Original Article

# Comparison of Efficacy of Mineral Trioxide Aggregate and Calcium Hydroxide as Pulpotomy Agents in Primary Molars

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## ABSTRACT

**Objective:** To compare the efficacy of MTA and CH in primary molars as pulpotomy medicaments.
**Study Design:** Randomized Control Trial study
**Place and Duration of Study:** This study was conducted at the OPD, Operative Dentistry, Liaquat College of Medicine & Dentistry, Gulistan-e-Jauhar, Karachi from August 2020 to July 2021.
**Materials and Methods:** 28 children between 5 to 9 years having carious primary molar were randomly assigned to CH and MTA groups with 14 children each. Following pulpotomy teeth were restored with composite and stainless steel crown. Clinical and radiographical examinations were performed at 1, 6 and 9 months. Statistical analysis was done using Chi square test; p-Value of <0.5 was taken as significant.
**Results:** 26 children out of 28 that underwent intervention came for evaluation. At 1 month follow up all patients showed100% clinical and radiographic in both groups. At 6 months two cases showed failure in CH group, whereas in MTA all teeth were 100 % successful. At the end of trial at 9 month with 2 teeth showing clinical failure and 3 with radiographic failure, the overall success rate of CH was found to be 64.2% and with only clinical failure in MTA group, was found to be 92.8%.
**Conclusion:** MTA exhibited higher clinical and radiographic success as compared to CH, hence, is recommended to be used as a substitute to CH.

**Key Words:** Calcium Hydroxide. Mineral Trioxide Aggregate, Pulpotomy, primary molar

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## INTRODUCTION

Pulpotomy is one of options of vital pulp therapy utilized when coronal pulp becomes inflamed whereby the infected and inflamed part of the coronal pulp is surgically removed leaving the healthy radicular pulp intact so as to preserve its vitality.[1]This treatment option is accepted widely primarily for the deciduous teeth in which the pulp has been exposed as a result of caries, trauma or a mishap during treatment procedure.[2] Following pulpotomy the remaining pulp is dressed with a suitable medicament to encourage pulp healing[3] eventually retaining the tooth in mouth until its physiological exfoliation.[4]

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Success of pulpotomy procedure is largely dependent upon the type of pulpotomy medicament used[5]. An ideal pulpotomy agent must be lethal to bacteria as well as promote the healing potential of the remaining vital pulp without harming it or the adjacent tissues.

To date various pulpotomy agents have been used. Formocresol, a devitalizing agent, since its introduction in1904 has remained in clinical use, undergoing several modifications in its concentration and techniques. However, despite its popularity, there are concerns regarding its use as a result of its cytotoxic, mutagenic and carcinogenic potential.[6] Calcium hydroxide (CH) entered into the clinical field to be used as an alternative to formocresol, having an antibacterial efficacy and ability to induce dentine bridge formation owing much to its high alkalinity.[7] However, its success rate dropped as result of researches reporting internal resorption and defects in the hard tissue formed.[8] This led the researchers in pursuit of a material that is more biocompatible with lesser drawbacks. Mineral trioxide aggregate (MTA), mainly consisting of calcium and silicate components, was introduced by Torabinejad in 1990. Ever since it has been assessed extensively and in the light of these studies it has been recommended to be used as a pulpotomy agent mainly on account of its extreme biocompatibility, ability to promote hard tissue formation and provide a good seal.[9] Literature review has reported MTA as a potential substitute of calcium

hydroxide as a pulpotomy agent , however, inspite of MTA's successful outcomes its drawbacks pertaining to its long setting time, discoloration of teeth and cost[10,11], limit its use in our part of the world and hence fewer researches have been done here. Therefore, the aim of the present study is to compare the clinical and radiographic outcomes of calcium hydroxide and MTA pulpotomies done on primary molars with a 9 month follow up.

# MATERIALS AND METHODS

The study was conducted at the department of Operative Dentistry, Liaquat College of Medicine & Dentistry, Gulistan-e-Jauher Karachi, Pakistan, It started in August 2020 and continued till July 2021. 28 healthy and cooperative children aged 5 to 9 years that reported in Operative Dentistry Opd with deep carious lesions in primary molars, were screened after thorough clinical and radiographic examination to be included in the study. The entire procedure, benefits of this treatment and associated risks were explained to the parents of the children and a written consent to participate in the study was taken from them prior to the start of the procedure. The protocol was approved by the ethical review board, Liaquat college of Medicine and Dentistry, before initiation of study. 28 envelops having the name of one pulpotomy medicament (14 envelops having calcium hydroxide and 14 having MTA written in them) were shuffled. Each child fulfilling the inclusion criteria was asked to choose one envelope. The child was then treated according to name of medicament mentioned in the envelope without disclosing to the patient. Thus the study was single blinded. The inclusion criteria were- 1) children aged 5-9 years, 2) patients having atleast one vital primary molar in the mouth with pulpal exposure after removal of caries (carious exposure) 3) teeth restorable following completion of treatment. The exclusion criteria were- 1) children having systemic diseases 2) patients with complain of spontaneous pain or nocturnal pain 3) signs of periapical or furcal pathology such as swelling or redness in soft tissue surrounding the tooth, mobility, tenderness to palpation and percussion and radiographic evidence of bone resorption. 4) Pathological root resorption. 5) non vital teeth. 6) teeth with uncontrollable hemorrhage

Sample size was calculated referring to a study closely matching our protocol[(12)]. The clinical procedure started with giving topical anesthesia (xylocaine spray) and then local anesthesia, lignocaine (1: 80000) epinephrine, followed by rubber dam application. After removal of caries, access to the pulp chamber was made with # 330 carbide bur in high speed handpiece. Coronal pulp was removed with slowly rotating #4 round bur. Pulp chamber was gently irrigated with sterile saline and a sterile cotton pellet moistened with saline was placed on the pulp stumps to control the bleeding. After ensuring that hemostasis has achieved, pulpotomy medicament (according to the chosen envelope) was placed on the pulpal tissue. For the CH group, CH paste was applied on the pulp stumps by dispensing from the syringe.

In other group, MTA: was mixed according to manufacturer's instructions with powder to distilled water ratio of 3:1. After placement MTA was condensed with gentle pressure using moist cotton.

After placement of pulpotomy agents in both groups, a layer of glass ionomer cement was placed followed by composite and finally restored with stainless steel crown.(3M Unitek SP), cemented with type 1 GIC. Finally a periapical radiograph with paralleling technique was taken using cone indicator. The entire procedure was done by the principal investigator in a single visit. A telephone call was made to inquire the condition of the patient, the next day and any problem noted.

The patient was called for evaluation after 1, 6 and 9 months. Clinical and radiographic examination was done by a senior faculty member other than principal investigator, in the department who was blinded to the type of medicament used.

Presence of any of the following symptom or signs was considered as a clinical failure: pain, tenderness to palpation and/or percussion, swelling, sinus, abnormal mobility. Radiographic features, that indicated treatment failure, if present upon evaluation, were: periapical and/or furcal radiolucency, pathologic root resorption.

The overall treatment was considered a success only when both, clinical as well as radiographic findings were sound.

Data was entered in SPSS version 21. Categorical variables were presented as frequencies and percentages whereas quantitative variables as age was expressed as mean ± standard deviation. Chi Square test was used for inter group comparison at different time intervals. P-Value of $< 0.5$ was considered as statistically significant.

# RESULTS

A total of 28 children who fulfilled the inclusion criteria and gave consent were included in this study. All of these had carious primary molars. Thus a total of 28 primary molars (7 maxillary molars and 21 mandibular molars) underwent pulpotomies using CH and MTA as pulpotomy agents, 14 in each group. The mean age of these children was 7.46 ± 1.29 that ranged between 5 and 9 years. These 28 patients comprised of 8 (28.57%) males and 20(71.42%) females. Out of 14 molars, CH was used on 2 males and 12 females, of these 3 were maxillary molars and 11 mandibular molars. MTA pulpotomy was done in 4 maxillary molars and 10 mandibular molars in a total of 6 males and 8 females (Table 1).

The children were recalled for evaluation after 1, 6 and 9 months. There was one loss to follow up after 6 months and another drop out at 9 month recall.

At one month recall, in both CH and MTA pulpotomy groups, all cases were clinically and radiographically successful. However, at 6 month interval, in the CH group, there was one drop-out. One patient of this group had pain and a draining sinus indicating clinical failure as well as radiographic failure as evident in the radiograph by periapical radiolucency. Another child of this group showed radiographic failure. The remaining 11 cases were clinically and radiographically sound. In the MTA group, at this stage, all teeth were analyzed to be clinically and radiographically successful. At 9 months follow-up, with one drop- out, 11 patients were analyzed in the CH pulpotomy group. 2 children in this group reported with clinical failure, one having pain and swelling and the other having tenderness to percussion. In addition when the radiographs of 3 patients were observed pathologic changes were seen; 2 cases showing internal resorption and one showing periapical radiolucency thus suggesting radiographic failure. In contrast MTA group at this stage had 100% recall rate. One clinical failure was observed; patient reported with pain and the tooth was tender to percussion, whereas the radiographic success was 100 %. Intergroup comparison between the CH and MTA group at 1, 6 and 9 months showed statistically significant difference in the radiological success rate at 9 month follow up (Table 2 & 3).

**Table No.1: Distribution of Pulpotomy Agents Based on Gender, Age and Tooth Category**

| Group | Gender (freq) | | Age (mean ± SD) | Tooth Category Maxillary Molars Mandibular Molars | |
|---|---|---|---|---|---|
| | Male | Female | | | |
| CH | 2 | 12 | 7.21 ± 1.25 | 3 | 11 |
| MTA | 6 | 8 | 7.71 ± 1.32 | 4 | 10 |
| Total | 8 | 20 | - | 7 | 21 |

**Table No.2: Clinical Success Rate of Pulpotomy at Different Time Intervals**

| Group | 1 month N (%) | 6 months N (%) | 9 months N (%) |
|---|---|---|---|
| CH | 14 (100) | 12 (92.3) | 9 (81.8) |
| MTA | 14 (100) | 14 (100) | 13 (92.8) |
| p-Value* | - | .341 | .131 |

*p-Value calculated using Chi-Square Test

**Table No.3: Radiological Success Rate of Pulpotomy at Different Time Intervals**

| Group | 1 months N (%) | 6 months N (%) | 9 months N (%) |
|---|---|---|---|
| CH | 14 (100) | 11 (84.6) | 7 (63.6) |
| MTA | 14 (100) | 14 (100) | 14 (100) |
| p-Value* | - | .186 | .009 |

*p-Value calculated using Chi-Square Test

Thus overall assessment at the end of the trial showed that in CH group, out of 14 patients, excluding 2 drop-outs, 81.81% (9/11) cases were clinically and 63.63% (7/11) cases were radiographically successful. Over all there were 7 cases out of 14 that were both clinically and radiographically successful, declining the success rate to 50 %. In the MTA group, the success rate was 92.8% (13/14) with 13 clinically successful cases. In addition, 100% (14/14) radiographic success was seen. With 13 clinically and radiographically successful cases, rate was calculated to be 92.8%. (Table 4).

**Table No.4: Overall Success Rate Among Two Groups at the End of Trial**

| Group | Total cases of intervention (n) | Successful N (%) | Unsuccessful N (%) |
|---|---|---|---|
| CH | 14 | 7 (50) | 7 (50) |
| MTA | 14 | 13 (92.8) | 1 (7.1) |
| Total | 28 | 20 (71.4) | 8 (28.6) |

# DISCUSSION

Pulpotomy is an acclaimed treatment for deciduous teeth with inflamed pulp particularly that exposed as a result of deep caries or mechanical injury, whereby inflamed portion of the pulp is amputated and dressed with a suitable therapeutic material[13]. Several pulpotomy agents have gone through trial and testing over the years and accepted or declined depending upon their properties[14].

The present study was conducted to assess the outcomes of 28 primary molars that underwent pulpotomy using either CH or MTA as pulpotomy medicaments. The evaluations were done after 1,6 and 12 months, where clinical as well as radiographic success rates were recorded. With 2 cases lost to follow up the recall rate was 92.8 %.

This randomized controlled trial provided excellent results with MTA where one case had a clinical failure giving an overall success rate of 92. 8%, whereas, greater clinical and radiographic failures were seen in CH group, hence having a compromised outcome of 64.2% success rate. Similarly other studies have reported lower success rates of CH, amongst which is the work of Moretti et al who presented clinical and radiographic failure rate of 64% in a 2 year trial in primary molars following pulpotomy with CH. [15]. Also these findings corroborate the results of clinical trial done by Mente et al[16] CH being the gold standard and most popular pulpotomy agent for many years was used as a control in this study. The lower success rates of CH have been mainly attributed to its inferior chemical and mechanical properties as greater solubility, increased micro leakage, tunnel defects and leading to internal root resorption. Because of these reasons and with the advent of biomaterials, MTA gained attention by having biocompatibility and superior antibacterial activity[17]. The results of this study also favour the preferable use of MTA as pulpotomy agent considering

there was only one clinical failure and 100 % radiographic success giving an overall success rate of 92.8%. Other researches that compared the efficacy of MTA with CH reported similar findings with MTA being superior to CH[18–20]. The most distinguishing feature of MTA underpinning high success rate is its superior sealing ability and higher resistance to dissolution[21].

# CONCLUSION

On the basis of the data analyzed at the end of 9 month trial to compare the efficacy of CH and MTA as pulpotomy agents to treat primary molars, it is concluded that based on number of clinical and radiological failures in CH group in comparison to MTA as well as overall success rates, it is recommended that MTA is a material of choice for pulpotomies in primary teeth despite its shortcomings as being expensive and causing discolouration of tooth, can prove to be a good substitute for CH. However further studies are required with larger sample size and a longer evaluation period.

**Author's Contribution:**

| | |
|---|---|
| Concept & Design of Study: | Naheed Najmi |
| Drafting: | Asmat Jameel |
| Data Analysis: | Asmat Jameel. Yawar Ali Abidi |
| Revisiting Critically: | Naheed Najmi, Asmat Jameel, Yawar Ali Abidi |
| Final Approval of version: | Naheed Najmi |

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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