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Clinical and Radiographic Assessment of Allium Sativum Oil versus Ferric Sulphate in Vital Pulpotomy of Primary Molars

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ABSTRACT

Background: There is a lack of reliable evidence to support using of Allium sativum oil as a medicament in vital pulpotomy in primary molars as well as comparing it with Ferric sulphate, therefor the current study aimed to provide a reliable basis for treatment decision. **Patients and methods:** This clinical control trial using a split-mouth technique on 30 primary molars indicated for pulpotomy, 13 children enrolled from the Outpatient Clinic of the Department of Pediatric Dentistry, Faculty of Dentistry, Suez Canal University. Sampling method was chosen as each child had both interventions and there wasn't a control group, thus helping to show the efficacy of both treatments. **Results:** The clinical success was 100% and 80% for Ferric sulphate and Allium sativum oil, respectively. Both groups were successful at baseline, after 3, 6 and 12 months, with no statistically significant difference between the two groups. Ferric sulphate and Allium sativum oil groups were 100% and 93.3% successful radiographically after 3 months, respectively. After 6 and 12 months, they were 100% and 80% successful, respectively, so there is no significant difference between two groups. **Conclusion:** The pulpotomy performed in primary molars using Allium sativum oil is likely to have similar clinical and radiographic success as that of Ferric, hence could be considered as suitable alternative to Ferric sulphate.

Keywords: Vital Pulpotomy ; Primary Molars ; Allium Sativum Oil ; Ferric Sulphate

Introduction

Dental caries is a preventable, localized transmissible, multifactorial disease resulting from interaction between host, diet, and microflora on the tooth surface over a period of time, resulting in demineralization of enamel and dentin and formation of cavities. The most commonly related bacteria in its etiology are *Streptococcus mutans* for its onset and *Lactobacilli* for its advancement [(1)]**.**

Preservation of the remaining vital portion of cariously exposed pulpal tissue in primary teeth, where the demand is to keep a functioning tooth in site, was one of the most frequent problems in pediatric dentistry. To solve this problem pulpotomy therapy was introduced, developed and classified according to treatment objectives. Pulpotomy is mainly used for any deciduous teeth and young permanent teeth with vital pulp exposure, with a clinical success

rate of 83%-100%. So pulpotomy is recommended in clinical treatment guidelines of the American Academy of Pediatric Dentistry to preserve the vitality of the pulp, to maintain the integrity and health of the teeth and its support tissues, where part of the pulp can be retained, so that the root can continue to develop to maintain the normal replacement of deciduous teeth with permanent teeth [(2)].

Pulpotomy involves amputation of the coronal portion of affected or infected dental pulp, treatment of the remaining vital radicular pulp tissue surface should preserve the vitality and function of all or part of the remaining radicular portion of the pulp. Furthermore, it is an accepted procedure for treating both primary and permanent teeth with carious pulp exposures, several materials have been used for capping the radicular pulp after pulpotomy, and these included formocresol, glutaraldehyde, ferric sulfate, collagen material, and mineral trioxide aggregate. To choose a pulpotomy agent, several characteristics should be considered, such as antibacterial activity, handling process and dentinogenesis [(3,4)].

Ferric sulphate has been commonly used as a pulpotomy medicament to control pulpal bleeding in vital pulp therapy for three decades. It induces hemostasis by forming a sealing membrane at the damaged vessels of pulpal tissue by agglutinating the blood proteins with ferric and sulfate ions [(5)].

There has been the use of herbal medicine as a pulpotomy medicament due to its good antibacterial effect and least complications compared to standard chemically synthesized pulpotomy medicaments [(6)].

Garlic oil and its scientific name is Allium sativum, is one of the most extensively researched medicinal plants and its antibacterial activity depends on allicin produced by enzymatic activity of allinase. Allicin and other thiosulfinates are believed to be responsible for the range of therapeutic effects reported for garlic. Allium sativum extract has been known to have inhibitory activity on various gram-positive and gram -negative pathogenic bacteria, viruses and fungi. As well as Allium sativum oil offers a good healing potential, leaving the remaining pulp tissue healthy and functioning [(3,6)].

Until now according to our knowledge, there is no study was conducted to neither compare Allium sativum with Ferric sulphate in vital pulp treatment in primary molars nor for a long period follow up. The objective of this study was clinical evaluation of Allium sativum oil and Ferric sulphate in the vital pulpotomy of primary molars in 3,6 and 12 months follow up periods in terms of pain, tenderness to percussion, swelling, presence of fistula and mobility. As well as, radiographic evaluation of Allium sativum oil and Ferric sulphate in the vital pulpotomy of primary molars in 3,6 and 12 months follow up periods in terms of periapical and furcation radiolucency, widening in periodontal ligament space, internal and external root resorption.

Patients and Methods

The present study was conducted in the outpatient clinic of the Department of Pediatric Dentistry, Faculty of Dentistry, Suez Canal University, between April 2020 and April 2022. An approval of the Research Ethics Committee (REC) of the Faculty of Dentistry, Suez Canal University (270/2020). The legal guardian of each participant signed an informed consent that comprises the full details of the clinical steps including any possible risks or failure (Appendix 1). The children's participants and their legal guardian were blinded to the type of material they received.

Sample size calculation for Vital Pulpotomy Technique:

$$N = \frac{(Z_\alpha)^2 * (S)^2}{(d)^2}$$ (***N***= Total sample size, Z_α= Is standard normal variation and its equal 1.96 at P<0.05; ***SD*** = Standard deviation of variable, ***d***= Absolute error or precision)

Z_α	***SD***	***D***
1.96	**5.58**	**2.0**

Total sample size $N = \frac{(1.96)^2 x (5.58)^2}{(2)^2} = 29.903 \approx 30$ Samples

Total sample size is 30 samples (15 in each group) and the data was recorded after three intervals 3, 6 and 12 months.

Inclusion criteria:

Children were selected from at the Outpatient Clinic,Suez Canal University according to **Mohammad and Baroudi** [3]**.** Children should be apparently healthy with no medical or developmental compromising conditions, patient and parent cooperation, and age ranged from 4-7 years of both sexes. No history of administration of Antibiotic or Anti-inflammatory drugs for at least 4 weeks before the treatment visit. Children having at least two bilateral decayed primary molars indicated for vital pulpotomy with selection criteria as follow:

1-Clinical criteria: included absence of clinical signs or symptoms suggesting a non-vital tooth such as fistula, sinus tract, soft tissue swelling, mobility or tenderness to percussion. No history of spontaneous pain or provoked pain. No signs of inflammation extending beyond the coronal pulp**.** Possibility for establishing crowns**.** Exposure of the vital pulp after excavation of caries with no clinical evidence of the extensive pulp degeneration or any periapical pathologic condition**.**

2- Radiographic criteria: Physiologic resorption does not exceed one third of the root, no pathological external or internal root resorption, no periapical radiolucency, as well as no calcific pulp degeneration**.**

Exclusion criteria:

Severe bleeding after complete removal of coronal pulp tissue. If allergic manifestations to any of the medications appeared during treatment. Patients could not attend to follow up visits.

- **Participants preparation**:

A comprehensive history and a thorough clinical examination were conducted on each of the selected children. Moreover, asking the parents or caregivers about any medical problems that may contraindicate the use of any of the intended procedures. The study enrolled the first eligible respondents having at least two bilateral primary molars indicated for vital pulpotomy. The rest of patients were referred to the Pediatric Dentistry Department's clinicians for management **(Fig. 1)**.

A diagnostic sheet had been made for each child including the personal information, clinical and radiographic evaluations. At least a pair of primary molars indicated for pulpotomy were selected for treatment in each child. A preoperative periapical radiograph of the intended tooth was performed as a treatment base radiograph. **Fig (2)**

Grouping:

This study included 30 decayed primary molars indicated for vital pulpotomy with split mouth technique allocated according to the type of medicament and dressing material:

- **Group 1 (Allium Sativum Oil)"AS":** Vital pulpotomy procedure using Allium sativum oil as a medicament was done on 15 primary molars on the left side, followed by application of Zinc oxide – Allium sativum.
- **Group 2 (Ferric Sulphate)"FS":** Vital pulpotomy procedure using Ferric sulphate as a medicament was done on 15 primary molars on the right side, followed by application of Zinc oxide – Eugenol.

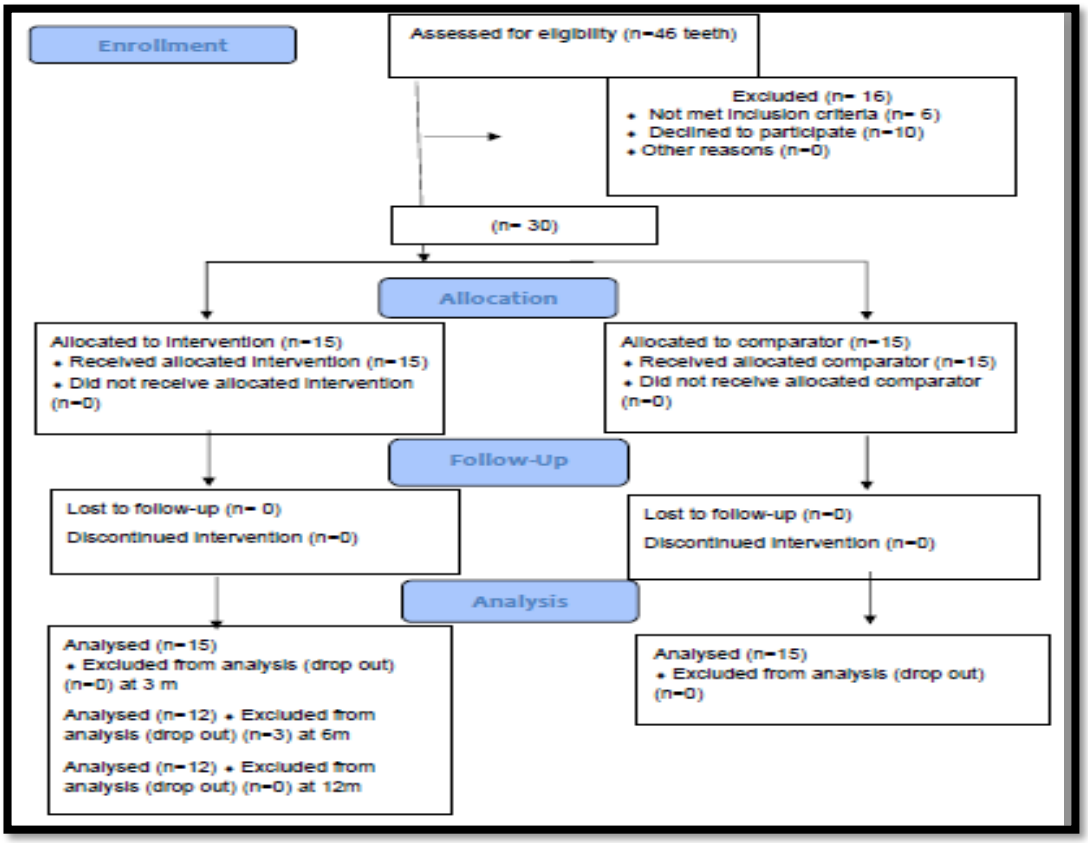

Figure (1): CONSORT flow diagram of the study

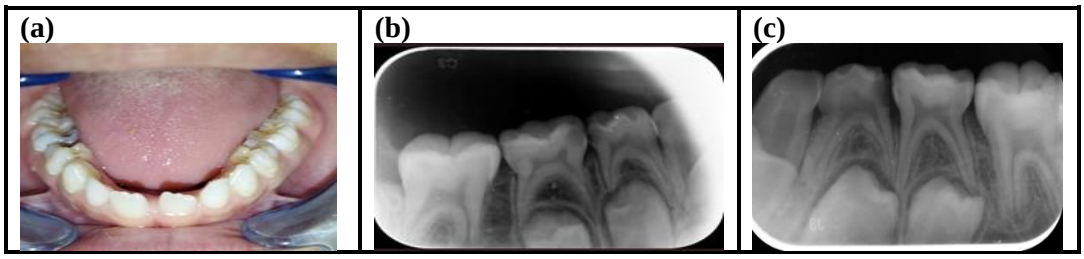

Fig (2):showing (a) pre-operative digital photo; (b) pre-operative radiograph for the FS group ; (c) pre-operative radiograph for the AS group.

Procedure for vital pulpotomy technique:

Topical anesthetic in the form of gel was applied at the area to be injected with cotton applicator after drying mucosa and with application of suction tip.

The syringe and its components were assembled outside the child's field of vision. The Articaine local anesthesia was used and injected slowly with distracting the child's attention; if two adjacent primary molars were to be treated the injection was applied between two neighboring teeth. Assuring the child by telling him that the tooth will "wake up" in due time. It was useful in some children to show them that the face has not changed using a mirror.

After the administration of anesthesia, the designated tooth was properly isolated with a rubber dam and suction. Complete removal of caries or undermined enamel was performed prior to pulpal access using a high-speed contra and round bur size #1. After that, gaining a small access to the pulpal chamber using a round bur with air/water spray, then pulp chamber was completely deroofed.

Complete removal of coronal pulp tissue was done using small cotton pellet and sharp spoon excavator, homeostasis was attained by placing small cotton pellets moistened in sterile saline with gentle pressure for 5 minutes then it was removed.

- **Dressing:**

Depending on group allocation, the pulp stumps of molars were dressed as follows:

Group 1: for molars in the left side; a cotton pellet damped with Allium sativum oil was applied for 5 minutes then pulp stumps were dressed with freshly prepared zinc oxide-allium sativum oil paste, by mixing one scoop of zinc oxide powder with one drop of Allium sativum oil till reaching suitable and malleable consistency (1:1 ratio by volume). **(Mohammad and Baroudi 2015)**

Group 2: for molars on the right side; a cotton pellet damped with Ferric sulphate was applied for 15seconds then pulp chamber was flushed with saline and dried with cotton pellet according to manufacture instructions, then pulp stumps were dressed with reinforced zinc oxide /eugenol paste.

All treated molars were restored with stainless steel crowns. Clinical photo and digital radiographic baseline were done immediately after treatment and digital radiographic follow up after 3, 6 and 12 months.

- **Data management:**

For each patient, both hard and a soft copy of his/her data had been saved.

- The hard copy included a printed diagnostic chart that was filled for each patient separately and stored with all printed periapical radiographs.
- A soft copy of the patient's diagnostic chart and periapical radiographs had been saved on a google drive
- Patient files were stored in numerical order and stored in a secure and accessible place.

A) Clinical investigation:

1. **History of pain**

The patient or the legal guardians was asked about Any pain or discomfort sensation related to treated primary molars, where the pain history of the complained tooth was

investigated through a series of questions about the location, intensity, description, duration, and timing of the pain and any possible relieving or predisposing factors**.**

2. **Tenderness to percussion**

Mainly we depend on evaluation if there is tenderness on percussion of the treated primary molar or not, percussion was done by the blunt side of the mirror, and making percussion from occlusal and buccal side **(Gopakumar and Gopakumar 2011)**.

3. **Teeth mobility**

The periodontal attachment surrounding the tooth is evaluated by using the teeth mobility test. The test is performed by using the blunt ends of 2 mirrors, and moving the tooth buccolingually and laterally in its socket. Teeth mobility was evaluated According to **Glickman (1972):**

a. Grade I: Normal or Slightly more than normal (from 0.5 -less than 1mm).
b. Grade II: Moderately more than normal (from 1– less than 2mm).
c. Grade III: Severe buccolingual mobility also in the lateral sides combined with vertical depression (greater than 2 mm).

4. **Erythema, swelling and fistulous tract**:

Presence of any sign in the surrounding gingival tissues and mucosa were evaluated through visual inspection.

B) Radiographic investigation:

Periapical radiographs were taken using digital radiographic system with phosphor storage plate size #0, periapical film holder and bisecting angle technique, exposure parameters were 70 KVp, 7 mA, and 0.280 seconds exposure time in pre-operative, 3-, 6- and 12-months post-operative, radiographic assessments were done using ImageJ Software **(Arifin et al.,2021)**. Radiographic criteria assessed:

1. **Presence or absence of furcation or periapical radiolucency.**

It was measured by using Mean Gray Value tool in ImageJ Software, and it was categorized as the absence of bone loss (no change in bone density), gray shade (varying degree of contrast) and complete radiolucency which means that there was buccal and lingual bone loss **(Farook et al., 2020).**

2. **Presence or absence of widening in the periodontal membrane:**

It was measured by using Measuring Distances Between Points tool in ImageJ Software.

3. **Presence or absence of pathologic internal or external root resorption**

It was measured by using Inter mode option of Threshold tool in ImageJ Software

- **Study dropouts**

Treatment was considered as clinically failure when one or more of the clinical investigation features was detected and radiographically failure when one or more of the

radiographic features was detected, when failure detected supervisor decided to shift to another line of treatment whether subtotal pulpectomy or extraction depending on diagnosis, and it was considered dropped out from the study.

Statistical analysis

Qualitative data were presented as frequencies and percentages. Fisher's Exact test and Friedman's test were used. Numerical data were explored for normality by checking the distribution of data and using Kolmogorov-Smirnov and Shapiro-Wilk tests. All numerical data showed parametric distribution. Numerical data was presented as mean and standard deviation (SD) values. Kaplan-Meier survival curve estimated mean survival estimates of the two groups. Comparison between survival times using Log rank test. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Results

The present study was conducted on 13 subjects; five boys (40%) and eight girls (60%). The mean and SD values for age was 5.5 ± 1.5 years old with a minimum of 4 and a maximum of 7 years old **(Table 1)**.

As regards Ferric sulphate group, there was no change in prevalence of pain by time. While for Allium sativum group, there was a statistically significant change in prevalence of pain. There was an increase in prevalence of pain after six months, where three first primary molars showed pain, two of them showed spontaneous pain so supervisor decided to shift the line of treatment into subtotal pulpectomy, and one showed discomfort sensation so supervisor decided to shift the line of treatment into extraction, according to diagnosis which depend on other clinical and radiographic investigations **(Table 2)**.

Table (1): Age and gender distribution in the study sample

Variables		Present	
		N	%
Age(yrs.)	Mean±SD	5.5 ± 1.5	
	Range	4-7	
Sex	Boy	5	40
	Girl	8	60

Table (2): Comparison between pain at different time periods within each group

Time	Allium sativum oil (no. = 15)		Ferric sulphate (no. = 15)	
	n	%	n	%
Base line				
Pain	0	0	0	0
No pain	15	100	15	100
Three months				
Pain	0	0	0	0
No pain	15	100	15	100
Six months				
Pain	3	20	0	0

No pain	12	80	15	100
12 months				
Pain	0	0	0	0
No pain	12	80	15	100
Drop-out	3	20	0	0
***P*-value**			**0.029***	
Effect size (w)			**0.2**	

: Significant at P ≤ 0.05

As regards Ferric sulphate group, there was no change in prevalence of tenderness to percussion by time. While for Allium sativum oil group, there was a statistically significant change in prevalence of tenderness to percussion. There was an increase in prevalence of tenderness to percussion after six months, where 3 first primary molars in the Allium sativum group showed tenderness on percussion **(Table 3)**.

There was no change in prevalence of mobility by time in FS group. While for Allium sativum group, there was a statistically significant change in prevalence of mobility. There was an increase in prevalence of mobility after six months, where one first primary molar showed GII mobility **(Table 4)**.

As regards Ferric sulphate group, there was no change in prevalence of swelling by time. While for AS group, there was a statistically significant change in prevalence of swelling, because there was an increase in prevalence of drop-outs after six months follow up period because 3 primary molars have been dropped out for other reasons rather than swelling **(Table 5)**.

There was no change in prevalence of fistula by time in FS group. While for AS group, there was a statistically significant change in prevalence of fistula. There was an increase in prevalence of fistula after six months **(Table 6)**.

Table (3): Comparison between tenderness to percussion at different time periods within each group

Time	**Allium sativum oil (no. = 15)**		**Ferric sulphate (no. = 15)**	
	No.	**%**	**No.**	**%**
Base line				
Tenderness to percussion	0	0	0	0
No	15	100	15	100
Three months				
Tenderness to percussion	0	0	0	0
No	15	100	15	100
Six months				
Tenderness to percussion	3	20	0	0
No	12	80	15	100
12 months				
Tenderness to percussion	0	0	0	0
No	12	80	15	100
Drop-out	3	20	0	0
***P*-value**			**0.029***	

Effect size (w)	**0.2**

**: Significant at P ≤ 0.05*

Table (4): Comparison between mobility at different time periods within each group

Time	Allium sativum oil (no. = 15)		Ferric sulphate (no. = 15)	
	No.	%	No.	%
Base line				
Mobility	0	0	0	0
No	15	100	15	100
Three months				
Mobility	0	0	0	0
No	15	100	15	100
Six months				
Mobility	1	6.7	0	0
No	14	93.3	15	100
12 months				
Mobility	0	0	0	0
No	12	80	15	100
Drop-out	3	20	0	0
***P*-value**			0.043*	
Effect size (w)			0.181	

**: Significant at P ≤ 0.05*

Table (5): Comparison between swelling at different time periods within each group:

Time	Allium sativum oil (no. = 15)		Ferric sulphate (no. = 15)	
	No.	%	No.	%
Base line				
Swelling	0	0	0	0
No swelling	15	100	15	100
Three months				
Swelling	0	0	0	0
No swelling	15	100	15	100
Six months				
Swelling	0	0	0	0
No swelling	15	100	15	100
12 months				
Swelling	0	0	0	0
No swelling	12	80	15	100
Drop-out	3	20	0	0
P-value			0.029*	
Effect size (w)			0.2	

**: Significant at P ≤ 0.05*

Table (6): Comparison between fistula at different time periods within each group

Time	Allium sativum oil (no. = 15)		Ferric sulphate (no. = 15)	
	No.	%	No.	%
Base line				
Fistula	0	0	0	0
No fistula	15	100	15	100
Three months				
Fistula	0	0	0	0
No fistula	15	100	15	100
Six months				
Fistula	2	13.3	0	0
No fistula	13	86.7	15	100
12 months				
Fistula	0	0	0	0
No fistula	12	80	15	100
Drop-out	3	20	0	0
***P*-value**			**0.041***	
Effect size (w)			**0.183**	

**: Significant at $P \leq 0.05$*

At base line as well as after three months, all cases in the two groups were clinically successful. After six, there was dropped out of 3 cases in the Allium sativum group, while after 12 months, all cases in the two groups were clinically successful. So, there was no statistically significant difference between clinical success in the two groups. Clinical success was 100% in ferric sulphate group and 80% in Allium sativum oil group **(Figure 3)**.

At base line, all cases in the two groups were radiographically successful. After three, six as well as 12 months, there was no statistically significant difference between radiographic success in the two groups. Radiographic success after three months was 100% and 93.3% for the two groups, respectively. Radiographic success after six as well as 12 months was 100% in Ferric sulphate group and 80% in Allium sativum group **(Figure 4)**.

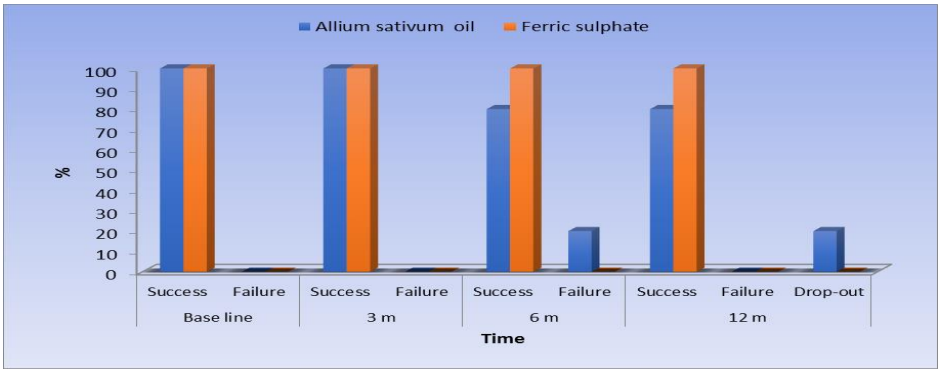

Fig (3): Bar chart representing clinical success in the two groups.

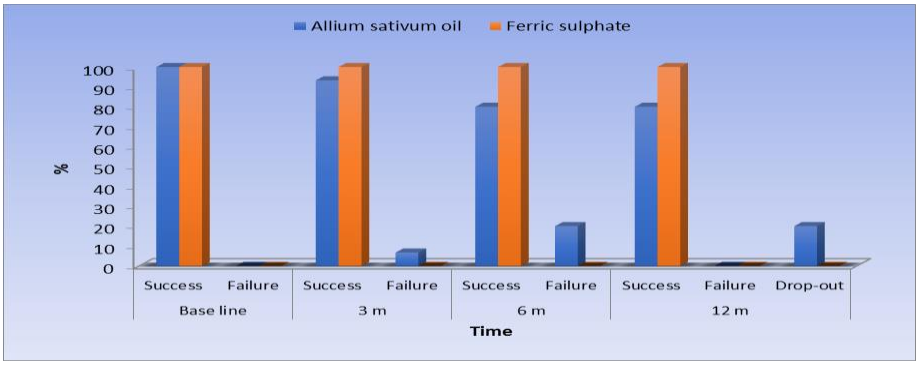

Fig (4): Bar chart representing radiographic success in the two groups.

DISCUSSION:

The current study compared Ferric sulphate and Allium sativum oil, while other studies compared Ferric sulphate or Allium sativum with other common materials specially formcresol as a gold standard material used as a medicament in pulpotomy. [13]

Gomaa and Allam 2020) compared garlic oil and formocresol (as a gold standard) using a randomization sampling method in order to reduce any potential bias. In addition, a split-mouth technique was used in this study to minimize the number of participants with preserving the power of the sample size, and also to clear out any control bias. (**Nematollahi et al. 2018)** used the same split-mouth technique to compare Mineral Trioxide Aggregate pulpotomy versus Formocresol pulpotomy .

One of the inclusion criteria for this study was the children's age, which was selected between the ages of 4 and 7 years old. Because if more advanced age children were chosen, physiologic root resorption will take place and the selection of children less than 4 years old will result in children's lack of cooperation, which in turn affects the judgment on the effectiveness of the used pulpotomy material as mentioned by **(El-Gebaly et al. 2022)** who used the same age range in their study. Furthermore, decayed mandibular and maxillary primary molars that required pulpotomy procedures were selected.

Moreover, a full patient history was the first step to reach a proper diagnosis in order to take the correct treatment option. On that basis, personal and medical histories with the chief complaint were obtained from the child with help of his/her legal guardian. Personal history was taken to reduce the child's anxiety about the operator and to establish a good rapport. Medical history was obtained to detect any systemic diseases or allergies from local anesthesia or pulpotomy agents used in this trial that could influence the treatment options.

In the framework of this study, another important eligibility criteria were to recruit children who apparently appeared healthy both medically and mentally. As systemic diseases might change the treatment plan and affect the pulp reaction to the pulpotomy material that was used as per (**El-Gebaly et al. 2022)**. As part of this study, children were included only with no history of administration of antibiotics or anti-inflammatory drugs for at least 4 weeks before the treatment visit in order to control the confounding variable of pre-operative medication effect on pain and to accurately investigate the efficacy of Allium sativum and Ferric sulphate materials solely for pulpotomy. On the other hand, some authors believed that they should give a single dose pre-operative anti-inflammatory medication such as in a study

of **(Shafie et al. 2018)** ibuprofen (4-10 mg/kg) was given as a single dose pre-operative medication as they thought it might relieve post-operative pain.

Furthermore, adding a base material is essential after adding the dressing material to preserve the remaining pulp tissue. In the current study, reinforced zinc oxide-eugenol was used in the ferric sulphate group and zinc oxide-allium sativum was used in the Allium sativum pulpotomy group as a base material as it has anti-inflammatory and palliative effects on the pulp tissue, where zinc oxide-allium sativum was used as a base by **(Mohammad and Baroudi 2015)** and **(Abirami et al. 2020)** in their studies, where **(Kahvand et al. 2019)** mentioned that adding Allium sativum oil to zinc oxide powder had a positive effect on their results as it maintained the main properties of garlic. while on the other hand it was difficult to obtain suitable base by mixing Ferric sulphate with zinc oxide powder as ferric sulphate had a solution form.

that both groups did not complain of pain or tenderness to percussion neither at baseline nor after 3 months. After 6 months, three cases of Allium sativum group complained from pain and tenderness to percussion but there was no statistically significant difference between the prevalence of pain and tenderness to percussion in the two groups, where (**Kahvand et al. 2019)** and (**Mahfouz et al. 2019)** claimed that the analgesic effect of A. sativum oil may be attributed to its active components, including ajoene and diallyl sulphide, which suppress prostaglandin production. As regards the Ferric sulphate group, there was no change in the prevalence of pain by time, so no statistical comparison was performed. By time in 12 months, no pain or tenderness to percussion noted in both groups

In the current study, when assessing presence of mobility it was clear that both groups had no any sign of mobility at base line as well as after three months , while after six months in Allium sativum group one first primary molar showed GII mobility not associated with exfoliation and this agreed with **(Mohammad and Baroudi 2014)** who noted two cases/ten cases treated with Allium sativum vital pulpotomy showing mobility in six months follow up , while no sign of mobility in Ferric sulphate group .By time in 12 months , no mobility noted in both groups.

This study also clarified that neither Ferric sulphate nor Allium sativum resulted in any swelling at baseline, after 3, 6 and 12 months. This disagrees with (**Havale et al. 2013)** who noted post-operative edema and pathologic movement as clinical failures in the Ferric sulphate group, linked to periapical and pulpal chronic inflammation, although in their study of ferric sulphate pulpotomy, the clinical success was 96.7% and clinical failure cases occurred after 1 year follow up.

Moreover, when assessing the presence of fistula, it was clear that both groups had no fistula at baseline and after 3 months. By time, there was no change with the Ferric sulphate group after 6 and 12 months in contrast to Allium sativum oil which showed an increase in the prevalence of fistula after 6 months, where two primary first molars showed fistula during thorough clinical examination, and this agreed with **(Mohammad and Baroudi 2015)** who noted draining fistula in only two teeth /20 teeth treated with Allium sativum oil pulpotomy after 6 months follow up. And by time, at 12 months no fistula noted in Allium sativum oil group.

The clinical success was 100% and 80% for Ferric sulphate and Allium sativum, respectively. Both groups were successful at baseline, after 3, 6 and 12 months, with no statistically significant difference between the two groups. Our results coincide with the

findings of (**Havale et al. 2013)** who concluded that Ferric sulphate was relatively successful as pulpotomy medication in primary teeth with a success rate of 96.7% after 1 year, and similar to **(Erdem et al. 2011)** who reported 100% success in their ferric sulphate group. Moreover, **(Huth et al. 2012)** also matched our findings as they observed 100% clinical success with Ferric sulphate after 1 year of follow-up.

Furthermore, the percentage of teeth that reach a predetermined point in time without showing any signs of inflammation, either clinically or radiographically, was previously used to calculate the success rate of pulpotomies. Similar to (**El-Gebaly et al. 2022), (Fuks et al. 2019)** and **(Durmus et al. 2014)**, the success rate of pulpotomy therapy in the present study was defined as the absence of clinical or radiographic pathology at follow-up sessions.

The present study has some of limitations included selection of the patient and molars with inclusion criteria was difficult especially with using split mouth technique. Difficulty to obtain Ferric sulphate as it is exported to our country and it is not available in the market till now. Limited number of researches concerning with evaluation of Alluim sativum oil and its comparison with Ferric sulphate.

Conclusion:

The pulpotomy performed in primary molars using Allium sativum oil is likely to have similar clinical and radiographic success as that of Ferric, hence could be considered as suitable alternative to Ferric sulphate.

Based on the observation and results of the present study, it is concluded that Allium sativum oil could be used successfully as a pulpotomy agent in primary molars. However, statistically there was no significant difference in the clinical as well as radiographic success between the two materials after a period of 12 months.

Conflict of interest: The authors declare no conflict of interest.
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Author contribution: Authors contributed equally in the study.

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