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Research Article

Comparative Evaluation of Apically Extruded Debris with Protaper Universal, Protaper Gold and Twisted File Adaptive Rotary Instruments- An *In-Vitro* Study

Trishagni Chaudhury[1]*, Ananthakrishna S[2], Veena Kumari R[3], Pradeep PR[4], Vijay Shankar[2], Raksha Sagar[5]

[1]*Post Graduate Student, Department of Conservative Dentistry and Endodontics, M.R Ambedkar Dental College and Hospital, India*

[2]*Reader, Department of Conservative Dentistry and Endodontics, M.R Ambedkar Dental College and Hospital, India*

[3]*Professor and HOD, Department of Conservative Dentistry and Endodontics, M.R Ambedkar Dental College and Hospital, India*

[4]*Professor, Department of Conservative Dentistry and Endodontics, M.R Ambedkar Dental College and Hospital, India*

[5]*Lecturer, Department of Conservative Dentistry and Endodontics, M.R Ambedkar Dental College and Hospital, India*

***Corresponding Author:** Trishagni Chaudhury, Post Graduate Student, Department of Conservative Dentistry and Endodontics, M.R Ambedkar Dental College and Hospital, India.

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Abstract

Aim: The aim of this study was to compare the amount of apically extruded debris with three endodontic rotary nickel-titanium instruments i.e ProTaper Universal, ProTaper Gold, and Twisted File Adaptive System.

Materials and Methods: Freshly extracted non-carious 30 single rooted mandibular premolars were selected. After preparation of the access cavity a 15 size k file inserted till the apical foramen and working length was determined by reducing 1mm from the apex. The apex was prepared with a #30 file in all instrumentation techniques. Specimens were grouped as according to various rotary instrumentation techniques;

Group1- Instrumentation done by Protaper Universal (Dentsply Maillefer, Ballaigues, Switzerland) n=10

Group2-Instumentation done by Protaper Gold (Dentsply Maillefer, Ballaigues, Switzerland) n=10

Group3-Instrumentation done by Twisted File Adaptive, (SybronEndo, Orange, CA) n=10

Empty Glass vials without stoppers were weighed with an electronic balance. Each tooth was inserted into the stopper of an eppendorf tube till the CEJ. A stopper of the vial was drilled, and each eppendorf tube that was perforated at the tip was attached to the stopper of the vial. A 27-G needle was placed alongside the stoppers to equalize the internal and external pressures. After change of each instrument 5ml of 2.5% NaOCl was used as an irrigating solution with a 30G side vented irrigating needle. The apically extruded debris was collected in pre weighed glass vials. The vials were then stored in an incubator at 50ºC for 10 days before weighing the glass vials with the dry debris. The net weight of the extruded debris was determined by subtracting the initial weight from the final weight.

Results: The data were analyzed with One-way ANOVA analyses followed by Post hoc Tukey HSD test. The testing was performed at the 95% confidence level. The Twisted File Adaptive and ProTaper Gold systems extruded significantly less debris than the ProTaper Universal files ($P < 0.01$). (Table 1, Graph 1).

Keywords: Apically Extruded Debris; Nickle- Titanium Rotary Instruments; Protaper Universal; Protaper Gold; Twisted File Adaptive

Introduction

During instrumentation of root canals, extrusion of dentinal debris into peri-radicular space may cause postoperative pain and complication. Most of the studies showed that almost all instrumentation techniques with their instruments are associated with apical extrusion of dentinal debris [1]. The extruded material

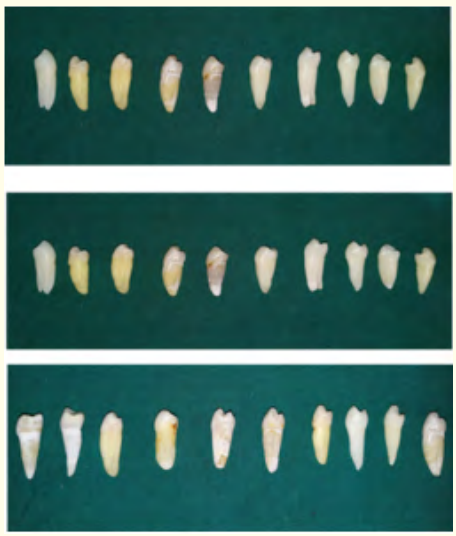
referred to as the 'worm of necrotic debris' has been related to periapical inflammation and postoperative flareups [2]. The immunological studies of postoperative flareups demonstrated that antigens originating from root canal preparation resulted in the formation of an antigenantibody complex when forced beyond the apical foramen, which could lead to a severe inflammatory response [3]. With the introduction of advanced nickle titanium rotary instruments, the concept of preserving the root canal shape during endodontic treatment with lesser errors have been developed [4]. Studies examining an apical extrusion of debris have stated that procedures using the pushpull motion tend to produce more debris than those involving some sort of rotational movement. This has led to the hypothesis that enginedriven instruments produce less debris than hand filing techniques, as they have a tendency to pull debris in the flutes of the instrument [5]. These file systems are more flexible and resistant to cyclic fatigue. Investigations of apically extruded debris using these systems with different design features and kinematics are important for understanding how the differences affect debris extrusion [6]. However, the amount of apically extruded debris after preparation with these new NiTi rotary systems has not yet been compared. In the present study apical extrusion of debris with the ProTapler Universal rotary system were compared with those of the ProTaper Gold and Twisted File Adaptive systems.

Aim

The aim of this study was to compare the amount of apically extruded debris with three endodontic rotary nickel-titanium instruments i.e ProTaper Universal, ProTaper Gold, and Twisted File Adaptive System.

Materials and Methods

Freshly extracted noncarious 30 single rooted mandibular premolars were selected from patients of age group (35-50)yrs. Specimens were immersed in 0.2% chlorhexidine solution(Hexide,Dey's medical, india) for 24hrs and stored following OSHA guidelines. After preparation of the access cavity a 15 size k file inserted till the apical foramen and working length was determined by reducing 1mm from the apex. During root canal instrumentation 1 ml of distilled water was used after every change of instrument. The apex was prepared with a #30 file in all instrumentation techniques. Specimens were grouped as according to various rotary instrumentation techniques;

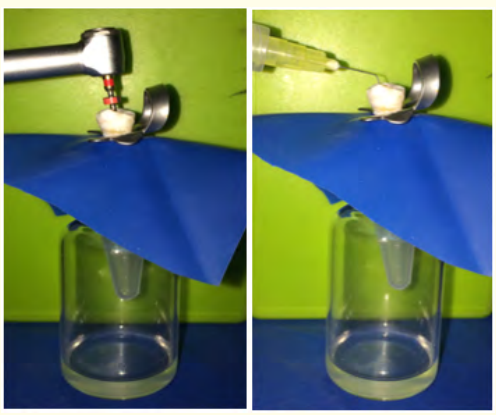


Picture 1: Sample teeth.

Group1- Instrumentation done by Protaper Universal (Dentsply Maillefer, Ballaigues, Switzerland) n=10

Group2-Instumentation done by Protaper Gold (Dentsply Maillefer, Ballaigues, Switzerland) n=10

Group3-Instrumentation done by Twisted File Adaptive, (SybronEndo, Orange, CA) n=10



Picture 2: Preparetion of the sample.

- Group 1: Protaper Universal file system was used with X-SMART™ (Dentsply, mallifer 16:1 contrangle endomotor). Following sequence was used till the working length-SX-S1-S2-F1-F2(Size 25, 0.08 Taper)

- Group 2: Protaper Gold file system was used with X-SMARTTM ™ (Dentsply. following sequence was used SX file (size 18, 0.10 taper), S1(size 18, 0.10 taper) and S2(size 20, 0.10 taper) files, F1 (size 20, 0.07 taper) file, and F2 (size 25, 0.08 taper) file till full working length.
- Group 3: Twisted Adaptive File instruments SM1, SM2, SM3 were used in sequence. The TFA motor (Sybron Endo) was set to the TFA program, which provides torque control and stability. The instruments were inserted carefully into the canal until the working length.

Debris collection

Empty Glass vials without stoppers were weighed with an electronic balance. The stoppers of the Eppendorf tubes were separated, and a hole was drilled in the tops. Each tooth was inserted into the stopper of an eppendorf tube till the CEJ. A stopper of the vial was drilled, and each eppendorf tube that was perforated at the tip was attached to the stopper of the vial. A 27-G needle was placed alongside the stoppers to equalize the internal and external pressures. During the instrumentation procedure, the teeth were isolated with a rubber dam to preclude the operator from seeing the root and to prevent irrigation solution extrusion through the hole. After change of each instrument 5ml of 2.5% NaOCl was used as an irrigating solution with a 30G side vented irrigating needle. The apically extruded debris was collected in pre weighed glass vials. The surface of the root was washed with 1 ml of saline into the vial to collect the debris adhering to the root surface.

Picture 3: Collection of dried debris.

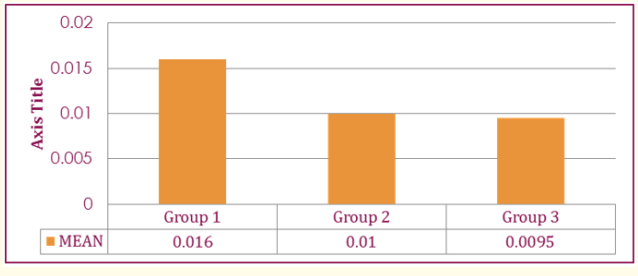
The vials were then stored in an incubator at 50ºC for 10 days before weighing the glass vials with the dry debris. The net weight of the extruded debris was determined by subtracting the initial weight from the final weight.

Picture 4: Measurement of the weight of dried debris.

Results

The data were analyzed with One-way ANOVA analyses followed by Post hoc Tukey HSD test. The testing was performed at the 95% confidence level.

The Twisted File Adaptive and ProTaper Gold systems extruded significantly less debris than the ProTaper Universal files ($P < 0.01$). (Table1, Graph 1).



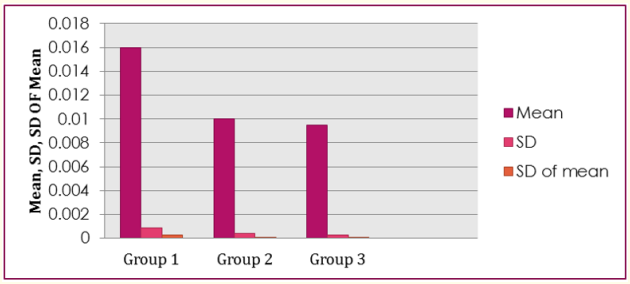
Graph 1: Showing difference of mean of collected debris.

Data	Group 1	Group 2	Group 3
n	10	10	10
ΣX	0.1599	0.1005	0.0951
Mean	0.0160	0.0100	0.0095
Sample SD	0.0009	0.0004	0.0003
SD of Mean	0.0003	0.0001	0.0001

Table 1: Showing mean value of apical debris in each group.

Statistically no significant differences were obtained between the Twisted File Adaptive and ProTaper Gold systems (P <0.01) using Tukey HSD test.

Difference was noted when comparison was group1 vs group2 and group 1 vs group 3. (Table 2, Graph 2).



Graph 2

Comparative groups	Tukey HSD P value	Tukey HSD inference
Group1 vs Group 2	0.0010053	P<0.01
Group 1 vs Group 3	0.0010053	P<0.01
Group 2 Vs Group 3	0.0938803	insignificant

Table 2

Discussion

Complete preparation of the root canal space is one of the most important goal of root canal therapy. During this therapy, pulp tissue fragments, necrotic tissue, microorganisms may get extruded from the apical foramen into periapical region. McKendry termed this extruded material as worm of necrotic debris and this causes periapical inflammation and pain [7].

Various types of injuries that can take place during chemo-mechanical preparation of the root canal, which lead to a flare-ups are: mechanical, chemical, and / or microbial [8].

Shovelton DS had reported that bacteria are also extruded along with debris through the apical foramen. The number of bacteria extruded apically has a direct correlation with the weight of the debris which is a quantitative factor and the type and virulence of the bacteria is related to the severity of the periapical inflammation (qualitative factor) [9].

In the present study crown down pressureless technique has been used. According to Ruiz –Hubard., *et al*. this technique produce less extrusion of debris compared to step back technique [10]. According to Martin H., *et al*. engine driven instruments produce less debris than hand filing technique as they have a tendency to pull debris into the flutes of the instruments. The difference in the root canal preparation using hand and rotary Protaper files is because of the time of contact between the file and the root canal wall [11]. The enginedriven Protaper file contacts the apical area for a lesser period of time and also the rotational speed and torque is fixed, whereas, the Hand Protaper file remains in contact with the the apical area for an extended period of time and the rotational movement of the file is an operator controlled which is a variable factor, extruding more amount of debris [12].

The Twisted File Adaptive (SybronEndo, Orange, CA) is a file that uses a combination of continuous rotation and reciprocating motion during biomechanical preparation. The file uses continuous rotation when it is exposed to minimal or no applied load and uses reciprocal motion when it engages dentin and a load is applied [13]. Manufacturers have claimed that this adaptive technology and twisted file design using R-phase treatment increase debris removal and flexibility and allow the file to adjust to intra-canal torsional forces depending on the amount of pressure placed on the file.

ProTaper GOLD is an upgrade from ProTaper Universal. ProTaper GOLD has the same philosophy as the first generation of ProTaper (file sequence, file sizes, motor settings, obturation methods) with strong additional benefits like increased flexibility (24% on average) and greater resistance to cyclic fatigue [13].

In this study The Twisted File Adaptive and ProTaper Gold systems extruded significantly less debris than the ProTaper Universal files. Statistically no significant differences were obtained between the Twisted File Adaptive and ProTaper Gold systems.

Ismail D Caper., *et al.* [14] studied the amount of amount of apically extruded debris by using ProTaper Universal, HyFlex systems., ProTaper Next and Twisted File Adaptive. They concluded that The ProTaper Next and Twisted File Adaptive instrumentation systems were associated with less debris extrusion compared with the ProTaper Universal and HyFlex systems. This result is in accordance to our study.

Fatih Cakici., *et al*. [15] conducted a study to evaluate Apically extruded debris during root canal preparation using ProTaper Gold, ProTaper Universal, ProTaper Next, and RECIPROC. The study revealed that the Pro Taper Gold, Pro Taper Next, and RECIPROC systems resulted in significantly less debris extrusion than the Pro Taper Universal system which is similar to our study.

The reduction of both torsional and bending stress of in twisted adaptive file system is the main advantage of reciprocating movement. Another possible advantage of reciprocation is a better maintenance of the original canal trajectory, mainly related to lower instrumentation stress and, consequently, its elastic return.

The Pro Taper Gold system has; smaller dimensions, an off-centered mass, and a regressive taper. The centering ability of Pro Taper Gold instruments may ensure that a greater percentage of dentin thickness is retained in the root canal and may facilitate greater bacteria elimination [16]. The convex triangular cross-section and progressive taper enhance the cutting efficacy of PTG, while decreasing rotational friction between the file blade and dentin [17]. According to Blum JY Pro Taper Gold has a significantly lower torsional resistance. The non-cutting tip design allows each instrument to safely follow the secured portion of the canal, while the small flat area on the tip enhances its ability to find its way through soft tissue and debris [18].

Conclusion

Following conclusions were drawn based on the findings of present study results

1. Within the limitations of this *in vitro* study, all 3 systems i.e ProTaper Universal, Pro Taper Gold, and Twisted File Adaptive System extruded apical debris.
2. The ProTaper Gold and Twisted File Adaptive instrumentation systems were associated with less debris extrusion when compared with the ProTaper Universal system.

Conflict of Interest

The authors have no conflicts of interest related to this study.

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