Comparative Evaluation of Formocresol and Mineral Trioxide Aggregate in Pulpotomized Primary Molars - 2 Year Follow Up

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Aim: *The aim of the present study was to clinically and radiographically evaluate Mineral Trioxide Aggregate (MTA) as an agent for pulpotomy in primary teeth and to compare it with that of Formocresol (FC) pulpotomy.* ***Method:*** *Seventy first and second primary mandibular molars of children were chosen on patients who required minimum two pulpotomies in either arch or same arch. After the standardized technique of Pulpotomy with MTA and Formocresol, all molars were treated with a thick mix of Zinc oxide Eugenol cement into the coronal pulp chamber followed by preformed stainless steel crown. The children were followed up for clinical and radio graphical examination after 6,12 and 24 month for Pain, Swelling, Sinus/ fistula, Periapical changes, Furcation radiolucency and internal resorption.* ***Results:*** *MTA represents 97% clinical success rate in comparison to Formocresol with 85% success. Radiographically also MTA showed more promising results with 88.6% success in comparison to Formocresol with 54.3%.* ***Conclusions:*** *Thus, MTA pulpotomy has emerged as an easier line of treatment to save the premature loss of primary teeth due to caries or trauma.*

Keywords: *MTA, Formocresol, Pulpotomy, children*

INTRODUCTION

Premature loss of primary molars due to dental caries, infection and trauma may cause aberrations in the arch length such as mesial drifting of permanent teeth, midline shift, cross bite and turns in malocclusion along with aberrant oral habits.

For this reason; maximum attempt is to be made to preserve the primary teeth in healthy state until normal exfoliation occurs. When the carious process advances deep into the dentin, the pulp reacts by producing an inflammation that is temporarily limited to area close to carious lesion. With the progression of the lesion, the inflammatory process spreads throughout the coronal pulp. When pulpotomy is performed, the complete coronal pulp is removed. The rationale for pulpotomy is based on the assumption that the inflammation is limited to coronal pulp.[1]

Formocresol has been the popular material of choice for the pulpotomy procedure. It has otherwise proved as "gold standard" in pediatric dentistry, may be mainly because of its ease in use and excellent clinical success but this clinical success rate has been always in close observation due to its safety considerations. Mineral trioxide aggregate (MTA) is a relatively newer material reported in the year 1993 at Loma Linda University by Torabinejad. It has become the material of choice for certain endodontic applications. It has been demonstrated that MTA has the ability to stimulate cytokine release from the bone cells, indicating that it actively promotes hard tissue formation. It has also been shown that MTA has antimicrobial properties similar to Zinc Oxide Eugenol and has no cytotoxic effects.[2]

Hence, the present study was conducted to evaluate the potential of Mineral Trioxide Aggregate for pulpotomy in primary molars as compared to Formocresol.

MATERIALS AND METHOD

Normal, healthy and cooperative children for the study were selected from the patients attending the Department of Pedodontics and Preventive Dentistry, Modern Dental College and Research Centre, Indore. Seventy first or second primary mandibular molars were selected from aged 6 to 8 years.The procedure, possible discomfort or risks, as well as benefits were explained fully to parents of the children involved and consent was obtained .Ethical clearance to conduct the study was obtained from the institutional review board . The two pulpotomy materials used in the study included Formocresol (Pharmadent Remedies Pvt. Ltd., Gundlav, India) Mineral Trioxide Aggregate (Proroot MTA ,Dentsply, Tulsa Dental, OK, USA),). The distribution of assessed teeth and distribution of samples is presented in Table 1 and 2. The clinical and radiographic criteria selected for the study are given below.[3]

i) Exposure of vital pulp due to dental caries, approximately to the pulp radiographically.
ii) Absence of symptoms indicative of advanced pulpal inflammation such as spontaneous pain or history of nocturnal pain.
iii) No clinical and radiographical evidence of pulp degeneration such as excessive bleeding from the root canal, tenderness to percussion, swelling or sinus tract, mobility, internal

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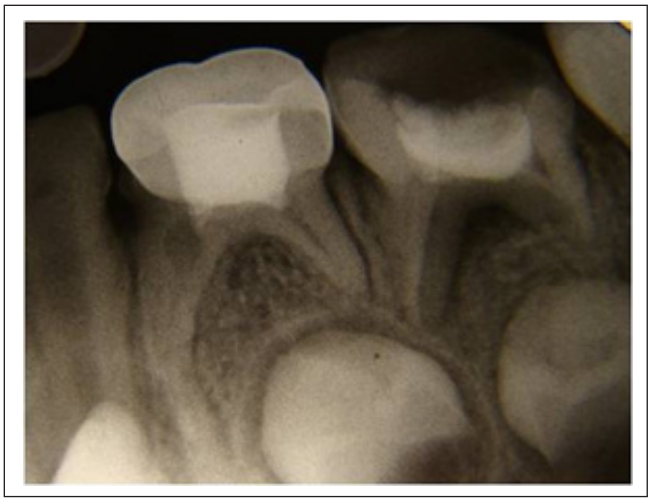


Figure 1. Radiograph showing Internal resorption in Formocresol treated tooth at 12 month recall.

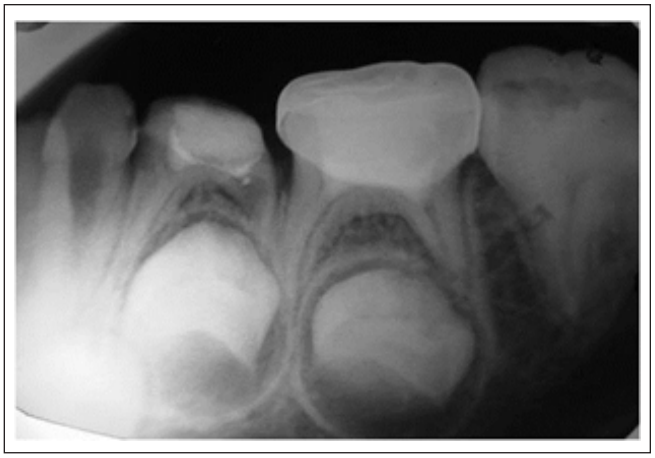


Figure 2. Radiograph showing Internal resorption in Formocresol treated tooth at 24 month recall.

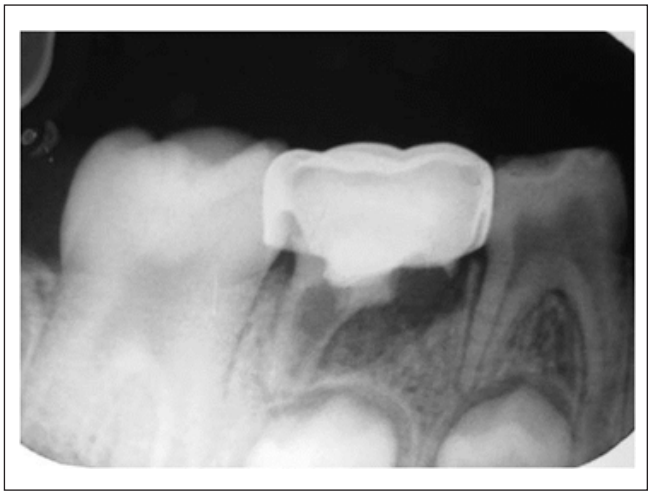


Figure 3. Radiograph showing Severe Internal resorption in Formocresol treated tooth at 24 month recall.

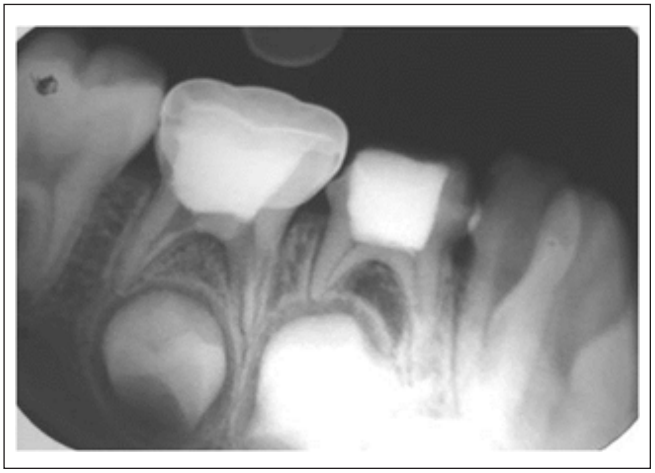


Figure 4. Radiograph showing Internal resorption and Furcal radiolucency in Formocresol treated tooth at 12 month recall.

resorption, inter-radicular and or periapical bone destruction, advanced physiological root resorption.

iv) Teeth should be restorable after completion of the procedure.

The procedure was carried out step by step in one visit using local anesthesia and rubber dam to isolate the teeth. Following the establishment of cavity outline form, all peripheral caries was removed before the pulp was exposed. Exposure of the vital pulp was carried out with a high speed hand piece and bur #330 to enlarge the access cavity to the limit of the pulp horns to simplify coronal pulp removal. The coronal pulp was removed with a sharp spoon excavator. The pulp was amputated at the entrance to the root canals, and then the pulp chamber was irrigated with water to prevent dentin chips from being forced into the radicular pulp. Following irrigation, sterile cotton pellets were used and applied to the amputated pulp stumps to aid hemostasis.

In Formocresol group, a cotton pellet moistened with 1:5 concentration was applied over pulp stump for 1 minute. The pellet was then removed and a thick mix of ZOE was placed over the pulp stumps.

In Mineral Trioxide Aggregate, Using a stiff metal spatula, MTA powder mixed with distilled water provided by manufacturer in 3:1 (powder: liquid) ratio and then placed over the exposure site with a plastic instrument. Then the mixture was compressed against the exposure site with a moist cotton pellet and is removed.[4] A thick mix of Zinc oxide Eugenol cement was placed into the coronal pulp chamber. A layer of intermediate restorative material (IRM) was placed at the same appointment as the pulpotomy. After eight days the tooth was then restored with a preformed stainless steel crown.

The children were recalled for clinical and radio graphical examination after 6, 12 and 24 months for Pain, Swelling, Sinus/fistula, Periapical changes, Furcation radiolucency and internal resorption. The treatment was regarded as a success in the absence of all clinical criteria evaluated. The differences were statistically analyzed by chi-square test.

RESULTS

All the 70 teeth were available for analysis till the 6 month of study. At 12 month of evaluation all teeth were available and at 24 month of evaluation only 60 teeth were available. No differences were found between the MTA and FC group regarding the children age at the time of treatment.

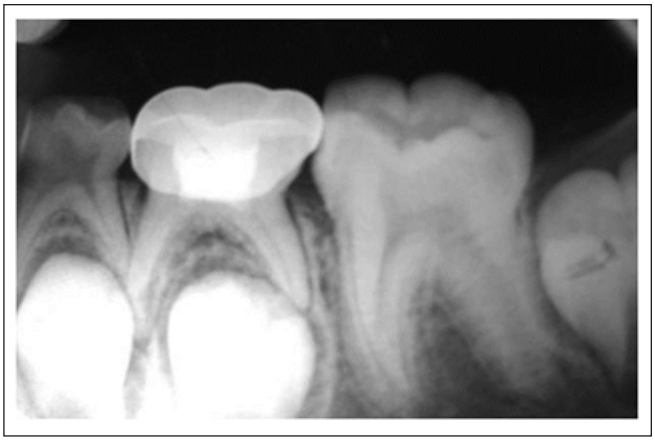


Figure 5. Radiograph showing Pulp Canal Obliteration in MTA treated tooth at 12 month recall.

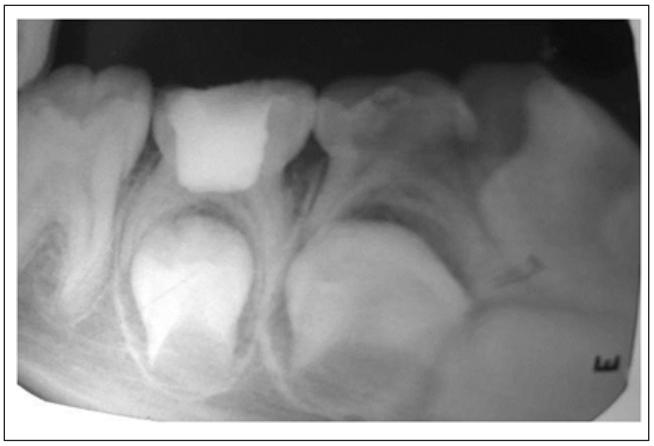


Figure 6. Radiograph showing Pulp canal obliteration in MTA I treated tooth at 24 month recall.

Follow up time of all the teeth in both the MTA and FC groups was 6, 12 and 24 months. All the teeth with successful treatment were followed until uneventful shedding with a follow up period.

The success rate of the pulpotomies of all the teeth in this study was 90 %; MTA was successful in 97.9% of cases and FC in 82.9%. The follow up clinical evaluation reveals 7 failures: 6 of them with FC and 1 with MTA. Failures were detected after a mean follow up period of 24 months .Chi square value was 12.96(Table 3).

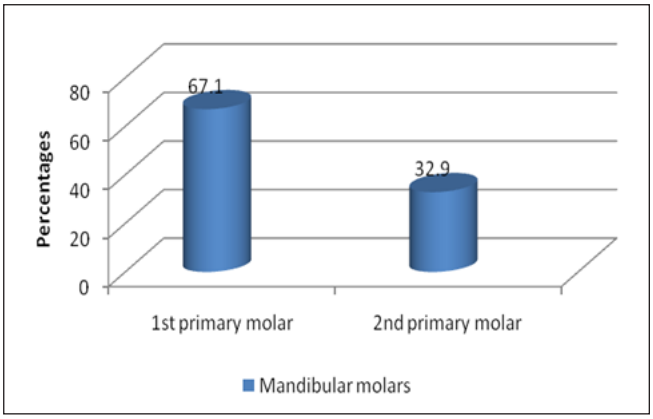
The most common finding was internal resorption which developed in 13 teeth, 11 in FC group and 2 in MTA group at 12 month evaluation and in 15 teeth at 24 month recall (Figure 1,2). Two teeth showed severe resorption at 24 month recall (Figure 3). Furcal radiolucency was reported in 5 cases of FC and 1 case of MTA after 12 month of evaluation (Figure 4). Another finding in the MTA group was pulp canal obliteration (Figure 5,6) seen in one case. This resulted in 88.6% radiographic success in MTA and 54.3% radiographic success in FC (Table 4).

DISCUSSION

This study was intended to examine the clinical and radiographic success rate of pulpotomies with MTA and Formocresol. Several in vitro and in vivo studies have shown that MTA prevents micro

Table 1. Distribution of assessed pulpotomized primary molars

Teeth	1st primary molar	2nd primary molar	Total
Mandibular	47 (67.1)	23 (32.9)	70



leakage, is biocompatible, and promotes regeneration of the original tissues when it is placed in contact with the dental pulp. FC was selected as the control group, since it is still considered as a Gold Standard in primary teeth inspite of reported toxic, mutagenic and carcinogenic properties. Eidelman *et al* [5] compared the clinical and radiographic success rates between formocresol and MTA pulpotomy in primary teeth. Clinical and radiographic success rates of 100% were demonstrated for MTA pulpotomy, at 35 months follow up. These results are similar with the present study. Furthermore, Agamy *et al* reported that the clinical and radiographic success rate of pulpotomy was 100% for gray MTA and 90% for formocresol, 12-months postoperatively. Additionally, according to the results of Holan *et al*, the success rate of pulpotomy was 97% for MTA and 83% for formocresol. A higher radiographic failure rate of FC pulpotomy was obtained in the present study as compared to previous investigations.

The total success rate of pulpotomies in all the teeth for this study was 90%. MTA was successful in 97% and FC was successful in 83% without statistical significant difference between the two materials. The clinical follow up evaluation revealed 6 failures (10%): 5 of them in the FC group and 1 in the MTA group.

The most common radiographic finding among all teeth was internal resorption 31.4% in FC and 7 % in MTA. Peng *et al* in 2006 did a review of the literature applying the metaanalysis technique and compared FC and MTA through six articles evaluated by means of the Jadad scale and found that there was a statistically significant difference between the success rates of FC and MTA in molars treated with pulpotomy. The clinical and radio graphical evaluations indicated that MTA was superior to FC with a lower failure rate. They concluded that MTA induced a less undesirable response and could be a good substitute for pulpotomies in primary teeth. Salako *et al*, radiographically and histologically compared the effect of several dressing materials, including MTA and FC, on the radicular pulp in pulpotomized molars. They found that, while FC showed zones of atrophy, inflammation, and fibrosis, MTA performed ideally as a pulpotomy agent, causing dentin bridge formation.

In the present study, at 6 month of evaluation, none of the

Table 2. Distribution of samples

	No. of children evaluated	Mandibular first molar	Mandibular second molar	Chi square value	Probability & Significance
Group 1 (Formocresol)	35	25 (71.4)	10 (28.6)	1.64	0.200
Group 2 (MTA)	35	22 (62.9)	13 (37.1)		Non-significant

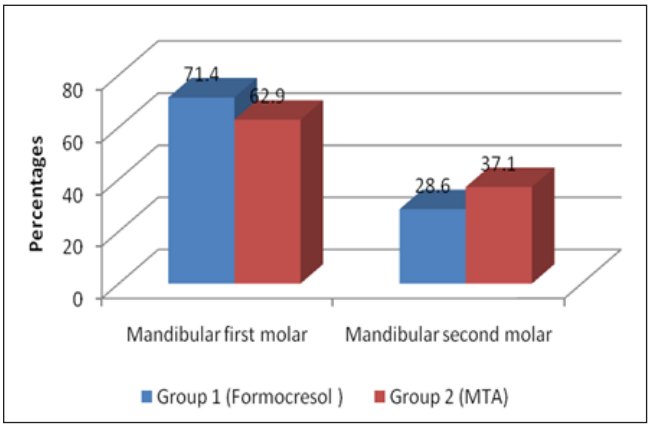
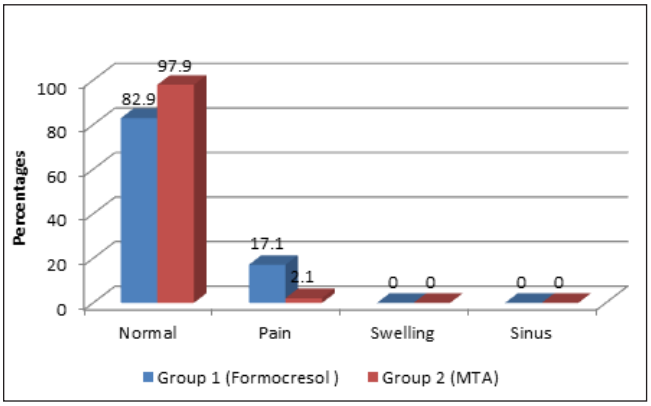


Table 3. Clinical assessment after 12 and 24 months

Groups	No. of teeth evaluated	Normal	Pain	Swelling	Sinus	Chi square value	Probability & Significance
Group 1 (Formocresol)	30	24 (82.9)	6 (17.1)	0 (0.0)	0 (0.0)	12.96	0.000 Highly significant
Group 2 (MTA)	30	29 (97.9)	1 (2.1)	0 (0.0)	0 (0.0)		



primary molars showed any clinical signs and symptoms in both groups. The gradual increase in internal resorption seen in the 11 molars treated with FC after 12 and in 15 teeth at 24 months could be due to histological reaction of pulp. Previous investigations of ZOE as a pulpotomy agent or as a base for pulpotomies suggest that ZOE can cause pulp inflammation, with a risk for subsequent internal resorption. Smith *et al* claimed that internal resorption is associated with Eugenol.

A dentin bridge or calcific metamorphosis was seen in one molar treated with MTA after a period of 24-months. The formation of dentinal bridge is a favorable response to conservative pulp therapy.

Although one primary molar treated with MTA and five molars treated with FC showed furcal radiolucency, though the teeth were clinically sound. This Furcation radiolucency could be due to improper diagnosis of radicular pulpal status, prior to treatment. Based on the observations of this study MTA appears to be highly successful pulpotomy agent in primary molars.

CONCLUSION

With growing concerns, regarding the use of FC and MTA is becoming the preferred choice for pulpotomy in primary molars due to its biocompatibility and regenerative properties.

Table 4. Radiographic appearance of the pulp in Assessed Pulpotomized Primary Molars

Groups	Normal	Internal root resorption at 12 and 24 months respectively	Furcal radiolucency	Periapical radiolucency	Pulp canal obliteration	Chi-square value	Probability & Significance
Group 1 (Formocresol)	19 (54.3)	11 (31.4) 15 (28.2)	5 (14.3)	0 (0.0)	0 (0.0)	36.49	0.000 Highly significant
Group 2 (MTA)	31 (88.6)	2 (5.7)	1 (2.9)	0 (0.0)	1 (2.9)		

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