How to Cite:
Nehete, P. B., Belsare, N., Sharma, D., Meshram, A. D., Wani, V. R., & Shah, K. (2022). An in vitro evaluation to quantify extruded debris during filing with three different systems: An original research study. *International Journal of Health Sciences*, *6*(S2), 11106–11113. https://doi.org/10.53730/ijhs.v6nS2.7978

An in vitro evaluation to quantify extruded debris during filing with three different systems: An original research study

Dr. Parag Balkrishna Nehete
Associate Professor, Department of Conservative Dentistry and Endodontics, MGV's KBH Dental College and Hospital, Nasik, India
Corresponding author email: dr_paragnehete@rediffmail.com

Dr. Neha Belsare
Associate Professor, Department of Prosthodontics, MGV's KBH Dental College and Hospital, Nasik, India

Dr. Deepak Sharma
Associate Professor, Department of Conservative Dentistry and Endodontics, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Navi Mumbai, India

Dr. Ashish Diwakar Meshram
Senior Lecturer, Department of Prosthodontics, MGV's KBH Dental College and Hospital, Nasik, India

Dr. Vaibhav Ravindra Wani
Professor and Head, Department of Pedodontics, Dr. R.R. Kambe Dental College and Hospital, Akola, India

Dr. Kunal Shah
Professor, Department of Orthodontics, Rishiraj Dental College, Bhopal, India

***Abstract*---**Aim: This study was planned to quantitatively estimate the amount of pushed off debris during instrumentation with three commercial files. Materials & Methods: Maxillary central incisors were chosen by simple random sampling. Only freshly extracted teeth were entertained for sampling procedure. For the ease of study and grouping, all samples were further divided into three study groups. This was solely based on available latest and economical NiTi files. Consequently in group I, canal cleaning and shaping was performed ProTaper Next system files. Authors attempted this in given recommended sequential manner as directed by manufacturer. In group II, Twisted File Adaptive adaptive files were engaged for canal

procedures in the recommended sequence. In group III, Reciproc R25 file system was checked for the similar factors. Results: Statistical analysis was done using statistical software 'Statistical Package for the Social Sciences (SPSS)'. The recorded data was subjected to suitable statistical tests to obtain p values and mean. $P \leq 0.05$ was considered as statistically significant. Mean values of pushed out debris was 0.00047 grams, 0.00058 grams and 0.00050 grams in group I, II and III respectively. The measured p value was not in the significant range. Conclusion: Within the limitations of the study the authors have concluded that among the all checked file systems, TF adaptive files showed maximum pushed out debris. Therefore, these particular files must be utilized very cautiously especially in the vulnerable situations.

***Keywords*---**extrusion, debris, protaper next files.

Introduction

Complete root canal cleaning and shaping are necessary for successful endodontic treatment and peri-radicular healing. More recently advanced instrument designs such as radial lands, non-cutting tips, and different flute depth have been introduced in the field of endodontics. Differently angled blades and cross-sections have been shown to increase the instrument efficiency even with less chairside time. Many researchers have clained that these innovations have drastically enhanced the overall outcome of root canal preparation. Such efficiently prepared canals are best suited with the future obturation and restoration in terms of biocompatibility and acceptability. In the basics of endodontics, biomechanical preparation is the foremost step to be taken by operator. This is primarily conducted to prepare the root canal to adapt with future materials.[1-4] Traditionally, most of the canal interuments used to work in push and pull action. Many of the studies have confirmed high amount of pushed out debris in to peri-foramen areas. With recent the development of rotary system, these dilemmas has been appeared to be within acceptable clinical limits. This was believed to be the biggest advantage of engaging rotary system over manual systems.[5-8] Despite of all these developments, researchers are still hunting to develop instruments that push negligible debris in the surrounding areas. In other words, none of the available system offers zero debris in peri-apical areas. Several experimental studied are under trial in these regards..[9-12] The ProTaper Next files has set of three files of nickel titanium alloy which is in turn constructed by heating procedure. The Reciproc single-file system has dedicated motor which produced unidirectional and anti-directional actions periodically. The Twisted File Adaptive are producing both circular and reciprocing action. This study was executed to quantitatively estimate the amount of pushed off debris while instrumentation with three commercial files.

Materials and Methods

This study was planned, abstracted and completed in the department of Conservative Dentistry and Endodontics of the institute. It has thirty freshly

extracted maxillary central incisors. All were removed for etiologies other than trauma. Any soft or hard deposits on the outer surface of samples were carefully cleaned by manual instrumentation. Maxillary central incisors sample those with multiple canal orifices were strictly excluded from the study. Sample teeth with any type of deveolopmental anomaly were also not included in the samples. Furthermore, authors ensured to study maxillary central incisors with root angulations within acceptable limits. Simple random sampling procedure was utilized for the study. Approach points were prepared and the working length was calculated. While initial filing, approximate working length was guessed. It was attempted with standard manner and recommended guidelines of working length estimations. Authors have taken especial care during these initial procedures since ultimate success is largely dependent on it. All the pushed out debris was identified and accumulated for weighting purpose. This was done for quantifying the debris under influence of different files and different systems. All teeth samples were comprehensively examined and tested under three study groups. This was necessary for comparison and evaluation purpose among the studied systems. In group I ProTaper Next system files (ProTaper Next system (PTN; Dentsply Maillefer, Ballaigues, Switzerland) were employed. These were used in the manufacturer's recommended sequences and directions. In group II, Twisted File adaptive instruments (Twisted File Adaptive (TFA; SybronEndo, Orange, CA, USA) were tested the manufacturer's suggested sequences and angulations. In both of the above systems, intermittent and in-between canal irrigation was ensured. In group III, Reciproc R25 files were evaluated for objectives. Preweighed glass vials containers (10 ml) were used for debris collection. The teeth were removed from Eppendorf tubes. The areas surrounding the orifice were isolated and prepared to accumulate sticked debris. For quantification procedure, the collected debris was weighted. This measurement procedure was attempted after thorough storage and proper conditioning of samples. The actual mass of the pushed out debris was calculated by deducting the mass of fresh glass container from the mass of debris container. All readings and relevant data was entered into master sheet and sent for statistical analysis. P value less than 0.05 was kept as significant.

Statistical Analysis and Results

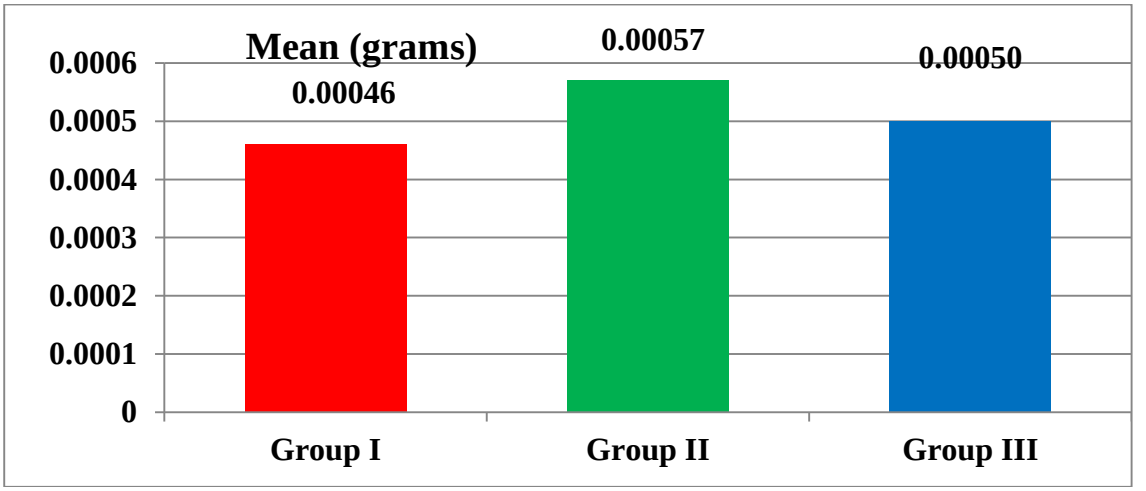
All interpretations and applicable data was entered into master sheet and sent for statistical analysis. Social Sciences version 21 software was used for efficient and precise statistical analysis. Suitable statistical tests was utilized to obtain significant and others statistical parameters like standard error. Most of the results were much unexpected since we compared latest file systems available in the field of endodontics. Here, every attempt has been made to genuinely process the data so as to make it authentic. The three types of files system with their segregation among groups was done carefully. Graph I is about mean pushed out debris out of the foramen. The mean weight of debris in group I was 0.00046 grams, in group II was 0.00057 grams and in group III was 0.00050 grams. Table I shows comparison of difference between groups and basic statistical description with level of significance evaluation using Pearson chi-square test. The difference was non- significant (P> 0.05). Pearson Chi-Square values were reported to be 2.885, 2.049, 2.234 respectively for group I, II and III. Standard Deviation values were reported to be 0.746, 1.387, 1.428 respectively for group I, II and III. 95%

coefficient of interval values was reported to be 1.93, 2.54, 1.12 respectively for group I, II and III (graph II and III).

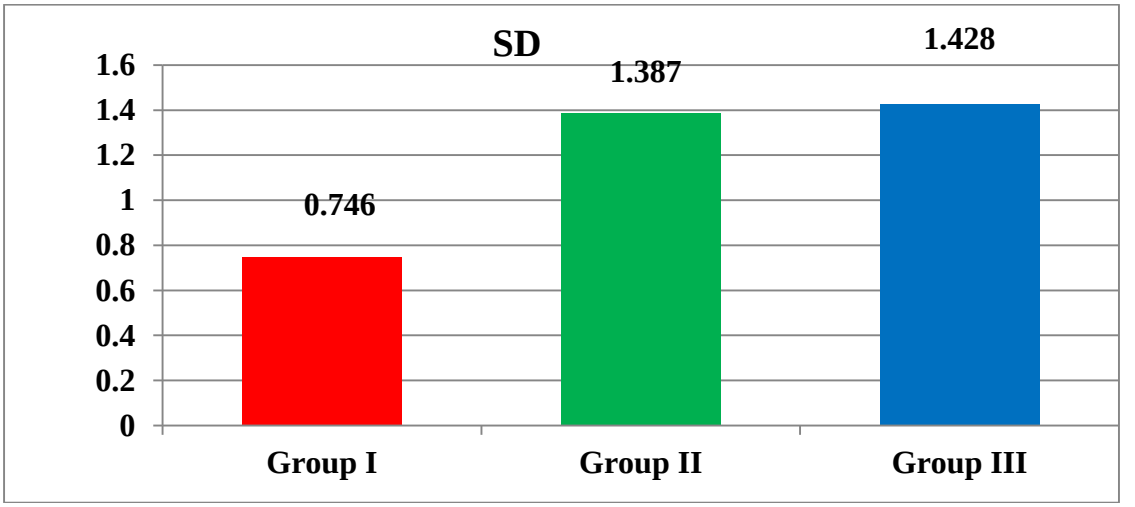
Table I: Comparison of difference between groups and basic statistical description with level of significance evaluation using Pearson chi-square test

Groups	Mean (grams)	Std. Deviation	Std. Error	95% CI	PCS test Value	df	p value
I	0.00046	0.746	0.048	1.93	2.885	1.0	0.58
II	0.00057	1.387	0.546	2.54	2.049	1.0	
III	0.00050	1.428	0.657	1.12	2.234	1.0	

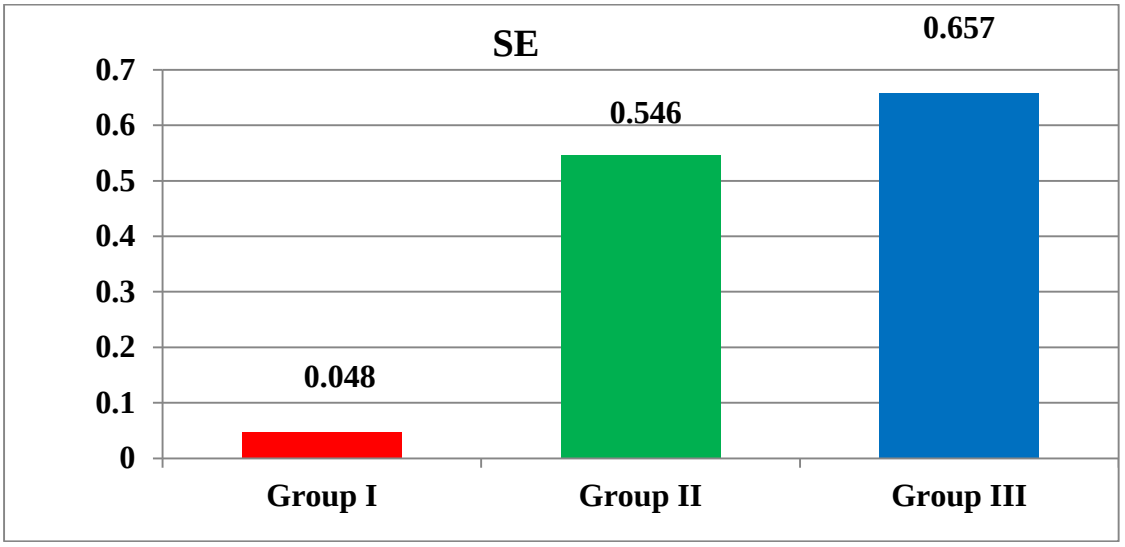
Graph I: Mean weight of pushed out debris in peri-foramen region



Graph II: Std. Deviation of three studied groups



Graph III: Std. Error of three studied groups



Discussion

Endodontic therapy enjoys a higher success rate in modern times with newer discoveries in cleaning and shaping systems. Many of the prominent researchers have stated that apical pushing of debris is an unavoidable phenomenon which can be minimized. Also, this unwanted event is mostly unnoticed by clinicians during routine endodontic procedures. Such apically pushed materials can trigger many undesirable bacterial and tissue reactions. All these procedures eventually lead to pain and associated symptoms to patient with extreme discomfort. Such conditions are fairly classified under failure of endodontic therapy.[13-17] Also, it's mentioned in the classic textbooks and published articles root canal shaping procedure itself produce dentinal flakes and necrosed pulp. Therefore intermittent irrigation is deemed necessary to wash off these undesired things out of the canal. Consequently, operator unknowingly produces debris and pushes it out of canal especially with non'roraty instruments. Debris pushed out of the root apex also initiate destructive processes in the surrounding tissues. Hence, dilemmas associated with debris are known to be minimum with rotary systems. Newer and advanced rotary files usually ends up with finest canal preparation with limited pushed out debris. Patients treated with these systems usually exhibit above fair prognosis in their follow up visits.[18-23] The present study was very judiciously framed to quantitatively guesstimate the amount of pushed off debris during instrumentation with three commercial rotary systems. Saavedra et al[24] randomly selected thirty extracted maxillary molars and performed canal standard instrumentations with predetermined file systems. Their results were highly comparable since the mean mass of debris was very close to our study findings. Doğanay et al[25] performed their study on a single file system with different motions, parameters and angulations. They measured pushed out debris while instrumentation with Reciproc file system. They attempted quantitative assessment of apically pushed out debris with Twisted File Adaptive instruments in non-curved root canals. They ensured to have reciprocation with dissimilar

directions and nonstop revolution. Arslan et al[26] evaluated pushed out debris during canal preparation with two popular rotary file systems. They concluded that the diameter of opening and amount of irrigant have a intricate correlation to the quantity of pushed out debris. A common finding of nearly all the studies in endodontic literature led to a generalized view that the crown-down technique extrudes less debris and irrigants apically as compared to the step-back technique and that a linear filing motion push more debris when compared to instruments used in rotational motion.

Conclusion

Within the limitations of the study, authors noticed that considerable amount of debris was pushed by all three studied file systems however; maximum quantity was seen with TF adaptive instruments followed by Reciproc and ProTaper Next files system. Our study inferences must be treated as evocative for presuming prognosis for comparable clinical conditions. However, authors expect some other large scale studies to be executed that may further create few standard and concrete guidelines in these perspectives.

References

1. Kaushal D, Reddy SG, Biswas KP, Dixit A, Chowdhry R, Chug A. Apical extrusion of debris with root canal instrumentation in primary teeth: A systematic review. J Indian Soc Pedod Prev Dent. 2022 Jan-Mar;40(1):9-18.
2. Hassan E, Sharaan M, Ragab M. Cleaning Efficacy and Debris Extrusion using XP-Endo Finisher and XP-Endo Finisher R as Supplementary Files during Retreatment: An in Vitro Study. Eur Endod J. 2022 Mar;7(1):40-46.
3. Ahmad MZ, Sadaf D, MacBain MM, Merdad KA. Effect of mode of rotation on apical extrusion of debris with four different single-file endodontic instrumentation systems: Systematic review and meta-analysis. Aust Endod J. 2022 Apr;48(1):202-218.
4. Tanalp J. A critical analysis of research methods and experimental models to study apical extrusion of debris and irrigants. Int Endod J. 2022 Mar;55 Suppl 1:153-177.
5. Kharouf N, Pedullà E, Nehme W, Akarma K, Mercey A, Gros CI, Haikel Y, Mancino D. Apically Extruded Debris in Curved Root Canals Using a New Reciprocating Single-File Shaping System. J Endod. 2022 Jan;48(1):117-122.
6. Singh AK, Chavan SC, Shah A, Parida R, Kansar N, Poojary S. Assessment of Apical Extrusion of Debris during Root Canal Preparation with Different Ni-Ti File Systems: An In Vitro Study. J Contemp Dent Pract. 2021 Apr 1;22(4):349-352.
7. Al Omari T, El-Farraj H, Arıcan B, Atav Ateş A. Apical debris extrusion of full-sequenced rotary systems in narrow ribbon-shaped canals. Aust Endod J. 2021 Jun 14.
8. da Silva EJNL, de Moura SG, de Lima CO, Barbosa AFA, Misael WF, Lacerda MFLS, Sassone LM. Shaping ability and apical debris extrusion after root canal preparation with rotary or reciprocating instruments: a micro-CT study. Restor Dent Endod. 2021 Feb 25;46(2):e16.

9. Bürklein S, Donnermeyer D, Hentschel TJ, Schäfer E. Shaping Ability and Debris Extrusion of New Rotary Nickel-Titanium Root Canal Instruments. Materials (Basel). 2021 Feb 24;14(5):1063.
10. Solda C, Padoim K, Rigo L, Silva Sousa YTC, Hartmann MSM. Assessment of Apical Extrusion using Rotary and Reciprocating Systems during Root Canal Retreatment. J Contemp Dent Pract. 2020 Mar 1;21(3):238-241.
11. Kucukyilmaz E, Savas S, Saygili G, Uysal B. Evaluation of Apically Extruded Debris and Irrigant Produced by Different Nickel-Titanium Instrument Systems in Primary Teeth. J Contemp Dent Pract. 2015 Nov 1;16(11):864-8.
12. Soi S, Yadav S, Sharma S, Sharma M. In Vitro Comparison of Apically Extruded Debris during Root Canal Preparation of Mandibular Premolars with Manual and Rotary Instruments. J Dent Res Dent Clin Dent Prospects. 2015 Summer;9(3):131-7.
13. Koçak MM, Çiçek E, Koçak S, Sağlam BC, Furuncuoğlu F. Comparison of ProTaper Next and HyFlex instruments on apical debris extrusion in curved canals. Int Endod J. 2016 Oct;49(10):996-1000.
14. Gunes B, Yeter KY. The effect of cervical preflaring on the apical debris extrusion of single or multiple rotary Ni-Ti files. Niger J Clin Pract. 2020 Apr;23(4):510-514.
15. Elashiry MM, Saber SE, Elashry SH. Apical extrusion of debris after canal shaping with three single-file systems. Niger J Clin Pract. 2020 Jan;23(1):79-83.
16. Nevares G, Xavier F, Gominho L, Cavalcanti F, Cassimiro M, Romeiro K, Alvares P, Queiroz G, Sobral AP, Gerbi M, Silveira M, Albuquerque D. Apical Extrusion of Debris Produced during Continuous Rotating and Reciprocating Motion. Scientific World Journal. 2015;2015:267264.
17. Arruda-Vasconcelos R, Barbosa-Ribeiro M, Louzada LM, Mantovani GD, Gomes BP. Apically Extruded Debris Using Passive Ultrasonic Irrigation Associated with Different Root Canal Irrigants. Braz Dent J. 2019 Jul 22;30(4):363-367.
18. Koçak S, Koçak MM, Sağlam BC, Türker SA, Sağsen B, Er Ö. Apical extrusion of debris using self-adjusting file, reciprocating single-file, and 2 rotary instrumentation systems. J Endod. 2013 Oct;39(10):1278-80.
19. Tanalp J, Güngör T. Apical extrusion of debris: a literature review of an inherent occurrence during root canal treatment. Int Endod J. 2014 Mar;47(3):211-21.
20. Topçuoğlu G, Topçuoğlu HS, Akpek F. Evaluation of apically extruded debris during root canal preparation in primary molar teeth using three different rotary systems and hand files. Int J Paediatr Dent. 2016 Sep;26(5):357-63.
21. Boijink D, Costa DD, Hoppe CB, Kopper PMP, Grecca FS. Apically Extruded Debris in Curved Root Canals Using the WaveOne Gold Reciprocating and Twisted File Adaptive Systems. J Endod. 2018 Aug;44(8):1289-1292.
22. De-Deus GA, Nogueira Leal Silva EJ, Moreira EJ, de Almeida Neves A, Belladonna FG, Tameirão M. Assessment of apically extruded debris produced by the self-adjusting file system. J Endod. 2014 Apr;40(4):526-9.
23. Dincer AN, Guneser MB, Arslan D. Apical extrusion of debris during root canal preparation using a novel nickel-titanium file system: WaveOne gold. J Conserv Dent. 2017 Sep-Oct;20(5):322-325.

24. Saavedra F, Tinoco JM, De-Deus G, Tinoco EM, Fidel RAS, Sassone LM. Apical extrusion of bacteria when using reciprocating single-file and rotary multi file instrumentation systems. Int Endod J 2014;47:560-566.
25. Doğanay E, Arslan H, Alsancak M, Çapar ID, Karataş E, GündüzHA. Comparison of apically extruded debris after root canal instrumentation using Reciproc instruments with various kinematics. Int Endod J 2016;49:307-310.
26. Arslan H, Karatas E, Kırıcı DÖ. Alsancak M, Çapar ID. Quantitative evaluation of apically extruded debris with Twisted File Adaptive instruments in straight root canals: reciprocation with different angles, adaptive motion and continuous rotation. Int Endod J 2016;49:382-385.