Original Article

DOI: 10.7860/JCDR/2025/73790.21860

Dentistry Section

Natural versus Conventional Medicaments for Pulpotomy in Primary Teeth: A Systematic Review

SUPRIYA THAMBIREDDY[1], SVSG NIRMALA[2]

ABSTRACT

Introduction: Natural medicaments are used in the treatment of infectious diseases due to their antibacterial and anti-inflammatory properties. Pulpotomy is an effective vital pulp therapy for carious primary teeth, aimed at preserving radicular pulp vitality. While natural medicaments can serve as pulpotomy agents, their efficacy in comparison to conventional medicaments remains questionable.

Aim: To analyse the scientific evidence comparing the efficacy of natural and conventional pulpotomy medicaments in primary teeth.

Materials and Methods: This systematic review included human studies, Randomised Controlled Trials (RCTs), in-vivo studies, studies comparing natural and conventional pulpotomy agents, and studies conducted using primary molars. An electronic database search was performed using MeSH terms, limited to English-language publications in MEDLINE (PubMed), the Cochrane Library, and Ovid, with no restrictions on publication date. A hand search of scholarly articles was also conducted to uncover supplementary data. Relevant publications were selected based on established criteria, and quality analysis was carried out using the Cochrane risk of bias assessment tool.

Results: Out of 483 articles, 11 randomised clinical trials were included in this systematic review. Ten of these evaluated clinical and radiographic efficacy, one assessed only histological efficacy, and one article examined all three outcomes of natural medicaments such as *Allium sativum, Curcuma longa, Elaeagnus angustifolia, Copaifera langsdorffii*, and *Rosmarinus officinalis*, comparing them with conventional medicaments in primary teeth. Quality analysis of the included studies indicated that four had good quality, three had fair quality, and four had poor quality.

Conclusion: Based on the available evidence, it is difficult to determine the efficacy of natural pulpotomy medicaments definitively. There is a paucity of literature regarding the histological efficacy of these natural agents. More high-quality studies are recommended to seek an appropriate alternative to conventional pulpotomy medicaments in primary teeth.

Keywords: Alliun sativum, Children, Deciduous teeth, Formocresol

INTRODUCTION

Dental caries is an infectious, chronic, degenerative, and multifactorial disorder that is the most common chronic disease worldwide, primarily affecting children [1,2]. Tooth decay represents one of the biggest public health problems associated not only with primary teeth but also with permanent ones. Despite the preventive techniques mainly employed in industrialised countries, approximately 2.4 billion adults and 486 million children are affected by dental decay in the permanent and deciduous dentition, respectively [3].

Early management of caries should aim to avoid the progressive destruction of dental hard tissue and the subsequent loss of dental vitality [4], which can lead to critical conditions necessitating premature tooth extraction [5]. Effective early caries control can prevent the gradual deterioration of dental hard tissue and the associated loss of dental vitality [4], thereby avoiding serious problems that could require early tooth extraction [5]. This is particularly true for primary teeth, which exhibit rapid progression of tooth decay due to anatomical considerations, a lower rate of mineralisation, and a higher incidence of risk factors [2,4,6].

To maintain the pulp vitality of deciduous or young permanent teeth with caries affected immature roots and no signs of radicular pathology, Vital Pulp Therapy (VPT) has been recommended [7,8]. Currently, the available therapeutic options for VPT include pulpotomy, direct pulp capping, and indirect pulp therapy, specifically indirect pulp capping. While both indirect capping and pulpotomy treatments are clinically effective in primary molars, indirect capping appears to be more effective than pulpotomy. Direct capping is primarily advised for the VPT of young permanent teeth [9,10]. By avoiding pulpectomy procedures, indirect capping helps maintain the vitality of primary teeth until their natural exfoliation and provides superior clinical survival rates over time [11].

Mineral Trioxide Aggregate (MTA), Biodentine (BD), Formocresol (FC), Ferric Sulphate (FS), and Calcium Hydroxide (CH) are the most commonly used agents, each with its own advantages and disadvantages [12,13]. For many years, Buckley's FC was regarded as the "gold standard" pulpotomy medication. When compared to FC, none of the aforementioned agents have achieved the same level of clinical efficacy and success rates [14]. According to the International Agency for Research on Cancer (IARC), FC is classified as a carcinogen to humans [15].

In 1970, the World Health Organisation established a program to promote the use of indigenous plant medicines in developing nations. India has a long history of using herbal therapy to treat a variety of ailments. Herbal remedies possess strong antibacterial and anti-inflammatory properties, making them valuable in dentistry for treating various infectious diseases [16]. Some of the herbal medicaments that have been studied so far as pulpotomy agents for primary teeth include Aloe Vera, *Allium sativum*, Ankaferd Blood Stopper, Propolis, *Elaeagnus angustifolia*, *Curcuma longa*, *Copaifera langsdorffii*, and *Rosmarinus officinalis* [17]. The major advantages of using herbal alternatives include easy availability, cost-effectiveness, increased shelf life, low cytotoxicity, and a lack of microbial resistance [16]. Therefore, this systematic review aims to examine the scientific evidence comparing the clinical, radiographic, and histological efficacy of natural and conventional pulpotomy medicaments in primary teeth.

MATERIALS AND METHOD

This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The current systematic review was registered as a protocol in the International Prospective Register of Systematic Reviews (PROSPERO2022CRD42022298437). The study aimed to evaluate the clinical, radiographic, and histological outcomes of natural pulpotomy medicaments in primary teeth.

An extensive electronic database search was conducted by two researchers independently (ST and SN) in PubMed Central, Cochrane Library, and Ovid® using existing literature covering the period from January 2012 to December 2022. A supplementary search was performed using Google Scholar, grey literature, and a hand search of cross-references from the included and relevant studies to ensure that no pertinent additional studies were missed during the electronic search.

Review question: Is there any scientific evidence comparing the efficacy of natural and conventional pulpotomy medicaments in primary teeth?

This review followed the PICO-S selection criteria [Table/Fig-1].

1	P	Participant	Children under going pulpotomy of primary teeth
2	I	Intervention	*Allium sativum*, Copaifera langsdorfii oil resin, Curcuma longa, *Elaeagnus angustifolia*, *Rosmarinus officinalis*
3	C	Comparison	Formocresol (FC), MTA, white MTA, Glutaraldehyde, Ferric Sulphate (FS)
4	O	Outcome	Clinical, radiographic and histological outcomes of pulpotomy
5	S	Study design	Inclusion criteria: Human studies Randomised Controlled Trails (RCTs) In-vivo studies Studies comparing natural and conventional pulpotomy agents Studies done using primary molars Exclusion criteria: Case reports In-vitro studies and Animal studies Systematic review and narrative review articles Studies with insufficient information Studies done using only natural pulpotomy agents Studies performed in children having permanent dentition

[Table/Fig-1]: Terms in search strategy used in PICO format.

The search utilised various descriptors and Medical Subject Headings (MeSH) terms [Table/Fig-2], both individually and in combination using Boolean operators ("OR" and "AND"). The search strategy was as follows:

- (Child) OR (children) OR (primary teeth) OR (primary tooth) OR (deciduous teeth) OR (deciduous tooth) OR (primary molars) OR (deciduous molars) OR (primary dentition) OR (deciduous dentition)

AND

- (Allium sativum) OR (garlic) OR (garlic oil) OR (*Curcuma longa*) OR (turmeric) OR (copaiba oil resin) OR (*Elaeagnus angustifolia*) OR (*Rosmarinus officinalis*) OR (Pulpotomy materials) OR (natural pulpotomy materials)

AND

- (Formocresol) OR (Glutaraldehyde) OR (Ferric Sulphate) OR (MTA) OR (Mineral Trioxide Aggregate) OR (white MTA) OR (grey MTA) OR (conventional pulpotomy materials) OR (traditional pulpotomy materials)

AND

- (Clinical) OR (radiographic) OR (histological) OR (clinical evaluation) OR (clinical efficacy) OR (radiographic evaluation) OR (radiographic efficacy) OR (histological evaluation) OR (clinical and radiographic evaluation) OR (clinical and radiographic success) OR (pulpotomy) OR (pulp treatment).

Data collection process: Two researchers (ST and SN) independently reviewed the titles of the studies first obtained through the databases and hand searches. The abstracts of the papers were evaluated after duplicates and unnecessary titles were removed. All abstracts that appeared to fit the inclusion criteria were considered for review. The full text of the relevant studies was accessed for those that met the inclusion criteria or if an abstract lacked sufficient information. In cases of unresolved issues regarding the inclusion of any study after the full text review, a consensus decision was reached through mutual discussion.

Data items: Data that matched the inclusion criteria were independently extracted and structured in the following fields:

- General information (author's name and publication year)
- Study features (design type and treatment comparison)
- Sample description (size and age).

Assessment of clinical, radiographic, and histological outcomes of natural pulpotomy materials:

	Population	Intervention	Comparision	Outcome
Characteristic	Children	*Allium sativum*	Formocresol (FC)	Clinical
		Copaibaoil resin	Glutaraldehyde	Radiographic
		Curcuma longa	Ferric Sulphate (FS)	Histological
		Elaeagnus	MTA	
		Angustifolia		
		Rosmarinus		
		Officinalis		
MeSH Terms	Child	*Allium sativum*,	Formocresol (FC)	Clinical
	Children	Garlic,	Glutaraldehyde	Radiographic
	Primary teeth	Garlic oil	FS	Histological
	Primary	Copaibaoil resin,	MTA	Evaluation
	Molars	CLOR	Conventional	Efficacy
	Deciduous	*Curcuma longa*,	Pulpotomy	Pulpotomy
	Molars	Turmeric	Materials	
		Elaeagnus		
		Angustifolia		
		Rosmarinus		
		Officinalis		

Alternate words	Primary tooth	Copaibaoil	White MTA	Success
	Deciduous	Copaifera langsdorfi	Grey MTA	Pulp treatment
	Tooth	Oil resin	Traditional	
	Deciduous	Natural pulpotomy	Pulpotomy	
	Teeth	Materials	materials	
	Deciduous dentition primary dentition			

Table/Fig-2]: MeSH terms conferring to PICO.

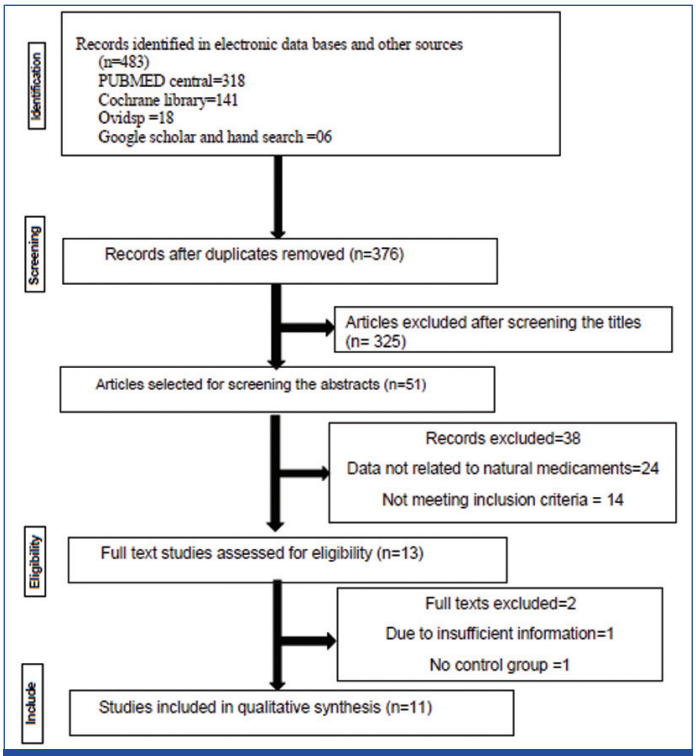
Quality assessment and risk of bias in individual studies: The risk of bias in the included studies was independently assessed by the same two authors (ST and SN) using "The COCHRANE RISK OF BIAS tool for assessing risk of bias" for randomised clinical trial studies [18]. The assessment sheet includes seven elements (random sequence generation, allocation concealment, selective reporting, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and other bias), each categorised as low risk, high risk, or unclear risk of bias.

The overall quality of the study was classified as good, fair, or poor based on these categories. A good quality study was defined as one where all seven elements in the assessment sheet scored low risk. A fair quality study was characterised by one element scoring high risk or two elements scoring unclear risk, provided these elements were unlikely to have biased the outcome. A poor quality study indicated either one element scoring high risk or two elements scoring unclear risk, suggesting these elements were likely to have biased the outcome; additionally, a study was considered poor quality if two or more elements in the assessment sheet were marked as high risk or unclear risk of bias [19].

RESULTS

Yield of Search

A flow diagram depicting the retrieval, filtering, and selection of articles for review is presented in [Table/Fig-3]. A total of 483 studies were obtained through electronic databases (PubMed, Cochrane Library, Ovid®), Google Scholar, and manual searches. After removing duplicates, 376 articles were identified. Following the screening of article titles, 325 titles were rejected for various reasons, including animal studies, adult studies, unrelated research, narrative reviews, systematic reviews, and letters to the editor. A total of 51 articles were selected for abstract screening, of which 38 were excluded for reasons such as irrelevant data related to natural pulpotomy medicaments and articles that did not meet the inclusion criteria. Thirteen studies were assessed for full-text eligibility, of which two were excluded due to insufficient information and lack of a control group. Ultimately, eleven studies were included in the qualitative synthesis [14,20-29].



[Table/Fig-3]: PRISMA flow diagram representing comprehensive search process with identification of relevant studies

Low-risk= + Hig High-risk= - Unclear= ?

Description of the studies: The characteristics of the studies are summarised in [Table/Fig-4a-d,5].

Quality assessment of the included studies (risk of bias): Among the included studies, four articles demonstrated good quality [20,21,23,29], three showed fair quality [23,26,27], and four articles exhibited poor quality [14,24,27,28] [Table/Fig-6].

DISCUSSION

The purpose of this paper was to investigate the clinical, radiographic, and histological success rates of herbal pulpotomy medicaments to substantiate their effectiveness as alternatives to standard pulpotomy medicaments. The articles included in this systematic review evaluated various herbal medicinal products such as *Allium sativum* [14,20-25], *Curcuma longa* [26], *Elaeagnus angustifolia* [27], *Rosmarinus officinalis* [28], and *Copaifera langsdorffii* [29] as pulpotomy medicaments compared to standard pulpotomy medicaments.

In all the studies included in this systematic review, information on the selection criteria of participants, including the setting and location of data collection, was provided, except in the study by El-Gebaly A et al., [22]. All eleven studies reported details about the age of the sample, sample size, intervention group, comparison group, evaluation criteria, and the duration of follow-up. Sample size calculation was mentioned only in the studies by El-Gebaly A et al., and Musale PK et al., [22,29].

Among the included studies, nine evaluated both clinical and radiographic success. Additionally, the study by Hashem SN et al., assessed clinical, radiographic, and histological outcomes [24]. The study by Mahfouz SM et al., focused solely on histological outcomes [25].

The follow-up periods varied among the included studies. In the studies by Kahvand M et al., and Sajadi FS et al., the follow-up period was three and six months, respectively [20,27]. Abirami K et al., and Musale PK et al., had follow-up periods of six and twelve months [21,29]. Hashem SN et al., and Hugar SM et al., conducted follow-ups at one, three, and six months [24,26]. In the study by El-Gebaly A et al., the follow-up periods were at 3, 6, 9, and 12 months [22]. Faghihi T et al., had follow-up periods at 6, 12, and 18 months [23], while Mohammed SG et al., had a follow-up period of only six months [14]. In the study by Mahfouz SM et al., follow-up periods were conducted at 15 and 30 days [25].

There were a few dropouts in some of the included studies. In the study by Sajadi FS et al., three participants dropped out: two at three months and one at six months. In the study by Musale PK et al., ten dropouts occurred at the six-month follow-up period [27,29]. Data regarding dropouts were not mentioned in the remaining studies.

Author/ year	Study design	Sample size and age	Materials used		Follow-up	Sample during follow-up		Outcome assessment (%)			
								Clinical success		Radiographic success	
								Control	Intervention	Control	Intervention
Sajadi FS 2014 [27]	RCT	64 molars	Formocresol (FC)	E.angustifolia	3	29	29	100	96.7	76.7	53.3
					6	29	29	96.6	96.6	71.4	51.7
Musale P and Soni AS 2016 [29]	RCT	152 molars(4-8 years)	F	MTA / CLOR	6	33 / 34	75	100 / 100	100	90.91 / 94.12	86.7
					12	34 / 75	75	100 / 100	100	90.91 / 88.23	76.0
Hugar SM et al., 2017 [26]	Preliminary study	60 molars(4-9 years)	Formocresol (FC)	Clonga	1	45	15	100	100	100	100
					3	45	15	100	100	100	100
					6	45	15	100	100	100	86.7

[Table/Fig-4a]: Characteristics of the included studies [26,27,29].

Author/Year	Study design	Sample size/age	Materials used		Follow-up	Sample during follow-up		Outcome reported
			Control	Intervention		Control	Intervention	Histological success
Hashem SN et al., 2019 [24]	In-vivo	6 molars (8-10 yrs)	Formocresol (FC)	*Allium sativum*	2 months	3	3	H/E of pulp tissues in A.sativum group showed well organised odontoblastic layer and chronic inflammatory cell infiltration than in Formocresol (FC) group.
Mahfouz SM and Wahba OM et al., 2019 [25]	In-vivo	30 molars (7-9 yrs)	Formocresol (FC)	*Allium sativum*	15 days	7	7	*Allium sativum* group showed mild inflammation with mild to moderate pulpal fibrosis with intact odontoblastic layer and dentin ship formation whereas Formocresol (FC) group showed no intact odontoblastic layer.

[Table/Fig-4b]: Characteristics of the included studies [24,25].

Author/year	Study design	Sample size/age	Materials used		Follow-up	Sample during follow-up		Overall clinical and radiographic success (%)	
			Control	Intervention		control	Intervention	Control	Intervention
Mohammad SG et al., 2014 [14]	RCT	40 molars (4-8 years)	Formocresol (FC)	*Allium sativum*	6 months	20	20	85	90
Elbaz GA and El Desouky GG 2017 [28]	RCT	50 molars (4-7 years)	Formocresol (FC)	R officalis	1 week,1, 3, 6 months	25	25	81	92

[Table/Fig-4c]: Characteristics of the included studies [14,28].

Author/year	Study design	Sample Size (Age)	Materials used		Follow-Up	Sample During Follow-Up		Outcome assessment (%)			
								Clinical success		Radiographic success	
			Control	Intervention				Control	Intervention	Control	Intervention
Abhirami K et al., 2020 [21]	RCT	83 molars (5-9years)	Formocresol (FC)	*Allium sativum*	6	26	26	100	100	92.3	92.3
					12	26	26	100	100	88.46	84.61
El-Gebaly A et al., 2022 [22]	RCT pilot	30 molars (4-7 years)	White MTA	A. sativum	3	15	15	100	100	100	93.3
					6	15	15	100	100	100	80.0
					9	15	15	100	93.3	100	46.7
					12	15	15	100	93.3	100	40.0
Faghihi T et al., 2021 [23]	RCT	90 molars (3-8 years)	White MTA	*Allium sativum* oil	6	45	45	100	100	95.6	91.1
					8	45	45	100	100	91.1	75.6
					12	45	45	100	100	91.1	75.6
Kahvand M et al., 2019 [20]	RCT	90 molars (3-10 years)	Formocresol (FC)	A. sativum	3	45	45	100	100	88.9	82.2
					6	45	45	100	100	84.4	80.0

[Table/Fig-4d]: Characteristics of the included studies [20-23].

In this systematic review, out of the eleven included articles, nine studies assessed clinical and radiographic outcomes. Specifically, three studies compared *Allium sativum* versus FC [14,20,21], two studies compared *Allium sativum* versus white MTA [22,23], and one study each compared *Curcuma longa* versus FC [26], *Elaeagnus angustifolia* versus FC [27], *Rosmarinus officinalis* versus FC [28], and Copaiba oil resin versus FC and MTA [29]. Additionally, two studies [24,25] assessed the histological success of *Allium sativum* and FC. The clinical and radiographic parameters assessed in the studies included tenderness to percussion, postoperative pain, presence of a sinus tract and mobility, presence of periodontal ligament widening, external or internal root resorption, furcal or periapical radiolucencies, and pulp canal obliteration of different herbal agents compared to the standard pulp dressing medicaments. Histological parameters included pulpal inflammation, fibrosis, odontoblastic layer formation, and dentin bridge formation.

The herbal agents evaluated in the studies showed similar clinical, radiographic, and histological success rates compared to conventional agents as pulpotomy medicaments in primary teeth, suggesting the use of natural medicaments as an alternative to conventional treatments. However, in the study by Sajadi F et al., (2014), *Elaeagnus angustifolia* fruit powder showed lesser clinical and radiographic success than FC [27].

Among the studies that assessed clinical and radiological outcomes, no statistically significant difference was found between the study groups, except in the study by El-Gebaly A et al., where a statistically significant difference in the overall radiographic success rate was observed at the 9 and 12-month

S. No.	Authors	Results	Conclusion
1.	Sajadi FS, 2014 [27]	The clinical success rate of *Elaeagnus angustifolia* group was 96.7% after 3 months that was significantly less than that in the Formocresol (FC) group (100%). After 6 months the clinical success rate of the two groups was 96.7%. The radiographic success rate of Formocresol (FC) and *Elaeagnus angustifolia* after 3 and 6 months were 76.7% and 53.3%, and 72/4% and 51.7%, respectively, with statistically significant differences.	Clinical and radiographic success of pulpotomised primary molar teeth with *Elaeagnus angustifolia* fruit powder was relatively less than that with Formocresol (FC).
2.	Musale P and Soni AS, 2016 [29]	At 12 months, 100 percent clinical success was observed with all groups. CLOR had the highest frequency of pathological radiolucencies at 12 months. The radiographic success at 12 months was 76 percent, 90.91 percent, and 88.23 percent for the CLOR, FC, and WMTA groups, Respectively (p=0.10).	*Copaifera langsdorffii* oil resin can be suggested as a pulpotomy agent for primary teeth up to one year. However, further clinical studies with long-term follow-ups are needed to test its efficacy as a pulpotomy medicament.
3.	Elbaz GA and El Desouky GG, 2017 [28]	After 6 months, the cumulative survival rates were 92.0% and 81.0% respectively for R-officinalis and FC with no statistically significant difference between the survival rates of the two medicaments. Clinical success for R-officinalis	Based on the high cumulative clinical and radiographic survival results revealed in the present study, *Rosmarinus officinalis* can be considered a successful alternative pulpotomy medicament for FC with promising results in
		showed 96.0% while FC showed 88.0% clinical success. In addition, radiographic evaluation revealed higher mean interradicular bone density in the R-officinalis pulpotomy group when compared to the FC pulpotomy group.	The treatment of vital primary molars.
4	Hugar SM et al., 2017 [26]	A comparable clinical and radiographic success rate was seen with all experimental groups as compared to the control (FC) group.	With concerns about the safety of FC appearing in the dental and medical literature for more than 20 years, the materials used in this study can be considered as promising alternatives for FC in pediatric endodontic treatment.
5	Mohammad SG et al., 2014 [14]	A. sativum oil offers a good healing potential, leaving the remaining pulp tissue healthy and functioning. Vital pulpotomy with allium sativa oil was given raise 90% success rate while that with FC was 85%.	A. sativum oil is a biocompatible material that is compatible with vital human pulp tissue. It offers a good healing potential, leaving the remaining pulp tissue healthy and functioning.
6	Hashem SN et al., 2019 [24]	No statistically significant difference between groups in the overall cumulative clinical or radiographic success at follow up visits. Histopathological examination revealed dentine bridge formation in primary molars treated with Miswak, Nigella sativa treated primary molars showed absence of odontoblastic layer, *Allium sativum* showed well organised odontoblastic layer and chronic inflammatory cellular infiltration, while FC	Miswak, and *Allium sativum* can be considered as good natural alternatives to FC in primary molars pulpotomy, however Nigella sativa cannot be a suitable substitute to FC.
		Specimens showed sever hyperemia and hyalinisation of pulp stroma.	
7	El-Gebaly A et al., 2022 [22]	Overall clinical success rate of Group (I) and Group (II) at the end of 12 months follow-up was (93.3%) and (100.0%) respectively. There was no statistical significance difference between two groups regarding overall clinical success rate. The overall radiographic success rate at the end of 12 months was (40.0%) and (100.0%) respectively. There was a statistical significant difference	Mineral Trioxide Aggregate (MTA) was found to be superior when compared to A.Sativum oil as pulpotomy agent in primary molar teeth
		regarding overall radiographic success rate at 9 and 12 months follow up. The overall success rate of Group (I) and Group (II) at the end of 12 months was (40.0%) and (100.0%) showing a statistically	
		significant difference between the two groups.	
8	Abhirami K et al., 2020 [21]	The teeth were then followed up for 6 and 12 months clinically and radiographically. Chi-square test was used to compare the clinical and radiographic results between the groups. McNemar test was used to compare the clinical and radiographic results at 6 and 12 months. The results revealed that there was no significant difference between the groups when comparing the experimental groups to the control.	The study shows that Aloe barbadensis gel and *Allium sativum* oil may be used as an alternative to FC as pulpotomy medicaments.
9	Mahfouz SM and Wahba OM et al., 2019 [25]	In group (IA) Nearly normal pulpal architecture was observed. Moderate amount of inflammatory cell infiltration was noted about 50-60% in cases after 15 and 30 days. In addition the results of group (IB), (IIB) there was pulpal inflammation was prominently observed in all cases treated with formacresol. After 15 days about 33.3% of cases showed severe inflammation with lymphocytes and foamy macrophages while 66.6% showed moderate inflammatory infiltration. By the end of 14 days severe pulpal inflammation were about 46.6%. Also, in group (IIA) there was pulpal inflammation was prominently observed in all cases treated with formacresol. After 15 days about 33.3% of severe inflammation with lymphocytes and foamy macrophages while 66.6% showed moderate inflammatory infiltration. By the end of 30 days, severe pulpal inflammation was about 46.6%.	Odontoblast remained vital in most cases treated with Both Tri-antibiotic paste and A. sativum Internal root resorption found in most specimens treated with formacresol
10	Faghihi T et al., 2021 [23]	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% after12 and 18 months in Group I in those follow-up points. The difference between the two groups was not statistically significant.	According to the results, *Allium sativum* oil has a high clinical and radiographic success rate comparable to those of MTA.
11	Kahvand M et al., 2019 [20]	The clinical success rate was 100% in both groups after 3 and 6 months. The radiographic success rate in the ALL group and the FC group after 3 and 6 months was 82.2% and 80% and 88.9% and 84.4%, respectively. The difference between the two groups was not statistically significant (p=0.46).	According to the results of this study, A.sativum oil can be used in the pulpotomy of the primary molars.

[Table/Fig-5]: Conclusion of the included studies [14,20-29].

follow-up periods [22]. In the study by Mahfouz SM et al., which assessed only histological outcomes (as the teeth were extracted due to orthodontic reasons), a statistically significant difference was found among the study groups [25].

Authors	Random sequence generation	Allocation concealment	Selective reporting	Other bias	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Quality of the study
Sajadi FS 2014 [27]	?	?	+	+	?	?	+	Poor
Musale P and Soni AS 2016 [29]	+	?	+	+	+	+	+	Good
Elbaz GA and El Desouky GG 2017 [28]	-	-	-	+	?	+	+	Poor
Hugar SM et al., 2017 [26]	-	?	+	+	+	+	+	Fair
Mohammad SG et al., 2014 [14]	-	?	+	+	?	?	+	Poor
Hashem SN et al., 2019 [24]	?	?	+	+	?	?	+	Poor
El-Gebaly A et al., 2022 [22]	+	+	-	+	+	+	+	Fair
Abirami K et al., 2020 [21]	+	+	+	+	+	+	+	Good
Mahfouz SM and Wahba OM, 2019 [25]	-	?	+	+	?	+	+	Fair
Faghihi T et al., 2021 [23]	+	?	+	+	+	+	+	Good
Kahvand M et al., 2019 [20]	+	?	+	+	+	+	+	Good

[Table/Fig-6]: Risk of bias assessment of included studies [14,20-29].

Limitation(s)

Following an intensive search, only a limited number of clinical trials were discovered, and it is essential to emphasise that the results derived from this review may change as new evidence becomes available. Furthermore, this review included only articles published in English. Therefore, papers published in other languages were not included.

CONCLUSION(S)

The effectiveness of natural pulpotomy medications as a replacement for traditional pulpotomy medications is difficult to determine based on the available data. There is no scientific evidence comparing the natural agents with glutaraldehyde or FS, and there is a paucity of literature assessing the histological efficacy of natural medicaments. Thus, more high-quality randomised clinical trials using natural agents are needed to establish and substantiate their efficacy as appropriate pulpotomy medicaments for primary teeth.

REFERENCES

[1] US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health. Oral Health in America: A Report of the Surgeon General; U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health: Rockville, MD, USA, 2000. Available online: https://www.nidcr.niih.gov/sites/default/fifiles/2017-10/hck1ocv.%40www.surgeon.fullrpt.pdf (accessed on 2 December 2019). Doi: 10.1038/sj.bdj.4810064.

[2] Smaïl-Faugeron V, Glenny AM, Courson F, Durieux P, Muller-Bolla M, Chabouis HF. Pulp treatment for extensive decay in primary teeth. Cochrane Database of Systematic Reviews. 2018;5(5):CD003220. Doi: 10.1002/14651858.CD003220.pub3.

[3] Collaborators GB. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Study 2017. Doi:10.1016/S0140-6736(18)32279-7.

[4] Stringhini Junior E, Dos Santos MG, Oliveira LB, Mercadé M. MTA and biodentine for primary teeth pulpotomy: A systematic review and meta-analysis of clinical trials. Clinical Oral Investigations. 2019;23:1967-76. Doi.org/10.1007/s00784-018-2616-6.

[5] Bhujel N, Duggal MS, Saini P, Day PF. The effect of premature extraction of primary teeth on the subsequent need for orthodontic treatment. European Archives of Paediatric Dentistry. 2016;17:423-34. DOI.org/10.1007/s40368-016-0247-7.

[6] Colak H, Dülgergil C, Dalli M. American Academy on Pediatric Dentistry. Policy on Early Childhood Caries (ECC): Classifications, Consequences, and Preventive Strategies. Pediatr Dent. 2011;30:40-43. Doi: 10.4103/0976-9668.107257.

[7] Dhar V, Marghalani AA, Crystal YO, Kumar A, Ritwik P, Tulunoglu O, et al. Use of vital pulp therapies in primary teeth with deep caries lesions. Pediatric Dentistry. 2017;39(5):146E-59E. Doi: 10.15419/peds.2017.39.5.146.

[8] Guideline on pulp therapy for primary and immature permanent teeth. Pediatr. Dent. 2016;38:280-88. Doi: 10.2349/2016.38.4.280.

[9] Brizuela C, Ormeño A, Cabrera C, Cabezas R, Silva CI, Ramírez V, et al. Direct pulp capping with calcium hydroxide, mineral trioxide aggregate, and biodentine in permanent young teeth with caries: A randomized clinical trial. Journal of Endodontics. 2017;43(11):1776-80. Doi: 10.1016/j.joen.2017.05.009.

[10] Li Z, Cao L, Fan M, Xu Q. Direct pulp capping with calcium hydroxide or mineral trioxide aggregate: A meta-analysis. Journal of Endodontics. 2015;41(9):1412-17. Doi: 10.1016/j.joen.2015.04.012.

[11] Smaïl-Faugeron V, Porot A, Muller-Bolla M, Courson F. Indirect pulp capping versus pulpotomy for treating deep carious lesions approaching the pulp in primary teeth: A systematic review. European Journal of Paediatric Dentistry. 2016;17(2):107-12. Doi:10.23896/ejpd.2016.21.

[12] Eidelman E, Holan G, Fuks AB. Mineral trioxide aggregate vs. formocresol in pulpotomized primary molars: A preliminary report. Pediatric Dentistry. 2001;23(1):15-18. Doi: 10.1111/j.1553-0302.2001.tb02404.x.

[13] Ratnakumari N, Thomas B. A histopathological comparison of pulpal response to chitra-cpc and formocresol used as pulpotomy agents in primary teeth: A clinical trial. International Journal of Clinical Pediatric Dentistry. 2012;5(1):6. Doi: 10.5005/jp-journals-10005-1161.

[14] 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. Journal of international oral health: JIOH. 2014;6(6):32. Doi:10.5005/jp-journals-10051-0184.

[15] International Agency for Research on Cancer. IARC Classifies Formaldehyde as Carcinogenic to Humans. Press release no. 153, June 2004. [WWW document.] URL http://www.iarc.fr/pageroot/PRELEASES/pr153a.html Doi: 10.1002/ijc.20770.

[16] Nair GR, Naidu GS, Jain S, Nagi R, Makkad RS, Jha A. Clinical effectiveness of aloe vera in the management of oral mucosal diseases-A systematic review. J Clin Diag Res. 2016;10(8):ZE01. Doi:10.7860/JCDR/2016/18142.8222.

[17] Divya S, Sujatha S. An insight on the success of various pulpotomy medicaments in pediatric dentistry-A review of literature. Research Journal of Pharmacy and Technology. 2018;11(6):2647-55. Doi: 10.5958/0974-360X.2018.00491.2.

[18] Jorgensen L, Paludan-Müller AS, Laursen DR, Savović J, Boutron I, Sterne JA, et al. Evaluation of the Cochrane tool for assessing risk of bias in randomized clinical trials: Overview of published comments and analysis of user practice in Cochrane and non-Cochrane reviews. Systematic reviews. 2016;5:01-03. Doi: 10.1186/s13643-016-0259-8.

[19] Higgins JP, Green S. Cochrane handbook for systematic reviews of interventions. The Cochrane Collaborations, UK.2011 Jan 30.

[20] 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. Journal of International Society of Preventive and Community Dentistry. 2019;9(4):390-95. Doi: 10.4103/jispcd.JISPCD_157_19.

[21] Abirami K, Ramkumar H, Senthil D. Clinical and radiographic evaluation of the efficacy of formocresol, Allium sativum oil, and Aloe barbadensis gel as pulpotomy medicaments in primary molars: A randomized controlled trial. International Journal of Clinical Pediatric Dentistry. 2020;13(5):518. Doi: 10.5005/jp-journals-10005-1802.

[22] El-Gebaly A, Omar N, El-Bardissy AA, Abd Al Gawad RY, Abd El-Samad AM. Post-operative pain after vital pulpotomy of primary molars using allium sativum oil versus mineral trioxide aggregate: A randomized pilot clinical study. International Journal of Health Sciences. (IV):1900-22. Doi: 10.53730/ijhs.v4nSpecial1.4863.
[23] Faghihi T, Haghgoo R, Taghizade F, Zareiyan M, Mehran M, Ansari G. The clinical and radiographic evaluation of Allium sativum oil (garlic oil) in comparison with mineral trioxide aggregate in primary molar pulpotomy. Dental Research Journal. 2021;18(1):100. Doi: 10.4103/1735-3327.305907.
[24] Hashem SN, Fawzy MI, Mostafa MH. Comparative study of some natural materials versus traditional medicaments used for pulp treatment of primary teeth. Al-Azhar Dental Journal for Girls. 2019;6(1):25-30. Doi: 10.21608/adjg.2019.28396.
[25] Mahfouz SM, Wahba OM. Comparative evaluation of pulpal response to tri-antibiotic paste and Allium Sativum with formacresol as pulpotomy medication in primary teeth: An in vivo study. Egyptian Dental Journal. 2019;65(4-October (Orthodontics, Pediatric & Preventive Dentistry)):3131-42. Doi: 10.21608/edj.2019.73990.
[26] 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. International Journal of Clinical Pediatric Dentistry. 2016;10(1):18. Doi: 10.5005/jp-journals-10005-1400.
[27] Sajadi FS. Clinical and radiographic findings after using formocresol and Elaeagnus angustifolia fruit powder for pulpotomy of primary molar teeth (Doctoral dissertation, Department of Food Hygiene and Public Health, Faculty of Veterinary Medicine, Shahid Bahonar University of Kerman).
[28] Elbaz GA, El Desouky GG. Rosmarinus officinalis pulpotomy for vital primary molars: A clinical and radiographic study. Egyptian Dental Journal. 2017;63(1-January (Orthodontics, Pediatric & Preventive Dentistry)):169-77. Doi: 10.21608/edj.2017.74384.
[29] Musale PK, Soni AS. Clinical pulpotomy trial of Copaifera langsdorffii oil resin versus formocresol and white mineral trioxide aggregate in primary teeth. Pediatric Dentistry. 2016;38(2):5E-12E. Doi: 10.5005/jp-journals-10005-1400.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, Department of Paediatric and Preventive Dentistry, Narayana Dental College and Hospital, Nellore, Andhra Pradesh, India.
2. Professor, Department of Paediatric and Preventive Dentistry, Narayana Dental College and Hospital, Nellore, Andhra Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
SVSG Nirmala,
Professor, Department of Paediatric and Preventive Dentistry, NDCH,
Nellore-524003, Andhra Pradesh, India.
E-mail: nimskrishna2007@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jul 03, 2024
- Manual Googling: Apr 14, 2025
- iThenticate Software: May 06, 2025 (17%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jun 24, 2024**
Date of Peer Review: **Jul 29, 2024**
Date of Acceptance: **May 08, 2025**
Date of Publishing: **Oct 01, 2025**