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Evaluation Of Retreatment Files and Rotary Files in Removal of Obturation in Teeth Treated with Single Cone and Thermoplasticized Technique- An In-Vitro Study

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Abstract:
The aim of this study is to assess the efficacy of ProTaper universal rotary retreatment system compared with a Nickel titanium rotary system in removal of root canal filling material in mandibular premolars with single canals treated with single cone and thermoplasticized obturation techniques. In this study 20 freshly extracted premolars with single canals where selected and the length was standardized to 13 mm. The canals were prepared till 25/0.06 size using NiTi rotary system, and the teeth was divided into two groups: Group 1 and Group 2, in which Group 1 was obturated using single cone technique and group 2 was obturated using thermoplasticized technique. These groups were further subdivided into subgroup A and B. In subgroup A the GP was removed using NiTi rotary system and in Subgroup B GP was removed using ProTaper universal retreatment system. The operating time was recorded and teeth were subjected to CBCT for evaluation of the areas of remaining GP/sealer. Statistical analysis was performed using analysis of variance (ANOVA). Results: The ProTaper Universal technique (Subgroup B) resulted in a smaller percentage pf canal area covered by residual GP/sealer than in subgroup A. Mean operating time for Group 1 was shorter than Group 2. It was concluded that the ProTaper universal retreatment system proved to be an efficient method for removing GP/sealer compared to rotary systems and operating time was shorter in single cone technique compared to thermoplasticized technique.

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I. Introduction

Endodontic failure might occur in case of persistence of bacteria in the root canal system as a consequence of insufficient cleaning, inadequate obturation, or when there is coronal leakage.[1] The failure might be successfully remedied by orthograde retreatment or, if that is not possible, by a surgical procedure.[2]

Nonsurgical procedures require the complete removal of filling materials from the endodontic space to obtain 3-dimensional cleaning, shaping, and obturation of the root canal system.[3] Non surgical retreatment is often considered the treatment of choice in management of failed endodontic cases with a success rate of 74 to 98 %.[8,9] During retreatment procedure, complete removal of root canal filling material is of utmost importance in order to achieve effective cleaning and disinfection of canal anatomy.[10]

Although various obturation materials have been introduced in recent years, however Gutta percha in combination with root canal sealer still appears to be the most commonly used material.[4]

Many techniques with rotary nickel-titanium (NiTi) instruments, ultrasonic instruments, heat pluggers have been proposed for removing root filling materials.

Rotary Ni-Ti instruments proved to be effective and time-saving in removing filling materials. However, none of the several treatment alternatives seems to guarantee canal walls that are completely free of debris.[4,5]

Progressively tapered Ni-Ti rotary files, ProTaper, were developed in 2001. Pro-Taper instruments (Dentsply Maillefer, Ballaigues, Swizerland) have a convex triangular cross- sectional design with different shafts.[6]

More recently, the ProTaper NiTi rotary system has been upgraded to the ProTaper Universal system, which includes shaping, finishing and retreatment instruments. The three retreatment instruments (D1, D2 and D3) are designed for removing filling materials from root canals.

They have various tapers and diameters at the tip, which are size 30, 0.09 taper, size 25, 0.08 taper and size 20, 0.07 taper. The full lengths of these retreatment files are 16 mm for D1, 18 mm for D2 and 22 mm for D3. D1, D2 and D3 are recommended to remove filling materials from the coronal, middle and apical portions of canals respectively. Similar to the shaping and finishing instruments, the retreatment series have a convex cross section, however, D1 has a working tip that facilitates its initial penetration into filling materials.[7]

Till date there are no studies comparing the efficiency of GP removal using proTaper files and retreatment files with different obturation techniques.

Thus, the aim of this study was to compare the effectiveness of retreatment file system and rotary file in removing the obturation in teeth with single cone obturation and thermoplasticized obturation using CBCT evaluation.

II. Material And Methodology:

Specimen selection:

Sixteen extracted single-rooted mandibular premolar teeth were selected (figure 1). The teeth were cleaned with an ultrasonic scaler and washed with sterile solution. Preoperative mesiodistal and buccolingual radiographs were taken to verify the presence of a single straight canal. The coronal access cavity was opened by using a high-speed carbide bur and water spray. After removal of the pulp tissue, patency was assured with a size 10 K-file (Dentsply Maillefer), and the working length was defined at the apical foramen. To standardize the samples, the tooth crowns were cut to obtain root canals with a working length of 13 mm (figure 2).

Canal preparation:

A single operator instrumented all the root canals using the NiTi ProTaper Rotary system (Dentsply Maillefer). The cervical and middle thirds of the canals were flared using the ProTaper SX and S1 rotary instruments. The canals were then finished using instruments F1 and F2 until the working length was reached. At each instrument change, canals were irrigated with a 2.5% sodium hypochlorite (NaOCl) solution using a total of 25 mL per specimen. After completion of root canal instrumentation, 5 mL 17% EDTA was applied for 3 minutes to remove the smear layer, and canals were irrigated again with 5 mL 2.5% NaOCl solution.

Canal obturation:
In all the samples, canals were dried using paper points and were randomly divided into two groups (8 samples in each group) for obturation:
Group A: teeth in this group were obturated using AH plus sealer and single cone gutta percha of size F2 (figure 3)
Group B: teeth in this group were obturated using AH plus sealer and thermoplasticized gutta percha with E & Q system. (figure 4)
Following obturation the samples were evaluated for complete three-dimensional obturation using CBCT.

The coronal access cavities were sealed using a temporary filling material (Cavit-G; 3M ESPE, Seefeld, Germany). All specimens were kept at 37^{o}C and 100% humidity for 30 days to allow full setting of the sealer.
Retreatment:

A single operator who was blinded performed the retreatment procedure, The groups were further subdivided into two subgroups:
Subgroup a: in these the cavit was removed and gutta percha along with sealer was removed using NiTi universal rotary files in the sequence of Sx, S1,S2, F1 and F2. (Figure 5)
Subgroup b: In these the cavit was removed and gutta percha along with sealer was removed using protaper universal retreatment files. D1, D2, and D3 were used for retreatment in the crown-down technique until D3 reached the working length. In consideration of the region of the canal each file is intended to clean, instrumentation was performed at a predetermined length from the reference point: D1 at 5 mm, D2 at 10 mm, D3 at 13 mm. (figure 6)
One ml of 3.0% NaOCl irrigation was dispensed during a period of 10 seconds after each file use. Files were discarded after 3 uses. After each use the file was examined under dental operating microscope, and any unwindings or separations were recorded. The time in seconds for each file to reach the predetermined working length, not including change of instruments or irrigation time, was recorded and this represents an objective measure of efficiency.
The canals were irrigated with 1 mL 17% EDTA for 1 minute and flushed with 1 mL 3.0% NaOCl for 10 seconds. Canals were then dried with paper points.
CBCT using CS3D software was done to evaluate the presence of remaining GP/sealer in the canal walls. (fig 5 & 6)

Statistical analysis:
The mean time of gutta-percha removal were evaluated for each group. Descriptive statistics were expressed by means and standard deviations. One-way anova was applied to compare the operating time

amongst the groups. The difference was considered as being of statistical significance at $P < 0.05$. The R software package was used for the statistical analysis.

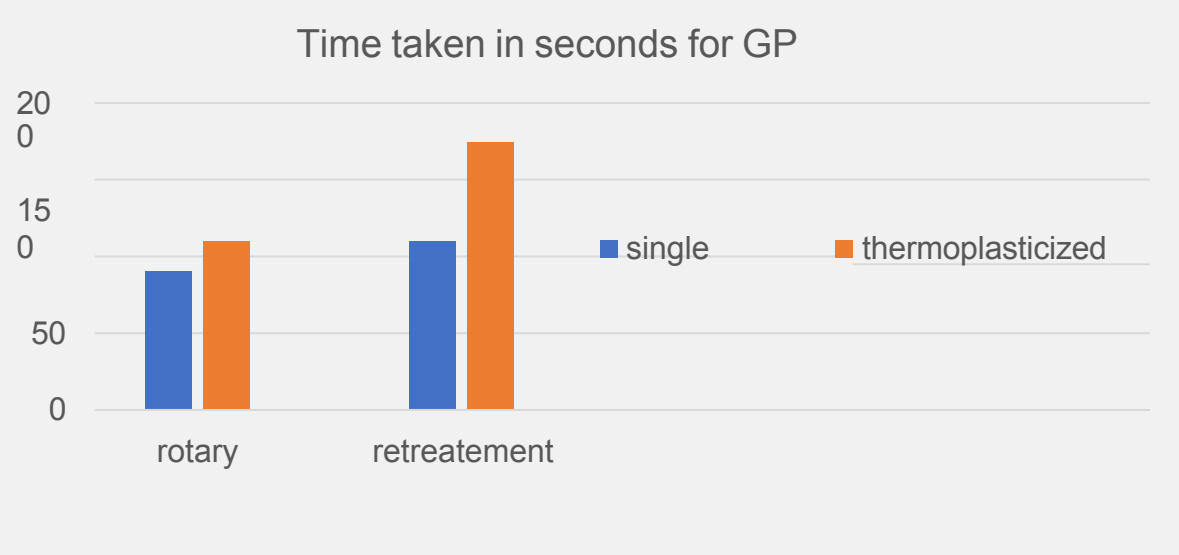
III. Results:

The time taken for the gutta percha removal was recorded and the mean value (in seconds) was calculated for all the groups (table 1)

Table 1:
Comparison of mean values of time taken (in seconds) by retreatment files and rotary files for removal of GP/sealer

	Single cone	Thermoplasticized
NiTi UNIVERAL ROTARY SYSTEM	90	110
ProTaper UNIVERSAL RETREATMENT SYSTEM	110	200

The mean time for removal of thermoplasticized gutta was more compared to removal of single cone obturation. Also, the time taken for removal using retreatment file system was more than that with NiTi rotary file



CBCT evaluation showed remnants in both the groups with both file systems.

With retreatment file system, it showed better removal of the GP and sealer along with canal shaping compared to the NiTi rotary files.

IV. Discussion:

A successful retreatment is contingent on the clinicians' ability to remove as much filling material as possible. This enables access to spaces containing necrotic tissues or bacteria that might be responsible for endodontic failure. In the current study, it was not possible to remove all traces of root canal filling as has been reported in previous studies .[10,4,12,13] The complete removal of filling materials in the middle and apical thirds was particularly difficult.[4,14,15]

The final ProTaper Retreatment file D3 has an apical diameter that would be insufficient to remove all traces of gutta-percha. Huang et al,[16] suggested further refining of the canal is necessary to permit a complete cleaning action. Hulsmann and Bluhm[4] used the F3 as a final apical file in retreatments; however, this was before development of retreatment files.

Enlarging the apical diameter may result in better cleaning of the canals; however, it may lead to more procedural errors.[11] For this reason, and since the apical tip diameter during cleaning was of size F2, F3 was not used for further shaping during retreatment procedure. In consideration of patient comfort and operator fatigue,

selecting a retreatment technique that is efficient should be used.

In the present study, the ProTaper Universal rotary instruments left a smaller percentage of area covered by GP/sealer remnants than those treated with NiTi Rotary Protaper files.

The better performance of ProTaper Universal retreatment instruments may be attributable to their design. D1, D2 and D3 have three progressive tapers and lengths. These features may enable the retreatment instruments to cut not only GP but also the superficial layer of dentine during root filling removal. Moreover, the specific flute design and rotary motion of the ProTaper Universal retreatment instruments tend to pull GP into the file flutes and direct it towards the orifice. Furthermore, it is possible that the rotary movements of engine-driven files produce a certain degree of frictional heat which might plasticize GP. The plasticized GP would thus present less resistance and be easier to remove.[17]

As has been shown in the literature, it was impossible to remove all traces of GP/sealer from root canals with any retreatment technique, regardless of single or combined action.[12,13] This was also demonstrated in the present study, as none of the specimens was free of GP/sealer remnant with CBCT evaluation.

In this study, even though the time required for gutta percha removal was more with retreatment files, the efficiency of these files for removal of the obturation as well as shaping the canal walls were more than NiTi rotary files.

As a general rule, NiTi rotary instruments should be used with great caution. When ProTaper Universal retreatment files are used to remove GP, slight apical pressure has to be exerted for file penetration. Files should be withdrawn frequently for the removal of the debris from instrument flutes before being reintroduced in the root canal system. If the rotary instruments fail to progress along the canal path, stainless steel hand files may be used to check the resistance and establish the glide path.

Solvents were not used in the present study as few previous studies have reports the formation of thin layer of softened gutta percha in the canal walls.[17] also in a study by Takahashi et al., found retreatment was faster without solvents.[19]

Clinicians are concerned not only about the ability to remove filling material effectively but also the level of safety provided by endodontic instruments during the removal procedure. Beasley et al reported fractures and deformations in some D3 files of the ProTaper Universal Retreatment System during filling removal in moderately curved canals.[18]

In this study, no instrument fracture was observed during the root canal filling removal procedure. This could be related to the more favorable anatomy of the canals used in our study (i.e., without curvatures).

V. Conclusion:

Within the limitations of this study, it can be concluded that the time taken for removal of obturating material/sealer were less in teeth obturated using single cone technique compared to thermoplasticized obturation technique.

Also, the time required to remove the material from canal with retreatment files were more than that with rotary file system, but the efficiency of removing the obturating material along with shaping of the canal was better with the retreatment file system.

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FIGURES

Fig 1: mandibular premolar, decoronated with a WL of 13mm

Fig 2: obturated teeth mounted on a wax block for CBCT evaluation

Fig 3: CBCT image of single cone obturation

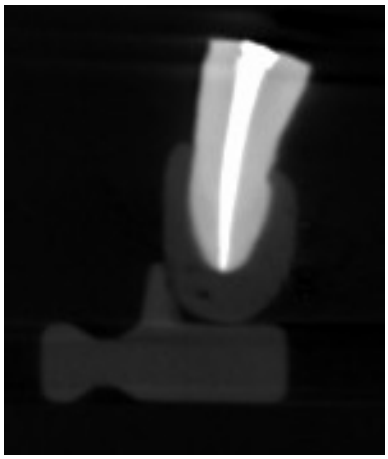


Fig 4: CBCT image of thermoplasticized obturation

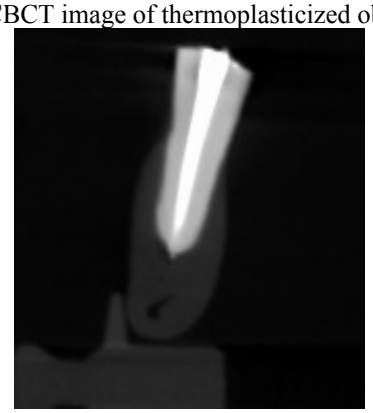
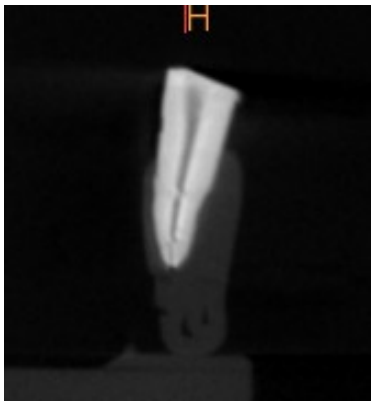


Fig 5 a & b: gutta percha removal with NiTi protaper files, a: for single cone obturation, b: for thermoplasticized obturation



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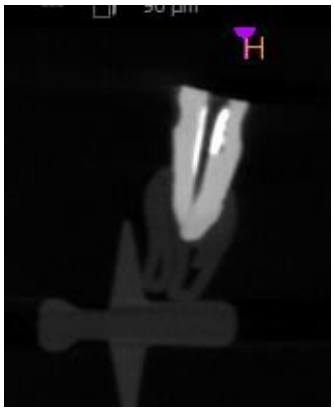

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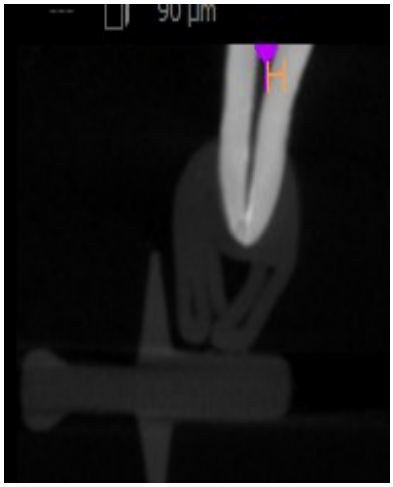
Fig 6 a & b: gutta percha removal with protaper universal retreatment files, a: for single cone obturation, b: for thermoplasticized obturation



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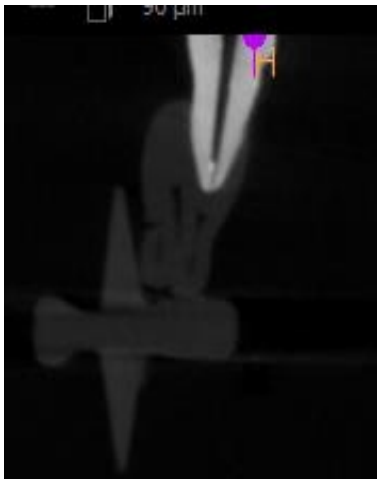

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