

EFFICACY OF MYRISTICA FRAGRANS AS A PULPOTOMY AGENT IN PRIMARY TEETH: CLINICAL AND RADIOGRAPHIC STUDIES

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Abstract

Aim: The present study was conducted to compare the effects of Myristica fragrans as pulp-dressing agents clinically and radiographically in primary molar teeth. **Materials and Methods:** Thirty healthy children aged from four to eight years, they were selected from patients attending outpatient clinic of Pediatric Dentistry department. Each child had at least bilateral deep carious lower primary molar indicated for pulpotomy. Pulpotomy was done in both groups; where group I treated by Myristica fragrans as a dressing agent while formocresol used as a dressing agent in group II. The study cases were recalled after three, six, nine and twelve months for clinical and radiographic evaluation. **Results:** The overall clinical success rate of Myristica fragrans group was 96.6 %, while formocresol group was 93.3%. The two groups were clinically successful with no statistically significant difference between them. The radiographic success rate of Myristica fragrans group was 93.2%, while for formocresol group was 89.6%. There was no statistically significant difference between the two groups. **Conclusion:** The Myristica fragrans showed higher clinical and radiographic success rate compared to formocresol as a pulpotomy agent in primary molars teeth. It can be considered as a satisfactory biomaterial for vital pulp therapy of deep caries in primary teeth.

Keywords: Myristica fragrans; Nut Meg Formocresol; Primary teeth; Pulpotomy.

INTRODUCTION

Maintaining primary teeth has longstanding effects on oral health, as it can influence the development of permanent teeth and jaw structure.^[1] Pulpotomy is one of the most widely accepted clinical procedures for treating deep caries in primary teeth. Pulpotomy is the amputation of infected coronal pulp to maintain the vitality and function of radicular pulp.^[2] Pulpotomy can be performed using different technique. Formocresol (FC) is regarded as the gold standard and has been the most widely used medicament universally due to its ease in use, bacteriostatic, fixative properties and high clinical success rates up to 97%^[3]; but there are concerns about its safety so, the modern medicine shifted toward herbal agents because they are natural, economical and less side effects. The use of biocompatible materials has become a major interest in modern dentistry. Phytotherapeutic substances have been tried in various aspects of dentistry. Myristica fragrans MF (nutmeg) has wide spectrum of beneficial pharmacological effects. Nutmeg extract has shown hepatoprotective, antioxidant, memory enhancing, anticancer, aphrodisiac, antidiabetic, antidepressant, hypolipidemic, hypocholesterolemia effects and anticarcinogenic activities. Also, it has excellent antibacterial, anti-inflammatory, analgesic and osteoblastic activity. ^[4, 5]

The essential oil of Nutmeg contains limonene, β -pinene, α -pinene, and sabinene which are known as 5-lipoxygenase inhibitors. Limonene is also a COX-2 selective inhibitor that has significant inhibitory effects on Prostaglandin E2 production. Terpene- suppresses the production of interleukin 1 beta and Tumor necrosis factor- α .^[6,7,8] The ideal capping material should be bactericidal, harmless to cells and surrounding structures promote healing of the pulp tissue and not interfere with the physiologic root resorption. Some natural products have amazing healing properties as *Myristica fragrans* (nutmeg) with a variety of beneficial biological properties ^[9, 10].

Nutmeg has anti-inflammatory, antioxidant properties and has a strong antibacterial effect against oral microorganisms such as *Streptococcus* species, *Lactobacillus* species, *Actinomyces viscosus*, *Porphyromonas gingivalis* and *Staphylococcus aureus*^[11]. Therefore this study aims to evaluate and compare clinical and radiographic efficacy of *Myristica fragrans* (Nutmeg) and formocresol when used as pulpotomy agents in primary molars.

MATERIALS AND METHODS

This study was conducted as a split mouth randomized clinical trial. This study was carried out on thirty healthy children aged from four to eight years, they were selected from patients attending outpatient clinic of Pediatric dentistry department, Faculty of Dentistry, Tanta University. Each child had at least bilateral deep carious lower primary molars (D&E) indicated for pulpotomy (figure 1). Preparation of nutmeg Extract was done at Pharmacognosy Department, Faculty of Pharmacy, Tanta University. Approval for this research was obtained from Faculty of Dentistry, Tanta University Research Ethics Committee. The purpose of the present study was explained to the patients and informed consents were obtained according to the guidelines on human research adopted by the Research Ethics Committee Faculty of Dentistry, Tanta University. (Ethical code # R-PED-7-22-1)

Sample size calculation

The sample size and power analysis were calculated using Epi-info software statistical package created by World Health Organization and center for disease control and prevention, Atlanta, Georgia, USA version 2002. The criteria used for sample size calculation was that study design was a randomized clinical trial , 95% confidence limit and 80% power of the study. Sample size based on previously mentioned criteria was found that $n > 28$ in each group but the sample size was increased to 30 to compensate for drop out of patient.

Inclusion criteria^[10]

a) Clinical criteria: (1) Healthy cooperative children free from any medical condition such as heart or leukemia that contraindicate pulp therapy. (2) No evidence of clinical signs and symptoms of pulp degeneration such as spontaneous throbbing pain, pain on percussion, tooth mobility, soft tissue swelling, fistula or sinus tract. (3) Absence of pulp hyperemia. (4) Restorable teeth.

b) Radiographic criteria: (1) No pathological external or internal root resorption. (2) Absence of calcific pulp degeneration. (3) Absence of furcation radiolucency.

Preparation of nutmeg Extract:

Seeds of nutmeg (300 g) were commercially purchased (entire form) and grounded into fine powder. The powder was then subjected to extraction with absolute ethanol as solvent, using maceration technique with absolute ethanol for 3 days at room temperature. The extraction was repeated for 3 times till the complete exhaustion of sample material. Evaporation of the solvent was carried out at 40 ° till dryness using the rotary evaporator under reduced pressure. The produced oily liquid was weighed (54.46 g), and then percentage yield was calculated as dividing the initial weight of raw material with the final weight of extracts (yield 18.2%). Figure 2

Clinical procedure

Pre-operative Periapical radiographs were obtained to assess the tooth condition and to ensure proper case selection using size 1 radiographic films using Extension Cone Parallel technique (XCP). The sixty selected primary molars out of thirty children were randomly divided into two groups of thirty teeth for each, according to the material used, Group I (Study group): Treated with *Myristica fragrans* (nutmeg) and Group II (control group): Treated with formocresol.

The procedure started with profound local anesthesia and rubber dam isolation, then caries was removed and conventional pulpotomy technique was performed. The roof of the pulp chamber was removed and the coronal tissue was then amputated by sharp spoon excavator followed by irrigation with normal saline. Initial pulpal homeostasis was obtained using moistened cotton pellet gently pressed against the amputated pulp stump. In group I *Myristica fragrans* was mixed with barium sulphate as radiopaque material then the cavity was sealed with reinforced zinc oxide eugenol. At the same visit, the tooth was restored with stainless-steel crown cemented with glass ionomer cement as a final restoration. In Group II, a small sterile cotton pellet moistened with Buckley's formocresol was placed over the pulp stumps for 1 minutes, then the pellet was removed and the cavity was sealed with reinforced zinc oxide eugenol. At the same visit, the tooth was restored with stainless-steel crown (Figure3).



Figure 1: A photograph showing bilateral carious mandibular first primary molars

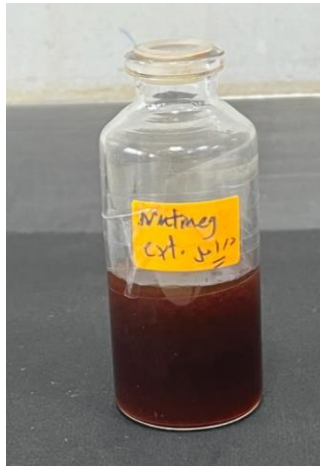


Figure 2: A photograph showing nut meg extract



Figure 3: Clinical procedure using *Myristica fragrans* A) Photograph shows the preoperative bilateral carious mandibular first molar. (B) Access opening of mandibular left first molar after removal of pulp tissue. (C) Applying of *Myristica fragrans* in the pulp chamber. (D) Stainless-steel crown in place at the same visit

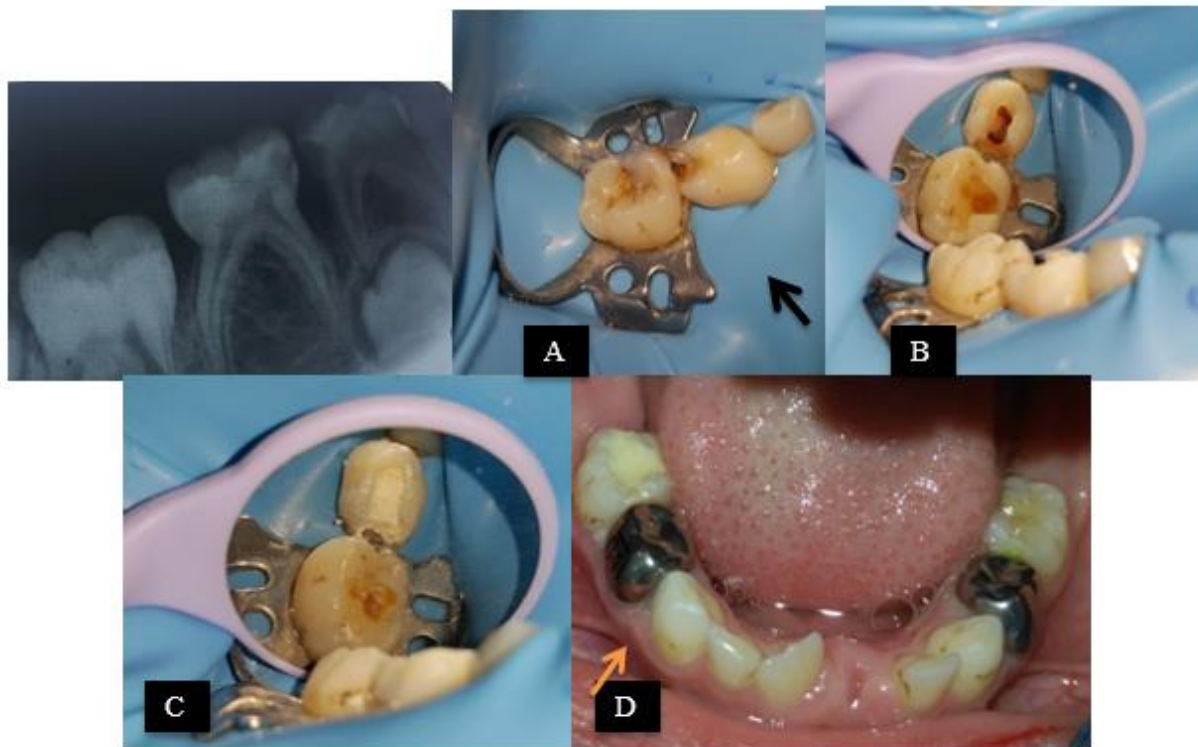


Figure 4: Clinical procedure using FC. (A) Preoperative photograph shows carious mandibular right second molar. (B) Access opening of mandibular first molar after removal of pulp tissue. (C) Application of cotton pellet moistened with Buckley's formocresol then the reinforced zinc oxide eugenol. (D)Stainless-steel crowns in place at the same visit

RESULTS

A total 60 vital mandibular primary molars from 30 children in the age of 4 to 8 years were treated in two groups; *Myristica fragrans* and formecresol. All teeth were clinically and radiographically checked at 3, 6, 9, 12 months.

At the end of the study at 12-month follow-up, the overall clinical success rate of *Myristica fragrans* group was 96.6 %, while FC group was 93.2%. The two groups were clinically successful with no statistically significant difference between them. (Table 1).

In the *Myristica fragrans* group, during the follow up periods all cases showed no sign of pain, gingival swelling or mobility, except at twelve-month one case came with gingival swelling which was treated by pulpectomy. While, for the formocresol group, one case represented with pain at 6 months and gingival swelling appeared at 9 months and another one case at twelve months. There was no statistically significant difference between the two groups as shown in (Table 2). Regarding radiographic results, the overall radiographic success rate of *Myristica fragrans* group was 93.2%, while formocresol

group was 89.6%. There was no statistically significant difference between the two groups (Table 1).

In *Myristica fragrans* group the treated teeth revealed no evidence of radiographic changes at 3, 6 and 9 month follow-up. But one tooth showed furcation radiolucency at 12 month. In formocresol group, the treated teeth showed no evidence of radiographic changes at 3 and 6 month follow-up. While two teeth showed furcation radiolucency and abnormal root resorption at 9, 12 month, there was no statically significant difference between the two groups at different follow up period as shown in (Table 3).

Table 1: Overall clinical and radiographic success rate after 1 year

after 12-month N=29				
	Clinical		radiographic	
	MF	FC	MF	FC
Success	96.60%	93.20%	93.20%	89.60%
Failure	3.40%	6.80%	6.80%	10.40%
X²	0.754		1.63	
P Value	0.385		0.284	

X²:Chi square test, P.value: Probability value

Table 2: Comparison of 2 groups at different follow up period regarding clinical criteria

N= 29

Failure criteria	3 months		6 months		9 months		12 month	
	MF	FC	MF	FC	MF.	FC	MF	FC
Pain	0 %	0 %	0 %	3.3 %	0 %	3.3%	0 %	6.6%
Gingival Swelling	0 %	0 %	0 %	0 %	0 %	3.3% ^s	3.3%	6.6%
Mobility	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
χ^2	-		1.44		1.25		1.46	
P value	-		0.24		0.34		0.53	

MF: *Myristica fragrans*; FC: Formocresol; S: Same patient presented with different symptoms; X² Chi square test

Table 3: Comparison of 2 groups at different follow up periods regarding radiographic criteria

N= 29

Follow-up periods								
Failure criteria	3 months		6 months		9 months		12 month	
	MF	FC	MF	FC	MF	FC	MF	FC
Furcation radiolucency	0 %	0 %	0 %	0 %	0 %	6.6%	3.3 %	6.6%
Periapical radiolucency	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Abnormal root resorption	0 %	0 %	0 %	0 %	0 %	6.6%	0 %	6.6%
Periodontal ligament defects	0 %	0 %	0 %	0 %	0 %	6.6% ^s	3.3 % ^s	6.6% ^s
χ^2	-		-		1.74		1.46	
P	-		-		0.46		0.53	

P: p value; X²: Chi square test; s: same patient with different symptoms

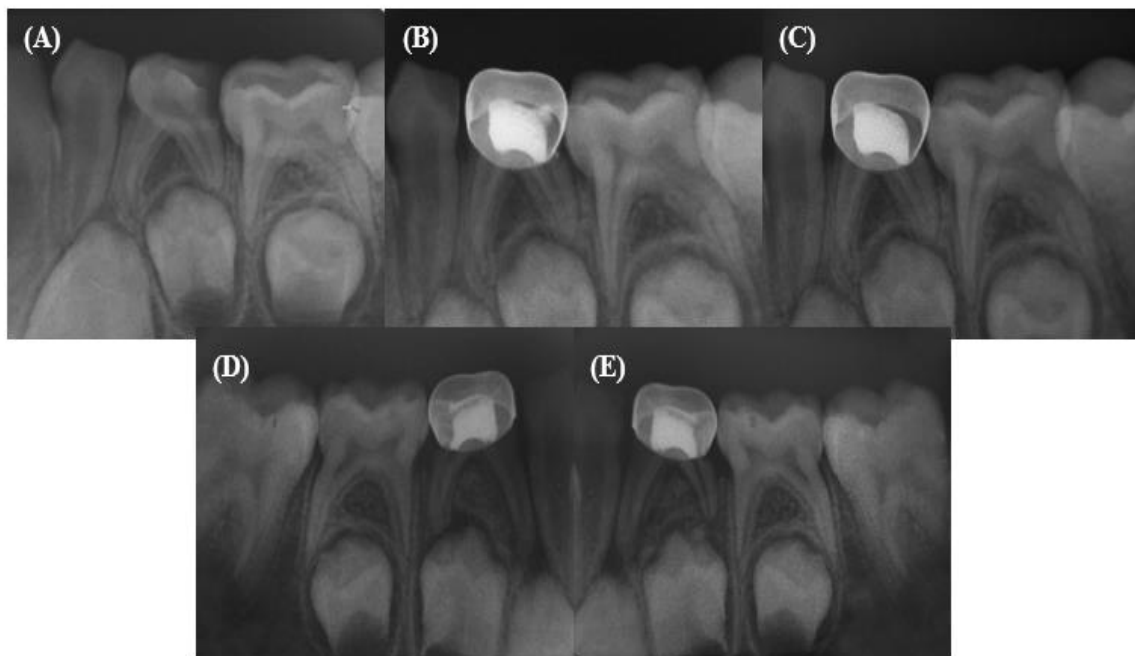


Figure 5. Periapical radiograph of mandibular first primary molar treated with M.fragrans: (A) Preoperative. (B) 3months postoperative. (C) 6 months postoperative. (D) 9 months postoperative. (E) 12 months postoperative

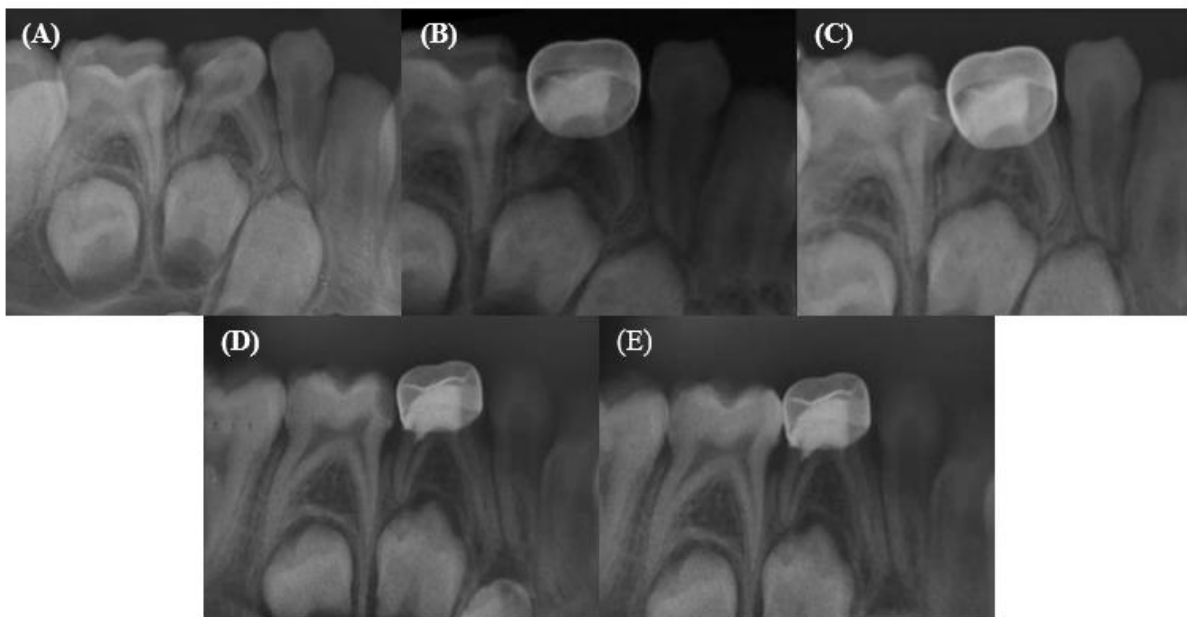


Figure 6 Periapical radiograph of mandibular first primary molar treated with formocresol: (A) Preoperative. (B) 3months postoperative. (C) 6 months postoperative. (D) 9 months postoperative. (E) 12 months postoperative

DISCUSSION

Pulpotomy has long been the most indicated vital pulp procedure in primary molars with extensive caries. Vital pulp therapy aims to preserve pulpal tissue and promoting dentin bridge formation. Pulpotomy is highly technique sensitive and it depends upon many factors, such as diagnosis, caries excavation method, materials used and the final restoration. [12, 13].

Ideal pulpotomy material properties should preserve healthy radicular pulp tissue, be highly biocompatible, prevent bacterial micro leakage, promote healing ability and should not interfere with the physiological root resorption process [14]. Formocresol is still considered the most popular devitalizing material, however, the evidence-based scientific literature has already demonstrated its potential cytotoxicity and carcinogenicity effect, so alternative materials may be used like *Myristica fragrans* [8]. The antimicrobial, anti-inflammatory, analgesic and osteoblastic activity may be beneficial for the healing of pulp which has shown success in this study. [15] Recently phytotherapeutic drugs have been used in dentistry for various treatment modalities. *M. fragrans* (nutmeg) has widely beneficial pharmacological activities.[16] So, this study was conducted to assess the efficacy of *Myristica fragrans* as a pulpotomy agent in primary teeth

The present study is the randomized clinical trial on vital pulpotomy on primary molar teeth. The standardization was achieved by randomly distributing the teeth among the treatment groups based on spin of the coin and each patient received pulpotomy with the two different medicaments. The split-mouth design was preferred so that the desired effects of *Myristica fragrans* can be compared clinically and radiographically with formocresol on the same patient to perform the treatment of both groups under the same environmental factors for accurate comparable results. The age group selected for this study was from four to eight years to preserve the primary molars till the time of exfoliation, as premature loss of primary molars is one of the factors that are responsible for space loss and malocclusion [14].

In the present study, the overall clinical success rate of *Myristica fragrans* after one year was 96.6%. This result coincides with Setty J. et al [17], they reported 100% success rate of *Myristica fragrans*. Also, the results coincide with Mali S. et al[18], they found after 12 months follow up, there was no significant difference in efficacy of the pulpotomy medicaments, Nutmeg and Formocresol. [18] These results may be contributed to anti-inflammatory function [19], osteoblast proliferation stimulation activity [20] and analgesic activity of *Myristica fragrans* [21] Regarding radiographic success rate of *Myristica fragrans* was 93.2%, this results in accordance with Setty J. et al [17] and Mali S. et al [18], they reported high radiographic success rates throughout the follow-up period also, Jyothsna et al[1]. They reported that 100 % clinical and radiographic success rates when *Myristica fragrans* was mixed with zinc oxide eugenol in a root canal filling material of primary teeth.

Regarding FC evaluation in the present study, the clinical success rate was 93.2%. These findings agreed with gonna et al ,[14] Eidelman et al [22], Yildirim et al [23] and Noorollahian[24]. While radiographic findings in FC group were 89.6%. These findings agreed with the

results obtained by sharaf et al^[25], Huth et al^[26] and gonna et al^[14]. The difference in the clinical and radiographical success rates may be attributed to the chronic inflammation of the pulp may be present without periapical or interradicular changes and the tooth may be clinically and radiographically normal.^[27] Furcation radiolucency and abnormal root resorption were observed as common radiographic findings in formocresol group in the current study. These findings may be attributed to the possibility of penetration of formaldehyde through the pulpal floor with subsequent damage to the interradicular area.^[13, 28] In the *Myristica fragrans* group, only one case presented with gingival swelling, this may be related to traumatic cutting during pulpotomy procedure.

CONCLUSIONS

Herbal material has a promising role in dentistry. *Myristica fragrans* being a natural product, it is very economical and affordable, so it can be considered as an effective alternative medicament in pulp therapies. Quite promising clinical and radiographic results of *Myristica fragrans* in the present study shows their potential to be an ideal pulpotomy agent. It is possible to conclude that *Myristica fragrans* showed high clinical and radiographic success rate compared to formocresol as a pulpotomy agent, so, it can be considered as an acceptable biomaterial for vital pulp therapy of deep caries in primary teeth.

Conflict-of-interest statement: The authors declare that there is no conflict of interest regarding the publication of this paper.

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