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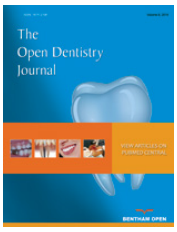

RESEARCH ARTICLE

Effectiveness of Reciproc and MTwo for Removing Filling Material During Root Canal Retreatment Using a Digital Radiograph System

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Abstract:

Objective:

To compare the efficacy of Reciproc (reciprocating) and MTwo (rotary) in the filling material removal during endodontic retreatment.

Methods:

Thirty simulated root canals (plastic blocks) were prepared and filled. The blocks were divided into 3 groups according to the filling removal techniques: Group I - hand files and Gates Glidden burs; Group II - Rotary technique with second series files of Mtwo system; Group III - Reciprocating technique with instrument R40 Reciproc. The blocks were radiographed, the total area of the root canal and the amount of remaining plug material was calculated. The total time required to complete the procedure was recorded and the instruments were evaluated for fracture or deformation.

Results:

The mean percentage of obturator material remaining in the root canal wall was 15.36% in Group I, 11.56% in Group II and 10.36% in Group III. There was a statistical difference between Group 1 and the other Groups. There was no statistical difference between Groups II and III. Removal of filling material was significantly faster in Group III (437.433 s), followed by Group II (616.535 s) and Group I (1587.651 s).

Conclusion:

The best results of filling material removal were obtained by groups II and III without statistical difference between them. The reciprocating technique was the fastest among the techniques tested, followed by the rotary technique and manual technique files.

Keywords: Retreatment, Root canal filling materials, Reciproc files, Rotary instruments, Reciprocating motion, Nickel-titanium instruments.

1. INTRODUCTION

The endodontic retreatment is a procedure performed on a tooth that received previous endodontic treatment and resulted in failure [1]. When a treatment failure is observed during clinical / radiographic control, the following

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procedures are: Root canal retreatment or apical surgery, which can be successful when correctly indicated. However, whenever access to the root canal is possible, the endodontic retreatment must be the first choice [2].

The presence of residual bacteria (persistent infection) or the re-infection of an endodontically treated tooth (secondary infection) are the most important etiological factors related to failures on endodontic treatments. These failures have highlighted the need for procedures of cleaning and disinfection of the entire root canal system [3 - 5]. The endodontic retreatment consists basically on the removal of filling material, reinstrumentation and new filling of the root canal system [6].

The safety and efficacy of the filling material removal from the root canal system is crucial to expose all areas which may harbor microorganisms and remnants of pulp or bacterial residues that lead to the persistence of periapical infection [7, 8].

The most common filling material found is gutta-percha associated with endodontic cement. However, the removal of these materials from the root canal can be more challenging and takes longer than the initial treatment, being one of the biggest difficulties achieving its complete removal. There are many techniques and technologies for removing these materials such as: Hand files, drills and automated devices; Which can be preceded by a softening of the gutta-percha using solvents or heat [9, 10].

The MTwo system (VDW) consists of four instruments (25.07, 30.05, 35.04 and 40.04) with inactive tips, avoiding deviations during preparation of the root canal. These instruments, despite having a high diameter at their tips, have a large escape area between their blades, facilitating the removal of the filling material [11].

In 2010 instruments using reciprocal movement were introduced in the market, such as Reciproc® (VDW), which relieves the tension in the instrument by counterclockwise (cutting action) and clockwise (release of Instrument) movements, extending the durability of an NiTi instrument and increases its fatigue resistance compared to the continuous rotation movement [12].

The Reciproc® system has benefits such as simplicity of use (reduction in the number of files) and its efficiency in the removal of the filling material [13].

Some studies have demonstrated that none of the instrumentation methods are able to completely remove the filling material [5, 14 - 17].

The remaining filling material may be contaminated with microorganisms that will be responsible for the failure of the endodontic treatment. Thus, it is necessary to remove them completely.

Therefore, the aim of this study was to compare the efficacy of reciprocating and rotary techniques to a hand file technique for removing filling material.

2. MATERIALS AND METHODS

2.1. Canal Preparation

Thirty simulated root canals (plastic blocks) with an angle of curvature of 30 degrees (IM do Brasil Ltda.) were used. Working length was performed introducing a K # 10 file passively into the root canal until its tip was just visible at the apical foramen. Then, using a dental operating microscope (DF Vasconcellos S.A.), the root canal length was recorded, and the working length was calculated by subtracting 1 mm from this measurement. The root canal was prepared for one single operator using a modified crown-down technique [18]. The coronal third of the root canal was flared with Gates-Glidden drills sizes 3 and 2, and the root canal was then instrumented with Flexicut reamers (VDW) to working length with a size 40 file. A total of 25 mL of 2.5% NaOCl (Formula e Ação) was delivered throughout instrumentation with a 24-gauge needle (BD PrecisionGlide) between each bur and file. The final aspiration was done with needle tip capillary (25 x 0.35 mm-Ultradent Products, Inc.) and absorbent paper points FM (Dentsply maillefer).

2.2. Canal Filling

The canals were filled using a gutta-percha cone type R25 (VDW) and endodontic sealer Endofill® (Dentsply Maillefer). The gutta-percha master cone was selected and customized. Afterwards, a sealer-coated master cone was placed up to the working length. A heated plugger was used to cut the gutta-percha at the entrance of the canal. Each block was radiographed in buccolingual and mesiodistal directions to ensure consistency of the root filling procedure. If there were any radiographic voids in the gutta-percha, the sample was discarded (Fig. **1**).

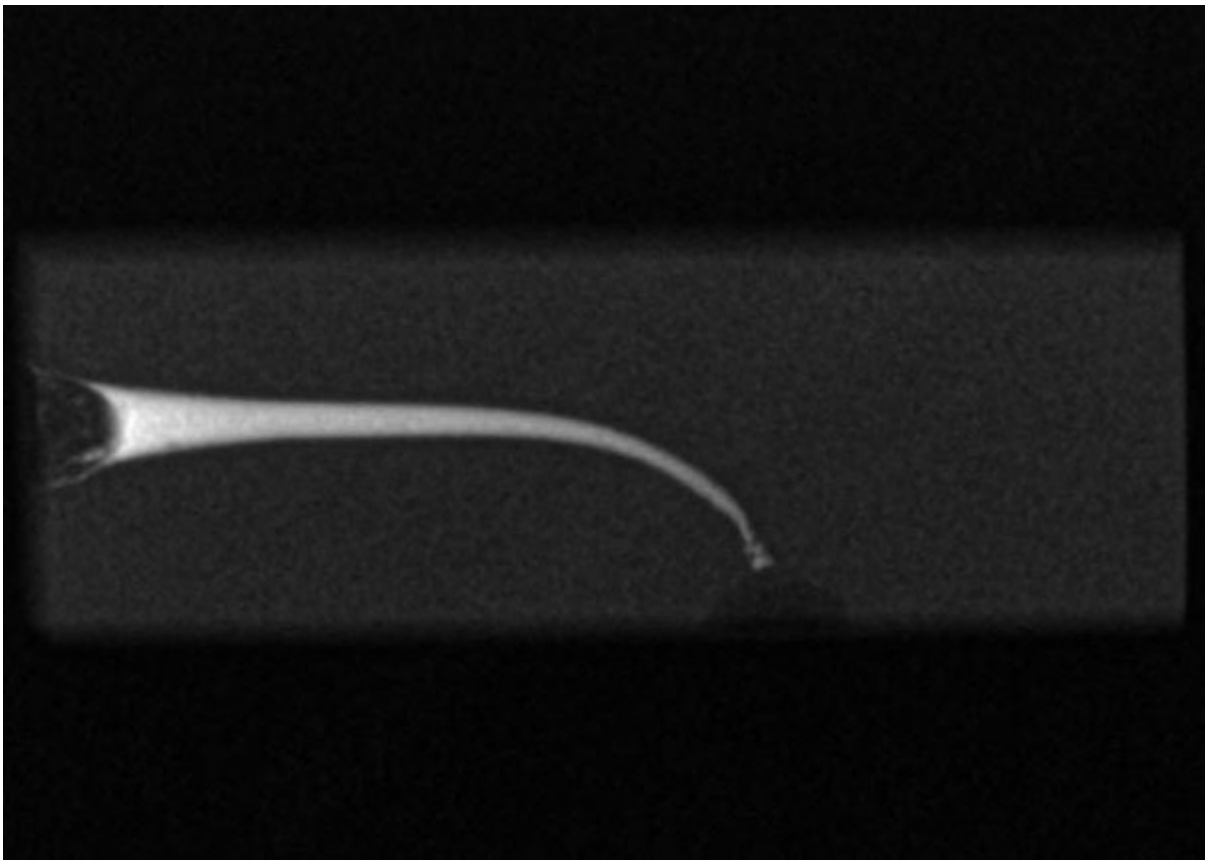

Fig. (1). Radiograp in buccolingual direction.

2.3. Re-Instrumentation and Filling Removal Techniques

Before the initial re-instrumentation, the blocks were insulated with insulation tape (Scotch 3M, São Paulo, Brazil). The initial step of filling removal of all root canals was performed in the same manner, as follows:

- Gates-Glidden drills size 5 (VDW) were used on the first 6 mm of the root canals.
- After using Gates-Glidden, the blocks were then randomly divided into three groups of 10 blocks each and re-instrumented as follows:

  Group I - Gates-Glidden burs sizes 2 and 3 were used in the middle third of the canals. The root canals were instrumented to the original working length with NiTi K-files (VDW) up to size 40. After reaching the working length with a size 40 file, file sizes 45, 50 and 55 were used in a step-back motion.

  Group II - MTwo® system (VDW) were used; in sequence 25 - 0.07 taper; 30 - 0.05 taper; 35 - 0.04 taper; and 40 - 0.04 taper were used with an electric motor (VDW Silver). The torque and speed settings for each file were used as recommended by the manufacturer. The instruments were applied in a gentle in-and-out technique, along with short stroking/brushing motion in a coronal direction to the full original working length. If the instruments failed to reach the working length after three strokes, they were removed from the canal, cleaned with sterile gauze and then used again until the working length was reached.

  Group III - The root canals were re-instrumented using the Reciproc R40 instrument (VDW). The instrument was introduced into the canal, activated by a VDW Silver electric motor and applied in a reciprocating motion. It was then moved towards the apex using an in-and-out pecking motion with an amplitude of approximately 3 mm. Gentle apical pressure was combined with a brushing action against the lateral walls, according to the manufacturer's instructions. After three pecking motions, the instrument was removed from the canal and cleaned with sterile gauze. This procedure was repeated until the instrument reached working length.

No solvent was used in the groups to avoid any interference with the removal of the materials in each technique, and the evaluation of this removal. The root canals in all groups were re-instrumented until there was no evidence of filling material on the instrument. A total volume of 50 mL of 2.5% NaOCl was delivered.

To eliminate inter operator variability, the same operator carried out all procedures. After re-instrumentation each block was radiographed in the buccolingual and mesiodistal directions.

2.4. Filling Material Removal Evaluation

After filling removal, the blocks were individually radiographed with a sensor of the Schick® digital system (Fona CDR Elite) and a radiographic apparatus (Gnatus, Timex 70xc) with exposure time of 0.16 seconds at a distance of 5 cm to the sensor. To obtain the images of the sample, two radiographs were performed, one buccolingual and one mesiodistal (Fig. **2**) Prior to radiographic procedures the insulation tape which covered the block was removed.

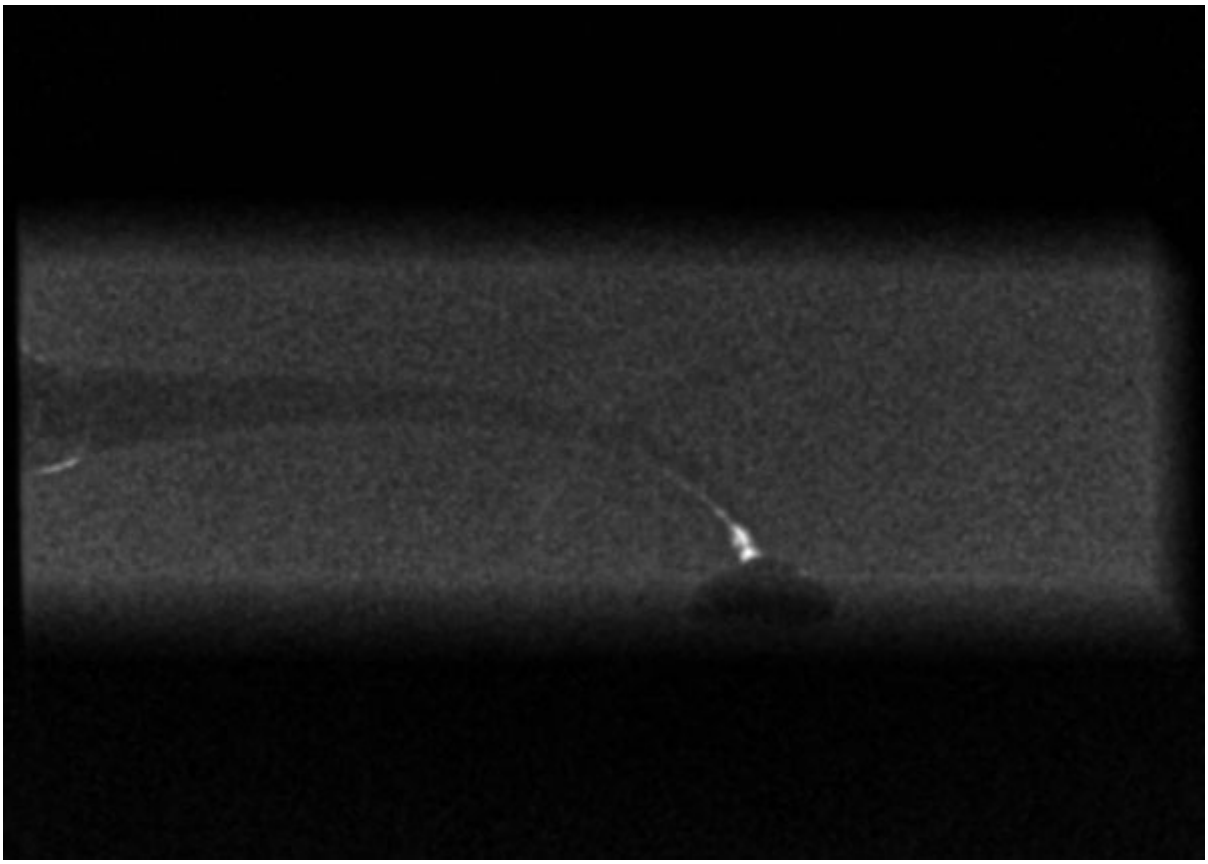

Fig. (2). Radiograp in mesiodistal direction.

The radiographic images obtained were stored in a computer and analyzed using the sensor's software itself. The area of remaining material was selected on the digital radiograph and using Adobe Photoshop the remaining filling material area was calculated.

2.5. Time Required for Gutta-Percha Removal

The total time required to remove the filling material was considered as the time elapsed from the initial moment that the instrument was applied in the canal until they left the canal without signs of sealing material. The time included the protocol of irrigation during the retreatment.

2.6. Instruments Evaluation

The instruments were evaluated for fracture or deformation using an operative microscope with a 16x magnification. It was observed which group the instrument belonged to, the size of the fragment and its location.

2.7. Statistical Analysis

The mean percentages of remaining material and the time difference required to remove it were compared using the Mann-Whitney test ($P < 0.05$) and the Kruskal-Wallis test.

3. RESULTS

Remnants of filling material were observed in all samples regardless of the groups examined. The mean percentage of remaining filling material was 15.36% in group I, 11.56% in group II and 10.36% in group III (Table **1**). There was a significant difference between group I and the other groups ($P < 0,05$). There was no significant difference between groups II and III ($P > 0,05$).

Table 1. Percentage of filling material debris found on the canal walls after performing the root canal filling removal techniques.

Group	Mean (%)	SD
I	15,36 A	1,29
II	11,56 B	1,297
III	10,36 B	0,730

Means followed by different letters are significantly different ($P = 0,05$).

The time required to perform the retreatment was significantly shorter in group III (437.433 s), followed by group II (616.535 s) and group I (1587.65 s) ($P = 0,05$) (Table **2**).

Table 2. - Time required to perform the root canal filling removal techniques.

Group	Time (s)	SD
I	1587,651 C	157,411
II	616,535 B	61,342
III	437,433 A	42,237

Means followed by different letters are significantly different ($P = 0,05$).

Two instrument fractures were observed during the removal of filling material in Group II. In both cases, the broken file was a MTwo 25.07. These fractures ocurred in block number 05 and 10. The fragments lengths were 2 and 1 mm and the instruments fractured after the curvature of the canal.

All the blocks used in the research were evaluated. No sample discarding was required due to failures detected in the methodology.

4. DISCUSSION

The success of the endodontic retreatment depends directly on the removal of contaminated filling material. The removal of as much material amount as possible allows the action of instruments and the irrigate solution on the root canal wall. This fact makes the endodontist uncover areas that could screen the remaining pulp and bacteria that could have caused the faillure on the previous treatment [5, 14, 19].

The present study compared three different techniques for the removal of filling material with the aim of analyzing which technique is able to remove it from the root canal with more efficiency and quickness. In this study, single root simulated canals with standardized angle and curvature were used.

The natural teeth and the plastic simulated canals have been used to compare the root canal shaping techniques. However, in studies in which natural teeth are used, it is very difficult to keep its patronization [20]. It happens due to its anatomic variations, that affect the results more than the instruments used. Then, the plastic simulated canals were used with the aim of eliminating the anatomic variations that the natural teeth presented [21]. However, the hardness of the plastic and the dentin is not the same. It makes indispensable the caution with the evaluation of the results of this study.

The method used for the quantification of the filling material remaining in the root canal after the endodontic retreatment was the radiographic image [5, 22]. It is the most used method by the clinicians and easily accessable for the dental surgeons; the radiographic analysis, on the other hand, only produces one two-dimensional image of the sample [2, 23, 24].

The results revealed that the removal of filling material using instrument Reciproc R40 (Group III) was superior to the techniques using rotatory files M-Two (Group II) and faster (437,433 s *versus* 616535 s). This result can be explained by the amount of instruments used, once the Reciproc system was projected to use only one file, which reduces significantly the working time. The manual files and Gates Glidden drill (Group I) left more material on the canal walls than the other techniques used, besides presenting a longer time of work (1587,651 s). The result obtained in this study was similar to the one found by Capar *et al*., [7], about the amount of filling material removed, however, the results differ regarding the time needed for the removal of the filling material, in which the rotatory group presented a shorter time. The difference found between these results can be attributed to the exclusion of time for file changes and irrigation.

On the other hand, Zuolo *et al*., [14], compared the efficiency on the removal of gutta-percha and filling material of the instruments Reciproc R50 and MTwo R (VDW) to stainless steel manual instruments and Gates Gliden drill. However, the rotatory instruments MTwo R left significantly more material on the canal walls than the other techniques used. The discrepancy between the obtained results can be attributed to the movement applied, in the rotary technique the instrument was inserted in the canal and performed smooth pecking movements in the apical direction without brushing against the walls, what justifies a lower removal of this material.

In this study, the rotatory and reciprocating manual instruments were used without the use of solvents to avoid any interference on the removal of the material and evaluation of this removal [16, 23]. Because, the gutta-percha chemically softened forms a thin layer and adheres to the wall of the canal [14]. This makes the removal of this filling material even more difficult and delayed.

In the present study, none of the techniques used completely removed the filling material of the canal walls in any of the tested samples. These findings are in accordance with the studies that used different techniques, instruments and technologies in the removal of filling material from the root canals [5, 15, 16, 23 - 25].

Instrument fractures were observed during the removal of filling material in Group II. In both cases, the file 25.07 fractured in the fifth block, after the curvature of the canal. These fractures can be attributed to the high inclination of the instrument and higher toughness of the block when compared to a human tooth, besides this the rotary system presents 360º of continuous movement which promotes a screwing effect of the instrument on the filling material, factors that may have caused an increase of the cyclic fatigue, causing a fracture of the instrument. This finding is important because the professionals are concerned not only with the ability of removing the filling material effectively, but also the safety level provided by the endodontic instruments during clinic procedures [23].

Considering the area of filling material in thirds, the apical third, the residual volume was significantly bigger when compared to the coronal and mid thirds. This is due to the fact that the studied blocks present a high inclination in its apical third, justifying the results found is the present study.

The Reciproc R40 instrument was considered effective on the removal of filling material on the root canal walls, with an average of 10.36% of covered areas with remaining filling material. Additionally, the reciprocating technique showed to be the quickest method when compared to the rotary technique and manual instrumentation technique.

CONCLUSION

The best results of filling material removal were obtained by groups II and III without statistical difference between them. The reciprocating technique was the fastest among the techniques tested, followed by the rotary technique and manual technique files.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none

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