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Size of Periapical Lesions of The Maxillary Anterior Teeth Root Canals Irrigated With 0.2% Chlorhexidine And 5.25% Sodium Hypochlorite One Year After Root Canal Treatment Using PSP Digital Radiography: A Clinical Trial

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ABSTRACT

Background and Objectives: Microbial invasion to the pulp tissue often leads to pulpal necrosis. This study aimed to assess the size of periapical (PA) lesions of root canals of maxillary anterior teeth irrigated with 0.2% chlorhexidine (CHX) and 5.25% sodium hypochlorite (NaOCl) one year after root canal treatment (RCT) using photostimulable phosphor plate (PSP) digital radiography.

Materials and Methods: In this randomized controlled clinical trial, 30 patients with maxillary anterior teeth with PA lesions (1-1.5 mm in size) were selected and randomly assigned to three groups of 10. During RCT, the root canals were irrigated with 0.2% CHX in group 1, 5.25% NaOCl in group 2 and saline in group 3. The teeth underwent PSP digital radiography by the parallel technique at baseline (preoperatively) and at 1 year postoperatively. The small and large diameters of the PA lesions were measured on the radiographs by two radiologists. Statistical comparisons were made using univariate ANOVA and Tukey's test.

Results: The mean reduction in small and large diameters of the PA lesions at 1 year postoperatively was not significantly different between the CHX and NaOCl groups (P>0.05). However, the CHX and NaOCl groups both showed significantly smaller PA lesions than the saline group at 1 year (P=0.00).

Conclusion: No significant difference was found in the efficacy of irrigation with 0.2% CHX and 5.25% NaOCl for reduction of the size of PA lesions at 1 year, postoperatively. However, both irrigating solutions were significantly superior to saline for this purpose.

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INTRODUCTION

Microbial invasion to the pulp tissue often leads to pulpal necrosis. Necrotic pulp provides a suitable environment for proliferation of oral microorganisms, and periapical (PA) lesions eventually develop as the result of host immune response to pathogenic bacteria and their byproducts. PA lesions are hard to differentiate radiographically, and definite differentiation of PA cyst from PA granuloma can only be performed with biopsy [1]. Most PA lesions often heal spontaneously over time following root canal treatment (RCT) and adequate disinfection and obturation of the root canal system [2].

At present, controversy exists regarding the selection of single-session or two-session endodontic treatment. Some accredited review studies have discussed that no significant difference exists between the single-session and two-session RCT for healing of PA lesions at 1 year postoperatively [2,3]. Thus, it would be ideal to perform single-session treatment by using more advanced equipment and more efficient root canal disinfection protocols.

Elimination of bacteria from the root canal system is the main goal of RCT, and plays a fundamental role in healing of PA lesions [4]. Biomechanical preparation of the root canal system and removal of organic and inorganic debris by using effective chemical irrigating solutions plays a pivotal role in elimination of microorganisms [4,5]. Sodium hypochlorite (NaOCl) solution is extensively used for root canal irrigation in infected teeth. Optimal antimicrobial activity, ability to dissolve the organic tissues, detergent activity, and low cost are among the main advantages of NaOCl. Also, it more effectively removes the smear layer when used in combination with 17% EDTA [6]. Chlorhexidine (CHX) also plays an important role in root canal disinfection. It is a broad spectrum antimicrobial agent, which is effective against both Gram-positive and Gram-negative bacteria. It has a cationic component that bonds to negatively charged components of the cell membrane and results in cell lysis. Also, due to its long-term antimicrobial effect (due to attachment to hydroxyapatite), it can be used as an effective root canal irrigating solution in RCT [7].

The outcome of RCT is often evaluated after a certain period of time. The healing status can be better monitored with long-term radiographic follow-ups. It should be noted that the success of RCT is defined as clinical absence of pain and swelling, optimal function of mastication, and absence of PA lesions or their resolution on radiographs [2].

Considering all the above, this study aimed to assess the size of PA lesions of root canals of maxillary anterior teeth irrigated with 0.2% CHX and 5.25% NaOCl at one year after RCT using photostimulable phosphor plate (PSP) digital radiography.

MATERIALS AND METHODS

This randomized controlled clinical trial study was conducted at the Endodontics Department of School of Dentistry of Ahwaz Jundi-Shapur University of Medical Sciences in 2012. The study was approved by the ethics committee of this university (IR.AJUMS.REC.1391.550) and registered in the Iranian Registry of Clinical Trials (IRCT201305226443N3).

Trial design

This randomized controlled clinical trial assessed the size of PA lesions of the root canals of maxillary anterior teeth irrigated with 0.2% CHX and 5.25% NaOCl at one year after RCT using PSP digital radiography. The criteria used to report the results were derived from the Consolidated Standards of Reporting Trials.

Participants, eligibility criteria, and settings

The inclusion criteria were absence of systemic disease, and having a maxillary anterior tooth with a PA lesion 10-15 mm in size (either horizontally or vertically) requiring RCT. The exclusion criteria were not consenting to participation in the study, not showing up for the 1-year follow-up, presence of persistent signs and symptoms after RCT necessitating apicoectomy, extraction of the respective tooth for any reason, trauma to the respective tooth after treatment, and loss of occlusal restoration of the respective tooth after treatment. A total of 30 patients presenting to our university clinic for endodontic treatment of their maxillary anterior teeth were enrolled by convenience sampling.

Interventions

The patients signed informed consent forms prior to participation in the study. A PA radiograph was obtained from the respective tooth right before treatment using an indirect digital dental radiography unit (Digora PSP Optime; Soredex, Helsinki, Finland) with the exposure settings of 70 kVp, 8 mAs, and 0.32 s time via the parallel technique. The vertical and horizontal angulations of the X-ray tube were recorded for each tooth for the purpose of standardization of preoperative and postoperative radiographs. Also, both preoperative and postoperative radiographs were obtained by the same operator with the same X-ray unit and exposure settings. Next, the patients were randomly assigned to three groups of 0.2% CHX, 5.25% NaOCl, and saline. The respective teeth then underwent RCT by a senior post-graduate student of endodontics. For this purpose, first, buccal and palatal infiltration anesthesia was administered

with 2% lidocaine plus 1:80,000 epinephrine (Darupakhsh, Tehran, Iran). After access cavity preparation under rubber dam isolation, #2, #3 and #4 Gates-Glidden drills were used for coronal flaring. Working length was determined 1 mm short of the apex using an apex locator (Raypex 4) and digital radiography (Schick, USA), and the root canals were cleaned and shaped up to F2 ProTaper rotary file. The sequence of root canal preparation was the same in all patients. After using each file, the root canals were irrigated with the respective irrigating solution (20 cc) using an irrigating syringe with 27-gauge needle. After drying the root canal with paper points (Gapadent, Korean Dental Material manufacturer) and controlling the working length again, the root canals were obturated with lateral compaction technique 1 mm short of the apex. The access cavity was temporarily sealed with Coltosol (ApadanaTak, Tehran, Iran). The patients were requested to show up for permanent restoration of their tooth after 1 week. The patients were recalled after 1 year to take a follow-up radiograph for assessment of the recovery course of their PA lesion. Radiographs were obtained with the same dental X-ray unit and the same geometric conditions. Digital images were stored in Scanora software in tiff format. Two radiologists with a minimum of 3 years of clinical experience measured the size of PA lesions on preoperative and postoperative radiographs on a monitor with 1440 ×1920 pixel resolution (Syncmaster MB 17980, SAMSUNG, Korea). They measured the size of PA lesions by measuring the largest and the smallest diameters of the lesions with the computer ruler with 0.1 mm accuracy. Each observer independently recorded his/her observations.

Outcomes (primary and secondary)

The primary objective of this study was to assess the size of PA lesions of the root canals of maxillary anterior teeth irrigated with 0.2% CHX and 5.25% NaOCl one year after RCT using PSP digital radiography.

Sample size calculation:

The sample size was calculated to be 10 teeth in each group according to a study by Tanomaru Filho et al, [4] assuming a constant variance of 1 and study power of 80%.

Randomization

Random assignment of patients to the three groups was performed by computerized generation of random numbers using Generate Random Numbers 1.0 software program.

Blinding

The patients were blinded to the type of irrigating solution used in RCT of their teeth. The two radiologists who measured the size of PA lesions on preoperative and postoperative radiographs were also blinded to the group allocation of patients and their treatment protocol (type of irrigating solution used). Each observer independently recorded his/her observations, and the statistician was also blinded to the group allocation of patients. Thus, the study had triple-blind design.

Statistical analysis

The intra- and inter-observer agreements were evaluated by calculating the kappa statistics via the symmetric measures in crosstabs test. Difference > 0.05 mm between the values reported for the large or small diameter of the lesions before treatment by the two observers was considered as error. The mean data provided by the two observers (considering their kappa coefficient) was used to assess the reduction in size of PA lesions at 1 year, compared with baseline using univariate ANOVA. Also, The Tukey's HSD test was applied for pairwise comparisons of the large and small diameters of the lesions in the groups at 1 year, postoperatively.

RESULTS

Harms

No patient was harmed during the study.

Subgroup analyses

Considering difference > 0.05 mm between the values reported for the large and small diameters of the lesions before treatment by the two observers as error, the inter-observer agreement was calculated to be 0.85, which was acceptable.

Small diameter of PA lesions

Table 1 shows the mean of the small diameter of the lesions before and 1 year after RCT in the three groups. The results showed the positive effect of RCT on reduction of the small diameter of PA lesions at 1 year post-treatment irrespective of the type of irrigating solution. The reduction in size of small diameter of the lesions was significant in all three groups at 1 year (P=0.00).

Table 1: Mean of the small diameter of PA lesions before and 1 year after RCT in the three groups (n=10)

Group	Time	Mean (mm)	Std. deviation	P-value
CHX	Before treatment	19.12	62530.0	00.0
	After treatment	65.2	45549.0	
NaOCl	Before treatment	00.12	67472.0	00.0
	After treatment	57.2	44796.0	
Saline	Before treatment	36.12	86468.0	00.0
	After treatment	74.9	39683.0	
All	Before treatment	18.12	71861.0	00.0
	After treatment	99.4	44552.3	

Pairwise comparisons of the group by the Tukey's test regarding the mean size of lesions (Table 2) revealed no significant difference between the CHX and NaOCl groups, although the reduction was slightly greater in the CHX group. However, the mean size of the lesions in both the CHX and NaOCl groups was significantly smaller than that in the control group at 1 year, postoperatively (P=0.00).

Table 2: Pairwise comparisons of the groups by the Tukey's test regarding the mean size of small diameter of PA lesions

Group (I)	Group (J)	Mean difference	Std. deviation	P-value	95% Confidence Interval for Difference[a]	
					Minimum	Maximum
CHX	NaOCl	135.0	562.0	811.0	991.0	261.1
	Saline	-630.3*	562.0	000.0	-756.4	-504.2
NaOCl	CHX	-135.0	562.0	811.0	-261.1	991.0
	Saline	-765.3*	562.0	000.0	-4.891	-639.2
Saline	CHX	630.3*	562.0	000.0	504.2	756.4
	NaOCl	765.3*	562.0	000.0	639.2	891.4

Large diameter of PA lesions

Table 3 shows the mean of the large diameter of PA lesions before and 1 year after RCT in the three groups. The results showed the positive effect of RCT on reduction of the large diameter of PA lesions at 1 year post-treatment irrespective of the type of irrigating solution. The reduction in size of large diameter of the lesions was significant in all three groups at 1 year (P=0.00).

Table 3: Mean of the large diameter of PA lesions before and 1 year after RCT in the three groups (n=10)

Group	**Time**	**Mean (mm)**	**Std. deviation**	**P-value**
CHX	Before treatment	90.15	96622.0	00.0
	After treatment	49.6	57242.0	
NaOCl	Before treatment	78.15	75057.0	00.0
	After treatment	22.6	37580.0	
Saline	Before treatment	83.15	83106.0	00.0
	After treatment	43.11	20509.1	
All	Before treatment	84.15	82550.0	00.0
	After treatment	04.8	55759.2	

Pairwise comparisons of the group by the Tukey's test regarding the mean size of lesions (Table 4) revealed no significant difference between the CHX and NaOCl groups, although the reduction was slightly greater in CHX group. However, the mean size of the lesions in both CHX and NaOCl groups

was significantly smaller than that in the control group at 1 year, postoperatively (P=0.00).

Table 4: Pairwise comparisons of the groups by the Tukey's test regarding the mean size of large diameter of PA lesions

Group (I)	Group (J)	Mean difference	Std. deviation	P-value	95% Confidence Interval for Difference[a]	
					Minimum	Maximum
CHX	Before treatment	19.0	470.0	680.0	-746.0	136.1
	After treatment	-43.2	470.0	000.0	-376.3	-494.1
NaOCl	Before treatment	-19.0	470.0	680.0	-136.1	/746
	After treatment	-63.2	470.0	000.0	-571.3	-689.1
Saline	Before treatment	43.2	470.0	000.0	494.1	376.3
	After treatment	63.2	470.0	000.0	689.1	571.3

DISCUSSION

This study assessed the size of PA lesions of the root canals of maxillary anterior teeth irrigated with 0.2% CHX and 5.25% NaOCl one year after RCT using PSP digital radiography. The results supported the use of both irrigating solutions for creating a suitable environment to enhance the healing of PA lesions. We evaluated the results at 1 year after treatment since this time period has been recommended for assessment of the outcome of surgical and non-surgical endodontic treatments [8]. The results showed that all three irrigating solutions decreased the size of PA lesions at 1 year post-treatment. However, the reduction in both diameters of the lesions was significantly greater in both CHX and NaOCl groups compared with the saline group. This result was in line with that of Venugopal et al [1]. They reported that RCT with irrigation with antimicrobial agents resulted in successful healing of PA lesions.

CHX has a cationic nature and is absorbed by the anionic surfaces. It can bond to proteins such as serum or saliva albumin, pellicles on the root surface, salivary glycoproteins, and mucosal membranes. This reaction is reversible. Also, CHX can reversibly bond to hydroxyapatite and root dentin. When the CHX concentration decreases in the environment, CHX is released. This effect depends on the concentration of CHX. In total, the residual antimicrobial activity of CHX remaining in the root canal system remains for up to 12 weeks [9,10]. Although in this study no statistically significant difference was noted between the CHX and NaOCl groups, the reduction in the mean diameter of the lesions was slightly greater in CHX group, which can be due to its long-term substantivity due to attachment to dentin hydroxyapatite. Difference in the size of lesions at 1 year between the CHX and saline groups can be due to the antimicrobial properties of CHX, which result in significant reduction in the count of intracanal microorganisms. Also, the reduction in size of lesions in all groups at 1 year indicates the optimal efficacy of mechanical debridement of the root canal system.

Strengths

The efficacy of root canal irrigation in elimination of debris and bacteria depends on several factors including the penetration depth of needle, root canal diameter, internal and external diameters of the needle, intensity of irrigation, speed of injection of irrigant, and the flowability of the irrigating solution. Size and length of the needle, relative to root canal dimensions, is the most important factor in optimal efficacy of irrigation [11]. In the present study, all canals were instrumented with ProTaper rotary file to the same final size. Also, similar syringe and injection needle were used in all groups to standardize the flow of irrigating solutions at least to 3-4 mm from the apex in all root canals, which was a strength of this study. Moreover, due to inaccurate measurements made on the conventional PA radiographs, digital PSP radiographs taken with the parallel technique were used for measurements with a computer ruler, which was another strength of this study.

Limitations

Small sample size was one limitation of this study. However, long-term follow-up of a large sample size is difficult to achieve [12]. Future studies with larger sample size and longer follow-ups are required to obtain more reliable results. Also, evidence shows that the quality of coronal restoration can affect the periapical status [13,14]. Although the role of high-quality RCT is more important than the quality of coronal restoration in resolution of PA lesions, a combination of adequate RCT and optimally sealed coronal restoration can

bring about more favorable results [15]. However, the quality of coronal restoration cannot be well determined by radiography. This was another limitation of the present study, which could have affected the long-term results. Future studies are required to standardize the teeth in terms of their coronal restoration to eliminate the effect of this confounding factor on the results.

CONCLUSION

No significant difference was found in the efficacy of irrigation with 0.2% CHX and 5.25% NaOCl for reduction of the size of PA lesions at 1 year, postoperatively. However, both irrigating solutions were significantly superior to saline for this purpose.

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CONFLICT OF INTEREST

There is no Conflict of Interest.

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