

# Comparative evaluation of removal of gutta-percha by different retreatment rotary files using cone beam computed tomography: An in vitro study

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## ABSTRACT:

**Aim:** Complete removal of the gutta-percha from the canal using three rotary systems after obturation using Epiphany sealer.

**Methodology:** 60 freshly extracted intact, single rooted, permanent maxillary anterior teeth were collected and decoronated at the cemento-enamel junction with a diamond disc to facilitate straight line access for instrumentation and obturation. Working length was determined by placing a size 15 k file in to the canal until it appeared at the apical foramen. The specimens were randomly divided into three experimental groups; with 22 specimens each for removal of gutta-percha by using one of the following techniques.

- Group A: Protaper universal retreatment files
- Group B: D-RaCe retreatment files
- Group C: Mtwo retreatment files

Time to reach working length (T1) and time needed for the complete gutta-percha removal (T2) were recorded. Specimens were scanned post-operatively using CBCT equipment within a full rotation. Data was analyzed using ANOVA and Post Hoc Tukey Test.

**Results:** The CBCT evaluation found significant difference between ProTaper, Mtwo, and D-RaCe in the removal of filling material. In this study ProTaper was the most effective system especially when compared with Mtwo and D-RaCe.

**Conclusion:** The findings from this study suggested that: 1. Non-surgical re-treatment is a valid treatment option for failed endodontic teeth rather than extraction. 2. Rotary instruments required less time for root filling material removal than manual instrumentation. 3. All instruments left filling material inside the root canal. 4. The analysis of coronal, middle, and apical thirds did not detect significant differences in the residual material between instruments. 5. CBCT proved to be reliable, non-invasive method of evaluating this study

**Key words:** Gutta-percha, rotary, obturation, epiphany

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## INTRODUCTION

The main goal of non-surgical endodontic retreatment is to remove the existing root filling material throughout the canal length to regain access to the apical foramen, to allow disinfection of the root canal space and creation of favorable conditions for periradicular healing.<sup>[1]</sup>

Causes of endodontic failure being improper cleaning and filling of root canal system, procedural errors or the lack of sufficient hermetic sealing enables the survival of a bacteria inside dentinal tubules, apical ramifications, accessory and secondary canals.<sup>[2]</sup>

Gutta-percha is the most popular root filling material, and in cases of endodontic failure, various methods have been introduced to remove it from root canal system which includes rotary files, ultrasonic instruments, hand files combined with heat or chemicals, and paper point with chemicals.<sup>[3]</sup>

Endodontic failure might occur in case of bacteria persisting in root canal system as a consequence of insufficient cleaning, inadequate obturation or when there is a coronal leakage.<sup>[4]</sup> Main goal of retreatment is to regain access to the apical foramen by complete removal of the root canal filling material. Therefore as much as possible, the obturating material must be removed to reduce the number of microorganisms within the canal.<sup>[5]</sup>

If nonsurgical treatment is not possible, surgical procedure may be performed to save the tooth. Various hand and rotary instruments have been used for gutta-percha removal including endodontic hand files, engine driven rotary files, ultrasonic tips and files, solvents and heat carrying instruments. The most commonly found root canal filling material is gutta-percha which is used widely, in conjunction with various sealers. Removing gutta-percha from inadequately prepared and obturated root canal systems is a major part of most root canal retreatments, and can be time consuming and challenging. Therefore much effort has been made to find a clinically practical method for removal of this material from the root canal. This ability to effectively remove root canal filling materials enabling a new attempt at canal cleaning is of great clinical importance.<sup>[6]</sup>

Chemical solvents are used to solubilize gutta-percha. Orange oil, eucalyptol, xylol, chloroform, halothane and rectified turpentine have all been used as adjuncts to remove endodontic filling materials.<sup>[7]</sup> Earlier eucalyptol and chloroform (solubilizes gutta-percha easily, inexpensive and easy to obtain) were used as gutta-percha solvents to facilitate canal obturation procedures.

The instruments specifically designed for retreatment includes Protaper Universal Retreatment system, which is effective in removing root filling material.

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The efficacies of re-treatment procedures can be assessed by the amount of residual gutta-percha and sealer on the root canal wall and epiphany sealer from root canal walls.

**Materials and methods**

Sixty freshly extracted human permanent maxillary anterior teeth were collected. This study was conducted at a private dental college in the Department of Conservative Dentistry and Endodontics. CBCT imaging was done at a diagnostic center, Kochi.

## Initial root canal treatment

Each tooth was decoronated at the cemento-enamel junction with a diamond disc to facilitate straight line access for instrumentation and obturation. Working length was determined by placing a size 15 k file in to the canal until it appears at the apical foramen; the length is measured and the working length is at 0.5mm short of this distance. A circumferential staging platform is established near the canal orifice ensuring a uniform working length of 15mm in each tooth. The samples were divided into three groups of 20 teeth each. Cleaning and shaping was done by step back technique. The coronal third was flared with sizes 1-3 Gates Glidden drills. Canal preparation was carried out with sequential use of K files up to 35 at working length. Upon withdrawal of each instrument, canals were irrigated alternatively with 5.25% sodium hypochlorite and 17% Ethylene Diamine Tetra Acetic acid (EDTA).

## Root canal obturation

The root canal of each tooth was dried with paper points. A size 30 master cone and root canal sealant were placed in the canal. Lateral condensation was accomplished using finger spreaders and gutta-percha accessory points with sealer until the canal was completely filled. The obturation was judged to be complete when a spreader did not penetrate more than 3mm into the gutta-percha mass and sealed with temporary filling material (CAVIT, 3M-ESPE, Seefeld, Germany). All teeth were to be stored at room temperature for 30 days to allow complete setting of the sealer.

## Retreatment technique

All the specimens were randomly divided into three experimental groups; with 20 specimens each for removal of gutta-percha by using one of the following techniques.

Group A: ProTaper universal retreatment files

Group B: D-RaCe retreatment files

Group C: Mtwo retreatment files

Group A: **ProTaper Universal retreatment files**

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ProTaper universal retreatment files were operated with a speed and torque controlled electric motor and the gutta-percha was removed using light apical pressure. The root canals were instrumented in crown down sequence. As recommended, ProTaper D1 was used to remove filling material from coronal portion of the root canal, whereas the middle and apical third of the canals were instrumented using ProTaper D2 and D3 files respectively.

**Group B: Mtwo retreatment files**

Mtwo retreatment files were used according to the manufacturer's instructions. Removal of root filling materials was done with the use of sizes 1-3 Gates Glidden drills in the coronal portion. The canals were instrumented in a simultaneous technique to the working length using Mtwo R2 (size 25, 0.05 taper) in a brushing action with lateral pressing at a speed of 300 rpm and torque of 1.2 N cm. Progression of the rotary files was done by applying slight apical pressure and frequently removing the files to inspect the blade and clean the debris.

**Group C: D-RaCe retreatment files**

Race rotary instrument sizes DR1 facilitate penetration in to the filling material at the cervical third of the canal and for DR2 at the middle and apical third of the canal was used with a brushing action in a crown down manner, until D-RaCe retreatment instruments were used according to the manufacturer's instructions.

**Specimen evaluation:**

Remaining filling material on canal walls were evaluated through CBCT.

According to guidelines described by Hulsmann and Stotz.

Score 0- No debris or only isolated small particles is present.

Score 1- Minimal debris particles are present in small clumps.

Score 2- Clumps of debris particles covered less than 50% of the canal wall.

Score 3- Clumps of debris particles covered more than 50% of the canal wall.

Score 4- Clumps of debris particles completely covered the canal wall.

The main purpose of this study was to determine the best removal technique based on removal time and material left in root canal.

**Result and statistical analysis-**

The mean and standard deviation among the groups was calculated by ANOVA (One Way Analysis Of Variance) and

**MASTER RESULTS**

Area of remaining Filling material			
Sample	ProTaper	Mtwo	D-RaCe
1	3.85	4.05	4.12
2	3.95	4.15	4.19
3	3.34	4.2	4.09
4	3.32	4.35	3.61
5	3.23	4.65	3.71
6	3.82	4.7	3.81
7	3.41	4.23	3.73
8	3.51	4.15	3.72
9	3.61	4.17	3.33
10	3.71	4.21	3.25
11	3.81	4.31	3.15
12	3.91	4.35	3.16
13	3.21	4.44	3.17
14	3.25	4.46	3.41
15	3.65	4.18	3.65
16	3.13	4.19	4.15
17	3.19	4.25	4.13
18	3.1	4.3	4.18
19	3.15	4.45	3.91
20	3.32	3.46	3.81
21	3.4	3.61	3.71
22	3.45	3.6	3.46

**TOTAL TIME TAKEN IN MIN:SEC**

SAMPLE	OTAP	Mtwo	D - RaCe
1	2:59	3:1	2:58
2	1:05	3:05	2:59
3	2:32	3:13	2:58
4	1:44	3:5	2:44
5	1:59	3:59	2:55
6	1:26	3:54	2:48
7	2:18	3:14	2:49
8	2:2	4:11	3:05

9	2.14	4.21	3.13
10	2.05	3.11	2.13
11	1.15	3.38	2.22
12	2.2	3.41	2.15
13	1.3	3.31	2.04
14	1:35	3.21	2.08
15	1:02	3.19	2.09
16	1:11	3.18	2.13
17	2.13	3.19	2.18
18	2.18	3.21	3.21
19	2.3	3.21	3.25
20	3.44	3.29	3.35
21	3.43	1.49	3.45
22	3.55	1.51	3.5
TOTAL TIME TAKEN	43.4	70.06	57.58

multiple comparisons among the various groups were carried out by using Post Hoc Tukey Test.

Individual comparison among the mean scores of 3 different groups by Mann Whitney U Test, showed statistically significant difference with respect to mean area of remaining filling material, and time in seconds between ProTaper universal retreatment system, Mtwo and D-RaCe (p<0.05)

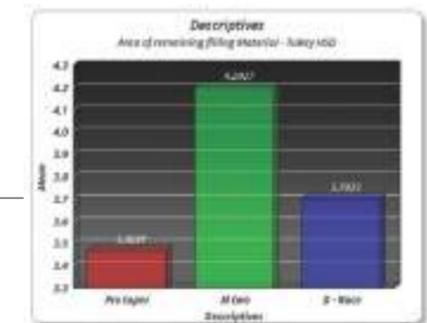
**DISCUSSION**

The utilization of rotary instruments as a coadjuvant in the retreatment of root canals results in a better cleaning of the apical third<sup>[9]</sup>. Successful root canal treatment is dependent on effective debridement and shaping of the root canal system. Post treatment disease is associated with the persistence of microorganisms in the root canal system after cleaning and shaping. The study was conducted on straight root canals because majority of experimental studies comparing the efficacy of different retreatment techniques have been performed using straight root canals to simplify standardization of specimens.<sup>[10]</sup>

The teeth were decoronated to obtain standardized working length to minimize variations amongst the specimens and to apply an identical protocol for root canal preparation, root

Area of remaining filling material

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.182	2	3.091	31.343	.000
Within Groups	6.213	63	.099		
Total	12.396	65			



**Multiple Comparisons**

Area of remaining filling material

Tukey HSD

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pro taper	M two	-.73364*	.09469	.000	-.9609	-.5064
	D - Race	-.23318*	.09469	.043	-.4605	-.0059
M two	Pro taper	.73364*	.09469	.000	.5064	.9609
	D - Race	.50045*	.09469	.000	.2732	.7277
D - Race	Pro taper	.23318*	.09469	.043	.0059	.4605
	M two	-.50045*	.09469	.000	-.7277	-.2732

\*. The mean difference is significant at the 0.05 level.

canal access, thus providing a more reliable comparison of the proposed retreatment techniques.<sup>[11]</sup>

However, in particular when used in severely curved canals, traditional stainless steel instruments often fail to achieve the tapered root canal shapes needed for adequate cleaning and filling.<sup>[12]</sup>

The main goal of non-surgical root canal retreatment is to re-establish healthy periapical tissues following the ineffective root canal treatment or reinfection.<sup>[13]</sup> If nonsurgical treatment is not possible, a surgical procedure may have to be performed to save the tooth. However, the option of retreatment through the root canal system is possible in almost all cases.<sup>[14]</sup> In such cases, complete removal of the previous root filling material is required to facilitate proper cleaning, disinfection and refilling of the root canal.<sup>[15]</sup>

Although numerous materials have been described for obturation of root canals, GP in combination with a sealer is the most frequently used material.

Removal of the obturation material can be effected with endodontic hand files, ultrasonic instruments, laser, heat carrying or engine driven rotary files with or without aid of solvents.<sup>[16]</sup>

Advantages of rotary files include maintenance of canal shape and shorter working time, whereas disadvantages include higher incidence of file fracture and more remaining filling material after retreatment.<sup>[17]</sup>

Sealers used in conjunction with gutta-percha may remain inaccessible to mechanical removal when they are in anatomical ramifications. In such cases, solvents are essential. There are also dangers of using purely mechanical means to remove gutta-percha, such as root perforation, canal straightening or altering the original canal shape.<sup>[18]</sup>

Various methods have been used in endodontic research to evaluate the efficacy of root filling removal including radiography and digitized images. Other techniques include splitting the teeth longitudinally and visualizing them using a stereomicroscope or by using images obtained with a camera and using image analyzer software.

In the present study, CBCT imaging displayed remnants of gutta-percha and sealer after retreatment, which was expressed as percentage of the filling material left in root canals.

Recently Computed Tomography (CT) scan has been used because it enables a three dimensional evaluation of the root canal system with a significantly lower effective radiation dose compared to CT. More recently the use of CBCT in endodontic research has enabled 3D appraisal of treatments performed within the root canal system. This non-invasive method allows detailed visualization of the morphological features and does

not require the destruction of the teeth.<sup>[19]</sup>

Prior to introduction of ProTaper Universal Retreatment files (PTUR), ProTaper rotary finishing files had been used for gutta-percha removal. This technique yielded a high fracture incidence of 22.7%. RaCe rotary instrument sizes DR1 (size 30) which has an active tip to facilitate its initial penetration in to the filling material at the cervical third DR 2 at the middle and apical third of the canal and to be used with a brushing action reaching the working length. D-RaCe retreatment instruments were used according to the manufacturer's instructions.<sup>[20]</sup>

Two retreatment files in a similar way to be used according to the manufacturer's instructions. Two Retreatment Files consist of two instruments with active cutting tip: R1 and R2. These instruments are characterized by two cutting edges, which are claimed to cut dentine effectively.

The CBCT evaluation found significant difference between ProTaper R-Mtwo R, D-RaCe in the removal of filling material.

In this study ProTaper retreatment files was the most effective system, especially when compared with Mtwo and D-RaCe. This when compared with Mtwo and D-RaCe. D-RaCe was more significant. Earlier it was found that Protaper was more effective when compared with other studies (Schirmermeister)

The present study reported similar amount of residual gutta-percha or sealer on root canal wall after ProTaper, Mtwo and D-RaCe files instrumentation.

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