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Efficacy of Chitosan Irrigation for Pulpectomy in Non-Vital Primary Teeth: A Clinical-Radiographic Study

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ABSTRACT

Introduction: Despite the antibacterial properties of sodium hypochlorite (NaOCl), it is cytotoxic and cannot effectively remove the smear layer. Chitosan is a natural nontoxic biopolymer having antimicrobial properties.

Aim: Clinical and radiographic assessment of 0.2% chitosan as final irrigating solution in pulpectomy in non-vital primary teeth for 1 and 3 minutes versus sodium hypochlorite.

Methods: A randomized clinical trial included 45 non-vital primary molars in 43 patients aged from four to seven years old were randomly divided into 3 equal groups. In Group I (control group), 2 ml of 1% NaOCl was used for irrigation after each file. In Group II, 5 ml of 0.2% chitosan was used as final irrigat and left in the canal for one minute. While in group III chitosan was left in the canal for 3 minutes. Clinical Assessment was performed regarding pain on percussion and changes in mucobuccal fold. Radiographical evaluation was done at 3,6,12 months follow up intervals using standardized periapical radiographs and analyzed using Image J program.

Results: Studied teeth were recorded as first primary molars (D) and second primary molars (E) with total percentage for each group (I, II and III). Although the high clinical and radiographic success rate, there was no significant difference between the three groups.

Conclusion: Pulpectomy irrigation using either NaOCl alone or chitosan as a final irrigant for one or three minutes exhibited a good clinical and radiographic success rate with no significance difference**.**

Keywords: *Radiographical evaluation; Non-vital primary teeth, Chitosan, Irrigation, Pulpectomy..*

1. INTRODUCTION

The intricate anatomy of the canal system of primary teeth including lateral and accessory canals and apical ramifications, leads to instrumentation challenging during pulpectomy. Therefore, in order to eliminate bacteria, dissolve and eradicate tissue debris, irrigating solutions are imperative (1). It was found that one of the predominant types of bacteria in deciduous root canal was Enterococcus faecalis (2). The several resistance mechanisms of E. faecalis enable it to survive in the presence of intracanal medications and irrigants, as well as to penetrate dentinal tubules and adhere to collagen (3).

Sodium hypochlorite (NaOCl) is the most often utilized root canal irrigant, it is able to dissolve organic tissues

during chemomechanical root canal debridement (4). Despite its antibacterial properties and its great tissue dissolving power, NaOCl cannot effectively remove the smear layer (5). In Addition, its cytotoxicity necessitates the search for a biocompatible and effective root canal irrigant (6).

Chitosan is a natural nontoxic biopolymer produced by partial deacetylation of chitin present in the cell walls of fungus, the exoskeleton of crustaceans primarily crabs and shrimp, insect cuticles, and algae.The antimicrobial activity of chitosan occurs due to the interaction of chitosan's polycations with the negatively charged surface of microorganisms forming the polymer

coating on the cells' surface and thus prevents the cells from accessing nutrients (7,8). Chitosan is effective to remove smear layer from the root canal (9).

Until the beginning of the study (according to our knowledge), nearly no in-vivo study was conducted to evaluate the chitosan as a final irrigant in pulpectomy in deciduous teeth. The null hypothesis proposes that there is no significant difference between the irrigating solutions

2. SUBJECTS AND METHODS

This study is a randomized clinical trial (RCT) that approved before the beginning of this study by the Ethics Committee and has been registered with the Clinical Trials.gov (approval no.33/2017). It was conducted in accordance with the World Medical Association Declaration of Helsinki. Following a diagnosis, the parents of the children received a detailed explanation of the treatment plan. Informed written consent was obtained prior to the therapeutic interventions.

Inclusion criteria of children

The children included were apparently heathy children aged from four to seven years. No previous history of antibiotics for at least two weeks.

Inclusion criteria of the teeth

This study comprised non-vital mandibular first and second primary molars with suitable residual tooth structure for rubber dam isolation and restoration. Clinical evidence of tooth non-vitality as intra-oral fistula was selected. Infection diagnosed by presence of periapical or furcation radiolucency in a periapical radiograph. Root resorption was not more than one third of the root.

Exclusion criteria

The teeth with serious reduction in bone support or extreme tooth mobility or internal root resorption were excluded.

Randomization method

Molars teeth were randomly assigned into control or experimental groups according to a sequence generated by a computer software (random.org). Allocation concealment was completed by numbered opaque sealed envelopes. The child chose randomly an envelope and opened it; thus, the operator recognized the type of irrigating material.

Sample size calculation

G*Power version 3.1.3 was used to calculate the sample size **(10).** The effect size was 0.57 using alpha (α) level of 0.05 and Beta (β) level of 0.05, i.e., power = 95%; the estimated minimum sample size (n) should be at least 45 teeth for the 3 groups in this experiment. The sample size calculations revealed that a sample size should be at least 15 teeth per group. Where; f= is the effect size=0.57; α= 0.05; β=0.1; Power (1- β) = 0.95

$$f = \frac{\sigma_\mu}{\sigma}$$

$$\sigma_\mu^2 = \frac{\sum_{j=1}^{k} n_j (\mu_i - \mu)^2}{N}$$

The 45 non-vital primary molars in 43 patients were randomly divided into 3 equal groups, either primary first or second molar. In group I (control group): teeth were irrigated by 2 ml of 1% NaOCl after each file. In Group II, 5 ml of 0.2% chitosan was used as final irrigating solution and left in the canal for one minute. While in group III, chitosan was left in the canal for 3 minutes.

Preparation of chitosan solution:

0.2 grams of chitosan powder and 100 milliliters of 1% acetic acid were mixed to create a 0.2% chitosan irrigant solution. The mixture was then agitated for two hours with a magnetic stirrer until the chitosan powder was dissolved and a homogenous, transparent solution was produced. It was then kept for two weeks at 4°C in the dark **(11).**

Clinical procedures

In the first visit, topical anesthesia was administered to the patient followed by nerve block anesthesia using Articaine HCI 4% with 1:100,000 epinephrine. The selected molar was isolated using rubber dam. After caries removal, a conventional access cavity was made using a high-speed round bur size 6 and the coronal pulp was removed using a sharp spoon excavator. The working length was kept 1mm shorter than radiographic apex in the periapical radiograph.

Root canal preparation was done using K- files with a pullback action (size 15, 20, 25, 30). In accordance with the pre-allocated sample grouping, every tooth was irrigated using its specific irrigation type. At the end, 5 ml of saline was used to

flush the root canal, the tooth was dried using paper points, then a cotton pellet was placed, and the tooth was temporarily sealed with glass ionomer restoration.

In the Second visit (after 48 hours), anesthesia was administrated for rubber dam application. Zinc oxide and eugenol mix was used as root canal filling material and the tooth was finally restored with stainless steel crowns.

Post-operative evaluation and follow-up

Clinical evaluation was done at 1,3,6,12 months follow-up intervals. Pain with percussion (present or absent) was evaluated. Changes at the muco-buccal fold as presence or resolution of fistula, were detected by visual examination. The patients' guardians were instructed to contact the investigator if any adverse signs or symptoms occurred between follow-up recalls.

Radiographical evaluation was done at 3,6 and 12-months follow-up intervals, using periapical radiograph. Standardized periapical parallel technique was done using the rinn (XCP) periapical film holder and a long cone, (sixteen inch in length) which was mounted to the x-ray tube and the plastic aiming ring of XCP film holder was fixed flush- ended with the round end of the long cone.

Immediate postoperative periapical radiograph was considered as baseline record for the successive films. Immediate postoperative periapical radiographs were taken using Kodak films employing the Rinn XCP alignment system and the long cone paralleling technique for standardization. All films were exposed using the dental x-ray machine at the Pediatric Dentistry Postgraduate Clinic.

The radiographs were digitized using a transparency scanner. The radiographic technique and exposure parameters were considered fixed for all patients and were repeated for the follow-up recalls. Digital image files were converted to 32-bit TIFF files using Image-J analysis software. TurboReg plug-in was used to transform non-standardized preoperative and postoperative radiographs at each time interval (3,6,12 months) into standardized images. The same radiographic records and measurements were obtained twice at different times by the same radiographic assessor, who was blind to the type of irrigating solution used. The software Image-J was used.

The failure cases were managed according to the clinical situation either with extraction or re-treatment.

Success Criteria

Clinical success criteria, including absence of post-operative pain, no tooth mobility, and the presence of healthy soft tissue; no swelling, redness or sinus tract **(13,14)**.The radiographic success criteria, including continuity of lamina Dura, static or reduction in the size of existing pathologic bifurcation radiolucency, no newly formed radiographic lesion. Also, absence of pathological external or internal root resorption and evidence of bone regeneration **(15,16)**.

Statistical analysis

One-way ANOVA followed by Tukey post hoc test was used to compare between more than two groups in non-related samples. Two-way ANOVA test were used to test the interactions between different variables. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

Results

The present study was conducted on 45 non-vital primary mandibular molars in 43 children aged 4 to 7 years. The selected teeth were divided into 3 equal groups according to the type of irrigation and duration of its application (15 teeth in each group).Age distribution in years for group I (5%NaOCl), II (0.2% chitosan for 1 minute) and III (0.2% chitosan for 3 minutes) respectively were (4.71±0.5), (4.62±0.57) and (4.65±0.5) with no significant difference between groups. The minimum age representing the studied patients was started at 4 years old while the maximum age for group I, II and III were (5.6), (5.7) and (5.5) years old.While for gender distribution, total percentage for each group (I, II and III) were estimated for each gender as (80%), (73.3%) and (66.7%) for males respectively. Total percentage of females for each group (I, II and III) were estimated for each gender as (20%), (26.7%) and (33.3%) respectively. Regarding the first primary molars (D), the total percentage for each group were (60%), (46.7%) and (53.3%) respectively. While for second primary molars, the total percentage for each group were (40%), (53.3%) and (46.7%) respectively **(Table 1).**

For one year clinical and radiographic follow up, there was absence of drop-out rate in baseline, one month and three months (0%). While, there was as increase in drop-out rate, one case in each group (6.67%) at six and twelve months. For significance evaluation of different groups using Chi square test, it revealed insignificant difference as P-value > 0.05 **(Table 2).**

For one year clinical follow up among fixed intervals (baseline, one month, three months, six months and twelve months), failure rate was recorded as count and percentages (%). Regarding group (I) and (III), there was absence of clinical failure in all follow-up intervals (one month, three months, six and twelve months (0%). Regarding group (II), there was absence of failure at one-month follow-up (0%). While at three months, there was an increase in failure rate, one case (6.67%) pain on percussion. At six months and twelve months, the same case represents 7.14% due to drop out (total number of the group at six and twelve months was 14 patients). For significance evaluation of different groups using Chi square test, it revealed insignificant difference as P-value > 0.05 **(Table 3).**

For one year radiographic follow up among fixed intervals (baseline, three months, six months and twelve months), failure rate was recorded as count and percentages (%). Regarding group I, there was absence of radiographic failure at one month and three months follow-up (0%). While at six months, there was one case with radiographic failure (external root resorption) representing (7.14%) out of 14 patients due to drop-out **(Table 4).**

Regarding group (II), there was absence of failure at one-month follow-up (0%). While at three months, there was an increase in failure rate, one case (6.67%) with external root resorption out of 15 patients. At six months and twelve months, the same case represents 7.14% due to drop out (total number of the group at six and twelve months was 14 patients). In Addition, there was absence of radiographic failure in group III at one month and three months follow-up (0%). While at six months, there was one case with radiographic failure (widening of periodontal ligament space) representing (7.14%) out of 14 patients due to drop-out. For significance evaluation of different groups using Chi square test, it revealed insignificant difference as P-value > 0.05 **(Table 4).**

Pain on percussion distribution as showed all patients came suffering from pain on percussion. After treatment (considered as baseline), the three groups showed 100% absence of pain on percussion. At one month and three months in group I and III, all 15 cases in each group were negative (100%). While after six months, there was a decrease in negative cases 14 (100%) due to one case drop-out (6.67%). After twelve months, the number of negative cases became 13 (92.85%) with one case with radiographic failure (7.14%) and one case drop-out **(Table 5).**

In addition, regarding pain on percussion in group (II), all 15 cases (100%) were negative at one month. While after three months, there were 14 (93.3%) negative cases with 1 positive case (6.67%). The negative cases decrease at six and twelve months to 13 (92.85%) as there was one case drop-out (6.67%) and one positive case (7.14%) **(Table 5).**

Muco-buccal fold changes distribution showed 11 positive cases (73.66%) with muco-buccal fold changes and 4 negative cases (26.67%) in group I. In addition, in group II and III there were 10 positive cases (66.67%) in each group with muco-buccal fold changes and 5 negative cases (33.33%)**.** At the base line, 1 and 3 months, all 15 cases (100%) were negative for all groups,. Regarding group I and III, there was a decrease in negative cases 14 (100%) after six months due to one case drop-out (6.67%). After twelve months, the number of negative cases became 13 (92.85%) with one case with radiographic failure (7.14%) and one case drop-out. In addition, in group (II). The number of negative cases decrease at six and twelve months to 13 (92.85%) as there was one case drop-out (6.67%) and 1 case with radiographic failure (7.14%). There was insignificant difference between all groups in all different follow up intervals as P-value > 0.05 **(Table 6).**

A 5 years old female patient was complaining from pain and swelling in lower left quadrant. Pulpectomy was done to lower left first and second molar and clinical success after 1,3,6 and 12 months follow-up **(Fig 1)**.

Table (1): Demographic Data among Studied Groups

		Group I	Group II	Group III	P-value
Age	M ± SD	4.71±0.5	4.62±0.57	4.65±0.5	**0.9 (ns)**
	Min	4.00	4.00	4.00	
	Max	5.60	5.70	5.50	
Gender	M	12 (80%)	11 (73.3%)	10 (66.7%)	**0.71 (ns)**
	F	3 (20%)	4 (26.7%)	5 (33.3%)	
Tooth	D	9 (60%)	7 (46.7%)	8 (53.3%)	**0.76 (ns)**
	E	6 (40%)	8 (53.3%)	7 (46.7%)	

M; Mean, SD; Standard Deviation, %; Percentage, ns; Insignificant Difference using Chi Square Test

Table (2): Evaluation of Drop-Out during Clinical and radiographic Follow Up

	Group I	Group II	Group III
	Drop-Out	**Drop-Out**	**Drop-Out**
Baseline	0 (0%)	0 (0%)	0 (0%)
One Month	0 (0%)	0 (0%)	0 (0%)
Three Months	0 (0%)	0 (0%)	0 (0%)
Six Months	1 (6.67%)	1 (6.67%)	1 (6.67%)

Twelve Months	1 (6.67%)	1 (6.67%)	1 (6.67%)
P-value	**1.000 (ns)**	**1.000 (ns)**	**1.000 (ns)**

%; Percentage, ns; Insignificant Difference using Chi Square Test, NB: Drop out include the number of absent patients.

Table (3): Clinical Failure percentage in Studied Groups during Follow-up Intervals

	Group I	**Group II**	**Group III**
Baseline	0 (0%)	0 (0%)	0 (0%)
One Month	0 (0%)	0 (0%)	0 (0%)
Three Months	0 (0%)	1 (6.67%)	0 (0%)
Six Months	0 (0%)	1 (7.14%)	0 (0%)
Twelve Months	0 (0%))	1 (7.14%)	0 (0%)
P-value	**1.000 (ns)**	**0.55 (ns)**	**1.000 (ns)**

%; Percentage, ns; Insignificant Difference using Chi Square Test

Table (4): Radiographic Failure percentage in Studied Groups during Follow-up Intervals

Radiographic Failure	**Group I**	**Group II**	**Group III**
Baseline	0 (0%)	0 (0%)	0 (0%)
One Month	0 (0%)	0 (0%)	0 (0%)
Three Months	0 (0%)	1 (6.67%)	0 (0%)
Six Months	1 (7.14%)	1 (7.14%)	1 (7.14%)
Twelve Months	1 (7.14%)	1 (7.14%)	1 (7.14%)
P-value	**0.55 (ns)**	**0.55 (ns)**	**0.55 (ns)**

%; Percentage, ns; Insignificant Difference using Chi Square Test

Table (5): Pain on Percussion Percentage among studied groups during follow-up periods

	Group I	**Group II**	**Group III**	**P-value**
Baseline	15 (100%) Negative	15 (100%) Negative	15 (100%) Negative	**1.000 (ns)**
Month	15 (100%) Negative	15 (100%) Negative	15 (100%) Negative	
Three Months	15 (100%) Negative	14 (93.3%) Negative 1 (6.67%) Positive	15 (100%) Negative	
Six Months	14 (100%) Negative 1 (6.67%) drop out	13(92.85%) Negative 1 (7.14%) Positive 1 (6.67%) drop out	14 (100%) Negative 1 (6.67%) drop out	
Twelve Months	13 (92.85%)Negative 1(7.14%) radiographic failure 1(6.67%) drop out	13(92.85%) Negative 1 (7.14%) Positive 1 (6.67%) drop out	13 (92.85%) Negative 1(7.14%) radiographic failure 1(6.67%) drop out	

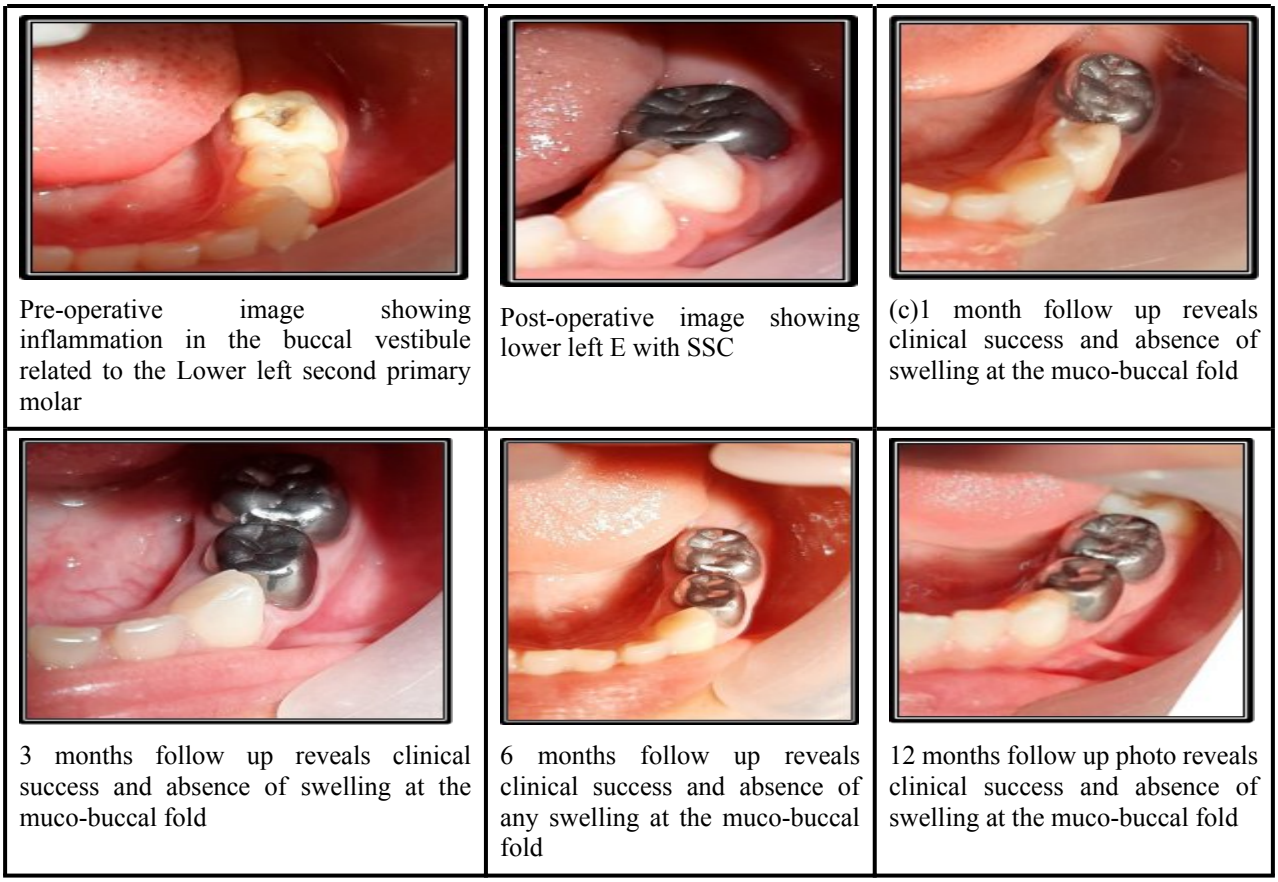
%; Percentage., P; Probability Level ; ns: Insignificant Difference using Chi Square Test

Table (6): Changes in Muco-buccal Fold Percentage among groups during follow-up periods

	Group I	**Group II**	**Group III**	**P-value**
Baseline	15 (100%) Negative	15 (100%) Negative	15 (100%) Negative	**1.000 (ns)**

(1)Month	15 (100%) Negative	15 (100%) Negative	15 (100%) Negative	
(3)Months	15 (100%) Negative	15 (100%) Negative	15 (100%) Negative	
Six Months	14 (100%) Negative 1 (6.67%) drop out	13(92.85%) Negative 1 (7.14%) radiographic failure 1 (6.67%) drop out	14 (100%) Negative 1 (6.67%) drop out	
Twelve Months	13 (92.85%) Negative 1(7.14%) radiographic failure 1(6.67%) drop out	13(92.85%) Negative 1 (7.14%) radiographic failure 1 (6.67%) drop out	13 (92.85%)Negative 1(7.14%)radiographic failure 1(6.67%) drop out	

%; Percentage., P; Probability Level ; ns: Insignificant Difference using Chi Square Test



Pre-operative image showing inflammation in the buccal vestibule related to the Lower left second primary molar

Post-operative image showing lower left E with SSC

(c)1 month follow up reveals clinical success and absence of swelling at the muco-buccal fold

3 months follow up reveals clinical success and absence of swelling at the muco-buccal fold

6 months follow up reveals clinical success and absence of any swelling at the muco-buccal fold

12 months follow up photo reveals clinical success and absence of swelling at the muco-buccal fold

Figure (1): Case 1 showing clinical success of pulpectomy in lower left first and second primary molar with absence of any swelling in muco-buccal fold

3. DISCUSSION

One of the most important concerns in pediatric dentistry is the loss of necrotic primary molars, therefore pulpectomy is considered as the treatment of choice for non-vital primary teeth. Chitosan has a significant effect on the reduction of E. faecalis count, in addition to its ability to remove smear layer especially the inorganic substance **(17,18)**. As a result of the intricate anatomy of root canal system of primary molars, irrigation with antibacterial irrigants is crucial to eradicate the microorganisms.

This study was performed to evaluate the clinical, radiographic and microbiological effect of 0.2 % chitosan as final irrigant for 1 and 3 minutes after 1% NaOCl after each file, in pulpectomy in 45 non-vital primary molars, in comparison with 1% NaOCl only after each file as a control group. This study was randomized controled trial which is the gold standard for a clinical trial and has the highest evidence. As much as possible, selection bias and confounding was reduced by

randomization, leaving the main difference between the three groups to be their exposure to certain therapies **(19).**

Allocation concealment was used to avoid selection bias by prohibiting researchers from influencing who is selected in the intervention or control group. It was carried out using numbered, sealed envelopes **(20)**.

In order to minimize any potential consequences on the prognosis and to eliminate any influence on the success rate of the treated teeth, apparently heathy children with no history of medical disorders were registered in this study **(21)**.

The age range of the children chosen for the current study was between four and seven years. This age is the most advantageous chronological age with significant root length, minimal or no root resorption, and patient participation **(14,22)**. In Addition, this age ensures a degree of patient cooperation **(23)**.

In the present study, teeth were selected according to predefined clinical and radiographic criteria that ensured to a great extent the fitting of the teeth to pulpectomy. Only mandibular primary molars were chosen due to the simplicity of visualization and the minimal overlap of permanent tooth buds onto the roots and furcation of lower primary molars, which enables the investigator to more clearly identify the radiographic pathology **(24,25).**

Patients included in this study, had necrotic mandibular primary molars with root resorption equal to or less than one-third, with adequate tooth structure for ultimate isolation with rubber dam, and adaptation of a stainless-steel crown **(26,27)**. Parents assured that there was no history of antibiotic coverage for at least 2 weeks before pulpectomy, to achieve precise and realistic antibacterial evaluation **(28,29)**.

Complete debridement and disinfection of the root canal space are essential for the success of pulpectomy. Microorganisms may be present in root lateral canals, dentinal tubules, apical ramifications, or areas of root resorption, limiting the ability of instruments to enter root canal systems completely **(30).** Disinfection with antibacterial irrigants is a crucial step in pulpectomy since instrumentation and irrigation with a neutral solution alone cannot effectively decrease the bacterial load. Due to the excellent antimicrobial activity, tissue solubility and capacity to breakdown organic materials, NaOCl has been the industry standard for irrigation in endodontics. However, it has some significant disadvantages including high toxicity, irritation of periapical tissues, a decrease in the elastic modulus and flexural strength of dentin and its inability to remove the smear layer **(31,32)**.

Therefore, side vented needles were used in this study as NaOCl must not exceed the apex as it is a strong tissue irritant. Furthermore, 1% NaOCl was used to assure best bacterial decontamination of root canals as recommended by the **(33).**

Due to perceived limitations of NaOCl, adjunctive final irrigant capable of cleaning dentinal tubules efficiently by eliminating the smear layer along with the debris and necrotic tissue of the canal, is an important concern. Chitosan is a natural polysaccharide derived from the shells of shrimp, and crabs by partial deacetylation of the natural polymer chitin. It is biocompatible, biodegradable and has bio-adhesive properties. It also acts as antibacterial agent. Additionally, it has a high capacity for chelating various metal ions **(34,35).** To evaluate its potential additive or synergistic effect on the viability of E. faecalis, chitosan has been used in this study.

As denoted by **Silva et al,** 0.2% chitosan as a final irrigation after 1% sodium hypochlorite in twenty-five canines, effectively removed smear layer from of the root canal middle and apical thirds. Therefore, 0.2% chitosan was used in this study, as final irrigating solution to evaluate its antibacterial effect against E.Faecalis **(34)**.

Regarding the time of the final irrigation of chitosan, two in-vitro studies were discussed its effect to remove smear layer. As reported by **Madhusudhana et al**. **(36)** revealed that chitosan was used as a final irrigant for 1 minute, while as denoted by **Silva et al (34)** chitosan was used as a final irrigant for 3 minutes. It was found that the time for them both was effective to remove smear layer from the middle and apical third. Regarding the time-dependent antibacterial effect of 0.2% chitosan as the final irrigation solution against the E.Feacalis, only limited studies were available in the literature. Therefore, the 1 and 3 minutes were investigated in the present study.

The volume 5 ml of chitosan as a final irrigation was in accordance **to Silva et al. (34).** While the choice of 2ml NaOCl during hand instrumentation, was in agreement with **Peters et al. (37)** and **Pawar et al.(38).**

Stainless steel K type hand files, not larger than size 30, was used cautiously in this study during chemo-mechanical preparation to avoid the possibility of broken segments, over enlargement of the canals and occurrence of lateral perforation **(14,28)**.

Pulpectomy of necrotic primary molars in the present study was performed on 2 visits. Completing the pulpectomy procedure over two or three visits in case of painful necrosis with purulence in the canals, should improve the likelihood of success **(39)**. The current study was also in accordance with many previous studies that completed pulpectomy in two visits procedure to evaluate the antibacterial effect of different irrigations on the bacteria present in the root canal of necrotic primary teeth **(40,41).**

After obturation, the teeth were restored with stainless steel crowns as a final restoration to allow optimal coronal seal and prevent microleakage **(33).**

Concerning the clinical evaluation, in the present study the success assessment of the tested material was performed by

evaluating the presence of pain on percussion and any changes in muco-buccal fold **(13,29,42)**.

The pulpectomy procedure considered to be clinically successful when tooth was asymptomatic. This was in agreement with a study performed by **Elsherbeny S et al.,** (43) to evaluate different obturating materials in pulpectomy of primary molars.

The best method for detecting root resorption, periapical tissue, periodontal state, osseous defects and any variations to the surrounding structures, is periapical radiography. Therefore, standardized periapical radiographs were performed in this study for radiographic assessment **(43-46).**

As regards the clinical parameters assessed, there was a decrease in prevalence of all the symptoms after one month, three, six as well as 12 months. Regarding pain on percussion, none of the cases in groups I and III showed pain in all follow-up periods except for one case in group II at 3 months interval showed pain with no significant difference between the three groups. Variation in the failures may be due to the individual body resistance as denoted by **Elsherbeny S et al (43)**.

Finally, regarding the clinical and radiographical success rate, in group II both success rates were 93.4%. While for group I and group III, the clinical success was 100 % while the radiographic success was 93.4%. This finding may be due to that some patients may be clinically asymptomatic but have radiographic evidence of failure in the treatment as denoted by **Sharaf et al (40).**The overall clinical and radiographic success rate of all groups was 93.4% with no significant difference between them.

4. CONCLUSION

Pulpectomy irrigation using either NaOCl alone or chitosan as a final irrigant for one or three minutes exhibited a good clinical and radiographic success rate..

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