ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 5, Issue – 2, March - 2022, Page No. : 501 - 507

Comparative evaluation of apically extruded debris using various file systems during root canal instrumentation

[1]Dr. Jisha Elizabeth, Post Graduate Student, M.R Ambedkar Dental College Hospital, Cline Road, Cooke Town, Bengaluru.

[2]Dr.Ananthakrishna. S, Professor and Head, M.R Ambedkar Dental College Hospital, Cline Road, Cooke Town, Bengaluru.

[3]Dr. Pradeep P. R., Professor, M.R Ambedkar Dental College Hospital, Cline Road, Cooke Town, Bengaluru.

[4]Dr.Farheen Farook, Post Graduate Student, M.R Ambedkar Dental College Hospital, Cline Road, Cooke Town, Bengaluru.

Corresponding Author: Dr. Jisha Elizabeth, Post Graduate Student, M.R Ambedkar Dental College Hospital, Cline Road, Cooke Town, Bengaluru.

Citation of this Article: Dr. Jisha Elizabeth, Dr. Ananthakrishna. S, Dr. Pradeep P. R., Dr. Farheen Farook, "Comparative evaluation of apically extruded debris using various file systems during root canal instrumentation", IJDSIR- March - 2022, Vol. – 5, Issue - 2, P. No. 501 - 507.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background and objectives: The study aimed to compare the apically extruded debris using various file systems during the root canal instrumentation.

Materials and method: Forty-five single rooted teeth were selected and randomly divided into three groups (n=15) according to instrumentation system used Group 1: Hy Flex EDM files, Group 2: Race files, Group 3: Protaper Universal files. The endodontic access cavity was prepared, canal orifices was located and confirmed with a 10 K-file. The working length was determined using a 20 K-file. Then the canals were prepared sequentially using various file systems. During instrumentation, intermittent irrigation with distilled water was done. The extruded debris along with irrigated solutions during instrumentation at apical area was collected into preweighed Eppendorf tubes. The tubes were then stored in the incubator at 70˚C for 5 days for the evaporation of distilled water. The difference of weight of dry extruded debris between PR instrumentation and post instrumentation was calculated using a microbalance. The data collected was analyzed using a Kruskal Wallis test.

Result: The test results demonstrate that the mean Apical Debris Extruded in Hy Flex EDM group was 0.080 ± 0.045, for Race group was 0.025 ± 0.015 and in Protaper Universal group, it was 0.044 ± 0.014. This mean difference in the Apical Debris Extruded between 3 groups was statistically significant at P<0.001

Interpretation and conclusion: Within the limitations of the study, it could be concluded that the Hy Flex EDM files extruded maximum amount of apical debris than the other two file systems used in this study.

Keywords: Apical extruded debris, Eppendorf tubes, Hy Flex EDM, Protaper Universal, Race

Introduction

The aims of endodontic instrumentation include debridement and disinfection of the root canal system in addition to creating an appropriate shape to achieve a complete 3D obturation.

During root canal preparation, pulp tissue, dentine chips, irrigants, and microorganisms may be extruded beyond the apical foramen.

Apically extruded materials may cause undesired consequences such as flare-ups, periapical inflammation, postoperative pain, and delay of periapical healing.

Recently, several new instrumentation techniques that enable the use of a single nickel-titanium (NiTi) file with different designs, alloy treatments and kinematics for the preparation of root canals have been introduced such as Protaper Universal, Protaper Next, Hy flex CM, Hy flex EDM, Race file system, One shape file system, Hero shaper file system, etc.

In the present study, Hy flex EDM file, Race file and Protaper Universal files were used. These files were selected because of the ease of availability and to compare the amount of apically extruded debris between each group.

Therefore, the purpose of the study was to assess the amount of apically extruded debris using various file systems during root canal instrumentation.

Materials and methods

Forty -five extracted human single rooted teeth with mature apices, single canals, and of similar lengths were selected for this study.

The teeth were kept in 5.25% sodium hypochlorite for 2 hr to clean the periodontal tissue remnants on the root surface.

The root surfaces were further scaled with a periodontal curette.

Teeth were selected and randomly divided into three groups (n=15) according to instrumentation system used

Group 1: Hy flex EDM files,

Group 2: Race files,

Group 3: Protaper Universal files

Debris collection

Weight of the Eppendorf tube was determined using a microbalance with an accuracy of 10^{-5} g

Each tube was weighed three times, and the mean value was recorded.

A hole was created in the cap and a 27-G needle was then placed alongside the cap to balance the air pressure inside and outside.

Each tooth was inserted up to the cementoenamel junction.

Then, each cap with the tooth and the needle was attached to an Eppendorf tube, and the tubes were fitted into vials.

The entire Eppendorf tube was handled only by the vial. The Eppendorf tube was never handled with bare fingers.

Root canal instrumentation

Standard access cavities were made using round diamond burs with a highspeed handpiece and air water spray cooling.

Apical patency of all root canals was confirmed with a size 10 K-file.

The working length (WL) was determined using a size 15 K-file. The WL was set 1 mm short of the apex.

To standardize root canal preparation and the amount of irrigating solution used for each sample, these steps were

repeated 5 times until the working length was reached and a total of 20 mL distilled water irrigating solution was used.

For the irrigation of each sample, a 30-G closed-ended side-perforated irrigation needle was used to the point reached by the instrument during the preparation.

Evaluation of apically extruded material

After the root canal preparation was complete, the stopper, needle, and the tooth were separated from the Eppendorf tube.

The debris adherent to the external root surface was collected by washing the root with 1 mL distilled water in the tube.

The tubes were then stored in an incubator at 70°C for 5 days to evaporate the distilled water.

All tubes were weighed three times using the same balance to calculate the mean.

The amount of extruded debris was calculated by subtracting the original weight of the empty Eppendorf tube from the gross weight.

Statistical analysis

Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp., will be used to perform statistical analyses.

Kruskal Wallis test followed by Mann Whitney's post hoc analysis was used to compare the mean Apical Debris Extruded between 3 study groups.

The level of significance was set at P<0.05.

Result

Table 1: Table showing apically extruded debris by each sample in each group

Sn.	Hy flex edm	Race	Protaper universal
1.	0.06	0.06	0.04
2.	0.08	0.05	0.06
3.	0.05	0.02	0.03
4.	0.04	0.02	0.02
5.	0.05	0.01	0.05
6.	0.03	0.02	0.05
7.	0.10	0.03	0.06
8.	0.08	0.04	0.05
9.	0.06	0.02	0.05
10.	0.18	0.01	0.04
11.	0.06	0.02	0.06
12.	0.05	0.01	0.03
13.	0.08	0.02	0.04
14.	0.10	0.02	0.02
15.	0.18	0.03	0.06

Table 2: Table illustrates the comparison of mean Apical Debris Extruded between 3 groups.

Comparison of mean apical debris extruded between 3 study groups using krushal Wallis test						
Groups	N	Mean	SD	Min	Max	P-Value
Hy flex EDM	15	0.080	0.045	0.03	0.18	<0.001*
Race	15	0.025	0.015	0.01	0.06	
Protaper Universal	15	0.044	0.014	0.02	0.06	

The test results demonstrate that the mean Apical Debris Extruded in Hy flex EDM group was 0.080 ± 0.045, for Race group was 0.025 ± 0.015 and in Protaper Universal group, it was 0.044 ± 0.014. This mean difference in the Apical Debris Extruded between 3 groups was statistically significant at P<0.001

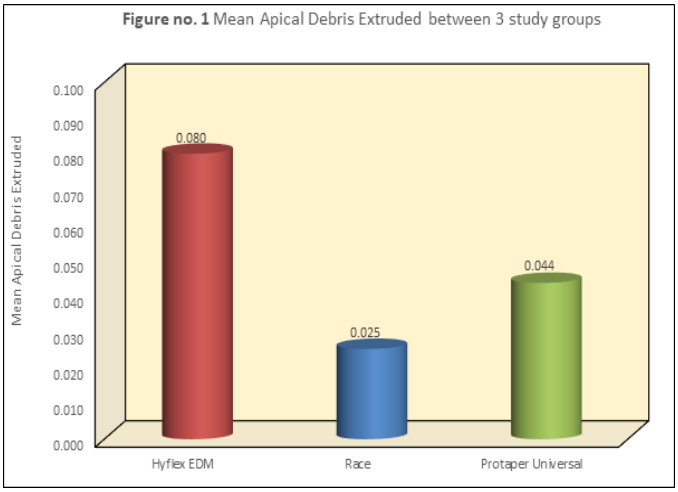


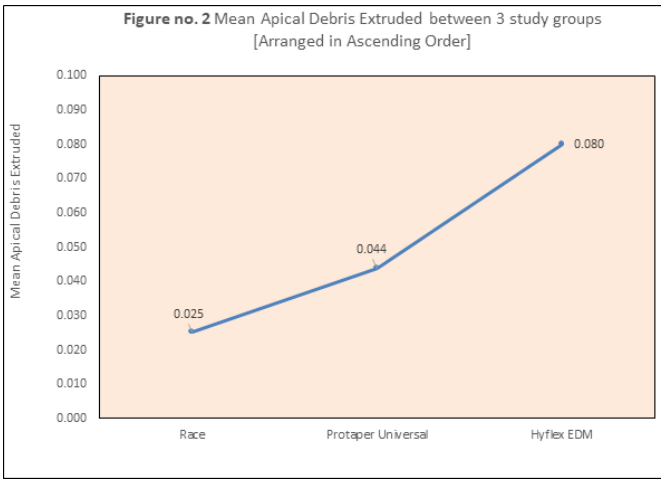
Table 3: table illustrates the multiple comparisons of mean differences in Apical Debris Extruded between 3 groups.

Multiple comparison of mean difference in apical debris extruded between groups using Mann Whitney post hoc test					
(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		P-Value
			Lower	Upper	
Hy flex EDM	Race	0.0547	0.0292	0.0802	<0.001*
	Protaper Universal	0.0362	0.0107	0.0617	0.005*
Race	Protaper Universal	-0.0185	-0.0440	0.0070	0.004*

The test results showed that Race group showed significantly least Apical Debris Extruded as compared to Protaper Universal and Hy flex EDM group at P=0.004 & P<0.001 respectively.

This was then followed next by Protaper Universal group showing significantly lesser mean value as compared to Hy flex EDM group at P=0.005.

This infers that Race group showed a significantly least mean Apical Debris Extruded, followed by Protaper Universal and highest in Hy flex EDM group.



Discussion

The pain and swelling after root canal treatment are often associated with the preparation procedures such as inflammatory reaction against the intracanal contents forced through the periapical region (dentine particles, necrotic pulp tissue, or microorganisms), irrigation solutions and foreign body reactions to filling materials.

Extrusion of intracanal debris and irrigants is common during root canal preparation and no technique or instrument has completely solved this problem.

There has been a rapid evolution of rotary instruments through the last decade, and many have been assessed for their debris extrusion potential and the amount of this debris.

The NiTi single-file systems that operate in a reciprocal movement have recently become popular in root canal preparation.

Files working with reciprocal movement cause apical extrusion of intracanal debris during root canal preparation.[1]

In the present study, three file system namely Hyflex EDM, Protaper Universal and Race system were assessed for the apical extrusion of debris.

Straight single-root teeth were used in this study because of the ease of availability and the elimination of possible complications in the curved canals.

Distilled water was used as an irrigant to avoid any crystallization of sodium hypochlorite because sodium crystals that remain after the evaporation of the solution cannot be separated from the debris, and these crystals can markedly impact the results.

Experimental model of Myers & Montgomery was used in this study.

Apical extrusion was not limited because the physical back pressure provided by periapical tissues was absent; thus, gravity may have carried the irrigant solution out of the canal.[12]

The literature reports that this technique has many advantages versus competing approaches because it allows quantitative separation between the amount of debris and the quantity of irrigant.

In the present study, Hy flex EDM files more amount of apically extruded debris. [Refer figure 01 and 02]

Hy Flex EDM files are single-file systems used with a continuous rotary movement. HEDM files are produced with the controlled memory alloy using electrical discharge machining technology.

The file has 3 different horizontal sections along the working part: quadratic in the apical part and trapezoidal and triangular in the middle and coronal parts.[2]

There are always four points of contact for the file with the canal walls that enhance the cutting efficacy.

The results of the present study are in accordance with earlier studies by Uslu Gul sab et.al. (2018) and Elashiry et.al. (2019) which have also proved that Hy flex EDM extrudes more apical debris than Wave one gold files. [2, 17]

The Protaper Universal system comprises of a unique design element with varying tapers along the instrument's long axes.

The system has three shaping and three finishing files. Shaping files have coronally increased tapers and finishing files have tapers which are more apically.[3, 16]

PTU has triangular cross-sectional area that cuts dentin with three-point contact symmetrically.[4, 13]

The greater cutting efficiency inherent in this design has been safely improved by balancing the pitch and helix angle, preventing the instruments from inadvertently threading into the canal.[14, 15]

The Protaper Universal rotary-file system generated greater expression of neuropeptides like SP (substance P) and CGRP (Calcitonin gene related peptide).[5]

The increased levels of SP and CGRP with Protaper Universal was because of the triangular cross section, semi active and active tips, and a large central mass in the structure of the instrument.

The results of the present study are in accordance with earlier studies by Kocak et.al. (2014) and Ozsu Damla et.al. (2019) which have also proved that Protaper Universal extrudes more apical debris than Protaper Next and Wave one file system.[18, 19]

In this study, Race files produced least amount of apically extruded debris. [Refer figure 01 and 02]

Race instruments have a triangular cross-sectional design with alternating cutting edges and are claimed to prevent the instrument from screwing into the root canal thus reducing intraoperative torque values.[6, 11]

The recommended working speed is 300–600 rpm.[7]

The surfaces of Race instruments are electrochemically treated for improvement of cutting efficacy.

Race instruments for the initial steps of crown-down preparation are manufactured from stainless steel as well

as from Ni-Ti alloy. Tapers range from 2 to 10%, sizes from 15 to 60.

The Race rotary system induced less extrusion of the debris. [8]

This can be attributed to an increased torsion resistance due to the electrochemical treatment and the alternating cutting edges in Race files which prevent threading.

Race files have an alternating cutting edge, and this design helps in two functions:

1. To eliminate screwing in and blocking in continuous rotation
2. To reduce the working torque.

Race system also possess a non-cutting tip.[9]

The Race system can be the instrumentation of choice in cases where a flare-up is suspected.

The results of the present study are in accordance with earlier studies by Altundasar et. al. (2011) and Nabavizadeh et.al. (2021) which have also proved that Race files system extrudes least amount of apical debris than Protaper files.[10, 20]

Conclusion

Within the limitations of this in vitro study, all the instruments tested caused extrusion of some debris from the apical foramen.

The amount of apically extruded debris registered for the different files tested was HEDM > Protaper Universal > Race system respectively.

The inflammatory reaction is not influenced by the number of files but the type of movement and instrument design.

References

1. Bürklein S, Schäfer E. Apically extruded debris with reciprocating single-file and full-sequence rotary instrumentation systems. Journal of endodontics. 2012 Jun 1;38(6):850-2.

2. Yilmaz K, Uslu G, Gündoğar M, Özyürek T, Grande NM, Plotino G. Cyclic fatigue resistances of several nickel-titanium glide path rotary and reciprocating instruments at body temperature. International Endodontic Journal. 2018 Aug;51(8):924-30.

3. Capar ID, Arslan H, Akcay M, Ertas H. An in vitro comparison of apically extruded debris and instrumentation times with Protaper Universal, Protaper Next, Twisted File Adaptive, and Hy Flex instruments. Journal of Endodontics. 2014 Oct 1;40(10):1638-41.

4. Ha JH, Kwak SW, Kim SK, Kim HC. Screw-in forces during instrumentation by various file systems. Restorative dentistry & endodontics. 2016 Nov 1;41(4):304-9.

5. Caviedes-Bucheli J, Castellanos F, Vasquez N, Ulate E, Munoz HR. The influence of two reciprocating single-file and two rotary-file systems on the apical extrusion of debris and its biological relationship with symptomatic apical periodontitis. A systematic review and meta-analysis. International Endodontic Journal. 2016 Mar;49(3):255-70.

6. Paqué F, Musch U, Hulsmann M. Comparison of root canal preparation using Race and Protaper rotary Ni-Ti instruments. International endodontic journal. 2005 Jan;38(1):8-16.

7. Guelzow A, Stamm O, Martus P, Kielbasa AM. Comparative study of six rotary nickel–titanium systems and hand instrumentation for root canal preparation. International endodontic journal. 2005 Oct;38(10):743-52.

8. Zarrabi MH, Bidar M, Jafarzadeh H. An in vitro comparative study of apically extruded debris sresulting from conventional and three rotary (Profile, Race, Flex Master) instrumentation techniques. Journal of oral science. 2006;48(2):85-8.

9. Schäfer E, Vlassis M. Comparative investigation of two rotary nickel–titanium instruments: Protaper versus Race. Part 1. Shaping ability in simulated curved canals. International endodontic journal. 2004 Apr;37(4):229-38.

10.Altundasar E, Nagas E, Uyanik O, Serper A. Debris and irrigant extrusion potential of 2 rotary systems and irrigation needles. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2011 Oct 1;112(4): e31-5

11.Bonaccorso A, Cantatore G, Condor Elli GG, Schäfer E, Tripi TR. Shaping ability of four nickel-titanium rotary instruments in simulated S-shaped canals. Journal of endodontics. 2009 Jun 1;35(6):883-6.

12.Myers GL, Montgomery S. A comparison of weights of debris extruded apically by conventional filing and Canal Master techniques. Journal of endodontics. 1991 Jun 1;17(6):275-9.

13.Topçuoğlu HS, Zan R, Akpek F, Topçuoğlu G, Ulus an Ö, Aktı A, Düzgün S, Ağırnaslıgil M. Apically extruded debris during root canal preparation using Vortex Blue, K3 XF, Protaper Next and Reciproc instruments. International endodontic journal. 2016 Dec;49(12):1183-7.

14.Huang X, Ling J, Wei X, Gu L. Quantitative evaluation of debris extruded apically by using Protaper Universal Tulsa rotary system in endodontic retreatment. Journal of endodontics. 2007 Sep 1;33(9):1102-5.

15.Üstün Y, Çanakçi BC, Dinçer AN, Er O, Düzgün S. Evaluation of apically extruded debris associated with several Ni–Ti systems. International endodontic journal. 2015 Jul;48(7):701-4.

16.De-Deus G, Brandão MC, Barino B, Di Giorgi K, Fidel RA, Luna AS. Assessment of apically extruded debris produced by the single-file Protaper F2 technique under reciprocating movement. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2010 Sep 1;110(3):390-4.

17.Elashiry MM, Saber SE, Elashry SH. Apical extrusion of debris after canal shaping with three single-file systems. Niger J Clin Pract. 2020 Jan 1;23(1):79-83.

18.Koçak MM, Çiçek E, Koçak S, Sağlam BC, Yilmaz N. Apical extrusion of debris using Protaper Universal and Protaper Next rotary systems. International endodontic journal. 2015 Mar;48(3):283-6.

19.Ozsu D, Karatas E, Arslan H, Topcu MC. Quantitative evaluation of apically extruded debris during root canal instrumentation with Protaper Universal, Protaper Next, Wave One, and self-adjusting file systems. European journal of dentistry. 2014 Oct;8(04):504-8.

20.Nabavizadeh M, Shokouhi MM, Kheirandish M, Sahebi S, Sadatshojaee N, Abbaszadegan A. A Comparison of the Apical Extrusion of Debris during the Preparation of Root Canal with Medin, Race, and Protaper Rotary Systems. Journal of Dentistry. 2021 Sep;22(3):193.