Apically Extruded Debris: Mtwo vs BioRaCe and K-file

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Abstract

Aim: *The aim of the present study was to compare the amount of debris extruded from the apical foramen in two rotary (MTwo/single length and BioRaCe/step-down) systems and one hand technique (K-file/step-back).*

Materials and methods: *The samples in the three study groups (n=20) in the present study were instrumented as follows: group 1:MTwo rotary system; group 2:BioRaCe rotary system; and group 3: hand step-back technique. Instrumentation of the root canals was carried out according to manufacturer's instructions, and the amount of debris extruded from the apical foramen was weighed. The mean amount of extruded debris was calculated in each group and one-way ANOVA was used to analyze the effect of instrumentation technique on the amount of extruded debris. Post hoc Tukey tests were used for the two-by-two comparisons of the groups. Statistical significance was defined at P<0.05.*

Results: *The maximum and minimum amount of debris was observed in groups 3 and 1, respectively. The mean amount of debris in the MTwo/single length technique group was significantly less than that in the two other groups (P<0.05).*

Conclusion: *The MTwo/single length technique resulted in less debris extrusion compared to the two other techniques.*

Key words: BioRaCe; K-file; Mtwo.

1. Introduction

Different instrumentation techniques used in endodontics result in debris production and its extrusion from the apical foramen. Such debris consists of pulp tissue remnants, microorganisms and dentin chips, which induce an inflammatory reaction in periradicular tissues and are considered one of the most important etiologic agents for endodontic flair-ups (Adl, Sahebi, Moazami, & Niknam, 2009; Elmsallati, Wadachi, & Suda, 2009; Tanalp & Gungor, 2014; Tanalp, Kaptan, Sert, Kayahan, & Bayirl, 2006). Therefore, techniques that lead to less debris are more favorable. The majority of studies on the amount of debris extruded from the apical foramen have shown that rotary techniques give rise to less debris extrusion compared to hand techniques. In fact, techniques that use pull-push movements lead to more debris extrusion compared to those that make use of rotational movements(Kustarci, Akpinar, & Er, 2008).

Use of NiTi rotary instruments is on the rise in endodontics. These instruments have different cross-sections and are used differently. In addition, they give rise to varying amounts of debris, with different amounts of debris extruded from the apical foramen(Dincer, Er, & Canakci, 2014; Huang, Ling, Wei, & Gu, 2007). The majority of rotary files are used in the crown-down technique; however, BioRaCe(FKG Dentaire, LaChauxde-Fonds, Switzerland)and MTwo(VDM,Germany)files are used with different techniques, referred to as step-down and single length, respectively(Garlapati, Venigalla, Patil, Raju, & Rammohan, 2013).

BioRaCe files have a triangular cross-section and neutral rake angle, with physical characteristics comparable to those of RaCe files; however, they have different tapers and sequence of use (Honardar et al., 2014). The principal aim of this system is to achieve larger sizes of apical preparation to facilitate antimicrobial irrigation(Chandrasekar, Ebenezar, Kumar, & Sivakumar, 2014; Honardar et al., 2014). MTwo files have S-shaped cross-sections with two cutting edges and a positive rake angle(Garlapati et al., 2013; Tanalp et al., 2006). Another properly of these files is the increasing length of the pitch from the file tip toward the file shaft, which prevents locking of the instrument on the root canal wall, decreasing the amount of debris extruded from the apical foramen(Garlapati et al., 2013; Hinrichs, Walker, & Schindler, 1998).

The aim of the present study was to measure and compare the amount of debris extruded from the apical foramen with the use of MTwo and BioRaCe rotary systems and the hand step-back technique.

2. Materials and Methodology

2.1. Selection of teeth and preparation of samples

Sixty maxillary central incisors with mature apices and straight roots were selected. After access cavity preparation, the root canal length was determined visually with the use of a #10 K-file and 1 mm short of this length was set as the working length. Based on the instrumentation technique used the samples were divided into three groups (n=20). The technique introduced by Montgomery and Mayers was used to collect debris extruded from the apical foramen during instrumentation. To this end the root was pushed into the elastic cap of large vials which had already been prepared. Beneath this elastic cap and within the large vial a smaller vial was placed so that the root end was placed inside it. These smaller vials had already been numbered and weighed using a digital weighing machine accurate to 0.00001 gr (Metller Instrument, Greifnsee-Zurich, Switzerland).

In the next stage, the large vial was fixed using a vice to prevent displacement of the whole component during the procedures. During the endodontic procedures and instrumentation, the debris extruded from the apical foramen was collected in the smaller vial. The debris attached to the apex was collected, too, in the vial at the end of instrumentation and after removal of the sample from the elastic cap by irrigation in distilled water.

2.2. Cleaning and shaping of the root canals

The root canals in group 1 were prepared with MTwo rotary files using the single length technique as follows:

1. File #20 with 0.06 taper up to the working length
2. File #25 with 0.06 taper up to the working length
3. File #25 with 0.07 taper up to the working length
4. File #30 with 0.05 taper up to the working length
5. File #35 with 0.04 taper up to the working length
6. File #40 with 0.04 taper up to the working length

The root canals in group 2 were prepared with BioRaCe rotary files using the step-down technique as follows:

1. File #25 with 0.08 taper in the coronal third
2. File #15 with 0.05 taper up to the working length
3. File #25 with 0.04 taper up to the working length
4. File #25 with 0.06 taper up to the working length
5. File #35 with 0.04 taper up to the working length
6. File #40 with 0.04 taper up to the working length

The root canals in group 3 were prepared with hand K-files (Dentsply-Maillefer) using the step-back technique as follows:

After determination of the working length the apical third was prepared up to file #40 and then the root canals were prepared up to file #55 with sequential decreases of 1 mm in file lengths.

In the present study an air-driven hand pieces with 1/32 torque was used. Each rotary file was used for 5-10 seconds in each root canal and each 6-piece set was used for the instrumentation of 8 root canals. In each group, a patency file was used up to the WL between two consecutive files to prevent packing of debris in the apical third. One mL of distilled water was used for irrigation between two consecutive files with the use of a needle placed passively within the root canal. The liquid debris was removed from the coronal area by suction. In both groups file #40 with 0.04 taper was considered as the MAF to bring about equal root canal preparation.

The flasks with the vials containing distilled water and debris were placed under direct sunlight for 24 hours to evaporate water. After complete drying the weighing procedure was repeated.

2.3. Statistical analysis of data

Data were analyzed with descriptive statistical methods (means ± standard deviations). One-way ANOVA was used to analyze the effect of instrumentation technique on the amount of debris extruded from the apical foramen. Post hoc Tukey tests were used for two-by-two comparison of the groups. Statistical significance was set at $P<0.05$.

3. Results

The mean amounts of debris extruded from the apical foramen in the BioRaCe/step-down, MTwo/single length and hand K-file/step-back groups were0.00106±1.2 gr, 0.00058 ±0.3 gr and 0.00115±0.7 gr, respectively. The instrumentation technique had a significant effect on the amount of debris extruded from the apical foramen ($P=0.001$); the differences between the MTwo and the other groups were significant ($P<0.05$).

4. Discussion

The aim of the present study was to evaluate the amount of debris extruded from the apical foramen with the use of MTwo and BioRaCe rotary systems and hand step-back technique. The results showed significantly less debris extrusion with the use of the MTwo system compared to the other two techniques.

Different factors affect the amount of debris extruded from the apical foramen, including the anatomy of the apical isthmus, the hardness of dentin, the amount and type of canal irrigation solutions used, the position of the tooth (maxillary vs. mandibular); the size of the master apical file, the technique used for root canal instrumentation, the instrument design, the speed at which the instrument is used and the hand movements of the operator carrying out instrumentation(Lambrianidis, Tosounidou, & Tzoanopoulou, 2001; Tanalp & Gungor, 2014; Tanalp et al., 2006; Tinaz, Alacam, Uzun, Maden, & Kayaoglu, 2005). On the other hand, with an increase in the number of instruments used for cleaning and shaping of the canal, the amount of debris extruded from the apical foramen will increase(Tanalp et al., 2006). Studies have shown that teeth with open apices and in cases in which canal instrumentation has exceeded beyond the apical foramen more debris is extruded. On the other hand, when the working length is determined 1 mm short of the apex less debris is extruded(Ferraz et al., 2001; Tanalp & Gungor, 2014).

In the present study all the samples were maxillary central incisors and all the teeth with open apices and curved roots were excluded from the study. Then working length was determined at 1 mm short of the anatomical apex and all the instrumentations were carried out by one operator. A total of 6 instruments were used in all the samples. Apical preparation was carried out up to file #40 (0.4 mm). Distilled water was used for irrigation to prevent an increase in the weight of debris extruded from the root canal due to the formation of sodium hypochlorite crystals. Heat was used to dry the samples to avoid the effect of ambient moisture on the weight of debris.

The results of the present study in relation to the extrusion of more debris in the step-back technique are consistent with the results of previous studies. In the step-back technique the file serves as a plugger in the apical third and application of force to the debris in the apical third results in the extrusion of debris. In contrast, rotational movements result in the movement of debris in the coronal direction (Ferraz et al., 2001; Tanalp & Gungor, 2014; Tanalp et al., 2006). It should be pointed out that in the present study there were no significant differences between one of the rotary systems (BioRaCe) and hand files in the amount of debris extruded, which is contrary to the results of the studies above(al-Omari & Dummer, 1995; Fairbourn, McWalter, & Montgomery, 1987; Kustarci, Akdemir, Siso, & Altunbas, 2008; Reddy & Hicks, 1998). In those studies rotary files were used with the crown-down technique, which is different from that in the present study. To confirm this, in one of the studies when MTwo files were used with the single length technique, there was more debris extrusion compared to the RaCe system used with the crown-down technique [19].Both the rotary systems used in the present study have a high cutting ability due to their small core diameter; on the other hand, none of them has a radial land and both are effective in cleaning the root canals(Elmsallati et al., 2009; Topcuoglu et al., 2014). MTwo files resulted in less debris extrusion compared to BioRaCe files in the present study. MTwo files have a positive rake angle and previous studies have shown that files with such characteristics result in less debris extrusion(Elmsallati et al., 2009; Kustarci, Akpinar, et al., 2008; Tanalp & Gungor, 2014). On the other hand, these instruments exhibit long pitches from the file tip to the file shaft and the flutes near the file tip are less shallow with shorter pitch lengths. It has been claimed that such a design decreases the amount of debris extruded from the apical foramen and facilitates the movement of debris in the coronal direction (Elmsallati et al., 2009).

Comparison of different techniques in relation to the amount of debris extruded from the apical foramen makes it possible to select the best technique with minimum postoperative pain. However, the amount of debris extruded is not important because any amount of debris might induce pain(Dincer et al., 2014; Er,

Sumer, & Akpinar, 2005; H, T, Goel, T, & Bhandi, 2014). In other words, the quality of the extruded debris (type and bacterial virulence) is important, too, because in such studies the instrumentation technique, the initial and final apical sizes and the sequence of the files used are different(Elmsallati et al., 2009). On the other hand, it should be noted that normal periodontal tissues and granulation tissues in chronic apical periodontitis serve as normal barriers and limit the amount at debris extruded (Elmsallati et al., 2009; Tanalp & Gungor, 2014; Tanalp et al., 2006). By taking these factors into account it appears it is necessary to design proper clinical studies to simulate the real conditions of tissues and match the factors affecting extrusion of debris.

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