ORIGINAL ARTICLE

The effect of different irrigation regimens on the apical seal of two endodontic sealers

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Abstract

Introduction: The purpose of this *in vitro* study was to investigate the influence of 5.25% sodium hypochlorite (NaOCl) and 0.12% chlorhexidine gluconate (CHX) use separately and combined as endodontic irrigants on the apical sealing ability of two endodontic sealers.

Materials and Methods: Eighty-six extracted maxillary central incisor teeth were used. The teeth were decoronated at the CEJ, access cavities were prepared, root canals were instrumented up to a master apical file size #40, irrigated with either 0.12% CHX alone, 5.25% NaOCl alone, 5.25% NaOCl and 0.12% CHX combined, or saline and dried using paper points. Obturation was accomplished by lateral condensation technique using one of two endodontic sealers AH26 or Apexit. Apical leakage was measured using dye penetration method and data were analyzed by one way ANOVA and Tukey's HSD test.

Results: The results showed significant differences between NaOCl+CHX/AH26 group and both CHX/AH26 and saline/AH26 groups ($P<0.05$). There was also a significant difference between saline/AH26 and other irrigant/AH26 groups ($P<0.001$) also there was statistically significant differences between saline/Apexit group and other irrigant/Apexit groups ($P<0.001$). The mean leakage of CHX/AH26 and CHX/Apexit was statistically different as well as for NaOCl/AH26 and NaOCl/Apexit ($P<0.05$).

Conclusion: Under the conditions of this *in vitro* study, combination of NaOCl/CHX can significantly increase apical sealing ability of AH26 sealer. **(Iranian Endodontic Journal 2008;3:119-22)**

Keywords: Apical, Irrigation, Leakage, Root canal therapy, Sealer.

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Introduction

Instrumentation of the root canal system must always be supported by an irrigation system capable of removing pulp tissue remnants and dentinal debris (1). Several solutions have been proposed as intra-canal irrigants. Sodium hypochlorite (NaOCl) has been widely used in endodontic therapy because of its antimicrobial activity (2) and tissue dissolving ability (3), but it has been found to cause severe inflammations in contact with vital pulp tissues (4-7).

Recently, Chlorhexidine gluconate (CHX) has been recommended as an endodontic irrigant because of its broad spectrum antimicrobial action (8), substantivity (9,10), and relative non cytotoxicity (8), however it does not dissolve pulpal tissues.

It has been postulated that the use of NaOCl and CHX, combined within the root canal, could gain an additive antimicrobial action and also a tissue dissolution property that is better than CHX alone and less cytotoxic than NaOCl. Kuruvilla *et al.* showed that the use of NaOCl and CHX combined within the root canal resulted in the greatest percentage reduction of post-irrigant positive cultures. This reduction was significantly more compared to using NaOCl but not significant compared to CHX (11).

Marley and Furguson *et al.* have investigated the effect of CHX 0.12%, NaOCl and saline on the apical sealing ability of Roth`s 811, AH26 and Sealapex sealers, they found no significant differences in the seals achieved using CHX in

both short-term (90 and 180 days) and long-term (270 and 360 days) observations (12,13). However, no study has been done on the effect of combined use of NaOCl and CHX on the apical seal.

The purpose of this *in vitro* study was to investigate the influence of 5.25% NaOCl and 0.12% CHX individually and combined on the apical sealing ability of endodontic sealers (AH26 and Apexit).

Materials and Methods

Eighty-six recently extracted human maxillary central incisors with single canals and mature apices were used in this *in vitro* study. All teeth were stored in normal saline after extraction and were disinfected by 5.25% sodium hypochlorite solution for 30 minutes. To eliminate root length as a variable, the crowns were removed at a level so that the remaining roots measured 15±1 mm. Patency and working length were determined using K-file size #10 (Mani, Tochigi, Japan) through the apical foramen, the working length being determined at 1mm just before the file went exited the root. Eighty roots were randomly divided into eight experimental groups. The remaining six teeth were used as negative and positive controls of three each. All root canals were cleaned and eight experimental groups shaped up to K-file size #40 (Mani, Tochigi, Japan) using step-back technique. Root canal flaring was performed by Gates Glidden drills #1 through #3 (Mani, Tochigi, Japan). Between each two files' use, root canals were irrigated with 1mL of different solutions for 10 seconds using 22-gauge needle. Canals in different experimental groups were irrigated with either 0.12% CHX alone (Peridex, Zila pharmaceuticals Inc., Cineinnati, OH), 5.25% NaOCl alone (ACE, Istanbul, Turkey), 5.25% NaOCl and 0.12% CHX combined, or saline (Darou pakhsh, Tehran, Iran) and obturated with gutta-percha (Sure-endo, Gyeonggi-do, Korea) and AH26 sealer (Dentsply, Konstanz, Germany) or Apexit sealer (Ivoclar, Vivadent, Schaan, Liechtenstein) using lateral condensation technique.

In negative control group, orifices of the canals were filled with wax and all external root surfaces were covered with two layers of nail polish. The root surfaces of three teeth in positive control group were remained uncovered but their orifices were filled with wax to prevent coronal dye leakage.

All external root surfaces except for apical 2 mm were covered with two layers of nail polish, so that dye could penetrate only from apical. After keeping the roots in Pelikan ink (Pelikan, Hanover, Germany) for 7 days, the samples were washed with water and were left to dry for 24 hours. Two grooves along the long axis of each root were made using a tapered bur in a high speed handpiece and a little water spray. All roots were then splited longitudinally using a chisel. All preparations were completed by an individual operator. Apical microleakage was assessed blindly by two examiners measuring the most extensive linear dye penetration using a stereomicroscope (Olympus, Tokyo, Japan) and a digital caliper to accurate 0.01 mm. The mean score was calculated. Finally, data were assessed using analysis of variance (ANOVA) at a significant level of $P<0.05$.

Results

The negative control demonstrated no dye penetration while the positive control showed dye penetration along the entire root canal.

The mean linear dye leakage in all groups is shown in Table 1.

The mean leakage among groups which were filled with AH26 sealer was statistically different ($P<0.001$). Tukey test revealed significant differences between NaOCl + CHX/AH26 group and both CHX/AH26 and saline/AH26 groups ($P<0.05$). There was also a significant difference between saline/AH26 and other irrigant/AH26 groups ($P<0.001$).

The mean leakage among groups which were filled with Apexit sealer was statistically different ($P<0.001$). Tukey test revealed that there were statistically significant differences between saline/Apexit group and other irrigant/Apexit groups ($P<0.001$).

Although the mean leakage for AH26 sealer was less than Apexit sealer for all four irrigant regimes, the mean leakage of CHX/AH26 and CHX/Apexit as well as NaOCl/AH26 and NaOCl/Apexit were statistically different ($P<0.05$).

Table 1. Mean leakage (mm) in all groups.

Irrigant	N	AH26 Mean (SD)	Apexit Mean (SD)	P value
NaOCl	10	0.88 (0.54)	1.49 (0.29)	0.006
CHX	10	0.66 (0.43)	1.33 (0.41)	0.03
NaOCl+ CHX	10	1.23 (0.42)	1.43 (0.62)	0.41
Saline (control)	10	2.23 (0.31)	2.13 (0.25)	0.46

Discussion

In this study, extracted maxillary central incisors were selected and were instrumented up to file #40 in order to minimize the variables such as anatomical variation, and the diameter of the apical foramen. As it has been reported that longer roots have a potential for greater leakage (14), roots with 15±1 mm length were used. To eliminate the operator variability, all preparations were completed by one operator. Buccolingual sectioning using a tapered bur in a high-speed handpiece were made and Pelikan ink was used for evaluating apical leakage. It has been shown that Pelikan ink does not stain the dentine and just shows the leakage path (15). In the present study, a simple irrigation method (without chelating agents) was used to avoid the affect of chelating agents on apical seal.

According to our results mean leakage for AH26 sealer was less than Apexit sealer, although it was not significant for all groups. This is supported by several investigations which reported that bisphenol A-based AH26 sealer adheres more than zinc oxide-based and calcium hydroxide-based sealers (16-18). It can be concluded that AH26 sealer is able to infiltrate the dentine tubules thus increasing the adhesive strength and be a formidable barrier to leakage. (16).

Mean dye leakage for AH26-saline and Apexit-saline groups or control groups were significantly more than other sealer-irrigant groups. This is supported by the findings of Furgusen *et al.* (12,13), they reported that Sealapex-saline had more significant leakage than saline-Roth and Peridex-Sealapex groups. One possible explanation may be that saline irrigant penetrate into the dentinal tubules less than NaOCl and CHX. This supposition is supported by a study that (19) evaluated the effectiveness of three endodontic irrigants to penetrate various tubular depths in human dentine and concluded that NaOCl 0.525% was superior. However, more dye leakage in NaOCl-sealer groups than CHX-sealer groups cannot be explained according to this report (19).

Probably, these results can be explained by the NaOCl mechanism of action: NaOCl acts as an organic and fat solvent degrading fatty acids, transforming them into fatty acid salts (soap) and glycerol (alcohol); this in turn reduces the surface tension of the remaining solution (saponification reaction). NaOCl neutralizes amino acids forming water and salt (neutralization reaction). With the exit of hydroxyl ions, there is a reduction of pH. When hypochlorous acid, a substance present in sodium hypochlorite solution, contacts organic tissues it acts as a solvent, releasing chlorine that combined with the protein amino group, forms chloramines (chloramination reaction) hypochlorous acid ($HOCl^-$) and hypochlorite ions (OCl^-) lead to amino acid degradation and hydrolysis (20).

Thus, the organic element of dentine and the wettability of dentine surface are decreased with NaOCl which in turn may decrease sealer adhesion and penetration into the dentinal tubules and increase the apical leakage of root canal obturation (21).

According to the results of this study, mean dye leakage following combination irrigation with NaOCl and CHX was increased for both sealers; however, there was statistically significant difference for AH26 sealer.

An *in vivo* study shows that the combination use of NaOCl and CHX can cause a toxic product which can be harmful (22).

Conclusion

Under the conditions of this *in vitro study*, NaOCl/CHX combined significantly increased apical sealing ability of AH26 sealer. More studies are required clinical use of NaOCl/CHX.

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