ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: www.ijmacr.com

Volume – 5, Issue – 3, May - June - 2022, Page No. : 120 - 128

A Comparative Evaluation of Apically Extruded Debris After Retreatment Procedure with Neo Endo, NRT GPR and Protaper Universal Retreatment File System- An In Vitro Study

[1]Dr. Yogesh Sahu, Professor, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

[2]Dr. Manjunath Malur, Head of Department, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

[3]Dr. Ankita Singh, Reader, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

[4]Dr. Praveen Mishra, Reader, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

[5]Dr. Shruti Sharma, Senior Lecturer, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

[6]Dr. Kalyan Lad, Postgraduate Student, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

Corresponding Author: Dr. Kalyan lad, Postgraduate Student, Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry and Research Centre, Durg.

How to citation this article: Dr. Yogesh Sahu, Dr. Manjunath Malur, Dr. Ankita Singh, Dr. Praveen Mishra, Dr. Shruti Sharma, Dr. Kalyan Lad, "A Comparative Evaluation of Apically Extruded Debris After Retreatment Procedure with Neo Endo, NRT GPR and Protaper Universal Retreatment File System- An In Vitro Study", IJMACR- May - June - 2022, Vol – 5, Issue - 3, P. No. 120 – 128.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: The Aim of the study was to Quantitatively evaluate and compare the amount of apically extruded debris during retreatment procedure using three different retreatment file system.

Materials & Method: 60 Mandibular premolars with single root and canal were instrumented with Protaper Universal rotary system (SX-F3) and obturated. The samples were randomly divided into three groups (n=20). Group 1 – PTUR files were used for Retreatment, Group 2- NRT GPR & Group 3- Neo Endo retreatment files were used. Debris weighed apically were collected in Prewieghed Eppendorf tubes. The difference between the weights of Eppendorf tubes is equal to weight of apically extruded debris. Statistical analysis was performed using one way analysis of Variance (ANOVA).

Result: All three experimental groups presented significant difference (P<.01). The post hoc Tukeys test confirmed that group 1 exhibited significantly less (P<.01) debris extrusion between the three groups tested.

Keywords: Apical Extrusion of Debris, Endodontic Retreatment, Eppendorf Tubes, Neo Endo Retreatment Files, NRT GPR Files, Protaper Universal Retreatment Files (PTUR)

Introduction

Root canal treatment can be described as the aggregate of mechanical instrumentation of root canal system, disinfection, chemical debridement and filling with an inert material, designed to maintain & repair the health of the periradicular tissues[1].62% to 96% achievement rate of endodontic therapy is determined through the criteria's namely, clinical outcome, radiographs and histological evidence.[2]

Persistent intra radicular infection in formerly uninstrumented canals, dentinal tubules, or with inside the complicated irregularities of the root canal system attributes to failure of healing. Endodontic retreatment is described as a method accomplished on a tooth that diagnostically demonstrates incomplete treatment, but the actual conditions require in addition endodontic treatment to acquire successful results.[3] De contamination of the root canal system so one can establish healthy periapical tissues, which include cleaning, shaping, and 3-dimensional filling of formerly obturated root canals[4] is constantly been the principle aim of non-surgical root canal retreatment.

Postoperative inflammation flare-up or failure of apical healing at some stage in endodontic retreatment, can be brought about because of ejection of filling material, necrotic pulp tissue, microorganism or irrigant. Hence, the correct retreatment method have to be decided on for complete elimination of the pre-existing filling material with minimum apical extrusion. SS Hand files, Ni-Ti files in reciprocal motion, Ni-Ti files in rotational motion, and retreatment files[5] are the unique instrumentation techniques delivered to dispose of the canal filling material. Effect of diverse retreatment structures have been studied and evaluated during retreatment procedures with confined research on quantification of the quantity of apically extruded debris. The predominant goal of the study is to examine the quantity of apically extruded debris in the retreatment procedure using Protaper retreatment files, NRT GPR Files and Neo Endo retreatment files.

Materials and Method

Methodology

Sixty extracted permanent mandibular premolar single rooted teeth with completely formed apex were selected for study.

Specimen Storage

The teeth were thoroughly cleaned using ultrasonic scaler and stored in normal saline until further use.

Specimen Preparation

Access cavity preparation was done using round diamond point for initial punch cut and followed by Endo access and Endo Z bur. Confirmation of apical patency was performed with #10K files until visible at the apical foramen (Fig.1) and the working length was determined by using Ingle's radiographic method (Fig.2). Initial Biomechanical Preparation was done using Hand files Up to #20 till working length. The root canals were prepared with the Protaper Universal system (Dentsply Maillefer) Ballaigues, Switzerland) in a crown-down manner in combination with a torque-controlled engine (X-Smart, Dentsply Maillefer, Ballaigues, Switzerland) at 250 rpm according to the

manufacturer's instructions. A Sx file was used at the root canal entrance as a guide for the other files and orifice opener. S1 and S2 files were used to prepare the coronal and middle thirds of the roots. Apical enlargement was performed using the F1, F2 and F3 files. The root canals were irrigated using 2 mL of 5% NaOCl between instruments.

Obturation

The root canals were dried with sterile paper points and were obturated using F3 Gutta percha and epoxy resin-based sealer (AH Plus, Dentsply De Trey GmbH, Konstanz, Germany).

Storage

The access cavities were filled with temporary material cavit. All specimens were stored in 100% humidity at 37°C for 7 days to allow the sealer cement to set.

Myers & Montgomery apparatus design for debris collection

The experimental model used to evaluate apically extruded debris was similar to that described by Myers & Montgomery (1991). This system consisted of a rubber stopper, Eppendorf tubes [Polyethylene vial], 27-gauge needle and glass vial. Aluminum foil was used to cover the whole of the experimental apparatus (Fig.3). Before starting the experimental procedure, three consecutive measurements were taken for each Eppendorf tube using digital micro-analytical weight with an accuracy of 10^{-5} gm; the mean was recorded (Fig.4). A hole was created in a rubber stopper and Eppendorf tube with obturated premolar was placed in the created hole and a 27gauge needle was used alongside the stopper to equalize air pressure inside and outside the tubes. The entire apparatus was handled only by the outer vial and not the inner Eppendorf tube with fingers. All vials were covered with aluminum foil to prevent the operator from viewing debris extrusion during the instrumentation. In this study, the samples were randomly divided into Three equal groups (n=20). The retreatment procedures were carried out in all the groups as follows:

Group A: PTR Group: The root fillings were removed using PTR files: D1, D2 and D3 as per the manufacturer's instructions with Endo motor in a brushing motion.

Group B: NRT-GPR: The root fillings in this group were first softened with 0.1 mL of Gutta percha solvent and 1S (70/0.04) was used only for canal entrance, 2S (50/0.04) was used for coronal third of the canal, 3N (40/0.04) was used in middle third and 4N (30/0.04) was used in apical third. These instruments were operated at 1000 rpm and no torque control, according to manufacturer’s recommendations.

Group C Neo Endo Retreatment files: The root fillings were removed in crown down technique N1(# 30/0.09) was used for coronal one third, N2(# 25/0.08) was used for middle third and N3(20/0.07) was used for apical one third of obturated root canals.

Following the completion of retreatment procedure, the periapical debris was collected by washing off the periapical area with 1ml of distilled water into the Eppendorf tube. The tubes were then stored in an incubator at 70^0C for Five days to allow the moisture to evaporate. The Tubes were then weighed thrice and the mean weight was calculated.

The weight of apically extruded debris was calculated by the formula

Dry wt. of debris = Wt. of Eppendorf tube with debris – Wt. of empty Eppendorf tube

Result

The aim of this in-vitro study was to compare the mean weight of dry debris extruded during retreatment procedure by different file systems. The empty Eppendorf tubes were weighed thrice by using digital microbalance which has accuracy of 10^{-5} gm. Then the mean weight of empty Eppendorf tubes was calculated and noted for each sample.

After completion of retreatment procedure, Eppendorf tubes which were used to collect debris were weighed thrice by using digital microbalance and mean weight of each sample was calculated. From this weight the mean weight of empty Eppendorf tube was sub structed to obtain the weight of debris extruded.

Group 1- 1.1mg

Group2-1.61mg

Group3- 2.21mg

These values show that the maximum debris extrusion was seen with group 3 followed by group 2 and group 1. Significant differences can be seen within group 1 and group 3 whereas the least difference is observed among group 1 and 2. Hence it can be seen that neo endo retreatment group showed the maximum debris extrusion which can be attributed to its higher dentin removal whereas the Protaper retreatment file system showed the minimum debris extrusion.

Study Group	N	**Mean Score in miligrams (Mean ± S.D.)**	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Study Group I (Protaper Universal Retreatment Group)	20	**1181.7 ± 7.08**	1.58465	1178.3863	1185.0197	1171.10	1191.12
Study Group II (MANI NRT GPR Retreatment Group)	20	**1180.8 ± 8.54**	1.91100	1176.7832	1184.7828	1167.84	1194.12
Study Group III (NEO ENDO Retreatment Group)	20	**1176.4 ± 7.71**	1.72620	1172.7730	1179.9990	1161.52	1185.52

Table 1: mean values of weight of Eppendorf tubes (in mg) among different study groups prior to debris collection.

Comparisons	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	14.714	2	7.357	20.356	0.00008 ($p<0.05$) Significant
Within Groups	20.601	57	.361		
Total	35.315	59			

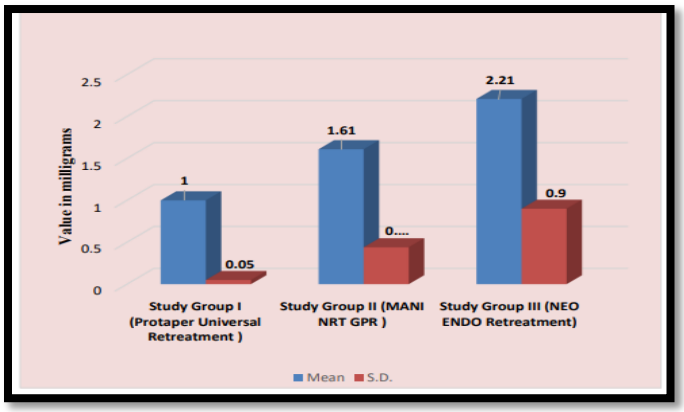
Table 2: One way ANOVA test results for comparison among different study Group with respect to debris.

Table 2 shows the comparision between the group and within the group ($p<0.05$)

Graph 1: Mean values of weight of Eppendorf tubes (in mg) among different study group prior to debris collection

Graph 1 shows mean values of weights of Eppendorf tubes (in mg) among different study group prior so debris collection

Graph 2: comparisons of mean values of debris in milligrams among different study group after retreatment



Graph 2 shows comparision of mean values of debris in milligrams among different study group after retreatment

Discussion

Achieving the complete debridement of root canal, disinfection and fluid tight obturation remains the main aim of the endodontically treated teeth. Failure of root canal treatment can be associated with poorly treated root canal alongside problems associated with canal anatomy and microbial factor that can explain failure rates of about 8% for treated root canals.[6] The most conservative approach and first choice to resolve the problem of failure is the retreatment.

The removal of root canal filling and further cleaning, shaping and refilling of the canal remains the only requirement of endodontic retreatment.[7]In the present study, experimental model used to evaluate apically extruded debris was similar to that described by Myers and Montgomery (1991).

It is crucial to emphasise that the usage of extracted tooth has its limitations. The outcomes obtained from this study may not be specific if implemented in a clinical situation, due to the fact the experimental model used in this study to evaluate the apical extrusion of debris had the apex of tooth suspended in the air without any physical back pressure, while in clinical scenario, the apex is surrounded by granulomatous or periradicular tissues that could limit the apical extrusion.[8,9]

Some investigators have recommended simulating the resistance of periapical tissues the usage of floral foam (Hach Meister et al. 2002, Altundasar et al. 2011). However, the usage of floral foam can also additionally have an effect on the quantity of extruded particles and irrigants apically. [10,11,12] Therefore, no try was made to simulate the presence of periapical tissues in the current study. Thus, the results should not be directly extrapolated to clinical situation.

Previously, studies evaluated the amount of apical debris in a semi quantitative form with the use of the scoring system. It would be difficult to detect the tiny differences among various techniques and thus tends to provide an overoptimistic evaluation of apical extrusion.[13] In contrast, studies measuring the quantity of debris with the aid of microbalance accurate to 10 thousandths digit did find out the difference.[14,15] So to calculate the amount of extruded debris, the method suggested by Myers and Montgomery was adopted and has been made simple, practical and affordable.

In the present study Protaper universal retreatment files (Group 1) showed least apical extrusion of debris as compared to Mani NRT GPR (Group 2) and Neo Endo retreatment files (Group 3).

The Protaper retreatment files were the earliest rotary files specifically designed for removing root canal filling. These files consist of a set of 3 files, D1, D2, D3. The D1 file has a tip size of 30 with 9% taper and is 16.0mm in length. It has an active cutting tip to effectively penetrate into the filling material. The D2 file a size of 25 with 8% taper and D3 file has size 20 with 7% taper. The D2 and D3 file have length of 20.0mm and 22.0mm respectively. The three files are designed to remove filling material from the coronal, middle and apical one-thirds respectively. All the three files have a convex triangular cross-section.

The Protaper retreatment files both soften the gutta-percha through rotary action and remove large amounts of gutta percha by cutting and incorporating it between the blades.[16]Protaper universal retreatment files tend to pull the gutta percha into flutes and lead it towards the canal orifice. The File blades have negative cutting angle with no radial land, thus exerting a cutting and not a planning action on gutta percha that may facilitate its

easier removal.[17]The triangular modified triangular cross section of Protaper produces a lower cutting efficiency and smaller chip space. The continuous rotary motion acts like a screw conveyor and improves the coronal transportation of dentin debris.[18]Guiliani et al. attributed the gutta percha removal ability of Protaper universal retreatment instruments to the spirals running around the instruments and the negative cutting angle which produces cutting action instead of planning the gutta percha against the canal walls. [19]

Bramante et al. attributed the rapid and efficient performance of Protaper retreatment instruments to their higher taper and more metallic core. Such a design of working blade causes increased heat release and rapid plasticization of gutta-percha.[19] In the present study Group 1 i.e, Protaper universal retreatment files showed least amount of extruded debris apically during retreatment. This may be due to the factors that the cross section of Protaper universal retreatment is triangular in design, which reduces the contact area between the file and root canal wall and consequently the amount of debris extrusion.[17]Protaper universal retreatment files have three point contact with root canal dentinal wall, there is ample of space between the instrument and the walls to accommodate the fragmented debris unlike other files.[16] In our study Protaper universal retreatment file system showed less amount of extruded debris as compared to Mani NRT GPR files and the difference was statistically significant this difference may be due to the fact that Mani NRT GPR files consist of four files and Protaper universal retreatment files consist of three files. Also the Negative cutting edge angle of Protaper universal files may be the reason for less extrusion of debris apically as Positive cutting edge angle of files removes the root filling material in chunks and pieces.[20]

The Mani GPR system (Mani Inc, Tokyo, Japan) is composed of 4 file instruments (1S, 2S, 3N and 4N) that are operated in continuous rotation. The first 2 instruments i.e 1S (16 mm, green, 0.70 mm tip size) and 2S (18 mm, yellow, 0.50 mm tip size) are manufactured from a stainless-steel alloy and are meant to remove the filling material from the coronal portion of the canal. Instruments 3N (21 mm, black, 0.40 mm tip size) and 4N (21 mm, blue 0.30 mm tip size) are made of nickel-titanium alloy and are used in middle and apical canal segments. All files are teardrop shaped in cross section.70,103 In our study NRT GPR files extruded more debris than PTUR files and the probable reason may be the no. instruments used. NRT GPR consist of 4 instruments whereas PTUR consist of only three instruments. Previous studies have concluded that more the number of instruments used more will be the extrusion of debris.[21]

Xu D. et al. had compared extrusion of debris apically during retreatment procedure by using NRT GPR, PTUR and H files and concluded that NRT GPR files extruded less amount of debris as compared to PTUR files and H files.[22] In our study Mani NRT GPR showed less extrusion of debris apically and the difference was statistically significant as compared to Neo Endo Retreatment files this may be due to the difference in cross section of two file systems, Mani NRT GPR files have a tear drop shaped cross section and Neo Endo files have Parallelogram cross section. This unique cross-sectional tear drop design that cuts exceptionally well, which eliminates the screwing in effect, while removing debris effectively and reducing instrument stress.[23]The deep helical grooves on NRT GPR files increases the elimination space of softened gutta-percha and make it easier to roll it in the blade edge resulting in less debris.

[22]Mani NRT GPR files have noncutting tip and greater tip diameter as compared to Neo Endo retreatment files which results less removal of Gutta percha during retreatment procedure and simultaneously less extrusion of debris apically. Mani NRT GPR instruments were designed based on GPX stainless steel instruments, they have only one cutting edge, wide radial land and neutral cutting angle which reduces their cutting capacity. Also another reason may be that NRT GPR files have limited cutting efficiency as compared to other retreatment files, which means that NRT GPR files are less efficient in removal of gutta-percha which may have resulted in less extrusion of debris apically.[21]

Neo Endo Retreatment files (Orikam Healthcare, India) consist of three instruments. N1 (#30/0.09) was used for coronal one-third, N2 (#25/0.08), for middle-one third, and N3 (#20/0.07), for apical one-third of the obturated root canals. Files were used in circumferential filing motion in a crown-down approach using a torque-controlled motor at a speed and torque of 350 rpm and 1.5 N-cm, respectively. Discussion Neo Endo retreatment files resulted in more extrusion of debris apically during retreatment procedure as compared to PTUR files (Group 1) and Mani NRT GPR files (Group 2) and the difference was statistically significant. There is insufficient information in literature to compare the use of Neo Endo retreatment files. Earlier no study had compared the amount of extruded debris by using PTUR, Mani NRT GPR and Neo Endo retreatment files.

However, A.V. Muraleedhar et al. had compared the efficacy of PTUR and Neo Endo retreatment files in removing Gutta percha from root canals and concluded that Neo Endo retreatment files were more efficient and less time consuming as compared to PTUR files.[17]NeoEndo retreatment files have a heat-treated Ni-Ti metallurgy design having parallelogram cross-section, positive cutting edge and a positive rake angle with micro grinding manufacturing technology which limits the engagement zone.[24]The parallelogram cross section limits the contact between the file and dentin to only one or two points at any given cross section. This will subsequently reduce the binding and make sure that there is little or no screwing in, thus, improving the safety and cutting efficiency. Also it has an active cutting tip which helps in easy initial penetration.[17]

However, following factors may be considered for more extrusion of debris apically. The main parameter of the file that causes apical extrusion of debris is the cross-section of file and design of the file. Higher taper and more metallic core as compared to Mani NRT GPR files, which results in more rapid and more effective removal of gutta-percha from canal and consequently more extrusion of debris. Positive Rake angle and cutting-edge angle Difference in cross section of all three retreatment files. There is limited literature review regarding the Neo Endo retreatment file; hence, the study was conducted with available data obtained from the manufacture.

Conclusion

Within the limitations of the study, following, it can be concluded that, all three retreatment files used in this study extruded debris apically. However, Protaper Universal Retreatment files extruded least debris and Maximum extrusion of debris apically was seen with Neo Endo retreatment Files.

References

1. Y.L. Ng, V. Mann, S. Rahbaran, J. Lewsey and K. Gulabival. Outcome of primary root canal treatment: systematic review of the literature – Part 2. International Endodontic journal 2008;41,6-31.

2. Oyama KO, Siqueira EL, Santos MD. In vitro study of effect of solvent on root canal retreatment. BrazDent.J 2002;13(3):208-11.

3. Marfisi K, Mercade M, Plotino G, Duran-Sindreu F, Bueno R, Roig M. Efficacy of three different rotary files to remove gutta-percha and resilon from root canals. Int Endo J 2010 Nov 1;43(11):1022-8.

4. Western JS, Dicksit DD. Apical extrusion of debris in four endodontic instrumentation systems: A meta-analysis. J Conserv Dent 2017; 20:30-6.

5. 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.

6. Siqueira JF Jr, Rocas IN, Favieri A, Machado AG, Gahyva SM, Oliveira JC, Abad EC. Incidence of postoperative pain after intracanal procedures based on an antimicrobial strategy. J Endod. 2002;28(6):457-60.

7. Hinrichs R, Walker W, Schindler W. A Comparison of Amounts of Apically Extruded Debris Using Handpiece-Driven Nickel-Titanium Instrument Systems. J Endod.1998;24:2.

8. Turker S.A, Kocak C, MuratKocak M, Saglam B.C. effect of glide path preparation on apical debris extrusion of rotary and reciprocating single file systems: one shape versus Wave One. Cumhuriyet Dental journal.2014:18:1:1-8.

9. Silva E. N, Teixeria J.M, Kudsi N, Sass one L.M, Krebs R. L, Tauby S. Coutinho F. Influence of Apical preparation size and working length on Debris extrusion. Braz Dent J: 27:1:28-31.

10. Topcuoglu H. S, Duzgun S, Akpek F, Topcuoglu G, Akti A. Influence of a glide path on apical extrusion of debris during canal preparation using single file systems in curved canals.Int Endo Journal. 2016:49:599-603.

11. Altundasar E, Nagas E, uyanik O, Ankara. Debris and irrigant extrusion potential of two rotary systems and irrigation needles. Oral Surg Oral Med Oral Pathol Oral Radiol Endod.2011;112:31-35.

12. Hachmeister D.R, Schindler W.G, Walker W.A, Thomas D.D. The sealing ability and retention characteristics of mineral trioxide aggregrate in a model of Apexification. Journal of Endodontics.2002;28:5:386-390.

13. Hulsmann M, Bluhm V. Efficacy, cleaning ability and safety of different rotary Niti instruments in root canal retreatment. International Endodontic Journal.2004;37:468-476.

14. Tanalp J, Kaptan F, Sert S, Kayahan B, Bayirl G. Quantitative evaluation of the amount of apically extruded debris using 3 different rotary instrumentation systems. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2006;101(2):250-257.

15. Reddy S.A, Hicks L. M. Apical Extrusion of debris using two hand and two rotary instrumentation technique.JOE.1998;24:3:180-183.

16. Vikram M, Comparison of apically extruded debris during retreatment procedure by two types of endodontic instruments.2017;3:1:7-9.

17. Muraleedhar A.V, Sarvapeli S.V, Patil A. M, Kovvuru S.K, Patil S. Comparative Evaluation of Efficacy of three different rotary retreatment systems with Manual instrumentation in removing gutta-percha from root canals- An invitro study. Journal of evolution of medical and dental science.2021;10:14:1025-1029

18. Tomar A.K, Mittal N, Behera A, Raina A.A, John A.G, Ramachandran M, Bhatheja A. A comparative

evaluation of gutta-percha removal by various rotary files: An in vitro study. International Journal of Dental Sciences.2019;1:1:11-13.

19. Joseph M, Ahlawat J, Malhotra A, Rao M, Sharma A, Talwar S. Invitro 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.

20. Dixit K, Shivanna V, Siddeshwarn V. An ex-Vivo comparison of apical extrusion of debris and working time used by three different Protaper file systems during endodontic retreatment. IOSR-JDMS.2018;17:8:22-25.

21. Amal F, Aswathy Y, Jenaki E. V, Lekshmi S. V, Noora M. Efficacy of various rotary retreatment instruments for gutta percha removal: An in vitro study. International Journal of applied dental sciences.2020; 6:4: 242-246.

22. D Xu, Liu S, Huang Y, Chen H, Fahim S, Niu Y, Pan S. Comparative evaluation of the efficiency of different files in removing Gutta percha from curved root canals during root canal retreatment.2020;14:24-31.

23. Koppolu M, Bassam R, Sunil Kumar C, Lavanya A. Apical debris extrusion during root canal preparation with Protaper Next and Mani Silk Rotary systems: an invitro study. Journal of Operative Dentistry and Endodontics.2016;1:2:66-69.

24. Bar Nawal H.C, Mittal N, Garg R, Yadav J, Rani P. Comparative evaluation of ret ratability of Bioceramic sealer and epoxy resin sealer with two different retreatment files: an in vitro study. Journal of conservative dentistry.2021;24:1:88-93.