

## COMPARISON BETWEEN THREE DIFFERENT ROOT CANAL ROTARY INSTRUMENTS IN RETREATMENT: AN IN VITRO STUDY

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### ABSTRACT

**Aim:** The aim of this study was to compare Protaper Universal retreatment files, M-Pro, and Twisted files in retreatment.

**Methodology:** Experimental groups were divided into three group; Group I: Protaper Universal Retreatment (PTU; Dentsply Maillefer, Ballaigues, Switzerland), Group II: M-Pro (Innovative Material and Devices, ShangHai, China), and Group III: Twisted File (TF; SybronEndo, Orange, CA). Each group was evaluated for time to reach the working length, amount of debris extruded during retreatment. Data were then collected, tabulated and statistically analyzed.

**Results:** Statistical analysis showed that TF recorded the least time to reach the working length, while M-Pro showed the highest amount of debris extruded.

**Conclusion:** Under the condition of the current study, TF was faster than M-Pro and PTU to perform gutta-percha removal in the retreatment of teeth. The use of M-Pro in retreatment increased the amount of apically extruded debris.

### INTRODUCTION

Retreatment has been increased recently because of increased emphasis on teeth preservation. When endodontic treatment fails, nonsurgical endodontic retreatment is often indicated as the first choice to eliminate and reduce microbial load from root canal <sup>(1)</sup>. However, well compacted filling offers challenge in its removal, leave residual debris <sup>(2)</sup>, limit the access to the apical foramen, and impair root canal proper shaping.

The main goal of nonsurgical root canal retreatment is to remove the filling material and re-establish the working length and to re-establish healthy periapical tissue <sup>(3)</sup>. Several studies and techniques have been proposed for removal of different root canal filling material and sealers such as: hot instruments and pluggers, ultrasonics <sup>(4)</sup>, manual instrumentation techniques and chemical solvents such as: chloroform <sup>(5,6,7)</sup>, and other solvents. Recently, the rotary NiTi instruments had been introduced for the purpose of

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retreatment<sup>(8)</sup> and many of them had been studied for their effectiveness such as: ProFile, PTU<sup>(9, 10)</sup>, K3, Mtwo<sup>(9, 10)</sup>, Race, R-endo<sup>(9)</sup>, and TF.

These instruments had been evaluated for their effectiveness in previous studies to achieve the main goals of retreatment such as: a) Amount of debris extruded during retreatment affect the periapical tissue health, the amount of post-operative pain and flare up. Large body of evidence indicated that almost all instrumentation techniques promote apical extrusion of debris to some degree. The amount and the mass of debris extruded affect the amount of flare up according to technique and instrument used.

Recently several new endodontic techniques and systems had been introduced at market specialized in retreatment with special properties such as tip design and pitch length. Little studies according to our knowledge up to date contain investigations about the use of these instruments in retreatment.

The purpose of this study was to compare these instruments (PTU, M-Pro, and TF) in debris extruded, and time to reach full working length.

## METHODOLOGY

### Specimen preparation

Mesio-buccal and mesio-lingual canals of thirty freshly extracted human mandibular first molar teeth (total 60 canals) were used in this study. The teeth were verified radiographically of having canal curvature below  $<25^\circ$  using Schneider method<sup>(11)</sup>. Preparation and instrumentation was performed using step back technique. Instrumentation was standardized with a size 30 K-file reaching the full working length, then stepping back with size 35, 40, 45 files 1 mm for each file. Finally, coronal flaring using Gates-Glidden bur sizes 2 and 3 was done. A size 10 k-file was used during root canal preparation to maintain patency of the canal. At each instrument change, 2 ml of 2.5% NaOCl irrigate was used. When instrumentation of the root canals was completed, 5

ml of 17% ethylenediaminetetraacetic acid (EDTA) was applied for 3 min to remove the smear layer. Final rinse was done with 5 ml of distilled water to remove the previously used solutions.

### Root canal filling

The root canals were dried using paper points and obturated using element obturation unit system B and extruder (SybronEndo Europe, Amersfoort, The Netherlands) and (AH Plus; DENTSPLY, Germany) was used as sealer. Continuous wave technique was used, the master cone of gutta-percha 0.04 size 30 (Meta Dental Co. Ltd, Korea) was used. Specimens were radiographed in bucco-lingual direction to confirm the adequacy of root filling. Access cavities were sealed by temporary filling and teeth were stored at 37°C in 100% humidity for 2 weeks to allow complete setting of sealer.

### Root Canal retreatment

Specimens were randomly divided into three experimental groups with twenty canals (10 specimens) each. The obturation removal was done using one of the following techniques:

**Group I (PTU):** The bulk of the obturation material was removed with PTU instruments at pre-set lengths: D1 (30/.09, 16 mm, coronal one third), D2 (25/.08, 18 mm, middle one third), and D3 (20/.07, 21 mm, apical one third) at 600 rpm. Retreatment was considered complete when instruments were removed with no obturation materials visible on their surface. A new set of instruments was used for each specimen.

**Group II (M-Pro):** Gutta-percha was removed till 3mm to root tip with #18 file. Working length was determined by SS k file #15. Preparation with #20 files (0.04 taper) till the working length followed by preparation with #25 (0.06 taper) till the working length.

**Group III (TF):** The most coronal gutta-percha was removed using gates Glidden drills # 1, 2, 3 to remove gutta-percha from the coronal third. TF

instruments were used with an electric motor; the torque setting and speed were selected according to the manufacturer instructions.

### Evaluation

- a) **Time to reach full working length:** Time to reach full working length was calculated using digital stopwatch <sup>(12)</sup>.
- b) **Amount of debris extruded:** After retreatment procedure, the Eppendorf tube was removed from the glass flask. The debris adhered to the external surface of the apex were scrapped using the internal surface of the tube and collected into the tube. The extruded debris were left to dry and weighted with the Eppendorf tube by using the microbalance using the mean of 3 weights of each tube. The net weight of the dry debris was determined by subtracting the original weight of the empty tube from the growth weight <sup>(13, 14, 15, 16, 17)</sup>. (Figure 1)

Data were presented as mean and standard deviation (SD) values. Time of removal data showed normal distribution so one way Analysis of Variance (ANOVA) was used for comparison between the three groups. Tukey's post-hoc test was used for pair-wise comparison between the means when ANOVA test is significant. Repeated measures ANOVA were used to compare between the three segments.

Weight of extruded debris showed non-normal distribution, so Kruskal-Wallis test was used for comparison between the three groups. Mann-Whitney U test was used for pair-wise comparisons procedure. Friedman's test was used to compare between the three segments. Wilcoxon signed-rank test was used for pair-wise comparison between the segments.

The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with SPSS 16.0 (Statistical Package for Scientific Studies) for windows.

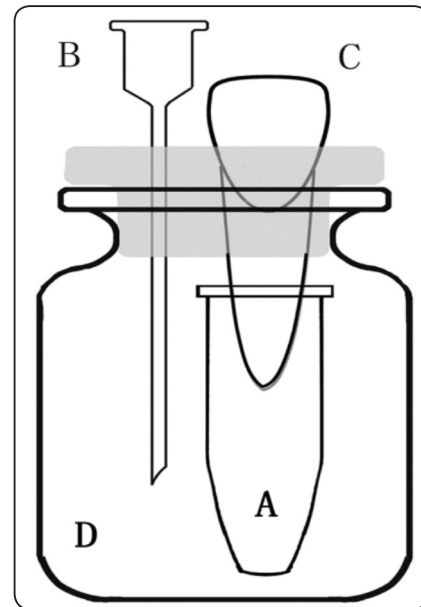


Fig. (1) Schematic representation of the collection assembly prepared for the evaluation of apically extruded debris. (A) Eppendorf tube in which the apically extruded debris is collected. (B) Needle inserted in the rubber stopper of ampule to equalize the internal and external pressures. (C) Tooth secured on the ampule's removable rubber stopper. (D) Ampule acting as a carrier.

### RESULTS

Regarding the mean time to reach working length, there was statistically significant difference between the mean time to reach working length. PTU showed the statistically highest mean time of the three groups ( $P < 0.001$ ). There was no statistically significant difference between mean time with (M-pro) and (TF), both showed the statistically significant lowest mean times to reach working length. (Table 1)

Regarding the extruded debris, there was a statistically significant difference between the three groups ( $P = 0.009$ ). Pair wise comparison revealed that there was no statistically significant difference between M-Pro and TF, both showed the statistically significant highest mean amount of debris, While PTU showed the statistically significant lowest mean amount of debris. (Table 2)

TABLE (1) Time to reach working length in each group.

Group	Time to reach working length	
	Mean	SD
PTU	9.01 <sup>a</sup>	0.5
M-pro	4.20 <sup>b</sup>	0.3
TF	3.09 <sup>b</sup>	0.3
P-value	<0.001*	

\*: Significant at  $P \leq 0.05$ , Means with different letters are statistically significantly different according to Tukey's test

TABLE (2) Comparison between the three groups regarding the weight of extruded debris.

Group	Amount of debris extruded	
PTU	0.0011 <sup>b</sup>	0.0009
M-Pro	0.0083 <sup>a</sup>	0.0066
TF	0.0058 <sup>a</sup>	0.0035
P-value	0.009*	

\*: Significant at  $P \leq 0.05$ , Means with different letters are statistically significantly different according to Mann-Whitney U test

## DISCUSSION

Endodontic retreatment has largely replaced periradicular surgery for management of failed root canal treatment. The effectiveness of different systems and techniques have been evaluated including use of manual files, rotary instruments, gates-glidden drills, heat, ultrasonics and use of adjunctive solvents (18, 19, 20, 21, 22, 23, 24).

The aim of the present study was to compare three rotary Nickel-Titanium systems Protaper universal retreatment, M-Pro and Twisted files. These systems were compared as regarding a) Time where it was calculated along the whole procedure and compared to clarify which of them save more

of the chair time, b) debris extruded out of the canal during retreatment which has proven clinically to cause postoperative pain and discomfort (25).

Root canal shaping and retreatment was performed in extracted human teeth, however extreme care was shown during selection of experimental teeth to reduce number of anatomical variations. M-Pro showed the highest amount of debris extruded which may be due to its largest cross section regarding size from Protaper and the sharp convex triangle which has less clearance spaces than the triangular cross section of the TF. This removed more amount of dentin causing debris accumulation and extrusion apically. TF came second while Protaper showed the least amount of debris extruded, this might be to its smallest apical diameter, which allowed clearance of debris coronally and prevented debris accumulation at apical area. M-Pro and TF showed no statistically significant difference in between. On the other-hand Protaper was statistically significant from the other two groups.

TF recorded the least time to reach the full working length among the other groups. Protaper was the slowest technique for retreatment, this was followed by M-Pro.

## CONCLUSIONS

Under the condition of the current study, TF was faster than M-Pro and PTU to perform gutta-percha removal in the retreatment of teeth. The use of M-Pro in retreatment increased the amount of apically extruded debris.

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