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Comparative evaluation of the efficacy of two different rotary retreatment systems and manual instrumentation in removing gutta-percha/sealer from root canals – An in vitro study

[1]Ananthakrishna S., [2]Iffath Hussain, [3]Pradeep P.R., [4]Akshata M.H., [5]Sai Radhika Priyanjali

[1-5]Department of Conservative Dentistry and Endodontics, M.R. Ambedkar Dental College and Hospital, Bangalore, Karnataka, India.

Corresponding Author: Dr. Iffath Hussain, Department of Conservative Dentistry and Endodontics, M.R. Ambedkar Dental College and Hospital, Bangalore – 560005, Karnataka, India.

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Abstract

Context: Complete removal of the root canal filling material to ensure that the canal can be completely cleaned is the primary goal of endodontic retreatment. In this present study, H-files and Neoendo Retreatment files and Hyflex Remover were used to remove the gutta-percha/ sealer.

Aim: To evaluate the efficacy of two different rotary retreatment systems and manual instrumentation in removing gutta percha/ sealer from root canals.

Methodology: 30 single rooted teeth with mature apices were used for this study. Samples were randomly divided into 3 groups. The samples were prepared and obturated using gutta percha and AH Plus sealer with lateral condensation technique and were retreated using the following files.Group 1 samples were retreated with H-files, group 2 samples with Neoendo Retreatment files and group 3 with Hyflex Remover files.

After the retreatment files were used, the samples were sectioned longitudinally and observed under a stereomicroscope of 10X magnification.

Statistical Analysis: One way ANOVA test followed by Tukeys post hoc analysis was used to compare the efficacy of retreatment files.

Results: The test results demonstrated that the mean % of remaining filling material for H-files group was 61.502 ± 4.252, Hyflex Remover group was 51.863 ± 3.364 and Neoendo group was 40.670 ± 4.753.

Conclusion: The engine driven systems were more efficient than the manual instrumentation in removing the gutta-percha/sealer from the canals.

Keywords: endodontic retreatment, gutta-percha, H-files, Hyflex Remover, Neoendo Retreatment files, AH Plus sealer.

Introduction

The aim of endodontic retreatment is complete removal of filling material (RFM) and elimination of remaining microorganisms and necrotic debris to re-establish the health and normal conditions of the periapical tissues (5).Failure of primary endodontic treatment may occur due to various reasons like complexity of the root anatomy, technical failures, and/or persistence of infection in the apical portion of the root canal, thereby necessitating retreatment.

Total intracanal filling removal is deemed mandatory during endodontic retreatment to allow for adequate disinfection of the root canal system followed by apical and coronal seal (1).

Many techniques have been advocated to remove gutta-percha from the canals like mechanical, manual and ultrasonic with or without the use of solvents (9).

Many rotary retreatment files like Protaper Universal Retreatment files(PTUR), R-Endo, D-RaCe, MTwo, Neoendo Retreatment files, Hyflex Remover, XP Endo Shaper have been introduced for removal of root filling materials. The Ni-Ti systems have proved to be more efficient and safer than the traditional hand files (Bramante & Betti 2000, Imura et al. 2000, Betti and Bramante 2001, Ferreira et al. 2001, Hülsmann and Bluhm 2004, Masiero and Barletta 2005, Zmener et al. 2005, de Carvalho Maciel & Zaccaro Scelza 2006, Kosti et al, 2006) (9).

Neoendo Retreatment files (Orikam Healthcare, India) consist of three files files: N1 (size 30/0.09 taper) for coronal one-third preparation, N2 (size 25/0.08 taper), for middle one-third, and N3 (size 20/0.07 taper) for apical one-third.

Hyflex Remover is a single file system and in this study, size 25/0.09% file was used.

An ideal retreatment instrument should allow complete removal of filling material in a short duration, with no alteration of the root canal space, no instrument separation and no apical extrusion of debris (2).

Until now, no retreatment technique has effectively possessed all the above mentioned criteria.

The aim of this study was to evaluate the efficacy of two different rotary retreatment systems namely, Neoendo Retreatment files and Hyflex Removerand manual technique in removing gutta-percha/sealer from the root canals.

Materials and Methodology

Specimen Preparation: Thirty single-rooted teeth with mature apices were collected, cleaned and stored in distilled water until further use. The criteria for selection included that the teeth should have single straight canal, with no resorption defects, caries, cracks, and canal calcifications.

The teeth were decoronated apical to the cemento-enamel junction to standardize the canal length to 16mm using a low-speed circular diamond disk. Access cavity preparation was done and a number10 K-file was introduced into the canal and was pushed towards apical part until the tip of the instrument was just visible at the apical foramen. This length of the file was recorded and 1mm was subtracted from the recorded length and the working length was determined.

Canal Preparation and Obturation

Biomechanical preparation was done using ProTaper Files upto F3.After each instrument was used, the canals were irrigated between instruments with 3% NaOCl and 17% EDTA and the irrigants were delivered through a 26-gauge needle which was placed as far as possible into the canal. On completion of the instrumentation process,

a 10 number K-file was passed through the apical foramen to ensure that the foramen was patent for dye penetration. After drying the canals with paper points, standardized gutta-percha cones were selected as master points.The fit of each master point was assessed by radiographs to determine whether the point was in accordance to the working length. The samples were prepared and obturated using gutta percha and AH Plus sealer and obturation was done using lateral condensation. Radiographs were taken to evaluate the obturation. The access cavities were sealed and the teeth were kept for a week for the sealer to set and retreatment was done.

Retreatment Technique

Teeth were randomly divided into three groups of 10 specimens each. Canals were irrigated with saline after each instrument change. When no traces of gutta-percha/sealer were found on the surface of the instrument, retreatment was considered complete.

Group 1: Hedstrom Files

H-files with sizes 30, 35 and 40 were used in a circumferential quarter turn push pull motion to remove the root fillings until the original working length had been reached**.**

Group 2: Neoendo Retreatment Files

Neoendo Retreatment files were used in a sequential manner using a light apical pressure as per the manufacturer's instructions. Files N1, N2, N3 were used for the coronal, middle and apical third respectively using crown down technique.

Group 3: Hyflex Remover

HyFlex Remover (Coltene-Whaledent, Allstetten, Switzerland), a single file (size 30; 7% taper) was utilized to remove the obturation material.

Analysis of gutta-percha/sealer removal from the canals

After the retreatment was done, the teeth were placed in 2% methylene blue dye solution for 1 week. The samples were then taken out from the solution and were thoroughly bathed in running tap water. The samples were sectioned longitudinally using a low-speed circular round disk in a path roughly parallel to the axis of the tooth and through the apex. After sectioning, the samples were studied under a stereomicroscope using 10X magnificationand images were analysed using image analysis system, MVIG 2005(Chroma Systems Private Limited, India). The remaining gutta-percha/sealer in the canal was observed and was calculated in %. For practical purpose, no attempt was made to differentiate between gutta-percha and sealer remnants.

$$\text{The percentage of residual filling material} = \frac{\text{Area of the remnant}}{\text{Area of the canal wall}} \times 100$$

Statistical Analysis

One way ANOVA test followed by Tukeys Post Hoc analysis was used to compare the mean percentage of remaining filling material between the three groups. The level of significance was set at $P<0.05$.

Results

The test results demonstrated that the mean % of remaining filling material for Neoendo group was 40.670 ± 4.753, H-files group was 61.502 ± 4.252 and Hyflex Remover group was 51.863 ± 3.364(Figure 1).

H-files group showed significantly highest % of remaining filling material as compared to Neoendo & Hyflex Remover group and the mean differences were statistically significant at $P<0.001$. This was then followed next by Hyflex Remover group, which showed significantly higher mean % of remaining filling material as compared to Neoendo group and the mean differences was statistically significant at

P<0.001(Figure 2). This inferred that the Neoendo group showed relatively least mean % of remaining filling material which was followed by Hyflex Remover and highest mean % was seen with H-files group.

Table 1

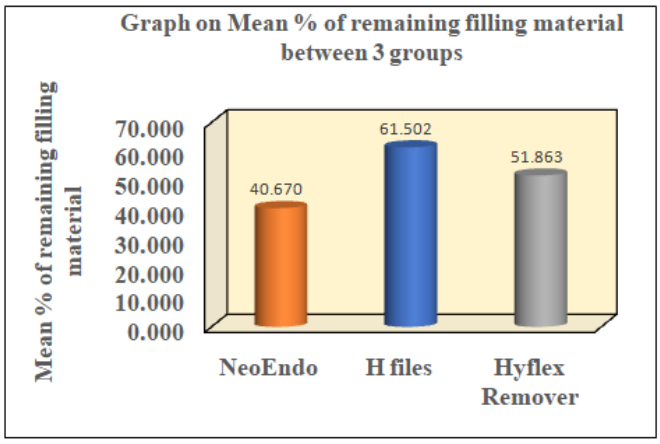
Comparison of mean % of remaining filling material between three groups using One-way ANOVA Test						
Groups	N	Mean	SD	Min	Max	P-value
Neoendo	10	40.670	4.753	34.06	48.30	<0.001*
H-files	10	61.502	4.252	54.00	69.60	
Hyflex Remover	10	51.863	3.364	47.70	57.50	

* - Statistically Significant

Table 2

Multiple comparison of mean difference in % of remaining filling material between 3 groups using Tukey's Post hoc Test					
			95% CI for the Difference		
(I) Groups	(J) Groups	Mean Diff.(I-J)	Lower	Upper	P-value
Neoendo	H-files	-20.83	-25.45	-16.22	<0.001*
	Hyflex Remover	-11.19	-15.81	-6.58	<0.001*
H-files	Hyflex Remover	9.64	5.02	14.25	<0.001*

* - Statistically Significant



Graph 1

Discussion

Myriad of studies have proposed techniques to remove the gutta-percha and sealer from root canals. These studies have generally compared the safety and efficiency of the rotary Ni-Ti systems with the stainless steel hand files (9).

The present study focuses on efficiency of H files, Neoendo and Hyflex Remover retreatment files to remove gutta-percha and sealer from root canals in retreatment cases. The present study found that no retreatment file was able to completely remove gutta-percha and sealer but when the Ni-Ti techniques were compared with manual instrumentation, there was a significant difference seen between H-files and rotary files both in terms of time taken and efficiency of gutta-percha removal.

The samples were prepared and obturated using gutta-percha and AH Plus sealer and obturation was done using lateral condensation. AH Plus sealer was used as it is compatible with warm and cold obturation techniques and because of its tight sealing ability and high adhesion to dentin in the root canals.

One of the main objectives of the non-surgical endodontic retreatment method is the arduous task of completely removing the root filling material (4). Complete removal of the root canal filling material was advised during non-surgical retreatment to ensure retreatment success (3).

Various methods like CBCT, radiographs, sectioning and visualising under stereomicroscope, clearing method have been used to evaluate the remnant material on the root canal walls. The present study involved longitudinal sectioning of the samples in the bucco-lingual direction and its examination under stereomicroscope of 10X magnification. This method is considered simple and efficient since the distance between the sample and the stereomicroscope is consistent, enabling the standardisation of the image. The results that were obtained were quantitative (expressed in percentages and mm^2) (3).

Gutta-percha removal on pulling motion is facilitated by the positive rake angle of H-files (4). Hand files being more rigid and stiffer than rotary files, and using them all the way to the working length might result in

procedural problems such as ledges, transportation, or and canal perforation(4). The design of the flutes of the H-files facilitates gutta-percha removal (3). Therefore, H-files might remove gutta-percha in large pieces, leaving remaining material of such a small size.

The cross-section of the Neoendo files is parallelogram-shaped, and the rake angle is positive (3). This type of cross-section allows only one or two point contact (3). In turn, this will lessen binding and ensure that there is little to no wedging in, improving cutting and effectiveness (3). The additional volume guarantees improved debris removal around the instrument (3). Additionally, it contains an active cutting tip for simple initial penetration (3). This system includes three files: N1 (size 30/0.09 taper) for coronal one-third preparation, N2 (size 25/0.08 taper), for middle one-third, and N3 (size 20/0.07 taper) for apical one-third. The better cutting efficacy of Neoendo Retreatment system instruments may be attributed to the three progressive tapers and length design of N1, N2 and N3 files.

Hyflex remover file, being a single file system(25/0.09 taper)and having controlled memory was easy to use than Neoendo Retreatment system which was stiffer because of the difference in metallurgy of both the files(5). The heat treatment renders it with excessive flexibility and cyclic fatigue resistance which allows it to respect the original anatomy and achieve a working length of 3mm thus, keeping the apical part safe. It is available in N°30, with a variable triplex helix cross section with an open flute which is symmetrical in the first 3mm and asymmetrical towards the shaft. Its non-active tip of 30/100mm allows its usage in curved canals with active edges offering decreased risk of ledges while respecting the anatomy with an improved cutting efficiency, thus proving to be an overall safe endodontic file. Its uniquely designed using 1mm wire which makes it smaller than that of the majority of re- shaping or retreatment instruments thus being minimally invasive and yet renders it with improved flexibility allowing protection of the peri-cervical part by preserving the dentin and respecting the natural anatomy of the canals.

In the present study, Neoendo retreatment files were more effective than Hyflex Remover and H-files. According to various studies, Ni-Ti rotary instruments are faster than hand files in retreatment cases for gutta-percha removal (4). The mechanically plasticised gutta-percha gives less resistance to the subsequent instrumentation's activity (3). Because of this, it was probably simpler to achieve the working length using Ni-Ti tools than with hand files(3). Additionally, these engine-driven files generate frictional heat that may cause gutta-percha to plasticise and make removal easier (16).A greater effectiveness of Ni-Ti retreatment systems may be due to the fact that they are specifically designed for removing the filling material (9).

Conclusions

No file system included in this study was able to entirely eliminate gutta-percha/sealer from the canals, but the engine driven systems were more efficient than the manual instrumentation in removing the gutta-percha/sealer from the canals. Neoendo retreatment files performed better than Hyflex Remover and H-files in gutta-percha/sealer removal from the canals. The group treated with Neoendo retreatment files had less overall residual filling compared to the groups treated with Hyflex Remover and H-files.

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