Removal of Root Canal Fillings in Curved Canals Using Either Reciprocating Single- or Rotary Multi-instrument Systems and a Supplementary Step with the XP-Endo Finisher

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Abstract

Introduction: This study compared the efficacy of a reciprocating single-instrument system and a rotary multi-instrument system followed by a supplementary approach with a finishing instrument in removing the filling material from curved canals during retreatment. **Methods:** Forty mesial canals from extracted mandibular molars were instrumented and filled. Then, each mesial canal was retreated by using either Reciproc (VDW, Munich, Germany) or Mtwo (VDW) instruments, alternating the technique used per canal from root to root. The working time was recorded, and the percentage of removed filling volume was assessed by means of micro–computed tomography imaging before and after retreatment. Canals still showing filling material remnants were subjected to an adjunctive approach with the XP-Endo Finisher (FKG Dentaire, La Chaux-de-Fonds, Switzerland), and another microCT scan was taken. Data were statistically analyzed with a significance level of 5%. **Results:** The percentage of filling material removed with Mtwo instruments (96%) was significantly higher than Reciproc (89%) ($P < .05$), both used up to a final instrument size of 40. Mtwo required less time to remove the filling material than Reciproc ($P < .05$). Intragroup analysis in the Reciproc group showed that the R40 instrument removed significantly more filling material than R25 ($P < .05$). The supplementary approach with the XP-Endo Finisher was effective in significantly enhancing the removal of filling material ($P < .05$). **Conclusions:** The rotary multiple-instrument system was more effective and faster than the reciprocating single-instrument approach in removing previous root canal fillings. As for the Reciproc group, it was observed that the larger instrument promoted significantly better results. The adjunctive finishing instrument XP-Endo Finisher significantly improved filling material removal. *(J Endod 2016;42:1114–1119)*

Key Words

Endodontic retreatment, reciprocating single-file system, root canal preparation, rotary instruments

Significance

Using a highly accurate evaluation method, this study showed that a rotary multi-instrument system (Mtwo) was more effective and faster than a reciprocating single-instrument system (Reciproc) in removing the filling material from curved canals during retreatment. Additionally, a supplementary approach with the XP-Endo Finisher enhanced filling removal.

Root canal retreatment usually represents a significant technical challenge for clinicians, especially in teeth with well-filled curved canals (1). The resistance imposed by the compacted filling material makes removal difficult with increased risks of accidents. Failure in completely removing the previous filling material can make proper disinfection difficult by restricting the access of antimicrobial agents to certain areas of the root canal system (2). Filling remnants may cover areas in which residual infection occurs. If bacteria remain in the apical canal, there is an increased risk for maintaining periradicular inflammation (3).

Different techniques have been proposed to remove filling materials, most of the recent ones using nickel-titanium (NiTi) rotary instruments. Some systems are specially designed for use in retreatment, including the Mtwo Retreatment instruments (VDW, Munich, Germany). This system comprises 2 instruments (R1 [15/0.05] and R2 [25/0.05]) that have a cutting tip in order to facilitate penetration into the filling mass. After the retreatment instrument removes the gross part of the filling material, the canal is prepared with the system of preference. Alternatively, some authors have proposed removing the previous filling material with reciprocating single-instrument systems originally designed for root canal preparation (4–11). In this case, filling removal is performed simultaneously with reinstrumentation. One of the most popular single-instrument systems used for this purpose is Reciproc (VDW). Three instrument sizes are available: 25/0.08 mm for narrow canals, 40/0.06 mm for

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0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2016.04.007

medium-volume canals, and 50/0.05 mm for large canals. The Reciproc instrument has the same cross-sectional design (2-fluted file with "S" shape) as the Mtwo instruments from the same manufacturer but with an opposed cutting direction of the flutes.

Irrespective of the retreatment technique, numerous studies have shown that complete removal of root canals fillings is not commonly attained (9, 10, 12–16), particularly in the apical portion of the root canal (14, 17, 18). Therefore, additional approaches have been suggested to enhance the removal of filling material (15, 18, 19). Recently, a new NiTi finishing instrument was developed with the purpose of improving root canal cleaning—the XP-Endo Finisher (FKG Dentaire, La Chaux-de-Fonds, Switzerland), which is a size 25 nontapered instrument made with the NiTi MaxWire alloy (Martensite-Austenite ElectropolishFleX, FKG Dentaire). Because of this special alloy, this instrument is straight in its martensitic phase, which is achieved below 30°C; however, when placed in the canal at the body temperature, it changes to the austenitic phase in which the instrument assumes a spoon shape in the last 10 mm with a depth of approximately 1.5 mm. When rotating, this instrument achieves a natural diameter of 3 mm in the last 10 mm (Fig. 1). According to the manufacturer, when the instrument tip is squeezed, the bulb can be expanded to 6 mm; when the bulb is compressed, the tip will expand to 6 mm. Thus, when the XP-Endo instrument is moved up and down for 7 to 8 mm inside the canal, the natural constrictions and expansions in the canal will alternately cause the bulb and tip to expand and contract. This makes the instrument scrape the canal walls and cause turbulence of the irrigant solution. It seems that the XP-Endo Finisher instrument has the potential to be applied as an additional procedure in retreatment cases to maximize filling removal.

As for removal of the root canal filling material in curved canals, the following questions remain unanswered: What instrumentation system is more effective for filling removal in curved canals? Do reciprocating single-instrument systems perform similarly to rotary multi-instrument systems? and Can supplementary approaches enhance filling removal? Few studies addressed these questions using a 3-dimensional high-accuracy method like micro–computed tomographic (microCT) imaging. In 1 study, the ProTaper Universal Retreatment system (Dentsply Maillefer, Ballaigues, Switzerland) was compared with Reciproc and Hedström files, and no significant differences were found between groups (9). However, in a study using flattened canals, Reciproc was associated with less remaining material when compared with ProTaper and Hedström files; a supplementary step with passive ultrasonic irrigation (PUI) significantly reduced the amount of residual material in all groups (20). Another study compared Reciproc with WaveOne (Dentsply Maillefer) systems before and after PUI with xylene and observed no statistical significant differences between the 2 instrumentation techniques; no significant reduction in residual material was promoted by the supplementary step of PUI with xylene either (11).

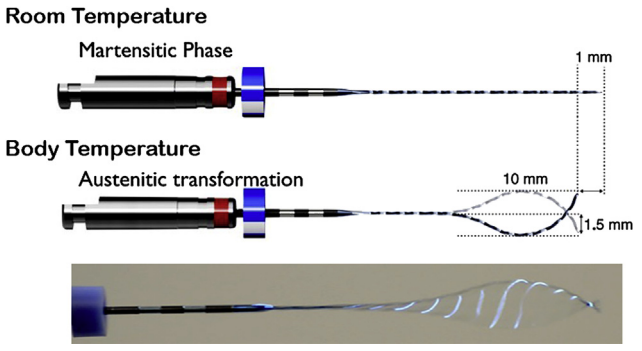

Figure 1. Mechanism of action of the XP-Endo Finisher instrument.

The purpose of the present study was 3-fold:

1. To compare the efficacy of a reciprocating single-instrument system (Reciproc) with a rotary multi-instrument system (Mtwo) both using instruments with a similar cross-sectional design
2. To compare the effects of using 2 instrument sizes of the Reciproc system (R25 and R40) on filling removal
3. To evaluate the additional cleaning effects of a new instrument (XP-endo Finisher) as an adjunctive approach

For these analyses, the microCT technology was used.

Materials and Methods

Specimen Selection and Initial Preparation

The study protocol was approved by the Ethics Committee of the University Center of João Pessoa, João Pessoa, PB, Brazil. The mandibular molars used were selected from a collection of 165 molars extracted for reasons not related to this study and pertaining to the institutional human tooth bank. Teeth with mesial root curvatures between 30° and 40° were initially radiographed both in the buccolingual and mesiodistal directions to check for the presence of 2 distinct mesial canals. Next, they were decoronated at the level of the cementodentinal junction, and the mesial roots were separated with the aid of a diamond disc (Brasseler, Savannah, GA). All roots were carefully inspected under an operative microscope with 5× magnification in order to verify the apexes were completely formed and the root surfaces were free from evident cracks or resorption. The root canals were explored with a size 10 K-type file (Dentsply Maillefer) until the instrument tip was visible at the apical foramen under magnification. This procedure was performed to measure the length of both mesial canals, check for the presence of 2 independent foramina, and confirm their patency. Finally, radiographs were once again taken with the files within the canals to confirm the occurrence of 2 independent canals. Therefore, only roots classified as Vertucci's type IV were included in the study. Twenty roots were selected according to these criteria.

Preparation of both mesial canals was performed with Mtwo instruments in the following sequence: 10/0.04, 15/0.05, 20/0.06, and 25/0.06. The instruments were used in continuous rotation powered by the VDW Silver motor in the Mtwo mode. The working length (WL) was established 1 mm short of the apical foramen. The canals were copiously irrigated with 2.5% sodium hypochlorite (NaOCl) and checked for apical patency with a size 15 K-type file throughout the instrumentation procedures. Irrigation was performed using 30-G NaviTip needles (Ultradent, South Jordan, UT) taken up to 3 mm short of the WL. After preparation was complete, the smear layer was removed by rinsing the canals with 2 mL 17% EDTA for 3 minutes followed by 2 mL 2.5% NaOCl. Afterward, the canals were dried with absorbent paper points and subsequently filled with the single-cone technique using Mtwo 25/0.06 gutta-percha points (VDW) combined with Sealer 26 (Dentsply, Petrópolis, RJ, Brazil). The coronal cavity was sealed with Coltosol (Vigodent, Rio de Janeiro, RJ, Brazil), and the quality of canal fillings was checked by buccolingual and mesiodistal radiographic projections. If voids were detected, the tooth was discarded and replaced. The specimens were stored in 100% humidity at 37°C for 14 days to allow the sealer to set.

Initial microCT Imaging Analysis

The specimens were scanned in an 800-μA SkyScan 1174v2 microCT scanner (Bruker-microCT, Kontich, Belgium) with a 50-kV X-ray source. The parameters used for scanning included a rotation