

Antimicrobial Efficacy of Different Root Canal Irrigants in Primary Teeth: Clinical Study

Nada H. Elmenbawy¹, Ahmed H. Wahba², Doaa Masallat³, Salwa Awad⁴

Abstract:

Objective: Evaluation of antibacterial efficacy of 2.5% Sodium Hypochlorite (NaOCl), 3.8% Silver Diamine Fluoride (SDF), and 25% water-soluble extract of Propolis as root canal irrigants in primary molars. **Materials and Methods:** Thirty primary molars with a necrotic pulp of children in the age group 4-7 years were selected and divided into 3 groups randomly based on the irrigating solution used. In group A, 2.5% NaOCl was used as a positive control group. In groups B and C, 3.8% SDF and 25% water-soluble extract of Propolis were used respectively. The bacterial samples were collected pre-and post-irrigation using paper points and transferred for microbial assay. **Results:** Antimicrobial effectiveness of 3.8% SDF and 25% water-soluble extract of Propolis as root canal irrigants in primary molars were confirmed. The reduction in the mean bacterial colony counts of all the isolated bacteria was noticed higher in group C than in groups A and B. **Conclusions:** Propolis showed the best bactericidal effect with a significant decrease in the bacterial growth count after irrigation.

Introduction:

Dental caries is a progressive disease of the dental hard tissue that may lead to pulpal, periapical, and/or intraradicular infections if not managed in its initial stages.¹ Treating caries in primary dentition is necessary to prevent the spread of bacteria, infection of the pulp, abscess, or facial cellulitis and to maintain tooth space.²

Depending on the child's signs and symptoms, pulp vitality, and radiographic evaluation, we can determine the proper treatment plan as indirect pulp capping, direct pulp capping, pulpotomy, or pulpectomy. The pulpectomy procedure involves complete pulp tissue extirpation from the crown and radicular canals. After cleaning and shaping root canals, a resorbable suitable material is used to obturate the canals.³

Successful root canal therapy relies on the combination of proper instrumentation, irrigation, and obturation of the root canal. Intracanal irrigants can augment mechanical debridement by flushing out debris, dissolving tissue, and disinfecting the root canal system.⁴ So, it is worthy to evaluate and compare the antibacterial efficacy of these materials on primary molars as there is limited data regarding this issue.

Materials and Methods:

The sample size was calculated based on an alpha significance level of 0.05 and a beta of 0.2 to achieve 80% power with an anticipated response on treatment with NaOCl of 95% and an anticipated response on the treatment of SDF and Propolis of 34% based on previous studies.⁵ The calculated sample size was 9 for each group with a total sample size of 27 subjects.

This in-vivo study protocol was approved by the Ethical Committee of the Faculty of Dentistry, Mansoura University with the code A14100221. Thirty children were selected and prospectively treated at the Department of Pediatric Dentistry, Faculty of Dentistry, Mansoura University, Egypt. The selected children's age ranged from 4 to 7 years, and both genders had good general health, and no history of antibiotic coverage for at least two weeks. Restorable primary molars with chronic dentoalveolar abscess were included in this study. Molars were divided randomly into 3 groups, based on the irrigating solution used. In group A, 10 primary molars were irrigated with 2.5% NaOCl solution as a positive control group. In group B, 3.8% SDF (Kids-e-dental company, India) was used as irrigating solution for 10 primary molars. In group C, 10 primary molars were irrigated with 25% water-soluble extract of Propolis (IMTENAN, Egypt).

Propolis was prepared in the Department of Pharmacognosy, Faculty of Pharmacy, Mansoura University, Egypt. Twenty-five grams of dried powder was sterilized via exposure to ultraviolet for 10 minutes and 5 ml of 98% methanol was triturated with propolis till we got a uniform homogenous emulsion. Methanol dissolved the resins in Propolis. In step 2: a few drops of Tween-80 were added to the prepared emulsion till we got a clear solution. About 50 ml of distilled water was added slowly with continuous stirring using a magnetic stirrer till complete dissolution. Finally, 50 ml of distilled water was added to reach 100 ml distilled water to get a 25% water-soluble extract of Propolis.

After local anesthesia administration and rubber dam placement, all carious tissue was removed and access to the root canals was gained. The distal canal of mandibular primary molar and the palatal canal of maxillary primary molar were chosen for the sampling procedure. Pre-irrigation sample was collected using paper point after the introduction of a sterile K-file size 20 into the canal to the predetermined working length. The paper point was allowed to rest in the canal for 1 min then removed and placed immediately into the eppendorf containing 1 ml sterile nutrient broth medium. The sample was sealed and kept separately for transportation to the microbiological laboratory.

¹Postgraduate MSc student, Department of Pediatric Dentistry, Faculty of Dentistry, Mansoura University, Egypt. Corresponding author: nelmenbawy@gmail.com

²Lecturer, Department of Pediatric Dentistry, Faculty of Dentistry, Mansoura University, Egypt.

³Associate Professor, Department of Microbiology and Immunology, Faculty of Medicine, Mansoura University, Egypt.

⁴Professor, Department of Pediatric Dentistry, Faculty of Dentistry, Mansoura University, Egypt.

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After pre-irrigation sample collection, the root canal was prepared using sterile H-files. Then the recommended irrigant for each group was used. After drying the canal, the post-irrigation sample was collected and stored the same as the pre-irrigation sample. In the laboratory, the sample was mixed in a vortex mixer for 10 min, each sample was plated on a separate blood agar plate. The plates were then incubated at 37° C for 24 hours aerobically and 72 hours anaerobically by using an anaerobic jar. The colony-forming units per 1 ml on the plates were counted and the numbers of the microorganisms were calculated and reported.

Data were collected, tabulated, and analyzed with IBM-SPSS software (IBM Corp, the release of 2017, IBM

SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.). The normality of data was first tested with Shapiro test. Continuous variables were presented as mean±SD (standard deviation). A T-test was used for the comparisons between groups. The results were considered significant when the probability of error is less than 5% ($p \leq 0.05$).

Results:

Comparison between study groups after irrigation revealed that Group C had the best bactericidal effect with a statistically significant decrease in the bacterial growth count after irrigation ($P < 0.05$) while group A and group B reported close results, (Table).

Table: Comparison between the culture results before and after irrigation by NaOCl; SDF and Propolis

Groups	Irrigant	Before (Mean ± SD (CFU/ml))	After (Mean ± SD (CFU/ml))	t-test	p
Group A	NaOCl	$13 \times 10^4 \pm 30 \times 10^4$	$4 \times 10^3 \pm 4 \times 10^3$	-1.010	0.200
Group B	SDF	$11 \times 10^4 \pm 31 \times 10^4$	$1 \times 10^3 \pm 3 \times 10^3$	-1.112	0.280
Group C	Propolis	$22 \times 10^3 \pm 30 \times 10^3$	$1 \times 10^3 \pm 2 \times 10^3$	-2.209	0.040*

*Significant $p \leq 0.05$

Discussion:

Preservation of primary teeth till the time of shedding is necessary to avoid arch length problems and crowding. Also to avoid deviation of the midline, ectopic eruption, and abnormal habits.⁶ Successful pulpextomy is useful in maintaining functioning primary teeth and healthy periodontium.⁷ Proper instrumentation and irrigation are mandatory for successful treatment. Irrigant material flushes debris and necrotic tissues and disinfects the microbial load.⁴ The usage of an effective irrigant that is causing no periapical tissue inflammation is important. So, the goal of this study was to examine the antibacterial effect of 3.8% SDF and 25% water-soluble extract of Propolis when compared to 2.5% NaOCl as a positive control group.

NaOCl is a common irrigant of choice which has many advantages regarding its bactericidal effect, denaturation of the albumin, low viscosity allowing easy introduction into the canal, and inexpensive.⁸ However, NaOCl has many disadvantages as it cannot remove the smear layer, toxic to vital tissues, corrodes metals, and has a bad taste and odor.^{9,10} However, trivial research studied the antibacterial effect of SDF and Propolis as endodontic irrigants clinically. Therefore, in the present study, the aim focused on investigating a more effective irrigating solution with fewer side effects on surrounding vital tissues.

In the current study, the 3.8% SDF solution was 1:10 dilution of the initial 38% SDF solution. That concentration was used for root canal disinfection by Hiraishi et al.¹¹ SDF is an anti-cariogenic agent which is deemed to be very effective, especially in pediatric dentistry.¹² The silver has antimicrobial efficacy, the

fluoride acts for remineralization and the ammonia stabilizes high concentrations in solution.¹³

Siddaiah and Varghese¹⁴ reported the difficulty of Propolis introduction into the canal due to the presence of waxes and resins. Therefore, a 25% water-soluble extract of Propolis was used. Propolis is a natural herbal product that has gained increased interest due to its antimicrobial activity against a wide range of pathogenic microorganisms due to the presence of flavonoid content.¹⁵

The antibacterial effect of 2.5% NaOCl was less than that of 3.8% SDF which was consistent with the results of Minavi et al.¹⁶ On the other hand, Al-Madi et al.¹⁷ found that 3.8% SDF had a significantly larger percentage of dead cells than 2% CHX, but 5.25% NaOCl as a positive control group showed the greatest percentage of dead cells. This may be attributed to the higher concentration of NaOCl that they used.

Propolis was found to have a superior bactericidal effect and the difference was statistically significant when compared to NaOCl and SDF which agreed with the results of Mattigatti et al.¹⁸ While Arslan et al.¹⁹, Jaiswal et al.²⁰, and Parolia et al.²¹ reported that Propolis was as effective as 6% NaOCl.

This could be explained as there is variability in the amount and type of bacteria isolated from the samples in clinical vs laboratory studies because bacteria colonize the entire root canal system in the lumen, accessory, secondary and lateral canals. Bacteria also colonize in dentinal tubules and apical foramen. In the present clinical study, the adsorbent paper point was used for collecting micro-organisms. It can collect bacteria present only inside the canal and on the

surface of canal walls but it can't collect bacteria from dentinal tubules and deeper areas.²²

Conclusions:

- Propolis as an herbal irrigant had the best antibacterial efficacy.
- A 3.8% SDF was found to be more effective against bacteria than 2.5% NaOCl.
- The diluted formula of NaOCl (2.5%) showed the least antibacterial efficacy.
- Coagulase-negative staphylococcus aureus (CONS) species were the dominant multiple strains of bacteria present in root canals of necrotic primary teeth.

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