Effect of apical patency apically extruded debris during canal enlargement using hand or rotary instruments

Manar Mohamed Galal Hamouda, Hossam Mohamed Essam El-Din Tawfik, Ahmed Fawzy Abou Elezz, Dalia Yehia Ibrahim

Department of Operative, Endodontic and Dental materials National Research Center
Department Faculty of Dentistry- Ain Shams UniversityLecturer in Department of Operative dentistry
Faculty of Dentistry- Suez canal University
Department of Orperative, Endodontic, and Dental materialsOral and dental medicine DivisionNational Research Center

Abstract: The aim of this study was to evaluate the amount of apically extruded debris of Protaper, HeroShaper and RT file. A sixty freshly extracted mandibular molars with root canal curvature angulation between 17 and 35 degree were used in this study. The experimental samples were divided into three equal groups according to the instrument used. Group one was instrumented using rotary hand NiTi Protaper, while group two was instrumented using NiTi HeroShaper. The third group was instrumented using StSt RT hand file. The effect of apical patency was evaluated by subdividing each group into two subgroups, one prepared with apical patency while the other prepared without using it. The amount of apically extruded debris was evaluated using electric microbalance. The result showed that the tested NiTi systems extruded apically more debris than the StSt file. The incorporation of apical patency in enlargement of root canal resulted in increase of the amount of extruded debris in all groups.

[Manar Mohamed Galal Hamouda, Hossam Mohamed Essam El-Din Tawfik, Ahmed Fawzy Abou Elezz, Dalia Yehia Ibrahim. **Effect of apical patency apically extruded debris during canal enlargement using hand or rotary instruments.** Journal of American Science 2011; 7(9):33-37]. (ISSN: 1545-1003). http://www.americanscience.org

Keyword: apical patency apically extruded debris during canal enlargement using hand or rotary instruments.

Introduction

During root canal preparation, dentin chips produced by instrumentation and fragments of apical pulp tissue tend to be compacted into the foramen, which may cause apical blockage and interfere with the working length. The repeated penetration of the apical foramen with a file of adequate size during instrumentation prevents the accumulation of debris in this area leaving the foramen unblocked (patent) which has been defined as apical patency.

Evidence indicates that almost all instrumentation techniques promote apical extrusion of debris to some degree. However the amount of debris extruded apically might vary according to the technique used. Engine-driven rotary instruments are suggested to produce less debris than hand filing techniques since they have a tendency to pull the debris into the flutes of the instrument, thus leading them out of the root canal in a coronal direction. Thus the direct relationship between apical patency and extrusion of debris needs to be clarified.

Materials and Methods

1-Selection of the samples: A total of sixty freshly extracted human permanent mandibular molars were collected to be used in this study. The selected teeth were cleaned from hard deposits and were kept in 2.5% sodium hypochlorite for one hour to remove any soft tissue and organic debris. Teeth were then stored in 0.9% normal saline till the time of use. The selected teeth were chosen to have mature apices without any noticeable defects or abnormal morphology and the angles of curvature of the mesial root canals ranged from 17-35 degrees according to Schneider [(1)] technique.

2-Classification and preparation of the samples: A total of 60 teeth were classified into three groups according to the type of instrument used:

Group I : instrumented using Protaper (20 teeth)
Group П: instrumented using Heroshaper (20 teeth)
GroupIII: instrumented using RT file (20 teeth).

Each group was further subdivided into two subgroups: **Subgroup (1):** was prepared without apical patency (10 teeth), and **Subgroup (2):** was prepared with apical patency using patency file between each instrument (10 teeth).

The teeth were decoronated at the cemento-enamel junction by a high-speed hand piece under water coolant using tapered fissure bur. The distal root of each tooth was resected using tapered fissure stone under water-cooling. Tooth lengths were determined by introducing K-file size 15 into the canal till the tip of the file immediately appeared from the apical foramen. The working length was then calculated by subtraction of one mm from the tooth length. Each root was stored in a coded polyethylene tube containing normal saline.

3-Cleaning and shaping: Before the initiation of root canal instrumentation, each sample was fixed from the apical end through the removable top of a polyethylene tube. A syringe needle was inserted in the tube's top next to the fixed root to equalize the external and internal pressures (fig.1). This tube acted as collector for the debris and irrigant produced during instrumentation. Each tube was weighed before instrumentation using a microbalance (Sartorius Analytical, Gottingen, Germany) (W_1). The values were recorded in terms of gram fractions. The top with the attached root was positioned on the preweighed tube so that the root was suspended within the tube.

Fig. (1): A photograph showing the collecting apparatus

Group 1: Canals prepared by Protaper rotary files: Canals were prepared by the Protaper rotary NiTi systems according to manufacturer's recommendation adopting the crown down approach at a speed of 250 r.p.m as follows:

Subgroup 1: S1 was used until three fourths of the working length. Instrumentation was carried out with SX until the point of resistance and coronal irregularities were removed. Shaping was accomplished with S1 at the working length and with S2 in a brushing motion. The apical preparation was performed with the use of F1, F2, and F3 files successively to the full working length in non-brushing manner. The files were cleaned periodically with a brush to prevent clogging of flutes. Irrigation was done using 2 ml of distilled water after each instrument.

Subgroup 2: Canal preparation was performed with the same sequence as subgroup (1). Apical patency was done between each two successive files using K-file # 10.

Group ∏: Canals prepared using HeroShaper rotary files: Canals were prepared by the HeroShaper rotary NiTi systems according to manufacturer's recommendation adopting the crown down approach at a speed of 300 r.p.m and adjustable torque, the following sequence was used:

Subgroup 1: A #25 file with 0.06 taper was initially introduced in two thirds of the working length. Shaping was completed with a #25 file with 0.04 taper then #30 with 0.04 taper at the working length. Irrigation was done using 2 ml of distilled water after each instrument.

Subgroup 2: Canal preparation was performed with the same sequence as subgroup (1). Apical patency was done between each two successive files using K-file # 10.

Group III: Canal prepared using RT hand file: The root canals of this group were prepared with RT file in crown down technique. Gates glidden drills were used then RT files were used in crown down technique to the apex in a sequential way.

Subgroup 1: Gates glidden number 3 and 2 were used respectively with low speed handpiece to flare the coronal 2/3 of the canal in an in and out motion. RT stainless steel hand files no. 15, 20, 25, 30 were introduced to the WL for enlarging the apical third of the canal using watch winding motion. Irrigation was done after the use of each file using 2ml of distilled water.

Subgroup 2: Canal preparation was performed with the same sequence as subgroup (1). Apical patency was done between each two successive files using K-file # 10. Irrigation was done after the use of each file using 2ml of distilled water.

4- Measurement of apically extruded debris: Debris extruded, along with the irrigating solution during root canal enlargement, were carefully collected in the polyethylene tubes. The lid of the tubes with the roots attached were separated from the tubes. The collected debris was dehydrated by storing the debris collector tubes upright and allowed to dry at room temperature for 4 weeks [2]. The tubes with the remaining debris were reweighed using the digital microbalance (W_2). The weight of the extruded debris was determined by subtracting the weight of the preweighed empty tubes from the weight of the tubes plus the dried debris ($W_2 - W_1$).

5-Statistical analysis: Collected data were tabulated and subjected to statistical analysis using one way analysis of variance (ANOVA). Data of significant difference between groups were subjected to Duncan's test. To delineate significant difference between subgroups, a Student t-test was done ($P \leq 0.05$).

Results

A) The effect of different systems: (Table 1, fig.2)

i) **Without using apical patency**: When apical patency was not applied, the greatest amount of apically extruded debris was recognized in group I (Protaper) followed by group II (Heroshaper). On the other hand, the lowest amount of apically extruded debris was seen in group III (RT file).

Statistically, the mean values of groups II and III were not significantly different. On the other hand, value of groupI was significantly higher than the other two groups.

ii) **With using apical patency**: When apical patency was applied, the greatest amount of apically extruded debris was recognized in group I (Protaper) followed by group II (Heroshaper). On the other hand, the lowest amount of apically extruded debris was seen in group III (RT file). Statistically, the mean values of the three groups were significantly different.

Table 1: Means in milligrams ± S.D. for the effect of different systems on apically extruded debris among the three tested groups with or without apical patency.

Group	Group I (Protaper)	Group II (Heroshaper)	Group III (RT file)
Mean±S.D. without apical patency.	3.21±1.16 a	1.64± 0.29 b	1.08±1.13 b
Mean±S.D. with apical patency.	4.01 ± 0.98 a	2.03 ± 0.32 b	1.24 ± 0.12 c

- Values with different letters are statistically significant.

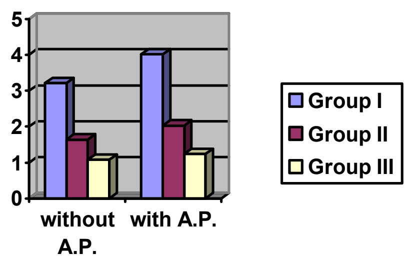

Fig.(2): Histogram showing the mean difference of apically extruded debris for all groups with or without apical patency..

B) The effect of apical patency : (Table 2, fig.3)

1) Group I (ProTaper): The amount of apically extruded debris among samples enlarged by Protaper system (group I) showed that apical patency caused more extrusion of debris. However, this difference was not statistically significant

2) Group II (HeroShaper): The amount of apically extruded debris among samples enlarged by Heroshaper system (group II) showed that apical patency caused more extrusion of debris. This difference was statistically significant**.**

3) Group III (RT file): _The amount of apically extruded debris among samples enlarged by RT file (group III) showed that apical patency caused more extrusion of debris. However, this difference was not statistically significant**.**

Table 2: Mean in milligrams ± S.D. for difference in the amount of apically extruded debris of samples of all groups with or without apical patency.

Groups Mean± S.D	Without apical patency	With apical patency	Sig.
GroupI	3.21 ± 1.17	4.02 ± 9.9	N.S.
GroupII	1.64 ± 0.29	2.03 ± 0.32	S.
Group III	1.08 ± 0.16	1.24 ± 0.12357	N.S.

- NS means not significant.
- S means significant.

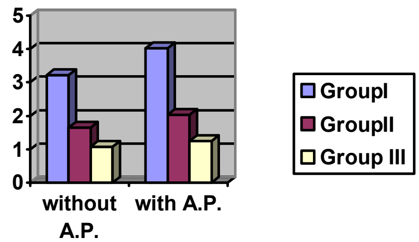

Fig.(3): Histogram showing the mean difference of apically extruded debris in all groups with and without apical patency.

Discussion

During root canal enlargement, cutting debris and remnants of pulpal tissue collect at the apical terminus of the root canal. This accumulated debris causes canal blockage thus jeopardizing the cleaning procedure. In presence of canal curvature, blockage could be a start point for ledging which can further complicate the case by canal perforation. Establishment of apical foramen patency have been advocated by some clinicians [3-6] in an attempt to prevent apical blockage. This step during canal enlargement was not approved by other clinicians [7, 8]. This second group assume that apical patency will be associated by an increase in post operative pain and delayed healing due to increasing the amount of apically extruded debris which can directly affect the development of post treatment apical periodontitis. Nevertheless, extrusion of enlarging tools beyond the apical foramen could mechanically irritate the periapical tissues. Should the establishment of apical patency during canal enlargement affect the degree of canal transportation appears to be a matter of debate that our study aimed to clarify. Furthermore, its effect on the amount of apically extruded debris was another target in the present investigation. The samples selected for the present study were mandibular human extracted molars with moderate to sever curvature as determined by

Schneider method [1]. This degree of curvature appeared to be appropriate as most of the curved molars falls within this range.

During root canal instrumentation, irrigation was carried out using distilled water which is not considered an appropriate irrigant during root canal enlargement. Sodium hypochlorite being the most popular irrigant was used in a pilot study before initiating the present investigation, however, it affected the accuracy of measurement of the apically extruded debris. This was in agreement with Mayers and Montogomery [9], Beeson et al [10], Hinrichs et al [11], Bidar et al [12], Zarrabi et al [13]. Vande Visse and Brilliant [14], Mckendry [15] and Haung et al [16] who used NaOCl as irrigating solution, found that dryness of the irrigant resulted in salt crystals which cannot be separated from the cutting debris. Thus in the present study we replaced the NaOCl with distilled water to avoid such discrepancy in data collection.

The amount of apically extruded debris among the tested tools either in the presence or absence of apical patency was evaluated by weighing the amount of debris using microbalance. This method was employed by other studies for its accuracy and reliability [9, 2, 10, 17, 18, 16, 19]. Other studies used different technique in which filter systems were the collecting apparatus for the extruded debris [20, 15, 21].

The amount of extruded debris varied among the three tested groups. The RT stainless steel files extruded the least amount of debris as compared to the two rotary systems. As much as it appears to be unexpected result, yet, if a tool causes the least amount of transportation, one would expect a minimum degree of cutting and subsequently the least amount of debris is expected to extrude. This was in agreement with Hayes et al [22] who found that instrumentation with RT file decreased the incidence of canal blockage, which might be due to its cutting edges that are set at a large angle thus promote the debris removal.

When comparing the two rotary systems, the Heroshaper was better than Protaper. This may be due to the flutes design of the Protaper which remove a substantial amount of dentin in a shorter period of time which is unable to coronally displace it with the same efficiency as it cuts, thus increases the risk of debris extrusion apically. This was in agreement with Tanalap et al [18] and Logani and Shah [23]. However, on the opposite Nazari and MirMotalebi [24] found that the least amount of extruded debris was associated with Protaper system in comparison with stainless steel K-file and NiTi FlexMaster file.

The incorporation of apical patency in the enlargement procedure did affect the amount of extruded debris where apical patency caused in more debris extrusion. This may be due to formation of apical dentin plug when apical patency was not used, thus decreasing the amount of extruded material. This was seen in the three tested tools, however, it was significant with group II (Heroshaper). This was in agreement with Mayer and Monogomery [9], Beeson et al [10] and Tinaz et al [25]. While, It was in disagreement with Buchanan [5] and Lambrianidis et al [26], who found that using patency file before irrigation displace settled apical debris back into the irrigating solution where it could be flushed out easily thus decreasing apical extrusion of debris.

The superior cleaning abilities of the RT stainless steel files tested in the present study opens the door for further testing of this tool in comparison to other rotary systems.

References

1. Schneider SW: A comparison of canal preparations in straight and curved root canals. Oral Surg 1971; 32:271-5.
2. Al-Omari MAO, and Dummer PMH: Canal blockage and debris extrusion with eight preparation techniques. J Endodon 1995; 21:154-8.
3. Hasheminia SH, and Shafiee M: The effect of using patency file on apical transportation in canals prepared with passive step back technique. Journal of Research in Medical Sciences 2004; 5:12-17.
4. Souza RA: The importance of apical patency and cleaning of the apical foramen on root canal preparation. Braz Dent J 2006; 17:1-9.
5. Buchanan LS. Management of curved root canal. J Calif Dent Assoc. 1989; 17:19-27.
6. Flanders D: Endodontic Patency, How to get it, How to keep it, Why it is so important. NYSDJ 2002; 30-32.
7. Holland R, Annajunior AS, Souza V, Junior ED, Bernabe PF, and Murata SS: Influence of apical patency and filling material on healing process of dogs'teeth with vital pulp after root canal therapy. Braz Dent J 2005; 16:9-16.
8. Naidorf IJ: Endodontic flare-ups, bacteriological and immunological mechanisms. J Endodon 1985; 11: 462-4.
9. Myers GL, and Montgomery S: A comparison of weight of debris extruded apically by conventional filling and canal master techniques. J Endodon 1991; 17:275-9.
10. Beeson T, Hartwell G, Thornton J, and Gunsolley JP: Comparison of debris extruded apically in straight canals, conventional filing versus Profile .04 Taper series 29. J Endodon 1998; 24:18-22.
11. Hinrichs RE, Walker WA, and Schindler WG: Compared the amount of apically extruded debris using handpiece driven nickel titanium

instruments systems. J Endodon 1998; 24:102-6.
12. Bidar M, Rastegar AF, Ghaziani P, and Namazikhah MS: Evaluation of apically extruded debris in conventional and rotary instrumentation techniques. J Calif Dent Assoc 2004; 32:665-71.
13. Zarrabi MH, Bidar M, and Jafarzadeh H: An in vitro study of apical extruded debris resulting from conventional and three rotary (Profile, Race, Flex Master) instrumentation techniques. Oral Science J 2006; 48:85-88.
14. VandeVisse JE, and Brilliant JD: Effect of irrigation on the production of extruded material at root apex during instrumentation. J Endod 1975; 1:243-6.
15. McKendry DJ: Comparison of balanced forces, endosonic, and step-back filing instrumentation techniques, quantification of extruded apical debris. J Endodon 1990; 16:24-7.
16. Huang X, Ling J, Wei X, and Gu L: Quantitative evaluation of debris Extruded apically by using ProTaper universal Tulsa rotary system in Endodontic retreatment. J Endodon 2007; 33:702-705.
17. Ferraz CC, Gomes BP, Zaia AA, Teixeira FB, and Souza-Filho FJ: Apical extrusion of debris and irrigant using two hand and three engine-driven instrumentation Techniques. Int Endod J 2001; 34:354-8.
18. Tanalp J, Kaptan F, Sert S, Kayahan B, and Bayirl G: Quantitative evaluation of the amount of apically extruded debris using 3 different rotary instrumentation systems. Oral Surg Oral Med Oral Radiol Endod 2006; 101:252-9.
19. El-msallati EA, Wadachi R, and Suda H: Extrusion of debris after use of rotary nickel-titanium files with different pitch, A pilot study. Australian Endod J 2009; 35:65-69.
20. Ruiz-Hubard EE, Gutmann JL, and Wagner MJ: A quantitative assessment of canal debris forced periapically during root canal instrumentation using two different techniques. J Endodon 1987; 13:554-8.
21. Reddy SA, and Hicks ML: Apical extrusion of debris using two hand and two rotary Instrumentation techniques. J Endodon 1998; 24:180-3.
22. Hayes SJ, Griffiths IT, Bryant ST, and Dummer PMH: Comparison of the shaping characteristics of stainless steel files with triangular or rectangular cross-sections. Int Endod J 2002; 35:492-494.
23. Logani A, and Shah N: Apically extruded debris with three contemporary NiTi instrumentation systems. Indian J Dent Res 2008; 19:182-185.
24. Nazari S, and MirMotalebi F: A comparative study on the amount of Extruded material from the apical foramen with NiTi rotary and stainless steel Hand instruments. Iranian Endodontic journal 2006; 1:69-72.
25. Tinaz AC, Alacam T, Uzun O, Maden M, and Kayaoglu G: The effect of disruption of apical constriction on periapical extrusion. J Endodon 2005; 31:533-5.
26. Lambrianidis T, Tosounidou E, and Tzoanopoulou M: The effect of maintaining apical patency on periapical extrusion. J Endodon 2001; 27:696-698.

7/27/2011