

ORIGINAL RESEARCH

Evaluation of apical extrusion of debris during endodontic instrumentation with continuous rotation and reciprocating motion

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ABSTRACT

Background: Apical debris extrusion may be clinically associated with pain and/or swelling in the presence of an intense inflammatory response. The present study was to evaluate apical extrusion of debris during endodontic instrumentation with continuous rotation and reciprocating motion.

Materials & Methods: 60 extracted single-rooted mandibular premolar human teeth which were divided into 4 groups of 15 teeth each. The canals were instrumented with the following instrument systems: ProTaper Next, 2Shape, Reciproc Blue and WaveOne Gold. Apically extruded debris during instrumentation was collected into pre-weighed Eppendorf tubes. The Eppendorf tubes were then stored in an incubator at 70°C for 5 days. The weight of the dry extruded debris was done with Eppendorf tubes.

Results: The mean debris (grams) with 2shape was 0.047, Protaper next was 0.091, Reciproc Blue was 0.054 and WaveOne gold was 0.051. The difference was significant ($P < 0.05$). Statistically significant difference was observed between TS and PTN, PTN and RB and PTN and WOG ($P < 0.05$).

Conclusion: All instruments were associated with apical extrusion of debris with TS rotary file system associated minimum extrusion and PTN, resulting in maximum extrusion of debris.

Key words: Apical debris, ProTaper Next, WaveOne

INTRODUCTION

Apical debris extrusion may be clinically associated with pain and/or swelling in the presence of an intense inflammatory response.¹This extrusion is an undesired consequence of the mechanical instrumentation of the root canal, and none of the available instrumentation systems can avoid apical debris extrusion. Thus, methods to minimize this phenomenon are continuously investigated. Apical debris extrusion has been demonstrated to vary based on kinematics, number of files used, taper, cross section, and cutting efficacy, and these findings justify the need for an analysis of the widely used systems.²

ProTaper Next (PTN) file system is composed of a set of instruments that are designed with variable tapers and have an off-centered rectangular cross-sectional design which generates snake-like swagging movement along its active portion resulting in a decreased screw-in effect and harmful taper-lock. 2Shape (TS) file system is made of T-wire heat-treated alloy with an asymmetric triple helix cross-section with two main cutting edges for improved cutting efficiency and one secondary cutting edge for improved removal of debris. It includes only two files for shaping and one optional file for apical finishing in continuous rotation with asymmetrical cross section.³

Reciproc Blue (RB) (VDW, Munich, Germany) is a thermally treated nickel-titanium single file system in reciprocation, which is the improved version of the original Reciproc.⁴ It has S-shaped cross-sectional design having two cutting edges, an increased resistance to cyclic fatigue and greater flexibility.⁵ WaveOne Gold (WOG) system has a parallelogram-shaped off-centered cross-section with 85° cutting edges in contact with the canal, having a variable and reducing taper.⁶ The present study was to evaluate apical extrusion of debris during endodontic instrumentation with continuous rotation and reciprocating motion.

MATERIALS & METHODS

The present study comprised of 60 extracted single-rooted mandibular premolar human teeth which were divided into 4 groups of 15 teeth each. The canals were instrumented with the following instrument systems: ProTaper Next, 2Shape, Reciproc Blue and WaveOne Gold. Apically extruded debris during instrumentation was collected into pre-weighed Eppendorf tubes. The Eppendorf tubes were then stored in an incubator at 70°C for 5 days. The weight of the dry extruded debris was established by subtracting the pre-instrumentation weight from post-instrumentation weight of the Eppendorf tubes. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Comparison of mean values of debris extrusion

Method	Mean (g)	P value
2shape	0.047	0.01
Protaper next	0.091	
Reciproc Blue	0.054	
WaveOne gold	0.051	

Table I, graph I shows that mean debris (grams) with 2shape was 0.047, Protaper next was 0.091, Reciproc Blue was 0.054 and WaveOne gold was 0.051. The difference was significant ($P < 0.05$).

Graph I Comparison of mean values of debris extrusion

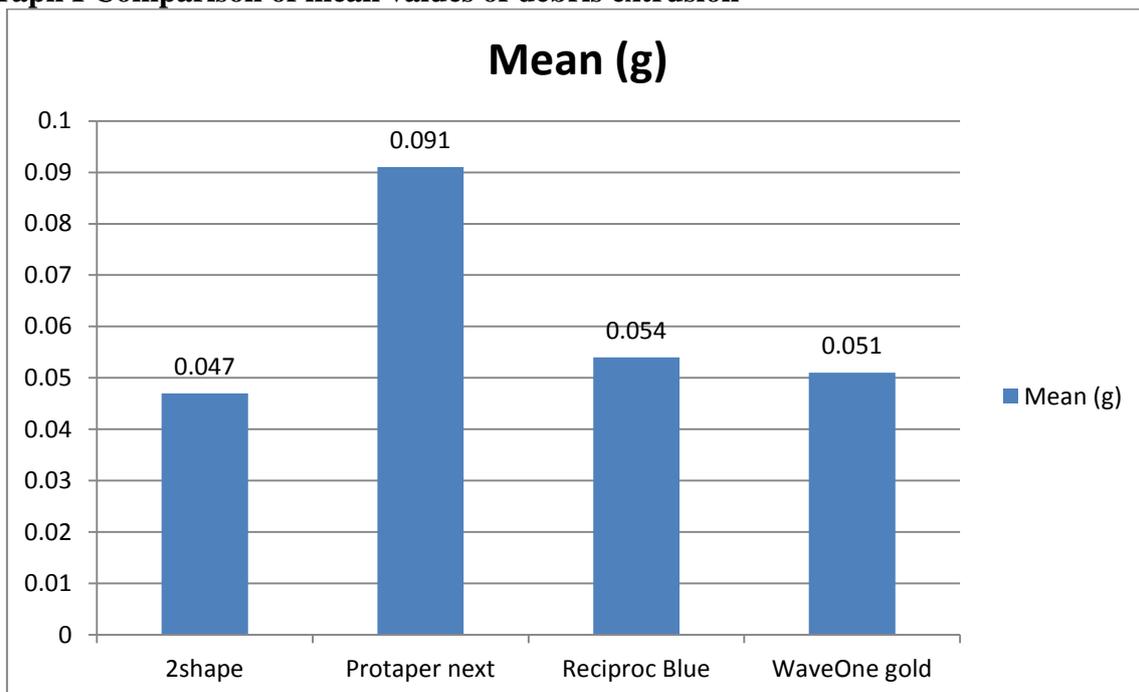


Table II Pairwise comparison of mean values of different file systems

Pairwise comparison	System	Mean difference	P value
2Shape IA	Protaper Next	-0.052	0.05
	Reciproc Blue	-0.021	0.06
	WaveOne Gold	-0.018	0.09
Protaper Next	Reciproc Blue	0.008	0.05
	WaveOne Gold	0.008	0.05
Reciproc Blue	WaveOne Gold	0.008	0.07

Table II shows that statistically significant difference was observed between TS and PTN, PTN and RB and PTN and WOG ($P < 0.05$).

DISCUSSION

The Reciproc and WaveOne single-file systems feature a specific motor that performs the reciprocating motion (i.e., movements alternating clockwise and counterclockwise) and are recommended for single use. Both systems are made of heat-treated nickel-titanium which is resistant to fatigue.^{7,8} The reciprocating motion also improves the resistance of the nickel-titanium instrument to cyclical fatigue.⁹ The Reciproc system features a cross-sectional S-shape along the entire length of the working part and sharp cutting edges. The WaveOne system features a modified triangular cross section and the neutral rake angle that modifies to a convex triangular transverse cross section in the middle and neck portions of the working part of the instrument.¹⁰ The present study was to evaluate apical extrusion of debris during endodontic instrumentation with continuous rotation and reciprocating motion.

We found that mean debris (grams) with 2shape was 0.047, Protaper next was 0.091, Reciproc Blue was 0.054 and WaveOne gold was 0.051. Nevareset al¹¹ aimed to analyse and compare apical extrusion of debris in canals instrumented with systems used in reciprocating and continuous motion. Sixty mandibular premolars were randomly divided into 3 groups ($n = 20$): the Reciproc (REC), WaveOne (WO), and HyFlex CM (HYF) groups. One Eppendorf tube per tooth was weighed in advance on an analytical balance. The root canals were instrumented according to the manufacturer's instructions, and standardised irrigation with 2.5% sodium hypochlorite was performed to a total volume of 9 mL. After instrumentation, the teeth were removed from the Eppendorf tubes and incubated at 37° C for 15 days to evaporate the liquid. The tubes were weighed again, and the difference between the initial and final weight was calculated to determine the weight of the debris. All systems resulted in the apical extrusion of debris. Reciproc produced significantly more debris than WaveOne ($p < 0.05$), and both systems produced a greater apical extrusion of debris than HyFlex CM ($p < 0.001$). Cross section and motion influenced the results, despite tip standardization.

We found that statistically significant difference was observed between TS and PTN, PTN and RB and PTN and WOG ($P < 0.05$). Parakkaret al¹² compared the apical extrusion of debris during endodontic instrumentation with continuous rotation and reciprocating motion.

Sixty extracted single-rooted mandibular premolar human teeth were randomly assigned to four groups of 15 teeth each. The canals were then instrumented with the following instrument systems: ProTaper Next (PTN; DentsplyMaillefer, Ballaigues, Switzerland), 2Shape (TS; MicroMega, Besancon, France), Reciproc Blue (RB; VDW, Munich, Germany) and WaveOne Gold (WOG; DentsplySirona, Ballaigues, Switzerland). Apically extruded debris during instrumentation was collected into pre-weighed Eppendorf tubes. Among the instruments tested in the present study, the least amount of extrusion of debris was seen with TS rotary file system (Group IA) followed by RB (Group IIA) and WOG (Group IIB) ($P < 0.05$), the results, however, were not found to be statistically significant between them. The maximum amount of debris extrusion was observed with PTN (Group IB) with a statistically significant difference when compared to TS, RB, and WOG file system ($P > 0.05$).

The most accepted method involves the model proposed by Myers and Montgomery¹³ which comprises an effective procedure of isolation and collection of apically extruded debris. Some investigators have suggested simulating the resistance of periapical tissues using an agar gel/floral foam. However, the foam may absorb some of the irrigant and debris when used as a barrier, thus giving erroneous results.

CONCLUSION

Authors found that all instruments were associated with apical extrusion of debris with TS rotary file system associated minimum extrusion and PTN, resulting in maximum extrusion of debris.

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