on human osteoblasts, showed that MTA stimulates cytokines release. Cytokines coordinate bone metabolism by stimulating proliferation bone cells. These results suggest possibility of stimulat− ing hard tissue formation by MTA. While examining MTA seal (microleakage), some authors con− cluded that bacterial leakage is less in the case of MTA in the compare with SuperEBA, IRM and amalgam .[1,2,3,22,24,25,26,27]

Ajwani and Saini8 have reported a case of successful treatment of mutilated maxillary central incisor with an open apex using intracanal calcium hydroxide and MTA, followed by fiber post and core. In the present case after placing the MTA apical plug, the subsequent increments were obturated using lateral condensation technique. The present case also produced the similar results with no symptoms thereafter.[28]

Günes and Aydinbelge4 in their report of cases on MTA apical plug method for treatment of non-vital immature permanent maxillary incisors have noticed radiological and clinical successful healing of the peripapical lesion after 1 year duration. In the present case report, complete healing of the periapical lesion was noticed in the duration of 6 months[29].

Holland et al.14 have conducted a study on periapical tissue response in dogs after root canal filling with MTA. They noticed biological closure of the apical foramen as well as the absence of the inflammation in the peripaical tissues after placement of MTA. The rationale for this response is due to cell adhesion and differentiation with consequent deposition of hard tissue by periapical tissue, which is in contact with MTA.

These results are consistent with the present case, where complete healing of the periapical lesion was noticed in the duration of 6 months with narrowing of the open apex, and no recurrence was noticed thereafter.[30]

Torabinejad and Chivian recommend before application of MTA initial use of calcium hydroxide for a week in order to bring under con− trol bleeding from periapical region. Authors of this work also applied disinfection insert with cal− cium hydroxide.[6]

In this case, the patient was known to have problems with compliance. Therefore, a calcium hydroxide apexification which would have taken a longer time and involved several recall appointments was ruled out. Further, the presence of a sinus complicated the prognosis. The clinical success depends on the ability to sterilize the tissue of infection; this was achieved with calcium hydroxide dressings and systemic antibiotic therapy. The patient education on the importance of asepsis and antibiotics should not be neglected as the outcome depends on the compliance to follow the prescribed medication and timely review appointments. In this case, the potential complication of failure due to the presence of a draining sinus was emphasized to the patient. This was also important to motivate the patient and improve her compliance.

This case demonstrates that the single-visit technique of apexification can be even applied in immature teeth with periradicular infection.It should be remembered that final effect and time of closing apex not only depends on kind of used material but also on factors connected with treatment process, well right diagnosis, instrumen− tation method and root canal disinfection. General health condition of patient is also very important because regeneration abilities of periodontal struc− tures depend on him. The authorst concluded, until now results of researches show that MTA might be used in apex− ification with very good result. It is confirmed by control x−rays after 3, 6 and 12 months that show correct condition of apex and absence of inflam− mation in periapical tissues.

IV. Conclusion

MTA is a new biocompatible material with numerous exciting clinical applications. It has been used on an experimental basis by dentists for several years with anecdotally reported success, some of it quite impressive. An ideal root repair material which has qualities like resistance to marginal leakage, allows normal healing response, ease of clinical manipulation non- resorbable. And finally the most important quality, especially of interest in our field it is non toxic.The clinical case reported here demonstrates that when MTA is used as an apical plug in necrotic teeth with immature apices, the canal can be effectively sealed. Follow-up radiographs showed osseous healing and, during clinical examination, the patients were asymptomatic.

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