Quantitative Evaluation of Debris Extruded Apically by Using ProTaper Universal Tulsa Rotary System in Endodontic Retreatment

Xiangya Huang, MS, Junqi Ling, PhD, Xi Wei, MS, MDS, and Lisba Gu, MS

Abstract

This study evaluated the amount of apical debris during endodontic retreatment by using the ProTaper Universal Tulsa rotary files. Forty-five extracted human anterior teeth were root filled before randomly assigned to 3 groups. In group A, gutta-percha was removed by using the ProTaper Universal Tulsa retreatment system, and canals were re-prepared with ProTaper rotary files. In group B, gutta-percha was removed by using Hedstroem files with chloroform, and canals were reshaped with ProTaper rotary files. In group C, the same method as that in group B was used for gutta-percha removal, and canals were reshaped with K-flex files. Apical debris was collected and compared among 3 groups. Although all retreatment techniques resulted in apical extrusion, the ProTaper Universal Tulsa rotary technique in group A produced significantly less amount of apical extrusion than other 2 methods (P < .001). The ProTaper Universal Tulsa rotary technique proves to be a viable alternative method in endodontic retreatment. (J Endod 2007;33:1102–1105)

Key Words

Apical debris, endodontic retreatment, nickel-titanium, ProTaper Universal Tulsa rotary instruments

Materials and Methods

Specimen Preparation

Forty-five extracted human maxillary anterior teeth of single canal and similar root length were collected. The soft tissue remnants and calculus on the external root surface were mechanically removed. Teeth were examined under an operating microscope (Carl Zeiss, Jena, Germany) to verify the presence of a single apical foramen (7). After access cavity, the canal patency was established with a size 10 K-type file (Dentsply Mailleefer, Ballaigues, Switzerland). Canals that were patent to greater than International Standards Organization (ISO) size 15 and/or with curvature >10 degrees were discarded (14).

Root Canal Preparation and Obturation

The working length (WL) of each canal was visually determined with the use of size 10 K-type files to 1 mm short of the major apical foramen. A circumferential “staging...
“platform” was created near the canal orifice so that a uniform WL of 15 mm was achieved.

Root canal preparation was performed with a modified step-back flare technique. The coronal portion was initially flared with sizes 1–3 Gates Glidden drills (Dentsply Maillefer, Ballaigues, Switzerland). Canals were then prepared with K-type files to a master apical file size 30 and step back in 1-mm increment to a file size 50. On withdrawal of each instrument, canals were irrigated alternatively with 2 mL of 5.25% NaOCl and 17% ethylenediaminetetraacetic acid. Canal patency was maintained by inserting a size 15 K-type file slightly beyond the apical foramen during recapitulation.

All canals were then obturated with gutta-percha and AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) by using cold lateral condensation technique. The coronal extension of root fillings was uniformly limited to the level of staging platform as an attempt to control the amount of root fillings in each tooth. The access cavities were sealed with Cavit (Dentsply DeTrey). Teeth were radiographed in buccolingual and mesial-distal directions to confirm the quality of obturation. All teeth were stored at 37°C in a humidor for 30 days to allow complete setting of the sealer.

### Retreatment and Debris Collection

Debris was collected as previously reported (15). The schematic representation of the collection assembly prepared for assaying the apical extrusion is shown in Fig. 1. All ampules were covered with adhesive tape to prevent the operator from viewing debris extrusion during the retreatment phase. The entire apparatus was handled only by the outer vial. In no case was the inner Eppendorf tube touched with fingers.

Before retreatment, the Eppendorf tubes were weighed to 10⁻⁵ precision by using a microbalance (Sartorius AG, Göttingen, Germany). Three consecutive measurements were taken for each tube, and the mean value was recorded. All teeth were coded and then randomly assigned to 3 groups of 15 specimens each.

#### Group A: Gutta-percha Removal With ProTaper Universal Tulsa Retreatment Files and Re-preparation With ProTaper Universal Tulsa Treatment Files

Gutta-percha was removed with ProTaper Universal Tulsa retreatment system following the manufacturer’s instructions. D1, D2, and D3 were sequentially used at 500 rpm until the pre-established WL was reached. No solvent was used. In case the rotary files could not go deeper, stainless steel K-type files were used to achieve the canal patency before reintroducing the rotary instruments. Root canal refining was accomplished with ProTaper Universal Tulsa rotary shaping (S1, S2) and finishing (F1, F2, and F3) files (Dentsply Tulsa) following the manufacturer’s instructions. The tapers and tip diameters of F1, F2, and F3 are equivalent to size 0.07/0.20 mm, 0.08/0.25 mm, and 0.09/0.30 mm, respectively. After re-preparation with F3, the canal was 0.39 mm in diameter at the level of 1 mm short of the WL.

#### Group B: Gutta-percha Removal With Hedström files and Chloroform and Re-preparation With ProTaper Universal Tulsa Treatment Files

Gutta-percha in the coronal portion was removed by using size 1–3 Gates Glidden drills. The root fillings in the apical portion were then removed by sequential use of sizes 20–30 Hedström files (Dentsply Maillefer) with chloroform. Once the bulk of root filling had been removed, chloroform in conjunction with paper points was used to remove the filling material that remained in the irregularities of canal system. ProTaper Universal Tulsa rotary shaping and finishing files were then used for root canal re-preparation.

#### Group C: Gutta-percha Removal With Hedström Files With Chloroform and Re-preparation With K-flex Files

The method for gutta-percha removal was the same as that in group B. Root canal reshaping was accomplished with stainless steel K-flex files (Dentsply Maillefer), with apical enlargement up to size 35 and step-back in 1-mm increments to size 50. Consequently, the canal
Some investigations (17, 18) demonstrated that the amount of debris a root canal system chemomechanically without any extrusion of debris. Extrusion was independent of the technique used. However, most of studies (7, 17, 18) and reinforce the fact that it is impossible to prepare was performed.

In this study, ProTaper Universal Tulsa technique in group A resulted in the least amount of debris. This might be due to the fact that this technique combines rotational motion with a crown-down pressureless action, whereas techniques used in the other 2 groups incorporated a push-pull filing action (16, 20, 21). The push-pull filing actions of the Hedström files and K-flec files act as a piston, posing a risk of pumping the debris and irrigant through the patent apical foramen (22). Furthermore, we observed that ProTaper Universal Tulsa retreatment files could remove gutta-percha from the canals in large pieces around the spirals of instruments, whereas Hedström files only removed gutta-percha in small increments. The better performance is probably attributed to the unique instrument design. D1, D2, and D3 have 3 progressive tapers and lengths, which fit the coronal, middle, and apical portions of the canal, respectively. Moreover, the files have a convex triangular cross section that reduces the area of contact between the instrument and the dentin walls. During instrumentation, the debris is positioned between the apical blades and augered up the flutes of the rotating instrument, which helps to decrease the amount of the debris extruded (23).

Caution should be exercised when applying the current result to clinical situations. The in vitro setup had the apex suspended in air, whereas in vivo the apex would be surrounded by granulomatous or periradicular tissues, which could help to restrict apical extrusion to some extent (24). Thus, further research will be necessary to evaluate the clinical performance of the ProTaper Universal Tulsa rotary system during retreatment.

In conclusion, the ProTaper Universal Tulsa rotary system caused a significantly less amount of debris extrusion during endodontic retreatment compared with other traditional techniques. It proved to be a viable alternative method in endodontic retreatment.

Acknowledgments

This study was supported by Key Clinical Program of the Ministry of Health, China.

References