



## EFFECTIVENESS OF ROTATIONAL AND RECIPROCATING MOVEMENTS IN ROOT CANAL FILLING MATERIAL REMOVAL

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### **ABSTRACT**

**AIM:** The purpose of this study was to evaluate the effectiveness of ProTaper Universal Retreatment system using rotational motion and Wave One system using reciprocating motion in the removal of root canal filling material.

**MATERIAL & METHODOLOGY:** A total of 90 extracted single rooted mandibular premolars were decoronated which were then instrumented with ProTaper Universal System and later obturated using lateral condensation with AH Plus sealer. The teeth were randomly distributed into two groups of 45 teeth in each group. Filling material was removed after 7 days using ProTaper Universal Retreatment System and Wave One System. The samples were split longitudinally and pictures were captured under stereomicroscope followed by analysis for remaining material using software AutoCAD. Total time for the removal of material was also recorded.

**RESULTS:** Study demonstrated significant difference between two groups. Both the systems left residual debris in the canal. But Wave One System had lesser amount of remaining debris and also took lesser time for retreatment when compared to ProTaper Universal System.

**KEYWORDS:** Retreatment, Reciprocating Motion, Continuous Rotational Motion, Wave One File, Protaper Universal Retreatment File

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## **INTRODUCTION**

The main goal of endodontic treatment is to reduce the amount of bacteria responsible for apical periodontitis.<sup>1</sup>The continuous presence of microbial infection is the main cause of root canal failure.<sup>2</sup> These failures can be managed either by non-surgical or surgical methods.<sup>3</sup>The first line of approach is non-surgical treatment with success rate ranging to 83% when evaluated over a period of 4-6 years.<sup>4,5</sup>The non-surgical procedures involve the removal of previous filling material followed by disinfection and obturation of the canal that will provide a sterile environment viable for healing to take place.<sup>6</sup>Traditionally, the non-surgical treatment was carried out with hand files with or without solvent, which proved to be very tedious and time consuming process.<sup>2</sup>To overcome this, various advancements were made which led to development of rotary NiTi instruments and various reciprocating system.

The purpose of this study was to compare the effectiveness of rotational and rotational and reciprocating movements in the removal of root canal filling material for retreatment.

## **MATERIALS AND METHODS**

This study was carried out at the Department of Conservative Dentistry and Endodontics, Bhojia Dental College, Bhud, Baddi, Himachal Pradesh. Study sample constituted 90 extracted mandibular premolar teeth with single straight canals. Teeth with no evidence of root resorption were included in the study whereas teeth with open apices and previous endodontic treatment were excluded. External debris was removed using ultrasonic scaler. Teeth were decoronated using stainless steel disc for standardization at 14mm root length from apex as measured by Vernier calliper.

After determining working length using size#15, cleaning and shaping was performed with Pro Taper Universal System with sequence SX, S1, S2, F1, F2, F3 using X-Smart Plus Endomotor. Irrigation protocol was followed with 17% EDTA, 2.5% sodium hypochlorite and normal saline. Canals were dried with paper points and obturation was done using lateral condensation technique with F3 cone and AH Plus sealer. Afterwards teeth were stored at 37 C in 100% humidity for 7 days. Then these samples were randomly distributed into two groups.

### Group 1 (ProTaper Universal Retreatment Files)

This group received the retreatment by ProTaper Universal D1, D2, D3 retreatment system in crown down technique. The D1 (size 30, 0.09 taper) file was used at a rotational speed of 500 rpm in the cervical third. The D2 (size 25, 0.08 taper) file at 400rpm in middle third and D3 (size 20, 0.07 taper) file was used at a rotational speed of 400 rpm and until the working length was reached and no more gutta-percha could be seen on the last instrument used.

### Group 2 (Wave One File)

Root filling material was removed with Wave One File (size 40, 0.08 taper) with reciprocating motion was used with Wave One motion program of the Endo Motor X-Smart Plus in the slow in-and-out pecking motions and a brushing action till working length was reached, and no more gutta-percha could be seen on the last instrument used.

The samples were evaluated for assessment of Gutta-Percha removal after sectioning teeth buccolingually with stainless steel disc and time taken for the procedure using stop watch.

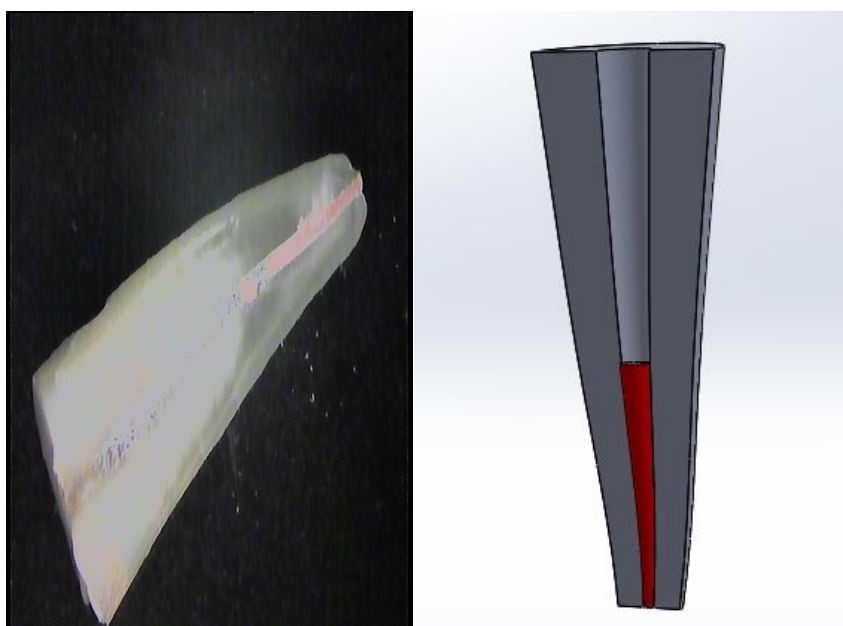
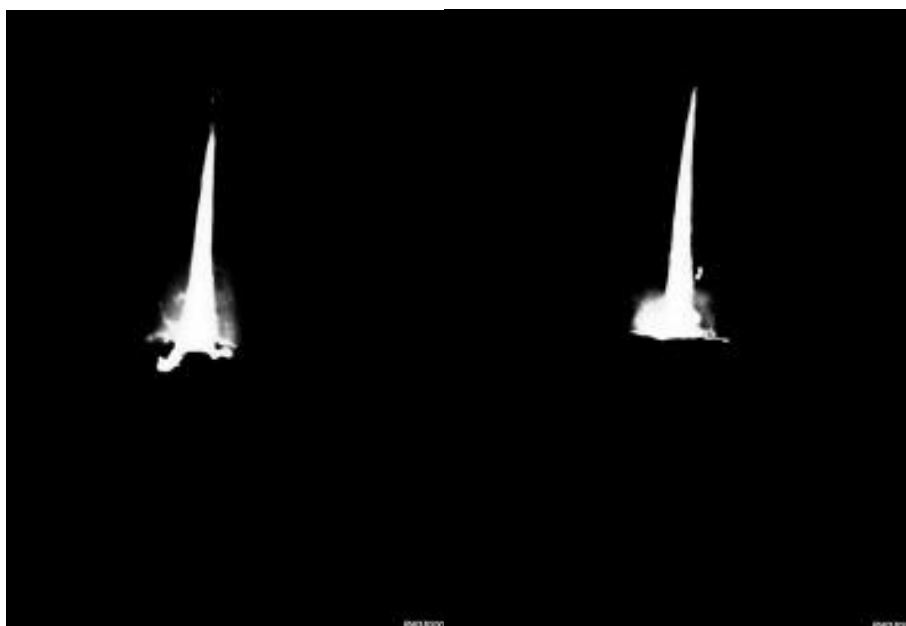
### **Evaluation Methods**

#### ***Assessment of Gutta-percha removal***

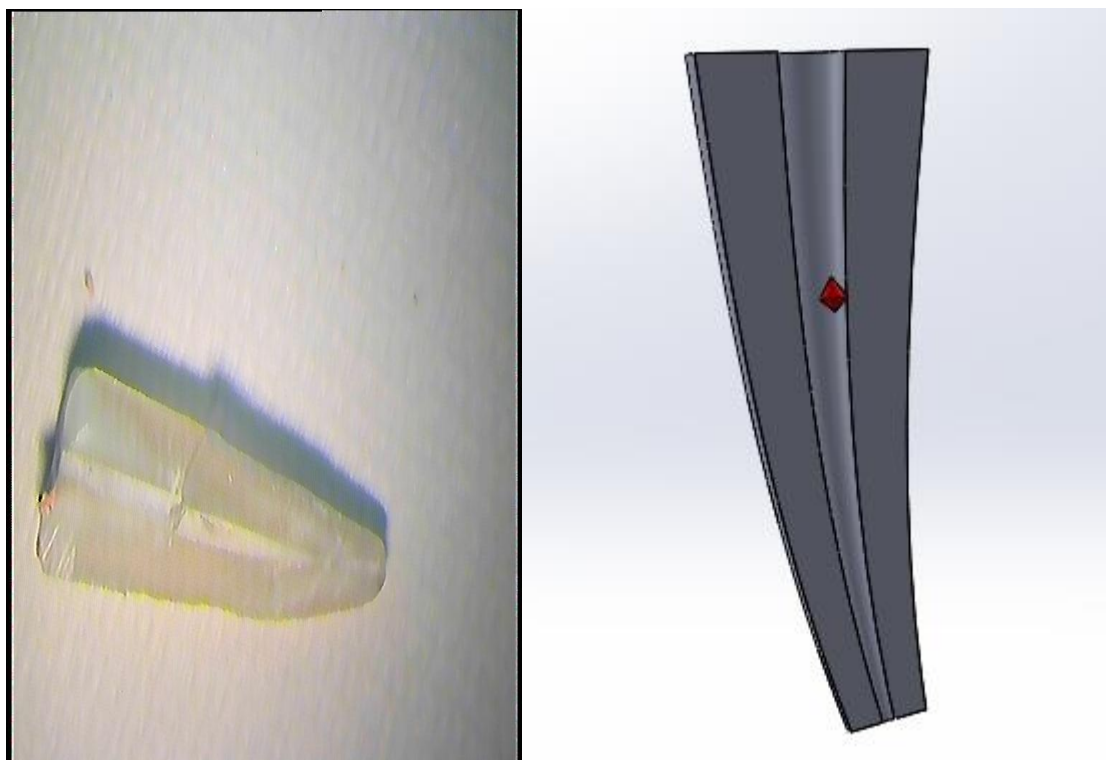
Digital images were obtained from both halves using stereomicroscope. On these images, the remaining filling material was calculated as a percentage using AutoCAD computer software.

#### ***Assessment of time***

Total time required to remove the root canal filling was measured from start of procedure till a clean file was seen with naked eye.



**Group 1(Stereomicroscope & AutoCAD images)**



Group 2(Stereomicroscope & AutoCAD images)

## RESULTS

Data were calculated in tabulated form and were subjected to statistical analysis.

### Time analysis

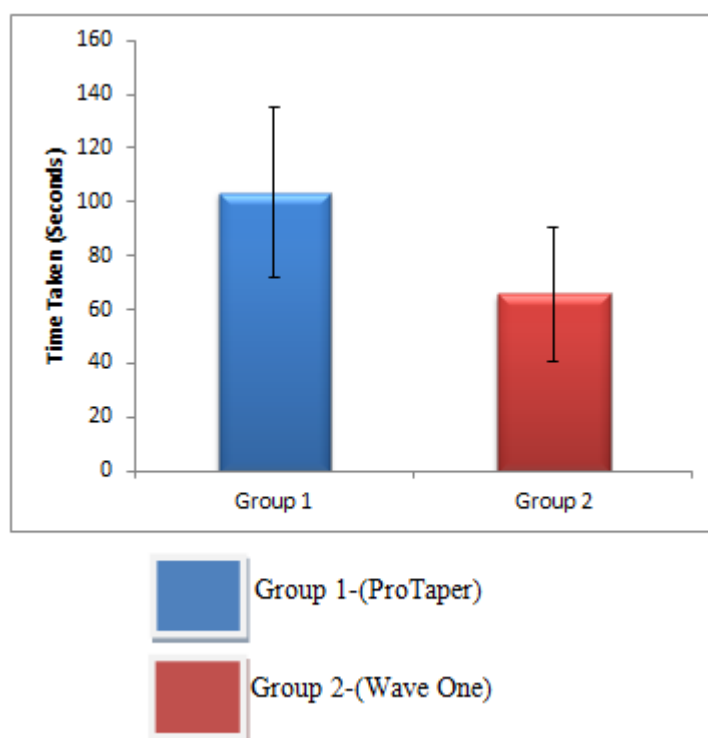
T –test was used to compare the values for the time taken by two groups for removal of filling material from the root canal. Mean for Group 1 was 103.52+31.84 whereas mean for Group 2 was 65.65+24.95 with p value <0.001 (highly significant). [Table1, 2& Graph 1]

**Table 1: Time taken by groups for retreatment in seconds**  
T-Test

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
<b>Time Taken</b>	1	45	103.5217	31.84461	6.64006
	2	45	65.6522	24.95743	5.20398

**Table 2: Independent Samples Test**

	t-test for Equality of Means					
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
<b>Time Taken</b>	4.489	<.001**	-37.86957	8.43634	-54.87189	-20.86724



Graph 1: Time taken for retreatment by different retreatment techniques

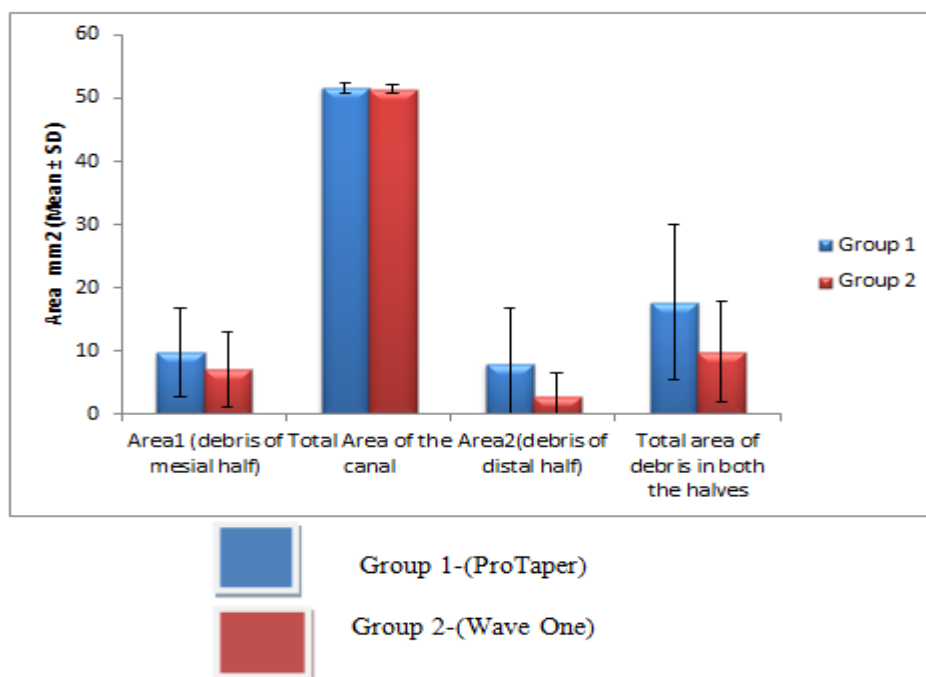
### Analysis for percentage of remaining debris for every third

Mean and standard deviation was estimated for each group for total residue filling material as calculated by AutoCAD Software (Table 3& Graph 2). Group 2 had lesser amount of remaining debris with mean value 9.88+7.91 as compared to Group 1 with higher amount of remaining debris in which mean came out to be 17.69+12.20. In present study, T-test showed significant difference between the two groups with p value=0.018. (Table 4)

**Table 3: T-test for remaining material in the canal**

**T-Test**

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
<b>Area1(debris of mesial half-mm<sup>2</sup>)</b>	1	45	9.7611	7.05404	1.47087
	2	45	7.1209	5.98340	1.24763
<b>Total Area of the canal</b>	1	45	51.6657	.82528	.17208
	2	45	51.3839	.65838	.13728
<b>Area2(debris of distal half-mm<sup>2</sup>)</b>	1	45	7.9348	8.83548	1.84233
	2	45	2.8936	3.79432	.80895
<b>Total area of debris in both the halves(mm<sup>2</sup>)</b>	1	45	17.6959	12.20804	2.54555
	2	45	9.8887	7.91571	1.65054



Graph 2- Remaining debris in different groups

Table 4: Independent Samples Test

	t-test for Equality of Means					
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
<b>Total area of debris in both the halves(mm<sup>2</sup>)</b>	2.471	.018*	7.65951	3.09990	1.40796	13.91105

## DISCUSSION

One of the primary goal of endodontic treatment is complete bio-mechanical preparation followed by three dimensional obturation of all the portals of root canal system so as to prevent endodontic re-infection.<sup>8</sup> The success rate of endodontic treatment ranges from 86%- 98% but sometimes failures occur due to various biological and technical factors like coronal leakage, inadequately filled canals, over and under filling etc.<sup>9,10</sup> These factors contribute to the persistence of micro-organisms and their by-products within the root canal system which lead to occurrence of peri-radicular lesions.<sup>11</sup>

These lesions can be treated either by non-surgical approach or by surgical intervention and the extraction of the offending tooth.<sup>12</sup> Among these, non-surgical retreatment is the most preferred as it re-establishes the health of peri-radicular tissues and is also most conservative.<sup>13</sup> Non-surgical retreatment involves regaining the access to canal intricacies and apical foramen by complete removal of pre- existing filling material followed by complete debridement, thorough disinfection and three- dimensional obturation of the root canal system.<sup>14,15</sup> According to various studies, it has shown success rate of 50-90%.<sup>16</sup> Various instruments and techniques have been developed for removing obturating material which includes hand instruments, ultrasonic instruments, rotary Ni-Ti instruments.<sup>14</sup> These instruments can be used with or without solvents to soften gutta-percha.

Earlier conventional hand files were used which was time consuming procedure and caused patient as well as operator fatigue.<sup>17</sup> Continuous research for safe and efficient systems lead to the development of newer systems for re-treatment such as rotary Ni-Ti instruments. Advancements were also made in the motion of the instrument for efficient and fast removal of filling material such as continuous rotational motion and reciprocating motion.<sup>18</sup>

In the present study, extracted teeth were measured with the help of Vernier caliperdecoronation using diamond disc at 14mm from root apex to establish standardization. Cleaning and shaping was done using Pro Taper universal system till # F3. Teeth were obturated with cold lateral condensation technique using AH-Plus sealer (Dentsply Mallifer Ballaigues, Switzerland) to obtain three dimensional hermetic seal. AH

Plus sealer is a resin based sealer which binds to the tooth structure, shows low shrinkage during setting and has long term stability.

Teeth were incubated and stored in 100% moisture at 37<sup>0</sup> for one week in 100% humidity so as to simulate conditions as in oral cavity. Also it allowed complete setting of sealer.

In the present study, solvent was not used in retreatment procedure as it forms layer of softened gutta percha on dentin thus hampering antimicrobial action of irrigants or intracanal medicaments. It also has adverse effects on bond strength of resin based sealer. Retreatment was done using two different file systems i.e. ProTaper (Dentsply Mallifer Ballaigues, Switzerland) and WaveOne retreatment files (Dentsply Mallifer Ballaigues, Switzerland) for removing obturating materials from the canals.

In recent times, new ProTaper rotary retreatment files (Dentsply Mallifer Ballaigues, Switzerland) have been introduced. Retreatment series of protaper universal system constitute 3 files (D1, D2 and D3) with a convex cross-section and has an active tip which aids in initial entrance into obturating material during its removal. It has larger cross-sectional areas and shallower pitches. These properties may increase the resistance to root canal walls during gutta-percha removal and may account for higher incidence of residual filling material. D3 ProTaper file has tip size of 20 and 7% taper which is smaller than the preparation size i.e. ProTaper F3 file #30 with 9% taper due to which D3 file is not able engage with canal walls thus leaving more residual material.

Recently, a new technique using reciprocating motion has been used for endodontic retreatment which relieves stress on the instrument by using special counter-clockwise (cutting action) and clockwise (release of the instrument) movements. It results in extended durability of the NiTi rotary instrument and increased resistance to fatigue as compared with the continuous rotation motion. WaveOne (Dentsply Mallifer Ballaigues, Switzerland) is one of the available reciprocating systems. It is a single file system that alternates different degrees of counterclockwise (CCW) and clockwise (CW) rotation movements, allowing the file to rotate 360° after performing 3 reciprocating movements. The reciprocating motion, together with the marked taper of Wave One files (Dentsply Mallifer Ballaigues, Switzerland), creates a greater contact area between the instrument and the gutta-percha thus allowing efficient removal of root canal filling material as that produced by full-sequence rotary systems.

Study conducted by D. Helvacioğlu-Yigit et al<sup>19</sup> compared efficacy of reciprocating (WaveOne System) and rotary systems (ProTaper Universal Retreatment system) for removing root canal filling material and found none of the mentioned techniques i.e reciprocating and rotary systems could completely remove obturating materials from the canals and no significant difference was found in terms of time as well as efficacy in retreatment. But in his study, they used solvent (Eucalyptol oil) prior to retreatment which aided in removal of gutta-percha. So we cannot assess the efficiency alone.

In another study by Emmanuel et al<sup>20</sup> showed no significant difference in efficacy of two systems used for retreatment i.e. between rotational movements of ProTaper Universal Retreatment System and reciprocating movements of Wave One system. The reason for this may be that they used ProTaper F4 file to completely remove the gutta-percha to match the tip of WaveOne file used.

The results of the present study concluded that both the instrumentation techniques removed root canal filling materials from the root canals. But Wave one system (Dentsply Mallifer Ballaigues, Switzerland) using reciprocating motion was more efficient in removal of root canal filling material during endodontic retreatment as compared to ProTaper universal retreatment system using continuous rotational motion.



Also wave one takes lesser time for removal because it is single file system and time to change instrument is saved.

The result of our study corresponds to study done by Zuolo et al.<sup>21</sup> The author compared the efficacy of reciprocating motion and continuous rotational system with hand files for removal of filling material and found continuous rotary system was not as effective as reciprocating system.

Another study done by Patricia et al.<sup>22</sup> compared the efficacy of reciprocating and continuous rotary Ni-Ti instruments for retreatment procedure and concluded that wave one system using reciprocating system to be faster procedure for retreatment than ProTaper universal Retreatment system using rotational motion

Limitations of this study:

- This was an in vitro study, thus the results of this study cannot be applied directly to the clinical situations.
- Apical extrusion was not taken into account, which is an important criterion.
- Study was conducted using straight root canals so conclusion of this study cannot be directly applied to all the teeth or the teeth with curvatures.
- No solvent was used during retreatment which may alter the results i.e. amount of remaining debris as well as the treatment time. Thus the results of this study cannot be correlated to the situations using solvents during retreatment procedure.

## **CONCLUSION**

Under the conditions of our in vitro study the use of Protaper universal retreatment system was time consuming than wave one system and did not show better results in regard to remaining debris. Wave one system proved to be faster and also yielded better cleanliness in all the thirds though both the systems left the residual debris in the canal especially in the apical third.

## **REFERENCES**

1. **S. Burklein, K. Hinschitza, T. Dammaschke & E. Schafer** Shaping ability and cleaning effectiveness of two single-file systems in severely curved root canals of extracted teeth: Reciproc and WaveOne versus Mtwo and ProTaper. *Int Endod J* 2012, 45, 449–461
2. **T. Rodig, T. Hausdorfer, F. Konietschke.** Efficacy of D-RaCe and ProTaper Universal Retreatment NiTi instruments and hand files in removing gutta-percha from curved root canals– a micro-computed tomography study. *Int Endod J* 2012; 45:580-588
3. **T. Tasdemir, K. Er, T. Yildirim& D. Celik.** Efficacy of three rotary NiTi instruments in removing gutta-percha from root canals. *Int Endod J* 2008 41, 191–196
4. **Mohammad Hammad, Alison Qualtrough, Nick Silikas.** Three –dimensional evaluation of effectiveness of hand and rotary instrumentation for retreatment of canals filled with different materials. *J Endod* 2008; 34:1370-1373

5. **Caroline Zanesco, Roberta Garcia Prestes, Ronise Ferreira Dotto.** Effectiveness of ProTaper Universal and D-RaCe retreatment files in the removal of root canal filling material: an in vitro study using digital subtraction radiography. *Stomatos* 2014; 20:39,42-50
6. **L.-S. Gu, J.-Q Ling, X. Wei & X.-Y. Huang.** Efficacy of ProTaper Universal rotary retreatment system for gutta-percha removal from root canals. *Int Endod J* 2007; 41:288-295
7. **Paulo Roberto Zanettini, Fernando Branco Barletta, and Nicole de Mello Rahde.** In vitro comparison of different reciprocating systems used during endodontic retreatment. *Aust Endod J* 2008; 34: 80–85
8. **Trope M.** The Vital Tooth-Its Importance In The Study And Practice Of Endodontics. *Endod Topics* 2003; 5:1
9. **Roda SR, Gettleman BH.** Non-surgical retreatment In: *Pathways of the pulp* 10<sup>th</sup> ed. Cohen S Hargreaves KM
10. **Zeliha Yilmaz, Senem Pinar Karapinar&BaharOzcelik.** Efficacy of rotary Ni-Ti retreatment systems in root canals filled with a new warm vertical compaction technique. *Dental Materials Journal* 2011; 30(6): 948–953
11. **A. Mollo, G. Botti, N. Principi Goldoni, E. Randellini.** Efficacy of two Ni-Ti systems and hand files for removing gutta-percha from root canals. *Int Endod J* 2012,, 45, 1–6
12. **Raju Chauhan, AP Tikku and Anil Chandra.** Detection of residual obturation material after root canal retreatment with three different techniques using a dental operating microscope and a stereomicroscope. *J Conserv Dent* 2012; 15(3)218-222.
13. **Jörg F. Schirrmeister, Karl-Thomas Wrbas, Katharina M. Meyer.** Efficacy of Different Rotary Instruments for Gutta-Percha Removal in Root Canal Retreatment. (*J Endod* 2006;32:469 –472)
14. **Pooja Ialait, Navneet Godara, K Ravi Varma.** Evaluation of efficiency of three NiTi instruments in removing gutta-percha from root canal during retreatment- An in vitro study
15. **Iriboz Eand SazakOvecoglu H.** Comparison of ProTaper and Mtwo retreatment systems in the removal of resin-based root canal obturation materials during retreatment. *Aust Endod J* 2014; 40: 6-11
16. **Chiara Pirani, Gian Andrea Pelliccioni, Silvia Marchionni.** Effectiveness of Three Different Retreatment Techniques in Canals Filled With Compacted Gutta-Percha or Thermafil: A Scanning Electron Microscope Study. *J Endod* 2009;35:1433–1440
17. **R. Gergi& C. Sabbagh** Effectiveness of two nickel-titanium rotary instruments and hand file for removing gutta-percha in severely curved root canals during retreatment: an ex vivo study. *Int Endod J* 2010; 40:532-537
18. **Paulo Roberto Zanettini, Fernando Branco Barletta, and Nicole de Mello Rahde:** In vitro comparison of different reciprocating systems used during endodontic retreatment. *Aust Endod J* 2008; 34: 80–85
19. **Helvacioglu-Yigit D, Yilmaz A, Kiziltas-Sendur G, Aslan OS, Abbott PV.** Efficacy of Reciprocating and Rotary Systems for Removing Root Filling Material: A Micro-Computed Tomography Study. *Scanning Microsc.*2014;1-6
20. **Emmanuel, Nayra, Daniel.** Effectiveness of rotatory and reciprocating movements in root canal filling material removal. *Braz. Oral res* 2015;29:1-8
21. **A. S. Zuolo, J. E. Mello Jr, R. S. Cunha.** Efficacy of reciprocating and rotary techniques for removing filling material during root canal retreatment. . *Int Endod J* 2013; 46: 947-953

22. **Patricia Fonseca de Souza, Leonardo Cantanhede Oliveira Goncalves, Andre Augusto Franco Marques.** Root canal retreatment using reciprocating and continuous rotary Ni-Ti Instruments. *Eur J Dent* 2015; 9(2):234-239