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# Efficacy of rotary vs. reciprocating files when used for removing root-filling residues after the use of Universal Protaper retreatment files

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ABSTRACT

*Aim:* The aim of current study is to compare the efficacy of 3 different files when used as supplementary files for removing obturation residues left after the use of Protaper retreatment files.

*Material and method:* A total of 30 freshly extracted mandibular premolars for orthodontic purpose were selected for the study. The samples were de-coronated to obtain a standard length of 16 mm. Instrumentation of the root canals with WaveOne large files was done. The samples were obturated using gutta-percha and AH Plus sealer with warm lateral compaction technique and stored for 30 days for the sealer to set. The samples were divided into 3 groups for 3 different retreatment protocols: Group 1 (Protaper RF + H-Files), Group 2 (Protaper RF + Protaper F4), and Group 3 (Protaper RF + WaveOne large). The samples were split longitudinally and observed under stereomicroscope. The images were captured and the remaining residues were calculated in percentage using Image Tool software and statistical analysis was performed using SPSS v15.

*Results:* Group 1 exhibited cleaner root canal surfaces ($p < 0.01$) compared to groups 2 and 3 that were statistically similar ($p > 0.05$).

*Conclusion:* The Protaper retreatment files, coupled with H-Files in circumferential motion, results in better removal of the root canal fillings.

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## 1. Introduction

Owing to associated failures with endodontic treatments and increasing interest by patients to preserve the natural dentition, the numbers of endodontic retreatments have increased substantially.[1] There has been a constant development in cleaning and shaping techniques, instruments, and obturating materials but still the microbial control presents no consistent development with respect to tissue repair leading to failure. These failures can be contributed to various reasons like diagnosis errors, lack of operative care, incorrect pulp cavity access, not detected root canals, and to endodontic obturations without proper sealing.[2,3]

In such cases, endodontic retreatment is indicated which requires the re-instrumentation of the root canal, removal of the root canal filling, and antisepsis of the root canal system. It also has to obtain a favorable shape facilitating a new fluid tight 3-dimensional obturation to inhibit the failures.[4,5]

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The removal of entire previous root canal filling is most important when it comes to endodontic retreatment.[3] Various different techniques have been researched and developed for effective removal of the filling materials. Some of these include stainless steel hand files, heat, ultrasonics, laser, and rotary instruments with or without the aid of solvents. Use of solvents facilitates the removal of filling material without damage to the tooth.[6–8]

Various automated instrumentation techniques and files have been developed that facilitate better removal of filling materials from root canal, also those adapted to the radicular dentin.[9] These instruments are also reported to be safe, fast, and efficient. They maintain the root canal shape more rapidly and also result in less apical extrusion of debris during instrumentation.[10,11]

It has been reported in literature by previous studies that canal walls completely free of debris are not obtained.[12] The criteria for evaluation in some retreatment studies for completion of retreatment were no evidence of gutta-percha or sealer on the files or paper points.[13] In others, it was evaluated radiographically.[14] But these methods failed to help to arrive at a decision whether the retreatment has resulted in complete removal of the root canal filling or not. Hence, direct observation method is more convincing siding in detecting the remaining root canal filling material after retreatment.

Hence, the current study was formulated to compare the efficacy of rotary Protaper F4 rotary file and WaveOne (Large) reciprocating files when used for removing obturation residue after the use of retreatment files (D1–D3). The obturations were made by warm lateral compaction technique using gutta-percha and AH Plus sealer. The null hypothesis was that rotary and reciprocating files would be associated with better removal of the obturating systems.

## 2. Materials and method

Thirty freshly extracted mandibular premolars (for orthodontic treatment) were acquired for the present study. Teeth with single root canals (confirmed radiographically) and fully formed apices were selected. The samples were decoronated obtaining a standardized root length of 16 mm. Placing a #10 K file just beyond the apex checked the canal patency and the working length was maintained by subtracting 1 mm. The samples facilitated the placement of the #25 K file; hence, they were instrumented by WaveOne (Large) (DENTSPLY Maillefer, Switzerland) single reciprocating file using a pre-programed endomotor (Xsmart Plus, DENTSPLY Maillefer, Switzerland). After every 3 pecks, the file was withdrawn from the canal, cleaned off debris, the canal was re-capitulated (#15 K file), irrigated with 2 ml of 5% Sodium Hypochlorite (NaOCl), and the file was reintroduced. The above procedure was continued till the file reached the apex. After the cleaning and shaping was complete, the samples were dried using sterile paper points and obturated using warm lateral compaction technique using gutta-percha and AH Plus sealer.

The master cones were confirmed radiographically (standard WaveOne black cones; 40.08, DENTSPLY Maillefer, Switzerland) and were seated apically in the canal after coating them with AH Plus sealer. A #25 finger spreader (DENTSPLY Maillefer, Switzerland) was heated over a gas torch and introduced apically (2 mm short of working length), creating a lateral place for the succeeding accessory gutta-percha cones. This procedure was continued till the entire canal was packed with gutta-percha and did not facilitate the placement of any more cones. The excess gutta-percha was seared off using a heated plugger (DENTSPLY Maillefer, Switzerland) and the samples were stored at 37 °C at 100% humidity for the sealer to set completely.

After this step, the samples were randomly divided into 3 groups for 3 different retreatment protocols:

1. Control – Protaper RF (D1–D3) + Hand H-Files (#40)
2. Experimental – Protaper RF (D1–D3) + Protaper (F4)
3. Experimental – Protaper RF (D1–D3) + WaveOne (large)

### 2.1. *Retreatment*

All the groups consisted of a 2-stage retreatment protocol. The initial stage for the three groups was the same, i.e. removal of the bulk of gutta-percha/sealer filling using Protaper RF (D1–D3) and three different files were used in the second to facilitate the removal of gutta-percha/sealer residue left in the canal.

### 2.2. *Group 1 Protaper RF (D1–D3) + Hand H-Files*

As stated earlier, the initial stage of removing the bulk of obturation was performed using Protaper RF (D1–D3). A drop of root-filling solvent (Endosolve R; Septodont, Paris, France) was placed above the root canal filling and D1 was introduced for the removal of the bulk in the coronal third. This was followed by irrigating the canal with 2 ml of NaOCl, drying the canal with sterile paper points and placing another drop of solvent. The use of D2 and D3 followed this in the sequential manner for the middle and the apical thirds, like D1. These files were used in the canal till no residue of the root-filling material was visible on the flutes.

The second stage in this group was to use Hand H-Files for removing the residue after the initial stage. The H-Files were used in circumferential quarter turn push pull motion to facilitate better wall contact. The files used sequentially were #25–40. These files were also used till no residue of the root-filling material was visible on the files after using them till working length.

### 2.3. *Group 2 Protaper RF (D1–D3) + Protaper (F4)*

The initial stage was performed in the same fashion as that of Group 1. The second stage for removal of remaining residue was performed using rotary Protaper F4 file. This file was also used till no residue of the root-filling material was visible on it and till it reached working length. The file was withdrawn from the canal on meeting obstruction, cleaned of debris, the canals were irrigated (2 ml NaOCl), dried, a drop of solvent was placed, and the file was reintroduced till it reached working length.

### 2.4. *Group 3 Protaper RF (D1–D3) + WaveOne (large)*

The initial stage in this group was also similar to Group 1. The second stage consisted of using reciprocating WaveOne large

file for the removal of remaining residue. This file was also used till no residue of the root-filling material was visible on it and till it reached working length. The file was withdrawn after every 3 pecks, cleaned of debris, the canals were irrigated (2 ml NaOCl), dried, a drop of solvent was placed, and the file was reintroduced till it reached working length.

### 2.5. *Root canal sectioning and evaluation*

Teeth were grooved longitudinally on the buccal and lingual surfaces using steel discs and split carefully using chisel, not touching the root canal. All the samples were photographed under uniform conditions using a Nikkon D3200 digital camera mounted on the microscope using 5× magnification. All the acquired images of the two halves were transferred to a computer. The canals in two halves of each sample were outlined and the root canal space was measured using Image Tools Graphic software 3.0, which resulted in the total root-canal space and remaining root-filling residues.

### 2.6. *Statistical analysis*

These readings were tabulated and the percentages of the root-filling residues were statistically analyzed using Student's *t*-test, with the level of significance set at 0.05.

## 3. Results

Three retreatment protocols tested in the present study failed to present an entirely clean root canals free of any obturation residues. The mean obturation material residue left after the retreatment protocols was 7.79 (±1.35), 12.37 (±1.09), and 12.57 (±1.75) for groups 1–3 respectively (Fig. 1a–c). On statistical analysis using One-way analysis of variance (ANOVA), the three groups presented a significant difference ($p < 0.01$, Fig. 2). The following post-hoc test for multiple comparisons to find out significant group revealed no significant difference between groups 2 and 3 ($p > 0.05$), whereas group 1 showed better results when compared to groups 2 and 3 ($p < 0.01$). Group 1 (Protaper RF + H-File) was associated less percentage of root-filling residues left when compared to groups 2 and 3 (Fig. 1a–c).

## 4. Discussion

From the results of the current study, some percentage of the obturation material was left in the root canal regardless of the two staged retreatment protocols tested in the three groups. The null hypothesis was rejected, as better results were associated with group 1 in which H-File was used as a supplementary file for removing residual obturation material residue left in the root canal after the initial bulk removal with the aid of Universal Protaper retreatment files D1, D2, and D3. This group presented a significant difference when compared to the other two groups ($p < 0.01$, Fig. 1a), which used rotary Protaper F4 and WaveOne large as supplementary files for residual removal.

Removal of maximum previous gutta-percha and sealer from root canals is a major step in endodontic retreatments. Removal of as much obturating material as possible is important to uncover remnants of necrotic tissue if any or bacteria that may be the responsible cause of endodontic failure.[12] In many cases, the combined use of different techniques can be efficient and time saving method also resulting in better removal of the obturating material.[12,15] The criteria for completion of retreatment is taken as to no evidence of the obturating material (gutta-percha/sealer) seen on the files used for retreatment[16] and radiographic evaluation.[7,14] However, Betti and Bramante showed that radiographic examination provided a negative impression of

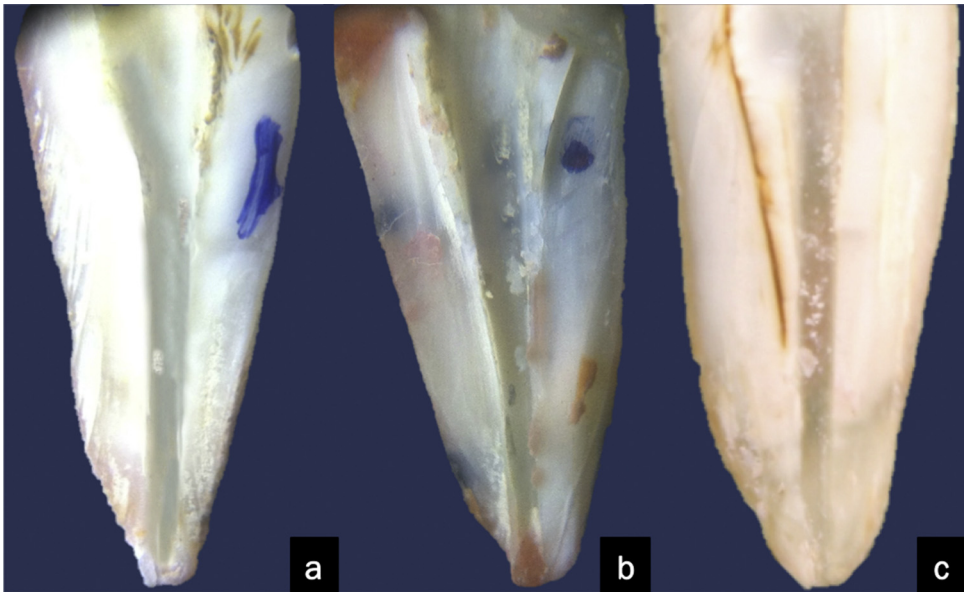



**Fig. 1 – Representative images of the remaining root-filling residues for the three groups: (a) Group 1 (Protaper RF + H Files), (b) Group 2 (Protaper RF + Protaper F4), and (c) Group 3 (Protaper RF + WaveOne large).**

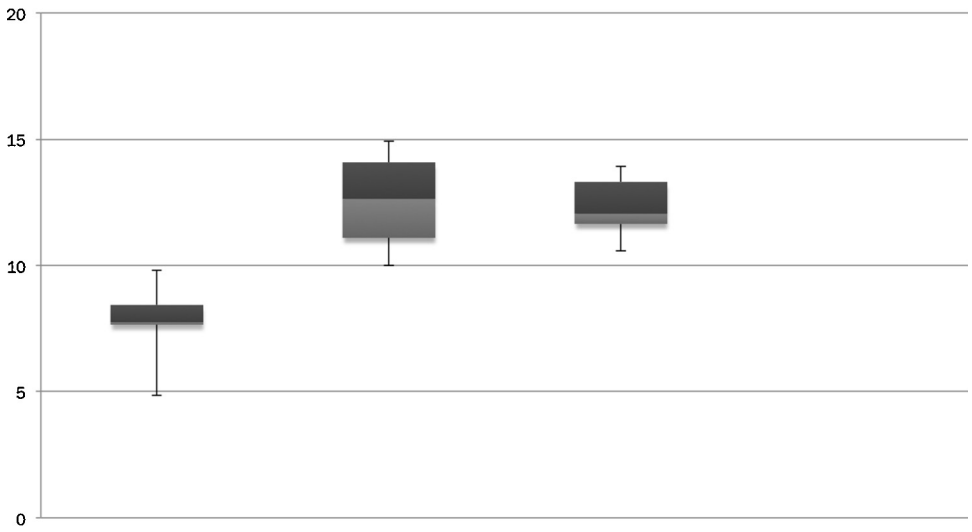



**Fig. 2 – A Box and Whisker Plot presenting the percentage (%) of remaining root-filling residues. Removal of root-filling residue for Group 1 (Protaper RF + H-Files), Group 2 (Protaper RF + Protaper F4), and Group 3 (Protaper RF + WaveOne large).**

cleanliness when they compared the same teeth after extracting and splitting them[16] (Table 1).

A warm lateral condensation of gutta-percha helps it adapt more closely creating a compacted and dense obturation, increasing the difficulty for its removal.[13] Also, an epoxy-resin based sealer when used with gutta-percha for obturation adapts readily to the radicular dentin, which is thus again difficult to retreat.[17,18] Hence, to test a difficult condition in retreatment, warm lateral compaction of gutta-percha coupled with AH Plus sealer was used as the method of obturation of the samples.

It has been reported in a recent study by Abramovitz et al. that using Universal retreatment files alone for retreatment left considerate amount of root-filling residues, and recommended the use of supplementary files after D1, D2, and D3.[19] Solomonov et al.[20] seconded this study by the results of their high-resolution MicroCT study that use of supplementary files after Protaper retreatment files was associated with cleaner root-canal space. Hence, the present study aimed at the efficacy of different file systems when using supplementary files for removing root-filling residues. The results of the current study state that the conventional H-Files used after Protaper RF resulted in cleaner root-canal space when compared to the other two groups ($p < 0.01$, Fig. 1a). The circumferential filing motion for the H-Files, used in the present study, may have resulted in increased contact surface, resulting in digging into the softened gutta-percha adhering to the radicular dentinal walls, also reported by a previous study.[21]

It has been reported that the presence of taper can additionally create a greater contact between the instrument and the obturation, thus aiding effective removal of the obturation.[22] The groups 2 and 3 used files with higher tapers (Protaper F4 6% and WaveOne 8%). This thought advantage also failed to influence the results for the samples in these groups. The results are rather in contrast with these groups being associated with more percentage of residues left as when compared to H-Files ($p < 0.01$, Fig. 1a–c). The WaveOne large file was used, as a supplementary file was also the initial file used to instrument the canal. This also failed to help the file to result in a better contact and remove more root-filling residues.

Kfir et al.,[23] from their recent study, concluded that using a two-dimensional radiograph failed to represent the canal cleanliness and thus the efficacy of the retreatment files that are tested. Hence, in the present study, the teeth were split vertically and the samples were observed under a stereomicroscope establishing a direct vision and assessment of the remaining obturation residue.

**Table 1 – Mean of the percentages (%) of the remaining residues of the root-filling material after retreatment.**

| Group | Number of samples (*n*) | Min | Max | Mean | SD (±) |
|---|---|---|---|---|---|
| Protaper RF + H-Files | 10 | 9.99 | 9.82 | 7.79* | 1.35 |
| Protaper RF + Protaper F4 | 10 | 10.57 | 14.93 | 12.37# | 1.09 |
| Protaper RF + WaveOne large | 10 | 4.85 | 13.92 | 12.57# | 1.75 |

* $p < 0.01$.
\# $p > 0.05$ post-hoc test.

## 5. Conclusion

The different retreatment protocols tested in the current study did not remove the entire root canal obturation and failed to present an entirely clean root canal. All the samples showed the presence of some obturation material (Fig. 1a–c). However, using Protaper RF (D1, D2, and D3) and Hand H-Files exhibited much cleaner root canals when compared to the other two groups.

## Conflicts of interest

The authors have none to declare.

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