



EVALUATION OF APICAL EXTRUSION OF DEBRIS DURING INSTRUMENTATION IN PRO-TAPER GOLD AND PRO-TAPER NEXT: AN IN VITRO STUDY

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Conflicts of Interest: Nil

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Abstract:

Aim: The study was intended to evaluate the amount of apically extruded debris following root canal preparation with two different endodontic file systems.

Materials and Methods: Thirty mandibular premolars were selected and randomly divided into two groups (n = 15) according to file systems used: ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland) and the ProTaper Gold (Dentsply, Tulsa, OK, USA). All the extruded debris was collected in a preweighed glass vials and again weighed by a analytical balance. The data were statistically analysed using one-way analysis of variance.

Conclusion: The ProTaper Next rotary file extruded a significantly lower amount of debris as compared to ProTaper Gold.

Keywords: Apical Extrusion; Glass vials; ProTaper Next; ProTaper Gold

Introduction

Root canal preparation aims at complete debridement of the canal with the help of files and a good irrigation system. Sometimes during this preparation, the dentinal chips, pulp tissue remnants, necrotic debris, microbes and intracanal irrigants might extrude out of the apical foramen into the periapical region [1]. All these leads to periapical disorders and postoperative flare-ups, that why the extruded material is referred to as the 'worm of necrotic debris' [2]. Some kind of extrusion of debris into the periapical region is seen in almost all the biomechanical preparations [3,4]. The amount of extrusion depends mainly on the design of the file system and the technique advocated preparing the canal [5-7]. A study conducted determined that maximum extrusion of debris occurred during linear filling motion, while the least extrusion was associated with crown-down and balanced-force technique [8]. Different file systems have different designs which might influence the amount of debris extruded out during preparation [9]. There are various rotary systems introduced in the market, out of which ProTaper Next and Protaper Gold have better physical properties.

ProTaper Next file system (Dentsply Maillefer, Ballaigues, Switzerland) was designed with varying tapers and an off-centred rectangular cross section. It is developed by new M wire alloy which shows advantages of strength, wear resistance and higher flexibility. It is said to be better than ProTaper Universal as fewer instruments are used to complete the root canal preparation [10].

Recently, Dentsply have introduced ProTaper Gold (PG; Dentsply, Tulsa Dental Specialties, Tulsa, OK, USA) with an advanced metallurgy. The cross-section is convex

triangular with progressive taper design. It has quite similar geometries but a better cutting efficiency than ProTaper Universal [11]. It is available in eight different sizes depending on the function and diameter of each file [12].

The aim and objective of this study was to evaluate the amount of debris extrusion into the apical region using two different NiTi rotary file systems ProTaper Next and ProTaper Gold.

Materials and Methods:

A. Sample Selection

Thirty freshly extracted single rooted human mandibular first premolars were selected for the study. The selected samples had mature apices and somewhat similar lengths. The samples were kept in 5.25% sodium hypochlorite (NaOCl) for two hours, after which teeth were cleaned with periodontal curette and inspected for any root fracture or cracks. All the teeth were radiographed for any kind of obstruction in the root canal.

B. Preparation of Specimens

Teeth were decoronated from the cemento-enamel junction. The working length was determined by subtracting 1mm from the length achieved by placing a 15 number K-file (Mani inc, Tochigi, Japan) through the orifice. The working length was reconfirmed by taking a radiograph for each sample.

Debris were collected in a preweighed glass vials (10ml). The glass were weighed by taking three readings using an analytical balance with an accuracy of 10^{-5} sensitivity (Shimadzu ATX224, Tokyo, Japan) and an average was taken. The samples were forcefully placed inside the rubber stopper hole which was created by hot instrument.

The teeth were fixed using cyanoacrylate at the level of cemento-enamel junction. A 27-gauge needle was placed at the side of rubber stopper in order to equalize air pressure inside and outside during instrumentation. All the samples were randomly divided into two groups depending upon the type of file system used during instrumentation (n= 15).

Group1: Root canal prepared by ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland). The canals of 15 samples were prepared by manufacturer's instructions. The file system consists of five shaping instruments: X1 (17/0.04), X2 (25/0.06), X3 (30/0.07), X4 (40/0.06) and X5 (50/0.06). The files X1 and X2 were used in a brushing outstroke motion till working length with an endodontic motor (X-Smart Plus, Dentsply, Ballaigues, Switzerland). The endomotor was set at 300 rpm and 2N/cm. The preparation was stop when the file X2 was freely moving till working length.

Group2: Root canal prepared with ProTaper Gold (Dentsply, Tulsa, OK, USA). 15 samples were prepared by manufacture's instruction. This file system is available in eight sizes: SX (19/0.04), S1 (18/0.02), S2 (20/0.04), F1 (20/0.07), F2 (25/0.08), F3 (30/0.09), F4 (40/0.06) and F5 (50/0.05). The root canal was prepared up to F2 file till working length. The instrumentation was carried out in a sequence. The files SX, S1 and S2 are shaping files and used in a brushing motion and the finishing files F1 and F2 are used in a nonbrushing action till working length.

All the samples of both the group were irrigated thoroughly in between instrumentations and also after completion of the procedure by 5ml of bidistilled water in each sample with a 27 gauge side vented irrigation needle.

C. Measurement Of Collection Of Debris

Following this the apparatus was disengaged and the apex was washed with 1ml of distilled water to collect the debris. The vials were then kept in an incubator for about 2 days at 68°C in order to evaporate the water completely. After this the vials were again weighed by the same analytical balance. Three readings were taken and an average was determined for each sample. Following formula was advocated to calculate the amount of debris extruded during canal preparation for each sample.

Amount of extruded debris= Final weight of the vial- Pre-weighted vial

D. Statistical Analysis

Descriptive and comparative statistics were performed using IBM SPSS v21. Differences among the groups were analysed by Analysis of variance (ANOVA) tests. P value <0.05 was considered statistically significant for all tests. Variables were expressed as means $\pm$ standard deviation.

Result

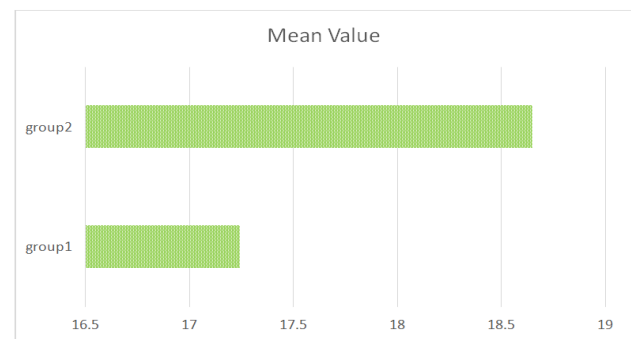
The result of present in vitro study revealed that both the file systems show extrusion of debris apically. However,

higher extrusion was observed in Group2 (ProTaper Gold) than Group1 (ProTaper Next) [Table 1]. This difference between the two groups was statistically significant (P < 0.05). The mean value of Group1 was lower (17.24) than group2 (19.65) [Graph 1].

Table 1: The mean values and standard deviation of apically extruded debris of both the group in milligrams

Group	n	Minimum Extrusion	Maximum Extrusion	Mean	SD	Median Value	p-value
Group1 ProTaper Next	15	2.7	35.6	17.24	8.43	16.55	<0.01
Group2 ProTaper Gold	15	3.4	36.2	18.65	9.66	18.02	<0.01

Abbreviations: SD, Standard Deviation; n, number of samples



Graph 1: Graph showing the intergroup mean value comparison of the extruded debris

Discussion

The problems with all endodontic file systems are that they show some kind of extrusion of debris into the apical region [13]. This may lead to post-operative pain and flare-ups. Several in vitro studies have been conducted in order to record the amount of apical extrusion of debris of different endodontic file systems. Today a rotary nickel-titanium (NiTi) instrument has been advocated to prepare the root canal. There has been tremendous evolution in file systems like radial lands, non-cutting tips, different cross sections and tapers. All these developments have led to increase in the efficacy and safety [14].

To our knowledge, no previous study has compared the debris extrusion of ProTaper Next and ProTaper Gold. Thus in this study, we aim to compare two different NiTi rotary file systems in terms of apical extrusion of debris. A number of methods have been used to assess the debris extruded apically. In this study an experiment by Myers and Montgomery [15] has been used. The apical extrusion mainly depends upon the patency, apical diameter, curvature and working length of the root canal. The canal preparation was ceased 1mm short of the apical foramen as it resulted in less debris extrusion as compared to filling

the root canal up till the foramen. This was similar to an experiment by Myers and Montgomery [15].

In the present study, the two rotary file systems show a significant amount of debris extrusion. ProTaper Next showed lower amount of debris and irrigant extrusion (17.24) in comparison to other group ProTaper Gold (18.65). ProTaper Next has an innovative off-centred rectangular cross section which gives the file a snake like movement during preparation of root canal. These files are said to have a higher cutting efficacy and also the use of less files during instrumentation. All these factors contribute to less debris extrusion as compared to other NiTi files. A study conducted by Capar et al, investigated that less debris extrusion was seen in samples prepared by ProTaper Next as compared to ProTaper Universal file system due to the file designs [16]. ProTaper Next file system is manufactured using M-Wire NiTi in order to increase the flexibility and resistance to cyclic fatigue. Many studies have shown that M-Wire are more superior to conventional NiTi alloy and also exhibit increased cutting efficiency [17,18]. A similar compared number of NiTi files and concluded that ProTaper Gold was associated with more extruded debris than ProTaper Next [19].

ProTaper Gold file system have advanced metallurgy which makes it different from ProTaper Universal files. These files have greater flexibility and greater resistance to cyclic fatigue [20]. Due to the multiple tapers along the surface, they are said to cut dentine more effectively with more amount of debris extrusion apically [21]. The ProTaper Gold file system causes preparation of the apical third of the canal as soon as the instrument reaches the working length, this might be another reason for greater amount of apical extrusion [22].

Since it is revealed in this study that ProTaper Next is a better file system, thus can be used for infected root canals and teeth with resorbed roots due to lesser amount of debris extrusion.

Conclusion

Within the limits of this study, it can be concluded that both the rotary file systems produced apical extrusion of debris. The ProTaper Next rotary file extruded a significantly lower amount of debris as compared to ProTaper Gold. More studies need to be done in order to understand both the NiTi file systems and get a better clinical knowledge.

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