IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 8 Ver. 4 (August. 2018), PP 22-25
www.iosrjournals.org

Original Research Article:An ex-vivo comparison of apical extrusion of debris and working time used by three different ProTaper file systems during endodontic retreatment

Dixit K[1], Shivanna V[1], Siddeshwaran V[2]
Department of Conservative Dentistry and Endodontics, College Of Dental Sciences, Davangere, Karnataka, India
Corresponding Author: Dixit K[1], Shivanna V[1]

Abstract: ***Objectives:*** *To evaluate the apical extrusion of debris and the time taken for complete removal of root canal filling material by ProtaperUniversal(PTU), Protaper Retreatment(PTR) and Protaper Next(PTN) file systems during endodontic retreatment.*
Materials and Methods: *Sixty extracted human mandibular premolar teeth were used. All the teeth were prepared with Protaper Universal files(DentsplyMaillefer) upto size F3 and obturated using F3 guttapercha cone with AH plus sealer. After one week, the teeth were divided into three groups based on the retreatment file systems used: Group I(PTU); Group II(PTR); Group III(PTN) and the retreatment procedure was carried out. The debris extruded was collected in eppendorf tubes using Myers and Montogomery model. The mean time taken by each file system to completely remove GP and the mean rate of debris extruded was recorded. Data was analyzed using two way ANOVA and post Hoc test.*
Results*: The PTN files took significantly less time to completely remove GP followed by the PTU files and then the PTR files. The mean weight of debris extruded was significantly less with the PTN files.*
Conclusion*: None of the file systems could avoid apical extrusion of debris during retreatment but the PTN files took less time with less apical extrusion of debris compared to the PTU and PTR files.*
Keywords:*Apical extrusion, endodontic retreatment, analytical balance, electronic weighing machine*.

Date of Submission: 27-07-2018 Date Of Acceptance: 13-08-2018

I. Introduction

Non-surgical endodontic retreatment is the first treatment approach for an endodontically failed tooth. The main goal of non-surgical endodontic retreatment is to completely remove the root canal filling, ensure effective decontamination and three dimensional obturation of the root canal space.

Apical extrusion of debris is an unavoidable and undesirable phenomenonthat occurs during the instrumentation of root canal space and is referred to as a "worm of necrotic debris."[1]During the retreatment procedure, root canal fillings, necrotic tissues, microrganisms, or irrigants may be undesirably pushedperiapically.[2]This can result in postoperative problems such as pain, discomfort, inflammation or failure of healing. Mechanical removal of obturation material from the root canalspace can help to minimize the apical extrusion of debris but the number of instruments used, the instrument design and kinematics have variable effects on the extrusion of debris.[3]

The Protaper Universal(PTU) rotary files(DentsplyMaillefer)primarily designed for preparation of the root canal space have been found to be equally effective as the Protaper retreatment(PTR) file system in removing root canal fillings.[4]

The Protaper Universal retreatment(PTR) files (DentsplyMaillefer) consist of three retreatment instruments(D1, D2, D3)specifically designed toremove filling materials from the coronal, middle and apical portion of canals respectively.[5,6]

The ProtaperNext(PTN) files(DentsplyMaillefer) have recently been used for removing root canal fillings. These files have a rectangular cross-section, with an offset center of mass/rotation resulting in an asymmetrical movement.[7]

Till date, no study has evaluated the working time used and debris extruded apically by Protaper Universal, Protaper Retreatment and Protaper Next file systems during endodontic retreatment.

Therefore, the aim of this study was to evaluate and compare the amount of debris extruded apically and working time used by PTU, PTR and PTN file systems.

II. Materials and Methods

Selection of teeth

60 extracted human mandibular premolar teeth with single, straight, oval canals were selected and stored in saline until use.

Exclusion criteria

Teeth with calcifications, immature apices and developmental disturbances were excluded.

III. Methodology

All the teeth were decoronatedusing a diamond disc mounted on a straight handpiece with water coolant to standardize the length to 15.0 mm. Patency was established with a # 10 K-file. WL was determined by subtracting 1.0 mm from the length at which a # 15 K-file was visible at the apical foramen.With #15 K-file in place, the external root surface of all the teeth was coated with two coats of nail varnish leaving apical 1.0 mm.

All the specimens were then prepared with the Protaper Universal files(Dentsply- Maillefer) in the sequence of S1, SX, S2, F1, F2, F3. 2.0 ml of 2.5% NaOCland normal saline was used for irrigation between each file.The root canal space was then dried with paper points and obturated with a F3 Gutta-percha(GP) cone and AH-plus sealer(Dentsply).

All the teeth were then stored in an incubator at 37˚C for 7 days to allow complete setting of the sealer.

Debris collection and Retreatment

For the debris collection during retreatment procedure, Eppendorf tubes were used.A hole was cut on the stopper of the tube and the empty tube was then weighed using a micro-analytical balance to 10^{-4}g precision.For each tube, three consecutive measurements were taken and the mean value was recorded.

The Eppendorf tube were then mounted over a glass vial and a 27-gauge needle was placed over the stopper to equalize air pressure.The glass vials were covered with aluminium foil to avoid operator bias.The teeth were randomly divided into 3 groups based on the retreatment file system used and mounted over the Eppendorf tube and glass vial assembly.

- **Group I:** Retreatment procedure was carried out using the Protaper Universal files in sequence of Sx, S1, S2, F1, F2, F3 at 300 rpm and 3 Ncm torque till the WL was reached.

- **Group II:** Retreatment procedure was carried out with the Protaper Retreatment files in the sequence of D1, D2, D3 at 500 rpm speed and 3Ncm torque till the WL was reached.

- **Group III:** GP was removed using Protaper Next files in the sequence of X1, X2, X3 at 300 rpm speed and 3 Ncm torque till WL was reached.

New set of files were used for each tooth. Distilled water was used for irrigation throughout the procedure. The retreatment procedure was deemed complete when no GP remnant was seen on the flutes of the file.The time taken for each file system to completely remove GP was recorded to the nearest second.After the retreatment procedure was completed, the tooth was removed from the Eppendorf tube and the debris adhered to the root apex of the tooth was washed off with distilled water into the tube.The Eppendorf tubes were placed in an incubator at 70˚C for 5 days to allow the moisture to evaporate.

The Eppendorf tubes containing the dry debris were weighed again using the same micro-analytical balance and the mean weight of three consecutive measurements was recorded. Weight of apically extruded debris was calculated by the formula.

Weight of the Apically extruded debris = Mean weight of Eppendorf tube with dry debris- Mean weight of empty Eppendorf tube.

Statistical Analysis

The mean time taken to completely remove the GP and the weight of the apically extruded debris were analyzed and completed using two-way ANOVA &Post-Hoc Tukey test($p<0.05$)

IV. Results

The mean values of the time taken to remove GP completely and weight of the apically extruded debris are depicted in Table 1 and Table 2 respectively.It was found that the PTN files needed the least time to completely remove the GP from the canals followed by the PTU files and than the PTR files with a significant difference between all the three groups.

All the techniques caused apical extrusion of debris where the PTN files produced significantly less apical extrusion than the other two groups.The PTU files resulted in less debris extrusion than the PTR files but the difference was statistically insignificant.

Table 1: Mean time taken to remove gutta-percha completely

Groups	Mean Difference	Standard Error	p-Value
Group I Group II	-0.84200	.11379	.000
Group III	1.70000	.11379	.000
Group II Group I	0.84200	.11379	.000
Group III	1.91200	.11379	.000
Group III Group I	-1.70000	.11379	.000
Group II	-1.91200	.11379	.000

Table 2: Mean wt of apically extruded debris

Groups	Mean Difference	Standard Error	p-Value
Group I Group II	0.00140	.00312	.896
Group III	0.1060	.00312	.006
Group II Group I	-0.00140	.00312	.896
Group III	0.00920	.00312	.017
Group III Group I	-0.1060	.00312	.006
Group II	-0.00920	.00312	.017

V. Discussion

An endodontic treatment may fail due to insufficient shaping, cleaning orobturation of the canals, iatrogenic errors, or re-infection of the root canal space due to loss of coronal seal following completion of treatment. Irrespective of the cause, the net result is leakage and bacterial contamination. The aim of non-surgical endodontic retreatment is to remove filling materials from the root canal space and address the flaws and defects which maybe pathologic or iatrogenic in origin.[8]

Several methods have been advocated for removing root canal filling materials which include the use of hand, rotary and ultrasonic instruments in conjunction with solvents. Rotary nickel-titanium(NiTi) systems because of their safety, efficiency and speed are preferred for endodontic retreatment procedures.[9]Use of NiTi rotary instruments is believed to generate frictional heat which helps to plasticize the gutta-percha and ease its removal.

In the present study single cone gutta-percha with AH plus sealer was used because the single cone technique is less time consuming than the other techniques and the single cone forms an uniform mass with the endodontic cement, thus preventing failures that occur among multiple cones.[10]AH-plus sealer was used becauseof the greater bond strength of this sealer to root dentin. The sealer cement penetrates into the micro-irregularities and results in mechanical interlocking between sealer and root dentin.[11]All the specimens were de-coronated to the length of 15.0 mm. Though decoronation does not mimic the clinical situation it helps in specimen standardization by eliminating variables such as crown anatomy and root canal length.[12]

In the present study, the Protaper Next system was the fastest in removing root canal filling followed by the Protaper Universal system and than the Protaper Retreatment system with a statistically significant difference among all the groups. This can be attributed to the fact that the PTN files have an offset mass of rotation. Owing to this, PTN fileshave a wave like motion and cut a larger envelope of motion compared with a file of similar size having a symmetrical mass and axis of rotation.[13]In this study the PTU files fared better than the PTR files in GP removal. Similar result was in another study where the Protaper Universal rotary instruments were foundto be faster to reach the WL and to perform GP removal than Protaper Universal retreatment instruments. The findings were related to the shorter length of the D1, D2 and D3 instruments compared to the S1, S2 and F3 instruments. The active tip of the D1 instrument facilitates easier penetration of the PTR files into gutta-perchabut overall the PTU files took comparatively lesser time than the PTR files to completely remove GP.[14]Also, the Protaper Retreatment file D3 has a tip diameter of 0.20 mm which is smaller than the size of the last finishing file used(F3) which had tip diameter of 0.30 mm. The PTU and PTN systems used an apical GP removal file with a tip diameter of 0.30 mm. This can be a reason for better efficacy of the PTN and PTU files in GP removal compared to the PTR files.

All the three systems resulted in debris extrusion.In previous studies also, the PTN system has been found to result in less debris extrusion apically. This can be attributed to the unique design of the PTN files

which along with the off-centered rectangular cross-section provides non-uniform two point contact and reduced contact points between the instruments and the root canal walls.[15]The PTU system was found to result in less debris extrusion than the PTR system but the difference was statistically insignificant. UEZU et al. found similar result through their study.[14] The lesser debris extrusion associated with the PTU files can be related to modified convex triangular cross section design of the F3 files compared to the convex triangular design of the D3 file used in the apical third.[16]

For evaluating the amount of debris extruded, the system described by Myers and Montogomery was used. The reason for choosing this system is that out of all the systemsthis is the most common and accepted.[17]In invitro conditions, floral foam maybe used to simulate the periapical tissues and their resistance to the pressure exerted from within the root canal space but the foam may absorb irrigant and debris and interfere with the results.[18] Thus, no attempt was made to simulate the periapical tissues.

Though distilled water is not an idealirrigant, it was the irrigant of choice in this study because the use of NaOClor Saline can have a positive effect on the amount of extruded debris.[19]No solvent was used in the study as the use of solvents results in a thin film of softened GP and sealer which is adherent to the root dentin and is difficult to remove.[20]Also when solvents are used, there is a tendency for the softened mass to dislodge into the complexities of the canalfrom where it cannot be easily removed.[21]

VI. Conclusion

Within the limitations of the present in-vitro study, it can be concluded that:-

i. None of the file systems can prevent the apical extrusion of debris during endodontic retreatment.
ii. The ProTaper Next (PTN) files, because of their offset design and swaggering motion take relatively less time in removing gutta-percha from root canal space with less apical extrusion of debris compared to the ProTaper Universal (PTU) and the ProTaper Retreatment (PTR) files.

References

[1]. Western JS, Dicksit DD. Apical extrusion of debris in four different endodontic instrumentation systems:A meta-analysis. J Conserv Dent 2017;20:30-6.
[2]. Vikram M. Comparison of Apically Extruded Debris Retreatment Procedure by Two types of Endodontic Instruments. Int J Recent Surg Med Sci 2017;3(1):7-9.
[3]. Nevares G, Romeiro K, Albuquerque D, et al. Evaluation of Apically Extruded Debris during Root Canal Retreatment Using PROTAPER NEXT and Reciproc in Severely Curved Canals. Iranian Endodontic Journal 2017;12(3):323-8.
[4]. Fariniuk LF, Azevedo MD, Carneiro E, Westphalen UP, Piasecki L, da Silva Neto UX. Efficacy of protaper instruments during endodontic retreatment. Indian J Dent Res. 2017;28:400-5.
[5]. Giuliani V, Coechetti R, Pagavino G. Efficacy of ProTaper universal retreatment files in removing filling materials during root canal retreatment. J Endod. 2008;34(11);1381-4.
[6]. Gu LS, Ling JQ, Wei X, Huang XY. Efficacy of Protaper Universal rotary retreatment system for guttapercha removal from root canals. IntEndod J. 2008;41:288-95.
[7]. Nevares G, de Albuquerque DS, Freire LG, Romeiro K, Fazel HM, Dos Santos M, Cunha RS. Efficacy of Protaper Next Compared with Reciproc in removing Obturation Material from Severely Curved Root Canals: A Micro-Computed Tomography Study. J Endod 2016;42(5);803-8.
[8]. Ruddle CJ. Non-Surgical Retreatment. OA Journal 2004.
[9]. Bernardes RA, Duarte MH, Vivan RR, Alcalde MP, Vasconcelos BC, Bramante CM. Comparison of three retreatment techniques with ultrasonic activation in flattened canals using micro-computed tomography and scanning electron microscopy. Int. Endod J. 2015;49(9):890-7.
[10]. Pereira AC, NishiyamaCK, Pinto LC. Single cone Obturation technique: a literature review. RSBO. 2012;9(4):442-7.
[11]. Pawar SS, Pujar MA, Makandar SD. Evaluation of the apical sealing ability of bioceramic sealer, AH plus & epiphany: An invitro study. J Conserv Dent.2014;17(6):579-82.
[12]. Turker SA, Uzunoglu E, Saglam BC. Evaluation of the amount of apically extruded debris during retreatment of root canals filled by different obturation techniques. Niger J ClinPract 2015;18:802-6.
[13]. Ruddle CJ, Machtou P, West JD. The shaping movement: fifth generation technology. Dent Today 2013;32(4);96-9.
[14]. UEZU MKN, BRITTO MLB, NABESHIMA CK, PALLOTA RC. Comparison of debris extruded apically and working time used by Protaper Universal rotary and Protaper retreatment system during gutta-percha removal. J Appl Oral Sci. 2010;18(6);542-5.
[15]. Kocak MM, Cicek E, Kocak S, Saglam BC, Yilmaz N. Apical extrusion of debris using Protaper Universal and Protaper Next Rotary systems.2014;48(3);283-6.
[16]. Dincer AN, Gunesa MB, Arsalen D. Apical Extrusion of debris during root canal preparation using a novel nickel-titanium file system: WaveOne gold. J Conserv Dent.2017;20(5):322-5.
[17]. Gkampesi S, Mylona Z, Zarra T, Lambrianidis T. Assessment of Apical Extrusion of Debris during Endodontic Retreatment with 3 Rotary Nickel-Titanium Retreatment Systems and Hand Files. Balk J Dent Med. 2016;20;22-8.
[18]. Tanalp J, Gungor T. Apical Extrusion of debris: a Interactive review of an inherent occurrence during root canal treatment. IntEndod J. 2014;47(3);211-21.
[19]. Uzunoglu E, Gorduysus M. Apical Extrusion of Debris and Irrigant using Novel Preparation Systems. J Contemp Dent Prac. 2014;15(4);423-7.
[20]. Vale MS, Moreno Mdos, Silva PM, Botello TC. Endodontic filling removal procedure: an ex-vivo comparative study between two rotary techniques. Braz Oral Res. 2013;27(6):478-83.
[21]. Kfir A, Tsesis I, Yakiravich E, Matalon S, Abramovitz I. The efficacy of five techniques for removing root filling material. Microscopic versus radiographic evaluation. IntEndod J.2012;45(1);35-41.