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Quantatitative assessment of apical debris extrusion in apical third using two different NiTi rotary systems- An in vitro study

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Abstract

Sterilization of the root canal is the ultimate goal for successful endodontics. The extrusion of apical debris has a harmful effect on the prognosis of root canal treatment. New innovative file designs and cutting rake angles have in abed in less extrusion of debris.

Materials and Methods: 40 straight rooted single rooted human mandibular premolar teeth were divided in 2 groups of 20 teeth each. Each group were instrumented with rotary Mtwo systems and Protaper next system. The apically extruded debris was collected on the pre-weighed Millipore plastic filter disk and weighed using microbalance. Intracanal debris was analyzed using binocular research microscope. The mean weight of extruded debris for each group in the root canal was statistically analyzed by a Kruskal-Wallis one-way analysis of variance and Mann-Whitney U test.

Results: The results show that all instrumentation techniques produce some amount of extruded debris and irrigant. The amount of extrusion was least in Protaper next group as compared to M two file group.

Conclusions: Considering the study, Rotary instruments with their innovative designs & less screwing in effect has drastically decreased the apical extrusion of debris & intracanal debris but extrusion of debris was seen in all the groups.

Keywords: Apical extrusion, Mtwo, Protaper next, Debris, Rotary.

Introduction

During cleaning and shaping of root canals, necrotic debris, pulp remnants, microorganisms, dentin chips and irrigants can extrude into the apical region.[1,2] The success rate of root canal treatment varies from 31%–96%.[3] The quantity of debris extruded varies on the type of preparation techniques.[4] Chapman et al. (1968) were the first to verify the expulsion of infective material from the root canal system during instrumentation. Numerous studies in the past have confirmed that chemo-mechanical debridement of the root canal results in extrusion of debris, dentinal fragments, bacterial remnants, microorganisms, and root canal irrigants through the apical foramen. All preparation techniques and instruments, despite maintaining working length strictly short of the apex have reported to be associated with extrusion of infected debris, Studies have shown less extrusion of debris and some have reported more extrusion.[5-9] Rotary nickel-titanium (NiTi) instruments have become very popular during the last years because it has been shown that most of them seem to be safe to use when used according to the manufacturers' guidelines, are able to enlarge root canals rapidly, and are well suited for preparing even severely curved root canal.[10-14]

Recently, ProTaper Next files (PTN) (Dentsply Maillefer, Ballaigues, Switzerland) have been launched in the dental market. PTN files exhibit a rectangular cross-section design which enables better strength while in motion and provides exceptional asymmetric rotary motion that cleans and shapes the canal for proper accessibility of irrigants and medicaments. They are manufactured by using M-Wire NiTi to enhance flexibility and cyclic fatigue resistance of the files.[15,16]

Mtwo(VDW) instruments have an s-shaped cross-section and two sharp cutting edges. Mtwo(VDW) is designed with minimum radial contact as well as large and deep flutes for continuous upwards evacuation of dentine chips. Instrument design enables flexibility, without hindering the instrument's strength.[17] The aim of this research was to compare the amount of apically extruded debris after preparation of straight root canals in extracted human teeth using Protaper next (Dentsply) and Mtwo system (VDW).

Materials and Methods

40 extracted human mandibular premolars with single canals and approximately same lengths were collected. All teeth were analyzed by digital radiovisiograp(VARIO^{DG}, Dentsply, Sirona).in the buccal and proximal directions. The teeth with caries, open apex, curved canals or more than one canals were excluded from the study.

The teeth were decoronated at the cementoenamel junction (CEJ) by using safe-sided diamond disk. The access was modified using Endoaccesss bur and Endo Z bur. After preparation of straight line access, coronal flaring into the canal of mandibular premolars was carried out by Gates-Glidden drill no 1-2. The 10-K file tip of the instrument was penetrated and reached upto the apical foramen and working length (WL) was calculated. The teeth were randomly divided into 2 groups according to the file used for the preparation of root canals. In this

study, the experimental model described by Myers and Montgomery (18) was used.
Group 1: Protaper Next (n=20)
Group 2: Mtwo(n=20)

The root canals were irrigated at each change of instrument with 1 ml of 0.5% NaOCl using an irrigating needle placed 3 mm from the WL. In order to standardize the procedure, the files were replaced after being used five times. The instrumented root canals were filled with 17% trisodium Ethylene Diamine Tetra-acetic Acid (EDTA) for 3 min, flushed again with 1 ml of 0.5% NaOCl, and dried with absorbent paper points.

The apical preparation of samples were done upto 25K file for both the groups.

All tooth specimens were mounted on the glass membrane filtration unit (Fig. 1). Pre-weighed Millipore plastic filter disk particle size 0.45 µm was placed in the glass membrane filtration unit. Filters were weighed twice to ensure an accurate assessment of their weight. A new filter paper was used for each specimen.

Fig. 1

Group 1: ProTaper instruments were used according to the manufacturer's instructions using a gentle in-and-out motion with an electric and torque-controlled endodontic motor (X-Smart, Dentsply Maillefer).The instrumentation sequence was SX at two thirds of the WL, S1 and S2 at WL_1 mm, and F1 (20.07) and F2 (25.08) at the WL. Once the instrument had negotiated the full WL and rotated freely, it was removed.
Group 2: All Mtwo instruments (size 10, 0.04 taper, size 15, 0.05 taper, size 20, 0.06 taper and size 25, 0.06 taper) were used to the full length of the canals.

Upon completion of instrumentation, the apically extruded debris was collected on pre-weighed Millipore plastic filter disk particle size 0.45 µm and carried in a glass membrane filtration unit. The collected material was then placed in an oven at 110˚cfor 4 minutes to eliminate moisture before being weighed (Fig. 2). A microbalance was used to weigh the samples.(Fig. 3)

Fig. 2

Fig. 3

The amount of debris produced in each group was determined by subtracting the previously recorded weight of the Millipore filter from the weight of the same filter containing the collected materials.

The data were statistically analyzed to compare the percentage of debris between the groups.

Results

The Statistical package SPSS (Statistical package for social science, version 4) was used for statistical analysis. Mean and standard deviation were estimated from the sample for each Study group. The mean values were compared by one-way ANOVA followed by *post hoc* tukey test. *Post hoc* tukey test was employed to identify the significant groups. In the present study, the level of significance was set at $P = 0.05$.

(Fig. 4) Shows the mean counts, standard deviation and *post hoc* tukey test of extruded debris between experimental groups.

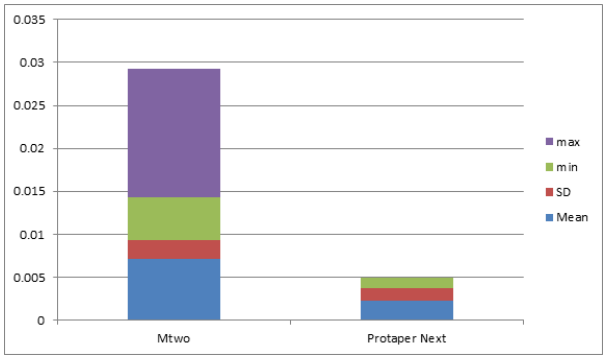

Fig. 4

Least amount of bacterial extrusion was observed with Protaper Next Rotary Ni-Ti (Table 1) Instruments in comparison with Mtwo. Mtwo Rotary Ni-Ti Instruments extruded more debris.

Table 1: The mean extrusion values(grams), standard divisions(SD) and number of tooth for each group

Debris Extrusion (g)

Instrument	Mean	SD	Min	Max
Mtwo	0.0071	0.0022	0.0050	0.0150
Protaper next	0.0023	0.0014	0.0012	0.0050

Discussion

This present study revealed that both the instruments caused apical extrusion of debris (Fig. 1, 2), consistent with the results of previous studies which demonstrated that no method completely avoids debris extrusion (Reddy & Hicks 1998, Mangalam et al. 2002, Tanalp et al. 2006, Kustarci et al. 2008, Logani & Shah 2008, Elmsallati et al. 2009, De-Deus et al. 2010). Apical extrusion of infected debris to the periradicular tissues is one of the main causative factor leading to post-operative pain.[2]

In this study, to standardize the clinical conditions, the teeth were decoronated at the cementoenamel junction (CEJ) by using safe-sided diamond disk. To overcome complications like fracture of instrument during biomechanical preparation single rooted teeth were used and files were discarded after being used in 5 samples .The generally accepted method of Myers and Montgomery[18] was used to collectapically extruded debris.

According tp the results obtained, extrusion of debris apically occurred independent of the type of instrument used. Differences in the results may be caused by the preparation technique, technical skills or the cross-sectional designs of the instrument.[9] Ghivari *et al*. found that step-back technique extruded a greater quantity of debris and irrigant in comparison to the other hand and rotary Ni-Ti systems[19,20] The rotary motion tends to direct debris toward the orifice, avoiding its compaction in the root canal.[21]

The PTN is an excellent rotary file system which is thermo mechanical processed resulting in a reported increased flexibility and very few reports indicates apical extrusion of debris after its clinical usage. Capar *et al*, investigated and concluded that there was less debris extrusion associated with PTN files when it was compared to the universal ProTaper file system.[22] PROTAPER NEXT has innovative off-centred rectangular cross section gives the file a snakelike "swaggering" movement as it moves through the root canal. A shorter clinical sequence means that less time is spent changing instruments. The high cutting efficiency also reduces the shaping time. This can be the main advantage of the file and may lead to least debris extrusion; hence, it was used as one of the instrumentation techniques for the present study.

Mtwo instruments have an s-shaped cross-section positive rake angle with 2 cutting edges, and increasing pitch length from the tip to the shaft which enables excellent lateral cutting. The basic series of Mtwo instruments comprises 8 instruments with tapers ranging between 4% and 7% and sizes from 10–40.

Based on the results of this study, independently of the systems used, all instrumentation techniques produced debris extrusion. The samples in the group instrumented by PTN resulted in less extrusion of the debris when compared to the Mtwo group.

Conclusion

Considering the study, the protaper next system used in the study appeared to be more beneficial as it extruded less debris compared to Mtwo system.

Within the limitations of the present study, rotary instrumentation was associated with debris extrusion. Taking into consideration the excellent shaping ability rotary file systems, clinical studies are required to assess whether these findings have an impact on the clinical outcome, particularly as the clinical relevance of debris extrusion still remains undetermined.

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