ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 4 Issue 1 January 2020

Research Article

Assessment of Apically Extruded Debris of Mesial Root of Lower Molar Using Protaper Rotary Files Versus Hyflex and Neolix Rotary Files(A Comparative *Invitro* Study)

Islam Talaat Ezzat Ameen[1]*, Nehal Nabil Roshdy[2] and Manar Yehia Fouda[3]

[1]*Master Degree Student, Endodontic Department, Faculty of Oral and Dental Medicine, Cairo University, Egypt*

[2]*Associate Professor of Endodontics, Endodontic Department, Faculty of Oral and Dental Medicine, Cairo University, Egypt*

[3]*Professor of Endodontics, Endodontic Department, Faculty of Oral and Dental Medicine, Cairo University, Egypt*

***Corresponding Author:** Islam Talaat Ezzat Ameen, Master Degree Student, Endodontic Department, Faculty of Oral and Dental Medicine, Cairo University, Egypt

DOI: 10.31080/ASDS.2020.04.737

Received: November 29, 2019

Published: December 23, 2019

Abstract

As a consequence of root canal preparation, dentinal chips, irrigants and pulp remnants are extruded into preradicular space. This phenomenon may lead to post endodontic flare-ups.

The Objective: Of this study was to compare the amount of extruded debris with three endodontic NiTi enginedriven systems.

Material and Methods: A total number of 63 freshly extracted human molars were selected. Teeth were divided randomly into three equal groups (21 teeth each group) according to type of Ni-Ti rotary file system; (A) Protaper Next, (B) Hyflex CM and (C) Neolix. Standard Access cavity prepared and checked for patency using K file #10 and #15. Root canal instrumentation on mesial root canals done. Root canal instrumentation on mesial root canals done. Debris were collected after mesial root instrumentation in pre-weighed eppendorf tubes. The eppendorf tubes were weighed 2 times on the analytical balance: First weight: Before instrumentation. Second weight: After evaporation of moisture and irrigant and incubation.

Results: Neolix rotary system showed least amount of extruded debris while Hyflex CM rotary system showed highest amount of extruded debris.

Conclusion: All endodontic rotary instruments tested produced apical extrusion of debris.

Keywords: Controlled Memory; Debris Extrusion; Mandibular Molar Teeth; Root Canal Preparation; Rotary Instrumentation; Protaper Next; Neolix Rotary Files; Hyflex CM

Introduction

The main objective of the root canal treatment is thorough debridement and complete shaping of the root canal system. A thorough control of the working length (WL) is necessary to minimize the risk of extrusion of any debris into the periarticular region. Extrusion of any debris during endodontic treatment may potentially cause post-operative complications such as flare-ups and periapical inflammation [1,2].

However, despite strict length control of the endodontic instruments during complete debridement of the root canal system, some amount of debris in the form of dentinal chips,

pulp fragments, necrotic debris, microorganisms, and intracanal irritants is inevitably pushed out from the root canal into the periapical tissues [3].

In an attempt to improve the root canal cleaning and shaping and decrease the amount of extruded debris, there is always a continuous evolution in endodontic instruments and techniques to fulfill these attempts [4,5].

Pro Taper Next (PTN) (Dentsply Maillefer, Ballaigues, Switzerland) is a fifth generation nickel titanium (NiTi) system with an off-centred rectangular cross section. The PTN system is composed of three instruments made of a unique NiTi alloy and M-wire [6]. The design of the instrument provides a snake-like movement as it progresses into the root canal Various studies reported that the flexibility and resistance to cyclic fatigue of the M-wire was superior to that of conventional NiTi alloy, and it retains its cutting efficiency [7].

Two new endodontic systems have been introduced to the market: Hyflex CM files (coltene, Switzerland) and Neolix Files (NEOlix, France). Hy Flex Controlled Memory and Neolix Files are made from a unique thermal process of Ni Ti that controls the material's memory. That unique design features of the CM instruments provided superior flexibility and enable the instruments to maintain the original canal curvature reducing the risk of ledging, transportation or perforation as well as increasing efficiency and safety during instrumentation. However, there is no available data evaluated the influence of these (Hyflex and Neolix) NiTi rotary instruments on the amount of apically extruded debris when used in root canals. The aim of the present study was to Compare and evaluate Hyflex CM files and Neolix files versus Protaper Next files regarding the amount of apically extruded debris in mesial root canals of human permanent mandibular molars.

The null hypothesis was that there would be no significant difference in the amount of extruded debris between Protaper next, Hyflex and Neolix rotary instruments regarding the amount of debris extruded.

Materials and Methods

Based on Kocak., *et al*. (2015) [8] on using power 80% and 5% significance level, 21 sample per group would be sufficient. The sample size was calculated by G power program. Freshly extracted human permanent mandibular molars were collected from the National Institute of Diabetes and Endocrinology after the approval of Ethical Committee of The Faculty of Dentistry, Cairo University. Mandibular molar teeth were extracted due to periodontal and prosthetic reasons. Teeth were cleaned from outer debris with ultrasonic then disinfected by sodium hypochlorite for 30 minutes and stored in saline solution for use. Inclusion criteria were two separate canals in the mesial root with two apical foramina. No root caries. No Internal or external resorption, No root canal calcification, No Pulp stones and No previous root canal treatment.

Procedure steps: External root surfaces were cleaned from adherent tissues and hard deposits using ultrasonic scaling. Pre-operative periapical radiographs of the teeth were taken with parallel and mesial shift to check for number of canals, root caries, root canal calcification or pulp stones. Occlusal surface of the mandibular molars was flattened using TR-12 tapered stone with round end under water coolant. Hemi-sectioning of teeth at the furcation level into mesial and distal roots was done using a low-speed diamond saw under water Isomet 1000.

Access cavity was prepared on the extracted mandibular molars using #BR-41 diamond round bur and Endo-Z bur in a high-speed handpiece under water spray cooling. Root canals were checked for patency to exclude teeth with root canal calcification or pulp stones. The working length (WL) was determined by passing K-file size #10 through the major foramen and then withdrawing it for 1 mm. Only apically extruded debris in the separated mesial root canals of the mandibular molars were evaluated.

Samples grouping

63 mesial root canals were randomly and equally divided into three groups

Group I ProTaper next (n=21): Mesial root canals were prepared using ProTaper Next in ProTaper mode with the sequence SX (Size 19, 0.04 taper) to 1/2 of the working length at 300 rpm with a torque of 3-4 Ncm. X1 (Size 17, 0.04 taper) and X2 (Size 25, 0.06 taper) to the full working length. All the Protaper Next instruments were used at 300 rpm with a torque of 4-5.2 Ncm using X-Smart Plus motor (Dentsply Maillefer, Baillagues, Switzerland).

Group II Neolix (n=21): Mesial root canals were prepared using Neolix (according to manufacturing instructions) with speed

300-500 rpm and torque 1.5 N.cm. Starting with neoniti C1 in the coronal third C1 (Size 25, 0.012 taper) as orifice opener in the coronal third to a maximum depth of 3 mm using a gentle back and forth motion and A1 (Size 25,0.06) to full working length.

Group III Hyflex (n = 21): Mesial root canals were prepared using HyFlex CM. HyFlex instruments were used at speed 500 rpm with torque 2.5 Ncm with sequence file (Size 25 - 0,08) as orifice opener, file (Size 20 - 0,04) and file (Size 25 - 0,06) for full working length.

All the root canals were irrigated after each file with 1mL of distilled water using 27-gauge Plastic Syringe inserted 2 mm short of the working length. All root canals were irrigated with 1 mL of distilled water as a final rinse.

Method of evaluation

A modified version of the experimental model described by Myers and Montgomery [9] was used to evaluate apically extruded debris. Empty Eppendorf tubes were numbered and weighed using an analytical balance three times and average weight was calculated (W1). Then, a hot instrument was used to create a hole in the stopper of the Eppendorf tubes. External root surface was covered with two layers of nail polish except for 1 mm around the apical foramen. Mesial root was inserted into these holes under pressure and a 27-gauge bent needle was inserted alongside the stopper to balance the air pressure. The whole apparatus was then assembled into a glass vial and the vial was covered with aluminum foil. After instrumentation and irrigation, separated stopper with the mesial root were removed from the pre-weighed Eppendorff tube, the external root surface was flushed with 1 mL distilled water to collect debris adhering to external root surface. The apically extruded debris collected in the pre-weighed Eppendorf tubes were weighed again (W2) after instrumentation and evaporation of moisture and irritant. The amount of apically extruded debris was determined by subtracting the average weight of the pre-weighed Eppendorf tubes from the average weight of Eppendorf tubes containing the dried debris obtained from three consecutive measurements (W2 - W1). All measurements were done using analytical balance (sartorius). Statistical analysis : data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 25. Data was summarized using mean, standard deviation, median, minimum and maximum. Data was explored for normality using Kolmogrov Smirnov test and Shapiro-Wilk test. Comparisons between quantitative variables were done using the non-parametric Kruskal-Wallis and Mann-Whitney tests (Chan, 2003a) [10]. P-values less than 0.05 were considered as statistically significant.

Results

Comparison of weight of debris between groups

On comparing Group, A (Pro Taper Next system) and Group B (Neolix system), there was statical significant difference between the two groups p value (< 0.001). On comparing Group A (ProTaper Next system) and Group C (Hyflex system), there was no statical significant difference between the two groups, p value (1.000). On comparing Group B (Neolix system) and Group C(Hyflex system), there was statical significant difference between the two groups. p value (0.001).

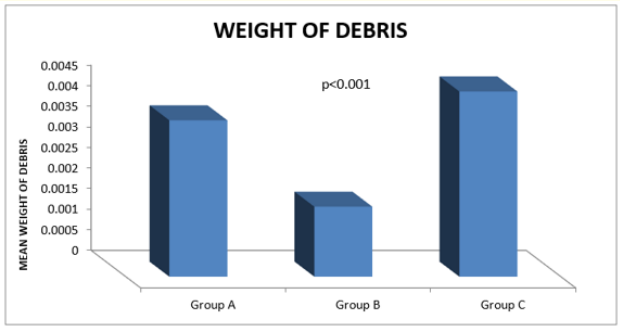

Figure 1: Bar chart presenting the mean values for apically extruded debris after Instrumentation with the three selected NiTi systems.

Discussion

The aim of the present study was to compare and evaluate Hyflex CM files and Neolix files versus Pro Taper Next files regarding the amount of apically extruded debris of mesial root canals of permanent mandibular molars. where, the practitioners encounter a common problem during root canal treatment which is the debris extrusion to the peri-radicular region created during the instrumentation of the root canal system, resulting in inter treatment flare-up and a persistent periapical inflammation [11].

The results of this study showed that Neolix rotary files extruded less debris than Pro Taper Next and Hyflex rotary files. This was in accordance to Capar., *et al.* [12] in 2014 and Shah., *et*

al. [13] in 2016. Which, could be due to that the files with short pitch design extruded less debris than the medium and long ones. Additional study by Singbal., *et al*. [14] in 2017 demonstrated that the constant helical angle allow debris to accumulate and varying the helical angle enhance removal of debris more efficiently. Neolix Ni-Ti files have a variable helical angle of 16 º to 28º so, Neolix files lead to less apically extruded debris.

The exact mechanism of the better performance of the Neolix group in relation to the Protaper Next could be attributed to the following factors: First; Since, the Neolix file is a single rotary system, it is assumed that it extrudes less debris than multiple file system like Protaper Next. In agreement is Mittal., *et al*. (2015) [15] who concluded that apical bacterial extrusion was significantly greater in multi-file compared to single-file rotary systems. Second; Neolix file is a control memory file system (CM wire) with less cutting efficiency than that with Protaper Next shape memory file system (M wire) which results in less debris collected in the apical area with less possibility of debris extrusion during preparation [13,16,17]. Third; The Neolix file has less tendency for canal transportation due to its control memory behavior. This could be explained by the fact that the shape memory files as Protaper Next tend to return to its original posture (straight) regardless the shape of the canal causing undue removal of dentin of the apical area with much debris extrusion [18]. Fourth; Although both the Neolix and Protaper Next files are similar in cross section geometery (non-homothetic rectangular) but they are different in the other design features (pitch length, helical angle, taper design). Those features may also be one of the critical reasons that can contribute to debris extrusion. This finding is in agreement with Diemer., *et al*. (2004) [19] who compared the effect of pitch length and stated that the increasing variable pitch decreases the tendency to screw in and also reduces the helical angle which in turn reduces the apical extrusion, Also Koch., *et al*. (2002) [20] stated that files with constant helical angle allow debris to accumulate and varying the helical angle enhances removal of debris more efficiently. The Neolix Ni Ti file possesses a variable helical angle of 28° to 16° from tip to rear reducing the screwing in effect. Finally, the surface treatment of the two files may have an indirect influence on the debris extrusion. The Neolix file is surface treated by Electro Discharge Machining (EDM) increasing the flexibility of the file. [14] The Protaper Next files cause more vibration during preparation that may have an adverse reaction on the periodontal ligament space which may cause postoperative pain. In agreement with Arslan., *et al*. (2014) [17]. and Ashraf., *et al*. (2015) [19]. who showed more number of dentinal cracks at apical foramen by Protaper Next when compared to HyFlex (CM wire) at apical foramen.

One the other hand, Hyflex files produced less debris extrusion as, unwinding the spirals of HyFlex rotary system occurs during instrumentation. This phenomenon may lead to decrease in the cutting ability and cleaning efficiency of instrument. As a result, production of dentainal chips and debris were decreased and less extrusion of debris happened as explained by Kocak *et al*. [22] in 2016 and Labbaf [23] in 2017. Contradicted with Surakanti (2014) [24] Nevares(2015) [25] and Ehsani (2016) [14] due to different incubation period, a different type of irrigant solution and the use of different teeth. Surakanti., et al. in 2014 [24] who stated that may be due to different incubation period that the all eppendorf tubes were incubated at 37ºC for 15 days intead of 68ºC for 5 days use in the present study. Also, Nevares., *et al*. in 2015 [25], who stated that it may be because he use a different type of irrigant solution (NaOCl) which has a different effect that may cause difference the results due to sodium crystallization phenomenon. Another reason for contradiction with Ehsani., *et al*. in 2016 [14] may be due to the use of different teeth, mandibular premolars instead of Mandibular 1st molars used in the present study Furthermore, the amount of debris in terms of weight is not adequate enough to make a speculation concerning the severity of the periapical response, as there may be other factors that trigger this reaction, such as the virulence of bacteria and host response. On the other hand, these types of studies may be helpful in the sense that they can give the practitioner an idea about the possibility of extrusion with each specific instrument.

The null hypothesis (there was no difference regarding the apical debris extrusion among different types of Ni-Ti rotary file systems) was rejected as the results of this study showed that, there was significant differences between the different Ni-Ti rotary file systems on the amount of apical extruded debris.

Conclusions

Within the limitation of this study it was concluded that all systems were associated with extrusion of debris. However, Hyflex files extruded more debris than other systems. While, Neolix files extruded less debris than the other systems. Also, the concept of crown-down technique is followed better in single-file systems than multiple sequence systems.

Bibliography

1. Leonardi LE., *et al.* "Apical extrusion of debris by manual and mechanical instrumentation". *Brazilian Dental Journal* 18 (2007): 16-19.

2. Gupta R., *et al.* "A new approach to single file endodontics: Neoniti rotary file system". *International Journal Advances in Case Reports* 2.16 (2015): 1030-1032.

3. Haapasalo M and Ya S. "Evolution of nickel-titanium instruments: from past to future". *Endodontic Topics* 29.1 (2013): 3-17.

4. Çiçek E., *et al.* "Comparison of apically extruded debris associated with several nickel-titanium systems after determining working length by apex locator". *Journal of Conservative Dentistry* 19.1 (2016): 68.

5. Uygun A., *et al.* "Variations in cyclic fatigue resistance among Pro Taper Gold, Pro Taper Next and Pro Taper Universal instruments at different levels". *International Endodontic Journal* (2015): 1-6.

6. Elnaghy AM and Elsaka SE. "Mechanical properties of ProTaper Gold nickel-titanium rotary instruments". *International Endodontic Journal* (2015): 1-6.

7. Ya Shen., *et al.* "Current Challenges and Concepts of the Thermomechanical Treatment of Nickel-Titanium Instruments". *Journal of Endodontics* 39.2 (2013): 163-172.

8. Kocak M., *et al.* "Apical extrusion of debris using ProTaper Universal and ProTaper Next rotary systems". *International Endodontic Journal* 48.3 (2015): 283-286.

9. Myers G and Montgomery S. "A comparison of weights of debris extruded apically by conventional filing and Canal Master techniques". *Journal of Endodontics* 17 (1991): 275-279.

10. Chan Y. "Biostatistics 102: quantitative data-parametric and non-parametric tests". *Blood Pressure* 140.24-08 (2003): 79-80.

11. Iqbal M., *et al.* "Incidence and factors related to flare ups in a graduate endodontic programme". *International Endodontic Journal* 42.2 (2009): 99-104.

12. Capar I., *et al.* "An In Vitro Comparison of Apically Extruded Debris and Instrumentation Times with Pro Taper Universal, Pro Taper Next, Twisted File Adaptive, and Hy Flex". *Instruments Endodontic Journal* 40.10 (2014): 1638-1641.

13. Shah S., *et al.* "Apical extrusion of debris and irrigant using neolix and one-shape rotary systems: a comparative study". *International Journal of Recent Scientific Research* 7.5 (2016): 11325-11327.

14. Ehsani M., *et al.* "Comparison of Apical Extrusion of Debris by Using Single-File, Full-Sequence Rotary and Reciprocating Systems". *Journal of Dentistry (Tehran, Iran)* 13.6 (2016): 394.

15. Mittal R., *et al.* "A comparison of apical bacterial extrusion in manual, ProTaper rotary, and one shape rotary instrumentation techniques". *Journal of Endodontics* 41.12 (2015): 2040-2044.

16. Türker S.A., *et al.* "Evaluation of apically extruded bacteria associated with different nickel-titanium systems". *Journal of Endodontics* 41.6 (2015): 953-955.

17. Arslan H., *et al.* "Effect of protaper universal, endoflare, revo-S, hyflex coronal flaring instruments, and gates glidden drills on crack formation". *Journal of Endodontics* 40.10 (2014): 1681-1683.

18. Ashraf F., *et al.* "Stereomicroscopic Evaluation of Dentinal Cracks at Different Instrumentation Lengths by Using Different Rotary Files (ProTaper Universal, ProTaper Next, and HyFlex CM): An Ex Vivo Study". *Scientifica (Cairo)* (2016): 7.

19. Diemer F and Calas P. "Effect of pitch length on the behavior of rotary triple helix root canal instruments". *Journal Endodontics* 30 (2004): 716-718.

20. Koch K and Brave D. "Real world Endo: Design features of rotary files and how they affect clinical performance". *Oral Health* 92 (2002): 39-49.

21. Guo Y., *et al.* "Process Capability of Wire-EDM of NiTi Shape Memory Alloy at Main Cut and Trim Cut Modes". *CIRP Annals Manufacturing Technology* 62 (2013): 83.

22. Koçak M., *et al.* "Comparison of ProTaper Next and HyFlex instruments on apical debris extrusion in curved canals". *International Endodontic Journal* 49.10 (2016): 996-1000.

23. Labbaf H., *et al.* "An In vitro Comparison of Apically Extruded Debris Using Reciproc, ProTaper Universal, Neolix and Hyflex in Curved Canals". *Iranian Endodontic Journal* 12.3 (2017): 307.

24. Surakanti J., *et al.* "Comparative evaluation of apically extruded debris during root canal preparation using ProTaper™, Hyflex™ and Waveone™ rotary systems". *Journal of Conservative Dentistry* 17.2 (2014): 129.

25. Nevares G., *et al.* "Evaluation of Apically Extruded Debris during Root Canal Retreatment Using ProTaper Next and Reciproc in Severely Curved Canals". *Iranian Endodontic Journal* 12.3 (2017): 323.