

Original Article

Comparative Evaluation of Formocresol and Electrosurgical Pulpotomy in Human Primary Teeth- An *In Vivo* Study

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ABSTRACT

Introduction: Vital pulpotomy is defined as the surgical amputation of the coronal portion of exposed pulp followed by the placement of medicament over the remaining radicular pulp thereby maintaining the vitality of the remaining radicular pulp.

Aim and Objective: The aim of this study was to compare clinically and radiographically the success rate of formocresol (FC) and electrosurgical pulpotomy in human primary teeth.

Materials and Methods: In this study, thirty primary molars between 3 and 8 years of age were taken from the Outpatient Department of Pedodontics and Preventive Dentistry. Teeth were randomly divided into two groups of fifteen teeth each based on type of pulpotomy performed (15 receiving electrosurgical pulpotomy and 15 receiving FC pulpotomy). Under rubber dam isolation, pulpotomy was performed in both the groups and teeth were restored with stainless steel crowns. The patients were recalled at 3, 6, and 9 months for clinical and radiographic follow-up. The data were evaluated using Chi-square test.

Results: Statistical analysis showed no significant difference between the two groups ($P > 0.05$). The overall clinical success of FC was 100%, whereas that of electrocautery was 96% at 3-, 6-, and 9-month follow-up. The overall radiographic success of FC was 100%, 93%, and 93% and that of electrocautery was 97%, 87%, and 77% at 3, 6, and 9 months, respectively. The teeth considered as failures were subjected to further treatment.

Conclusion: There was statistically no significant difference in the pre-operative clinical and radiographic features between the two groups with the $p > .05$ as statistically analysed using chi-square test. Further studies using larger samples and longer evaluation periods are recommended.

KEY WORDS: *Electrocautery, formocresol, primary teeth, pulpotomy*

INTRODUCTION

Preservation of arch space is one of the primary objectives of pediatric dentistry;^[1] hence, every effort is made to preserve the natural primary teeth as they are considered to be the best space maintainers.^[2,3] Pulpotomy is indicated in primary molars when the radicular pulp tissue is healthy or is capable of healing after surgical amputation of the affected or infected coronal pulp.^[4] According to the American Academy of Pediatric Dentistry, pulpotomy is defined as the ablation of infected or affected pulp tissues leaving the residual vital pulp tissues intact, thus preserving vitality and function (totally or partially) of the radicular pulp, while the remaining pulp stump is covered with a medicament.^[5] Various pulpotomy medicaments used in primary dentition are formocresol (FC), glutaraldehyde, ferric sulphate, electrosurgery (ES), laser, freeze-dried bone, bone morphogenetic protein, Portland cement, and sodium hypochlorite, but still, FC has been considered as “gold standard” because it is economical and easily available.^[6,7] It was first introduced by Buckley in 1904.^[6]

ES has been defined as the intentional passage of high-frequency waveforms, or currents, through the tissues of the body to achieve a controllable surgical effect.^[8,9] The use of ES to promote pulpal hemostasis as a nonpharmacological pulpotomy technique has proven to be a merit as it leads to good visualization and hemostasis and is less time-consuming than the FC approach.^[10] Therefore, this study compares the clinical and radiographic success of electrosurgical and FC pulpotomy techniques used on human primary molar teeth requiring vital pulpotomy.

MATERIALS AND METHODS

The samples were selected among children aged 3–8 years of age from the Outpatient Department of Pedodontics and Preventive Dentistry, Himachal Dental College, Sundernagar.

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Care was taken to include those children who were free from any systemic illness and had no history of hospitalization. A certificate of clearance for this study was obtained from the ethical committee of the institution.

Teeth were selected based on the following criteria:

- Teeth with deep carious lesion restorable after completion of pulpotomy
- Irreversible pulpitis where inflammation and infection are limited to coronal pulp
- No night awakening pain, no prolonged pain, no throbbing pain
- Absence of symptoms indicative of advanced pulpal inflammation such as spontaneous pain or history of nocturnal pain
- Hemorrhage should stop within 5 min from amputated pulp stumps using sterile pellet of moist cotton
- No sinus or fistula, no mobility
- No intraoral swelling and extraoral swelling
- No evidence of intraradicular radiolucency (bifurcation or trifurcation area).

The teeth were randomly divided into two groups:

- Group I: Fifteen primary molars were treated with FC
- Group II: Fifteen primary molars were treated with electrosurgery (EC).

CLINICAL PROCEDURE

After proper anesthesia and isolation with rubber dam, proper access cavity was prepared and coronal pulp was amputated using sharp spoon excavator. Sterile cotton pellets were placed to obtain postamputation hemostasis for 5 min. Later, either electrosurgical electrode was placed or 1:5 dilution FC was placed to control the hemorrhage. ES dental electrode was placed 1–2 mm above the tissue with the power set at 40% [Figure 1]. The electrical arc was allowed to bridge the gap to the first pulpal stump for 1 s followed by cooling down period of 10–15 s. Heat was minimized by keeping the electrode as far away from the pulpal stumps and the tooth structure as possible while still allowing the electrical arcing to occur. The procedure was repeated at least three times at each pulpal orifice. After each current application, a new large sterile pellet was placed with pressure on the next pulpal orifice to be electrosurgically treated to absorb any blood or tissue fluid before the next current application. Alternately, FC (Pharmadent remedies Pvt. Limited, Gujarat, India; Composition: Formalin - 20% v/v [B.P.], Cresol - 32% v/v [I.P.], Glycerine - q.s.[I.P.]) dampened cotton pellet was placed against the pulpal stumps for 5 min [Figure 2]. Zinc oxide-eugenol was placed into the coronal chamber [Figure 3] followed by filling the cavity with glass ionomer cement. Final restoration was done with stainless steel crowns using standard techniques [Figure 4]. Subsequently, clinical and radiographic evaluations were done at 3, 6, and 9 months, and findings were noted.

CRITERIA USED DURING FOLLOW-UP TO ASSESS SUCCESS/FAILURE

Criteria for clinical success were

- Absence of pain, abscess, and fistula



Figure 1: Application of electrocautery electrode on pulp stumps



Figure 2: Application of 1:5 dilution of formocresol



Figure 3: Zinc oxide-eugenol was placed on both teeth

- Presence of healthy soft tissue
- Absence of abnormal mobility.

Criteria for radiographic success were

- Presence of normal periodontal ligament space



Figure 4: Restoration of tooth with stainless steel crowns

- Absence of pathological root resorption or canal calcification
- Absence of periradicular radiolucency.

DISCUSSION

Despite modern advances in the prevention of dental caries and increased understanding of the importance of maintaining the natural primary dentition, many teeth are still lost prematurely. This can lead to malocclusion with esthetic, phonetic, and functional problems that may be transient or permanent.^[11,12] Therefore, maintaining the integrity and health of the oral tissues is the primary objective of pulp treatment. Pulp therapy was first described in 1756 by Phillip Pfaff who performed pulp capping by covering the exposed pulp with a small piece of gold in an attempt to promote healing.^[13]

Initially, Buckley introduced FC in 1904 who contended that equal parts of formalin and tricresol would react chemically with the intermediate and end products of pulp inflammation to form a “new, colorless, and noninfective compound of a harmless nature.”^[14] The FC pulpotomy technique currently used is a modification of the original method reported by Sweet in 1930. By 1955, Sweet claimed 97% clinical success in 16,651 cases.^[15] Since then, FC remains the “gold standard” for therapeutic pulpotomy in human primary teeth at a 1:5 dilution. Hence, in the present study, FC was selected as the control group.

SUCCESS AND FAILURE OF ELECTROCAUTERY [TABLE 1 AND TABLE 2]

Postoperative pain was found in two cases at 3- and 6-month follow-up which may be attributed to the inaccurate diagnosis at the time of treatment [Table 1]. It is probable that the radicular pulp must be healthy at the time of treatment for the outcome of electrocautery pulpotomy to be successful since the electrocautery effects do not penetrate and sterilize the contaminated radicular tissue. ES has no antiseptic or fixative properties. Placing a particular base over the remaining pulp stumps had a significant effect on the clinical and radiographic success. Following hemostasis, there is no physical barrier to protect healthy normal radicular pulp from the toxic effect of

Table 1: Clinical evaluation of formocresol and electrocautery pulpotomies at recall

	3 months		6 months		9 months	
	Success	Fail	Success	Fail	Success	Fail
EC	13	2	13	2	13	2
FC	15	0	15	0	15	0
<i>P</i>	0.1		0.5		0.3	

FC: Formocresol, EC: Electrocautery

Table 2: Radiographic evaluation of formocresol and electrocautery pulpotomies at recall

	3 months		6 months		9 months	
	Success	Fail	Success	Fail	Success	Fail
EC	14	1	13	2	10	5
FC	15	0	13	2	13	2
<i>P</i>	0.39		1.0		0.19	

FC: Formocresol, EC: Electrocautery

Table 3: Overall clinical and radiographic success at recall

	Clinical		
	3 months	6 months	9 months
	EC (%)	95.5	95.5
FC (%)	100	100	100
	Radiographic		
	3 months	6 months	9 months
	EC (%)	96.6	86.7
FC (%)	100	93.3	93.3

FC: Formocresol, EC: Electrocautery

subbase. Electrocautery process cannot eliminate inflammation of the radicular pulp; thus, the success of the electrocautery pulpotomy depends on the initial pulp status which renders electrocautery technique more diagnosis sensitive.

Postoperative internal resorption was found in 5 cases at 3, 6, and 9 months leading to loss of supporting bone which causes exfoliation/extraction of the affected tooth [Table 2]. The reasons for internal resorption are lateral heat production which causes coagulation necrosis on the cell layers adjacent to all incision sites and to the fact that roots of primary teeth are undergoing normal physiologic resorption.^[15] This leads to increased vascularity in apical region which may predispose the tooth to internal resorption when an irritant in the form of a pulp capping material is placed on pulp.^[16] The tooth was kept in place till the signs and symptoms of morbidity and exfoliation occurred. The reason for this may also be attributed to study done by Magnusson^[17,18] that best demonstrated the resultant inflammation and internal resorption as eugenol possesses destructive properties.^[19,20] In an effort to overcome the internal resorption seen in zinc oxide-eugenol pulpotomies, a dressing containing a corticosteroid was evaluated clinically.^[17,18]

Postoperative furcal radiolucency was seen in 2 patients at 6 and 9 months, the involved tooth was extracted, and a space maintainer was given to prevent the space loss [Table 2].

These results were in accordance with the study conducted by Bahrololoomi *et al.* (2008)^[10] who observed these changes in three teeth at 9-month follow-up.

SUCCESS AND FAILURE OF FORMOCRESOL PULPOTOMY [TABLE 1 AND TABLE 2]

No postoperative pain, abscess, fistula, and furcal radiolucency were seen in the present study [Table 1]. Our results were contradictory with the study conducted by El Meligy and Mahmoud^[21] which showed cases with pain and tenderness to percussion on 6-month follow-up. And also, a similar study was done by Farrokh Gisoure^[22] who showed three cases having pain. The difference in the results was attributed to the difference in applied techniques. Moreover, coagulation necrosis on the cell layers adjacent to all incision sites and the roots of primary teeth are undergoing normal physiologic resorption.^[15] This leads to increased vascularity in apical region which may predispose the tooth to internal resorption when an irritant in the form of a pulp capping material is placed on pulp.^[18]

OVERALL SUCCESS RATE FOR FORMOCRESOL AND ELECTROCAUTERY GROUP AT 3-, 6-, AND 9-MONTH FOLLOW-UP [TABLE 3]

The clinical success rate was 100% in FC group and 87% in electrocautery group. Treatment was considered to be radiographically successful in case there was no reported internal resorption or furcal radiolucencies. Radiographically, there was less failure in FC group (6%) than ES group (13%) [Table 3].

The overall success rate clinically and radiographically was found to be insignificant ($P > 0.05$) in both the groups.

Clinical success of ES in our study was attributed to its limited pulpal penetration which is only few cell layer deep, thus it aids in hemostasis and good visualization without chemical coagulation. Although the electrosurgical group had more negative signs, there was no significant difference between the two groups. However, the electrosurgical procedure has two distinct advantages: it can be performed more quickly and there are no drugs involved that may produce undesirable systemic effect.

Overall success of our study after 9-month observation time was found; the clinical and radiographic success rate for the electrosurgical groups were 96% and 86%, respectively, and for FC group, 100% and 96%, respectively [Table 3]. The results of our study were similar to the studies done by Dean *et al.*^[23] who reported clinical and radiographic success of electrosurgical groups to be 96% and 84%, respectively, and for FC group, 100 and 92%, respectively. Other similar studies were also done by Bahrololoomi *et al.* (2008)^[8] and El Meligy and Mahmoud.^[21]

Success and failure of pulpotomy depend on accurate diagnosis; however, FC has proven to be more forgivable technique that helps to retain primary teeth even with chronic and silent inflammation. On the other hand, pulpotomy with ES requires more severe diagnosis so it is rendered diagnosis sensitive.

CONCLUSION

There was statistically no significant difference in the preoperative clinical and radiographic features between the two groups with $P > 0.05$ as statistically analyzed using Chi-square test. The overall clinical success of FC was 100% whereas that of electrocautery was 96% at 3-, 6-, and 9-month follow-up. The overall radiographic success of FC was 100%, 93%, and 93% and that of electrocautery was 97%, 87%, and 77% at 3, 6, and 9 months, respectively. The teeth considered as failures were subjected to further treatment. Further studies using larger samples and longer evaluation periods are recommended.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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