Do the Sealer Solvents Used Affect Apically Extruded Debris in Retreatment?

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Abstract

Introduction: We evaluated apically extruded debris in the retreatment of root canals filled with different root canal sealers and gutta-percha using different solvents. **Methods:** Ninety human mandibular central and lateral teeth were prepared using the Reciproc #25 .08 nickel-titanium system (VDW GmbH, Munich, Germany) and were divided randomly into 6 groups. In groups 1, 2, and 3, root canals were filled with epoxy resin–based sealer and gutta-percha, and in groups 4, 5, and 6, root canals were filled with zinc oxide–eugenol–based sealer and gutta-percha. Each tooth was placed in a glass vial experimental apparatus. All root canal fillings were removed with the ProTaper Retreatment nickel-titanium system (Dentsply Maillefer, Ballaigues, Switzerland). During the retreatment procedure, in group 1, Resosolv (Pierre Rolland, Merignac, France) was used; in group 4, Endosolv E (Septodont, Paris, France) was used; and in groups 2 and 5, Guttasolv (Septodont) was used as the solvent. In the control groups (groups 3 and 6), no solvent was used. Reciproc #40 .06 was used for the final preparation. The times required for retreatments were recorded. **Results:** The weight of the extruded debris and the time required for retreatment were decreased significantly in the groups in which a solvent that was intended specifically for the root canal sealer was used (groups 1 and 4). In the Guttasolv groups (groups 2 and 5), the amount of apically extruded debris and the time required decreased for both root canal sealers. **Conclusions:** The amount of apically extruded debris and the duration of retreatment were reduced by the use of a solvent specific to the sealer compared with a gutta-percha solvent or no solvent. *(J Endod 2015;41:1507–1509)*

Key Words

Apical extrusion, retreatment, solvent

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Root canal treatment and retreatment, despite their high rate of success, may lead to undesired responses, and failure may occur (1, 2). The main causes of endodontic retreatment failure are thought to be ineffective treatment, reinfection of the root canal system, extraradicular infections, cystic lesions, and foreign body reactions related to extruded debris (3, 4). During root canal retreatment, intracanal debris, organic tissue remnants, and irrigants may extrude from the apical foramen and cause postoperative inflammation, flare-ups, and long-term failure (5). It is generally accepted that none of the instruments or techniques can prepare root canals or remove root fillings without producing some apically extruded debris (6–8). Several techniques and instruments can be used to remove gutta-percha, including nickel-titanium (NiTi) systems (9), ultrasonic systems (10), laser systems (11), and solvents (12). Resosolv (Pierre Rolland, Merignac, France) is a solvent specifically produced for solving resin-based sealers, such as AH Plus (Dentsply DeTrey, Konstanz, Germany). Resosolv contains 95% dimethylformamide and 1%–2% *Cinnamomum cassia*. Endosolv E (Septodont, Paris, France) is a solvent specifically for eugenol-based sealers, such as Tubli-Seal (Kerr Italia SPA, Scafati, Italy). Endosolv E contains 50%–90% tetrachloroethylene, 2.5%–10% isopentyl acetate, and 1% thymol. Guttasolv (Septodont) is an eucalyptol-based solvent for softening gutta-percha.

Although studies evaluating the amount of the apically extruded debris during retreatment procedure generally compare the effectiveness of various retreatment and shaping systems (13–16), to our knowledge, none has assessed the effects of various solvents and root canal sealers on the amount of apically extruded debris. The aim of this study was to evaluate the weight of apically extruded debris in the retreatment of root canals filled with various root canal sealers (AH Plus and Tubli-Seal) and gutta-percha using 3 solvents (Resosolv, Endosolv E, and Guttasolv).

Materials and Methods

Ninety freshly extracted human mandibular central and lateral teeth with a single root canal, mature apex, and a root canal curvature of $<10^\circ$ (17) were used. Radiographs were taken in the buccal and proximal directions to ensure that there was no internal resorption or root canal calcification. Soft tissue remnants and calculi on the external root surface were removed with hand and ultrasonic devices.

To standardize specimen lengths, all teeth were shortened to 20 mm by flattening the incisal edge, and a coronal access cavity was opened using a high-speed bur. The working length (WL) was determined as 1 mm short of the length of a size 15-K file so that the tip of the file was visible at the major apical foramen using an operating microscope (Opmi Pico; Carl Zeiss, Oberkochen, Germany). All teeth were prepared with a Reciproc #25 .08 NiTi system (VDW GmbH, Munich, Germany) to the WL, with a reciprocating slow in-and-out pecking motion according to the manufacturer's recommendation. The apical canal patency was controlled with a size 15-K file.

During the instrumentation procedure, 5% NaOCl was used for irrigation. For the final irrigation, 5 mL 17% EDTA, 5 mL 5% NaOCl, and 10 mL distilled water were used. Then, the root canals were dried with paper points (VDW GmbH) and divided randomly into 6 experimental groups ($n = 15$).

In groups 1, 2, and 3, root canals were filled with AH Plus sealer and gutta-percha, and in groups 4, 5, and 6, root canals were filled with Tubli-Seal sealer and gutta-percha using a cold lateral condensation technique; #25 .08 gutta-percha cones (VDW GmbH) were used as master cones. Root canal fillings were uniformly cut limited to 16 mm so

TABLE 1. Median Weight of Apically Extruded Debris in Groups

Group no.	Group name	Median (25%–75%)
1	AH Plus + Resosolv	39.0 (34.75–48.50)[a]
2	AH Plus + Guttasolv	115.0 (84.50–138.0)[b]
3	AH Plus control	181.0 (154.50–109.25)[c]
4	Tubli-Seal + Endosolv E	28.00 (23.50–44.25)[a]
5	Tubli-Seal + Guttasolv	140.0 (116.25–164.00)[b]
6	Tubli-Seal control	185.0 (145.50–203.25)[b,c]

Different letters indicate statistically difference. ($P < .001$) (10^{-5} g).

TABLE 2. Median Time Values in Groups

Group no.	Group name	Median (25%–75%)
1	AH Plus + Resosolv	85.00 (69.50–92.00)[a]
2	AH Plus + Guttasolv	165.00 (158.00–189.50)[b]
3	AH Plus control	284.00 (207.00–350.50)[b]
4	Tubli-Seal + Endosolv E	59.00 (51.25–92.50)[a]
5	Tubli-Seal + Guttasolv	190.00 (182.00–208.50)[b]
6	Tubli-Seal control	350.00 (304.00–387.00)[b]

Different letters indicate statistically difference ($P < .001$) (seconds).

that the volumes of gutta-percha and root canal sealers were approximately equal in all teeth. The quality of the root canal fillings was confirmed by radiography. All specimens were stored in 100% humidity and 37°C for 2 months.

All teeth were placed in the vial system, which had been preweighed 3 times using an analytical balance (AUW-220D; Shimadzu, Tokyo, Japan) with an accuracy of 10^{-5} g. Holes were created in the rubber stoppers of vials with a hot instrument. The tooth was inserted under pressure through the rubber stopper, which was fixed to the cementoenamel junction using cyanoacrylate (Quickstar; Furkan Inc, Istanbul, Turkey). The rubber stopper with the tooth was then fitted into the mouth of the vial. The apical part of the root was suspended within the vial, which acted as a collecting container for the apical material evaluated through the foramen of the root. A 25-G needle was placed through the rubber stopper to equalize the air pressure inside and outside the vial.

The groups were as follows:

1. *Group 1:* Size 2 and 3 Gates-Glidden drills were used to remove the coronal 3 mm of the root canal fillings. Then, 0.01 mL Resosolv was placed for 2 minutes. ProTaper Universal Retreatment files (Dentsply Maillefer, Ballaigues, Switzerland) were used to remove the root canal filling according to the manufacturer's instructions with a gentle in-and-out motion to the WL. After removal of every 4 mm of root canal filling, 0.01 mL solvent was placed into the root canal for 2 minutes. A total volume of 0.04 mL solvent was used for each specimen. Removal of the filling material was judged to be "complete" when no more gutta-percha/sealer could be seen on the instrument followed by inspection with an operating microscope to verify the cleanliness of the visible root canal walls. Reciproc #40 .06 NiTi files were used to the WL for final preparation. For each specimen, a total of 20 mL distilled water was used for irrigation between files and the pecking sequences during the retreatment and final preparation procedure. Instruments were used to prepare only 1 canal. All root canal preparations were completed by 1 operator. The durations of retreatment and the final preparation periods were recorded.
2. *Group 2:* Same procedure as in group 1; Guttasolv was used as solvent.
3. *Group 3:* Same procedure as in group 1; no solvent was used.
4. *Group 4:* Same procedure as in group 1; Endosolv E was used as solvent.
5. *Group 5:* Same procedure as in group 1; Guttasolv was used as solvent.
6. *Group 6:* Same procedure as in group 1; no solvent was used.

After the instrumentation was complete, the stopper, needle, and tooth were separated from the bottle, and the debris adhering to the root surface was collected by washing the root with 1 mL distilled water in the tube. The tubes were stored in an incubator at 68°C for 5 days to evaporate the distilled water.

Weight calculations were performed by a second examiner who was blinded to the group assignment. The vials were weighed using the same method to obtain their final weight including the extruded debris. The vials were weighed 3 times, and the mean value was calculated. The dry weight of the extruded debris was calculated by subtracting the weight of the empty vial from that of the vial containing debris.

Statistical Analysis

Data were subjected to 1-way analysis of variance, the Kruskal-Wallis test ($P < .001$), and the Tukey test ($P < .05$) using SPSS software (version 22.0; SPSS Inc, Chicago, IL).

Results

The median weights of debris extruded are presented in Table 1 and Figure 1. The median retreatment durations are presented in Table 2 and Figure 2. Regarding the amount of debris and retreatment

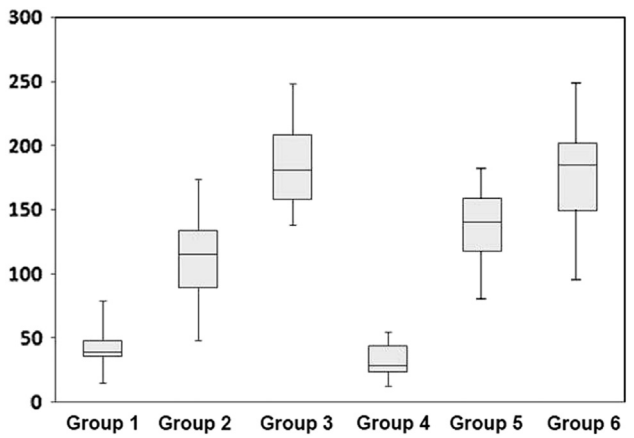

Figure 1. The median weight of apically extruded debris in groups (10^{-5} g).

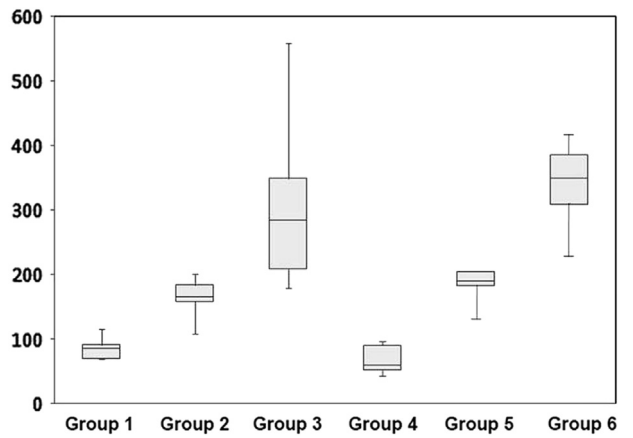

Figure 2. The median time values in groups (second).

durations, there was no statistically significant difference between group 2 (AH Plus) and group 5 (Tubli-Seal) in which Guttasolv was used as the solvent. Also, there was no statistical difference between control groups 3 (AH Plus) and 6 (Tubli-Seal). There was no statistically difference between groups 1 (AH Plus + Resosolv) and 4 (Tubli-Seal + Endosolv E) in which a solvent specific to the sealer was used.

Discussion

During retreatment procedures, extrusion of debris containing organic and inorganic remnants, gutta-percha, and sealer may cause flare-ups and long-term failure, acting as a foreign body (18, 19). The amount of apically extruded debris using various instrumentation techniques and systems in endodontic retreatment has been investigated extensively (13, 16, 20). The aim of this study was to evaluate the weight of apically extruded debris during the retreatment of root canals filled with different root canal sealers (AH Plus and Tubli-Seal) and gutta-percha using 3 solvents (Resosolv, Endosolv E, and Guttasolv). To our knowledge, no study has investigated the effects of the solvent used on various root canal sealers in terms of the amount of apically extruded debris. Thus, no previous data with which to compare our findings are available.

The use of a gutta-percha solvent (Guttasolv) or a solvent specific to the root canal sealer (Resosolv + AH Plus and Endosolv E + Tubli-Seal) reduced the amount of apically extruded debris during retreatment. This may be explained by the softening and solving effect of solvent on gutta-percha and sealer. NiTi rotary files can penetrate into a gutta-percha mass with minimal resistance; thus, NiTi files may push debris coronally (21). Using a solvent specific to the sealer may reduce the microhardness of the sealer to a greater degree than other solvents (22). This may explain why using a solvent specific to the sealer reduced the amount of apically extruded debris compared with the gutta-percha solvent.

Contrary to our results, some studies have suggested that using a solvent did not reduce the duration of retreatment procedures (23–26). This may be because in those studies solvent was used only once in the coronal portion of the root canal. Thus, the softening and solving effect of the solvent may have been limited. However, in our study, solvent was used after removing every 4 mm of gutta-percha for a total volume of 0.04 mL for each specimen.

Within the limitations of this study, any kind of solvent usage has a positive effect on decreasing apically extruded debris and time required. Considering the toxic properties of various solvents (27), the possible benefits and harms of the use of a solvent should be evaluated with further studies.

Conclusion

The amount of apically extruded debris and the duration of retreatment were reduced by the use of a solvent specific to the sealer (Resosolv for resin-based sealer and Endosolv E for zinc oxide–eugenol–based sealer) compared with a gutta-percha solvent (Guttasolv) or no solvent. Also, the use of a gutta-percha solvent reduced the amount of apically extruded debris and time taken versus the use of no solvent.

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The authors deny any conflicts of interest related to this study.

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