CHLORHEXIDINE AS AN ENDODONTIC IRRIGANT: *IN VITRO* APICAL SEAL EVALUATION

José Carlos Yamashita[1]
Leandro Amadeo Stochi[2]
Sylvio de Campos Fraga[1]
Milton Carlos Kuga[1]
Marco Antonio Hungaro Duarte[1]
Eliane Gulin de Oliveira[1]

[1]*Discipline of Endodonty, Department of Dentistry/ Center for Biological Sciences and Health Professions - USC*

[2]*Dentist, Endodontist - USC*

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ABSTRACT

The aim of the present in vitro study was to evaluate the apical dye leakage presented by endodontic treatment using different irrigation regimens. Forty extracted human canines were divided into four experimental groups according the following irrigation regimens: Group I, 2% chlorhexidine solution (CHX); group II, 1% sodium hypochlorite solution (NaOCl); group III, CHX+EDTA; group IV, NaOCl+EDTA. After obturation the specimens were immersed in 2% methylene blue solution; sectioned and then the dye leakage were measured. The non-parametric Kruskal-Wallis and Dunn's multiple comparison tests were used to statistical analysis. The results showed less leakage in the group IV, followed to the groups III, I e II. There was significant difference between the groups IV and I; IV and II. It was concluded that the irrigation regimen using CHX+EDTA showed a similar leakage results than NaOCl+EDTA. The irrigation regimens using CHX or NaOCl alone, showed more leakage but there was no difference between this groups.

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INTRODUCTION

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Endodontic treatment aims to clean and mold the canal system in order to allow filling and the hermetic sealing of this system, which can be attained through an adequate biomechanical preparation through a conjoint action of instrumentation and irrigation.

Sodium hypochlorite solution has been widely used in the endodontic treatment, mainly in teeth showing pulpar necrosis (BAUNGARTNER; CUENIN, 1987; CHEUNG; STOCK, 1993; LEONARDO, 1998). This solution seems to present some important qualities: antimicrobian activity, dissolvent of organic material, detergent, with quick action and able to neutralize the septic and toxic content of the root canals (LEONARDO, 1998). On the other hand, the solution shows some cytotoxicity that increases in proportion to the concentration. According to Spangberg et al. (1973) the ideal irrigating solution is the one that combines the maximum antimicrobian activity and minimal toxicity. Looking for an alternative less irritating to Sodium hypochlorite, some studies were done on solutions of chlorhexidine (JEANSONNE; WHITE, 1994; YELSILSOY et al, 1995; WHITE et al., 1997; TANOMARU FILHO et al, 2002).

Chlorhexidine solution is a bisguanide cationic with good antimicrobian action, being active against a varied sort of gram-positive and gram–negative microorganisms, spores, lipophilic virus, blastophores and dermatophites. In addition, the solution is bacteriostatic in low concentration and bactericide in high concentrations (LEONARDO et al., 1999). In a concentration of 2% it shows antimicrobian activity similar to sodium hypochlorite (YELSILSOY et al., 1995, WHITE et al., 1997) and with tissue irritation similar to that of saline and lesser than the solution of 0.5% sodium hypochlorite (TANOMARU FILHO, 2001), besides its residual effect and its substantivity. The residual antibacterian activity remained from 48 to 72 hours (WHITE et al., 1997; LEONARDO et al., 1999) while used as endodontic irrigant and for 7 to 21 days when used as a delay dressing for 7 days (KOMOROWSKY et al., 1999; LENET et al., 2000). As a superficial cleanser, chlorhexidine has shown contradictory or even unsatisfactory results in some studies (ABBOTT et al., 1991; CHEUNG; STOCK, 1993; YAMASHITA, 2000) but Ferraz et al.(2001) report favorable results while using chlorhexidine as gel as endodontic irrigant.

As a result of the biomechanical preparation it is recognized that the surface of canals will be lined with an irregular and amorphous material of necrotic dentin or pulp remains and, sometimes, microorganisms (MCCOMB; SMITH, 1975; SEN et al, 1995),

known as *smear layer*. Removal of this layer is needed to guarantee direct contact of the obturing material with the dentinary wall of channels. Otherwise, it could harm the hermetic sealing of the obturation (CZONSTSKOWSKY et al., 1990; SEN et al., 1995). The removal of the *smear layer* is carried out with organic and non-organic solvents and the combination of sodium hypochlorite with EDTA (ethylenediamine tetra-acetic acid) has been widely recommended (SEN et al., 1995). However, there are few studies on the use of chlorhexidine in the biomechanical preparation concerning its influence in the apical marginal infiltration.

The aim of this study was to compare, *in vitro,* the marginal infiltration in biomechanized teeth using different regimens of irrigation in comparison to the use of chlorhexidine solution 2% and sodium hypochlorite 1%.

MATERIAL AND METHOD

Forty straight and uniradicular canines were used in this study. A high-speed spherical drill was used for conventional coronal approach and the pulpar tissue was removed with a Hedströem file with a previous exploration with an nº 10 K file till its active point was seen coming out through the apical foramen. In this way the real teeth length (RTL) was evaluated as well as the working length (WL), one millimeter less than the RTL. The apical foramens were standardized by instrumentation with nº 20 K file in the RTL.

Teeth were divided in 4 experimental groups with 10 specimens each with were instrumented by stepwise technique with pre-established 1 mm step backs by means of catheter movements associated to widening and circumferential scratching. The memory instrument was a nº50 K file and the step back ended with a nº80p K file. In each group teeth were irrigated with 2 mL of irrigating solution with a syringe and a 30 X 5 cannula at 3 mm from total length.

Each group received a specific irrigation regimen as can be seen in TABLE 1. In group I the preparation used chlorhexidine gluconate 2.0% (CHX); in group II it was used Sodium hypochlorite 1.0% (NaOCl); group III received similar irrigation to group I plus a final irrigation with EDTA flooding the channel for 3 minutes (CHX+EDTA); in group IV the irrigation was similar to group II plus a later conditioning with EDTA for 3 minutes (NaOCL+EDTA).

TABELA 1 - Distribution of experimentl groups according to the irrigation regimen.

Experimental group	Irrigation regimen	n
I	CHX a 2%*	10
II	NaOCl a 1%**	10
III	CHX*+EDTA***	10
IV	NaOCl a 1%**+EDTA***	10

*Chlorhexidien acquous solution (2 digluconate chlorhexidine) FGM (Joinville-SC).

**Farmácia Veritas (Bauru-SP).

*** trisodic E.D.T.A., Biodinâmica(Ibiporã-PR).

After the biomechanical preparation teeth were dried by aspiration and adsorbent cone papers and obtured with AHPlus® (Denstsply – De Tray) cement and gutta-percha cones by means of the sole cone technique.

After the endodontic treatment teeth were made impermeable except in a circumference of 1 mm having as central point the apical foramen. A layer of epoxy adhesive (Araldite, Ciba Especialidades Químicas) and a layer of nail polish (Risqué, Niasi). When the impermeabilitzation was dry teeth were immersed in a solution of Methylene blue 2% kept closed for 7 days in a temperature of 37ºC.

After that, teeth were cut longitudinally and sulci were made with a diamond drill in high rotation. Sulcus in the vestibular and lingual facets did not reach the obturing material. With a surgical chisel and hammer teeth were separated in 2 parts. The marginal infiltration was then assessed in a perfilometer (Profile Projector, model 6C, Nikon, Japan) with a 20 X magnification taking into consideration the great extension of infiltration showed by the staining agent. Obtained data were submitted to statistical analysis by Kruskal-Wallis test for global analysis and Dunn's test for multiple comparisons for individual comparison among experimental groups with significance of 5% ($p<0,05$).

RESULTS

TABLE 2 shows the observed apical infiltration measured in millimeters. FIGURE 1 shows the dispersion of measures and the

horizontal continuous bar marks the median. From these findings it is possible to ordinate the experimental groups from lesser to greater marginal infiltration: group IV (NaOCl+EDTA) < group III (CHX+EDTA) < group I (CHX) < group II (NaOCl). The statistical analysis has shown a significant difference ($p<0,05$) among groups IV and I and among groups II and IV (TABLE 3).

TABLE 2 - Distribution of obtained values marginal infiltration according to each experimental group (in mm).

	GROUP I	GROUP II	GROUP III	GROUP IV
1	4.0820	3.2120	4.0980	2.5120
2	3.4690	4.7540	3,8550	2.8100
3	3.6980	3.0920	3.2330	3.3530
4	5.3730	4.3210	3.2590	2.2770
5	3.6180	5.5360	2.2260	1.5270
6	4.5040	2.2790	2.9950	1.1060
7	3.1790	5.3050	2.7500	2.0780
8	2.6040	3.3140	2.2390	2.0500
9	3.2500	4.0970	2.5540	2.2470
10	4.2470	4.2470	3.8710	2.9180

FIGURE 1 - Dispersion diagram for marginal infiltration

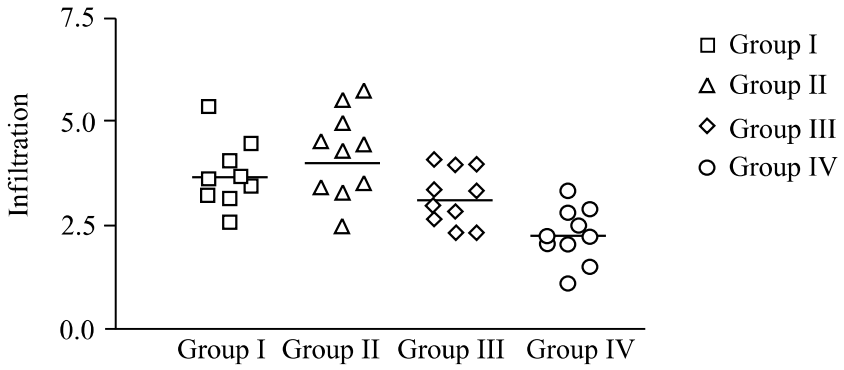

TABLE 3 - Statistical comparison among experimental groups.

Dunn's test	difference	p value	Significance
Group I vs Group II	-1.000	P > 0.05	ns
Group I vs Group III	8.800	P > 0.05	ns
Group I vs Group IV	18.20	P < 0.01	**
Group II vs Group III	9.800	P > 0.05	ns
Group II vs Group IV	19.20	P < 0.01	**
Group III vs Group IV	9.400	P > 0.05	ns

DISCUSSION

The removal of the *smear layer* from the dentinary wall after the biomechanical preparation may be disputable (GUTIERREZ et al., 1990) but is indication is becoming more and more unequivocal (CZONTSKOWSKY et al., 1990; SEN et al., 1995). The use of irrigant agents acting in the dentinary surface to remove the residual layer tend to favor the apical endodontic sealing and the NaOCl solution associated to EDTA, in particular, has been recognized as effective to this task (SEN et al., 1995). In the present study the solution was 1% NaOCl due to its greater stability and cleaning action similar to those shown by greater concentrations (BAUNGARTNER; CUENIN, 1992).

The citotoxicity of Sodium Hypochlorite solution and the possible accidents with its use has called for alternatives. Many other substances have been suggested to the biomechanical preparation of necropulpectomy in which is necessary an antimicrobian activity that is, usually, antagonic to the necessary biocompatibility (SPANGBERG et al. 1977). Among them it is chlorhexidine with a proved antimicrobian activity and a residual action associated to a tissue tolerance (DELANY et al., 1982; WHITE et al., 1997; LEONARDO et al., 1999; KOMOROWSKY et al., 1999; LENET et al., 2000, TANOMARU FILHO, 2001). Little is known about the apical infiltration in obtured root canal prepared with this irrigant.

Leonardo et al. (1999) report that the cationic detergents tend to produce deposits in the dentinary walls because they are negatively charged. On one hand, there will be a residual antimicrobian action, on the other hand there will be a great amount of remains in the dentinary wall (YAMASHITA, 2000). Hypothetically, this remains would interfere in the apical sealing inducing a greater marginal infiltration.

The results of the present study show lesser infiltration in teeth using the regimen of irrigation with NaOCl+EDTA, which can be regarded as the most efficient regimen. However, the results of this group did no show significant difference from that using CHX+EDTA even though presenting an inferior result. Groups that did not use EDTA to the final rinsing (Groups I and II) showed more apical infiltration with statistical significance as compared to group IV. This result is quite understandable since the smear layer has an organic and a non-organic nature (DAUTEL-MORZIN et al., 1994) being a sole irrigation solution non efficient to its removal (YAMADA et al., 1984; GARBEROGLIO; BECCE, 1994). Therefore, the use of a sole irrigant agent is not recommended for clinical use.

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Assuming that the low rate of infiltration is a consequence of improved preparation of the walls and, thus, providing better adaptation of the endodontic obturing material, it is believed that chlorhexidine has some room for endodontic use. In addition, its antibacterian activity, substantitivity and biocompatibility should be mentioned, characteristics that have been proved by many authors (JEANSONNE; WHITE, 1994; YELSILSOY et al, 1995; WHITE et al., 1997; LEONARDO et al., 1999; TANOMARU FILHO et al, 2002). Its main indication is in cases of infections in which the there is an additional risk of tissue harm by Sodium hypochlorite solution. If used, it is advisable to use the chelant solution to remove the smear layer and to favor the apical sealing. In this way it is possible to have a result, on the marginal infiltration aspect, similar to that of the NaOCl+EDTA association. However, additional studies to elucidate biological and physic-chemical aspects are necessary to consolidate its indication.

CONCLUSION

Taking into consideration the result and the limitations of the adopted methodology, it is possible to conclude that the regimen of endodontic irrigation with CHX solution associated to 2% EDTA allows greater marginal infiltration in endodontic obturations, although similar to that of NaCL associated to 1% EDTA.

The regimen of endodontic irrigation with CHX or NaCl alone shows greater marginal infiltration, without any difference between them.

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