# Detection of Residual Obturation Material after Root Canal Retreatment with Four Different Files Using a Stereomicroscope: An In-Vitro Study

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**ABSTRACT:** The endodontic treatment success is directly related to many factors which are linked in a chain so that if one is broken, the probability of treatment failure increases. These factors include accurate diagnosis, maintenance of the aseptic chain, and knowledge of tooth morphology, correct chemical-mechanical preparation and three dimensional filling of the root canal system. Possible faults in any of these steps will lead to endodontic treatment failure. The purpose of this in-vitro study is to detect residual obturation material after root canal retreatment with H file, GG drill + H file, ProTaper Universal retreatment file and Race using a stereomicroscope. Material and method: This ex-vivo study was undertaken to detect residual obturation material after root canal retreatment with H file, GG drill + H file, ProTaper Universal retreatment file and Race using a stereomicroscope. Time taken by each files was recorded to analyse the operating time. All samples were made transparent by Robertson Method and observed under stereomicroscope at 6.5x, magnification and images are subjected to Image analysis software for detection of residual obturating material. Result: After One Way Analysis of Variance, LSD post hoc test, Kruskal -wallis test and Mann Whitney U test was applied for pairwise comparison. Conclusion: On comparative evaluation of results of this ex-vivo study, it was concluded that D-Race showed better efficiency in removing gutta percha as compared to H-file, gates glidden drill, protaper universal retreatment files. Also the operating time taken to remove gutta percha by D-Race file was less as compared to all files This study was a humble effort to evaluate the efficiency of different retreatment files. However, it is still open for further research.

**Keyword:** Hence forth the above study showed that D-RACE proved to be best in removing gutta percha from the canal.

# I. INTRODUCTION

The endodontic treatment success is directly related to many factors which are linked in a chain so that if one is broken, the probability of treatment failure increases. These factors include accurate diagnosis, maintenance of the aseptic chain, and knowledge of tooth morphology, correct chemical-mechanical preparation and three dimensional filling of the root canal system. Possible faults in any of these steps will lead to endodontic treatment failure<sup>1,2</sup>. In addition to the above reasons the teeth with inadequate obturation, unfilled canals or under extended root fillings may require retreatment before coronal restoration, as failure due to these causes may occur in future<sup>3</sup>. The main goal of retreatment are regaining access to the apical foramen by complete removal of root canal filling material, thus facilitating sufficient cleaning and shaping of complete root canal system and finalobturation<sup>4</sup>. If the filling material can be removed completely and the root canal negotiated to the apical foramen allowing thorough debridement, only then the retreatment can be successfully done<sup>5,6</sup>. Aim of the root canal retreatment is to substantially reduce or eliminate the microbial load from the root canal. (Stabholz & Friedman 1988)<sup>7</sup>

The most important step in cases of endodontic failure and also the first treatment of choice is retreatment of the root canal involving the complete removal of the root canal filling material<sup>8</sup>. It has been reported that irritants in the form of filling material, necrotic pulp tissue, bacteria, or irrigants may be extruded into the peri-radicular tissues when endodontic retreatment is performed. Apically extruded materials have clinically been held responsible for discomfort, including postoperative inflammation and flare-up an even failure of apical healing. Several studies show that the amount of debris extruded apically might vary according to the preparation technique used and the design of root canal instruments<sup>9</sup>...Most frequently Enterococcus faecalis, followed by Streptococcus and Tannerella was found in poorly filled root canal.Many techniques, instruments and substances have been used for removing gutta-percha. Among them, the use of hand

instruments either without or with solvents are Emphasized<sup>10</sup>, because the hand instruments decrease the risks of damaging to the tooth structure during the gutta-percha removal<sup>11</sup>. Gutta-percha can also be removed by many manners: solvents<sup>12</sup>, Gates-Glidden drills, ultrasound ,motor-driven rotary instruments<sup>1-9</sup>, ultrasonic tips and files, and heat carrying instruments. Chemicals are also sometimes used as solvents (Wilcox et al.1987, Lewis & Block) Other factors for endodontic treatment failure are reinfection, contamination of root canal systems already filled<sup>11</sup> and incomplete obturations.

Conventional retreatment is the first choice in these cases with favourable long-term results. Endodontic treatment goal is to re-access the apical foramen, by completely removing the obturation, making easy the cleaning and shaping<sup>13</sup>. Although numerous materials have been described for obturation of root canals, gutta- percha in combination with a sealer is the most frequently used material of the root canals .Conventional endodontic retreatment has largely replaced endodontic surgery for the management of failed root canal treatment. However, the removal of gutta-percha filling material, particularly from apparently well-condensed root canals (Ladley et al. 1991), may be time-consuming. Unfortunately, this is essential for the success of retreatment (Friedman et al. 1990). Mechanical systems have been proposed as an alternative to hand instrumentation for removing gutta-percha. However few studies (Hu<sup>-</sup>Ismann & Stotz1997, Bramante & Betti 2000, Barletta & Lagranha2002) have investigated and compared the effectiveness of these instruments in the removal of filling material.

The purpose of this study was to compare the efficacy of gutta percha removal from the root canal system using H file,GG drill +H file,ProTaper Universal retreatment file and Race using a stereomicroscope .

# II. MATERIAL AND METHODS

The present in-vitro study of detection of residual obturation material was carried out at the Department of Conservative and Endodontics, Jaipur Dental College, Jaipur, Rajasthan, India

**Study Location**: Department of Conservative and Endodontics, Jaipur Dental College, Jaipur, Rajasthan, India **Study Duration**: November 2016 to November 2017.

#### Sample size: 80 tooth

**selection method**: 80 human maxillary central and lateral incisors extracted for periodontal regions were collecting and stored in distilled water until use. Human teeth used for research are to be treated as potential source of blood-borne pathogens, according to the United States Occupational Saftey and Health

Administration(OSHA).So soft tissue and calculus was removed using scaler and were stored in 10% formalin for disinfection for 7 days.

#### **Inclusion Criteria:**

- Teeth with completely formed root apices
- Teeth without resorptive effect.
- Root without cracks.

#### **Exclusion Criteria For Teeth Selection**

- Teeth with presence of any type of carious lesions were discarded.
- Teeth with restorations or any defects were excluded from the study.
- Teeth having improper anatomy, hypoplastic and fractured teeth were discarded.
- All teeth were inspected for the presence of cracks. Those with apparent cracks were excluded from the study.

#### Procedure methodology

# 1. SPECIMEN PREPARATION

Crowns were removed at the cemento-enamel junction level using a diamond cutting disc under copious water cooling to leave a root 16 mm in length,ensuring a uniform working length. Access Cavity was made using endo access bur no.2 (Dentsply) in a high speed handpiece(NSK) and then the working length is determined using a radiograph. Cleaning and shaping were performed using a modified stepback flare technique (Walton,1989). The cervical third was flared with sizes 1-3Gates Glidden Drill (Dentsply,Maillefer) ,the apical preparation is then enlarged upto size 50 K-File at working length in all samples while irrigating frequently with 3% Naocl and 17% Ethylenediaminetetraacetic Acid(EDTA,prime dental).After biomechanical preparation, the root canal is dried with paper points and obturated with Gutta Percha and AH Plus Sealer (Dentsply),(Fig.10), using a cold lateral compaction technique (Fig.11),(Fig.12). the access cavity were sealed with cavit (DeTrey, Dentsply). All teeth were stored in normal saline for 1 week

# 2. SAMPLE GROUPING

Eighty samples are then randomly distributed in four groups and retreatment procedure was carried.

**Group 1**: The samples are retreated using H-File. Gutta Percha is removed from the root canal with Xylene as a solvent and H-Files in a circumferential quarter turn push pull motion. The retreatment is complete when there is no Gutta Percha or filler material are not seen on the instrument, also the canal appeared clean when inspected with naked eyes.

**Group 2**: The sample in this group are retreated with H-Files and Gates Glidden Drill(Dentsply maillefer) fixed in the micromotor. The filling material is removed using xylene and Gates Glidden Drill from the coronal and middle third of the root canal and apical third is to be cleaned using H-file.

**Group3** : The sample in this group are retreated with xylene and Protaper Universal retreatment file and an endodontic motor with torque control and a reduction gear handpiece (X-SMART, Dentsply maillefer) was used with the rotational speed at 500Rpm as recommended. Without engaging dentin, D1 is gently pressed into the obturating material. D1 is used to remove the obturation material from the coronal one-third of the root canal. After using D1, D2 is used to progressively remove material from middle one-third. The remaining obturation material from the apical one-third of the root canal is then removed with D3.

**Group 4**: The sample in this group are retreated with xylene and D-Race retreatment (KFG Dentair)files which was used at a rotational speed of 600Rpm. The first instrument DR1, has an active tip for handling the root filling material and is used in the first millimetres of the coronal and a straight part of canals. Once access is cleared with the DR1, the second instrument, DR2, is used to reach the working length.

All specimens were rendered transparent according to the technique described by Shirrmeister <sup>71</sup> et.al (2006). The specimens were decalcified in 5% Nitric acid for 72hours, washed for 4 hours and dehydrated in increasing concentration of alcohol ( i.e; 80% for 12 hours, 90% for 1 hour and 99% for 3 hours ).

After clearing, the samples are observed under a stereomicroscope(fig 21) at 6.5\* magnification to detect residual obturation material. The photographs of all the samples are then stored on a computer and later on evaluated for the remaining filling material using image analysis software (Image Tool 3.00 UTHSC scan Antonio). Linear measurement of the remaining filling material is to be done in millimetres and scores are to be given to each sample for cleanliness of wall as follows:

| Citeria  | Score |
|--|-------|
| 1)Filling material completely removed                                      | 01    |
| 2)one small remanent of filling material<br>(<2mm extension )              | 02    |
| 3)Two or three small remanents of filling<br>material (<2mm of extension)  | 03    |
| 4)more than three small remanents of filling material (,2mm of extension ) | 04    |
| 5) Remanents of filling material (>2 or<br><5mm extension)                 | 05    |
| 6) Large remanent of filling material<br>(>5mm extension)                  | 06    |

#### 3. Evaluation

In this present study the following parameters were evaluated

#### A) Remaining Gutta Percha and Sealer

Remaining Gutta Percha and Sealer were evaluated under the scoring criteria mentioned above.

# **B)** Operating Time

The operating time which elapsed from initial Gutta Percha removal with the first instrument until reaching the original working length was recorded as T1. The time required to achieve satisfactory Gutta Percha removal after reaching the working length was recorded as T2. Total time for treatment was the sum of T1 and T2. **Statistical analysis** 

Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL). Mean square of residual filling material was assessed using Kruskal-wallis test. Mann-Whitney U test was used for intergroup comparision of mean score. The mean time taken was compared using one way chi square test.

| Table no 1: Score of residual filling material |        |                                    |                   |            |                     |          |  |  |
|--|--------|------------------------------------|-------------------|------------|---------------------|----------|--|--|
|  |        | Score of residual filling material |                   |            |                     |          |  |  |
|  | Number | Mean                               | Std.<br>Deviation | Std. Error | Chi-square<br>value | p-value  |  |  |
| Group 1 (H-file)                               | 20     | 4.950                              | 0.605             | 0.135      | 74.165              | < 0.001* |  |  |
| Group 2 (GG+H-<br>file)                        | 20     | 3.900                              | 0.641             | 0.143      |                     |          |  |  |
| Group 3 (Protaper file)                        | 20     | 3.000                              | 0.562             | 0.126      |                     |          |  |  |
| Group 4 (RACE file)                            | 20     | 2.100                              | 0.718             | 0.161      |                     |          |  |  |

III. Result







|                         |        | Time taken |                   |               |                     |          |  |
|-------------------------|--------|------------|-------------------|---------------|---------------------|----------|--|
|                         | Number | Mean       | Std.<br>Deviation | Std.<br>Error | Chi-square<br>value | p-value  |  |
| Group 1 (H-file)        | 20     | 12.28      | 1.90              | 0.425         | 78.927              | < 0.001* |  |
| Group 2 (GG+H-<br>file) | 20     | 10.02      | 1.62              | 0.362         |                     |          |  |
| Group 3 (Protaper file) | 20     | 7.80       | 1.22              | 0.273         |                     |          |  |
| Group 4 (RACE file)     | 20     | 5.42       | 1.03              | 0.230         |                     |          |  |



Graph no 2: mean time taken was compared

#### IV. DISCUSSION

The major factors associated with endodontic failure are persistence of microbial infection in the root canal system and/or the peri-radicular area. Thus, root canal retreatment has largely replaced peri-radicular surgery for the management of persisting or emerging diseases. It is therefore important to remove as much sealer and gutta-percha as possible during retreatment, to uncover remnants of necrotic tissue or bacteria that might set as the antigenic source (Saad et al. 2007)<sup>14.</sup>

The management of failed root canals includes nonsurgical retreatment, apical surgery or extraction. The success rate of endodontic retreatment ranges from 56-84%. Although there are no statistical difference between the success rate of surgery and conventional retreatment the preferred treatment of failing endodontic cases is nonsurgical retreatment.

The goal in retreatment of endodontically treated teeth is complete removal of the root canal filling material, followed by cleaning and shaping of the root canal for final obturation. Thus, several techniques were investigated to find an effective, easy method of removing root canal filling material<sup>15</sup>.Gutta-percha is the most frequently used filling material for root canal obturation. Most retreatment studies have used teeth filled by lateral condensation, which does not create a homogenous mass of gutta-percha but tends to entrap pools of sealer between the gutta percha cones. It also tends to result in better condensation in the middle and coronal thirds rather than the apical third.

The different methods used for removal of gutta-percha during endodontic retreatment are mechanical, thermal, chemical or even an association of them, and also special instruments such as ultrasonic instrument can be used. Most often gutta-percha cones are composed of vegetable resin, which lends its name to the product, and they are softened by chemical solvents. Gutta-percha is also soluble in essential oils. Among them the most frequently used in endodontics are: chloroform, xylol, halothane, eucalyptol, turpentine (terebintine) and orange oil<sup>16</sup>. However, these substances seem to show variable degrees of success regarding dissolution and removal of this material from the root canal. Organic solvents have been used for a long time as an auxiliary or principal method of gutta-percha removal, being the more effective chemical substances to dissolve the filling endodontic material.

# Detection of residual obturation material after root canal retreatment with four different files using...

Gomes F.D.A. et al  $(2013)^1$  conducted a study in which they used chloroform, xylene, eucalyptol and orange oil and concluded that chloroform and xylene showed similar results regarding the rate of dissolution of gutta-percha, yet they were statistically significant higher than eucalyptol and orange oil from 1 to 5 minutes. Their properties should be taken in consideration regarding effectiveness in the dissolution of the endodontic filling material.

Hwang C.J.I. et al (2015)<sup>17</sup> conducted a study to compare the effectiveness of endodontic solvents to remove endodontic sealers and concluded that the use of proper endodontic solvent makes complete removal of the sealer from the root canal is necessary for successful retreatment. Chloroform appears to be a universally used and cost effective solvent for gutta-percha during retreatment. It was significantly faster to remove AH-Plus with EndoSolv E than other solvents tested, and significantly faster than MetaSEAL regardless of the solvent, or no solvent. Solvents are required to remove MetaSEAL. The retreatment of root canal filling with AH Plus is more effective than MetaSEAL. The retreatment of root canal filling with AH Plus is more effective than MetaSEAL because AH Plus is soluble in a variety of solvents. EndoSolv E was more effective in removing a resin-based sealer, especially AH Plus, than EndoSolv R.

Xylene is an aromatic hydrocarbon widely used in industry and medical technology as a solvent.it is a colorless sweet smelling liquid or gas ocuuring naturally in petroleum and wood tar and is so named because it is found in crude wood spirit(Gr.xy'lon-wood).It has a chemical formula of C6H4(CH3)<sub>2</sub>, and it is reffered to as dimethyl benzene.It is available nowadays for clinical use, and it is not considered a Carcinogen. It is also less volatile as compared to chloroform and trichloroethylene.

Conventionally, the removal of gutta-percha using hand files with or without solvent canbe a tedious, time consuming process, especially when the root filling material is well condensed (de Oliveira et al. 2006). Jadhav A. et al (2017)<sup>16</sup> conducted a study in which they concluded that H-files showed the maximum amount of gutta-percha within the root canals and took more time than R-Endo & ProTaper. Therefore, the use of rotary NiTi instruments in the root canal retreatment may reduce the working time and decrease patient & operator fatigue.

Recently, NiTi instruments specially designed for removal of filling materials have been marketed, including ProTaper retreatment files, D-RaCe retreatment files, Mtwo retreatment files and R-Endo retreatment files. In the present study H file, GG drill, ProTaper and Race have been used for retreatment. Samples of group 1 have been retreated with H file. H file has a Christmas tree design with the cross section of coma/tear drop shape with one cutting edge.Gutta percha is removed from the root canal with sizes 25,30,35,40,45 and 50 in circumferential quater turn push pull motion.

The canal filling in Group 2 are retreated with Gates Glidden and H file.GG drill comes in six sizes ,the filling material is removed using GG drill from the coronal and middile of the root canal and the apical third is to be cleaned using H file.

The samples in Group 3 are retreated with ProTaper Universal retreatment file at 500 rpm. The ProTaper retreatment system consists of three flexible instruments D1 size 30(taper 0.09), D2 size 25(taper 0.08),D3 size 20(taper 0.07),which are specially designed for root filling removal from the coronal middle and apical portion of the root canals respectively. The specific flute design and rotary motion of the ProTaper Universal retreatment instruments tends to pull GP into the flutes and directed towards the orifice.

The Group 4 samples are retreated with D-Race retreatment files at 600 rpm. The D-Race set consists of two NiTi files-DR1 and DR2. The first instrument, DR1 has an active tip for handling the root filling material and is used in the first millimetres of the coronal and straight part of the canal. Once access is cleared with DR1 the second instrument DR2 is used to reach the working length.

In the present study the teeth were made transparent after retreatment to allow the measurement of area covered by filling material. The analysis was carried out by means of an image analysing software(image Tool 3.00UTHSC scan Antonio), which was attached to the stereomicroscope .However ,this method has limitations as radiographic images provides only two dimensional information on a three dimensional structure.

In the present study D-Race retreatment instrument proved to be efficient method for removing gutta percha and is less time consuming as, specimem showed smaller percentage of area covered by GP/sealer remnants than those treated with other techniques .The better performance of D –Race retreatment instrument may be attributable to their flexibility and tip design. These features may enable the retreatment instruments to cut not only GP but also the superficial layer of dentine during remeval of root filling.

However, further studies are required to assess the efficacy of hand and rotary instruments in a clinical scenario.

# V. CONCLUSION

The present study titled **"DETECTION OF RESIDUAL OBTURATION MATERIAL AFTER ROOT CANAL RETREATMENT WITH FOUR DIFFERENT FILES USING A STEREOMICROSCOPE"** was conducted in the Department of Conservative Dentistry and Endodontics, Jaipur Dental College and Hospital, Jaipur.

This study aimed to compare and evaluate the effectiveness of four different gutta-percha removing techniques using stereomicroscope. The readings from the Stereomicroscope were statistically analyzed and, it was concluded that-

1. It was not possible to remove gutta-percha/sealer from the root canal completely during retreatment. Some traces of filling material always remain in the canal.

2. None of the four file systems was capable of removing gutta-percha completely from the root canals during retreatment.

3. Comparing the mean difference in between Four groups, it was found that Group 4 i.e. D-Race retreatment files showed the best results .

4. When the overall comparison of the mean difference in the time in between four groups, it was found that Group 4, D-Race retreatment files showed the best result.

5. Comparable results to remove gutta-percha/sealer from the root canal and mean difference in the time were also shown with the proTaper retreatment files.

However, further research should be conducted in order to assess the efficacy of these rotary instruments in a clinical scenario.

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