

# A comparative evaluation of two rotary Ni-Ti instruments in the removal of gutta-percha during retreatment

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## Abstract

**Aim:** The purpose of this study is to achieve an effective method to remove root canal filling material from the root canal system. The study, thus, aims to evaluate the efficacy of the cleaning ability of two different rotary Ni-Ti systems; ProTaper Retreatment files and RaCe System compared to hand instrumentation with Hedstrom files for the removal of gutta-percha during retreatment. **Materials and Methods:** Thirty mandibular premolars with one single straight canal were decoronated and instrumented with ProTaper files and filled with thermoplastic gutta-percha. After 30 days, the samples were divided into three groups and gutta-percha was removed with the test instruments. The postoperative radiographs were evaluated with known criteria by dividing the root into cervical third, middle third, and apical third. The results were tabulated and Statistical Package for Social Sciences Software (IBM Corporation) was used for analysis. **Results:** The mean deviation of the results were first calculated and then *t*-test and analysis of variance test (two-tailed *P* value) were evaluated for establishing significant differences. The rotary instruments were effective in removing the gutta-percha from the canals. Therefore, significant difference was observed between the efficacies of the two rotary systems used. The rotary instruments showed effective gutta-percha removal in the cervical and middle one third. (*P* > 0.05). However, apical debridement was effective with Hedstrom files. **Conclusion:** The study concluded the use of both rotary and hand instrumentation for effective removal of gutta-percha for retreatment.

**Key words:** Gutta-percha removal, Hedstrom files, ProTaper Retreatment system, RaCe Rotary System, retreatment procedure

## INTRODUCTION

The success of a root canal filled tooth depends mainly on the extent of re-cleaning and re-shaping followed by the complete filling of the root canal system.<sup>[1]</sup>

Gutta-percha is the most commonly used material for filling the root canals, and it should be removed when retreatment is indicated.<sup>[2]</sup>

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There are various methods that are followed to remove gutta-percha from the canal system; these include hand files, rotary files, as well as ultrasonic instruments.<sup>[3]</sup> Studies have shown that none of the re-treatment procedures are able to completely clean the root canal walls,<sup>[3]</sup> particularly in the apical third, where microorganisms generally persist. It is considered that the combined use of different techniques is more effective in the complete removal of gutta-percha.<sup>[4]</sup>

It has been reported in various studies that the use of Ni-Ti instruments for the purpose of gutta-percha removal during re-treatment is safe, fast, and efficient; Ni-Ti also maintains the shape of the root canal and its use also avoids the apical extrusion of debris.<sup>[5-7]</sup>

Few similar previous studies have contradicted the abovementioned findings; these studies have reported that the manual use of Hedstrom files is more effective in the removal of gutta-percha when compared to Ni-Ti rotary systems during retreatment procedures.<sup>[8-11]</sup> In addition, it should be noted that, many studies have not concluded the efficacy of one single rotary Ni-Ti system in the removal of root canal filling material. All the Ni-Ti rotary systems that were studied showed no significant difference among them in removing gutta-percha.<sup>[8-13]</sup>

The purpose of the present study is to compare manual and automated instrumentation techniques for the removal of root canal filling material as well as to compare the efficiency among automated systems, of which Ni-Ti system is especially designed for endodontic re-treatment procedures.

## MATERIALS AND METHODS

### Preparing the samples, shaping, and obturation

Thirty extracted single rooted teeth of similar length were selected. The sample size for the study was calculated using Microsoft Excel and similar previous studies were considered.<sup>[3]</sup> Soft tissues and calculus were mechanically removed from the root surfaces immediately after extraction. Soft tissue remnants were cleaned by immersing the tooth in 3% sodium hypochlorite for 24 h.<sup>[7]</sup>

The samples were decoronated at the cemento-enamel junction with a diamond disc (D&Z, Berlin, Germany), leaving the root length to be approximately 18 mm in length [Figure 1]. Working length of 17 mm was established [Figure 2].

Cleaning and shaping of the canal system was done using the ProTaper system (Dentsply Maillefer) according to the manufacturer's instructions using an X-Mart (Dentsply). The preparation was performed in a crown-down technique. Canals were irrigated between instruments with 5.25% NaOCl and 17% EDTA alternatively.

The canals were filled in increments using Obtura II and hand plugger was used to condense and plug the thermoplastic gutta-percha. Postoperative radiograph were obtained to determine the quality of root fillings [Figure 3]. The specimens were sealed



Figure 1: Decoronated samples

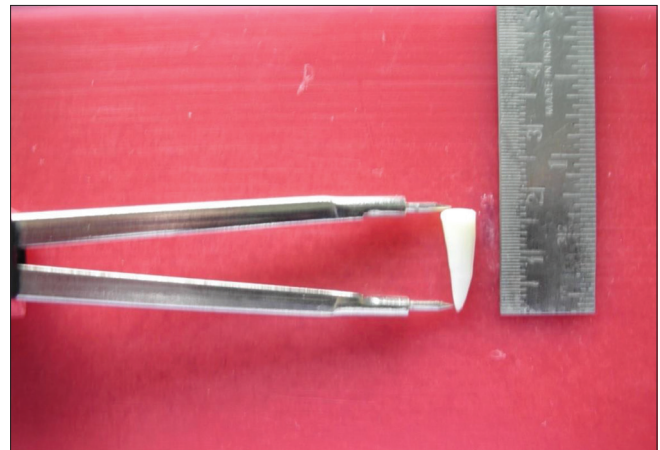


Figure 2: Standardized decoronation of samples

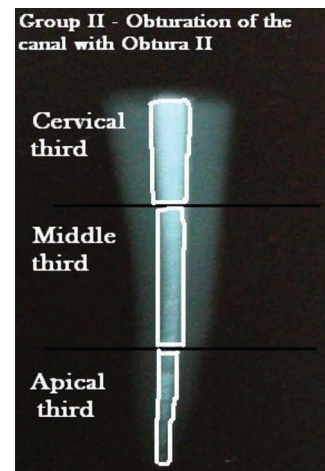


Figure 3: Post-obturation radiograph

with temporary filling material (Cavit, 3M ESPE Dental). The samples were stored at 37°C for 30 days, and then, they were divided into three groups of 10 samples each, and each group was treated using a different technique.

### Retreatment procedure

The canal filling material in Group I was removed using Hedstrom files; file sizes from #45 to #30 were used. The filling material was removed in a crown-down technique by using the file sizes in a reverse sequence.

Canal filing material in Group II was removed using ProTaper Universal retreatment files. ProTaper Retreatment files D1, D2, and D3 were used in a crown-down technique. D1 is used for cervical debridement, followed by D2 at the middle one third and D3 is worked to working length of the canal.

Root canal filling material in Group III was removed using RaCe files, sequence were used as suggested by the manufacturer (9 instruments, Tapers range from 2 to 10%).

All the samples were digitally radiographed after the re-treatment procedure with their respective instruments. Radiograph standardization was maintained. A standard exposure time of 0.08 seconds and a standard distance of 5 cm was maintained.<sup>[6]</sup> The digital radiograph used for a study was Dr. Suni dental radiovisiograph (RVG). The digitized images were analyzed by dividing the canal into coronal, middle, and apical areas [Figure 3].

Using standardized scoring criteria, the radio-opacity of the canals in each of the three divided areas were scored and evaluated [Figure 4].<sup>[3]</sup>

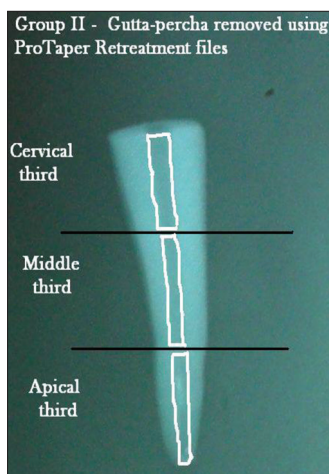


Figure 4: Post-retreatment radiograph

### Criteria of score

- 0 = no radiopaque debris observed;
- 1 = <25% debris;
- 2 = 25–50% debris;
- 3 = >50% debris.

### RESULTS

The mean and standard deviation [Table 1] of the three groups were analyzed first followed by performing the *t*-test along with analysis of variance test (two-tailed *P* value) among the three groups to determine the significant difference [Table 2].

When the results were analyzed it was noted that there was a significant difference ( $P < 0.05$ ) between the effectiveness of manual method using Hedstrom files to that of using rotary files. Both the rotary systems were effective in removing the root canal filling material from the canal walls.

No significant difference ( $P > 0.05$ ) was observed between ProTaper Retreatment to that of the RaCe file system in removing gutta-percha from the canal walls. When the cervical, middle, and apical thirds were analyzed separately, it was observed that all the groups performed well in removing the filling material from the canal walls at the cervical region. However, the significance of difference ( $P < 0.05$ ) was recorded when instrumentation was performed at the middle and apical third regions.

The overall time taken to perform the procedure is also comparatively less when using rotary system to that of the manual method. The use of the ProTaper Retreatment files was faster than the RaCe files because of the less number of files (3 files) that are used for the procedure compared to the 9 files for the RaCe file system.

Table 1: Mean and standard deviation of the three study groups

	Group I	Group II	Group III
Mean	4.2	1.8	2
S D	0.62	0.79	0.82

Table 2: *t*-test and analysis of variance test with two-tailed *P* value among the three study groups

	<i>t</i> -test	Two-tailed <i>P</i> value	Difference
Group I–Group II	7.511	<0.0001	Significantly different
Group I–Group III	6.727	<0.0001	Significantly different
Group II–Group III	-0.554	>0.0001 (0.5854)	Not significantly different

## DISCUSSION

A growing demand to conserve teeth has been seen in recent times. It also includes the cases wherein root canal therapy has failed.<sup>[14]</sup> The choice of treatment for a failing root canal treated tooth is either a surgical procedure (apical surgery or extraction) or nonsurgical retreatment,<sup>[15]</sup> out of which the latter is the most preferred.<sup>[16]</sup> Filling material left after retreatment procedure may harbor necrotic tissue and bacteria, which could lead to a persistent disease and reinfection of the root canal system.<sup>[10]</sup>

The present study was undertaken to determine the effectiveness of gutta-percha removal technique in a root canal retreatment procedure. Complete removal of the old root canal filling material along with good debridement is very important for a successful root canal retreatment procedure. Many methods are used during endodontic retreatment, which include endodontic hand files, endodontic rotary files, ultrasonic files, and chemicals such as chloroform, zylene, turpentine, and many others.<sup>[17-20]</sup>

In this scenario, there are a number of endodontic rotary file systems introduced by different manufactures promising an effective filling material removal from the root canals. Some manufactures have even introduced exclusive root canal filling material removal systems such as the ProTaper Retreatment files. However, few studies point out that the effectiveness of these exclusive retreatment systems is same to that of rotary system. A study compared the effectiveness of ProTaper and Mtwo to that of retreatment system from the same manufactures, the ProTaper Retreatment and Mtwo Retreatment systems; the study concluded that there was no significant difference among the study groups, and ProTaper and Mtwo were as effective as ProTaper Retreatment and Mtwo Retreatment file systems.<sup>[11]</sup>

All these systems to some extent challenge the conventionally used hand Hedstrom files, which is/was used by many clinicians for gutta-percha removal during retreatment procedures. Hence, this increases the necessity for a clinician to access and know the best technique he can employ in the removal of gutta-percha with a rotary or hand file and sometimes the use of both the rotary and hand might become necessary. This study helps in evaluating the efficiency of two such rotary systems, the ProTaper Retreatment files and RaCe Rotary files, along with Hedstrom files.

In the present study, single rooted premolar teeth were selected to reduce the variation in the effectiveness of

the technique among the different study groups. The samples were shaped with ProTaper Rotary system and obturated with thermoplastic gutta-percha so that they receive a relatively uniform quantity of filling material in their canals. The samples were randomly divided into three groups and preoperative radiographs were taken. The samples of Group I were re-treated with Hedstrom files, Group II were re-treated with ProTaper Retreatment files and Group III with RaCe rotary system.

The primary outcome of the study is that none of the systems or the technique used were effective in a total or 100% removal of the gutta-percha from the root canals of the samples.<sup>[21]</sup> Hulsmeann *et al.*,<sup>[22]</sup> who also studied the cleaning ability of rotary instruments in retreatment, concluded that there was no system that was 100% effective in gutta-percha removal. This outcome of the study is also supported by other previously done studies.<sup>[23,24]</sup>

The present study used a unique scoring criterion to determine the effectiveness of the gutta-percha removal not just in the whole of the root canal but also helped in determining the exact effectiveness of the different techniques at different parts of the root canal system. The canals were divided into three parts as the apical, middle, and the cervical thirds, and depending on the presence of residual filling materials the scoring was done. When the groups were compared at these different levels, the effectiveness of the techniques varied between the rotary and the hand methods.

Group II and Group III which represented the rotary systems did not show much difference in their efficiency in removing filling material from the middle and cervical one third of the canals. The mean scours of Group II and Group III when compared showed no difference. Both the rotary Ni-Ti files were very effective at the middle and cervical one third regions. The effectiveness of the rotary at these areas can be attributed to the greater tapers of the files at these areas, like that of RaCe files used were 10% and 8% at the cervical areas, thus engaging more of the filling materials during the cleaning process. Files such as the RaCe sized 10.40 and 8.35 are made of stainless steel; it is also concluded in a few studies that stainless steel files have a higher cutting efficiency than Ni-Ti files.<sup>[25-27]</sup> Few recent studies have established that effectiveness of ProTaper Retreatment files in GP removal, a study that compared ProTaper Retreatment files to that of RaCe, K3 and Hedstrom files showed its efficacy in retreatment procedures.<sup>[12]</sup> It is also estimated that the ProTaper Retreatment system worked faster than Mtwo



Retreatment files in removing root canal obturation material, both retreatment systems were considered to be effective, reliable, and fast.<sup>[28]</sup>

There are a few studies like those by Hulsmann *et al.* and Betty *et al.* that advocate the use of endodontic hand files for the removal of endodontic filling material.<sup>[17,29]</sup> Studies by Rodig *et al.* also support the effectiveness of hand files in the removal of gutta-percha.<sup>[8,9]</sup> In the present study, samples of Group I, where the method of filling material removal was Hedstrom files, showed less or no residual gutta-percha at the apical one third region. This might be because of the availability of a greater number of files with large tip sizes in the Hedstrom file system, thus providing the comfort to use one size larger than the original size used in the initial cleaning of the canal, thus, helping in engaging the whole of the filling material from the area. The hand files also provide an unparallel tactile feel to the operator thus helping in understanding a better engagement of the filling material at the apical region.

Unfortunately, one limitation of this study is that, an *in-vitro* study does not provide the same conditions as that of an *in-vivo* study, even though all the steps were taken to reduce as much errors as possible. A standardized method of root canal preparation was employed to minimize the variation among the study groups in relation to the quantity of gutta-percha that will be removed in the study. The obturation of the samples was performed by thermoplastic obturation technique to attain a homogenous mass of gutta-percha, which eliminates pools of entrapped sealer in the filling and also eliminates any loose filling at the apical third.<sup>[30]</sup> The limitation of the study points toward the need of further research on the subject and technique of gutta-percha removal. Further, research should be oriented in reproducing more *in-vivo* conditions for more accurate results and to help the clinician in implementing the techniques for a more effective retreatment procedure.

Recent studies have compared not just the rotary files systems in root canal obturation material removal but also the efficacy of reciprocating systems like the WaveOne and Reciproc systems are studied. One study has concluded that both Wave One and Reciproc when compared were effective but did not completely remove the obturating material from the root canals.<sup>[31]</sup> These reciprocating systems are no different compared to the rotary systems in gutta-percha removal.<sup>[32,33]</sup> One big advantage of reciprocating systems is that it does not extrude apical debris as much as rotary systems do during retreatment procedures.<sup>[34]</sup>

Most of the research concerning retreatment procedures is aimed at establishing the type of system that is more effective in gutta-percha removal, or the type of technique that is faster in the gutta-percha removal. However, in the middle of all this it is important to guide the clinician in employing the type of movement or motion in which the systems are to be used for complete gutta-percha removal. It is most effective if an adaptive motion is employed, by engaging all the sides of the root canal when the retreatment procedure is done, compared to a rotation movement, irrespective of the file system used.<sup>[35]</sup>

## CONCLUSION

It can be concluded that the effective removal of root canal filling material might not be achieved by the use of one system or method. A more effective way of an endodontic retreatment would be the use of both the rotary and hand file systems. The rotary system would help us in achieving the complete removal of filling material from the cervical and middle one third as well as help us in reaching the apical region faster compared to the use of hand files in these areas; the final apical region can be debrided by the use of hand files, thus completing the filling material removal without leaving behind any residual filling materials.<sup>[29,36-38]</sup>

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## Conflicts of interest

There are no conflicts of interest.

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