



**Evaluation of Efficacy of Hand Files and Protaper Retreatment Files in Removal of Gutta-Percha from Teeth Obturated With Lateral Condensation and Thermoplastisized Techniques: An Ex-Vivo Study**

<sup>1</sup>Dr. Anshdeep Singh, Reader, Dept of Conservative Dentistry And Endodontics, Seema Dental College And Hospital, Rishikesh

<sup>2</sup>Dr. Azhar Malik, Associate Professor And Head, Dept of Conservative Dentistry And Endodontics, Indira Gandhi Govt. Dental College Jammu, India

<sup>3</sup>Dr Aina Kumar, Senior Lecturer, Dept of Conservative Dentistry And Endodontics, Dr .B R Ambedkar Dental College Patna, India

<sup>4</sup>Dr Sumit Sabharwal, Senior Lecturer, Dept of Conservative Dentistry And Endodontics Seema Dental College And Hospital, Rishikesh, India

<sup>5</sup>Dr Amit Narayan, Reader, Dept of Conservative Dentistry And Endodontic, Azamgarh Dental College And Hospital Azamgharh, U.P. India

<sup>6</sup>Dr. Sankalp Verma, Sri Sai Hospital, Delhi Road, Moradabad, U.P. India

**Correspondence Author:** Dr. Sankalp Verma, Sri Sai Hospital, Delhi Road, Moradabad, U.P. India

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**Abstract**

**Introduction:** Endodontic trends reflect changes in care provided and this is a dramatic change. This vast increase in endodontic is described as the “*good news-bad news dilemma*”. The good news is that hundreds of millions of teeth are salvaged through the combination of endodontic, periodontics and restorative dentistry. The bad news is that tens of millions of endodontically treated teeth are failing each year for a variety of reasons.

**Aim:** To compare under SEM the efficacy of H-files and Protaper Universal rotary instruments (D1, D2, D3) using solvent in removing the gutta-percha from root canals obturated with either lateral condensation or injectable thermoplastisized techniques.

**Materials & Methods:** This experimental study consisted of 100 extracted human maxillary central incisors that were evaluated under scanning electron microscope for the cleaning efficacy of rotary instruments over hand

instruments. The statistical test employed was descriptive statistics and Z test.

**Conclusion:** Rotary files are less effective in the apical third as compared to the H-files in the apical third. H-files are effective for the removal of gutta-percha condensed laterally than the thermoplastic gutta-percha while rotary files are more effective for the removal of thermoplastic gutta-percha than the laterally condensed gutta-percha.

**Keywords:** Endodontic, Protaper, Rotary, Scanning Electron Microscope, Condensation

**Introduction**

Endo-mathematics suggested by survey of American association of endodontic (AAE) is about 40,000,000 teeth are treated by root canal treatment every year and the success rate for conventional-treated teeth is 85% to 90% ,this still leaves a failure rate of 10% to 15% . A 10% failure rate would thus result in about 400,000 teeth to be retreated annually.<sup>1</sup>Due to the increasing demand to

preserve teeth, including cases with post-treatment disease following root canal treatment; there is a growing interest in conventional retreatment. The successful removal of gutta-percha and sealer is an important step; however, it is a very difficult and time consuming task requiring special materials and instruments.<sup>2</sup>

Traditionally different methods have been applied to remove root filling materials from canals. These include use of hand file, hand files with solvents<sup>3,4</sup>, hand or rotary instruments with heat<sup>5</sup>, ultrasonic files<sup>3,4</sup>, engine-driven instruments<sup>6,7,8</sup> and laser irradiation, removal of root filling material was also achieved by, engine-driven rotary instruments, heat-carrying or ultrasonic devices<sup>3-5</sup>. Furthermore, solvents were used to soften and dissolve gutta-percha in the root canal to facilitate its penetration and removal. Solvents available for dissolution of gutta-percha filling materials are chloroform, eucalyptol, xylene, orange oil, methyl chloroform, halothane, turpentine oil, pine needle oil, and white pine oil<sup>9</sup>.

So, this study compares the efficacy of hand files and the Protaper retreatment files in canals obturated with lateral condensation and thermoplastic techniques, which files are more effective in removing the gutta percha and sealer at the apical, middle and coronal aspects of the root canal and to verify the efficacy of Protaper rotary instruments which are easier, faster and saves time of retreatment which are most commonly used now days and which material is removed faster the laterally condensed or the injectable thermoplastic gutta-percha.

### **Materials and Methods**

This ex-vivo study was conducted in the post-graduate department of Conservative dentistry and Endodontics, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, with the aim of comparing the efficacy of rotary instruments over hand instruments in removing the gutta-percha and sealer from root canals

obturated both with lateral condensation and the thermoplastisized techniques. This experimental study consisted of 100 extracted human maxillary central incisors (n=100) collected from the Dept. of Oral & Maxillofacial surgery. The SEM study was conducted at Wadia Institute of Himalayan Geology, Dehradun (Uttarakhand).

**The inclusion and exclusion criteria were as follows:**

**Inclusion criteria:** Non-carious maxillary central incisors. Presence of straight roots with Schneider angle less than 5°. Existence of single root canal.

**Exclusion criteria:** History of caries, curved roots, Schneider angle more than 5°, enamel cracks or fracture, incomplete crown fractures, Open apex, Internal or external resorption and Calcification of canal

**Study Design:** The 100 human extracted central incisors were washed under running tap water, cleaned of attached tissue, autoclaved in hot air oven and stored in 0.2% thymol in normal saline solution until use. All samples were cleaned with ultrasonic scalers, and randomly divided into two main groups (G1) and (G2).

**GROUP G1-** randomly selected 50 teeth were obturated with gutta-percha and AH Plus sealer using cold lateral condensation.

**GROUP G2-** randomly selected 50 teeth were obturated with injectable thermoplastisized gutta percha and AH Plus sealer.

These groups were subdivided into (G1A) (G1B), (G2A) (G2B) of 25 teeth each.

**GROUP (G1A)-** GP and sealer were removed by hand instrumentation using H-file# 30, # 40, #50.

**GROUP (G1B)-** GP and sealer were removed using Protaper rotary (D1,D2,D3) instruments.

**GROUP (G2A)-** GP and sealer were removed by hand instrumentation using H-file #30,#,40,#50.

**GROUP (G2 B)-** GP and sealer were removed by rotary (D1,D2,D3) instruments.

### Evaluation of Samples under SEM

The coronal, middle and apical thirds of all root halves were examined using a SEM (at 10–15 kV and at a standard magnification of 40X and further at 2000X and scored as follows:

**Score 0-** No GP no sealer.

**Score 1-**Debris of sealer

**Score2-**Debris of sealer and gutta-percha

**Score 3-** Heavy debris of gutta-percha

The results were subjected to statistical analysis.

### Results & Observations

In this study, the amount of debris remained in three areas of canal i.e. Apical, Middle and Coronal after the re-treatment via both H-Files and Rotary-Files was evaluated through SEM and following comparisons were done

1. Debris in Apical third in both G1A and G1B.
2. Debris in Middle third in both G1A and G1B.
3. Debris in Coronal third in both G1A and G1B.
4. Debris in Apical third in both G2A and G2B.
5. Debris in Middle third in both G2A and G2B.
6. Debris in Coronal third in both G2A and G2B
7. Efficacy of H-Files vs. Rotary files in both G1and G2 individually i.e. between
  - a. G1A and G2A
  - b. G1B and G2B
8. Debris left in G1 and G2.

For the comparisons mentioned from 1 to 8, Z tests were employed. For comparison of two population means, the mean of the average ratings generated based on the evaluation through SEM was used. The level of significance was 5%. It is also to be noted that all the tests above are single tail tests and as such we shall consider Z critical  $|1.96|$ , and as such we shall reject the null

hypothesis if the calculated value of  $Z > |1.96|$  or in other words if p value of the test  $< .05$ .

**For this study following assumptions were made (table 1):**

1. The samples are collected from independent normal populations. The samples were also assumed to be following the same distribution with the same mean and variance as that of the population from which they come.
2. It is to be noted that, the comparison was done between only two populations/samples; we used Standard Normal Distribution Test or a Z test. In case we do comparison of the larger subgroups we shall not consider the effects of difference in values of the smaller subgroups of which they are formed, and as such consider each observation independent of the other.

For the study the Null Hypothesis is as below

**$H_0$ : There is no significant difference between the means of the two groups**

And an Alternative Hypothesis is as below:

**$H_1$ : There is significant difference between the means of the two groups (and specifically that of group 1 is  $\neq$  group 2 as the case may be.**

Else we shall accept the null hypothesis.

### Statistical Conclusion

In this study the null hypothesis assuming that there is no difference in canal cleanliness between hand and rotary was rejected. As such it was found that rotary was more effective to clean the thermoplastic gutta-percha as compared to the laterally condensed gutta-percha, and hand files were more effective in cleaning the laterally condensed gutta-percha.

### Discussion

It was demonstrated in the study that different areas in the canals had significantly different outcome after material

removal but none of the specimens was free of GP/sealer remnant under scanning electron microscope. Regardless of the technique, more residual canal filling material remained in the apical third than in the middle and coronal third as has been reported previously<sup>7,8,10</sup>.

In group ( G1A ) in which re-treatment was done with H-files in canals obturated with laterally condensed gutta-percha ,maximum canal cleanliness was obtained at all the three levels as compared to other three groups ( p value  $0.0002 < .05$  ) mean values , apical(  $1.76 \pm 0.44$ ), middle (  $1.12 \pm 0.33$ ). coronal (  $1.16 \pm 0.37$ ). Minimum debris in the middle as compared top the coronal aspect and maximum was seen the apical area .These findings were in accordance to the results of two previous studies on retreatment efficacy in canals obturated with laterally condensed gutta-percha and sealers, in which the largest amounts of residual debris were observed in the apical levels of all canals examined.<sup>3,11</sup>

In group (G1B) in which retreatment was done with Protaper retreatment file (D1, D2, D3) and obturated with laterally condensed gutta-percha did not achieve complete canal cleanliness with the minimum debris in the coronal aspect, mean value ( $1.24 \pm 0.44$ ), followed by the middle with a mean value (  $1.48 \pm 0.65$ ) and the maximum debris in the apical aspect with a mean value (  $2.24 \pm 0.52$ ). The middle third area showed the less debris than the apical as according to the previous studies by (L.S.gu, J.Q.Ling 2008)<sup>12</sup> which states that the Protaper retreatment files should be used along with the hand files (H-files) to achieve complete canal cleanliness. This difference might be due to the rotary file design in which D3 was having apical diameter of 20 , but apical preparation in the samples were done till # 35.

In group (G2A) obturation done with thermoplastic gutta-percha and the techniques of retreatment i.e. H-files and solvent did not achieve complete canal cleanliness as

compared to the group G1A in which H-files were more effective than this group. With the minimum debris in the coronal aspect, (p value  $0.0272 < .05$ ) mean value ( $1.28 \pm 0.46$ ), followed by the middle with a mean value (  $1.40 \pm 0.50$ ) and the maximum debris in the apical aspect with a mean value (  $2.08 \pm 0.49$ ). As in this group the obturation was done by injectable thermoplsatisized gutta-percha and retreatment done by H-files which when used in a circumferential quarter-turn push-pull motion shears the gutta-percha which does not allow its complete removal.

In group (G2B) obturation done by thermoplastic gutta-percha and retreatment with the Protaper retreatment files (D1,D2,D3) and solvent achieved the better results as compared to the other groups ( p value  $0.0040 < .05$ ) with the minimum debris in the coronal aspect , mean value ( $1.20 \pm 0.41$ ), followed by the middle with a mean value (  $1.12 \pm 0.53$ ) and the maximum debris in the apical aspect with a men value (  $1.84 \pm 0.37$ ) but better than the group (G2A) as these files were used following the manufactures instruction i.e. were sequentially used in the crown-down manner to reach the pre-established working length ,they were more effective in removing thermoplastic gutta-percha as in accordance to a previous study by( Ferreira JJ, Rhodes JS, Pitt Ford 2001)<sup>7</sup>, which suggested that heat generated by profile rotary instruments in addition to the softening effect of the solvent facilitates movement of softened debris resulting in comparably cleaner walls than the manual H—files. The better performance of Protaper Universal retreatment instruments in removing thermoplastic gutta-percha may be attributable to their design. D1, D2 and D3 have three progressive tapers and lengths. These features may enable the retreatment instruments to cut not only GP but also the superficial layer of dentine during root filling removal. Moreover, the specific flute design and rotary motion of the ProTaper Universal retreatment instruments tend to

pull thermoplastic GP into the file flutes and direct it towards the orifice. Furthermore, it is possible that the rotary movements of engine-driven files produce a certain degree of frictional heat which might plasticize GP. The plasticized GP would thus present less resistance and be easier to remove<sup>12</sup>.

H-files were more effective for the removal of gutta-percha condensed laterally than the Protaper retreatment files as the amount of debris left in group G1A<G1B. This is in accordance with the study which concluded that H-files left less gutta-perch overall compared to other files systems such as HERO 642 in retreatment cases<sup>11</sup>. Other studies in the past have also stated that specific rotary files such as Protaper universal, R-Endo and Mtwo-retreatment files was not found superior than hand instrumentation.<sup>10</sup>

Rotary files were more effective in the removal of gutta-percha compared to the H-files in the removal of thermoplastisized gutta-percha as the amount of debris left in group G2B<G2A. This is in agreement with the findings of other studies by (L.S.Gu, J Q Ling; 2008)<sup>12</sup> which stated that better performance of ProTaper Universal retreatment instruments in removing thermoplastic gutta-percha may be attributable to their design. D1, D2 and D3 have three progressive tapers and lengths. These features may enable the retreatment instruments to cut not only GP but also the superficial layer of dentine during root filling removal. Moreover, the specific flute design and rotary motion of the ProTaper Universal retreatment instruments tend to pull thermoplastic GP into the file flutes and direct it towards the orifice. Furthermore, it is possible that the rotary movements of engine-driven files produce a certain degree of frictional heat which might plasticize GP. The plasticized GP would thus present less resistance and be easier to remove<sup>6</sup>.

However, the present study indicated that material could not be removed completely from the canal walls. This observation was consistent with those of the previous studies on retreatment efficacy in which various root filling materials and retreatment technique were used<sup>5,10</sup>. Nevertheless further clinical studies are necessary to confirm these results and evaluate their relevance to treatment outcome.

### Summary

- Rotary files are less effective in the apical third as compared to the H-files in the apical third.
- H-files are effective for the removal of gutta-percha condensed laterally than the thermoplastic gutta-percha.
- Rotary files are more effective for the removal of thermoplastic gutta-percha than the laterally condensed gutta-percha.
- Cleaner canals were obtained in the laterally condensed gutta-percha than the thermoplastisized gutta-percha.

### Conclusion

This *ex-vivo* study concludes that only SEM can reveal the GP/sealer remnants but not DDR. In clinical situations improved visibility of root canal walls either with dental operating microscope or precise radiographic methods can act an adjunct for viewing canal cleanliness which is important criterion for successful endodontic retreatment results.

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**Legends for table**

Table 1: Statistical conclusion of intergroup comparison based on eight tests

<b>Table 1</b>			
<b>TEST NO</b>	<b>P VALUE</b>	<b>RESULT</b>	<b>CONCLUSION</b>
1	0.0002 < .05	Null Hypothesis Rejected	Debris in Apical in G1A < G1B
2	0.0072 < .05	Null Hypothesis Rejected	Debris in Middle in G1A < G1B
3	0.2431 > .05	Null Hypothesis Accepted	Debris in Coronal in G1A = G1B
4	0.0258 < .05	Null Hypothesis Rejected	Debris in Apical in G2A > G2B
5	0.0272 < .05	Null Hypothesis Rejected	Debris in Middle in G2A > G2B
6	0.2582 > .05	Null Hypothesis Accepted	Debris in Coronal in G2A = G2B
7 a	0.0031 < .05	Null Hypothesis Rejected	Debris left under H-File G1A < G2A
7 b	0.0040 < .05	Null Hypothesis Rejected	Debris left under R-File G1B > G2B
8	0.4226 > .05	Null Hypothesis Accepted	Debris left in G1A = G1B