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# A Comparative Evaluation of Gutta-Percha and Sealer Removal of Rotary Niti File Retreatment Systems

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## Abstract

Forty lower premolars with single root canals prepared with ProtaperNext files to size 25, and obturated with GP/sealer using lateral compaction. Teeth divided randomly into four groups (group n=10). Protaper universal retreatment kit (PUR), D-Race desobturation files (DRD), R-Endo retreatment kit (RE) and Hedstrom (H) files (control) were used to remove GP/sealer in each group. Removal effectiveness assessed by measuring the GP /sealer remnants in the roots after sectioning them into two halves. Stereomicroscope with a digital camera used to capture digital images. Images processed by ImageJ software to measure the percentage of GP/sealer remnants surface area in total, coronal, middle and apical areas of the canal. In the coronal area, PUR had significantly lower R% than RE and H groups, respectively ($p<0.05$). Also, DRD had significantly lower R% than RE ($P<0.05$). There was no significant difference between PUR and DRD ($p>0.05$), as well as no significant difference between RE and H groups($p>0.05$). In the middle, apical and total root areas, Both PUR and DRD had significantly lower R% than RE and H groups, respectively ($p<0.05$). There was no significant difference between PUR and DRD ($p>0.05$). Also, there was no significant difference in R% between RE and H groups ($p>0.05$).

***Keywords***: *DRace, Hedstrom, REndo, retreatment, Protaper*

## Introduction

Retreatment of endodontically treated teeth after the failure of the initial endodontic treatment is a common and a conservative procedure compared to tooth extraction and endodontic surgery. Retreatment procedure involves removal of the root canal filling materials such as gutta-percha and sealer which are the most frequent materials to be used for root canal filling. The success of retreatment is directly related to the effectiveness of any file system to remove the old filling materials, which may harbor bacteria and debris. [1] The techniques used for removal of gutta-percha from root canals include Hedstrom (H) instruments with/without chloroform, ultrasonics, lasers, heat carrying instruments, as well as NiTi rotary instruments.[2] Recent advances in NiTi rotary files systems used in removal of gutta-percha and sealer enable better cleaning, less time and less fatigue to patient and operator compared to the conventional stainless-steel files because of super elasticity, shape memory and resistance to torsional fracture, which enhancing their accessibility to distant parts of root canal and their removal effectiveness.[3-5] Many NiTi rotary systems introduced for gutta-percha/sealer removal such as Protaper universal retreatment (PUR) system (Dentsply Maillefer, Ballaigues, Switzerland), Re-Endo system (RE) (Micro-Mega, Besancon, France), D-Race desobturation system (DRD) (FKG Dentaire, La Chaux-de-Fonds, Switzerland). A modified guiding tip, triangular convex cross-section and progressive increase in tapers are the main characteristics of ProTaper universal retreatment files. This system consists of D1, D2 and D3 files which have sizes and tapers of 30/0.09, 25/0.08 and 20/0.07, respectively. D1 file has an active tip, D2 and D3 have non-active tips in order to reduce root canal retreatment mishaps. [6] D-Race retreatment files consist of DR1 and DR2 files with sizes and tapers of 30/ 0.10 and 25/0.04, respectively. Length of DR1 and DR2 are 15mm and 25mm, respectively. DR1 used in the straight and coronal section of the canal as it has

an active tip to penetrate the filling materials followed by DR2 which is used to reach the full length of the canal. [7] R-Endo retreatment files consist of four files, Re, R1, R2, and R3 in addition to an optional finishing file Rs. Retreatment of root canals with R-Endo retreatment system start with coronal conditioning followed by repreparation of the canal using the mentioned sequence of files.[8] Determining the effectiveness of different rotary NiTi systems in removing gutta-percha/sealer may help dentists to choose the best system that enables the greatest/fastest removal of gutta-percha/sealer. Previous studies had controversial findings regarding the best effective rotary NiTi system in removing obturated GP/sealer.[4, 5, 9-11]

## Materials and Method

***Sample Preparation:***

Forty extracted single canal teeth were selected for the study. To standardize the samples, all teeth were decoronated to obtain root segments of 12mm length, working length was established by subtracting 1 mm from the real root length determined by introducing a number 10 K-file (Dentsply Maillefer, Ballaigues, Switzerland) until it was visible through the apical foramen. Root canal instrumentation was performed using Protaper next system (Dentsply Maillefer, Ballaigues, Switzerland), as recommended by the manufacturer, up to size 25 using a crown-down technique and a standardized amount of 2.5% NaOCl was used to irrigate the canal. then each root canal was obturated with gutta-percha (Protaper next cones, Dentsply Maillefer, Ballaigues, Switzerland) and Endofill sealer (PD, Switzerland) using the lateral compaction technique. The temporary filling was used to seal the coronal orifice, then the teeth were stored for one week in 37C$^{o}$ at 100% humidity. The roots were randomly divided into four groups (n=10/group) according to each retreatment file system was used:

**Group I**

The X-smart endodontic motor (Densply Sirona, Ballaigues, Switzerland) alongside the Protaper universal retreatment (PUR) system (Dentsply Sirona, Ballaigues, Switzerland) were used to remove the root canal filling materials. The PUR system was employed using D1 (size 30, .09 taper) in the cervical and beginning of middle thirds of working length. D2 (size 25, .08 taper) was used to remove GP from the middle and apical thirds until the working length was reached. D1 and D2 were used only without using D3 ((size 20, .07 taper) files. Speed setting used to remove gutta-percha/sealer from the canals was 500-700 rpm, guttapercha/sealer removal was considered complete when no more remnants were detected in the file.

**Group II**

The DRD system (FKG Dentaire, La Chauxde-Fonds, Switzerland) was employed using DR1 (size 30, .10 taper) and DR2 (size 25, .04 taper) files to remove guttaprcha/sealer from the coronal and apical half areas, respectively, until the working length was reached. The DR1 and DR2 files were used at slowest speed dictated by the manufacturer (600 RPM) and the torque was adjusted at 1.5 Ncm. The verification of complete gutta-percha/sealer removal was as previously described.

**Group III**

Re-Endo system (Micro-Mega, Besancon, France) files (Rm, Re, R1, R2, R3) were used as per the manufacturer's instructions. The Rm stainless steel manual file (17 mm, 25/.04 taper) was used first to its full length. It was followed by nickel-titanium rotary instruments Re (25/.12 taper) orifice opener, R1(25/.08 taper) till cervical third, R2 (25/.06 taper) till middle third, R3 (25/.04 taper) to full working length at a speed of 300 rpm and a torque of 1.2 N cm.

**Group IV**

H files were used to remove the obturating material, H-files of sizes 20, 25 were used in a circumferential quarter turn push-and-pull motion until WL was achieved. The retreatment procedure was considered to be complete when no material could be visualized in the canal or file flutes.

***Guttapercha/sealer remnant quantification***

Roots were grooved longitudinally in a buccolingual direction, then split into two halves using a chisel. Canals walls were examined under the stereomicroscope; and imaged at 25x magnification using a digital camera (Nikon, Tokyo, Japan) stabilized at a fixed distance using a holder. The images were magnified 100% using a digital zoom tool. The images were analyzed with ImageJ software (version 19 windows). The canal surface was divided into coronal, middle and apical areas digitally. The percentage of the area of remnants GP/sealer (A) was calculated using the following equation: A = (area of the remnants GP/sealer × 100)/area of the root canal at either coronal, middle, apical thirds. The

total area of the root canal and remnant GP/sealer were calculated by summing the data of the coronal, middle and apical thirds. SPSS 24 was used to analyse the data, Inferential statistics included Kruskal Wallis H test and Man-Whitney U test, the significance level was assumed at *p*-value less than 0.05.

## Results and Discusion

Table (1) shows the mean of the percentage of the area of remnants GP/sealer (R%) in coronal, middle and apical areas of the root canals, also, it shows the mean of the percentage of the area of remnants GP/sealer in the total surface area of the root canals. The lowest R% in coronal, Middle, apical and total root areas achieved in PUR, DRD, DRD and DRD groups, respectively. In each one of the tested groups, there was no significant difference in R% between coronal, middle, apical and total root areas, except in the H file group, there were significantly lower R% in coronal compared to middle areas of the root canal ($p<0.05$). In addition, there were significant differences ($p<0.05$) in R% between groups in each of the levels (the coronal, middle, apical and total root areas), respectively. In the coronal area, PUR showed the lowest R% compared to other systems. PUR had significantly lower R% than RE and H groups, respectively ($p<0.05$). Also, DRD had significantly lower R% than RE ($P<0.05$). There was no significant difference between PUR and DRD ($p>0.05$), as well as no significant difference between RE and H groups($p>0.05$). In the middle, apical and total root areas, Both PUR and DRD had significantly lower R% than RE and H groups, respectively ($p<0.05$). There was no significant difference between PUR and DRD ($p>0.05$). Also, there was no significant difference in R% between RE and H groups ($p>0.05$), as shown in Table (1).

**Table (1): Remnant GP/sealer area mean percentages ± (SD) of all groups at coronal, middle, apical and total root areas.**

| Levels | Groups | | | |
|---|---|---|---|---|
| | R-Endo | D-Race | Protaper | Hedstrom |
| Coronal area (Remnant % mean±(SD)) | 20.1 ± (18.6) [a, b] | 4.4 ± (4.2) [a] | 3.0 ± (5.3) [b, c] | 16.2 ± (16.2) [c] |
| Middle area (Remnant % mean±(SD)) | 34.2 ± (32.6) [a, b] | 1.5 ± (0.7) [a, c] | 3.09 ± (3.8) [b, d] | 54.3 ± (26.4) [c, d] |
| Apical area (Remnant % mean±(SD)) | 45.7 ± (21.7) [a, b] | 4.6 ± (3.1) [a, c] | 7.2 ± (12.7) [b, d] | 38.6 ± (28.9) [c, d] |
| Total root area (Remnant % mean±(SD)) | 28.9 ± (21.3) [a, b] | 3.5 ± (1.9) [a, c] | 3.8 ± (5.8) [b, d] | 35.2 ± (12.9) [c, d] |

Identical small letters superscript in the same raw represent significant differences between relevant groups.

Periapical inflammation and failure may be occurred postoperatively because of the inadequately prepared and obturated root canal systems that harbor bacteria and necrotic tissue that need to be eliminated therefore removing as much sealer and gutta-percha as possible in retreatment procedure seem necessary. This study aimed to assess and compare the effectiveness of PUR, RE, DRD and H files in removing gutta-percha and sealer in natural single root canals by measuring remnant GP/sealer surface area percentage. As reported by other authors, none of the techniques tested was able to irradiate all GP/sealer remnant from retreated root canals.[4, 11, 12]

To simplify the standardization of the specimens, premolars with straight roots and relatively wide canals were selected for this study. The use of a longitudinal split to obtain images to inspect the root canal walls was advocated by several authors. [9, 10, 12] longitudinal sectioning together with the use of the stereomicroscope has been shown to be more efficient for detecting the remaining root canal filling material compared with radiographic techniques. [13]

In the present study, speed and torque used were adjusted according to the manufacturer's instruction for all tested groups. However, in order to standardize the size of the final instrument used to remove GP/sealer in the canals, the files with size 25 tip in each system were the final instrument used to remove GP/sealer, therefore, D3 file of PUR was not used to remove GP/sealer. No solvent was used to help remove the root canal filling materials with the rotary NiTi systems, as they generally plasticize gutta-percha through the heat generated by friction. Also, the solvent was not used with H files in order to minimize the number of variables involved in the study. In addition, using a solvent would generate a thin film of gutta-percha on the root canal walls that would be difficult to identify and remove. Similarly, we did not use Gates Glidden burs with H files, which are known to be effective in removing GP/sealer in the coronal part of the root canals. Also, three-dimensional visualization of the root canal after retreatment was not used, which would provide superior quantification of the filling remnant and prevent remnant loss during the splitting procedure as reported by. [14]

The present study showed that root filling materials could not be completely removed from the root canal walls. This observation was in agreement with those of the previous studies on retreatment efficacy in which various retreatment technique and root filling materials were used. The results of the present study revealed that PUR and DRD showed the lowest R% compared to other groups. There were no significant differences between PUR and DRD ($p>0.05$) in R% at all levels (the coronal, middle, apical and total areas, respectively). These findings agree with that of Colaco and Pai 2015 and Ibrahim et al. 2018, they have reported that there are no significant differences between PUR and DRD regarding GP remnants.[10, 15] However, both PUR and DRD were more efficient than R-Endo and H files in removing GP/sealer by leaving less amount of remnant GP/sealer, this higher efficiency of PUR and DRD may be attributed to the design of the PUR and DRD files. PUR files have a convex triangular cross-section, a larger internal mass and area, and variable helical pitch and taper. Which result in effective removal of GP coronally in the canal.[4, 14, 16, 17] DRD files exhibit smooth surface because of a special electrochemical surface treatment, in addition to a triangular cross-section, which enhances removal efficiency of GP from the canal and superior sharpness.[18]

## Conclusion

The amount of GP/sealer remaining after root canal retreatment with PUR and DRD was not significantly different but showed better retreatment efficiency than Re-Endo and H files. However, because all experimented techniques showed remnants of filling materials on the canal walls, additional measures such as the combination of manual and rotary techniques can help completely remove GP during endodontic retreatment.

**Financial Disclosure:** There is no financial disclosure.

**Conflict of Interest:** None to declare.

**Ethical Clearance:** All experimental protocols were approved under the College of Dentistry, University of Baghdad, Baghdad, Iraq and all experiments were carried out in accordance with approved guidelines.

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