



## **Comparative Evaluation of Apical Debris Extrusion during Root Canal Preparation using Two Different Rotary File Systems: An In-vitro Study**

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**Background:** Apical extrusion of debris leads to postoperative inflammation and endodontic failure. Objective of the study is to comparatively evaluate debris extrusion by using Waveone rotary files, ProTaper rotary files.

**Material and Method:** Forty Extracted single rooted human premolar teeth will be included in the study. After access opening, canal patency will be established by 15 K-file till the apical foramen followed by determination of working length by visual method. Now the samples will be divided into 2 groups: Group1: WaveOne, Group 2: ProTaper file. Following this the manufacturer's instructions will be followed for the instrumentation. During instrumentation,

extruded debris and irrigants will be collected into the preweighed test tubes. Following this, these tubes will be stored in an incubator at the temperature of 70°C for next 5 days. To evaluate the resultant weight of extruded debris, these test tubes will be weighed.

**Result:** Result of this study showed that Waveone was associated with more debris extrusion compared with ProTaper rotary file.

**Conclusion:** All instrumentation techniques were associated with debris and irritant extrusion but Wave one rotary file produce significantly more debris extrusion compared to ProTaper files.

**Keywords:** Apical Extrusion, Rotary File. Endodontic Treatment

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**Introduction:** The periapical tissues may be exposed to pulp tissue, microbes, dentin chips, and irrigants. The patient experiences an endodontic flare-up as a result, which causes pain, inflammation, and delayed recovery. An apical extrusion of dentinal debris, pulp tissue, irrigants, and the numerous bacteria present in the root canals is the most frequent cause of this. Debris ejection into the periradicular tissues can be reduced by restricting the preparation to regions above the apical terminal.<sup>1</sup> Even when the area of preparation does not reach the apical terminus, literature suggests that all current instrumentation techniques result in the extrusion of intracanal content into the periradicular tissues; nevertheless, the quantity of extruded debris varies between instruments and file designs.<sup>1-3</sup>

Apical extrusion exists in all instrumentation procedures to varying degrees, depending on the technology being employed. The number and design of instruments, their motion kinematics, irrigation protocol, and intricacy of root canals are some of the most crucial elements that have a significant impact on the amount of material that is extruded apically.<sup>4</sup> Manufacturers have recently released single-file systems with various designs and motion kinematics (rotary and reciprocating). Studies on the best file system to use to extrude less debris have shown mixed results.<sup>5,6</sup>

Each instrument in the ProTaper<sup>TM</sup> (Dentsply Maillefer, Ballaigues, Switzerland) system has gradually changing tapers, creating a "progressive preparation" in both the vertical and horizontal directions. The ProTaper<sup>TM</sup> has a convex core, three machined cutting blades, and a cross-sectional shape that resembles a reamer.<sup>7</sup> Dentsply Maillefer's WaveOne Gold files, which are used in clinical settings, are among the most widely used reciprocating rotary systems. These files offer higher cycle fatigue resistance, enhanced flexibility, form memory that reduces canal transportation, changeable pitch, and increased helical angles.<sup>8,9</sup> Hence the aim of present study

was to comparatively evaluate debris extrusion by using Waveone rotary files, ProTaper rotary files.

**Material and Method:** In this study, we gathered 40 mandibular premolars with a single straight canal that were removed from patients between the ages of 20 and 30 for orthodontic treatment. Tooth with any malformation, internal and external resorption were excluded from the study. The teeth were cleaned of calculus and soft tissue with a scaler, and any remaining soft tissue and organic debris was subsequently removed by submerging the teeth in 5.25% NaOCl for two hours. The length of the teeth was measured with a digital calliper, and the crown was then marked with a marker pen to indicate that only 15 mm would remain following decoronation of the teeth with a diamond disc and plenty of water cooling. Two groups were made, 20 teeth were kept in each group.

1. Group 1: A large reciprocating WaveOne™ file (40/08) was used in a reciprocating motion according to the manufacturer's instructions.
2. Group 2: ProTaper™ instruments were used according to the manufacturer's instructions by a gentle in-and-out motion in the recommended sequence up to F4 (40.06) till the WL.

The instrumentation was done till the file rotated freely

Specimens were stored in distilled water until use. The working length was determined with number 10 K file up to root canal terminus and subtracting 1 mm from it and confirmed radiographically. The size of the minor foramen was controlled using the number 20 K file. An endodontic motor with both continuous and reciprocating motion settings (X-smart plus, Dentsply) was used with 6:1 gear reduction handpiece. A disposable side vented 30-gauge navi tip needle was used for irrigation in all groups. It was passively inserted 2 mm from the apex and delivered 8 mL of distilled water as the total volume, 4 mL during instrumentation, and 3 mL as a final flush. To get rid of any material that was externally connected to the root, 1 mL of distilled water was then used to wash the root's surface.



**Figure 1: Eppendorf tube**

The extruded debris and irrigant during preparation were collected in eppendorf tube. (Fig 1) The eppendorf tube was removed from the glass vial after canal preparation. Before weighing the dry debris, all of the eppendorf tubes were incubated at 37°C for 15 days to allow moisture to evaporate. On an electronic microbalance, three successive measurements of each eppendorf tube were made, and the mean of these readings was taken to determine the weight of each tube. By deducting the tube's pre-experiment weight from the weight of the tube containing dried debris, the weight of the extruded debris in each tube was estimated. For each group, the mean weight of the extruded debris was computed.

**Result:** The results of the descriptive statistics which include mean values (in gram), and standard deviation of apically extruded debris and irrigants for all groups are shown in table 1. Group 2 (protaper) showed the lowest mean value of apically extruded debris and irrigants (0.0027) in comparison with group 1 (WaveOne gold).

<b>Table 1. Descriptive statistics of the weight of extruded debris in gm</b>			
<b>Group</b>	<b>N</b>	<b>Mean with Std Deviation</b>	<b>P value</b>
Group 1 WaveOne gold	20	0.0078	P< 0.001
Group II Protaper	20	0.0027	

**Discussion:** Chemomechanical preparation of the tooth's root canals must be followed by obturation with the proper substance for endodontic therapy to be successful. Tradition dictates

using hand equipment to prepare teeth's root canals. Numerous advantages have resulted from the use of nickel-titanium rotary files for endodontic instrumentation, including improved efficiency for shaping and debridement of canals, decreased procedural time, decreased manual fatigue of the treating practitioner, decreased chairside time, decreased patient fatigue, and decreased procedural errors related to traditional instrumentation.<sup>10</sup>

The extrusion of apical debris, filling materials, and irrigants, which can cause foreign body reaction owing to disruption in the microbial balance, is one of the most important causes for delayed healing or flare-ups in endodontically treated teeth.<sup>11</sup> The degree of acute infection or flare-ups is thought to be mostly influenced by the virulence and volume of the microorganisms. Physical factors that influence the amount of apical extrusion include the amount and velocity of irrigant, the size of the apical constriction, the hardness of the dentin, and the position of the tooth; mechanical factors include the amount of irrigant used, the final size of the file, motion kinematics, and file design.<sup>12</sup>

Present study was conducted to compare the apical extrusion of the debris of rotary system with two commonly used rotary systems, including WaveOne and ProTaper. *in vitro* nature of this study means that it cannot precisely replicate the periapical tissues' essential circumstances, yet it still allows for file system comparisons. In order to prevent any decrease in the weight of the debris due to dissolution in sodium hypochlorite, distilled water was utilised as an irrigant.

The results of this study revealed that all the tested rotary systems produced apically extruded debris *in vitro* but Waveone was associated with more debris extrusion compared with ProTaper rotary file.

In their investigation, De-Deus et al. found no differences in debris extrusion between the single-file ProTaper F2 employed in reciprocating action and the traditional ProTaper Universal technique.<sup>13</sup> The findings of the current work, however, are consistent with earlier research by Bürklein and Schafer<sup>14</sup>, which demonstrated that reciprocating single-file systems extruded more detritus than full-sequence rotary NiTi instruments.

The results of the present study were similar to the study conducted by Ehsani M et al.; where the single-file reciprocating Wave One and Reciproc instruments were compared to full sequence rotary instrumentation systems (ProTaper universal and Mtwo), the single-file systems caused more debris than the other systems.

The observed variations could be attributed to factors like the kinematic motion of the files and the cross-sectional design of the devices. Lower cutting efficiency and a smaller chip space are produced by Wave One's triangular or modified triangular cross-section. Because of the reduced chip space, they are unable to allow for coronal clearance of debris, which causes a piston-like effect. As a result, reciprocal motion instrumentation may improve the conveyance of debris to the apex. The coronal conveyance of dentin debris is improved by a constant rotational action, which functions like a screw conveyor.<sup>16-18</sup>

**Limitation:** The present findings are restricted to teeth with mature apices and cannot be extrapolated to teeth with open apices. Only teeth with a single tooth were chosen, hence the results cannot be generalised to all teeth. The periapical tissues cannot be reproduced in an in vitro experiment in any way. As a result, apical extrusion is constrained and the results can vary depending on the clinical context due to the existence of back pressure generated by periapical tissues.

**Conclusion:** Within the limitations of this *in vitro* study, the findings showed that, during canal preparation, ProTaper rotary systems produced less apical extrusion of debris compared waveOne rotary systems.

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**Conflicts of interest:** There are no conflicts of interest.

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