

Comparative Evaluation of Apical Debris Extrusion During Root Canal Preparation Using Two Different Rotary File Systems: “A Wave One Gold and Hyflex EDM Rotary File Comparison”

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Abstract

Background: Apically extruded debris following root canal treatment leads to postoperative complications like inflammation, postoperative pain, and delay in periapical healing. Additionally, debris extruded during treatment is responsible for persistent apical area inflammation. Hence, a decrease in debris extrusion is necessary for reduction in postoperative complications.

Aim: Two distinct instrumentation methods were used to measure the amount of apically extruded debris after root canal preparation in the present study.

Materials and Method: Idea was to include thirty extracted single rooted human premolar teeth for study purpose. After access opening, canal patency was established using a 15 K-file till the apical foramen then it is to be followed by determination of working length by visual method. The samples were divided into 2 groups:

Group1: Wave One gold.

Group 2: Hyflex EDM Rotary file.

The manufacturer's instructions were followed for the instrumentation. During instrumentation, extruded debris and irrigants were collected into the preweighed test tubes. Following this, these tubes were stored in an incubator at the temperature of 70°C for the next 5 days. To assess the resultant weight of extruded debris, the test tubes were weighed. The final mass of the extruded debris was calculated by subtracting the weight of the initial empty vial from vial containing dry debris.

Result: According to the results obtained in this study, both the tested files caused extrusion of debris apically. The debris extrusion in Hyflex EDM system was reported to be highest, whereas WaveOne Gold showed the lowest value.

Conclusion: Result of this study showed that Waveone gold was associated with less debris extrusion in comparison to hyflex EDM rotary file.

Keywords: Apical Extrusion, Debris, Rotary Files.

Introduction

Following certain biologic and mechanical goals is essential for the effective cleaning and shape of root canals. The eradication of irritation-causing elements and preservation of healthy periapical tissues is the ultimate goal of canal preparation. Inflammation in the periradicular region and postoperative flare-ups may result from irrigant and debris that are extruded into the area during preparation, including bacteria, dentin filings, and necrotic tissue.¹⁻³

Debridement and disinfection of the canal system, as well as the creation of the 3D shape necessary for full obturation, are two of the most crucial objectives of root canal instrumentation.⁴ Following mechanical preparation, the apex is frequently used to introduce dentin chips together with any remaining pulpal tissue, bacteria, their endotoxins, and occasionally irrigating material into the periapical tissues. This protrusion beyond the apex may result in postoperative pain, inflammation, and flare-ups that could cause the healing process to be slowed down.⁵

When pressed periapically during instrumentation, dentin and pulp tissue from both contaminated and uncontaminated sources might cause an inflammatory response.³ Numerous studies examined the immunologic features of postoperative flare-ups and came to the conclusion that antigens from the root canal form an antigen antibody complex that, when driven past the apical foramen, might trigger a severe inflammatory response.⁷⁻⁹

Nickel-titanium (NiTi) endodontic instruments have been developed, which has various benefits including reduced operator fatigue, time savings, and instrumentation errors. Due to their high flexural and torsional stresses, which raise the risk of instrument breakage, these rotary files do have some disadvantages.¹⁰ Apical extrusion exists in all instrumentation procedures to varying degrees, depending on the technology being employed. Some of the most crucial elements that have a significant impact on the amount of material that is extruded apically include instruments number and design, its motion kinetics, irrigation protocol and intricacy of root canals etc.¹¹

Recently single-file systems with various designs and motion kinematics (rotary and reciprocating) have been introduced in the market. Studies on the best file system to use to extrude less debris have produced conflicting findings.^{12,13} The HyFlex EDM File (COLTENE/Whaledent AG, Switzerland) is one of the single-file systems used in rotation movements; it has a changeable cross-section with an asymmetrical pitch, a noncutting tip, and a negative rake angle. These files are made using a special procedure known as a "electric discharging machine." This method involves spark erosion, which lessens cyclic fatigue and increases fracture resistance on the file surface.^{14,15}

WaveOne Gold files (Dentsply Maillefer, Ballaigues, Switzerland) is most popular reciprocating rotary system. Increased flexibility, shape memory that minimizes canal transportation with high resistance to cyclic fatigue, and also have variable pitch and increased helical angle are some characteristics of this system. In the present study, it was planned to assess and compare the performance of WaveOne Gold, HyFlex EDM in terms of extrusion of debris apically.

Material and Method

The study included, 30 mandibular premolars with a single straight canal that were extracted from individuals between the ages of 20 and 30 for orthodontic reasons. The study excluded any malformed teeth as well as those that had undergone internal or exterior resorption. After using a scaler to remove calculus and soft tissue from the teeth, any soft tissue or organic debris was then removed by soaking the teeth in 5.25% NaOCl for two hours. A digital calliper was used to measure the length of the teeth, and the crown was then marked with a marker pen to show that just 15 mm would be left after the teeth were decorated with a diamond disc and plenty of water cooling.

Two groups were made, 15 teeth were kept in each group.

Group I (Hyflex EDM): Glide path was established using size #15 K-File. The HyFlex EDM file with the size of 25.08 was used in a gentle in-and-out motion operated at 500 rpm rotary motion and 2.5 Ncm torque.

Group II (Waveone Gold): Countering motion back and forth was used with a reciprocating WaveOne Gold file. 0.07 tapered reciprocating WaveOne Gold file (Dentsply Maillefer, Ballaigues, Switzerland) was used slowly with an in-and-out pecking motion as suggested by the manufacturer. The instrument flutes were cleaned after every three pecks. No glide path created prior to instrumentation because the primary size of the all canals was equivalent to 20. Highest torque level of 2.5 N/cm at 350 RPM speed was utilized.

Distilled water was used to store the specimens. The working length was determined with number 10 K file up to root canal terminus and subtracting 1 mm from it and confirmed radiographically. 20 K file was used to control the size of the minor foramen. 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. 1 mL of distilled water was then used to wash the root's surface to get rid of any material that was externally connected to the root. Eppendorf tube was used to collect the extruded debris and irrigant during the preparation. The eppendorf tube was removed from the glass vial after canal preparation. All of the eppendorf tubes were incubated at 37°C for 15 days to allow moisture to evaporate, before weighing the dry debris.

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 have been summarized in table 1. The results indicated that all the instrumentation systems tested caused measurable apical extrusion of debris and irrigants. Group II (WaveOne gold) showed the lowest mean value of apically extruded debris and irrigants in comparison with group I (Hyflex EDM).

Table 1. Descriptive statistics of the weight of extruded debris in gm.

Group	Mean with Std Deviation	P value
Group 1 Hyflex EDM (n=15)	0.0086	P < 0.05
Group II WaveOne gold (n=15)	0.0034	

Discussion

The trio of biochemical prepping, microbial management, and total obturation of the root canal space serves as the basis for endodontic therapy. It has been reported in previous studies that incomplete root canal obturation causes 60% of endodontic failures, while other factors such as continuous trauma, fragmented instruments, external root resorption, root perforations, empty root canals, grossly overextended or overfilled root canals, and other negligible causes—cause 40% of endodontic failures. These factors include unintentional removal of silver points.¹⁶

Apical extrusion is characterized as an acute inflammatory reaction caused by an imbalance between the host defenses and infectious intracanal microorganisms, which calls for the restoration of homeostasis. Debris ejection from the apex can therefore be reduced to diminish the postoperative responses brought on by continuously revolving and reciprocating devices. Due to the large frequency of extracted teeth, mandibular premolars with a single canal were employed in the current investigation. Furthermore, using only one type of tooth can help to make the samples more comparable to one another.¹⁷

NiTi files encourage coronal rather than apical displacement of debris during the preparation process. The flat outer edges helps in keeping the file centered in the canal and interflute distance accumulate dentinal debris and direct it coronally.

This study compared the apical extrusion of the debris of rotary system with two commonly used rotary systems, including WaveOne and Hyflex EDM. As it is an In vitro study, thus it cannot precisely replicate the periapical tissues' essential circumstances, however it still allows for file system comparisons. To prevent any decrease in the weight of the debris due to dissolution in sodium hypochlorite, distilled water was utilized as an irrigant.

HyFlex EDM file system showed the greater extrusion of debris in comparison to Waveone Gold rotary files. One possible cause of the high amount of debris extrusion of Hyflex EDM file system is the unwinding of file flutes which increases the length of pitch and subsequently increases extrusion.¹⁵ When Elmsallati et al. compared the apical extrusion produced by files with short, medium, and long pitches, they discovered that the longest pitch design produced the most detritus. Additionally, compared to the rotational systems employed in the study, the reciprocating WaveOne Gold demonstrated the least amount of debris. These findings are in agreement with previous research showing that reciprocating systems produce less trash.¹⁷

The WaveOne extruded less detritus than the ProTaper system, according to research by Ozsu et al. These contradictory findings may be the result of variations in the cross-sectional design of the files, tips, cutting effectiveness, motion kinematics, flexibility, alloy, and number of files. The triangular cross section of the tip, which has been redesigned with radial lands to produce less cutting power, may be the cause of the minimal debris extrusion produced by the WaveOne Gold system.¹⁸

Due to the ex vivo nature of this investigation, the study circumstances are not appropriate for in vivo settings. The method's main shortcoming is the inability to accurately mimic apical essential tissues.

The ejection of debris and irrigating fluids from the apical foramen in vivo may be hindered by the presence of periapical tissues around the foramen. Additionally, the results may differ based on each situation's periapical tissues' level of resistance. Apical tissues that might serve as a natural barrier to an apical extrusion are not present in our investigation. Through blinding during the intervention, data collection, and analysis, we made an effort to reduce the bias.

Conclusion

From the findings of the present study, it can be concluded that all endodontic rotary instruments can lead to extrusion of debris. The results also showed that that Waveone gold system was associated with less debris extrusion in comparison to hyflex EDM rotary file.

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Nil

Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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