

## FERRIC SULPHATE VERSUS FORMOCRESOL IN PULPOTOMIES OF PRIMARY MOLARS

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### ABSTRACT

**Objectives:** *To compare the outcomes of application of dilute formocresol and ferric sulphate in pulpotomies of primary molars.*

**Material and methods:** *This study was carried out at the Department of Operative Dentistry, de'Montgomery College of Dentistry, Lahore. Sixty primary molars in 60 children were treated by conventional pulpotomy technique. Thirty teeth were treated by 15.5% ferric sulphate solution for 40 second. In the other 30 teeth, a cotton pellet moistened with dilute formocresol was placed for 4 minutes and removed. The pulp stumps of both groups were covered by zinc oxide eugenol paste and the teeth were restored with amalgam. Follow-up evaluations were conducted 3 and 5 months after the procedure.*

**Results:** *The success rate was 93.3% in dilute formocresol group and 90% in ferric sulphate group. Chi Square test showed that these differences were not statistically significant ( $p=0.64$ ).*

**Conclusion:** *There is no difference in the success rate of dilute formocresol and ferric sulphate application in pulpotomies of primary molars. Ferric sulphate a non-toxic medicament can be a better alternative to dilute formocresol.*

**Key Words:** *Ferric sulphate, formocresol, pulpotomy, success and failure rate*

### INTRODUCTION

Pulpotomy is a therapeutic procedure, used in reversible inflammation of pulp of primary teeth, when the radicular pulp tissue has remained healthy and capable to serve for long time until normal exfoliation<sup>1,2</sup>.

Many efforts have been made to determine the safest and the most efficient pharmacotherapeutic agent for pulpotomy in primary teeth. A number of studies have been done researching different materials for use in pulpotomies<sup>3,4</sup>. However, the use of formocresol pulpotomy in the treatment of primary teeth is widely accepted as the treatment of choice<sup>5</sup>. Clinical studies investigating the long-term success rates of formocresol pulpotomy have justified its use and it has been the most popular pulp-dressing material for pulpotomized primary molars for the past 60 years<sup>6,7,8</sup>.

However, additional studies have demonstrated

the potential for the local and systemic distribution of formocresol with attendant potentially toxic effects<sup>9,10</sup>. These systemic manifestations must be considered a possibility since formocresol is a material that is toxic to cells and tissues<sup>11</sup>. It is for these reasons that more biocompatible treatment alternatives have been sought, including ferric sulphate, electrosurgery, laser irradiation, calcium hydroxide and mineral trioxide aggregate.

Of these medicaments that have been used, ferric sulphate seems to be a promising alternative to formocresol; Ferric sulphate (15.5%) has been reported in animal and human studies as a haemostatic agent in pulpotomy procedures. On contact with blood, ferric sulphate forms a ferric ionprotein complex, and the membrane of this complex seals the cut vessels mechanically, producing haemostasis. Thus it acts by blocking capillary blood flow and thus initiating haemostasis without any clot formation. No concerns about toxic or harmful effects of ferric sulfate have been published in the dental or medical literature despite its regular clinical use<sup>3,10,12-14</sup>.

The purpose of this study is to compare the outcomes of dilute formocresol and ferric sulphate

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application in pulpotomies of primary molars.

**MATERIALS AND METHODS**

The study was carried out at the Department of Operative Dentistry, de'Montmorency College of Dentistry, Lahore, from January 2009 to March 2010.

Sixty cases meeting the inclusion criteria were selected. Healthy children aged 4-8 year with cariously or mechanically exposed vital primary molars, absence of clinical or radiographic evidence of pulp degeneration and no evidence of furcal or periapical radiolucency were included in the study. Patients with swelling and tenderness to percussion, pathological mobility and initial unsuccessful hemorrhagic control for 2 minutes after application of cotton pellet and preoperative radiographic pathoses such as resorption, periapical or furcal radiolucency, a widened periodontal ligament space, or physiological root resorption of more than one third were excluded from the study.

Diagnosis was made on history, clinical examination and periapical radiographs. An informed parental consent was obtained. After diagnosis was completed, the selected tooth was anesthetized and isolated.

All caries were removed and the roof of the pulp chamber was removed with a sterile bur and copious water spray. All the coronal pulp was removed with a large spoon excavater. The pulp chamber was thoroughly washed with water to remove all debris. The water was removed by vacuum and cotton pellets. Hemorrhage was controlled by slightly moistened cotton pellets, placed against the stumps of the pulp at the opening of the root canals. Dry cotton pellets were placed over the moist pellets with pressure to control the hemorrhage. The teeth in which hemostasis was not achieved within 2 minutes after the application of cotton pellet were excluded from the study and were treated with pulpectomy.

The selected cases were randomly allocated into two groups I and II, each having 30 cases, in such a way that odd numbers were used for formocresol and

even numbers were used for ferric sulphate. The teeth in group I were treated with formocresol. A cotton pellet moistened with 1:5 dilute formocresol (DFC) was placed in contact with the pulp orifices for 4 minutes. After fixation of radicular pulp, a cement base of ZOE was placed over the pulp stump and allowed to set. The teeth were then permanently restored with amalgam.

The teeth in group II were treated with ferric sulphate. A 15.5 % ferric sulphate solution in an aqueous vehicle (astringent ®, Ultradent product, Inc, Salt lake city, UT, USA.) was placed in contact with radicular pulp for 40 seconds with the syringe applicator supplied by the manufacturer. After irrigation with normal saline and observation of hemostasis, a cement base of ZOE was placed over the pulp stump and allowed to set. The teeth were then permanently restored with amalgam.

Clinical and radiographic evaluation of each tooth was carried out at 3 and 5 months interval after pulpotomy. Informations were collected on a specially designed proforma. The pulpotomy was considered clinically successful if the treated primary molar showed no history of pain, swelling or sinus tract, tenderness to percussion and pathological mobility.

The pulpotomy was considered radiographically successful at follow-up appointments if the radiograph showed no evidence of furcal or periapical radiolucency, widened periodontal ligament space and internal root resorption.

**RESULTS**

Sixty teeth were treated in 60 patients, 38 were males (63.3%) and 22 were females (36.7%) The age of the patients was ranged between 4 and 8 years. Eight patients (13.3%) were of 6 years, 34 patients (56.7%) were of 7 years age and 18 patients (30%) were of 8 years age. The mean age was 7.16± .0642 years. Of the total patients 50% were treated with formocresol and 50% with ferric sulphate.

**Table - 1: Clinical and Radiographical failure/success of Ferric Sulphate and Formocresol**

Pulp Medicaments	No of teeth	Clinical failure		Radiographic failure		Clinical success	Radiographic success
		n	%	n	%	%	%
Ferric sulphate	30	2	6.6	1	3.3	93.3	96.6
Formocresol	30	1	3.3	1	3.3	96.6	96.6

The clinical evaluation of teeth in both groups, after three months revealed that one tooth failed in formocresol group and two teeth failed in ferric sulphate group because of pain but no other sign and symptoms were experienced. On radiographic evaluation all of the teeth in both groups were considered successful after three months follow up.

The clinical evaluation after 5 months revealed that none of the teeth showed tenderness, pain, swelling, fistula or pathological mobility. Thus all the teeth in both groups were considered clinically successful.

The radiographic evaluation revealed that one tooth failed in formocresol group and one tooth failed in ferric sulphate group because of periapical radiolucency.

After five months the clinical and radiographic success rate for formocresol was similar i.e. 96.6%. The clinical and radiographic success rate for ferric sulphate was 93.3% and 96.6% respectively as shown in Table 1. This success rate in both groups was not statistically significant ( $p=0.553$ ).

The overall success rate at the end of the study, was 93.3% in formocresol group and 90% in ferric sulphate group. Chi Square test showed that these differences were not statistically significant ( $p=0.64$ ).

## DISCUSSION

Ferric Sulphate as a pulpotomy medicament was used in the present study and its clinical and radiographical success was assessed and compared to that of formocresol. Ferric sulphate promotes pulpal haemostasis through a chemical reaction with blood. On contact with blood, a ferric ion-protein complex is formed, and the membrane of this complex seals the cut vessels mechanically, producing haemostasis. The agglutinated protein complex forms plugs which occlude the capillary orifices, preventing blood clot formation<sup>15,16</sup>.

The overall success rate was 93.3% in formocresol group and 90% in ferric sulphate group. There was no statistically significant difference in the success rate of formocresol group and ferric sulphate groups. Findings of this study were comparable to the studies of Ibricevic<sup>17</sup>, Papagiannoulis<sup>18</sup> and Fuks et al<sup>19</sup>.

Only three patients reported postoperative pain, two teeth were in ferric sulphate group and one in formocresol group. But this was readily controlled

with systemic medication. These teeth later on developed draining sinus and tenderness to percussion. It is possible that the pulps in these teeth were inflamed prior to treatment but without clinical signs of such inflammation. The initial postoperative pain is likely to be a sign of an exacerbation of this inflammation following treatment. The subsidence of symptoms may be partly due to the effect of the medication but it may also be a result of the pulps undergoing necrosis at which stage the symptoms generally disappears. It is not possible to determine why this occurred in these three teeth although it may be due to poor case selection which is a result of the uncertainties associated with diagnosing pulp disease, especially in children.

Radiographic failure occurred in two teeth, one in formocresol group and one in ferric sulphate group. These teeth showed periapical radiolucencies. No other clinical signs and symptoms were observed in these patients. It may be due to the necrosis of the remaining radicular pulp which causes the release of bacteria and their toxins via the apical foramina and resulting periapical radiolucency.

One of the difference between the current study and other reports<sup>17,18,19</sup> is the difference in application times of formocresol and ferric sulphate. In these studies, after completion of the pulpotomy the pulp stumps were treated in the ferric sulphate group by applying a 15.5% solution of ferric sulphate for 10-15 seconds. In the formocresol group 1:5 diluted formocresol was applied for 5 minutes. In the present study the duration of application of 1:5 diluted formocresol was decreased to 4 minutes while 15.5% ferric sulphate was applied to the pulp stumps for 40 seconds.

Ferric sulphate promotes pulpal haemostasis through a chemical reaction with blood and forms a protective metal-protein clot over the underlying vital radicular pulp. Further histological studies are needed to observe the effects of different application times of ferric sulphate on the pulpal tissue.

The most common radiographic findings, in the previous studies<sup>18,19</sup>, were internal resorption and pulp canal obliteration. In this study no such findings were noted which may be due to short follow up period of 6 months.

One of the difference between the current study and other reports is the restoration of the teeth after pulpotomy. In the studies of Fuks et al<sup>19</sup> and Ibricevic-

ic<sup>17</sup> stainless steel (SS) crown was the only means of restoration and in the study of Papagiannoulis<sup>18</sup> the teeth were restored with SS crown and composite resin. In the present study the teeth were restored with amalgam. The type of restoration did not effect the success rate of both the groups.

An advantage of Ferric sulphate over formocresol observed in this study is the less time needed for procedures, when ferric sulphate is used as pulpotomy agent. One of the disadvantages of formocresol observed, compared to ferric sulphate, is its bad smelling for patients and the clinician, while such effects were not noted with ferric sulphate. .

A number of authors<sup>20</sup> have speculated that the eugenol may in fact promote internal resorption when placed in contact with vital tissue following a ferric sulphate pulpotomy. No such findings were observed in this study which may be due to short follow up period. This possible complication warrants further investigation.

Though clinically and radiographically the success rate of Ferric Sulphate in this study is promising, a histological evaluation of ferric sulphate and a long follow up period is necessary to reach sound conclusions.

Ferric sulphate showed clinical and radiographic success, as a dressing material 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 evaluation of ferric sulphate as a pulpotomy agent need to be carried out.

**CONCLUSIONS**

There is no difference in the success rate of dilute formocresol and ferric sulphate in pulpotomies of primary molars. Ferric Sulphate, a non-toxic medicament, can be a better alternative to dilute formocresol. The results of the study further suggest that using 4 minutes application time for dilute formocresol and 40 seconds for ferric sulphate to medicate the radicular pulp, is an acceptable variation of the traditional application times of these medicaments in pulpotomy of primary molars.

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