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Original Research

Comparing the efficacy of smear layer removal by octanidine dihydrochloride with sodium hypochlorite and HEDP with sodium hypochlorite

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ABSTRACT:
Background: To assess and compare the effectiveness of smear layer removal between OCT with sodium hypochlorite and HEDP with sodium hypochlorite. **Materials & Methods:** 20 human mandibular premolars, freshly extracted and featuring a single root each, underwent decoronation, with their root specimens standardized to a length of 14mm. The $p<0.05$ was considered significant. **Results:** Twenty premolars were examined, revealing significant differences in smear layer scores between the treatment groups at all root levels ($p<0.001$). **Conclusion:** At the apical level of the root canal, the use of OCT with sodium hypochlorite demonstrated an improvement in smear layer elimination.
Keywords: sodium hypochlorite, smear layer, octanidine.

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INTRODUCTION

Bacteria have been identified as the main cause of pulp infection and periapical disease. [1,2] It has been established that irrigants, coupled with mechanical instrumentation, are mandatory to ensure the elimination or greatest possible reduction of pathogens from the infected root canal. Irrigants have varying degrees of antimicrobial activity. The characteristics of an ideal endodontic irrigant includes good antimicrobial activity, non-cytotoxicity towards the surrounding periapical tissue, and the ability to inactivate endotoxins, to act as a lubricant, and to dissolve organic tissue remnants.[3,4] The present study focused on the antimicrobial aspect of irrigants, as there are over 700 bacterial species in the oral cavity, with any individual harboring 100–200 species. [5] Furthermore, it has also been proven beyond doubt that the presence of bacteria is a major contributor to endodontic infections. A root canal sealer plays an important role in the formation of a bond between root filling material and root canal dentin and also obtains a bacteria-tight seal of the root canal system. [6] As the currently used root filling materials do not effectively seal and resist ingress of microorganisms, augmentation of the root canal seal is also a desirable clinical goal because it may improve the outcome of the root canal treatment. [7] Epoxy resin-based sealers such as AH Plus (Dentsply DeTrey, Konstanz, Germany) have been widely used because of their acceptable physical properties, reduced solubility, apical sealability, adhesiveness to root dentin, and adequate biological performance. [8] More recently, sealers based on tricalcium silicate or other calcium silicate formulations were introduced due to their superior biocompatibility and bioactivity, and their ability to set in a wet environment. [9] Because the latter property, these materials, which are sometimes erroneously called bioceramic sealers, have been named hydraulic CaSi sealers. BioRoot RCS (Septodont, Saint Maur des Fosses, France) is one of the latest hydraulic CaSi sealers available to the dentist, and to the best of our knowledge the only one

that incorporates a liquid phase for controlled hydration.

DualRinse HEDP (Medcem GmbH, Weinfelden, Switzerland) consists of 0.9 g of etidronate powder. Adding etidronate powder to a NaOCl solution results in a mixture of NaOCl + 9% HEDP, which keeps NaOCl active during a 1-hour treatment and adds a chelating action. [10] While the chelating effect of DualRinse HEDP has shown to be weaker than conventional chelators, such as 17% EDTA, it acts throughout the whole treatment when NaOCl and the chelator are applied together rather than in an alternating fashion. This clinical concept was introduced as "continuous soft-chelation", and the main benefit is reduced irrigation time since the removal of the smear layer and inorganic debris after instrumentation is not required as the continuous release of the calcium complex prevents debris accumulation. [11,12] Hence, this study was conducted to assess and compare the effectiveness of smear layer removal between OCT with sodium hypochlorite and HEDP with sodium hypochlorite.

MATERIALS & METHODS

20 human mandibular premolars, freshly extracted and featuring a single root each, underwent decoronation, with their root specimens standardized to a length of 14mm. The smear layer was introduced by Instrumentation with rotary protaper file f2 , and subsequently, the specimens were categorized into 2 groups (n=10) based on the irrigation protocol: Group I employed OCT with sodium hypochlorite, while Group II utilized HEDP with sodium hypochlorite. The data underwent statistical analysis through ANOVA, and paired t-test was done. The $p<0.05$ was considered significant.

RESULTS

Twenty premolars were examined, revealing significant differences in smear layer scores between the treatment groups at all root levels ($p<0.001$). Specifically, at the apical level, the scores were lower for OCT with sodium hypochlorite compared to HEDP with sodium hypochlorite.

Table 1: Scores of smear layer according to the root level

	Smear layer score according to root level			
	Apical	**Middle**	**Coronal**	**P value**
OCT with sodium hypochlorite	3	2	2	0.001
HEDP with sodium hypochlorite	4	4	4	0.4
P value	<0.001	<0.001	<0.001	

DISCUSSION

Octenidine dihydrochloride is a type of bispyridine antimicrobial compound that carries 2 cationic active centers per molecule and had shown antimicrobial effects which are broad spectrum in nature and includes both gram-positive and gram-negative bacteria, fungi, and several viral species. [13] It exerts bactericidal/fungicidal effects by interfering with cell walls and membranes. It is widely utilized in the medical field for skin burns and decontaminating mucous membranes and open wounds [14] and is also utilized in mouthwash formulations and other dental applications. Reports had been shown that Octenidine dihydrochloride used in the form of mouthrinse can be beneficial to inhibit bacterial plaque accumulation and progression of dental caries both in rats [15] and humans. Octenidine dihydrochloride has shown relative non-cytotoxicity at the site of action [16] and good antimicrobial activity. Hence, this study was conducted to assess and compare the effectiveness of smear layer removal between OCT with sodium hypochlorite and HEDP with sodium hypochlorite.

In the present study, twenty premolars were examined, revealing significant differences in smear layer scores between the treatment groups at all root levels ($p<0.001$). A study by Mohan M et al, systematic review literature search was undertaken in the databases Medical Literature Analysis and Retrieval System Online (MEDLINE) Ovid (from 1946), Scopus, and Google Scholar, as well as a hand search of the references of included publications. Ex vivo and in vitro, studies were included. The risk of bias was assessed using a customized tool. In vitro and ex vivo studies were done on a natural tooth and agar cultures to measure the colony forming unit (CFU), zone of inhibition (ZOI), minimum inhibitory concentration (MIC), and proportion of dead cells to evaluate the antimicrobial efficacy of octenidine and CHX were considered outcomes in this review. From 152 articles, 25 were reviewed for full text. A total of 12 in vitro studies were included for qualitative analysis. Out of 12 studies, eight studies reported better antimicrobial efficacy for OCT than CHX; two studies showed comparable results, and two studies favored CHX. Octenidine was a more potent disinfectant in the root canal for better antimicrobial efficacy than CHX as an irrigant against E. faecalis. Octenidine dihydrochloride (OCT) has been described as a potential substitute for CHX during chemomechanical debridement in endodontic treatment. OCT is less cytotoxic to the periapical tissues than CHX; however, as an antimicrobial, it is highly effective against a range of gram-positive and gram-negative oral bacterial species. The substance of CHX in dentin seems to be an advantage over OCT. Thus, different studies have been conducted to compare the effectiveness of OCT and CHX for disinfection of the root canal, and the evidence seems to support the clinical use of OCT more. [17]

In the present study, specifically, at the apical level, the scores were lower for OCT with sodium hypochlorite compared to HEDP with sodium hypochlorite. Another study by Cherian B et al, compared and evaluated antimicrobial effects of 2% Chlorhexidine (CHX) versus 0.1% Octenidine Dihydrochloride (OCT) as root canal irrigant with and without passive ultrasonic irrigation against Enterococcus faecalis (E. faecalis) in vitro and to evaluate the depth of penetration of irrigant solution into the dentinal tubules at the junction of middle and apical third. Forty eight freshly extracted, single rooted human mandibular premolars were decoronated and root specimen standardized to 14mm. Biofilm of E. faecalis (strain ATCC 29212) was grown for seven days and the specimens were divided into four groups (n=12) based on irrigation protocol : Group I- Conventional Syringe Irrigation (CSI) with 2% CHX, Group II- CSI + 0.1% OCT, Group III- Passive Ultrasonic Irrigation (PUI) + 2% CHX and Group IV- PUI+ 0.1% OCT. Dentin shavings were collected at two depths (200µm and 400µm) and total number of colony forming units were determined. The data were statistically analyzed using ANOVA, Scheffes multiple comparison of means and paired t-test ($p<0.05$). Group III and IV (PUI) showed significant difference compared to Group I and II (CSI) both at 200µm and 400µm ($p=0.000$). For Group III and Group IV no significant differences were found at 200µm and 400µm ($p=1.000$ and 0.363 respectively), however significant difference was found between data at 200µm and 400µm for all the four groups ($p=0.000$). Octenidine (0.1%) was more effective than 2% Chlorhexidine against E. faecalis both at 200µm and 400µm. Passive ultrasonic irrigation proved to enhance the antimicrobial action of the irrigants. [18] Aoun C et al, assessed the effect of sodium hypochlorite (NaOCl) combined with a novel chelating agent DualRinse HEDP (Medcem GmbH, Weinfelden, Switzerland), a product consisting of 0.9 g of 1-hydroxyethylidene-1,1-diphosphonic acid (HEDP) powder, with or without high-power sonic activation on debris and smear layer removal. Seventy-five mandibular premolars were divided into 5 groups (n=15) and treated with different irrigation protocols: group 1 (D3N), DualRinse HEDP+3% NaOCl without activation; group 2 (D3NA), DualRinse HEDP+3% NaOCl with activation (EDDY, VDW, Munich, Germany) during the final irrigation; group 3 (3NE), 3% NaOCl+17% Ethylenediaminetetracetic acid (EDTA)+3% NaOCl without activation; group 4 (3NEA), 3% NaOCl+17% EDTA+3% NaOCl with activation during the final irrigation; group 5 (NC), negative control group, 0.9% saline. Samples were analysed by scanning electron microscopy (SEM) to evaluate residual debris and smear layer at 3 levels of the root canal: coronal, middle, and apical. Statistical analysis was performed with a level of significance set at $p<0.05$. The normality distribution of scores within each group was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests. A Kruskal-Wallis test followed by multiple comparison tests was used to compare scores among the 5 groups on the apical, middle, and coronal levels of the root canal. A Friedman test followed by multiple comparison tests was used to compare scores within the apical, middle, and coronal levels for each treatment group. Debris score was significantly the lowest for D3NA, followed by D3N, 3NEA and 3NE at all root levels ($p<0.05$). The smear layer score was significantly the lowest for D3NA, followed by D3N, 3NEA and 3NE only at the apical level, while no significant difference was found in the middle and coronal levels between the groups ($p<0.05$). DualRinse HEDP resulted in less debris and smear layer compared to the classic approach of NaOCl without activation. Implementing sonic activation further improved debris and smear layer removal. DualRinse HEDP+3% NaOCl improved debris removal at all levels and smear layer elimination at the apical level of the root canal. These results were further enhanced when adding high-power sonic activation. [19] Recently a new irrigant Octenidine Dihydrochloride (Octenisept, Schulke and Mayr GmBH, Norderstedt, Germany.) a bispyridine derivative(N,N'-[1,10-decanediyldi-1(4H)-pyridinyl-4-ylidene] bis(1-octanamine) dihydrochloride), has been suggested as an alternative endodontic irrigant based on its antimicrobial effects and lower cytotoxicity. [20] Octenidine shows properties of positively charged (cation-active) chemical compounds, exhibits high antimicrobial efficacy and specific ability to adhere and form complexes with chemical components of cells and whole cells. [21] Tandjung et al., demonstrated efficacy of octenidine against E. faecalis in infected root canal dentin model. [22]

CONCLUSION

At the apical level of the root canal, the use of OCT with sodium hypochlorite demonstrated an improvement in smear layer elimination.

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