ORIGINAL RESEARCH

Effectiveness of Different Rotary Files Systems in Removal of Gutta-percha during Endodontic Retreatment with or without Solvents: A Comparative Study

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Abstract

Aim: The purpose of the present study was to compare the efficacy of three different file systems in removing gutta-percha during endodontic retreatment with or without solvents.

Materials and methods: The current study used 120 freshly extracted, single-rooted human mandibular premolars extracted for orthodontic procedures. The canal was prepared utilizing the step-back technique and obturation was done. The samples were allocated into three experimental groups at random, group I: Hedstrom Files, group II: D-RaCe rotary system, and group III: Mtwo retreatment files system. The three groups were again split into two subgroups of 20 samples each, i.e., with solvent and without solvent. Then, a stereomicroscope with a magnification of × 20 was used to examine the samples. The amount of GP and sealer left was measured in three sections: At apical third (1 mm above the apex), middle third (8 mm from the apex), and coronal third (2 mm below the cementoenamel junction). The obtained data were analyzed using parametric Analysis of Variance (ANOVA). *p*-values less than 0.05 were considered significant.

Results: The overall least debris on the dentinal surface was found in the middle third with/without solvent. The D-RaCe rotary system was 1.24 ± 0.11 and 1.44 ± 0.14, Mtwo retreatment files system was 1.38 ± 0.17 and 1.72 ± 0.09 and Hedstrom files was 2.08 ± 0.21 and 2.18 ± 0.16 respectively and A significant difference was found between the three different file system groups ($p < 0.001$).

Conclusion: The current study concluded that, when combined with a solvent, the D-RaCe rotary retreatment system is more effective than the Mtwo rotary retreatment system and Hedstrom Files in removing gutta-percha and sealant from root canal walls.

Clinical significance: When it comes to treating chronic infections, non-surgical retreatment is a more cautious method than periapical surgery. Retreatment should be performed efficiently and with appropriate instruments to ensure effective treatment.

Keywords: Endodontic retreatment, Gutta-percha, Rotary files, Solvents.

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Introduction

The success rate of root canal therapy is dependent on creating a fluid-tight seal in three dimensions across the root canal system. This therapy is effective in roughly 86–98% of instances, although certain circumstances, such as an inappropriate apical seal, persisting pulpal tissue, incomplete cleaning, missed canals, or an inadequate filling, may necessitate retreatment. Nonsurgical canal retreatment is often preferable over surgical canal retreatment.[1]

Many procedures have been used to remove gutta-percha from root-filled teeth. Endodontic hand files paired with heat or chemical solvents, ultrasonic instruments, engine-driven rotary files, lasers, and heat-transporting devices are examples of these. Cleaning, shape, and three-dimensional obturation of previously obturated root canals are all part of nonsurgical endodontic retreatment. When access to root canals is possible, it is the therapy of choice for the management of endodontic failures. To complete retreatment successfully, all obstacles blocking direct straight-line access to the root canals must be removed.[2,3]

Gutta-percha is the most commonly utilized obturation material in endodontic practice. Gutta-percha solvents, h files, retreatment files, ultrasonic instruments, lasers, heated instruments, and other methods can be used to remove gutta-percha from the root canals. Rotary tools are becoming more common, and most dentists prefer them overhand instrumentation procedures because they save

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time. Solvents such as chloroform, xylene, orange oil, benzene, and others are also employed to dissolve the gutta-percha cones and allow for speedier access to the working length and their application, as well as particular retreatment. Rotary systems have the potential to increase canal cleanliness.[4]

The D-RaCe rotary system consists of two files. The DR1 is capable of coronal third cleaning and includes a cutting tip to aid in the initial penetration of the filling material. The DR2 instrument, which has a non-cutting tip, was employed until the working length was reached and is used to remove filler from the apical two-thirds of the root canal. The Mtwo R instruments with positive rake angles tend to remove large amounts of filler material.[5]

As a result of advancements in mechanized rotary instrumentation, various manufacturers have developed rotary gutta-percha removal devices, each claiming improved efficiency and efficacy in the process. And very limited literature is available on the comparison of these different rotary systems with solvents. Hence, the current study was designed to evaluate the efficacy of three different file systems in removing gutta-percha during endodontic retreatment with or without solvents.

Materials and Methods

Selection of Samples

The present study was conducted in the department of conservative dentistry and endodontics, Sri Balaji Dental College, India, during the year 2022. The current study used 120 freshly extracted, single-rooted human mandibular premolars extracted for orthodontic procedures and stored in 10% formalin until further use. The study included teeth with a single straight canal and totally developed apices. Teeth exhibiting internal/external resorption, cavities, obvious cracks, morphological flaws, developmental problems, or decalcification were excluded from the study.

Preparation of Canal and Obturation

Access cavities were made before inserting a size 10 K file (Dentsply Maillefer, Ballaigues, Switzerland) into the root canal until the apex was visible. Subtracting 1 mm from this measurement yielded the working length. A diamond disc was used to decorate the samples to attain a standard size of 15 mm. Step-back preparation was used to size 30 K file at working length, and step-back preparation was done until the size 45 K file. Glades Glidden drills (Dentsply Maillefer, Ballaigues, Switzerland) was used for the final coronal flaring. 5.25% NaOCl, 17% EDTA, and finally saline were used to irrigate the canals during instrumentation. Using the lateral compaction technique, the root canals were dried with paper points and obturated with gutta-percha (Dentsply-Maillefer, Ballaigues, Switzerland) and AH Plus sealer (Dentsply De Tray, Konstanz, Germany). Cavit was used to temporarily plug access cavities. The samples were stored in an incubator at 37 degrees Celsius and 100% humidity for 4 weeks to allow the sealer to be completely set.

Retreatment Procedure

The samples were sorted into three experimental groups of forty samples each at random. The three groups were then split into two subgroups of twenty samples each (with solvents and without solvents). All samples had two millimeters of obturation material removed from the cervical region using Gates Glidden drills 2. Retreatment was performed after utilizing Gates Glidden drills using three different methods without using gutta-percha solvent and using gutta-percha solvent for a specific length of 5 minutes. To soften gutta-percha in solvent groups, a drop of gutta-percha solvent RC Solve (Prime Dental, Mumbai) was inserted into each canal. 5.25% sodium hypochlorite was irrigated into canals in all samples during obturation material removal. The obturation was removed using one of the following methods:

Group I: Hedstrom Files

Gutta-percha was removed from the canal's coronal part using Gates Glidden drill sizes 2. Hedstrom files in sizes 35, 30, and 25 (Dentsply Maillefer, Ballaigues, Switzerland) were used in a circumferential quarter turn push-pull motion to remove root fills from the middle and apical parts until the original working length was attained.

Group II: D-RaCe Rotary System

The DR1 device was used to remove root canal fillings in a crown-down approach, followed by the DR2. To finish the cleaning process, #35 and #40 files with 4% flaring were used.

Group III: MTwo Retreatment Files System

As instructed by the manufacturer, M2 retreatment files were used in a gentle in-and-out technique with a quick brushing action utilizing an air-driven rotary hand piece at a constant speed of 300 revolutions per minute (RPM). R2 (size 25; 5% taper) was then used to the working length after R1 (size 15; 5% taper) had been used initially. A Single investigator participated in the present study.

Assessment of the Efficacy of Rotary Files Systems in Removal of Gutta-percha

After the retreatment procedure, a diamond disc was used to separate the roots lengthwise. The amount of GP and sealer left was measured in three sections: At apical third (1 mm above the apex), middle third (8 mm from the apex), and coronal third (2 mm below the cementoenamel junction). The samples were then examined using a stereomicroscope at a magnification of 20. The following scores were used to calculate the proportion of residual filler material in the root canal walls.[6]

Score 1: No to minor presence of obturation debris (0–25%) on the dentinal surface.

Score 2: Some obturation debris (25–50%) on the dentinal surface.

Score 3: Moderate presence of obturation debris on the dentinal surface (50–75%).

Score 4: Obturation debris on the dentinal surface is abundant (>75%).

Statistical Analysis

The Statistical Package for Social Sciences software version 20.0 was used for statistical analysis. The gathered data was shown using descriptive statistics such as mean and standard deviation values. The Kolmogorov-Smirnov test was used to determine the data's normality. The data was determined to be regularly distributed, thus it was further analyzed using parametric analysis of variance (ANOVA). All *p*-values less than 0.05 were considered significant.

Table 1: Assessment of the efficacy of three rotary files systems in removal of gutta-percha with or without RC Solve at apical third

Rotary files systems	*With solvents*	*Without solvents*
Group I: Hedstrom files	2.18 ± 0.16	2.42 ± 0.21
Group II: D-RaCe rotary system	1.76 ± 0.09	1.98 ± 0.14
Group III: Mtwo retreatment files system	1.92 ± 0.07	2.14 ± 0.10
f-value	9.816	10.224
p-value	0.001	0.001

Table 2: Evaluation of the efficacy of three rotary files systems in removal of gutta-percha with or without RC Solve at middle third

Rotary files systems	*With solvents*	*Without solvents*
Group I: Hedstrom files	2.08 ± 0.21	2.18 ± 0.16
Group II: D-RaCe rotary system	1.24 ± 0.11	1.44 ± 0.14
Group III: Mtwo retreatment files system	1.38 ± 0.17	1.72 ± 0.09
f-value	7.321	8.178
p-value	0.001	0.001

Table 3: Evaluation of the efficacy of three rotary files systems in removal of gutta-percha with or without RC Solve at coronal third

Rotary files systems	*With solvents*	*Without solvents*
Group I: Hedstrom files	2.10 ± 0.08	2.26 ± 0.14
Group II: D-RaCe rotary system	1.36 ± 0.02	1.52 ± 0.11
Group III: Mtwo retreatment files system	1.44 ± 0.12	1.90 ± 0.17
f-value	8.590	9.052
p-value	0.001	0.001

Results

At apical third, with/without solvents the least debris on the dentinal surface was found with D-RaCe rotary system (1.76 ± 0.09 and 1.98 ± 0.14) followed by Mtwo retreatment files system (1.92 ± 0.07 and 2.14 ± 0.10) and Hedstrom files (2.18 ± 0.16 and 2.42 ± 0.21) and there was a statistically significant difference found between the three different file system groups (Table 1).

In the middle third, with/without solvents the minimum debris on the dentinal surface was found with D-RaCe rotary system (1.24 ± 0.11 and 1.44 ± 0.14) followed by Mtwo retreatment files system (1.38 ± 0.17 and 1.72 ± 0.09) and Hedstrom Files (2.08 ± 0.21 and 2.18 ± 0.16) and A significant difference was found between the three different file system groups ($p < 0.001$) (Table 2).

At coronal third, the least debris on the dentinal surface found with D-RaCe rotary system group (1.36 ± 0.02 and 1.52 ± 0.11) followed by Mtwo retreatment files system (1.44 ± 0.12 and 1.90 ± 0.17) and Hedstrom files (2.10 ± 0.08 and 2.26 ± 0.14) and A significant difference was found between the different file system groups ($p < 0.001$) (Table 3).

The inference of the present study indicates that the overall least debris on the dentinal was surface found with the D-RaCe rotary system followed by Mtwo retreatment files system and Hedstrom files respectively.

Discussion

Post-treatment disease can result from inadequate cleaning, shape, obturation, and final restoration of an endodontically infected tooth. If initial endodontic therapy does not remove all bacteria from the canal space, if obturation does not adequately encapsulate those that remain, or if new microorganisms are permitted to enter the cleansed and sealed canal space, the post-treatment disease can and typically does arise.[7]

In endodontics, the capacity of the practitioner to remove as much filling material as feasible is crucial to the effectiveness of retreatment. This makes it easier to reach areas with germs or necrotic tissue that could lead to endodontic failure.[8] Endodontic failure can be caused by a number of things, such as missing canals, insufficient root canal cleaning, and insufficient obturation. This could cause pain or other post-operative issues that would necessitate retreatment. Since it is a less invasive approach, non-surgical retreatment is often recommended over surgical intervention. In fact, the preferred method for treating recurrent periapical infections is endodontic retreatment, which has essentially replaced endodontic surgery.[9]

All of these rotational methods pose a slight challenge to the hand Hedstrom files, which have been traditionally employed by many practitioners to remove gutta-percha during retreatment treatments. As a result, it is more important than ever for a physician to have access to and be familiar with the optimum method for removing gutta-percha using a rotary or hand file. In some cases, using both a rotary and hand file may be required. Along with Hedstrom files, the present study aids in comparing the effectiveness of two rotating systems.[10]

In this investigation, the greater root canal cleanliness following retreatment with D-RaCe is consistent with Rödig et al.,[11] who demonstrated that the D-RaCe rotary system is an effective tool for retreatment. In the current investigation, the higher RPM employed as compared to the RPM used for Mtwo R rotary retreatment files may also be responsible for the greater cleaning efficacy of D-RaCe rotary retreatment files. Bhagavaldas MC et al.[5] claims that removing GP requires greater RPMs than cleaning and shaping techniques. The benefit of employing higher RPM is that speed generates enough friction to mechanically soften and remove GP from the root canals. Both the D-Race and the Mtwo R retreatment systems in the current investigation were more effective at cleaning the coronal and middle third of the root canals. Additionally, according to Bodrumlu E et al.,[12] the Gates-Glidden size 2, which equates to size 70, was utilized to remove 2 mm of filling materials from the orifice. The use of the Gates-Glidden drill is the most effective technique for removing root-filling material from the coronal and middle parts of the root canal system.

For the removal of gutta-percha, the use of several solvents including xylene, orange oil, halothane, and tetrachloroethylene has been recommended. In the present study, RC Solve, one of several commercially available solvents, was employed. This employed a derivative of orange oil whose primary component is D-limonene. It is discovered that D-limonene is not carcinogenic and has good biocompatibility with human tissues.[13]

Hedstrom files were used in the current study's samples from Group I, which had higher leftover gutta-percha debris on the dentinal surface. There are a few studies that support the use of endodontic hand files for the removal of endodontic filling

material, including those by Hulsmann M and Stotz S[14] and Betti LV and Branante CM[15] provide additional evidence for the efficiency of hand files in removing gutta-percha. This might be due to the Hedstrom file system having a larger selection of files with larger tip sizes available. This would make it more convenient to use a file size larger than the one initially used to clean the canal, which would aid in removing all of the filling material from the area. The operator is also given an unparalleled tactile sense by the hand files, which aids in knowing how the filling material is engaged at the apical area.

The *in-vitro* study methodology, which makes it challenging to compare with clinical settings, and the complexity involved in it were among the study's drawbacks. Additionally, the solvent's chemical analysis was lacking. More *in-vivo* settings should be replicated in research to produce more accurate results and to aid clinicians in using the strategies for a more successful retreatment procedure.

Conclusion

Within the limitations, the present study concluded that, with the use of solvent, D-RaCe rotary retreatment system is more effective than Mtwo rotary retreatment system and Hedstrom files in removing gutta-percha and sealant from root canal walls.

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