

ORIGINAL RESEARCH

Comparative evaluation of debris extrusion by three file systems with different cross-sectional design

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ABSTRACT:

Background: To compare three file systems for debris extrusion. **Materials & methods:** A total of 15 mandibular first premolars were randomly assigned to 3 groups (n = 5 teeth/group). The debris that was extruded apically was collected in pre weighed Deppendorf tubes and assessed with an electronic balance and compared. The debris extrusion was compared and statistically analyzed using analysis of variance and SPSS software. **Results:** The mean apically extruded weight of debris in Wave One (0.0078 g) was more when compared with the Hyflex (0.0014 g). **Conclusion:** The Wave One™ and Pro Taper™ rotary instruments produced significantly more debris compared with Hyflex CM™ rotary instruments (P < 0.05).

Keywords: Debris, Pro Taper, Hy flex.

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INTRODUCTION

Endodontic treatment and preservation of the primary teeth are important not only for the normal development of the jawbone and musculature but also for the eruption of succeeding permanent teeth into the ideal position and for functional reasons. Early loss of primary teeth can result in altered phonation, development of aberrant habits, and alteration in the eruption pathway of permanent teeth.^{1,2} Periapical infection of the primary teeth is one of the major contributing factors for early loss of deciduous teeth.³ Hence, endodontic treatment is the treatment of choice for treating the teeth with chronic pulpitis and nonvital teeth.⁴ For the ultimate success of the endodontic treatment, all the procedures should be carried out with the aim of maintaining or healing of the periradicular tissues, thus saving the primary tooth till the eruption of the permanent successor.⁵

At present, all preparation techniques and instruments are associated with extrusion of debris, even when the preparation is maintained short of the apical terminus and manual instrumentation happens to produce greater extrusion when compared to engine driven rotary preparation.^{6,7} The studies so far have proven

that none of the various techniques and instruments can clean and shape the root canal system without producing some apically extruded debris (AED).⁸ However, it has been proved that various instrumentation techniques have been associated with different amounts of AED.⁹ ProTaper™ (Dentsply Mail lefer, Ballaigues, Switzerland) system exhibits progressively variable tapers of each instrument that develop a "progressive preparation" in both the vertical and horizontal directions. The ProTaper™ cross-sectional design mimics that of a reamer, with three machined cutting edges and convex core.¹⁰ Hyflex EDM (HEDM) (Coltene-Whaledent, Switzerland) is single rotary file system produced by innovative manufacturing process called "Electrical Discharge Machining" using a controlled memory Niti wire which has advantages such as high precision, creation of various designs without tool constraints, and limited manufacturing stress to the file surface. This method also produces a rough surface, which can enhance the cutting abilities of the file. This entirely unique combination of flexibility and fracture resistance makes it possible to reduce the number of files required for cleaning and shaping

during root canal treatment without having to compromise preservation of the root canal anatomy. They have a three different cross-sectional design with 3 cutting edges. The rectangular cross section at the tip provides more “core material,” which results in high resistance to breakage of these files. Then the cross section becomes trapezoidal in the middle of the file and finally near the handle, the cross section changes to triangle which keeps the file more flexible there.¹¹ Hence, this study was conducted to compare three file systems for debris extrusion.

MATERIALS & METHODS

A total of 15 mandibular first premolars were randomly assigned to 3 groups (n = 5 teeth/group). The root canals were instrumented according to the manufacturers' instructions using the Reciprocating single-file system Wave One™ (Dentsply Mail lefer, Ballaigues, Switzerland) and full-sequence rotary Hyflex CM™ (ColteneWhaledent, Allstetten, Switzerland) and ProTaper™ (Dentsply Maillefer, Ballaigues, Switzerland) instruments. The canals were then irrigated using bidistilled water. The debris that was extruded apically was collected in preweighedependorf tubes and assessed with an electronic balance and compared. The debris extrusion was compared and statistically analyzed using analysis of variance and SPSS software.

RESULTS

A total of 15 teeth were enrolled. The mean extruded debris weight of the three groups were included. The mean apically extruded weight of debris in WaveOne (0.0078 g) was more when compared with the Hyflex (0.0014 g). Wave One™ and ProTaper™ (0.0065 g) was significantly more when compared to Hyflex™ (P < 0.05). However, no statistical significant difference was obtained between WaveOne™ and ProTaper™ (P > 0.05).

Table 1: amount of apically extruded debris.

Debris extrusion (g)	Pro Taper	Hy flex	Wave One
Mean	0.0065	0.0014	0.0078
Standard deviation	0.0022	0.0008	0.0016

DISCUSSION

Apical extrusion of infected debris may potentially disrupt the balance between microbial aggression and the host's protection, resulting in episodes of periapical inflammation and flare-ups. Various factors that affect apical extrusion are patency, apical diameter, canal curvature, working length, instrument design, technique of instrumentation, irrigation needle type, needle insertion depth, and irrigation methodologies or devices. Even though the root canal preparation is maintained short of the apical terminus, it causes some extrusion of debris seen by all instrumentation techniques.^{12,13} A common finding of nearly all the studies in endodontic literature led to a

generalized view that the crown-down technique extrudes less debris and irrigants apically as compared to the step-back technique and that a linear filing motion extrudes more debris when compared to instruments used in rotational motion.^{14,15} Hence, this study was conducted to compare three file systems for debris extrusion.

In the present study, a total of 15 teeth were enrolled. The mean extruded debris weight of the three groups were included. The mean apically extruded weight of debris in WaveOne (0.0078 g) was more when compared with the Hyflex (0.0014 g). A study by Surakanti JR et al, the WaveOne™ and ProTaper™ rotary instruments produced significantly more debris compared with Hyflex CM™ rotary instruments (P < 0.05). Under the conditions of the study, all systems that were used resulted in extrusion of apical debris. Full-sequence rotary instrumentation was associated with less debris extrusion compared with the use of reciprocating single-file systems.¹⁶

In the present study, WaveOne™ and ProTaper™ (0.0065 g) was significantly more when compared to Hyflex™ (P < 0.05). However, no statistical significant difference was obtained between WaveOne™ and ProTaper™ (P > 0.05). Another study by Nabavizadeh M et al, medin instrument caused significantly less debris extrusion in comparison with ProTaper and RaCe (p < 0.05). The differences between the ProTaper and RaCe rotary systems were not statistically significant (p = 0.752). Within the limitations of the in vitro study, Medin rotary system produced less apical extrusion than ProTaper and RaCe.¹⁷ Vankayala B et al, hand K-files extruded more bacteria when compared to other four rotary systems, K3XF file system extruded least number of bacteria. All instrumentation techniques extruded intracanal bacteria apically. However, engine-driven nickel-titanium instruments extruded less bacteria than the manual technique. The K3XF rotary file system comparatively extruded less bacteria than other rotary file systems.¹⁸ Asif A et al, hand files produced more apical debris extrusion than ProTaper and Kedo-S files (P < 0.05) while Kedo-S produced the least (P < 0.05). All instrumentation systems cause apical debris extrusion. Kedo-S produced less apical debris extrusion when compared to the hand files and ProTaper files.¹⁹ Chemomechanical preparation of the root canal is the most essential factor that ultimately determines the success of the endodontic treatment in primary teeth.^{20,21} Conventionally, mechanical preparation of the root canals in primary teeth was carried out using hand files. With continuous evolution and advancements in the endodontic field of pediatric dentistry, the primary root canals are now being instrumented with rotary files.²²⁻²⁴ The ProTaper rotary files are the most commonly used rotary file system for the canal instrumentation in primary teeth.²⁵ It has the shaping files (S) and finishing files (F). Shaping files have an increasing taper in the coronal

direction and finishing files (F) have a decreasing taper. Studies have shown that instrumentation with ProTaper files produce a more regular canal diameter and is less time-consuming than that manual files.^{26,27}

CONCLUSION

The Wave One™ and ProTaper™ rotary instruments produced significantly more debris compared with Hyflex CM™ rotary instruments ($P < 0.05$).

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