



Clinical Evaluation of Chitosan as Final Irrigating Solution for Pulpectomy in Non-Vital Primary Teeth

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KEYWORDS

Chitosan,
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ABSTRACT:

Introduction: Chitosan has antibacterial properties and has a high capacity for chelating various metal ions.

Aim of the study: To clinically assess 0.2% chitosan for 1 and 3 minutes as final irrigant solution for pulpectomy in non-vital deciduous teeth versus sodium hypochlorite (NaOCl).

Patients and methods: This study is a randomized clinical trial, directed on 43 children aged from 4-7 years old. Forty-five non-vital primary molars were categorized into three 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 irrigating solution and left in the canal for one minute. While in group III chitosan was left in the canal for 3 minutes. Clinical evaluation regarding spontaneous pain and tooth mobility was done for all patients preoperative, postoperative and after 1,3,6,12 months intervals.

Results: None of the cases in groups I and III showed pain or tooth mobility in all follow-up periods. Only one positive case was found in group II at 3 months interval. The difference between the three groups was insignificant.

Conclusion: Irrigation in pulpectomy with either NaOCl only or with chitosan as a final irrigating solution for 1 and 3 minutes, showed high clinical success rate with no significance difference.

Introduction

The most frequent causes of early primary tooth loss are pulpitis and periapical periodontitis caused by severe dental caries. ⁽¹⁾ Pulpectomy is considered more conservative than tooth extraction. As a result, improving pulpectomy success rate is crucial to preserve the integrity of the primary dentition.⁽²⁾ Pulpectomy is defined as a root canal treatment for necrotic or irreversibly inflamed pulp tissue provoked by caries or traumatic injury.⁽³⁾

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.⁽⁴⁾

Disinfection with irrigating solution as sodium hypochlorite (NaOCl) and/or chlorhexidine is a crucial step in ensuring the most effective bacterial decontamination of the root canals for the reason that instrumentation and irrigation with an inert solution alone are insufficient to effectively diminish bacteria in a root canal system.⁽⁵⁾ The most frequently used irrigant in endodontics is NaOCl. Its antimicrobial effect and the ability of free chlorine to dissolve organic tissue, make it the gold standard of root canal irrigants.⁽⁶⁾



NaOCl has disadvantages as toxicity, potential caustic effect and its inability to remove smear layer.⁽⁷⁾ Chitosan (CS) is a natural nontoxic biopolymer produced by partial deacetylation of chitin, a polysaccharide from crustaceans' shells (shrimp, crab).⁽⁸⁾ Different mechanisms for the anti-bacterial activity of chitosan are proposed.⁽⁹⁾

The aim of this study was to clinically assess 0.2% chitosan for 1 and 3 minutes as final irrigant solution for pulpectomy in non-vital deciduous teeth versus sodium NaOCl regarding spontaneous pain and tooth mobility. The null hypothesis proposes that the difference between the irrigating solutions is insignificant.

Material and Methods

This study was randomized clinical trial (RCT). The ethics committee approval was obtained before the beginning of the study (approval no.33/2017) which was conducted in accordance with the World Medical Association Declaration of Helsinki.

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

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

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

Teeth grouping

Regarding the type of irrigation and duration of its application, 45 non-vital deciduous molars were distributed into three 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 irrigating solution and left in the canal for one minute. While in group III chitosan was left in the canal for 3 minutes.

The children were selected from the postgraduate clinic of Pediatric Dentistry and Dental Public Health Department - Faculty of Dentistry, Suez Canal University. After full diagnosis, the parents of the children were given a detailed description of the treatment strategy. Before beginning any therapeutic procedures, informed written consents were acquired.

Inclusion Criteria of children

The children included in this study were apparently healthy children aged from four to seven years.

-Inclusion Criteria of selected teeth

Non-vital deciduous teeth with adequate remaining tooth structure for isolation and restoration were included in this study. Teeth with clinical evidence of tooth non-vitality were selected. Radiographic evidence of infection as radiolucency and root resorption less than two thirds of the root.

Clinical procedure

Adequate isolation was performed using rubber dam followed by caries removal. Using a highspeed round bur size 6, a conventional access cavity was completed, and the pulp tissue 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).

According to the pre-allocated sample grouping, each tooth was irrigated with its type of irrigation. At the end, 5 ml of saline was used to flush the root canal. Obturation of root canals was performed using Zinc oxide and eugenol mix. The teeth were finally restored with stainless steel crowns.

The preparation of chitosan solution was performed at the Inorganic Chemistry Department, Faculty of Science, Suez Canal University.⁽¹¹⁾

Post-operative Clinical evaluation and follow-up:

Clinical evaluation was done at 1,3,6,12 months follow-up intervals and the following parameters were evaluated:



1-Spontaneous pain: It was documented by asking the patient if spontaneous pain was present or absent.

2-Mobility: Presence or absence of abnormal mobility was evaluated by pressing two non-working ends of the dental instruments (i.e., the mirror handle and the probe handle) on the buccal and lingual surfaces of the tooth.

-The patients' guardians were instructed to contact the investigator if any adverse signs or symptoms occurred between follow-up recalls⁽¹²⁾

Clinical success criteria^(13,14)

- Absence of post-operative pain

- No tooth mobility

Statistical analysis

It was performed using computer software Statistical Package for Social Science SPSS (with IBM® SPSS® Statistics Version 20 for Windows).

Results

After treatment (considered as baseline), the three groups showed 100% absence of spontaneous pain. At one month and three months in group I and III, all 15 cases in each group were negative (100%). While in Group II at 3 months, there were 14 (93.3%) negative cases with one positive case (6.67%). At 6 months, there was one case drop out in each group. In addition, after twelve months in both Group I and II, the number of negative cases became 13 (92.85%) with one case with radiographic failure (7.14%) and one case drop-out. Furthermore, the number of negative cases in Group II decreases at twelve months to 13 (92.85%) due to one case drop-out (6.67%) and one positive case (7.14%) (Figure 1). Using Chi square test for testing significant difference between proportions. There was insignificant difference between all groups in all different follow up intervals as P-value > 0.05.

Mobility distribution was represented as total number and percentage for each group (I, II and III) at definite follow up intervals (baseline, one month, three months, six months and twelve months). Regarding group I, II, III, all patients came suffering from grade II tooth mobility (100%) positive cases. After treatment (considered as baseline), the three groups showed 100% absence of tooth mobility. After twelve months, the

number of negative cases became 13 (92.85%) with one case drop-out. In each group, one case with radiographic failure (in Group I &III) and 1 positive case (in group II) (Figure 2). Regarding the clinical success rate, it was 100%, 93.4%, 100% for group I, II, III respectively.

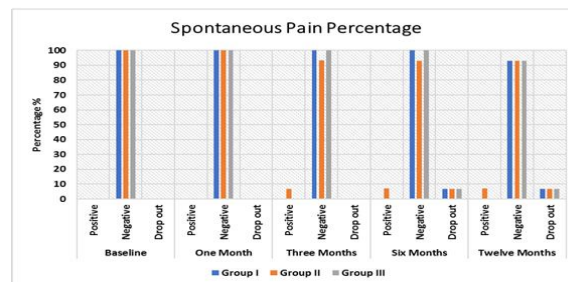


Figure (1): Bar Chart revealing Spontaneous Pain Percentage among Studied Groups during follow-up periods

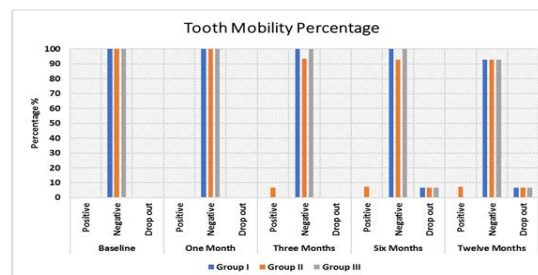


Figure (2): Bar Chart revealing Tooth Mobility Percentage among Studied Groups during follow-up periods

Discussion

Chitosan is a natural, biocompatible polymer with antimicrobial and chelating properties, making it a promising final irrigant in pulpectomy of non-vital primary teeth. A recent clinical trial evaluated 0.2% chitosan as a final rinse after NaOCl irrigation, showing potential benefits such as effective smear layer removal, reduced bacterial load (*E. faecalis*), and preservation of dentin structure. Compared to traditional agents like EDTA, chitosan may offer safer, gentler alternatives for primary teeth with resorbing roots. However, while early results are encouraging, more published clinical data are needed before it can be widely recommended as a standard irrigant in pediatric endodontics⁽⁴⁻⁸⁾.

Although the antimicrobial activity of NaOCl, it has some significant disadvantages encompassing significant toxicity and its ineffectiveness in eliminating the smear layer.



⁽¹⁵⁾ Chitosan was used in this study as it is biocompatible, antibacterial agent and has a high capacity for chelating various metal ions.⁽¹⁶⁾

The age of the children included in the current study were four to seven years. Regarding the significant root length, minimal or no root resorption, and patient participation, it is the most advantageous chronological age.^(14,17)

Patients included in this study, had necrotic lower deciduous molars with root resorption not more than two-thirds, with adequate tooth structure for ultimate rubber dam isolation, and stainless-steel crown retention. (18,19)

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, excessive canal enlargement and lateral perforation hazards. (20,14)

The pulpectomy procedure considered to be clinically successful when tooth was asymptomatic. This was in agreement with a study performed by Elsherbeny et al.⁽²¹⁾ to evaluate different root canal filling materials in pulpectomy of deciduous molars.

The 12 months follow up in the present study was in agreement with different authors' recommendations assessed pulp therapy of primary teeth clinically and radiographically^(22,23).

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 spontaneous pain and tooth mobility, 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 and grade II mobility with insignificant difference among the 3 groups. Distinct body resistance may be the reason of variations in the failures.⁽²¹⁻²⁴⁾

Conclusion

Irrigation in pulpectomy with either NaOCl only or with chitosan as a final irrigating solution for 1 and 3 minutes, showed high clinical success rate with no significance difference.

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