



Efficacy of Rotary and Hand Instrument in removing Gutta-percha and Sealer from Root Canals of Endodontically Treated Teeth

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ABSTRACT

Aim: One of the common dental procedures employed these days in patients with irreversible pulpitis is root canal therapy. In retreatment cases, it is necessary for complete removal of obturate gutta-percha (GP) from obturate root canal system. Various methods and techniques are available these days for this purpose. This study was aimed to assess the efficacy of D-RaCe files, ProTaper retreatment files, Mtwo retreatment files, and manual Hedstrom files (H-files) in removing filling materials from the root canals of the endodontically treated teeth.

Materials and methods: The present study included comparative evaluation of efficacy of nickel–titanium (NiTi) retreatment instruments and H-files in removing GP and sealer from root canals. All the samples were randomly and broadly divided into four study groups based on the instrumentation technique for removing the root canal fillings. Evaluation of the results was done based on operating time and remaining root canal filling material. Stereomicroscopic evaluation of the samples was done at 8× magnification.

Results: All the results were assessed and analyzed by Statistical Package for the Social Sciences (SPSS) software. Least quantity of filling material was left by ProTaper retreatment files. When put together in decreasing order, the efficacy of different study groups, in terms of mean time taken for retreatment, was found to be as follows: D-RaCe > ProTaper Retreatment > Mtwo Retreatment > H-file.

Conclusion: No single technique can completely remove obturating fillings from the root canals of endodontically treated

teeth. However, rotary instruments are better in comparison with hand instruments for removing the GP from obturate root canals.

Clinical significance: ProTaper retreatment files and D-RaCe files are recommended over other instrument systems in terms of quality for managing retreatment root canal cases.

Keywords: Hand instruments, ProTaper, Retreatment, Rotary instruments, Stereomicroscope.

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INTRODUCTION

Root canal therapy is one of the commonly performed dental procedures. Success of endodontic therapy is largely dependent upon the quality of root canal therapy done. Inadequately filled root canal space with root canal obturating material requires removal of the obturated material.^{1,2} In retreatment cases, the first primary purpose of endodontic therapy is the complete removal of GP from the root canal system.^{3,4} This is a very tedious and time-consuming job. Endodontists recommend retreatment for establishing the healthy periapical tissue with the purpose of removing the infection due to leakage (coronal or apical). This is done by creating access to the pulp canal system by removing the obturating material from the root canal, followed by further cleaning and finally reobturing. For the complete removal of GP fillings, various instruments and instrumentation motions are available.^{5,6} This includes hand files, NiTi rotary instruments, ultrasonic devices, and lasers. Commonly involved technique is use of hand files with or without solvent.⁷⁻¹⁰ Results

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of one of the past studies conducted by Karamifar et al¹¹ showed that in cleaning the apical third of the root canal, efficacy of RaCe was better than conventional hand instrumentation. From the results, they concluded that in removal of GP, efficacy of rotary instrumentation was significantly higher. However; in complete removal of these filling materials, none of the above-mentioned techniques is fully effective. Hence, under the light of above-mentioned data, we planned the present study to assess and compare the efficacy of D-RaCe files, ProTaper retreatment files, Mtwo retreatment files, and manual H-files in removing filling materials from the root canals of the endodontically treated teeth.

MATERIALS AND METHODS

The present study was conducted in the Department of Conservative Dentistry of the dental institution and included comparative evaluation of efficacy of NiTi retreatment instruments and H-files in removing GP and sealer from root canals. Ethical approval was obtained from institutional ethical committee and written consent was obtained after explaining in detail the entire research protocol. For the present study, we analyzed 80 freshly extracted mandibular premolars. Only those teeth which had closed apex, single pulp canal, with absence of any form of root fracture were included. Decoronation of the teeth specimens was done to a length of 15 mm as measured from the apex of the tooth. The procedure was conducted by diamond disk with the aim of establishing a stable reference point; 10 number K file was used for checking the apical patency of the canals. Working length was determined followed by cleaning and shaping of root canals up to 40 number sizes. This was followed by performance of step back technique till 70 number size of K-File. Ethylenediaminetetraacetic acid (EDTA) and sodium hypochlorite (NaOCl) were used as lubricating

agents during the biomechanical preparation of the teeth specimens. For 1 minute, after the completion of instrumentation process, EDTA solution at a concentration of 17% was placed and kept in the root canal for removing the smear layer, followed by irrigation with NaOCl solution. This was followed by final rinsing with normal saline solution. Obturation of the root canals was done using cold lateral compaction technique with GP and AH Plus sealer. Cavit was used for sealing the coronal access. All the samples were randomly and broadly divided into four study groups as follows based on the instrumentation technique for removing the root canal fillings:

1. Group I: ProTaper retreatment files,
2. Group II: D-RaCe files,
3. Group III: H-files with solvent, and
4. Group IV: Mtwo retreatment files.

Evaluation of the results was done based on two parameters, i.e., operating time and remaining root canal filling material. Operating time was defined as total time required for the complete removal of root canal fillings, excluding the time of instrument change and irrigation. For the remaining root canal filling material, all the samples were rendered transparent (according to the criteria described by Schirrmeister et al).¹² This was followed by decalcification of the samples in 5% nitric acid for 3 days with subsequent washing (for 4 hours) and dehydrating in elevating concentrations of alcohol. Thereafter, the clearing of the roots was done by methyl salicylate. Stereomicroscopic evaluation of the samples was done at 8× magnification (Figs 1 to 3). Software ImageJ (Java, USA) was used for assessing the percentage of area of the remaining root canal filling material. All the results were assessed and analyzed by SPSS software version 17.0. Student's t test, Mann-Whitney U test, and chi-square test were used for the evaluation of level of significance; p-value < 0.05 was taken as significant.

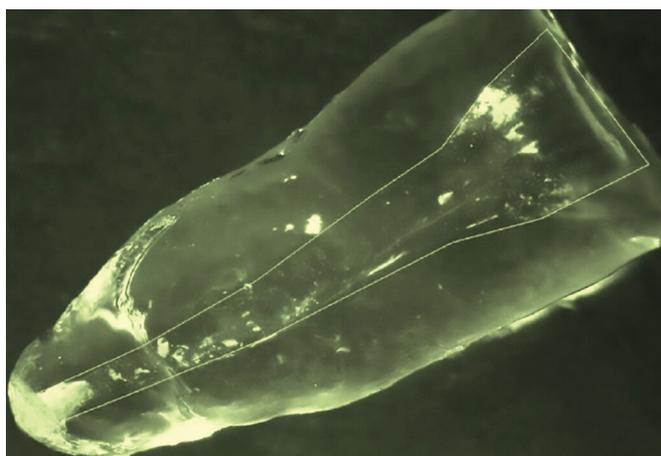


Fig. 1: Canal area marked on stereomicroscopic image (using ImageJ image analysis software)

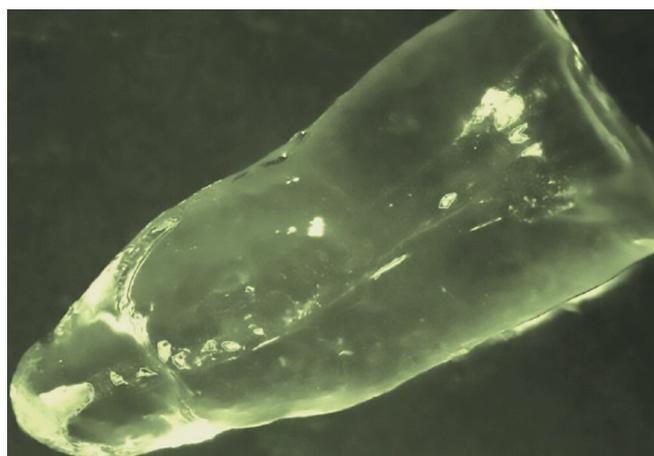


Fig. 2: Remaining root canal filling material at apical region outlined on stereomicroscopic image (using ImageJ image analysis software)

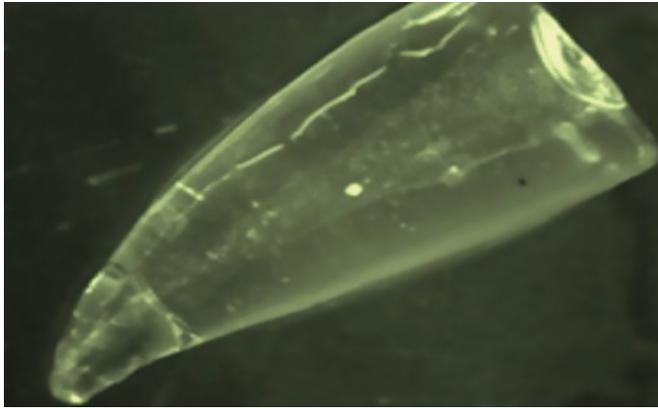


Fig. 3: Sample transparent teeth as seen under stereomicroscope (8×) in various groups

STATISTICAL ANALYSIS AND RESULTS

All the observational findings were compiled and sent for statistical evaluation using statistical software SPSS version 21 (IBM Inc., Armonk, New York, USA). While assessing remnants of material, some quantity of filling material was left inside the root canal by all the individual techniques. However, the performance of all the three rotary groups was superior to H-files. Least quantity of filling material was left by ProTaper retreatment files (Table 1). However; we did not observe any significant difference while comparing the amount of remaining filling material in between group I and II specimens and also between group III and IV specimens (p-value > 0.05) (Table 2). When (operating retreatment time) put together in decreasing order, the efficacy of different study groups, in terms of mean time taken for retreatment, was found to be as follows: D-RaCe > ProTaper retreatment > Mtwo retreatment > H-file.

Table 1: Mean quantity of remaining GP

Group	No. of specimens	Mean
I	20	8.02
II	20	8.22
III	20	16.06
IV	20	12.08

Table 2: Comparison of mean quantity of remaining GP in between various groups

Group (I)	Group (J)	Mean difference (I-J)	p-value
Group I	Group II	(-)0.20	0.75
	Group III	(-)8.04	0.02*
	Group IV	(-)4.06	0.03*
Group II	Group III	(-)7.84	0.01*
	Group IV	(-)3.86	0.02*
Group III	Group IV	3.98	0.81

*Significant (p-value > 0.05)

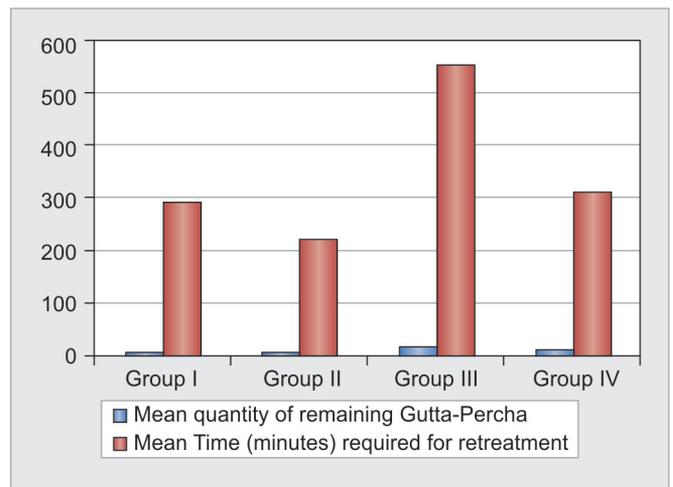
Table 3: Mean time (minutes) required for retreatment

Groups	No. of specimens	Mean
I	20	290.5
II	20	221.7
III	20	550.9
IV	20	310.2

Table 4: Comparison of mean time (minutes) required for retreatment

Group (I)	Group (J)	Mean difference (I-J)	p-value
Group I	Group II	68.8	0.03*
	Group III	(-)260.4	0.02*
	Group IV	(-)19.7	0.65
Group II	Group III	(-)329.2	0.01*
	Group IV	(-)88.5	0.03*
Group III	Group IV	(-)240.7	0.01*

*Significant (p-value > 0.05)



Graph 1: Mean quantity of remaining GP and mean time (minutes) required for retreatment

Group III specimens took maximum time for retreatment as shown in Table 3. Significant results were obtained while comparing the mean time required for retreatment in between groups I, II, and III. However, we did not observe any significant difference while comparing the difference of mean time required for retreatment in between groups I and IV (p-value > 0.05) (Table 4). Among all the study groups, group II specimens required minimum time for retreatment (Graph 1).

DISCUSSION

For obturating the root canal systems during the endodontic therapy, several biocompatible materials have been developed, among which GP material is the most commonly used obturating substance with sealers. In cases in which root canal therapy has failed, retreatment with endodontic therapy is a commonly employed

treatment protocol. The primary goal of the retreatment of such cases is the complete removal of previous obturating material from the entire root canal.¹³⁻¹⁵ In the present study, we observed that mean quantity of remaining GP was found in group I specimens, while maximum quantity of remaining GP was found to be present in group III species, the results of which were found to be statistically significant (Tables 1 and 2). Our results are in accordance with the results of Akhavan et al,¹⁶ who also reported similar findings. In their study also, it was reported to be in significant ranges (p -value > 0.05). Our results were also comparable to one of the past studies conducted by Tachinami and Katsuumi.¹⁷ Here, the authors examined the efficacy of erbium-doped yttrium aluminum garnet (Er:YAG) laser in removing fillings from the root canals of previously endodontically treated teeth. Somewhat similar to our study, they evaluated 21 freshly extracted permanent anterior teeth, by commencing endodontic therapy on them, followed by filling and sealing them with GP points. At 30, 40, and 50 mJ/pulse energy outputs of Er:YAG laser, they removed the filling materials, and recorded the respective time required for the same. With the help of microfocus X-ray computed tomography, they recorded the quantity of remaining filling materials and amount of dentin ablation in the root canal walls. Significantly larger amount of time was required for removing the filling materials from root canals at 30 mJ, in comparison with 40 and 50 mJ. However, contrary to our results, they did not observe any significant difference while comparing the amount of remaining filling materials and quantity of dentin ablation in between the three energy outputs. This could be attributed based on the differences in material and other parameters. The authors, from their results, concluded that root canal fillings can be effectively removed with Er:YAG laser irradiation.

Bodrumlu et al¹ assessed the effectiveness of different techniques of removing root canal fillings from root canal-treated teeth, filled with laterally compacted Resilon/Epiphany and GP/AH Plus during retreatment. They collected 90 maxillary and 90 mandibular anterior single-rooted teeth and divided them broadly into six study groups, with 15 straight and 15 curved canals teeth in each group. They obturated three groups with GP/AH Plus and the remaining three groups with Resilon/Epiphany. They removed the root canal fillings after storing them for 3 weeks, using Gates Glidden drill. On analysis of results, they observed that significantly higher quantity of remnants of obturation materials was present among specimens that were obturated with GP/AH Plus, in comparison with the tooth specimens obturated with Resilon/Epiphany. Under the light of their results, the authors concluded that lesser quantity of remnants

remained while removing Resilon/Epiphany fillings in comparison with GP/AH Plus fillings.

In a study, Anjo et al¹⁸ analyzed the efficacy of pulsed Nd:YAG laser in eliminating different obturating materials from root canals of teeth specimens. They evaluated and measured the time period needed for extracting the obturating material from the root canal space, either by conventional Gates Glidden drill method or by Nd:YAG laser irradiation method. They further used the contact microradiography for evaluating the quantity of root canal filling material left. They also assessed the root canal surfaces under electron microscopy after the removal of obturating materials. They did not find any effective method of completely removing the debris from the wall of root canals. However, among the analyzed techniques in their study, in comparison with the conventional methods, shorter time was required for the removal of root canal fillings by laser ablation method. They concluded that for the removal of root canal obturation materials, Nd:YAG laser irradiation is an adequate tool. In the present study, we observed that in terms of time required for retreatment, most efficient results were obtained in group II and I specimens (Table 3). We obtained significant results while comparing the mean time required for retreatment among all the study groups (Table 4). Maximum time required for retreatment was obtained among group III specimens (Graph 1). Various past authors have also compared the efficacy of removal of root canal fillings by different rotary methods. In one of the past studies conducted by Khalilak et al,¹⁹ the authors compared the effectiveness of H-file and ProTaper in removing the GP fillings in retreatment cases. They assessed 60 mandibular premolars and obturated them with GP points. After storing the teeth specimen for 2 weeks, they divided all the specimens broadly into four study groups with 15 specimens in each group. H-file and ProTaper files were used by them for removing the GP. They evaluated the quality of root canal removal by stereomicroscope. Marfis et al²⁰ also showed comparatively less residual filling materials in ProTaper system over H-file system. These study results were largely comparable to ours, as they also reported significant differences among the groups.

CONCLUSION

Under the light of above results, we conclude that no single technique can completely remove obturating fillings from the root canals of endodontically treated teeth. However, rotary instruments are better in comparison with hand instruments for removing the GP from obturate root canals. However, further studies are recommended for improving the prognosis of retreatment cases.

CLINICAL SIGNIFICANCE

Results of this stereomicroscopic evaluation clearly showed that ProTaper Retreatment files and D-RaCe files could be successfully advocated over other instrument systems in terms of quality for managing retreatment root canal cases.

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