

Original Article

The clinical and radiographic evaluation of *Allium sativum* oil (garlic oil) in comparison with mineral trioxide aggregate in primary molar pulpotomy

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ABSTRACT

Background: Mineral trioxide aggregate (MTA) is known as a common biomaterial for pulpotomy of primary molars, with limitation including high cost, difficult handling, and long setting time. This study was conducted to compare the clinical and radiographic success rate of *Allium sativum* oil and MTA in pulpotomy of primary molar teeth.

Materials and Methods: This randomized, controlled, clinical trial was performed on a group of children with at least two symptom-free primary molars requiring pulpotomy. A total of 90 teeth were randomly assigned into two groups: After pulp amputation and hemostasis, Group I received MTA as medication in the pulp chamber and Group II received *Allium sativum* oil over the pulp stumps. Pulp chamber was then filled with reinforced ZOE paste (zinc oxide eugenol) and teeth were restored using stainless steel crowns. The follow-up scheme of 6, 12, and 18 months was set, and teeth evaluation was conducted by a calibrated pediatric dentist based on the modified criteria proposed by Zurn and Seale. The results were analyzed using the generalized estimating equation analysis with the $P = 0.05$ as the level of significance.

Results: The clinical success rate was 100% in both groups after all follow-ups. The radiographic success rate was, however, 91.1% after 6, 75.6% after 12 and 18 months in Group II while it was 95.6% after 6, 91.1% after 12 and 18 months in Group I in those follow-up points. The difference between the two groups was not statistically significant.

Conclusion: According to the results, *Allium sativum* oil has a high clinical and radiographic success rate comparable to those of MTA.

Key Words: *Allium sativum*, mineral trioxide aggregate, molar, primary teeth, pulpotomy

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INTRODUCTION

As many patients are referred to dental offices for toothache routinely, it is highly important to have reliable safe systems to treat pain while maintaining the tooth. Usually, pulp is involved to different degrees

when pain is experienced from a decayed tooth. Pulpotomy is indicated following pulp exposures by extensive caries in a symptomatic or symptom-free primary tooth.^[1] Treatment success depends on the

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extent of the pulpal damage and healing ability of the radicular pulp after the amputation of the infected coronal part.^[1] For many years, pulpotomy has been conducted and researched through variant materials and procedures.^[2-7] An ideal bactericide agent is expected for pulp treatment to stimulate the repair of the remaining intact pulp and preventing root resorption.^[8]

Formocresol had been widely employed for pulpotomy of the primary teeth for decades.^[9] However, its local and systemic side effects such as cytotoxicity, mutagenicity, and carcinogenicity have limited its use as a common substance in some parts of the world.^[10] Mineral trioxide aggregate (MTA) is from Calcium Silicate family with a hydrophilic powder introduced by Torabinejad in 1993. Its composition includes tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide, and bismuth oxide.^[11] It is a biocompatible material proposed for vital pulp therapy, repair of perforations, and root-end fillings. However, it has limitations including its high cost as well as technique sensitivity and long-setting time.^[12] These limitations make it even worse when it is used in those uncooperative children. More recently, the use of natural products has captured the attention of the clinicians more significantly.^[13-17]

Among the natural products are garlic, *Allium sativum*, from liliaceous family, which has been widely used in herbal medicine.^[18] Garlic has been proved to have anti-microbial and antioxidant effects,^[19-21] while regulating the immune system^[22] and contributes to the wound healing process.^[23] This characteristic is mainly because of Allicin and Thiosulfonates components. Garlic has been tested successfully as potential effective medication to reduce the rate of Gram-positive and Gram-negative bacteria.^[19,20] Application of garlic in dentistry includes the use of garlic solution as a root canal detergent^[24] and as mouthwash.^[19,20] In an earlier study, garlic oil had been shown to have clinical and radiographic success rate of 90% in the pulpotomy of human primary teeth.^[10] In another histologic study, garlic had shown higher success rate in pulpotomy of primary teeth when compared to that of formocresol.^[25]

This investigation is aimed to further evaluate the clinical and radiographic effect of MTA and garlic extract on pulp treatment of primary molar teeth in children.

MATERIALS AND METHODS

This randomized, split-mouth, double-blind, controlled clinical trial was performed on a group of child patients referred to the Department of Pediatric and Preventive Dentistry at Shahed University during 2018. Consort guideline was adhered to with all criteria and steps being followed. The sample size of 90 teeth was determined as minimum required based on earlier similar studies.^[26] Attempts were made to include the total of 45 patients aged 3–8 years who had pairs of primary molars needing pulp treatment. Consent forms were obtained from the parents before the start of the study. The study protocol was approved by the Ethics Committee of Shahed University. (IR. Shahed. REC.1396.87) and clinical trial registration was carried out on Iranian registry of clinical trials (IRCT20190313043046N1). The selection criteria to include children: No systemic disease, having at least two decayed contralateral primary molars, with no clinical symptoms such as soft-tissue swelling, fistula, mobility, and tenderness. Radiographic symptoms include the absence of internal and external pathologic resorption, periapical radiolucency or calcific degeneration of the pulp, or physiological resorption of more than one-third of the root. The exclusion criteria included children with clinical symptoms (such as spontaneous pain, soft-tissue swelling, fistula, mobility, and tenderness), radiographic symptoms (such as internal or external pathologic resorption, periapical radiolucency, or calcific degeneration of the pulp), or physiologic resorption of more than one-third of the root along with those with poor cooperation.

Selected teeth were randomly allocated into one of the two groups receiving different medicaments. Randomization on group allocation was performed using the coin toss technique. Periapical radiographs were performed using F-speed film before the procedure using the bisecting angle technique. Treatment was then delivered by a pediatric dentistry resident. After the local anesthetic application (Lidocaine 2% epinephrine 1/100,000 Darou Pakhsh, Tehran, Iran), caries were removed using a round carbide bur (Size: 05, Teeskavan, Iran) before exposing the pulp. A sterile, high-speed, round bur (No. 330) (Teeskavan, Iran) was used with water spray to remove the roof of the chamber and open the coronal access to the pulp. Isolation was obtained using cotton rolls along with a high velocity suction,

while the coronal pulp was removed using a sharp spoon excavator. Pulpal space was then irrigated with copious saline followed by the placement of moistened cotton pellets with sterile distilled water over the pulp stumps, for 5 min to achieve haemostasis.

At this stage, teeth in Group I received MTA (Angelus, Londrina, PR, Brazil) prepared according to manufacturer's instructions and covered lightly with a moistened sterile cotton pellet for 15 min to ensure a thickness of 2–3 mm. Teeth in Group II received a cotton pellet damped with *Allium sativum* oil (Noshad company registration number IRC1228208638) (containing diallyl mono-sulfide, diallyl disulfide (DADS), diallyl tri-sulfide, and diallyl tetra-sulfide) for 1 min and then removed. Access cavity was then sealed in both groups with a thick mixture of reinforced ZOE cement base (Zonalin Kemdent, UK). Teeth were then restored using Stainless Steel Crown (3M ESPE, St. Paul, MN, USA). Cementation was performed using a glass ionomer (GC1 LUTING CEMENT, Japan). Evaluation of the pulpal status was conducted by an assigned calibrated pediatric dentist who was unaware of the group of treatment when judging on a tooth pulpal status. This was to keep the evaluator blind to the groups for removing any bios. Treated teeth had an immediate clinical and radiographic assessment followed by the same in 6, 12, and 18 months. These assessments were performed based on the criteria proposed by Zurn and Seale^[27] [Table 1].

Data were analyzed using the Wilcoxon signed-rank test and generalized estimating equation (GEE).

RESULTS

In total, 90 primary molars in 45 children (16 boys and 29 girls) were treated in this trial. The mean (\pm standard deviation) age at the time of treatment was 5.91 ± 1.63 years.

The sign or symptoms of failure were not clinically observed at the 6, 12, and 18 months follow-up. (100% clinical success rate for both groups).

The radiographic success rate in the *Allium sativum* group was at 91.1% after 6 and 75.6% after 12 and 18 months. While these figures were at 95.6% after 6, 91.1% after 12 and 18 months follow-ups in the MTA group. There were no significant differences between the two groups using the Wilcoxon signed-rank test ($P > 0.05$) [Table 2].

Based on the results of GEE analysis for effects of material and time interval on radiographic success rate at 6, 12, and 18 months, there were no statistically significant differences between materials used at the three time intervals of 6-, 12- ($P = 0.002$), and 18-month follow-ups ($P = 0.001$).

DISCUSSION

Among several ways for vital pulp therapies, the traditional so called deep pulpotomy is acknowledged as the most convenient, reliable yet successful treatment choices to preserve primary molars with pulp involvement due to caries. Many different materials used have been proved effective among which MTA has the ability to maintain pulp vitality with highest effectiveness reported in the literature.^[28] Although MTA has high clinical, radiographic, and histologic success rates, its high cost technique sensitivity and long-setting time are among its remarkable constraints. Handling and time-taken for preparation makes its routine use more complicated, especially in young unco-operative less tolerant children.^[12]

Based on the outcome of this investigation, high clinical success rate of both garlic and MTA (100%) is promising after 18 months follow-up. Although radiographic success rate was found to be slightly higher in the MTA control group after the 18 months control, the difference was not significant ($P < 0.05$).

Garlic oil extract seems be a potential natural alternative to the currently used pulp medications including MTA. Earlier investigations have revealed several pharmacological properties of garlic, including anticoagulant, anti-inflammatory, analgesic, antioxidant, antimicrobial, and wound-healing.^[29] The effect of garlic on dental pulp and its pathologic causative agents is mainly due to its active components as anti-microbial, antifungal, and antiviral properties.^[30,31] The most important determinant in pulp recovery is by providing a germ-free environment.^[32,33] Garlic is effective on a wide range of Gram-positive and Gram-negative bacteria. Components including diallyl mono-sulfide, diallyl disulfide (DADS), diallyl tri-sulfide, and diallyl tetra-sulfide are responsible for the antimicrobial and anti-fungal properties of garlic.^[34]

The suitable substance for pulpotomy should be bactericidal. Garlic extract has recently been reported to have strong antibacterial effects on major bacteria

Table 1: Clinical and radiographic scoring criteria

Clinical score	Clinical symptom	Definition
1	Asymptomatic	Pathology: Absent Normal functioning Mobility (physiological) ≤ 1 mm
2	Slight discomfort, short-lived	Pathology: Questionable Percussion sensitivity Gingival inflammation (due to poor oral hygiene) Mobility (physiological) >1 mm, but <2 mm
3	Minor discomfort, short-lived	Pathology: Initial changes present Gingival swelling (not due to poor oral hygiene) Mobility >2 mm, but <3 mm
4	Major discomfort, long-lived extract immediately	Pathology: Late changes present Spontaneous pain Gingival swelling (not due to poor oral hygiene) Periodontal pocket formation (exudate) Sinus tract present Mobility ≥ 3 mm Premature tooth loss, due to pathology

Radiographic score	Radiographic finding	Definition
1	No changes present at 6 months follow-up	Internal root canal form tapering from chamber to the apex PDL/periapical regions; normal width and trabeculation
2	Pathological changes of questionable clinical significance at 3 months follow-up	External changes are not allowed (widened PDL) widening, abnormal Inter-radicular trabeculation or variation in radiodensity Internal resorption acceptable (not perforated) Calcific metamorphosis is acceptable and defined as: Uniformly thin Root canal; shape (nontapering); variation in radiodensity from canal to canal (one cloudier than the other)
3	Pathological changes present at 1-month follow-up	External changes are present, but not large Mildly widened PDL Minor inter-radicular radiolucency with trabeculation still present Minor external root resorption; internal resorption changes are acceptable, but not if external change is also present (perforated form)
4	Pathological changes present extract immediately	Frank osseous radiolucency present

PDL: Periodontal ligament

Table 2: Radiographic score and frequency rate in mineral trioxide aggregate and others (zurn and seale scoring criteria)

Follow up episode/ Medication used	Radiographic score (%)				Total
	1	2	3	4	
6 th month					
MTA	43 (95.6)	2 (4.4)	0	0	45
ALL	41 (91.1)	4 (8.9)	0	0	45
12 th month					
MTA	41 (91.1)	3 (6.7)	1 (2.2)	0	45
ALL	34 (75.6)	9 (20)	2 (4.4)	0	45
18 th month					
MTA	41 (91.1)	1 (2.2)	3 (6.7)	0	45
ALL	34 (75.6)	4 (8.9)	7 (15.6)	0	45

MTA: Mineral trioxide aggregate; ALL: Allium Sativum

responsible for dental caries including *Streptococcus mutans*.^[35] In addition, human studies have shown, dimethyl sulfone, phenols, and flavonoids are associated with an induced wound healing,^[36] which can help preserve the intact radicular pulp following the removal of irreversibly damaged coronal

pulp.^[29] Garlic extract has strong anti-oxidant and anti-inflammatory effects. Antioxidant potential of garlic is due to its high polyphenol and flavonoid content, essential for the synthesis of collagen, angiogenesis, and the inhibition of inflammation.^[23]

According to a series of immunologic studies, garlic has the potential to inhibit the production of inflammatory cytokines and T-Helper 1 cells.^[37] As an antioxidant, garlic protects the endothelial cells of the blood vessels from the oxidative stress induced by H₂O₂, which results in a continuous angiogenesis that is necessary for wound healing.^[38] As an immune regulator and an anti-inflammatory effector, garlic has components such as allicin and ajoene, which could inhibit the synthesis of nitric oxide in macrophages. Nitric oxide is a pro-inflammatory mediator produced by macrophages. It inhibits the inflammatory cytokines and prostaglandins by suppressing cyclooxygenase and 5-Lipoxygenase enzymes.^[10] There have been reports on the use of more healing inducible materials'

use recently put forward in a systematic review by Parisay *et al.* who believe preservation of the healthy pulp tissue in deciduous teeth could be a priority in vital pulp therapy by induction of the reparative dentin formation using various recently introduced more biocompatible products.^[39]

Few studies have been conducted on the effect of garlic on dental pulp to date. Formocresol has been used as control group in many earlier pulpotomy-related investigations as the gold standard medicament^[40] while its use is no longer advocated and the use of MTA is recommended by many policy-makers including the American Academy of Pediatric Dentistry. In this respect, the effect of formocresol and garlic oil has been investigated as the pulpotomy medication in primary teeth^[10] and resulted in no significant differences with similar success rates. In another study, Mohammad stated that *Allium sativum* has the potentials to act as a new reliable material for nonvital pulpotomy of the primary teeth too as it had shown higher success rates with *allium sativum*.^[25]

Kahvand *et al.* evaluated clinical and radiographic success of *Allium sativum* oil compared in comparison to that of formocresol and exhibited that *allium sativum* is a potentially safe and effective material in primary molar pulpotomy procedure.^[40] This present study successfully illustrated the clinical and radiographic acceptability of garlic oil and MTA in a rather comparable rate. Future studies, however, are recommended to compare the success rate of pulpotomy with garlic oil vs MTA using histological assessments. The success rate of pulpotomy with garlic oil is also suggested to be examined over a 24–36 month follow-up periods. As a limitation of this investigation was the availability and cooperation of participants fit for study and throughout the full phase of the study.

CONCLUSION

The findings of this investigation suggest that *Allium sativum* extract from garlic has the potential to be used as a medicament in vital pulpotomy of primary teeth. The success rate of *Allium sativum* was as high as that of MTA. MTA remains to have its limitations and formocresol with its side effects.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

REFERENCES

- Haghgoo R, Abbasi F. A histopathological comparison of pulpotomy with sodium hypochlorite and formocresol. *Iran Endod J* 2012;7:60-2.
- Ansari G, Ranjpour M. Mineral trioxide aggregate and formocresol pulpotomy of primary teeth: A 2-year follow-up. *Int Endod J* 2010;43:413-8.
- Asgary S, Ahmadyar M. Vital pulp therapy using calcium-enriched mixture: An evidence-based review. *J Conserv Dent* 2013;16:92-8.
- Haghgoo R, Abbasi F. Clinical and radiographic success of pulpotomy with MTA in primary molars: 30 months follow up. *Iran Endod J* 2010;5:157-60.
- Oliadarani FK, Haghgoo R, Mashhadiabbas F, Kahvand M. Histopathological evaluation of dental pulp of primary teeth pulpotomized with formocresol with/without a capping agent: A randomized clinical trial. *J Int Soc Prev Community Dent* 2018;8:420-3.
- Ansari G, Safi Aghdam H, Taheri P, Ghazizadeh Ahsaie M. Laser pulpotomy-an effective alternative to conventional techniques-a systematic review of literature and meta-analysis. *Lasers Med Sci* 2018;33:1621-9.
- Ansari G, Morovati SP, Asgary S. Evaluation of four pulpotomy techniques in primary molars: A randomized controlled trial. *Iran Endod J* 2018;13:7-12.
- Nowak A, Christensen JR, Mabry TR, Townsend JA, Wells MH. *Pediatric Dentistry-E-Book: Infancy through Adolescence*, 6th edn. Chicago: Saunders: Elsevier Health Sciences; 2018.
- Kahl J, Easton J, Johnson G, Zuk J, Wilson S, Galinkin J. Formocresol blood levels in children receiving dental treatment under general anesthesia. *Pediatr Dent* 2008;30:393-9.
- Mohammad SG, Raheel SA, Baroudi K. Clinical and radiographic evaluation of *allium sativum* oil as a new medicament for vital pulp treatment of primary teeth. *J Int Oral Health* 2014;6:32-6.
- Neamatollahi H, Tajik A. Comparison of clinical and radiographic success rates of pulpotomy in primary molars using formocresol, ferric sulfate and mineral trioxide aggregate (MTA). *J Dent Tehran Univ Med Sci* 2006;3:7-14.
- Parirokh M, Torabinejad M. Mineral trioxide aggregate: A comprehensive literature review – part III: Clinical applications, drawbacks, and mechanism of action. *J Endod* 2010;36:400-13.
- Aghazadeh S, Haghgoo R, Mehran M, Kadkhodaei F. Comparative evaluation of clinical and radiographic success of MTA and propolis in pulpotomy of primary molars. *Iran Endod J* 2018;13:508-14.
- Hugar SM, Kukreja P, Hugar SS, Gokhale N, Assudani H. Comparative evaluation of clinical and radiographic success of formocresol, propolis, turmeric gel, and calcium hydroxide on

- pulpotomized primary molars: A preliminary study. *Int J Clin Pediatr Dent* 2017;10:18-23.
15. Kalra M, Garg N, Rallan M, Pathivada L, Yeluri R. Comparative evaluation of fresh *Aloe barbadensis* plant extract and mineral trioxide aggregate as pulpotomy agents in primary molars: A 12-month follow-up study. *Contemp Clin Dent* 2017;8:106-11.
 16. Musale PK, Soni AS. Clinical pulpotomy trial of copaifera langsdorffii oil resin versus formocresol and white mineral trioxide aggregate in primary teeth. *Pediatr Dent* 2016;38:5-12.
 17. Purohit RN, Bhatt M, Purohit K, Acharya J, Kumar R, Garg R. Clinical and radiological evaluation of turmeric powder as a pulpotomy medicament in primary teeth: An *in vivo* study. *Int J Clin Pediatr Dent* 2017;10:37-40.
 18. do Carmo Ota CC, da Silva DV, Jacon KC, Baura V, Nunes S. Avaliação da atividade antimicrobiana e anti-inflamatória do extrato hidroalcoólico do *Allium sativum* (alho). *Tuiuti: Ciência e Cultura* 2010;4(43)
 19. Bakri IM, Douglas CW. Inhibitory effect of garlic extract on oral bacteria. *Arch Oral Biol* 2005;50:645-51.
 20. Motamayel FA, Hassanpour S, Alikhani MY, Poorolajal J, Salehi J. Antibacterial effect of eucalyptus (globulus Labill) and garlic (*Allium sativum*) extracts on oral Cariogenic bacteria. *J Microbiol Res Rev* 2013;1:12-7.
 21. Narendhirakannan R, Rajeswari K. *In vitro* antioxidant properties of three varieties of *Allium sativum* L. extracts. *J Chem* 2010;7:S573-S9.
 22. Oosthuizen C, Arbach M, Meyer D, Hamilton C, Lall N. Diallyl polysulfides from *Allium sativum* as immunomodulators, hepatoprotectors, and antimycobacterial agents. *J Med Food* 2017;20:685-90.
 23. Farahpour MR, Hesarakhi S, Faraji D, Zeinalpour R, Aghaei M. Hydroethanolic *Allium sativum* extract accelerates excision wound healing: Evidence for roles of mast-cell infiltration and intracytoplasmic carbohydrate ratio. *Braz J Pharm Sci* 2017;53(1).
 24. Ambareen Z, Chinappa A. Go green-keep the root canal clean. *Int J Dent Sci Res* 2014;2:21-5.
 25. Mohammad SG, Raheel SA, Baroudi K. Histological evaluation of *Allium sativum* oil as a new medicament for pulp treatment of permanent teeth. *J Contemp Dent Pract* 2015;16:85-90.
 26. Togaru H, Muppa R, Srinivas N, Naveen K, Reddy VK, Rebecca VC. Clinical and radiographic evaluation of success of two commercially available pulpotomy agents in primary teeth: An *in vivo* study. *J Contemp Dent Pract* 2016;17:557-63.
 27. Zurn D, Seale NS. Light-cured calcium hydroxide vs formocresol in human primary molar pulpotomies: A randomized controlled trial. *Pediatr Dent* 2008;30:34-41.
 28. Haghgoo R, Ahmadvand M. Evaluation of pulpal response of deciduous teeth after direct pulp capping with bioactive glass and mineral trioxide aggregate. *Contemp Clin Dent* 2016;7:332-5.
 29. Ejaz S, Chekarova I, Cho JW, Lee SY, Ashraf S, Lim CW. Effect of aged garlic extract on wound healing: A new frontier in wound management. *Drug Chem Toxicol* 2009;32:191-203.
 30. Petropoulos S, Fernandes Â, Barros L, Ciric A, Sokovic M, Ferreira IC. Antimicrobial and antioxidant properties of various Greek garlic genotypes. *Food Chem* 2018;245:7-12.
 31. Singh VK, Singh DK. Pharmacological effects of garlic (*Allium sativum* L.). *Ann Rev Biomed Sci* 2008; 10:6-26.
 32. Çelik BN, Mutluay MS, Arıkan V, Sarı Ş. The evaluation of MTA and Biodentine as a pulpotomy materials for carious exposures in primary teeth. *Clin Oral Investig* 2019;23:661-6.
 33. Dean, J.A. McDonald and Avery's Dentistry for the Child and Adolescent, 10th ed.; Elsevier Health Sciences; Amsterdam, The Netherlands, 2016.
 34. Casella S, Leonardi M, Melai B, Fratini F, Pistelli L. The role of diallyl sulfides and dipropyl sulfides in the *in vitro* antimicrobial activity of the essential oil of garlic, *Allium sativum* L., and leek, *Allium porrum* L. *Phytother Res* 2013;27:380-3.
 35. Vellayappan R, Varghese SS. Antibacterial effect of the crude extract of garlic on *Streptococcus mutans*. *Drug Invention Today* 2018; 10(S3):3258-3261.
 36. Jalali FS, Saifzadeh S, Tajik H, Hobbi S. The efficacy of aqueous extract of Iranian garlic on the healing of burn wound: A clinical and microbiological study. *Asian J Anim Vet Adv* 2008;3:162-8.
 37. Sahbaz A, Isik H, Aynioglu O, Gungorduk K, Gun BD. Effect of intraabdominal administration of *Allium sativum* (garlic) oil on postoperative peritoneal adhesion. *Eur J Obstet Gynecol Reprod Biol* 2014;177:44-7.
 38. Sidik K, Mahmood A, Salmah I. Acceleration of wound healing by aqueous extract of *Allium sativum* in combination with honey on cutaneous wound healing in rats. *Int J Mol Med Adv Sci* 2006;2:231-5.
 39. Parisay I, Ghoddusi J, Forghani M. A review on vital pulp therapy in primary teeth. *Iran Endod J* 2015;10:6-15.
 40. Kahvand M, Mehran M, Haghgoo R, Faghihi T. Clinical and radiographic evaluation of *Allium sativum* oil (garlic oil) in comparison with formocresol in primary molar pulpotomy. *J Int Soc Prev Community Dent* 2019;9:390-5.