COMPARATIVE EVALUATION OF TWO DIFFERENT ROTARY INSTRUMENTATION SYSTEMS FOR REMOVAL OF GUTTA-PERCHA FROM ROOT CANAL DURING ENDODONTIC RETREATMENT: AN IN VITRO STUDY

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Abstract

Aim: To compare efficacy of ProTaper Universal retreatment files with Endostar RE Re-endo rotary file system for removal of gutta-percha from root canal during endodontic retreatment.

Materials & Methods: Forty freshly extracted human mandibular premolar were treated endodontically. The teeth specimens retreated by one of the two rotary systems after randomly distributing samples in 2 groups. Specimen teeth were sectioned in bucco-lingually direction and images were taken under stereomicroscope and transferred to AutoCAD Software2020.

Statistical Analysis: Results were analyzed using Mann-Whitney U test and one-way analysis of variance test and post hoc Tukey-HSD test ($p<0.05$).

Result: The mean percentage of remaining filling material was significantly higher in apical third of canal as compared to other thirds in both the groups. Post hoc tukey test showed that there was significantly higher residual filling material in all thirds of canals retreated with Endostar Re than Pro Taper universal group.

Conclusion: Pro Taper universal retreatment instruments were effective in removing root canal filling in all thirds of canal in comparison with Endostar retreatment instruments.

Keywords: Gutta percha removal, Pro Taper retreatment, Endostar retreatment.

Introduction:

Desire to retain natural dentition is now very high, that makes it very essential to have are liable treatment option to salvage natural dentition. Endodontic therapy is one of the commonly performed dental procedures. Endodontic treatment is predictable in nature with reported success rates up to 86–98%.[1] Despitethe high success rate of endodontic treatment, failures do occur in a large number of cases which could necessitate retreatment. Glossary of Endodontics defines retreatment as it is a procedure to remove root canal filling material from the tooth, followed by cleaning, shaping, and obturation of the canals.[2] The primary goal of orthograde retreatment is regaining access to the apical foramen by complete removal of root canal filling material, thus facilitating sufficient shaping cleaning and of the complete root canal system and then final obturation.[3]

For the complete removal of gutta-percha fillings, various instruments and instrumentation techniques are available like the use of hand files, rotary instruments, heat, ultrasonic, laser a adjunctive use of solvents.[4] Over the last couple of decades, various rotary nickel titanium retreatment instrument systems have been introduced to allow effective removal of filling material from a previously treated root canal. Among the various rotary nickel titanium retreatment instrument systems, ProTaper Universal retreatment files (Dentsply Maillefer, Ballaigues, Switzerland) have proved to be most efficient than other file systems in removal of root filling materials.[5-7]

Recently, a new Endostar RE Re-endo rotary file system (Poldent Co. Ltd., Warsaw,Poland) for removal of gutta-percha from root canal during endodontic retreatment has been introduced.

Root canal Procedure: Access were opened with Airotor and bur. Patency was achieved with [6,8,10] no K files. Working length was achieved with size15K-file (Dentsply,Maillefer, Ballaigues, Switzerland) was inserted into the canal until it was visible at the apical foramen. The working length was established as 0.5 mm short of this point. Root canal shaping and cleaning was performed with Protaper Universal rotary system till F5 with electric powered MotorX-Smart (Dentsply, Maillefer, Ballaigues,Switzerland).Manufacturer's instruction for speed and torque were followed for shaping of canals. Irrigations was done with 5% of sodium hypochlorite during cleaning and shaping of root canals and 17%Ethylenediamine tetra acetic acid was used as final rinse for 30 seconds followed by rinse of 5ml saline for removal of smear layer and better adhesion of AH plus sealer. All the specimens were obturated with gutta-percha and Ah Plus sealer using cold lateral compaction technique. The quality and extent of obturation were confirmed radiographically. Specimens were stored in an incubator at 37°C and 100% humidity for three weeks to simulate oral condition and to ensure complete setting of sealer.

Retreatment Procedure: Specimens were randomly distributed into 2 groups (n=20).Each of the groups were retreated with one of the retreatment system.

The obturation was then removed using one of the following techniques:

Group1:ProTaper Universal retreatment files system
ProTaper Universal retreatment files were used in crown-down manner in a brushing motion at constant speed of 500 rpm. D1 (tip of 0.30mm; 9% taper) was used in the coronal third, D2(tip of 0.25; 8% taper) in the middle third, and D3 (tip of 0.20; 7% taper) in the apical third as specified by the manufacturer.

Group2: Endostar Re-endo rotary files system
Endostar RE Re-Endo Rotary files was used in crown-down manner in gentle up-and-down motion at constant speed of 150 rpm. Number 1 file (tip of 0.30mm; 0.12% taper) was used in the coronal third. Number 2(tip of 0.30mm; 0.08% taper), 3(tip of 0.30mm with 0.06%taper) and 4 (tip of 0.30mm with 0.04% taper) files was sequentially used to reach up to the working length as recommended by the manufacturer.
Removal was considered complete in both groups when no filling material was observed on removal of the files. In both the groups, canal was rinsed with 5 ml of 5% NaOCl between each instrument. One set of retreatment files was used for retreatment of five root canals. Files were cleaned regularly using air-water spray to remove obturation material and debris.
Each root canal was prepared, filled, and retreated by the same operator to reduce the interoperate variability

Statistical Analysis:
The data collected was entered in Microsoft Excel and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS,IBM version 20.0). The level of significance was fixed at 5% and p≤0.05was considered statistically significant. Kolmogorov- Smirnov test and Shapiro-Wilks test were employed to test the normality of data. Mann-Whitney U test, Kruskal-Wallis and post hoc tukey analysis was performed for quantitative variables.

Results:
The descriptive statistics, including mean and standard deviation were calculated for each group tested. The evaluation of mean canal cleanliness (%) by different rotary instrumentations was done. An evaluation of canal cleanliness revealed significant differences (p value.001) for both the retreatment rotary instrumentation systems with significantly higher cleanliness in coronal area when compared with the other two. (Table 1) With respect the comparison of canal thirds, the mean percentage of remaining filling material was significantly higher in apical third in all groups (p<0.05).In concern with mean canal cleanliness (%) by different retreatment rotary instrumentation with respect to coronal, middle and apical third Protaper retreatment rotary group showed significantly (P<0.05) better results in cleaning efficacy as compared to Endostar retreatment rotary group {Table 1(a) and (b)}. Comparative evaluation of the overall effectiveness of different rotary instrumentation system for gutta-percha removal from the root canal during endodontic retreatment results revealed significant differences between the two systems (p value .001) with higher effectiveness for ProTaper rotary instrumentation system when compared with Endostar (Table 2)

Rotary Instrument	Area	Mean + SD	p value
Pro Taper	Coronal	97.5+4.60	.001* (s)
	Middle	87.10+13.74	
	Apical	76.25+14.83	
Endostar	Coronal	91.95+8.58	.001* (s)
	Middle	67.30+14.18	
	Apical	67.45+9.25	

Table 1: Evaluation of the mean canal cleanliness (%) in different areas by rotary instruments.

	Coronal	Middle	Apical
Coronal	----	.022*	.001*
Middle	.022*	-----	.016*
Apical	.001*	.016*	-----

Table 1(a): Post hoc analysis – Pro taper

Area	ProTaper	Endostar	p Value
	Mean + SD	Mean + SD	
Coronal	97.5+4.60	91.95+8.58	.001* (s)
Middle	87.10+13.74	67.30+14.18	.001* (s)
Apical	76.25+14.83	67.45+9.25	.05* (s)

Table 2: Comparison of the mean canal cleanliness (%) by different rotary instrumentation

Discussion: In today's era of advancements, dentistry has come up with advanced armamentarium and newer technologies which have made nonsurgical retreatment more predictable and less cumbersome, thus making it a viable option over surgical Endodontics. Nonsurgical retreatment is a non-invasive procedure which primarily focuses on completely removing all the root canal filling material and re- establishing sterile condition of root canal to further receive an appropriate obturation[8].Gutta-percha is one of the oldest and widely accepted obturating material in the root canal treatment and therefore it is considered as a gold standard material for root canal filling.[9]Various techniques has been employed to fill gutta-percha in the root canal but cold lateral compaction is the simplest, cost effective yet predictable and most commonly taught technique worldwide.[10] As a consequence of this gutta-percha and cold lateral compaction was used in this study. Along with gutta-percha, sealers also play an important role in sealing of the remaining spaces and adhering gutta-percha to root canal wall. In the midst of sealers available in market AH plus has been widely accepted due to its better adhesion properties with gutta-percha in root canal filling.[11]

Hand instruments are the most commonly utilized method for removal of gutta-percha with or without solvent. But this technique proves to be time consuming and unpredictable as it is more prone to mishaps such as canal transportation or ledge formations while the rotary technique is considered to be more time saving and safe for removal of well-condensed obturation.[12]

ProTaper universal retreatment files are used in many retreatment-based studies. As many studies agrees to the fact that Pro Taper universal retreatment files has better cleaning ability than other files in market. Possible explanation to this might be because of large spirals being utilized to remove large amounts of gutta-percha in spirals around the instruments and its negative cutting angles and the lack of radial land might allow a cutting action rather than a planning action.[13,14]

In this study Endostar Re retreatment rotary system was used because it is recently introduced file system which consists of 4 files each has same tip size of 30 with non-cutting tip but different taper and different cross section, File 1 and 2 has got k-file type cross section with 4 cutting edges while file no, 3 and 4 have S type of cross section with 2 point contact by which it can cut 90 degree to canal wall.[15]

In this study single rooted mandibular premolar teeth were opted as it rules out the chance of root canal anatomy variations that can affect the final outcome of the study. All the teeth were decoronated to standardized workinglengthat16mm to minimize bias of varying working length as this was implied in previous studies.[13] Shaping and cleaning was facilitated using a ProTaper universal NiTi file instead of hand file as NiTi rotary system poses less chances of errors in preparation and also, they are less time consuming.12Shaping and cleaning was performed with standard protocol followed by obturation with cold lateral compaction. Samples incubated at 37°C for 2 days to ensure and simulate complete setting of sealer at mouth temperature[13].

Several techniques have been employed to analyse the remaining filling material in the canals such as computed tomography[16,17] and splitting the roots longitudinally to view it under Stereomicroscope 18,19. In present study, the teeth were grooved longitudinally and split and stereomicroscope is used to visualize it and photo-graphs were taken as proposed in other studies.[18,19]

This method is considered to be a simple and efficient method for analyzing the root canal walls but it also has an objection, which is displacement of the filling material that might occur during splitting and affect the accuracy of scoring[20].All the endodontic procedures were conducted by single operator to minimize operator bias. This study also correlated to other studies that independent of the type and technique of retreatment the highest amount of filling material was remained in apical portion as compared to coronal and middle thirds of canal space [19-21]. This can be attributed to anatomical variability and difficulty of instrumentation[22]. Coronal third depicted cleaner walls than middle and apical third. This can be because of wider diameter at coronal area and larger size and taper of retreatment file that was utilized for coronal section[15].It has been observed that during retreatment with Endostar Re particularly initial files fails to quickly penetrate the coronal gutta-percha as this system poses non-active tip design. Gutta-percha was pushed laterally rather than transporting shredded gutta- percha coronally.This can be attributed to geometrical cross-sectional design of the Endostar rotary file. In Endostar RE file no 1 and 2 have K-type of cross section that is square in shape which will give the file negative rake angle which in turn will result in

scrapping rather than cutting action. Square cross section will also contribute to less chip space which will result in less auguring of debris in coronal direction[15]. According to results of this study irrespective of rotary system used remnants of gutta-percha were seen present in coronal, middle, apical third of the canal. In this study efficacy of removal of canal filling material from coronal, middle and apical third of canal was evaluated. With regards to mean canal cleanliness in coronal third as compared to the middle and apical region was superior and found to be statistically significant (p value .001).In context of ProTaper universal Rotary retreatment file it has been observed that there was significant difference in the mean canal cleanliness between coronal, middle and apical third of canal space (P<0.05).While as with respect to Endostar rotary instrumentation there was significant difference for all the areas except between middle and apical area.(p=.001)

In further evaluation of cleaning efficacy between two file systems, it was revealed that ProTaper Universal Retreatment rotary file system performed significantly better in the coronal, middle and apical thirds of canals space, nevertheless appertaining to comparison of overall combined efficacy between both file system ProTaper universal retreatment rotary file exhibited significantly better result as compared to Endostar RE rotary file system(p value.001) this can be attributed to geometrical cross section and active tip design of ProTaper instruments. No instrument separation occurred during this study that can be attributed to straight canal anatomy. The use of these files in curved canals cannot be correlated to results of this study. [22-23]

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