Mineral trioxide aggregate as a pulpotomy agent in primary molars: An in vivo study

NAIK S.ᵃ, HEGDE A. H.ᵇ

Abstract

The retention of pulpally involved deciduous tooth in a healthy state until the time of normal exfoliation remains to be one of the challenges for Pedodontists. A scientific noise has been generated about several materials some of which have been popular pulpotomy medicaments. Concerns have been raised about the toxicity and potential carcinogenicity of these materials, and alternatives have been proposed to maintain the partial pulp vitality, however to date no material has been accepted as an ideal pulpotomy agent.

Mineral trioxide aggregate (MTA) is a biocompatible material which provides a biological seal. MTA has been proposed as a potential medicament for various pulpal procedures like pulp capping with reversible pulpitis, apexification, repair of root perforations, etc.

Hence the present study was done to evaluate the efficacy of MTA as a pulpotomy medicament. A clinical and radiographic evaluation was done on children where MTA was used as pulpotomy medicament in primary molars for a period of 6 months and it was found to be a successful material.

Key words: Mineral trioxide aggregate, pulpotomy

Introduction

Pulpotomized teeth help in maintaining arch integrity by allowing preservation of the teeth that would otherwise be destined for extraction.¹ ²

Formocresol has been critically evaluated for its toxic effects on pulp tissue. For decades formocresol has been a popular pulpotomy medicament. Concerns have been raised about the toxicity and potential carcinogenicity of formocresol in humans,³ and alternatives have been proposed to maintain partial pulp vitality. These include electrosurgery,⁴ laser,⁵ glutaraldehyde,⁶ ferric sulfate,⁷ and enriched collagen solution.⁸ Mineral Trioxide Aggregate (MTA) is compositionally formulated to have physical properties,⁸ setting requirements⁹ and characteristics necessary for an ideal repair and medicament materials.¹⁰ ¹² MTA, with an excellent long term prognosis, relative ease at which it can be used and with its numerous exciting clinical applications promises to be one of the most versatile materials of this century in the field of dentistry. When the physical and chemical properties of MTA,¹⁰ ¹² were described it was found to be biocompatible¹³ and its sealing ability¹² ¹³ was better than zinc oxide eugenol.

MTA has been proposed as a potential medicament for pulpotomy procedures³ as well as capping of pulps with reversible pulpitis.¹¹ ¹⁴ MTA was tested in dog’s teeth as a pulp capping material and produced favorable pulp responses.¹¹ Not many clinical studies have been done with MTA as a pulpotomy medicament and hence in the present study MTA was used as a pulpotomy medicament in the primary molars and its efficacy were observed both clinically and radiographically over a period of 6 months.

Materials and Methods

50 primary molars in children whose pulpal status warranted pulpotomy and who reported to the Department of Pedodontics and Preventive Children Dentistry, A.B. Shetty Memorial Institute of Dental Sciences, Mangalore were treated by a conventional pulpotomy technique. The procedure and its possible discomfort, or risks, and benefits were explained fully to the parents of the children involved, and their informed consent, as approved by the institutional review board of human subjects experiments, were obtained prior to the investigation.

Teeth with asymptomatic deep carious lesion involving the marginal ridge without any frank pulp exposure were selected for the pulpotomy procedure.

Pulpotomy procedure

50 selected teeth were randomly assigned to either control (formocresol) or experimental (MTA) group of 25 teeth each (Table 1).

The pulpotomy procedure were then performed on the selected teeth as follows:

• Anesthetize the tooth.
• Obtain Rubber dam isolation
• Caries removal and coronal access obtained with high speed bur with water spray to expose the pulp chamber.
• Removal of the coronal pulp with a spoon excavator.
• Hemostasis obtained. (A moistened cotton pellet was gently pressed against the amputated pulp stumps in both the group.)

In formocresol (control) group - cotton pellet dipped and squeezed in 1/5th dilution of Buckley formocresol, was placed in pulp chamber for 5 minutes. The pulp chamber was then covered with a Zinc oxide Eugenol thick mix.

In the MTA (experimental) group - the MTA paste was obtained by mixing 3 parts of powder with 1 part of water to obtain a putty consistency. This mix was then placed in the pulp chamber and condensed lightly with a moistened cotton pellet. This was followed by a layer of Zinc oxide Eugenol thick mix.

Following pulpotomy all the 50 teeth were restored with stainless steel crown after 24 hours. Finally the patients were recalled after 1 month, 3 months and 6 months respectively and evaluated clinically and radiographically (Tables 2-5).

Table 1: Shows distribution of samples

<table>
<thead>
<tr>
<th>Observed period</th>
<th>Number of children</th>
<th>Number of teeth evaluated</th>
<th>Mandibular first molar</th>
<th>Mandibular second molar</th>
<th>Maxillary first molar</th>
<th>Maxillary second molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (formocresol Group)</td>
<td>17</td>
<td>25</td>
<td>9</td>
<td>10</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Group 2 (MTA group)</td>
<td>21</td>
<td>25</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2: Clinical assessment for formocresol group

<table>
<thead>
<tr>
<th>Observed period</th>
<th>Total No. of teeth evaluated</th>
<th>Pain Mobility Swelling Sinus Change in color</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hrs.</td>
<td>25</td>
<td>- - - - Not observed</td>
</tr>
<tr>
<td>1 month</td>
<td>24</td>
<td>- - - - Not applicable</td>
</tr>
<tr>
<td>3 months</td>
<td>24</td>
<td>- - - - Not applicable</td>
</tr>
<tr>
<td>6 months</td>
<td>24</td>
<td>- - - - Not applicable</td>
</tr>
</tbody>
</table>

Table 3: Clinical assessment for MTA group

<table>
<thead>
<tr>
<th>Observed period</th>
<th>Total No. of teeth evaluated</th>
<th>Pain Mobility Swelling Sinus Change in color</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hrs.</td>
<td>25</td>
<td>- - - - 15</td>
</tr>
<tr>
<td>1 month</td>
<td>24</td>
<td>- - - - Not applicable</td>
</tr>
<tr>
<td>3 months</td>
<td>24</td>
<td>- - - - Not applicable</td>
</tr>
<tr>
<td>6 months</td>
<td>24</td>
<td>- - - - Not applicable</td>
</tr>
</tbody>
</table>

Table 4: Radiographic assessment for MTA group

<table>
<thead>
<tr>
<th>Observed period</th>
<th>Total number of teeth evaluated</th>
<th>Internal root resorption</th>
<th>External root resorption</th>
<th>Periapical / furcal radiolucency</th>
<th>Root resorption in relation to contra lateral tooth</th>
<th>Pulp canal obliteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hrs.</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1 month</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3 months</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 months</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 5: Radiographic assessment for formocresol group

<table>
<thead>
<tr>
<th>Observed period</th>
<th>Total number of teeth evaluated</th>
<th>Internal root resorption</th>
<th>External root resorption</th>
<th>Periapical / furcal radiolucency</th>
<th>Root resorption in relation to contra lateral tooth</th>
<th>Pulp canal obliteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hrs.</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1 month</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3 months</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 months</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Results

Of the 50 teeth selected, 3 were not available for further follow-up after 1 month. The follow up after 1 month, 3 months and 6 months did not reveal any clinical or radiographic pathological findings in the rest of the 47 teeth. Hence, no statistical analysis was performed regarding the success of the treatment.

The only significant findings were the discoloration of 60% of the teeth where MTA was used as a medicament after 24 hours, but which was later masked by restoring with a stainless steel crown.

Discussion

Mineral trioxide aggregate (MTA), as a pulpotomy medicament was used in the present study and its clinical and radiographical success was assessed. Formocresol was selected as the control group, since it is still considered the gold standard in primary tooth pulp therapy, in spite of the reported toxic, mutagenic and carcinogenic properties.

Mineral trioxide aggregate (MTA) is a fine hydrophilic pow-
Mineral trioxide aggregate as a pulpotomy agent in primary molars

...nder developed by Mahmoud Torabinejad in Loma Linda University (USA). It consists of tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and bismuth oxide which are supplied as a grey powder. Each pack of PROROOT (Densply) MTA comes with a pre measured unit dose of water for convenience in mixing. Studies by Mahmoud Torabinejad and co-workers have shown that MTA prevents microleakage, is biocompatible, and promotes regeneration of the original tissues when it is placed in contact with the dental pulp or periradicular tissues. 

The success rates of MTA in this study has been promising, with all 24 molars in the experimental group being clinically and radiographically successful.

Pulp canal obliteration was a common finding in both formocresol and MTA group in a study conducted by Eidelman 2001. But in the present study we did not come across any such findings which may be due to the short follow up period of 6 months.

The time duration taken to complete the procedure in case of MTA group was longer, since first MTA had to be manipulated and placed in the pulp chamber followed by manipulation and placement of zinc oxide eugenol. There are reports of complete dentine bridge formation when MTA was used as a pulp capping agent. Hard tissue bridge deposition next to MTA may occur because of its sealing properties, biocompatibility, alkalinity and other properties associated with this material. In the present study, no dentin bridge formation was observed radiographically after a period of six months.

In case of the MTA group, discoloration of the crown was observed in 15 cases, which was later masked by placement of a stainless steel crown. No such discoloration was reported by any other authors, but in most of the studies MTA was used as root end filling material. Only in a few selected cases it has been used in clinical crown where studies have been limited to case reports only. In any case it’s mandatory to give stainless steel crown following MTA pulpotomy, which in addition to restoring the tooth, helps in masking the discolored crown.

During the manipulation of MTA we observed that the mix was messy when excess of moisture was present in the preparation which results in the material becoming soupy and difficult to use. Similar observations have been reported by Schwartz et al. This often makes it important to follow some guidelines to prepare the site for MTA. All irrigation should be performed before the material is placed because irrigation after placement will cause significant wash out of the material. The increased cost and non-availability of MTA is another factor to be noted. In contrast the placement of formocresol as a medicament is very simple, neat and very economical.

There are reports that, in the formocresol procedure the cotton pellet sometimes adheres to the clot and bleeding reoccurs when the pellet is removed. But no such problems were encountered with formocresol in the present study. However this does not occur with MTA which is directly applied over the amputated pulp.

The mutagenic potential of MTA was assessed using the Ames test and was compared with those of intermediate restorative material and super EBA and they concluded that MTA was less cytotoxic and non-mutagenic. This further supports the superiority of MTA over formocresol as a pulpotomy medicament.

Though clinically and radiographically the success rates of MTA in this study are quite promising, a histological evaluation of MTA and a longer follow up period is necessary to reach sound conclusions. Mineral trioxide aggregate (MTA) showed clinical and radiographic success as a dressing materials following pulpotomy in primary teeth after a short term evaluation period and has a promising potential to become a replacement for formocresol in primary teeth. Further long term clinical evaluation of MTA as a pulpotomy agent needs to be carried out.

References


Reprint requests to:
Dr. Amitha M. Hegde
Department of Pedodontics and Preventive Dentistry,
A.B. Shetty Memorial Institute of Dental Sciences,
Deralakatte, Mangalore - 575018,
Karnataka, India
E-mail: amipedo@yahoo.co.in