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RESEARCH ARTICLE

MINERAL TRIOXIDE AGGREGATE- A WONDER CURE": CLINICAL APPLICATIONS IN PEDIATRIC DENTISTRY

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ABSTRACT

Background: An ideal endodontic repair material is the one that not only seal the pathways of communication between the root canal system and its surrounding tissues but in addition, should be nontoxic, noncarcinogenic, nongenotoxic, biocompatible, insoluble in tissue fluids and dimensionally stable. Because existing materials did not have these ''ideal'' characteristics, mineral trioxide aggregate (MTA) was developed and recommended. MTA has been proposed as the material of choice for root-end filling, pulp capping, pulpotomy agent, apical barrier formation for teeth with necrotic pulp and open apex, perforation repair and apexification. Numerous clinical investigations have been performed evaluating MTA for each one of the above mentioned applications and have found it to be an efficient material. This paper presents a case series of five different clinical conditions involving use of MTA for its successful management.
Materials and Methods: This paper describes the efficacy of MTA in various clinical condition. Four case reports have been described, in case 1 MTA was used for apexification in anterior teeth, in case 2 MTA has been used to form a barrier in horizontal root fracture, in case 3 it was used as a retrograde sealing material after apicoectomy, in case 4 MTA was used in posterior tooth for apexification. The powder was mixed with saline in a ratio of 3:1, after placing it in the desired place a wet cotton pellet was placed for a time period of 24 hours. After the MTA was set further treatment was carried out. All the cases showed successful healing both radiographically and clinically.
Conclusion: MTA materials are very positive, existing information as a whole are equivocal and more studies are encouraged. The use of MTA changed dramatically the treatment plan and increased the success rate of many previously thought of as hopeless cases. MTA is an efficient and promising dental material that should be used routinely in the practice of pediatric endodontics.

Key Words: Immature Teeth, Apexification, MTA.

INTRODUCTION

Traumatic injuries and dental caries are the greatest challenges to the integrity of the developing tooth that can cause the pulp to undergo irreversible damage, arresting the normal root development. Abnormal root development will have an impact on the long-term prognosis for tooth retention (Robertson *et al*., 2000). Over 24 million endodontic procedures are performed on an annual basis, with up to 5.5% of those procedures involving endodontic apical surgery, perforation repair and apexification treatment. Surgical treatment usually involves placement of a material designed to seal the root canal contents from the periradicular tissues and repair root defects (Chong, 2004). Understandably, this material should not only seal the pathways of communication between the root canal system and its surrounding tissues but in addition, should be nontoxic, noncarcinogenic, nongenotoxic, biocompatible, insoluble in tissue fluids and dimensionally stable. Because existing materials did not have these ''ideal'' characteristics, mineral trioxide aggregate (MTA) was developed.

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MTA has been proposed as the material of choice for root-end filling (Dominguez *et al*., 2003), pulp capping (Parirokh *et al*., 2005), pulpotomy agent (Briso *et al*., 2006), apical barrier formation for teeth with necrotic pulps and open apexes (Asgary *et al*., 2008), perforation repair (Faraco Junior and Holland, 2004) and apexification (Simon *et al*., 2008). Numerous clinical investigations have been performed evaluating MTA for each one of the above-mentioned applications. This article presents five case reports showing various applications of MTA.

Case Report 1

A 8 year old male child reported to the department of Pediatric and preventive dentistry, PGIDS, Rohtak, with the chief complaint of broken tooth due to fall associated with pain and bleeding since 3 days. On clinical examination an oblique fracture line of crown extending subgingivally was noticed. An Intraoral periapical radiograph confirmed the presence of a complicated crown root fracture of 21 extending below the CEJ (Figure 1). The parents were informed that a definite treatment plan could be planned only upon completion of exploratory sulcular incision, once the sulcular incision was completed, fractured fragment was removed it was classified as superficial crown root fracture extending subgingivally, with pulp exposure. Inspection of fragment revealed that it extended 2-3 mm below the CEJ. The sulcular incision at the subgingival extent of fracture line was extended till the deepest portion of fracture line and the fractured fragment was removed. The gingiva was removed to get clear margins maintaining the biological width. An incomplete apex could be an obstacle to immediate treatment consideration but with MTA successful apexification was carried out followed by post and core and PFM crown (Figure 2).

Figure 1. Complicated crown root fracture of 21

Figure 2. Apexification with MTA

Case report 2

A 14 year old male reported to the department of Pediatric and preventive dentistry, PGIDS, Rohtak after suffering dental trauma 2 days back. He reported with a broken tooth associated with constant pain. Clinical examination revealed class III Fracture of 11 (Ellis and Gravey classification) with Grade 1 mobility. It was sensitive to percussion but not to thermal stimulation. IOPA revealed a horizontal root fracture at middle third root of 11 with normal PDL space (Figure 3). Since 11 had a complicated crown fracture along with pain, RCT of the portion of tooth above the fracture line was planned. The apical portion of root was supposed to have an intact vasculature so it was not disturbed till asymptomatic .Working length x-ray was done to determine the length of root above the fracture line. MTA was placed at a length of 6mm (Figure 4) and a wet cotton pellet was placed above it which was followed by post and core (Figure 5) in the next appointment.

Figure 3. Horizontal root fracture at middle third root of 11

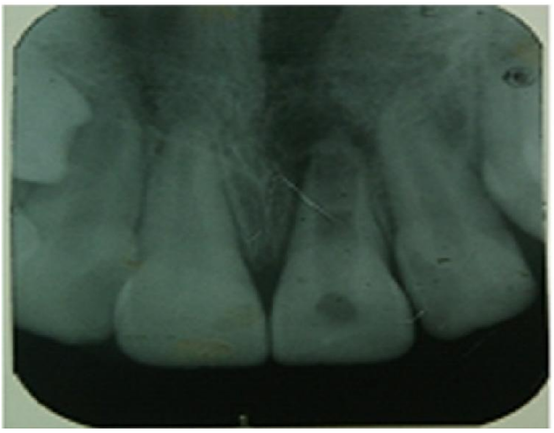
Figure 4. MTA placed at the horizontal fracture line

Figure 5. Post and core fabrication

Case report 3

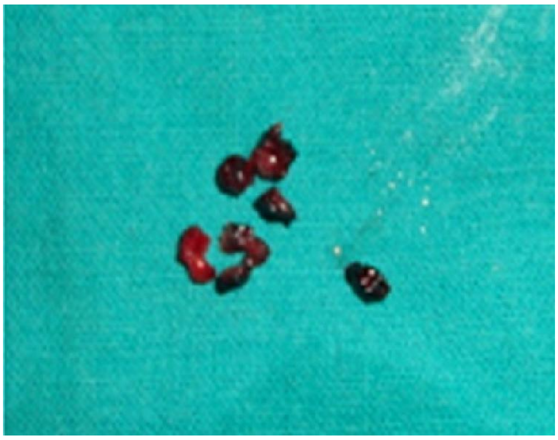
A 10 year old male child reported to the department of Pediatric and preventive dentistry, PGIDS, Rohtak with the chief complaint of pain and pus discharge from upper front teeth. Clinical examination revealed abscess formation wrt 21. Patient gave a history of trauma 6 months back for which he did not sought any treatment until he became symptomatic. The tooth was mobile and sensitive to percussion and palpation.

Intraoral periapical radiograph revealed widening of lamina dura with periapical radiolucency and apical root resorption in relation to 21. It was a large periapical radiolucency that could not be managed conservatively so apicoectomy followed by retrograde placement of MTA was done to seal the pathways of the root canal from the periradicular tissues. Orthograde obturation was done using gutta-percha (Figure 6a, 6b, 6c, 6d, 6e)

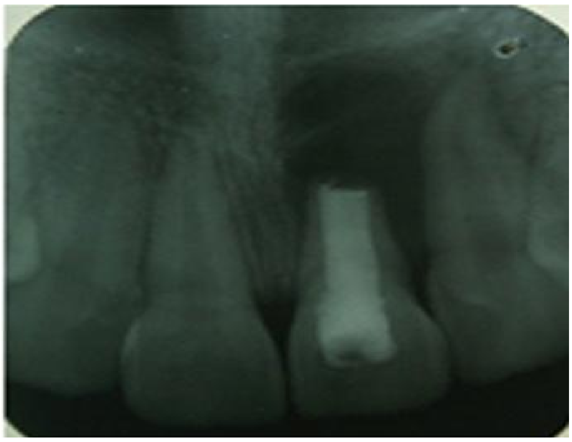


(a)

(b)



(c)



(d)

(e)

Figure 6 (a,b,c,d,e). Apicoectomy followed by retrograde placement of MTA

Case report 4

A 9year old male child reported to the department of Pediatric and preventive dentistry, PGIDS, Rohtak with pain and swelling in lower left first permanent molar since 4 day. Root canal treatment was planned but radiograph revealed an open distal root (Figure 7) so after biomechanical preparation, apical matrix was created by placing Biograft hydroxyapatite through the root canal into the periapical area. Following this, a paste of MTA powder and distilled water were applied to the canal with a fine tipped MTA carrier and compacted. The procedure was repeated until the thickness of MTA plug reached about 5 mm followed by obturation (Figure 8).

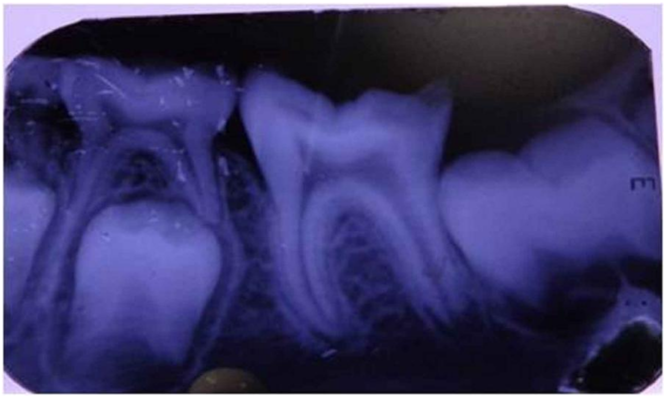


Figure 7. Open apex of distal root

Figure 8. MTA of about 5mm at apex of distal root

DISCUSSION

MTA is a bioactive material that was developed in the early 1990s, originally as a retrograde filling material and first appeared in the dental scientific literature in 1993. It was given approval for endodontic use by the U.S. Food and Drug Administration in 1998 (Schmitt and Bog en, 2001). Since then the indications for MTA have expanded significantly. The development of Mineral Trioxide Aggregate (MTA) material by Torabinejad in 1993 was truly a landmark event in dentistry and in endodontics in particular. This event dramatically increased the success rate of many cases that used to have high failure rates. Several studies had been conducted time and again to evidence the mechanism of action of MTA. In an attempt to know the action of mineral trioxide Sarkar *et al.* (2005) filled root canals with MTA and placed them in contact with PBS for 2 months. After resection of the root ends and examination of the samples under an optical microscope and then with SEM, the authors discovered the presence of a white layer between MTA and the root canal walls. This structure composed of calcium, phosphorus, and oxygen and was similar in composition to hydroxyapatite.

This stated that Hydroxyapatite can release calcium and phosphorus continuously, a process required for bone metabolism. In addition, this phenomenon increases the sealing ability of MTA and promotes the regeneration and remineralization of hard tissues (Sarkar *et al*., 2005). On the basis of these results, they suggested that the biocompatibility, sealing ability, and dentinogenic activity of MTA result from the physiochemical reactions between MTA and tissue fluids during the formation of HA. A layer of HA forms over the material that fills the voids and surface defects. Formation of this layer develops a chemical bond between MTA and the dentinal walls that might be the key characteristic responsible for the successful performance of this material. Sarris *et al.* (2008) used MTA as an apical plug in 17 incisors and followed them for a mean time of 12.53 months. Of these, 94.1% were assessed as being successful clinically, whereas 76.5 % were reported to be successful radiographically. A recent survey by Mooney and North showed that 86.3% of consultants in pediatric dentistry agree that the use of MTA as an apical barrier for immature permanent incisors with necrotic pulps is an acceptable method.

Current data shows that MTA can be used as an apical barrier in teeth with necrotic pulps and open apexes. MTA is a hydrophilic material and sets in presence of moisture. Studies have shown that presence of blood does not affects its sealing ability. In a review article regarding modern concepts in endodontic surgery, Kim and Kratchman (2006) stated that MTA is the most biocompatible root-end filling material and can be used with predictable outcomes in endodontic surgery. In a prospective case series study on 276 teeth with WMTA as a root-end filling material, Saunders (2008) reported 88.8% clinical and radiographic success after 4–72 months. He concluded that using careful microsurgical techniques combined with MTA as a root-end filling material results in high success rates for endodontic surgery. Thus the diverse application of MTA in the practice of pediatric dentistry is evident in its use as an apical barrier in immature nonvital teeth and in the coronal fragment of fractured roots, as a pulpotomy medicament in primary and permanent teeth, a pulp-capping agent in young permanent teeth, and as a repair material for perforation and resorptive defects, so the use of MTA in pediatric dentistry should be encouraged.

Conclusion

By far MTA is only one such endodontic repair material available with diverse applications that has brought a revolution in dentistry. Its physical, chemical and mechanical properties makes it a suitable wonder cure. Although it has certain shortcomings that includes its discoloration potential, presence of toxic elements, difficult handling , long setting time, high material cost, an absence of a known solvent ,but efforts have been made to overcome it. Introducing new compositions of MTA should await comprehensive investigations.

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