Original Research Paper

University J Dent Scie 2023; Vol. 9, Issue 2

Comparative Evaluation of Amount of Apically Extruded Debris in Endodontic Retreatment Procedures Using Four Different File Systems- An Invitro Study.

Abstract:

Objective(s): To compare the amount of apical debris extruded during endodontic retreatment procedures performed using H files, R-Endo Retreatment files, GPR files and ProTaper Universal Retreatment files.

Materials and Methods: The conventional coronal access cavity was prepared for 40 extracted Mandibular Premolars. The root canals were prepared with ProTaper Next Rotary files till X1. Obturation was done by combination of Lateral and Vertical Compaction technique. All the samples were later attached to Eppendorf tubes. The samples were then divided into four groups each containing 10 samples on the basis of different retreatment files to be used. After complete removal of root canal filling material, the debris and the root filling material remnants adhered was collected in preattached Eppendorf tubes. For final weight computation and comparison, the weight of empty tube was deducted from the weight of tube accommodating the debris. ANOVA and Tukey test were applied for statistical analysis.

Results: The R-Endo retreatment files showed minimum apical extrusion of debris than all the other examined files in the study. The apical extrusion of debris for R-Endo min to max was -0.045 to 0.009. However, there was no statistically significant difference in amount of apical extrusion of debris by different files system ($p>0.005$).

Conclusion(s): There was no significant difference between the groups in apical extrusion of debris. Also rotary retreatment files showed lesser apical of debris than Hedstrom hand files. R-Endo extruded less debris apically in this study.

Key-words: *:* Apical extrusion of debris; Gutta-percha; Retreatment files

Introduction:

For protection and good longevity for a painful, harmful and diseased tooth, an endodontic treatment is requisite.[1] Although endodontic treatment fails.[2] Options include endodontic retreatment or extraction in botched treatment. [3,4] Today's scenario rules out tooth extraction so as to treasure one's natural tooth's occlusion, function, and esthetic.[5] Non- surgical or surgical method are tracks to avoid extraction. A conservative, non-invasive method i.e., retreatment attempts for tooth stability with insignificant afterwards soreness.[6,7]

A couplisation of host's immunoglobulin and antigens i.e., microorganisms, irrigants, obturating materials leaked periapically favours pain and flare-ups in retreatment instrumentation procedures.[8,9] Thus significance of an instrument's anatomy and its use governs endodontic

Access this article online

Website: www.ujds.in

Quick Response Code

DOI: https://doi.org/10.21276//ujds.2023.9.2.1

[1]SANJEEV SRIVASTAVA , [2]TARUN SAXENA, [3]AAKANSHA YADAV , [4]SANDEEP DUBEY, [5]HARPREET SINGH CHHABRA

[1,3,5]Department of Conservative Dentistry & Endodontics. Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow.

[2,4]Department of Conservative Dentistry & Endodontics. Babu Banarasi Das College of Dental Sciences. Lucknow

Address for Correspondence: Dr. Tarun Saxena
MDS, Senior Lecturer
Department of Conservative Dentistry & Endodontics
Babu Banarsai Das College of Dental Sciences, Lucknow (U.P.)
Email: tarunsaxena7237@gmail.com

Received : 6 Jan., 2023, **Published :** 30 June, 2023

How to cite this article: Saxena, T. (2023). Comparative Evaluation of Amount of Apically Extruded Debris In Endodontic Retreatment Procedures Using Four Different File Systems- An Invitro Study. UNIVERSITY JOURNAL OF DENTAL SCIENCES, 9(2). 01 - 06

retreatment prognosis.[9] Gutta-percha retrieval manually and with Nickel Titanium retreatment rotary files etc. has been a cumbersome, in a skilful obturated root canal.[8,10] Previous dentistry has favoured secured, swift and methodical NiTi rotary instruments.[4,9,11]

A new rotary retreatment file system i.e. GPR (Mani, Japan) with helical grooves along the working section is nowadays in picture.[12]

Apical extrusion of infected debris, irrespective of the preparation done short or up to the apical foramen in retreatment procedures is evidenced. [13,14,15] Thus present study goal was to compare and evaluate the magnitude of debris extruded apically during endodontic retreatment procedures using hand H-files, R-Endo rotary etreatment files, GPR gutta-percha remover files and ProTaper Universal rotary Retreatment files.

Materials and Methods:

Teeth selection

Forty mandibular premolars freshly extracted due to orthodontic and periodontal reasons were collected. Teeth having root caries, root canal calcification, presence of two roots or canals, root resorption or any developmental anomalies were excluded. Digital radiographic analysis of collected premolars were done in two positions i.e., mesially and distaliy, respectively to fulfil above mentioned inclusion criteria. All soft tissues remnants, calculi and debris on the external root surface of teeth were cleaned mechanically by periodontal hand scaler. Autoclaving of samples was done at 121 degrees Celsius for 15 minutes at 15 psi and stored in 0.9% saline solution until further experiment.

Flattening of buccal cusp of the samples up to 1mm were done to have a standardized tooth length. After preparation of conventional endodontic access cavity, a K file of size No# 10 was placed in the canal till it was at apical foramen radiograpically. Root canal working length was estimated by subtracting one millimetre from that length. Root canal preparation was done with ProTaper NEXT rotary file system till X1 using Crown Down technique. Canal irrigation between instrumentation was done with 2ml of 5% sodium hypochlorite. The canal was then flushed with 10ml distilled water and 2ml of 17% EDTA was used for smear layer removal. Final irrigation was done with 10 ml of distilled water, to flush out all debris. The side vented irrigating needle was used for irrigation. Combination of Lateral and Vertical Compaction method was utilized to obturate the prepared canals, using corresponding Gutta Percha and AH Plus sealer. Access cavity was completely filled with cavit (Ammdent, Mohali, India) or temporary material and placed in an incubator for two weeks at room temperature and 100 % humidity. Measurement of the Eppendorf tubes were done by analytical balance. Later premeasured Eppendorf tubes were attached to the samples up to cementoenamel junction.

According to various endodontic retreatment instruments applied in present study, samples were divided into the following four groups (n=10)

Group A- (Hedstrom File) Control Group: The root canal retreatment procedures were performed by using Hedstrom hand files, using a circumferential quarter-turn push-pull filing motion.

Group B- (R-Endo File): According to manufacturer instructions Re, R1, R2, R3, retreatment files were used to remove the root canal filling materials. These files were used in a sequential manner using Crown Down method using brushing movements with in and out motion.

Group C-(GPR Files): According to manufacturer's recommendation 1S, 3N, files were used to remove the root canal filling materials by Crown down method with punch - out motion.

Group D- (Protaper Universal Retreatment System):

Using Crown Down method in brushing action with lateral pressing movements, till working length D1,D2,D3 files were used.

During every gutta percha stroke removal, the file was removed from the root canals so as to inspect and clean the flutes. During root canal preparation and retreatment procedures separate hand files and rotary files were used for each samples to avoid variation due to any defects in the file.

When files or paper points are free of gutta-percha or sealer, retreatment procedure was halted and verified by radiographs. If these essential steps were not fulfilled, the canals were further instrumented with the last file used until these criteria were met. After the completion of the retreatment procedure samples were removed from the Eppendorf tube and left to dry. Tubes were then stored at room temperature at 100 % humidity in the incubator for two weeks. Then the Eppendorf tube containing debris was weighed by analytical balance. Final weight computation, noted by simple subtraction of the weight of the empty Eppendorf tube from the Eppendorf tube containing debris.

Statistical Analysis:

A raw data thus collected was subjected to statistical analysis using One-way ANOVA, Tukey's HSD, Shapiro-Wilk's test and Levene's test. A two-tailed (α=2) $P<0.05$ will be considered as statistically significant. Analysis was performed on SPSS software (Windows version 17.0).

Results:

The retreatment files used in the study showed apical extrusion of debris. However, the difference was statistically insignificant in apical extrusion of debris, even though R Endo showed minimum apical extrusion of debris followed by ProTaper Universal retreatment files, GPR files and Hedstrom files.

Discussion:

Apical extrusion of debris, being a culprit for an endodontic therapy failure or an interappointment flare ups also roots in retreatment failures.[16,17] Researches also affirms, instrumentation during retreatment procedures leads to more debris extrusion apically.[8,18] Extruded foreign bodies in periapical tissues induces zealous an inflammatory reactions and periapical pathological lesions consistent with apical periodontitis.[19] Debris (quantitative factor), microbes and their by-products extruded from apical foramen are in direct proportion to each other.[20,21] This direct association severes the periapical inflammation.[22] In past various techniques were used to detect the apically extruded debris.[23] The present study mimics Myers and Montgomery method to quantify debris extruded apically.[24] This model imitates natural oral cavity habitat, thus masking visual view of an apical foramen from an operator during root canal preparation.[24,25]

In the present research H-files ***(GROUP – A)*** exhibits the maximum apical extrusion amongst all the tested files systems. The apical extrusion of debris when H – file was used ranged from 0.001 to 0.110, mean (± SD) 0.026 ± 0.032, and median 0.018 (Table 1). The reason behind is, instrument applied in the apical one- third of the tooth used in push and pull motion, makes coronal space less for flushing, force debris through the apical foramen.[8,26] Hedstrom files caused more apical extrusion of debris than ProTaper Universal retreatment files (Delai et al).[27] Similar investigations were reported by Gkempsi et al that hand instruments (Hedstrom files) resolved in more apical debris extrusion compared to NiTi rotary retreatment files.[28] On the contrary Somma F et al suggested that Hedstrom files extrude less apical debris than engine-driven NiTi instruments. Somma F et al explained that variations in readings may vary with increased master file size of NiTi rotary instruments used for canal retreatment to achieve cleaned apical third. [29]

The apical extrusion of debris by R-Endo files ***(GROUP-B)*** ranged from -0.045 to -0.009, mean (± SD) -0.016 ± 0.011, and median -0.012. R-Endo-files demonstrated minimum apical extrusion amongst all experimental groups (Graph 1). The files used, eliminates gutta-percha from the coronal third thus creating the space for evacuation of debris and remaining filling material from apical third, reducing the likelihood of extrusion.[30] Kustarci A et al R-Endo retreatment files caused less apical extrusion of debris than K3, Hedstrom files.[4] On the contrary Hakkan G et al (2014) in their study investigated and demonstrated more apical extrusion of debris by R-Endo retreatment files as compared to other retreatment files. This contradictory result may be due to difference in experimental conditions, sealers and irrigants used.[31]

The apical extrusion of debris by GPR retreatment files ***(GROUP – C)*** ranged from -0.085 to 0.136 with mean (± SD) 0.010 ± 0.068, -0.011. These files demonstrated maximum apical extrusion of debris among tested retreatment rotary system files but less than Hedstrom (hand) files (Table 1). Lower flexibility and positive rake angle of these files resulted in more apical extrusion of debris which were difficult to flush out in comparison to other retreatment file systems.[12] Akhavan et al carried out a study and concluded that GPR retreatment files exhibit maximum apical extrusion

than ProTaper Universal Retreatment files which supports the findings of present study.[32] Since GPR is a comparatively new rotary file system, not much scientific evidence has been found about it. Therefore, more studies are needed to have stronger evidence about the system's debris production and debris extrusion.

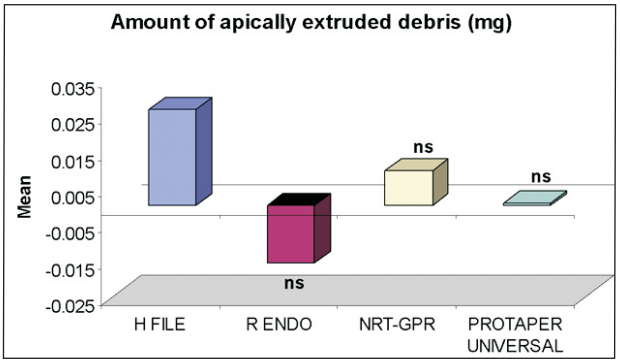
In the study ProTaper Universal Retreatment files (PTUR) ***(GROUP - D)*** demonstrated apical extrusion of debris range from -0.018 to 0.059 with mean (± SD) 0.001 ± 0.029, and median -0.012 (Graph 1). The PTUR system extruded less debris in this study. PTUR files extrude less debris apically due to their specific flute design and variable tip diameter that allows to clean root canal area with one file towards the orifice. This creates more space for removal of cutted gutta percha along with debris in spiral fashion, around the rotary files.[10] Canakci BC et al did a study and revealed that less tapered R-Endo retreatment files extruded less debris apically than more tapered ProTaper Universal Retreatment files which supports results of present study.[33] The findings of Jena A et al. also support the result of Canakci BC et al and this current study with statement ProTaper Universal Retreatment files causes more apical extrusion of debris as compared to R-Endo retreatment files. During instrumentation ProTaper Universal Retreatment systems characterizes decreased cutting efficiency due to inbuilt convex triangular cross-section with three cutting edges which ships smaller chip space, as a whole act as a piston forcing the debris. Moreover, D3 file with a larger taper and tip diameter also contributes more debris extrusion apically.[9]

Table 1: Summary statistics for amount of apically extruded debris (mg) of four groups

Summary statistics	H FILE (HEDSTROM FILE) (GROUP A)	R- ENDO FILE (GROUP B)	GPR FILE (GUTTA PERCHA REMOVER) (GROUP C)	PTUR FILE (PROTAPER UNIVERSAL RETREATMENT) (GROUP D)
N	10	10	10	10
Min	0.001	-0.045	-0.085	-0.018
Max	0.110	-0.009	0.136	0.059
Mean	0.026	-0.016	0.010	0.001
SD	0.032	0.011	0.068	0.029
Median	0.018	-0.012	-0.011	-0.012

Table 2: Comparison in mean amount of apically extruded debris (mg) between groups by Tukey test

Comparison	Mean Diff.	Q	P value	95% CI of diff
GROUP A vs. GROUP B	0.042	3.28	P > 0.05	-0.00683to 0.09116
GROUP A vs. GROUP C	0.017	1.30	P > 0.05	-0.03232 to 0.06568
GROUP A vs. GROUP D	0.026	2.01	P > 0.05	-0.02323 to 0.07477
GROUP B vs. GROUP C	-0.025	1.98	P > 0.05	-0.07448 to 0.02351
GROUP B vs. GROUP D	-0.016	1.28	P > 0.05	-0.06539 to 0.03260
GROUP C vs. GROUP D	0.009	0.71	P > 0.05	-0.03991 to 0.05809



Graph 1. Mean amount of apically extruded debris (mg) of four groups.

Conclusion:

Within this study determents, it can be inferred that the rotary retreatment files systems extrude less debris apically than manual files. R-Endo (GROUP-B) retreatment files showed minimum apical extrusion of debris, which was followed by ProTaper Universal Retreatment file (GROUP-D) systems, GPR file systems (GROUP-C), and maximum by (manual) Hedstrom files (GROUP-A).

References:

1. Madarati AA, Al-Nazzawi AA, Sammani AMN, Alkayyal MA. The efficacy of retreatment and new reciprocating systems in removing a gutta percha based filling material. J Taibah Uni Med Sci 2018; 13(5) : 452-458.
2. Tabassum S, Khan FR. Failure of endodontic treatment: the usual suspects. Eur J Dent 2016; 10(1): 144-147.
3. Vale MSD, Moreno MDS, Silva PMFD, Botelho TCF. Endodontic filling removal procedure: an ex vivo comparative study between two rotary techniques. Braz Oral Res 2013; 27(6) : 478-483.

4. Kustarci A, Altunbas D, Akpinar KE. Comparative study of apically extruded debris using one manual and two rotary instrumentation techniques for endodontic retreatment. J Dent Sci 2012; 7: 1-6.
5. Alsalem AF. Endodontic therapy (root canal therapy). Oral Health Dent Manag 2015; 14(2): 67-68.
6. Qazi SS, Manzoor MA, Rana MJA. Success rate of re-root canal treatment at a teaching hospital. Pakistan Oral & Dent. Jr 2004; 24(2) :149-154.
7. Hargreaves MK, Berman L. Cohen pathways of pulp. First South Asia edition 8th. 2016: 381.
8. Kasam S, Mariswamy AB. Efficacy of different methods for removing root canal filling material in retreatment an in-vitro study. J Clin DiagnRes 2016; 10(6): 106-106.
9. Jena A, Shashirekha G, Barai S, Mahaprasad A. Comparison of apically extruded debris after retreatment procedure with ProTaper and Endostar retreatment file systems. J Clin Diagn Res 2018; 12(7): 31-34.
10. Lalit P, Godara N, Varma KR. Evaluation of efficiency of three NiTi instruments in removing gutta-percha from root canal during retreatment- an in vitro study. Endodontology 2012; 12(1): 80-88.
11. Sunil SM, Rajkumar B, Gupta V, Bhatt A. A comparative evaluation of removal of gutta percha using two retreatment file system: An invitro study. Indian J Conserv Endod 2020;5(1):53-57.
12. Joseph M, Ahlawat J, Malhotra A, Rao M, Sharma A, Talwar S. In vitro evaluation of efficacy of different rotary instrument systems for gutta-percha removal during root canal retreatment. J Clin Exp Dent 2016; 8(4): 355-360.
13. Sreegowri K, Shetty KHK, Varma KR, Prathap MS. Apical extrusion of bacteria from the root canal system following instrumentation - an ex vivo evaluation. Endodontology 2010; 22(2): 46-54.
14. Ladley RW, Campbell AD, Hicks ML, Li SH. Effectiveness of halothane used with ultrasonic or hand instrumentation to remove gutta-percha from the root canal. J Endod 1991; 10(5): 221-224.
15. Madhusudan K, Mathew VB, Reddy NM. Apical extrusion of debris and irrigants using hand and three rotary instrumentation systems. -an in vitro study. Contemp Clin Dent 2010; 1(4): 234-236.
16. Iqbal A. The factors responsible for endodontic treatment failure in the permanent dentitions of the patients reported to the college of dentistry, the University of Aljouf, kingdom of Saudi Arabia. J Clin Diagn Res 2016; 10(5): 146-148.
17. Dincer AN, Er O, Canakci BC. Evaluation of apically extruded debris during root canal retreatment with several NiTi systems. Int Endod J 2015; 48: 1194–1198.
18. Padmaja K, Shah A, Malpani S, Kakkar M, Thakkar R. Retreatment in endodontics. J Adv Med Dent Sci Res 2015; 3(1) :205-208.
19. He J, White RK, White CA, Schweitzer JL, Woodmanseyt KF. Clinical and patient-centered outcomes of nonsurgical root canal retreatment in first molars using contemporary techniques. J Endod 2017; 43(2): 231-237.
20. Cicek E, Kocak MM, Kocak S, Saglam BC. Comparison of the amount of apical debris extrusion associated with different retreatment systems and supplementary file application during retreatment process. J Conserv Dent 2016; 19: 351-354.
21. Huang X, Ling J, Wei X, Gu L. Quantitative evaluation of debris extruded apically by using ProTaper Universal Tulsa rotary system in endodontic retreatment. J Endod 2007; 33(9): 1102-1105.
22. Sheetal B Ghivari, Girish C Kubasad, Manoj G Chandak, NR Akarte. Apical extrusion of debris and irrigant using hand and rotary systems: A comparative study. J ConserV Dent 2011;14 (2) :187-190
23. Topcuoglu HS, Akti A, Tuncay O, Dincer AN, Duzgun S, Topcuoglu Gl. Evaluation of debris extruded apically during the removal of root canal filling material using ProTaper, D-Race, and R-Endo rotary nickel titanium retreatment instruments and hand files. J Endod 2014; 40(12): 2066-2069.
24. Myers GL, Montgomery S. A comparison of weights of debris extruded apically by conventional filing and canal master techniques. J Endod 1991; 17(6) : 275-279.
25. 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 metaanalysis. Int Endod J 2016; 49: 255–270.
26. Uzunoglu E, Turker SA. Impact of different file systems on the amount of apically extruded debris during endodontic retreatment. Eur J Dent 2016 ;10: 210-214.
27. Delai D, Boijink D, Hoppe CB, Grecca FS, Kopper PMP. Apically extruded debris in filling removal of curved

canals using 3 NiTi systems and hand files. Braz Dent J 2018 ; 29(1) : 54-59.

28. 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: 22-28.
29. Somma F, Cammarota G, Plotino G, Grande NM, Cornelis H. Pameijer CH. The Effectiveness of Manual and Mechanical Instrumentation for the Retreatment of Three Different Root Canal Filling Materials. J Endod 2008;34(4) :466-469.
30. Mollo A, Botti G, Goldoni PN, Randellini E, Paragliola R, Chazine M, Ounsi HF, Grandini S et al. Efficacy of two Ni-Ti systems and hand files for removing gutta-percha from root canals. Int Endod J 2012; 45: 1–6.
31. Gokturk H, Yucel AC, Sisman A. Effectiveness of four rotary retreatment instruments during root canal retreatment. Cumhuriyet Dent J 2015; 18(1): 25-36.
32. Akhavan H, Bahrami Z, Moshari A, Sadighnia A, Haeri A, Ghannad S. The comparison of two rotary systems effect, ProTaper and NRT-GPR on the amount of debris extrusion during root canal retreatment. Ind J of Fund Appl Life Sci 2015; 5(4): 141-146.
33. Canakci BC, Ustun Y, Er O, Sen OG et al. Evaluation of apically extruded debris from curved root canal filling removal using 5 nickel-titanium systems. J Endod 2016; 42(7): 1101-1104.