The Effectiveness of Manual and Mechanical Instrumentation for the Retreatment of Three Different Root Canal Filling Materials

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Abstract

The aim of this study was to compare the effectiveness of the Mtwo R (Sweden & Martina, Padova, Italy), ProTaper retreatment files (Dentsply-Maillefer, Ballaigues, Switzerland), and a Hedström manual technique in the removal of three different filling materials (gutta-percha, Resilon [Resilon Research LLC, Madison, CT], and EndoRez [Ultradent Products Inc, South Jordan, UT]) during retreatment. Ninety single-rooted straight premolars were instrumented and randomly divided into 9 groups of 10 teeth each ($n = 10$) with regards to filling material and instrument used. For all roots, the following data were recorded: procedural errors, time of retreatment, apically extruded material, canal wall cleanliness through optical stereomicroscopy (OSM), and scanning electron microscopy (SEM). A linear regression analysis and three logistic regression analyses were performed to assess the level of significance set at $p = 0.05$. The results indicated that the overall regression models were statistically significant. The Mtwo R, ProTaper retreatment files, and Resilon filling material had a positive impact in reducing the time for retreatment. Both ProTaper retreatment files and Mtwo R showed a greater extrusion of debris. For both OSM and SEM logistic regression models, the root canal apical third had the greatest impact on the score values. EndoRez filling material resulted in cleaner root canal walls using OSM analysis, whereas Resilon filling material and both engine-driven NiTi rotary techniques resulted in less clean root canal walls according to SEM analysis. In conclusion, all instruments left remnants of filling material and debris on the root canal walls irrespective of the root filling material used. Both the engine-driven NiTi rotary systems proved to be safe and fast devices for the removal of endodontic filling material. *(J Endod 2008;34:466–469)*

Key Words

EndoRez, gutta-percha, hand instrumentation, Resilon, root canal retreatment, rotary instrumentation

The main goal of nonsurgical root canal retreatment is to re-establish healthy periapical tissues (1). Only if the filling material can be removed completely and the canal negotiated to the apical foramen, can the prerequisites for successful retreatment be fulfilled (2–4).

Many materials are being used for the filling of root canals, of which gutta-percha with a variety of sealers is the most common (5, 6). Recently, a new endodontic filling material based on a thermoplastic-filled polymer (Resilon; Resilon Research LLC, Madison, CT) has been developed that handles like gutta-percha. EndoRez (Ultradent Products Inc, South Jordan, UT) is another resin-based sealer, which is a dual-cure radiopaque hydrophilic methacrylate endodontic sealer. No studies are present in the current literature on the retreatment of EndoRez filling material.

Many techniques have been advocated for the removal of gutta-percha in root canal–treated teeth. These include endodontic hand files combined with heat or chemical solvents, engine-driven rotary files, ultrasonic instruments, heat-carrying instruments, paper points with chemicals, and lasers (7, 8). Two nickel-titanium (NiTi) systems have recently introduced rotary instruments specifically designed for removing semisolid filling materials: the Mtwo R (retreatment) rotary files (Sweden & Martina, Padova, Italy) and the ProTaper Universal retreatment files (Dentsply-Maillefer, Ballaigues, Switzerland). No studies are present in current literature on the ex vivo or in vivo efficacy of this instruments in the retreatment of filling materials.

The purpose of this study was to compare ex vivo the efficacy of two new engine-driven NiTi rotary systems: the Mtwo R and the ProTaper retreatment files with a manual technique in the removal of 3 root filling materials (gutta-percha, Resilon, and EndoRez).

Material and Methods

Ninety intact straight single-rooted permanent extracted premolars with a round canal and a curvature $<5°$ (9) and with completely developed apices were selected for this study on the basis of similar root lengths, approximately 16 mm. The length of each root was measured with a digital calliper (Mitutoyo, Tokyo, Japan) and recorded and reference points established.

The cusps were removed, and access to the pulp chamber was established with a cylindrical diamond bur (Komet # 6881; Komet-Brasseler, Lemgo, Germany) using a high-speed handpiece under copious water cooling. After the root canal orifice was identified, canal patency was determined by using a size 10 K-Flexofile (Dentsply-Maillefer).

Endodontic treatment was performed using Mtwo NiTi rotary instruments (Sweden & Martina). Canals were enlarged to a size 40, .04 taper at the working length.

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0099-2399/$0 - see front matter

doi:10.1016/j.joen.2008.02.008

TABLE 1. Experimental Groups of the Present Investigation

Group	Filling Material	Retreatment Technique
1	Gutta-percha and pulp canal sealer	Gates Glidden + Hedström
2	Gutta-percha and pulp canal sealer	ProTaper Universal
3	Gutta-percha and pulp canal sealer	Mtwo R
4	Resilon + Real Seal primer + Real Seal sealer	Gates Glidden + Hedström
5	Resilon + Real Seal primer + Real Seal sealer	ProTaper Universal
6	Resilon + Real Seal primer + Real Seal sealer	Mtwo R
7	Resin-coated gutta-percha and EndoRez sealer	Gates Glidden + Hedström
8	Resin-coated gutta-percha and EndoRez sealer	ProTaper Universal
9	Resin-coated gutta-percha and EndoRez sealer	Mtwo R

During shaping, each canal was irrigated between each successive instrument with 2.5 mL of 5.25% NaOCl. A final flush was performed with 5 mL of 17% EDTA solution for 30 seconds followed by a rinse with 5 mL of saline solution.

The teeth were divided into 9 groups of 10 teeth each ($n = 10$). To determine standardization of root lengths, a one-way analysis of variance was performed to show if any significant differences existed between the groups ($p > 0.05$). After drying with paper points, all roots were filled using lateral condensation. Thirty roots (groups 1, 2, and 3) were filled with gutta-percha and Kerr Pulp Canal Sealer (gutta-percha groups); 30 roots (groups 4, 5, and 6) were filled with Resilon points, Real Seal Primer, and Root Canal Sealant (SybronEndo, Orange, CA) (Resilon groups); and the remaining 30 roots (groups 7, 8, and 9) were filled with resin-coated gutta-percha cones and EndoRez endodontic sealer (EndoRez groups). After lateral condensation, the coronal surface of Resilon and EndoRez groups was light cured (Starlight Pro; Mectron S.p.A., Carasco, Italy).

The total length of the root canal fills did not exceed more than 16 mm from apex to coronal aspect so that the volume of filling material was approximately equal for all teeth. All roots of groups 1, 4, and 7 had approximately 5 mm of filling material removed from the coronal part of the canal using Gates Glidden burs 2 and 3 at 5,000 rpm. The roots of groups 1, 4, and 7 were retreated using hand instrumentation (Hedström groups); groups 2, 5, and 8 were retreated using rotary instrumentation with ProTaper retreatment files (ProTaper groups); and the roots of groups 3, 6, and 9 were retreated using rotary instrumentation with Mtwo R files (Mtwo R groups). Each instrument was only used to retreat 5 root canals.

In the Hedström group, a drop of chloroform solvent was used, and hand instrumentation was performed with H-type files, sizes 20, 25, 30, 35, 40, in a circumferential quarter-turn push-pull filing motion to remove canal filling material and sealer by pushing against the root canal walls.

All instrumentation of the ProTaper and Mtwo groups was performed using a 16:1 reduction gear handpiece (Anthogyr, Sallanches, France) with a high torque endodontic electric motor (E-Go, Sweden & Martina) operated at 600 rpm.

In the ProTaper groups, the retreatment files were used according to the manufacturer's instructions. The canals were instrumented in a crown-down sequence using ProTaper D1 file to remove filling material from the coronal portion of the root canal, whereas the middle and apical third of the canals were instrumented using ProTaper D2 and ProTaper D3 files, respectively, using a brushing action with lateral pressing movements. ProTaper D3 file was taken to the working length.

The Mtwo retreatment files were also used according to the manufacturer's instructions. The canals were instrumented in a simultaneous technique to the working length using Mtwo R2 size 25 .05 taper in a brushing action with a lateral pressing movement. Progression of the rotary files was performed by applying slight apical pressure and frequently removing the files to inspect the blade and clean the debris from the flutes.

Retreatment was deemed complete when the last file reached the working length, there was no filling material covering the instrument, and the canal walls were smooth and free of visible debris. All root canals were irrigated at each change of instrument with 2 mL of 5.25% NaOCl using an endodontic syringe. After irrigation with 5 mL of 17% EDTA solution, a final rinse with 5 mL of saline solution was used.

The experimental groups of the present investigation are summarized in Table 1. The evaluations were carried out blind by one operator who was unaware of the treatments that were rendered. Each instrument was carefully examined under a stereomicroscope at 10× magnification (Global G6, St Louis, MO) between use for signs of plastic deformation or separation. In addition, perforations, blockages, or ledging were noted. The time required to achieve satisfactory filling material removal was recorded.

Extrusion of debris of root canal filling material through the apical foramen was observed visually using loupes with 3× magnification and scored according to the following system: 0 = no extrusion of filling material; 1 = minimal extrusion of filling material, barely detectable; 2 = moderate extrusion of filling material, easily detectable; and 3 = extrusion of considerable amount of filling material.

Canal wall cleanliness was evaluated through optical stereo microscopy (OSM) and scanning electron microscopy (SEM) analysis. The roots were split longitudinally, and each half was examined by using an OSM (Zeiss Stemi DV4 Spot; Carl Zeiss S.p.A., Arese, Italy) at 8, 16, and 32× magnification and photographed with a digital camera. A grading system was used to score the amount of residual filling material and debris establishing a different score for the coronal, middle, and apical portions of the root canal of each section. The following criteria were used: 0 = none to slight presence (0%–25%) of residual debris covered the dentinal surface, 1 = presence of 25% to 50% of residual debris on the surface, 2 = moderate presence (50%–75%) of residual debris, and 3 = the entire or almost the entire surface (75%–100%) is covered with residual debris. No attempt was made to distinguish between filling material or sealer remnants.

After the OSM analysis, the root sections were prepared for the SEM analysis and examined by using the OSM grading system at 50 and 150× magnifications. In addition, the presence of open dentinal tubules in the coronal, middle, and apical portions of the root canals was recorded through further examination at 300 and 600× magnifications.

A linear regression analysis was performed to assess the influence of different covariates on the time required for material removal, whereas three different logistic regression analyses were performed to investigate the influences of filling materials, instruments used, and level of observation, considered as potential prognostic factors on the prevalence of apical extrusion of material and of amount of residual filling