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Comparison Of 3 Pulpotomy Agents in Deciduous Molars

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Abstract:
The aim of the study was to compare clinically and radiographically the pulpotomies are done using form cresol (FC), calcium hydroxide (CH), and mineral trioxide aggregate (MTA). Nineteen children in the age group of 3 – 6 years with a total of 39 teeth requiring pulpotomy were selected. Thirty-nine teeth were divided into 13 in each group and randomly treated with 1 of the 3 pulpotomy agents. The children were called for a follow-up at 3, 6, and 9 months. The follow-up evaluation resulted in 92.31% success for FC, 61.53% for CH and 100% success for MTA at the end of 9 months. Statistics revealed no significance in the success rate between formocresol and MTA while the difference in the success rate between calcium hydroxide and MTA was statistically significant. Discoloration of the crown was observed in teeth treated with MTA though there were no clinical and radiographic signs and symptoms.
Keywords: Calcium hydroxide, formocresol, mineral trioxide aggregate, primary teeth, pulpotomy

Introduction:

Pediatric dentistry is a challenging branch and it is even more challenging to conservatively treat a decayed tooth to maintain its vitality so as to prolong the functional life of the tooth till exfoliation. Pulpotomy is the surgical amputation of the infected coronal pulp while maintaining the healthy radicular pulp. Pulpotomy is recommended in primary teeth with a deep carious lesion approximating the pulp with no clinical or radiographical signs or symptoms [1].

On coronal amputation, the radicular pulp stumps need to be treated with a pulp dressing agent. The pulp dressing agents used are formocresol(FC), ferric sulfate, calcium hydroxide (CH), and mineral trioxide aggregate (MTA). These materials are classified as devilatising – formocresol, preservative – ferric sulfate, and regenerative – calcium hydroxide and mineral trioxide aggregate[2,3].

Formocresol is a widely used and accepted pulpal dressing material that acts by devitalizing the pulp. Some investigators have reported total necrosis of the pulp tissue on use of FC while some researchers suggest that the coronal 1/3rd of the radicular pulp is mummified, the middle 1/3rd remains chronically inflamed and the apical 1/3rd radicular pulp remains vital[4]. There are some reports that suggest that FC is immunogenic and mutagenic but this has not resulted in the discontinuation of the use of FC due to the high success rate in pulpotomy of primary teeth[5].

The use of calcium hydroxide in pulpotomy of primary teeth was proposed in 1962[6]. There was a lot of interest generated with the use of CH as it has regenerative property and induces a calcific barrier. CH causes a superficial layer of necrosis with mild inflammation and the formation of a calcific layer that separates the vital pulp from the necrosed tissue[7]. A major side effect seen was a failure due to internal or external resorption which made the material far from ideal[8].

MTA was first described in 1993[9]. It is a modification of Portland cement and is available as white MTA and gray MTA. The white MTA was introduced as an esthetic improvement and contains tricalcium silicate, dicalcium silicate, tricalcium aluminate,

calcium sulfate dehydrate, and bismuth oxide [10]. MTA has demonstrated the ability to stimulate cytokine release from bone cells indicating that it promotes hard tissue formation [11]. Hence lately researchers are looking into its use as a pulpotomy agent [12].

This study was carried out to compare the success rate of formocresol, calcium hydroxide, and white mineral trioxide aggregate as pulpotomy agents under similar conditions over a 9-month period.

Method and Material:

A total of 19 children in the age group of 3-6 years that reported for treatment to Paediatric Dental Department India were selected (Table 1). One of the inclusion criteria was that the children stay close to the hospital to facilitate a regular follow-up. All the children selected did not have any relevant medical history. The parents have explained the context of the study and after answering their queries, informed consent was taken.

Only the teeth that had no clinical signs and symptoms, as well as no radiographical abnormalities (no periapical lesion, root resorption, no h/o nocturnal pain, swelling or sinus tract formation), were selected. Caries approximating the pulp and the tooth that was restorable were other inclusion criteria. It was decided that if the pulpal bleeding during amputation of the pulp did not stop on a 5-minute pressure application the tooth would be excluded for the study and pulpectomy done. A pre-operative Intraoral periapical radiograph (IOPA) was taken to check for the extent of caries. Thirty-nine teeth were included for pulpotomy treatment in 19 children selected (Table 2).

The children were randomly treated with formocresol, calcium hydroxide, and MTA. To prevent any bias, the materials were used alternately. The child was seated in a Paediatric dental chair and after anesthetizing the quadrant, isolation was achieved by using cotton rolls and suction. Caries was removed and access opening was done using a cylindrical diamond point with water spray. The pulp was scooped out using a spoon excavator. The bleeding was arrested using a damp cotton pellet placed for 5 minutes. On hemostasis, the pulp stumps were covered with one of the pulpotomy agents, and permanent restoration using FUJI II glass ionomer, GC corporation, Japan (GIC) was done on the same appointment.

A) Formocresol pulpotomy was carried out on 13 deciduous molars by placing a cotton pellet dampened with formocresol (Pharmadent Remedies Pvt Ltd, India) in the pulp chamber for 5 minutes. A zinc oxide eugenol base was placed and GIC restoration was done.

B) Thirteen teeth were treated with Calcium hydroxide powder (Extra Pure Calcium Hydroxide, Deepti dental products, India) mixed with sterile saline to form a paste. The paste was placed in the pulp chamber following pulpotomy and GIC restoration done.

C) White MTA (Pro Root MTA, Dentsply, Tulsa Dental, USA) was used as a pulpotomy agent in 13 deciduous teeth. MTA was mixed as per instruction with sterile water provided and the paste placed in the pulp chamber followed by GIC restoration.

Post restoration instructions were given and the importance of a regular follow up explained. A post-operative IOPA was taken as a baseline and x-rays were repeated at 3, 6, and 9 months.

The children were telephonically reminded about the follow-up. During the follow-up examination, the treated tooth was examined clinically and parents were asked if there had been any swelling or pain in relation to the tooth. Also, IOPA were taken to radiographically check for periapical radiolucency, furcation radiolucency, internal or external resorption, or periodontal ligament widening. In the event any of the above were present, the pulpotomy was considered a failure. Obliteration of pulp canal and discoloration of the crown without any symptoms were not considered failures.

All but one came for a regular check-up and hence 12 teeth in the MTA group were available for a 9-month follow-up. After the 9 month follow-up, the teeth that were rated successful were given Stainless steel crowns.

Results:

All teeth treated with formocresol were rated successful at the 3 months follow-up. The formocresol group had 1 failure when a child reported at 4 months with an intraoral swelling with mild radiolucency seen on the IOPA . No other failure was seen at the 6 and 9-month follow-up. 12 out of 13 children (92.31% success) treated with formocresol were successful without any clinical and radiographical signs at 9 months.

Of the 13 teeth treated with CH, 8 were successful (61.53%) while 5 teeth failed within 9 months. One child reported at 2 months with an intraoral swelling in tooth treated with calcium hydroxide. At the 3 months follow-up, 3 teeth showed failure in CH pulpotomy, one had an intraoral swelling with no pain hence child had not reported earlier and 2 children showed periapical and furcation radiolucency on IOPA (Fig.1). No more failures were noted at the 6 months check-up. One child treated with CH reported an extraoral swelling 3 days before a crown was given after 9 months.

The group treated with MTA did not have a single failure in terms of clinical and radiographic follow-up (100% success). 5 out of 13 teeth treated with MTA showed a wide radiographical barrier near the pulp stumps (Fig. 2). All the teeth showed various degrees of crown discoloration and loss of tooth luster with no signs or symptoms at 3 months that did not increase over the other follow-ups (Fig.3,4,5). As this did not lead to any loss of function, the teeth were considered successfully treated. All the teeth were given stainless steel crown at the end of 9 months thus masking the discolored teeth.

On completion of the study protocol of 9 months, the success rate of MTA was 100% which was followed by FC at 92.31%. CH had the least success rate of 61.53%(Table 3). The Fisher Exact Test was applied for the comparison of the success rate between the two groups. The difference in the success rate between formocresol and calcium hydroxide was not significant with the $\underline{P}$ =0.08. also, there was no significant result obtained between formocresol and MTA while the success rate between calcium hydroxide and MTA was found to be statistically significant (Table 4,5,6). Hence, formocresol and MTA were found to be equally effective as a pulpotomy agent while calcium hydroxide showed a significantly lower success rate.

Discussion:

This study evaluates the success of the 3 pulpotomy materials over a 9 months period. To prevent a bias and achieve standardization inpatient and tooth selection, the materials were used alternately and treated under similar conditions. Hence cotton rolls and suction were used for isolation of the teeth prior to the procedure as a few children of age 3 and 4 years were not cooperative for placement of rubber dam[13].

This study results showed MTA and formocresol to be as effective in successfully treating a tooth. Calcium hydroxide showed a high failure rate than FC and MTA. The study results are comparable to the results obtained by Moretti AB et al where he observed a 100% success with both FC and MTA and a 64 % failure rate with CH[14]. The results of the study carried out by Sonnez et al showed some variation with FC performing better with 76% success than MTA at 66.6% success while CH showed 46.1% success over two years[15].

There are a few studies that individually compare MTA with FC. Eidelman et al reported a single failure with FC and no failure with MTA in his study which in turn is comparable to the results obtained in the present study[16]. Another study carried out by Farsi et al showed more favorable results with MTA (100%) while FC showed a radiographic success of 86.8% and clinical success of 98.6%[17]. The results of both studies were not statistically significant, thus suggesting that both are equally good as pulpotomy agents. Both the agents have their effects, FC is thought to be immunogenic and mutagenic with its use being constantly questioned but it is able to give a high success rate as a pulpotomy agent in

primary teeth while also being cost effective[18]. MTA induces the formation of a wide dentinal bridge thus maintaining the integrity of the radicular pulp which is an essential property when it comes to treating children where the primary teeth need to be maintained a number of years before exfoliation. MTA 's major negative component is it's cost which makes its regular use not feasible.

Huth et al, in their study, found CH to be less effective than FC while Waterhouse et al reported a statistically insignificant difference between FC and CH.[19,20]. Most of the failure in CH was seen due to internal resorption. He recommended the use of pure CH powder which was used in the present study. Percinoto reported no significant difference in the success of CH and MTA contrary to the present study which showed a 100% success rate with MTA while CH had a 61.53% success rate[21].

An interesting observation of the study was the discoloration of the clinical crowns treated with MTA. This observation seems similar to that made by Naik, Hegde in 2005.[22] The discoloration was not seen within 24 hours as seen by Naik, Hegde but it was noticed on the 3-month follow-up. The discoloration varied from loss of luster to grayish tinge on the clinical crowns The discoloration also did not seem to increase during the 6 and 9-month check-up. Composition of Pro Root MTA – calcium silicate (51.9%), dicalcium silicate (32.2%), bismuth oxide (19.8%) and trace elements Fe,Ni,Cu and Sr.In the present study, bismuth oxide used as a radioopacifier could be the cause of the discoloration[23]. It is proposed that amino acids in collagen seem to destabilize bismuth oxide molecules leading to a change in colour to black[24]. Some studies also propose that discoloration be caused or enhanced by the interaction of WMTA and blood. It is proposed that the unset WMTA permits absorption and hemolysis of erythrocytes from adjacent pulpal tissue.[25]

The teeth that successfully completed the study protocol were capped with stainless steel crown after the 9-month follow-up to facilitate the clinical and radiographic examination[26]. The post-operative restoration was done using GIC that results in the chemical bond with the tooth thus preventing microleakage while giving the opportunity to examine the crown during follow-ups[27]

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To conclude, the author would definitely recommend the use of MTA for posterior tooth pulpotomy where the discoloration is masked by the steel crown but given the side effect of discoloration would not recommend it in the anterior region where esthetics is also important. Also, the long terms effects of the use of MTA need to be considered over a period of 5 -7 years, as that would generally be the life span of the deciduous tooth treated. The cause for the discoloration of the crown after use of MTA needs to be still explored and a solution needs to be found for the discoloration. FC still remains a viable alternative.

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Table 1: Age Group Of Children Treated With Pulpotomy

Age in years	Children treated	Teeth treated
3	4	8
4	5	12
5	5	14
6	5	5

Table 2: Teeth Treated With Pulpotomy Agents

	Left 1st molar	Left 2nd molar	Right 1st molar	Right 2nd molar
Upper	4	3	5	3
Lower	8	6	6	4

Table 3: Treatment Details At A Glance

Materials	Teeth treated	9 month follow-up	Success rate	Success %	failure
Formocresol	13	13	12	92.3	1
Calcium hydroxide	13	13	8	61.53	5
MTA	13	12	12	100	0
Total	39	38	32		

Table 4: Fisher Exact Test- Comparison of success rate between two materials

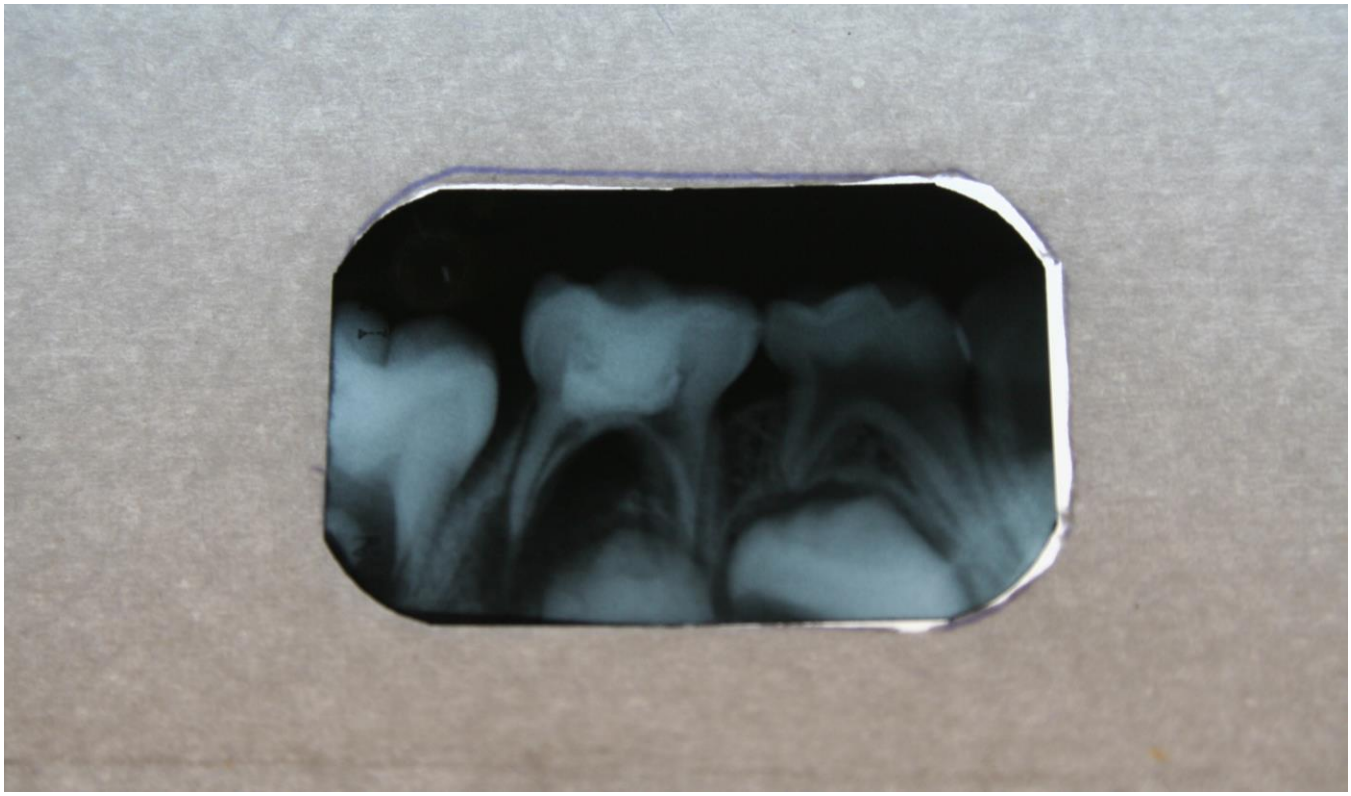
Material	success	failure	P-value	significance
Formocresol	12	1	0.08	Not significant
Calcium hydroxide	8	5		

Table 5: Fisher Exact Test- Comparison of success rate between two materials

Material	success	failure	P-value	significance
Formocresol	12	1	0.52	Not significant
MTA	12	0		

Table 6: Fisher Exact Test- Comparison of success rate between two materials

Material	success	failure	P-value	significance
Calcium hydroxide	8	5	0.024	significant
MTA	12	0		



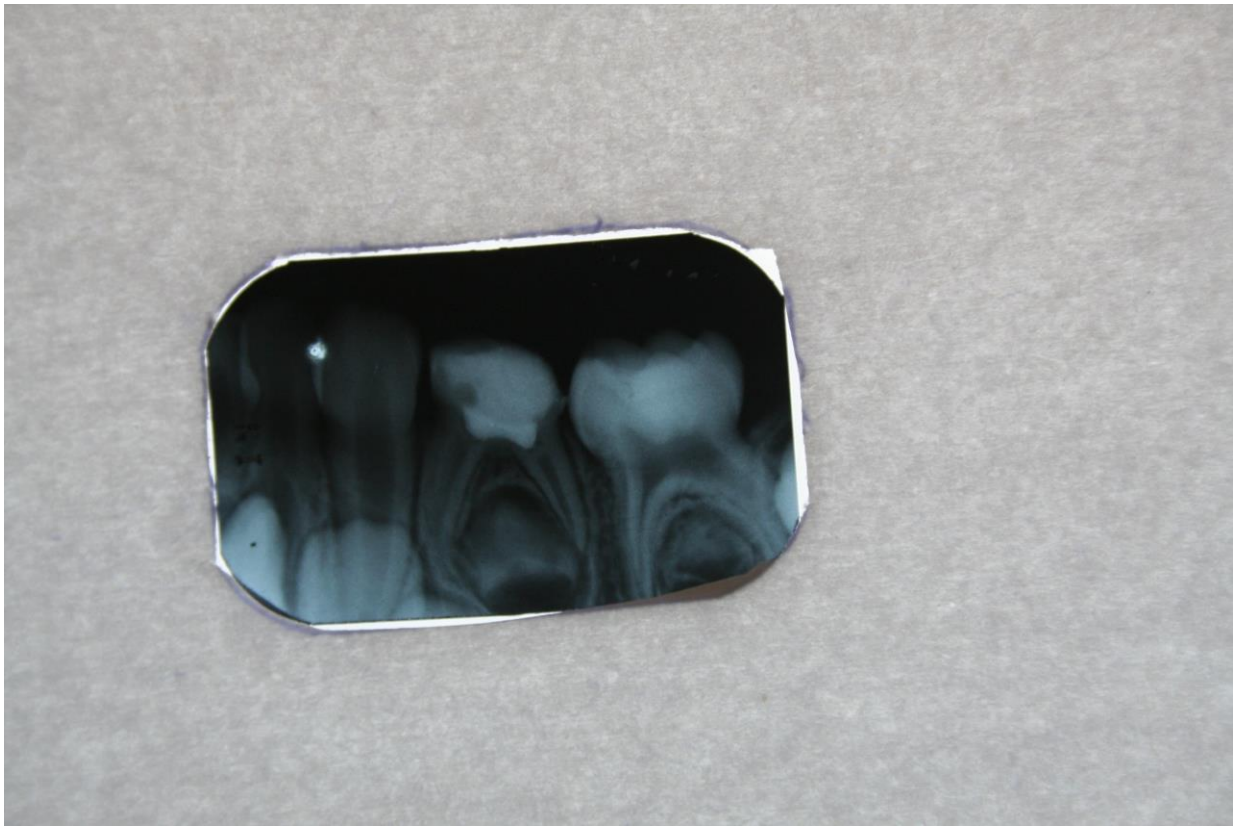


Figure Legend:

Fig 1 : (IMG_5338_1.jpg) Radiolucency resulting in failed Formocresol pulpotomy

Fig 2 : (IMG_5341_1.jpg) Wide calcific barrier with MTA pulpotomy

Fig 3: (IMG_5270_1.jpg) Teeth treated with MTA discoloured after 3 months

Fig 4: (IMG_4995_1.jpg) Teeth treated with MTA discoloured after 3 months

Fig 5: (IMG_5102_1.jpg) Teeth treated with MTA discoloured after 3 months