Dissolution of root canal sealers in EDTA and NaOCl solutions

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Despite being highly successful in general, some endodontic treatments do not respond to initial therapy for different reasons and, hence, necessitate re-treatment. Removal of endodontic filling material from the root canal is a requirement for re-treatment.[1]

The most commonly used root canal filling material is gutta-percha in combination with a root canal sealer, because the use of gutta-percha without a sealer fails to seal the root canal system completely. Therefore, re-treatment of previously filled canals demands that both the gutta-percha and the sealer must be removed from the canal walls and anatomical ramifications to ensure complete cleaning of the root canal system during the chemomechanical preparation and application of antimicrobial dressings.[2] Various removal methods are available, including the use of solvents, heat and mechanical instrumentation, alone or in combination.[3] Usually, mechanical removal is accomplished by means of various chemical solvents.[4]

Different solvents for dissolving root canal filling material have been studied. Many solvents that would be effective for dissolving root canal–filling materials are considered too toxic.[5] Some of these solvents have been reported to be cytotoxic[6,7] and some to be potential

ABSTRACT

Background. Solutions of ethylenediaminetetraacetic acid (EDTA) and sodium hypochlorite (NaOCl) have been used as canal irrigants in endodontic treatment. The authors conducted a study to compare the ability of these solutions to dissolve sealers.

Methods. The authors assessed the solubility of six sealers—calcium hydroxide, polyketone, zinc oxide–eugenol, silicone and two epoxy resins—in EDTA and two concentrations of NaOCl (2.5 percent and 5.0 percent). They immersed standardized samples (n = 5) of each sealer for two minutes and 10 minutes. They obtained the mean values of sealer dissolution in solutions by calculating the difference between the original preimmersion and postimmersion weights to determine the amount of sealer removed. They compared the values via factorial analysis of variance. They analyzed differences between the six sealers with respect to their solubility in EDTA or NaOCl solutions at two minutes and 10 minutes by using a one-way analysis of variance ($P < .05$).

Results. In comparison with NaOCl solutions, EDTA was markedly superior in dissolving root canal sealers ($P < .05$). There were no significant differences between the two concentrations of NaOCl. The two epoxy resins and the silicone-based sealer were of low solubility. The zinc oxide–eugenol—based sealer was significantly more soluble than were the epoxy resins and the silicone-based sealers. Polyketone and calcium hydroxide–based sealers were the most soluble sealers ($P < .05$).

Conclusions and Clinical Implications. The results of this study indicate that during nonsurgical endodontic re-treatment, EDTA and NaOCl solutions used for removing smear layer aided in the re-treatment by dissolving some root canal sealers.

Key Words. Sodium hypochlorite; ethylenediaminetetraacetic acid; solubility, sealers.

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carcinogens.[8-10] The choice of an ideal solvent for endodontic re-treatment requires a balance between clinical safety in usage (substances with low toxicity and aggressivity toward tissues) and great chemical capacity for dissolution.[11]

Irrigation solutions are used in endodontic therapy to remove debris from the root canal, eliminate microorganisms and serve as a lubricant during instrumentation.[12] The tissue-dissolving and disinfecting properties of sodium hypochlorite (NaOCl) make it the irrigant of choice. In endodontics, ethylenediaminetetraacetic acid (EDTA) is used to open calcified canals and eliminate potentially infected smear layers[13,14] and is used as a lubricant during treatment of root canals.

Irrigating solutions have been analyzed from different points of view by several authors. Some of them looked for solutions capable of removing the smear layer[15,16] or disinfecting the dentin and root canal system,[17,18] and others compared the solutions' cytotoxic effects.[12,19,20] To our knowledge, no investigators have performed a study of the relative solubilities of root canal sealers in EDTA and NaOCl solutions. Therefore, the aim of our in vitro study was to compare the ability of EDTA and NaOCl solutions to dissolve six different root canal sealers.

MATERIALS AND METHODS

In this study, we examined 15 percent EDTA (Wizard, Rehber Chemistry, Istanbul, Turkey) and two concentrations (2.5 percent and 5.0 percent) of NaOCl (Wizard, Rehber Chemistry). We used six sealers (Table 1): two epoxy resins (AH 26 and AH Plus, both manufactured by Dentsply DeTrey GmbH, Konstanz, Germany), a silicone (RSA, Roeko, Langenau, Germany), calcium hydroxide (Sealapex, Kerr, Salerno, Italy), polyketone (Diaket, 3M ESPE AG, Seefeld, Germany) and zinc oxide–eugenol (Endométhasone N Powder, Septodont, Paris). We used 180 standardized stainless steel molds 8 millimeters in diameter and 2 mm in height, and we drilled a 4 mm–diameter hole centrally in each mold for specimen placement (4 mm in diameter × 2 mm thick). We cleaned all molds with acetone for 15 minutes and weighed each three times before use. All weight measurements throughout the study were in grams recorded to four decimal places.

We mixed sealers in accordance with the manufacturers' instructions and carefully introduced freshly mixed materials into sample molds. Because calcium hydroxide–based sealer requires moisture for setting,[21] we mixed Sealapex with a spatula moistened with tap water. We left all samples to set at room temperature for 48 hours. We then trimmed excess material level to the surface of the mold with a scalpel. For each sealer, we prepared 30 samples, which we divided into three groups; we further divided each of those groups into two subgroups of five each according to immersion period (two minutes and 10 minutes). Thus, we prepared a total of 180 samples for this study. Before immersing the samples, we weighed all sealers in their molds three times and recorded the average reading.

At room temperature, we immersed sealer samples in 20 milliliters of solvent. The immersion was such that both surfaces of each sample were readily accessible to the solvent. We did not agitate the samples in the solutions.

We removed the sealer samples from the solvents after the specified immersion period (either two or 10 minutes) by using a pair of tweezers, touching only the metal mold. We then washed samples with 100 mL of double-distilled water. We placed the specimens on a grating in such a way that only the metal molds touched the grating and allowed them to dry for 24 hours. Thereafter, we weighed the samples three times and determined the amount of sealer removed from the specimen as the difference between the original weight of the sealer and its final weight.

Eighteen empty sample molds acted as controls in terms of solvent action on metal molds. We immersed three molds for two minutes and three others for 10 minutes in each of the three solvents and recorded any changes in weight.

We calculated the mean and SD values of weight loss at each time interval for each group of specimens. We compared the values by means of factorial analysis of variance by using commercially available software (SPSS 10.0, SPSS, Chicago). We analyzed differences between the six sealers with respect to their solubility in EDTA or NaOCl solutions at two or 10 minutes by using a one-way analysis of variance ($P < .05$). We further analyzed multiple comparison intervals to identify statistically homogeneous subsets ($P = .05$) by using the post hoc Duncan multiple range test ($P < .05$). We analyzed differences between the six sealers within each solution

ABBREVIATION KEY. EDTA: Ethylenediaminetetraacetic acid. **NaOCl:** Sodium hypochlorite.