

IN-VITRO COMPARISON OF PROTAPER AND D-PERFECT GOLD RETREATMENT ROTARY FILES EFFICACIES IN ROOT CANAL FILLING REMOVAL

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ABSTRACT

Aim: To compare the efficacy of D-perfect gold to protaper retreatment rotary files in gutta percha removal and the operational time.

Materials and methods: Thirty distobuccal roots were instrumented till an apical diameter of 25 then obturated using the matching gutta percha cone via warm vertical compaction. Roots were kept under 100% humidity at 37 C for one month. Obturation quality was checked using CBCT imaging. Teeth were allocated into 2 groups according to the file type used, (n=15 for each group) (A) for protaper retreatment files, Group (B) for D-perfect gold retreatment files. Time frame needed to fully detach the gutta percha was registered in seconds. Roots were longitudinally halved then examined stereomicroscopically under 20X magnification. Image J software was used to calculate the percentage of residual gutta percha to the total canal area. Data was statistically analyzed using OneWay ANOVA , α was set at 0.05.

Results: Protaper retreatment files resulted in significantly lower amount of residual gutta percha in relation to total canal area as compared to D-perfect files, ($P < 0.05$). The coronal third displayed the least amount of residual gutta percha in comparison to the middle and apical thirds, ($P < 0.05$). The 2 systems did not achieve a complete gutta percha removal from the canals. There was no significant differences in operational time for both file systems ($P > 0.05$).

Conclusion: Protaper retreatment files were more efficient in gutta percha removal than D-perfect gold retreatment files.

KEYWORDS: Endodontic retreatment, D-perfect gold RT, Protaper RT, Residual gutta percha

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INTRODUCTION

Root canal filling removal is a crucial step during endodontic retreatment of failed cases. Retreatment tools should completely remove the filling material in a short time frame, without inflicting canal shape aberration, without getting fractured and with minimal debris extrusion. All these criteria are not yet fulfilled by the available instruments^(1,2).

Non-surgical retreatment has been variably attempted using rotary instrumentation techniques and files with variable cross sections, rake angles, radial lands and various tapers. Retreatment files have been provided with active cutting tips and higher cutting efficiency to facilitate the penetration process through canal filling materials⁽³⁾. Pro-Taper Universal System retreatment files (Dentsply Sirona, NC, USA) were introduced and performed as a gold standard. Each set has 3 files with different lengths, tapers and apical tip diameters. The D1 PTU instrument is provided with an active tip to enable initial penetration into the gutta percha; it has a length of 16 mm, a tip of 0.30 mm, and a 0.09% taper. The D2 is designed for removal of gutta percha from the middle third of the root and has a length of 18mm, a tip of 0.25mm, and a 0.08% taper. The D3 PTU file has a length of 22 mm, a tip of 0.20 mm, and a 0.07% taper, is used to reach the working length and removes the gutta percha from the apical third^(4,5).

D-Perfect gold is a newly introduced Chinese retreatment file system is marketed with 3 instruments; D1(size 30, 0.09 taper) to enlarge the coronal-most few millimeters of the canal and 2 files (ie, D2 and D3) designed to each root canal third to a size of 25 then 20 with 0.09, 0.06, or 0.04 tapers, respectively. The files are designed with a triangular cross-section with three equally-spaced cutting edges and no radial land. The tips are inactive^(10,11). It is manufactured using a special heat treatment which imparts an increased cyclic fatigue resistance and a

higher flexibility. They are triangular in cross-section with three cutting edges and a large core with a progressively increasing pitch along the blades. The kit includes three files (D1, D2, and D3); size 25 with 0.08, 0.06, and 0.04 tapers, respectively.

In an elaborate literature review, the investigation of the retreatment efficiency of the D-Perfect gold files (IMD; ShangHai, China) could not be found. Therefore, this study aimed to compare the efficacy of perfect RT gold retreatment files to that of Protaper retreatment files in gutta percha removal as well as the operational time.

MATERIALS AND METHODS

Specimens selection and groups allocation

Twenty distobuccal roots of human maxillary first molars were included. The extracted teeth were obtained from the maxillofacial department at the faculty of Dentistry, Ain Shams University. The extraction reason was unknown. Roots with wide apical openings, resorptions, calcified masses, cracks, with an apex accommodating a file size larger than size #15 K-file were discarded. Samples were randomly allocated into two main groups (n = 15) for each file system.

Root canal instrumentation and filling

12 mm root segments were obtained by decoronation. Patency was ensured by a #10 manual K-file (Mani INC, Tochigi, Japan). The working length was established at 0.5 mm from the apical terminus. Canals were instrumented using E flex gold rotary files (Eighteeth, Changzhou, China) till 0.04/25. Canals were irrigated using 5 mL of 2.5% sodium hypochlorite and 5 ml of EDTA 17% were added as a final flush by means of a 27 gauge needle. Canals were dried with paper points size 25. Obturation was carried out by warm vertical compaction using the corresponding gutta percha cones 0.04/25 (Meta Biomed, Chungcheongbuk-do, Republic of Korea).

Filling quality was confirmed using CBCT images. Samples were kept in 100% humidity at 37°C for 30 days.

Gutta percha removal

Files were assigned into two groups; group 1 for Protaper retreatment (Maillefer Instruments Holding Sàrl, Baillaigues, Switzerland) and group 2 for D Perfect retreatment files (Shenzhen Perfect Medical Instruments, Shanwei, China). For the two groups, D1 and D2 were inserted up to coronal and middle thirds respectively. D3 was then brushed to the full working length (12 mm) against the canal walls circumferentially. Operational speed was set at 350 rpm and torque at 1.5 Ncm using EndoMate DT (NSK, Tokyo, Japan).

A single endodontist performed the technical procedures under microscope magnification (Labomed, Los Angeles, USA). Files were used aiming for complete gutta percha removal. When the working length was reached, files were brushed against the canal walls vertically for 5 strokes. Canals were scouted using a #15 manual K-file. Canals were irrigated at each file change by adding 5 mL of 2.6% NaOCl per root. Each file was discarded after five root canals. Files were used in a pecking motion with slight apical pressure and with a brushing motion against the canal walls.

Time needed to attain the working length

Time needed to attain the working length was digitally recorded (Timex, Middlebury, CT, USA) in seconds.

Assessment of residual gutta percha

Roots were longitudinally demarcated using a low-speed diamond disc then halved with a hammer and chisel for stereomicroscopic examination. Each half was imaged at 4 X magnification by a digital camera (DP-70; Olympus, Tokyo, Japan).

Image J software (1.42a/ Java 1.6.0-10 image analyzer software) was used to measure the remaining gutta percha in the 3 canal thirds. Residual gutta percha percentage to the total canal area was then determined using the following equation: $A = (\text{area of the residual gutta percha}) / \text{area of the root canal} * 100$.

Technical errors

Canal perforations, loss of working length, ledges and file fractures were recorded. When instruments were separated, they were substituted.

Statistical Analysis

Statistical package for social sciences (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY) was used for data analysis. One-way ANOVA was used for statistical analysis of residual gutta percha and for the operating time. α level was set at 0.05.

RESULTS

Gutta percha removal

Protaper retreatment showed a significantly higher efficiency in gutta percha removal as compared to D-perfect file system at the three canal levels and for the whole canal length, ($P < 0.01$). Nevertheless, both file systems failed to completely remove the filling. A significantly lower gutta percha percentage was found at the coronal, followed by the middle then the apical thirds, ($P < 0.05$), (Figure 1,2).

Operating time

Full working length was similarly reached by both file systems with no significant difference between both, ($P > 0.05$), (Figure 3). 3 samples of the D-perfect file system showed apical file separation. No other apical iatrogenic aberrations were found.

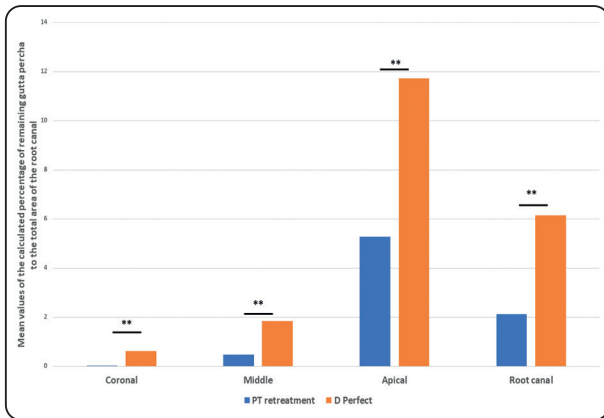


Fig. (1). Bar chart illustrating the mean values of calculated residual canal filling percentage to the root canal total area at the coronal,middle and apical levels and for the whole root canal. ** denotes that P<0.01.

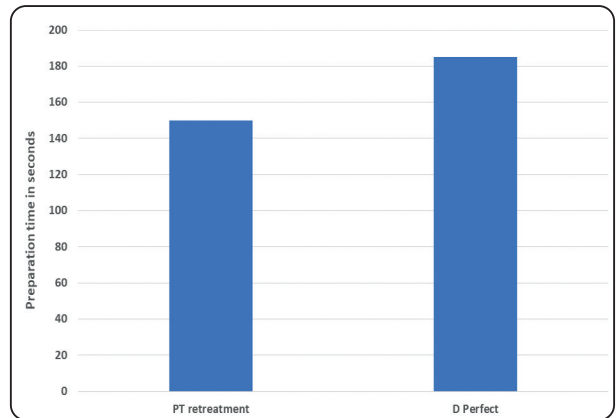


Fig. (3). Bar chart illustrating the canal preparation time in seconds

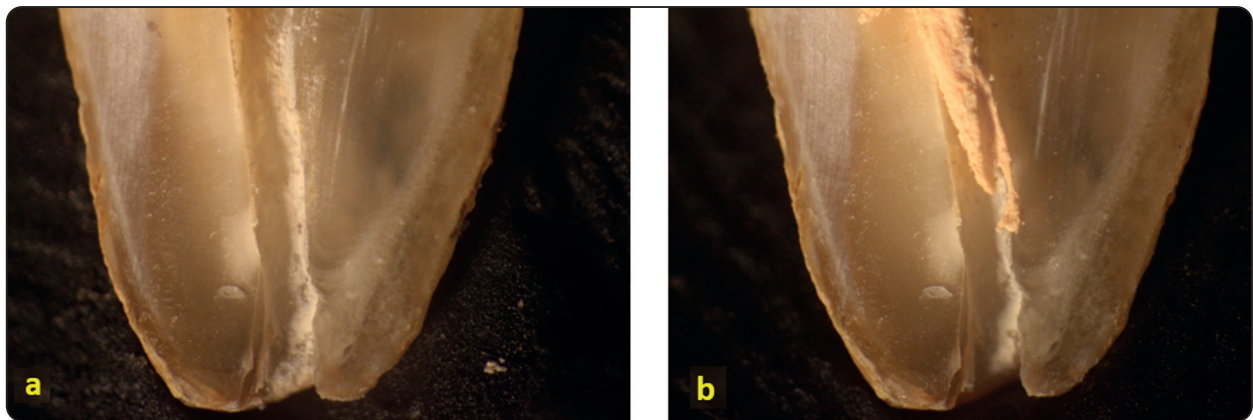


Fig. (2). Stereomicrographs showing variable proportions of remaining gutta percha in 2 different canal thirds: a. a noticeable amount b. a negligible amount

DISCUSSION

The importance of gutta percha removal in re-treatments cases stems from the fact that it allows for better accessibility to the residual or recurrent infection that provoked the treatment failure and prompted its remake. Distobuccal roots of maxillary molars were included for their peculiar narrowness and curvature which would pose a challenge for the instrumentation process⁽¹²⁾. These roots were decoronated to standardize the canal length and to eliminate the other variables related to the variable pulp chamber morphologies and radicular accessibilities.

Obturation was carried out with the warm vertical technique in order to ensure a better homogeneity of radicular filling and to reduce the likelihood of entrapment of voids that could be encountered with the lateral condensation technique⁽⁶⁾. Instrumentation was performed in accordance with manufacturer’s instructions , torque and rpm were specified at low levels to reduce the probability of iatrogenic errors including instrument fracture, ledges or perforations⁽⁷⁾. Removal was totally reliant on mechanical action of the files without any added chemical plasticization, as it was reported that it can result in a layer on the dentinal surface that might

reduce efficiency of bacterial removal⁽⁸⁾. The examination of remaining gutta percha was visually performed by the stereomicroscope after longitudinal splitting of the root segments for its convenient direct assessment of the remaining gutta percha. This cleavage method was asserted by Baratto-Filho⁽⁹⁾ et al and Takahashi et al⁽⁹⁾. Alternatively, other studies have examined it by CBCT⁽¹⁰⁻¹³⁾ or by microCT^(14,15). Radiological method is another method that enables only two-dimensional evaluation of a three-dimensional object and limited display of small volumes of the filling residues⁽¹⁵⁾.

Neither of the two systems achieved complete gutta percha removal. Protaper system was more efficient than D-perfect in removing the gutta percha from each canal third separately and for the whole canal length. This could be attributed to two factors, Protaper D1, D2, and D3 are designed with three progressive tapers and lengths and a specific flue design. Adding this to the rotary motion, they can cut and pull a large amount of gutta percha into the file flutes and channel it coronally. This feature enables them also to remove the superficial layer of dentin⁽¹⁷⁾. Meanwhile, the D-perfect gold files are heat treated so have a higher flexibility, and are super elastic as per the manufacturer, therefore with a lower cutting efficiency than Protaper retreatment files. This in turn would reduce their ability to remove the gutta percha in comparison to the stiffer Protaper files. Comparing this outcome to similar ones from the previous studies could not be directly performed given that D-perfect gold retreatment file system was not previously investigated.

This higher performance of Protaper retreatment files was also reported in the literature⁽¹⁸⁻²¹⁾. Contrarily, they were less efficient than Protaper Next files, secondary to the offset design of PTN files⁽¹⁶⁾. they similarly performed to H files and D Race files⁽¹⁰⁾ and to Flexmaster⁽²²⁾. When used in the adaptive motion, Protaper retreatment files performed better than when used in rotational motion, mostly due to the entanglement of the gutta

percha with the first movement and its dislodgment from the canals via the second movement⁽²³⁾.

In this study, Protaper were safer than D-Perfect gold retreatment files, which showed file separation in 20% of the samples. As a general rule when using rotary file to remove GP, files should penetrate with light apical pressure. Moreover, they should be frequently removed for check up of flutes cleanliness at each file change. In case a resistance is encountered, stainless steel manual files can be used to establish the glide path.

Investigating the canal levels, the coronal third displayed the lowest percentage of residual gutta percha in comparison to the middle and apical thirds. This could be related to the better accessibility of this region to the instruments action besides the larger amount of irrigating solution that could be delivered. Additionally, it is easier to view the obturating material in the cervical third, using the microscope, which would facilitate its removal by the instruments when brushed against the canal walls. The apical third showed a higher percentage of residual gutta percha than the middle third. This could be attributed to the higher anatomical diversity and the more challenging shaping in this region. Maxillary molars distobuccal roots display multiplanar curvatures in this part, which renders the direct instrumentation against the entire circumference of canals more difficult^(24,25).

Working length was reached within comparable time intervals with both systems, which would be related to the comparability of torque and speed settings used for both file systems, and the same number of files. Moreover, the size and taper were similar for both of them.

Under the circumstances of this experiment, Protaper retreatment file system was significantly more efficient than D Perfect RT gold system in gutta percha removal. The two systems left residual gutta percha. Timewise, there was no significant difference in the time interval required to attain the full canal working extent.

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