



To Evaluate and Compare the Efficacy, Cleaning Ability of Hand and Two Rotary Systems in Root Canal Retreatment

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ABSTRACT

Aim: To evaluate and compare the efficacy, cleaning ability of hand and two rotary systems in root canal retreatment.

Methodology: Sixty extracted premolars were retreated with following systems: Group 1—ProTaper Universal retreatment files, Group 2—ProFile system, Group 3—H-file. Specimens were split longitudinally and amount of remaining gutta-percha on the canal walls was assessed using direct visual scoring with the aid of stereomicroscope. Results were statistically analyzed using ANOVA test.

Results: Completely clean root canal walls were not achieved with any of the techniques investigated. However, all three systems proved to be effective for gutta-percha removal. Significant difference was found between ProTaper universal retreatment file and H-file, and also between ProFile and H-file.

Conclusion: Under the conditions of the present study, ProTaper Universal retreatment files left significantly less gutta-percha and sealer than ProFile and H-file.

Clinical significance: Rotary systems in combination with gutta-percha solvents can perform superiorly as compared to the time tested traditional hand instrumentation in root canal retreatment.

Keywords: Root canal retreatment, Eucalyptol, ProTaper Universal retreatment files, ProFile, H-file.

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INTRODUCTION

Nonsurgical endodontic retreatment is preferred line of treatment for management of failed pulp space therapy.¹ The main cause of endodontic failure making retreatment necessary are thought to be insufficient cleaning and inadequate obturation.²

Techniques used for gutta-percha removal include the use of hand, rotary, ultrasonic, heat carrying instruments and solvents. In many cases, the combined use of different techniques may be most efficient and time saving method. Hulsmann M and Bluhm V² have reported that the canal walls completely free of debris are not usually obtained.

Rotary NiTi instruments have been proposed for the removal of filling materials from root canal walls and various studies reported their efficacy cleaning ability and safety.³

Hence, this study aims to evaluate the efficacy, cleaning ability of hand and two rotary systems in root canal retreatment using, ProTaper Universal retreatment system, ProFile and H-file.

With the objectives to evaluate:

- The cleanliness of root canal walls after gutta-percha removal.
- Time taken to reach the working length by different instruments.
- Time taken by different instruments for complete removal of gutta-percha.
- To detect for apical extrusion of gutta-percha following different instrumentation techniques.
- To check for the instrument separation

METHODOLOGY

A total number of 60 extracted intact human permanent mandibular premolars, single rooted, straight single canal and fully formed apices were selected for the study. Teeth with fractures, calcifications, internal resorption and apical root canal diameter greater than size 25K-file were excluded from the study (Radiographs Kodak). Premolars were decoronated at the cemento enamel junction to a root length of 14 mm.

Working length was determined with size 10K-file (Prime dental products). Cleaning and shaping was done to

a master apical file size 30 K-file in a step back technique upto a size 50K-file using 1% NaOCl solution and EDTA17% (Pulpdent-File-Rite) was applied for 3 mins for complete smear layer removal and finally canals were flushed with 1% NaOCl. Canals were obturated with thermoplasticized gutta-percha Obtura II (Dentsply-Calamus flow) and AH Plus sealer (Dentsply) using hybrid technique. Specimens were sealed with Cavit G (3M ESPE) and stored at 37°C in 100% humidity for 1 month.

After 1 month depending upon the technique used for gutta-percha removal, teeth were randomly divided into 3 groups of 20 specimens each, i.e. group 1: ProTaper universal retreatment files (Dentsply), group 2: ProFile (Dentsply) and group 3: H-files (Mani). Cavit G was removed with a round bur, thus forming a reservoir for eucalyptol oil that was used as a solvent.

Drop of eucalyptol was applied to the gutta-percha for 3 mins and a size 25K-file was used to establish a glide path before introducing rotary instruments.

At each change of instrument, the root canals were irrigated with 2 ml of 1% NaOCl solution and another drop of solvent was applied. When the instrument reached the apical one-third, use of solvent was discontinued. Rotary instruments were used with a low torque and at a constant speed of 500 rpm.

- Group 1—ProTaper universal retreatment files were used in a gear reduction hand piece (J.Morita). D1 (size 30, 0.09 taper), D2 (size 25, 0.08 taper) and D3 (size 20, 0.07 taper) were sequentially used in a crown-down manner to reach the pre-established working length and manipulated in a brushing action.
- Group 2—ProFile was used for retreatment in the coronal one-third (size 30-0.06 taper, size 25-0.06 taper), middle one-third (size 30-0.04 taper, size 25-0.04 taper) and apical one-third (size 25-0.04 taper, size 30-0.04 taper) and final flaring till working length (size 30-0.04 taper).
- Group 3—Retreatment was done using H-files size 60 to 30 in a crown down technique.

Retreatment time for gutta-percha removal was recorded two times using a stop watch—(1) time was recorded from creating a glide path up to the reach of working length and (2) complete removal of gutta-percha was recorded when the working length was obtained and no more gutta-percha was removed. Time was recorded again for removing any remnants and added to the first measurement. Working length was maintained and the apical diameter was enlarged to a size 35K-file for complete removal of the filling. Gutta-percha removal was considered complete unless, debris was observed on the instrument flutes, in the irrigating solutions and on the radiographs. Apical extrusion of gutta-percha was observed clinically during retreatment and separation

of instrument was assessed clinically and radiographically. The teeth were grooved with a diamond disk, split longitudinally and viewed under a stereomicroscope at 70× magnification.

The specimens were evaluated separately in the coronal, middle and apical third using the following scoring criteria given by Hulsman M and Bluhm V.²

- Score 1—Gutta-percha completely removed.
- Score 2—Small remnants of sealer (<2 mm)
- Score 3—Large remnants of sealer (>2 mm)
- Score 4—One to three small (<2 mm) remnants of gutta-percha.
- Score 5—More than three small (<2 mm) remnants of gutta-percha.
- Score 6—Large remnants of gutta-percha (>2 mm)
- Score 7—Gutta-percha covering more than 4 mm.

Results were evaluated and statistically analyzed using ANOVA test and Kruskal-Wallis test.

RESULTS (TABLE 1)

Table 1: Mean values and SD for time taken to reach working length and complete removal of gutta-percha

Groups	Working length	Complete removal
ProTaper universal retreatment files	1.46 ± 0.87 sec	5.71 ± 0.42 sec
ProFile	1.65 ± 0.15 sec	8.14 ± 0.41 sec
H-file	3.04 ± 0.35 sec	10.35 ± 0.27 sec

Time taken to reach the Working Length

There was no significant difference found between groups 1 and 2 ($p = 0.569$).

Significant difference was found between groups 1 and 3 ($p < 0.0001$).

Significant difference was found between groups 2 and 3 ($p < 0.0001$).

Time taken for Complete Removal of Gutta-Percha

Significant difference was found between all the three groups as follows:

1. Groups 1 and 2 ($p < 0.0001$)
2. Groups 1 and 3 ($p < 0.0001$)
3. Groups 2 and 3 ($p < 0.0001$)

ANOVA Test

The mean values for time taken to reach working length differs significantly between three groups ($F = 48.680$, $p < 0.001$).

The mean values for complete removal of gutta-percha differs significantly between three groups ($F = 761.920$, $p < 0.001$).

Cleanliness of Root Canal Walls (Table 2)

Table 2: Mean scores of cleanliness of root canal walls of all three groups in coronal, middle and apical third			
Group	Coronal	Middle	Apical
ProTaper Universal retreatment file	1.1 ± 0.31	1.6 ± 0.68	2.5 ± 1.14
ProFile	1.25 ± 0.44	2.5 ± 0.83	3.3 ± 1.71
H-file	1.4 ± 0.94	1.9 ± 0.85	4 ± 1.77

Kruskal-Wallis Test

The mean score of coronal third between the three groups did not differ significantly ($\chi^2 = 1.530$, DF = 2, $p = 0.465$) (χ^2 —chi square).

The mean score of middle third between the three groups differs significantly ($\chi^2 = 12.846$, DF = 2, $p = 0.002$).

The mean score of apical third between the three groups differs significantly ($\chi^2 = 6.74$, DF = 2, $p = 0.034$).

Apical extrusion and Instrument separation were not detected in any of the specimens, hence no statistical analysis was done.

DISCUSSION

Premolars were selected in this study because they are extracted commonly for orthodontic treatment. Canals are flattened mesiodistally, an important anatomic variation during their treatment. Decoronation assured standardization of specimens.¹

Premolars were prepared initially to size 30 with 2% taper K-file. This was assumed to represent, narrow and underprepared root canals. Such canals are frequently found in retreatment.²

Removal of smear layer with 17% EDTA pretreatment and use of AH Plus sealer adds to the difficulty during retreatment, AH Plus sealer has shown to have better adhesion to the canal walls after pretreatment.⁴ The thermoplasticised gutta-percha technique provides a greater challenge for retreatment.^{5,6} Solvent helps in dissolving the gutta-percha and in lubrication of instruments thus diminishing the possibility of instrument breakage, root perforation and canal straightening.⁷

According to the results of the present study: To reach the working length and for complete removal of gutta-percha, group 1 was significantly more effective and faster. The mean values of retreatment time were consistent with other studies showing that engine driven instruments perform significantly faster than manual instrumentation. Hulsman M et al and Gu LS et al suggested that the faster rotational speed plasticizes the gutta-percha more rapidly making it easier to remove, unlike the group 3.^{2,8}

Completely clean root canal walls were not achieved with any of the techniques, as previously reported by Marfisi

K et al⁹ and Athikesavan Jayasenthil et al.¹⁰ The better performance of group 1 may be attributable to their design. D1, D2 and D3 have three progressive tapers and lengths. These features enable the instruments to cut not only gutta-percha but also the superficial layer of dentine. Moreover, the specific flute design and rotary motion of the group 1 files tend to pull gutta-percha into the file flutes and direct it toward the orifice.⁸

In the middle and coronal parts of the canals, group 1 performed better than in the apical part, which was probably due to variable taper of the instrument, unlike the group 2 with their radial lands probably do not cut but rather smear or burnish the softened gutta-percha onto the walls.²

Group 3 was effective in the coronal and middle thirds, because stainless steel instruments are stiffer than NiTi rotary instruments and can be safely directed toward the canal walls allowing for better performance in oval areas of the canal walls.¹¹

Apical third of the root had more amount of remaining filling material as there is increased anatomical variability, making it impossible to direct NiTi rotary instruments against entire root canal walls⁵ (Figs 1 and 3).

The majority of remnants appeared to be sealer, which is consistent with other studies. Sealer adheres well to the canal walls when solvents are used.^{8,12} Thus, the results of the present study could have been affected by the removal of the smear layer there by increasing penetration of sealer into dentin⁴ (Figs 1 and 2).

Instrument separation: No instrument separation occurred during retreatment. A low torque motor with constant speed of 500 rpm was used. This approved to increase tactile sensitivity, control of rotary instrumentation, decreased risk of ledge, perforations and instrument separation.⁸ In



Fig. 1: Split specimen demonstrating completely removed gutta-percha in coronal and middle third (score 1) small amount of sealer in middle third (score 2) but a large amount of gutta-percha and sealer seen in apical third (score 7)



Fig. 2: Split specimen demonstrating gutta-percha in coronal third (score 4) and gutta-percha and sealer in apical third (score 2 and 4)



Fig. 3: Split specimen demonstrating completely removed gutta-percha and sealer in coronal and middle third (score 1) large amount of gutta-percha seen in apical third (score 7)

addition, each set of instruments were used to prepare only two root canals. The use of a solvent, added to reasons for lack of instrument separation.

Apical extrusion of debris: The present study did not reveal any apical extrusion of debris. Some factors that could have contributed toward these results, i.e. common to all the techniques were the type of irrigant, the operator and the preparations were performed equally to a size 35 file, having all been flared cervically initially. This finding was similar to that reported by many investigators and indicating that rotary instruments tend to direct the debris coronally rather than apically.^{13,14}

However, it would be of further interest to evaluate teeth with curved canals, teeth obturated with different obturation techniques, gutta-percha in conjunction with different sealers and different rotary NiTi instruments.

CONCLUSION

Under the conditions of the present study, completely clean root canal walls were not achieved with any of the techniques investigated. However, all three systems proved to be effective for gutta-percha removal. The shortest time to reach the working length and the fastest technique for complete removal of gutta-percha was found to be ProTaper Universal retreatment system, followed by ProFile and then H-file. Occurrence of apical extrusion and instrument separation was not detected in any of the specimens.

CLINICAL SIGNIFICANCE

In modern day endodontic practice, use of NiTi instruments for gutta-percha removal has gained momentum. Review of literature suggest that rotary instrumentation is more effective in their cleaning ability and safety. This study shows that rotary systems in combination with gutta-percha solvents can perform superiorly as compared to the time tested traditional hand instrumentation in root canal retreatment.

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