Application of MTA in Pediatric Endodontics

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Introduction

Pediatric endodontics poses a unique challenge for the dental clinician .The reasons which make the treatment of the deciduous and young permanent teeth very complicated are,

1. Lack of reliability of pain as a clinical indicator of pulpal diseases due to age and behaviour of the child.
2. Lack of correlation between clinical features and histological status of dental pulp.
3. The goals of the pediatric endodontic procedures are usually short term and primary importance is given to the development of the permanent dentition.

That is why vital pulp therapy is of great importance in pediatric endodontics .The success of vital pulp therapy is completely dependent on the preservation of the vital non inflamed pulp. For the success of the vital pulp therapy the use of biocompatible and versatile material is of paramount importance. Over the years Calcium hydroxide has claimed its priority in vital pulp therapy however it has also shown its limitations like internal root resorption and intra canal calcifications.

The newer material called 'Mineral Trioxide Aggregate' has shown very promising results to overcome the problems faced with calcium hydroxide. This material was developed by Dr. Torabinejad in 1993 at Loma Linda University. A patent was taken out for MTA in 1995 (Torabinejad & White1995).Since then, it has been widely used in the treatment of the vital pulps in deciduous and young permanent teeth . This article provides an overview of both,the applications as well as the limitations of this material in pediatric endodontics .

Composition of MTA

The MTA powder consists of fine hydrophilic particles. A patent was taken out for MTA in 1995 Torabinejad & White.[1] According to this patent, MTA consists of 5075% (wt) Calcium oxide and 1525% Silicon dioxide. These two components together comprise 7095% of the cement. When these raw materials are blended they produce Tricalcium silicate, Dicalcium silicate, Tricalcium aluminate and Tetracalcium aluminoferrite . Along with this Bismuth oxide is added to this material to provide the radio- opacity to the material. On addition of water the cement hydrates to form silicate hydrate gel.

Setting Reaction

According to Santos et al 2005[2] principle components of MTA tricalcium silicate and dicalcium silicate react with water to produce a poorly crystallized hydrated salt and calcium hydroxide . The author considered that MTA is calcium hydroxide contained in the silicate matrix. The SEM study did by Camilleri et al. 2005[3] revealed the presence of two phases: the crystalline material was essentially calcium oxide and amorphous calcium phosphate. Hydration of MTA powder resulted in the formation of a colloidal gel that hardened. The pH of MTA immediately after mixing is 10.2, rising to 12.5 after 3 hrs. The composition of the MTA is almost similar to the Portland cement which is commercially used in the construction procedures. The first research paper on the chemistry of Portland cement that had potential for dental use demonstrating the similarity of grey MTA Loma Linda University, Loma Linda, CA, USA to Portland cement was published in 2000 Estrela et al. 2000.[4]

A study comparing white MTA (White MTA, Dentsply;Tulsa Dental Products) to white Portland cement showed the cements to have similar constituent elements except for the bismuth oxide in the MTA[5] .

Mechanism of action

According to the overall literature available three basic mechanisms are suggested for MTA and its actions on the surrounding tissues.[3]

1. Interlukin production
2. Production of calcium hydroxide as a by product of the setting reaction.
3. Production of hydroxyapatite.

Even if these mechanisms have been described by various authors there has been no consensus on any of this mechanism and it still requires further research to come to any conclusion.

Commercial Availability

Gray MTA was introduced in the field of endodontics in 1993[5] and has been clinically very successful. White mineral trioxide aggregate (WMTA), a new type of MTA, has recently been introduced to the profession. The major difference is in the concentrations of carborundum (Al2O3), periclase (MgO), and especially FeO, with the values for each of these oxides being considerably lower in the WMTA than in the GMTA.[1] The GMTA and WMTA are marketed by Dentsply under the brand name 'PROROOT MTA' .Recently a Brazilian product called 'MTA Angelus' has also been marketed

Clinical applications in Pediatric endodontics

Direct pulp capping

Direct pulp capping has been a controversial procedure when done in the deciduous teeth. The high cellular content of pulp tissue is usually responsible for direct pulp-capping failures in primary teeth. Undifferentiated mesenchymal cells may give rise to odontoclastic cells in response to either the caries process or the pulp-capping material, resulting in internal resorption. Because of the pulp cellular content, increased inflammatory response, and increased incidence of internal resorption is seen in the deciduous teeth. Pitt Ford et al. documented superior bridge formation and preservation of pulp vitality with MTA when compared with calcium hydroxide in a direct pulp-capping technique[6]. Bodem et al 2004[7] presented a case of direct pulp capping in primary molar. After follow up of 18 months they didn't find any abnormality in the tooth both clinically and radiographically. This study advocated the use of MTA for the pulp capping.

Even if these studies have shown very promising results still there have been some constrains in its regular use in the direct pulp capping is its availability and cost.

Pulpotomy

Method of Application

The pulpotomy procedure should be carried out in a conventional way. The MTA powder is obtained by mixing 3 parts of powder with 1 part of water to get a putty consistency .This mix should be placed in the pulp chamber and condensed lightly with a moist cotton pellet. Over this a layer of thick mix of zinc oxide eugenol is given.

This material has given a new option to the pediatric endodontics as it is a very biocompatible material and is suitable for the procedure like pulpotomy where there is a direct contact of the material with the living tissue and chances of systemic absorption are high.

Conventionally formocresol is suppose to be an ideal material for pulpotomy and has given very favourable results. There are many comparative studies which have compared formocresol with MTA as a pulpotomy medicament.

Naik S and Hegde A H [8]concluded that MTA showed promising results when used as pulpotomy medicament in short term follow up studies. According to the authors histological evaluation and longer follow up periods are necessary to reach any sound conclusion.however the Gray MTA used for this study showed the discoloration of the teeth.

Li Peng et al 2006 [9]presneted an article comparing the clinical and radiographic effects of mineral trioxide aggregate with formocresol when used as wound dressing for pulpotomy of primary molars. They

included six studies in this article. The meta analysis of these 6 articles were formulated. Based on the available evidence, there was significant difference between FC- and MTA-treated primary molars . MTA appeared to be superior to FC for pulpotomy dressing with a higher clinical and radiographic success rate and a lower rate of internal root resorption.

Root apexification

MTA has provided a potent alternative to the lengthy apexification procedure .A conventional apexification procedure which is done with calcium hydroxide requires a lot of time and follow up before the apexification occurs . The apexification with MTA is a single visit apexification

Method of Application[10]

- Using a rubber dam, debride the root canal sytem using intra-canal instruments, and irrigate with NaOCI.
- Dry the canal system with paper points and for disinfection place calcium hydroxide paste in the root canal system for one week.
- Place a temporary restoration to seal the access opening.
- After one week, using a rubber dam, remove the CaOH from the canal system using NaOCI irrigation and instrument as needed. Dry the canal with paper points.
- Mixing of MTA should be done according to manufacturers instructions.

Using the MTA carrier or an amagam carrier, disperse the cement into the apical region. Condense the MTA root repair material into the apical region of the canal with pluggers or paper points. Create a three- to five millimeter apical barrier using MTA root repair material.

Confirm placement of the MTA root repair material with a radiograph. If an adequate barrier has not been created, rinse the 'MTA root repair material out of the canal and repeat the procedure.

Take a wet corton pellet, remove excess moisture from the pellet and place in the canal. Seal the access preparation with a temporary restoration for a minimum of four hours. After four hours, or at a later appointment, use a rubber dam and examine the MTA root repair material. This material should be hard. If not, rinse and repeat the application. When the MTA root repair material is hardened, obturate the remaining canal space.

The advantage of MTA technique is that there is no need to wait for the root formation before the permanent obturation. MTA provides a solid base on which the obturation can be directly done. Chances of communication with the surrounding periapical tissues is also reduced because of the better sealing ability of MTA as compared to calcium hydroxide.

Giuliani et al 2002[11] presented a clinical report of three patients showing premature interruption of tooth development secondary to trauma. Author performed the apexification procedure with MTA . Follow up was done at 6 months and 1 year interval .The radiographic examination showed the resolution of the periapical lesion. Author concluded that MTA can be a valid option for the apexification procedures and also stressed that the speed of the treatment with MTA is a great advantage over the other materials.

Darlene Hachmeister et al 2002[12] evaluated the sealing ability and retention characteristics of MTA in the model of apexification . MTA showed a significantly less amount of microleakage and better retention and recommended that MTA is a promising material for the treatment of immature pulpless teeth. They also observed the lapses in the delivery method of MTA.

In this review article we have tried to collect the various aspects of the "Mineral Trioxide Aggregate which is a relatively new material that has attracted widespread interest in endodontic treatments. This material is a versatile material which has been used successfully in the variety of clinical situations like, pulp capping, pulpotomy, partial pulpotomy, as a root filling material following pulpectomy, to fill wide open apices in immature teeth ,to repair perforations and root fractures, and as a retrograde root filling material.

Clinicians report favorable treatment outcomes and various research reports indicate that this material is biocompatible, encourages pulp, bone and periodontal ligament repair and it seals well in fluid penetration studies.

MTA can solve the various previous problems encountered during complicated operating procedures and has a potential to improve the success rate of the procedures like the periapical surgeries and root end completion.

However it has few limitations like It is a technique-sensitive material that can be difficult to place and it takes about four hours to set. This is a costly material and that's why may not be affordable for the normal practitioners. Its availability in the local Indian market is also limited. However the investigators are working on the economical materials which works on the same principles like the Portland cement and MTA Angelus (Brazilian product).

As this is a new material the research work is still going on and there will be a constant improvement in a clinical performance and shortcomings of this material .so it is important to maintain the constant track of the newer developments which are taking place.

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