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COMPARATIVE EVALUATION OF HAND & ROTARY FILES IN RETREATMENT WITH OR WITHOUT USE OF SOLVENTS: MICROSCOPIC VERSUS RADIOGRAPHIC EVALUATION – AN IN VITRO STUDY

[1*]Dr. Anubhuti, [2]Dr. Priyanka Kumari and [3]Dr. Yogita Deshpande

[1]*Tutor Department of Conservative, Endodontics & Aesthetic Dentistry, Dental Institute, Rajendra Institute of Medical Sciences, Ranchi- 834009, Jharkhand.

[2]Tutor Public Health Dentistry & Preventive Dentistry Dental Institute, Rajendra Institute of Medical Sciences, Ranchi- 834009, Jharkhand.

[3]Senior Lecturer Department of Conservative Dentistry & Endodontics, Rural Dental College, Loni, Ahmednagar, Maharashtra.

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***Corresponding Author**
Dr. Anubhuti
Tutor Department of Conservative, Endodontics & Aesthetic Dentistry, Dental Institute, Rajendra Institute of Medical Sciences, Ranchi- 834009, Jharkhand.

ABSTRACT

Introduction: The success of endodontic retreatment is related to the complete removal of the obturation material from the root canal system. The main goals of orthograde retreatment are regaining access to the apical foramen by complete removal of the root canal filling material thus facilitating sufficient cleaning and shaping of the complete root canal system and final obturation. **Aim**: To compare the efficacy of hand and rotary retreatment system. This study also investigated the effect of solvent on retreatment. **Materials and Methodology:** Sixty maxillary anterior single-rooted teeth were selected. The coronal third of each root canal was prepared with peeso reamer whilst the apical two thirds were prepared with manual files. Obturation was performed using lateral condensation **method**: The teeth divided into four groups. The root filling material were removed with H file and Mtwo retreatment files with and without chloroform. The presence of remaining filling material was evaluated radiographically and then by the microscopic evaluation of split roots. **Result and conclusion:** From present study we conclude that, 6-11–% of the canal wall remained covered with filling material. The use of solvent did not speed up the mechanized procedures. Radiographic evaluation failed to adequately and reliably

detect the extent of filling material remaining on the canal walls, which was later observed by microscopic evaluation. Retreatment using Mtwo retreatment files presented with better results. **Conclusion**: All methods left root canal filling material on the canal walls. Radiographic evaluation failed to detect the extent of remaining root filling material, which could only be detected using microscopy.

KEYWORDS: Chloroform, Microscopy, Radiography, Mtwo, Retreatment.

INTRODUCTION

Endodontic retreatment is indicated when the root canal system becomes reinfected. The procedure requires the complete removal of the original root filling, further cleaning and refilling.[1]

An important step in retreatment is the removal of existing filling material to regain access to the entire canal, expose remnants of necrotic tissue and microorganisms and facilitate their removal. The most common root canal filling material to be removed is gutta-percha.[2]

However, it remains unclear what method of evaluation indicates complete removal of filling material. A variety of techniques have been used to remove root filling materials including stainless steel hand instruments alone or combined with solvents, endosonics and rotary devices.[3]

Conventionally, the removal of gutta-percha using hand files with or without solvent can be a tedious, time-consuming process especially when the root filling material is well compacted. Therefore, the use of Ni-Ti systems have been suggested for removing gutta-percha from the root canal, and studies have shown that they could be both effective and safe.[4]

This study was designed to test and compare the efficacy of four methods for the removal of root canal filling material and to test the hypothesis that radiographs fail to represent the actual cleanliness of the canal walls after this procedure.

MATERIALS AND METHOD

Sixty maxillary anterior single-rooted teeth with straight root canals were selected. Preoperative mesio-distal (M-D) and bucco-lingual (B-L) radiographs of each root were taken (FIGURE-1).

The crowns were removed at the CEJ using a diamond-coated high-speed bur with air-water spray cooling. The roots were ground coronally to establish a uniform 16-mm working length for all teeth. The coronal thirds of all root canals were enlarged with Gates-Glidden drills (Mani) (3, 2 and 1). The apical two-thirds were enlarged to working length using K-files (Mani) (up to size 40) using step back technique & thus confirming Master apical file (MAF). Recapitulation was done. At each instrument change, 2 mL of 3% NaOCl & saline (Neelkanth health care) was used for irrigation. Root canals were dried by paper points (Dentsply). Removal of smear layer is done by 17% EDTA (Ultradent). The root canals were dried with paper points (Dentsply). The sealer (Dentsply) was mixed according to the manufacturer's instructions and placed in the canal using lentulo filler (Dentsply) & obturation was done using lateral condensation technique. With a heated plugger, the excess GP was removed to a level short of the canal orifice. The coronal orifice of each canal was then sealed with a temporary filling material. Teeth were radiographed in B-L and M-D directions, to confirm the radiographic adequacy of root filling using the following criteria:

a) Reaching working length.
b) Uniform radiopacity.
c) No voids.

The teeth were stored at 37°C in 100% humidity for 1 week to allow complete setting of the sealer.

Retreatment Procedures

The temporary fillings were removed. All specimens were then coded and randomly assigned to four groups of 15 specimens each & following procedure is done.

Group 1 – Hedstrom files with chloroform.
Group 2 – Hedstrom files without chloroform.
Group 3 – Mtwo retreatment files with chloroform.
Group 4- Mtwo files without Chloroform.

Retreatment was considered completed for all groups when there was no gutta-percha/ sealer on the instruments when the last instrument reached working length. After final instrumentation, all canals were copiously irrigated with NaOCl and dried with paper points.

Radiographic evaluation

Each root was radiographed mesio-distally and bucco-lingually after the completion of the retreatment procedure (FIGURE-2). The area covered by residual radio-opaque material in the apical two-thirds of the root canal after the retreatment procedure was evaluated using Motic Images plus 2.0 morphometric software and expressed as a percentage of the area of the root canal as seen in a given radiographic projection. The area of the apical two thirds of the root canal, as measured in either the B-L or M-D projections, was considered as 100%. The total area of radio-opaque material in the apical two-thirds in each projection was measured and expressed as a percentage of the root canal area, as seen in the corresponding projection.

Microscopic evaluation

The teeth were grooved vertically on their mesial and distal surfaces using a high-speed diamond bur. The teeth were then mounted on a custom made stand and split longitudinally into halves, using a chisel and a mallet. The amount of remaining root filling material was then evaluated using an endodontic operating microscope at 10x magnification and photographed (FIGURE- 3). The total area covered by residues in the apical two-thirds of both halves was measured and expressed as per cent of the total area of the root canal in the apical two thirds of the two halves of the root canal, as seen in the digital images.

STATISTICAL ANALYSIS

The areas of root filling material residues remaining on the walls, as observed either microscopically or radiographically, were used to compare the various protocols, using ANOVA with repeated measures.

RESULTS

Time required for the completion of the procedure

Removal of root canal filling material using Hedstrom files and chloroform took significantly longer than Mtwo retreatment files and chloroform : 8.0(±2.8) min vs.6.8 (±2.3) min respectively ($P < 0.001$, Table 1). Adding chloroform to assist with the mechanized methods prolonged the time required to accomplish the procedures. Nevertheless, the difference between procedures performed with and without chloroform was not significant.

FIGURES

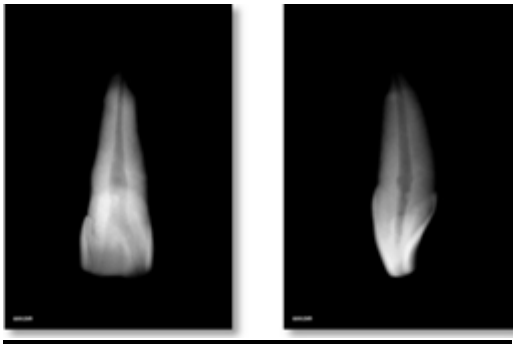

Fig 1: Pre-operative radiographs in M-D and B-L directions.

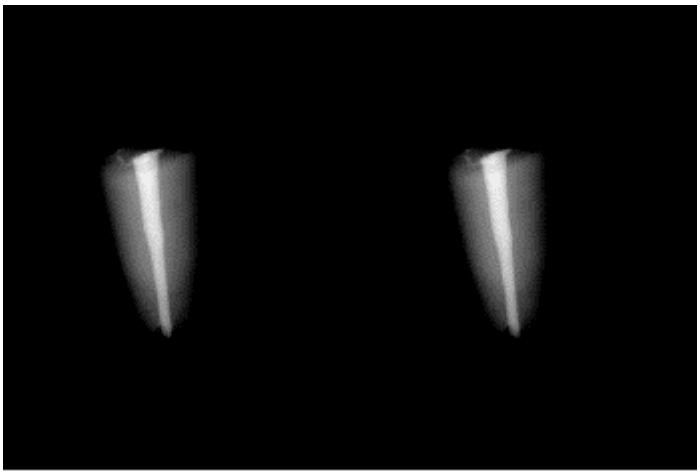

Fig 2: Radiographs showing obturation done.

Fig 3: Teeth were split longitudinally into halves and evaluated under endodontic microscope at 10X.

Table -1: Time required for removal of root filling material.

Sl.no	Groups		Time (min)
1	Group 1	Hedstrom files with chloroform	10.0±6.6
2	Group 2	Hedstrom files without chloroform	8.0±2.8
3	Group 3	Mtwo retreatment files with chloroform	8.5±2.3
4	Group 4	Mtwo retreatment files without chloroform	6.8±2.3

Table -2: Radiographic evaluation of root filling material retained on the canal walls.

Sl.no	Groups		B- L Projection %	M-D Projection %
1 2 3 4	Group 1 Group 2 Group 3 Group 4	Hedstrom files with chloroformHedstrom files without chloroformMtwo retreatment files with chloroformMtwo retreatment files without chloroform	6.3±2.5 0.9±0.8 2.1±1.6 .9±.8	4.1±1.5 3.7±2.9 1.8±1.7 4.5±2.4

Table -3: Microscopic evaluation of root filling material retained on the canal walls.

Sl.no	Groups		
1	Group 1	Hedstrom files with chloroform	6.4±3.6
2	Group 2	Hedstrom files without chloroform	1.9±1.7
3	Group 3	Mtwo retreatment files with chloroform	2.1±1.4
4	Group	Mtwo retreatment files without chloroform	1.9±1.9

There was also no significant difference between the time required for removal of root canal filling material using the Mtwo retreatment files as compared with the Hedstrom files.

Radiographic evaluation

Radiographic evaluation of root filling material left in the canal revealed no difference between the groups (Table 2).

Hedstrom files left radio-opaque material that covered 6.3(±2.5) % of the root canal area in the B-L projection whilst the material left after the use of Mtwo retreatment files alone covered 0.9(±0.8)% (Table 2).

Microscopic evaluation

Microscopic evaluation revealed substantial amounts of root filling residues in all groups with no difference amongst them (Table 3). The canals treated with Hedstrom files used with or without chloroform presented with 6.4(±3.6) % 1.9(±1.7) %, canal walls covered with residues, respectively and of the canal wall covered with residues. Those in which Mtwo

retreatment files was used with or without chloroform had 2.1(±1.4) % and 1.9(±1.9) % the canal walls covered with residues, respectively (Table 3).

A difference between radiographic and microscopic examination

Differences between B-L radiographs and microscopic examination were found in 33 of 60 samples (66%). Similarity between B-L radiographs and microscopic examination was found in only 17/60cases (34%). In 32/60 of the cases (64%), the residue scores were higher when submitted to microscopic compared with B-L radiographic examination. Furthermore, in 11 of the 60 cases (22%), residues labelled 'clean' on the B-L radiograph were instead labelled 'Heavy' when the same root canals were examined microscopically.

DISCUSSION

Complete removal of pre-existing filling material from canals is a prerequisite for successful nonsurgical root canal retreatment.[5] This procedure can uncover residual necrotic tissues or bacteria that may be responsible for persistent periapical inflammation, and allow further cleaning and refilling of the root canal system.[6]

In the presence of an endodontic failure, a non-surgical approach to the root canal system is preferable to a surgical procedure. The variability of the outcome of endodontic retreatment is related to various factors: the possibility of removing the coronal restorations to access the pulp chamber, the patient's age and types of teeth treated, the presence of alterations in the natural course of the root canals and the techniques used to remove the existing filling materials.[7]

Removal of filling material is an important factor in root canal retreatment because it allows for chemo mechanical re-instrumentation and re-disinfection of the root canal system. To date, complete removal of filling material has not been demonstrated to ensure success of root canal retreatment, and that remaining material will cause the retreatment to fail. However, removal of as much filling material as possible from inadequately prepared and filled root canal systems would appear to be essential to uncover remaining necrotic tissue or bacteria that may be responsible for periapical inflammation and persistent disease. Complete removal of these residues may increase the success of endodontic retreatment.[8]

Various methods have been used in endodontic research to evaluate the efficacy of root filling removal including radiography and digitized images. However, they only provide two-

dimensional information for a three-dimensional (3D) object. Other techniques include splitting the teeth longitudinally and visualizing them using a stereomicroscope or by using images obtained with a digital camera and using image analyzer software, or making teeth transparent.[9]

In the present study Mtwo retreatment files was chosen as they have an S-shaped cross-section. An increasing pitch length in the apical-coronal direction and non- cutting safety tip. Therefore these instruments are characterized by a positive rake angle with two cutting edges which are claimed to cut dentine effectively. The initial reports concluded that Mtwo was successful in root canal retreatment as they have sharp blades. lt is possible to cut through the canal and reach apical end-point whilst bypassing gutta-percha.[10]

Adjunctive solvents like Chloroform effectively dissolve gutta-percha and allow quicker access to the working length and help to maintain the original route by facilitating instrumentation inside the obturation mass.[11]Chloroform was used as a solvent due to its known capacity for dissolving gutta- percha and its limited toxicity when used clinically .This solvent has been used in the majority of studies that evaluated gutta-percha and sealer removal using a similar methodology to the one employed in this study.[12 13]

In the present study, the teeth were split longitudinally into halves, using a chisel and a mallet. The amount of remaining root filling material was then evaluated using a Stereo microscope at 10x magnification and photographed. The total area covered by residues in the apical two-thirds of both halves was measured and expressed as per cent of the total area of the root canal in the apical two thirds of the two halves of the root canal.[14]

In this study in Group I when Hedstrom files with chloroform were used it took significantly longer time (8.0±2.8 min) than in Mtwo retreatment files when used with chloroform in Group III (6.8 ±2.3 min) ($P < 0.001$) (Table 1) Adding chloroform prolonged the time required to accomplish the procedures. As the chemically softened gutta-percha forms a fine layer and it adheres to the canal walls. This makes the removal of filling material even more difficult and time-consuming.[15, 16]

In Group II Mtwo retreatment files were used without using chloroform (8.5±2.8 min) took longer time and in Group IV- Mtwo retreatment files without chloroform took less time (6.8±2.3 min) in removing gutta percha. ($P < 0.001$, (Table 1).

Radiographic evaluation of root filling material left in the canal revealed no significant difference between the groups. In Group I when Hedstrom files were used with chloroform left radio-opaque material that covered 6.3(±2.5) % of the root canal area in the B-L projection and 4.1(±1.5) % in M-D Projection whilst in Group III- Mtwo retreatment files were used with chloroform, the material left radio-opaque material that covered 0.9(±0.8) % in B-L projection and 3.7(±2.9) % in M-D Projection (Table 2).

In Group II when Hedstrom files were used without chloroform, it left radio-opaque material that covered 0.9(±0.8) % in B-L projection and 2.9 (3.7) %in M-D Projection. In Group IV when Mtwo retreatment files were used without chloroform, it left radio-opaque material that covered 0.9(±0.8) % in B-L projection and 4.5(±2.4) % in M-D Projection (Table 2).

Microscopic evaluation revealed substantial amounts of root filling residues in all groups with no difference amongst them. In this study In Group I when Hedstrom files were used with chloroform, the canal wall presented with 6.4(±3.6) % canal walls covered with residues and in Group III- Mtwo retreatment files with chloroform presented with 1.9(±1.7) % the canal wall covered with residues (Table 3).

In Group II when Hedstrom files were used without chloroform, presented with 2.1(±1.4) % the canal wall covered with residues and In Group IV when Mtwo retreatment files were used without chloroform the canal wall covered with residues presented with 1.9(±1.9) % the canal wall covered with residues (Table 3).

When comparing the two NiTi instruments, it can be explained by the fact that the Mtwo retreatment files work on crown-down approach eliminates the filling material from the coronal third more effectively than the Hedstrom files.[17,18] When used Mtwo NITI instruments for retreatment, the procedure can be completed more easily, quickly, and predictably but effective cleaning of the entire root canal is still challenging. Further studies are needed to assess the efficacy, maintenance of original canal morphology and safety of NiTi rotary instruments during retreatment and complicated root canal anatomy.

CONCLUSION

In the present study, none of the techniques were efficient in removing all the obturating material from the canals. Mtwo retreatment files left significantly lesser gutta-percha and sealer in the root canals than the Hedstrom files. There were stastically significant difference

between Hedstrom files and Mtwo retreatment files. The Mtwo retreatment files without chloroform proved to be more efficient than Hedstrom files. Radiography alone failed to detect all remaining root canal filling material, which could be detected using stereo microscopy.

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