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EFFICACY OF NON-SURGICAL RETREATMENT WITH AND WITHOUT USING ULTRASONICS AND DENTAL MICROSCOPE

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ABSTRACT:

Introduction: Nonsurgical retreatment is often the first choice to address endodontic failure. The aim of this study was to compare the effectiveness of two techniques (hand files and rotary protaper universal) for removing gutta-percha and sealer from root canals, with and without using clinical microscope and ultrasonics.

Materials and Methods: Forty single straight rooted, extracted human mandibular premolars were prepared, filled with gutta-percha and sealer (Zinc oxide with eugenol). Specimens were then divided into four groups (n =10), and root filling material was removed using H-files with Eucaliptol (group 1); H-files with Eucaliptol, followed by microscope with ultrasonic tip (group 2); Rotary Universal Protaper system with Eucaliptol (group 3); Rotary Universal Protaper system with Eucaliptol followed by microscope with ultrasonic tip (group4). After retreatment, the efficacy of each technique was examined at 8× magnification in a stereomicroscope then the images were analysed using AutoCAD 2010 according to Hulsmann and Stotz scale. Data were statistically analysed using Kruskal–Wallis and Mann–Whitney U-tests.

Results: There was a significant difference when using clinical microscope ($p<0.05$), when considering the root canal in its entirety. And when dividing it to three thirds, there was a significant difference, between group 1 and 2 in the cervical third. And between 3 and 4 in the medial third, but there wasn't a statistically significant difference between groups in the apical third.

Conclusions: The use of the dental operating microscope and ultrasonic tips removed the filling material from root canal walls better, but all examined teeth, in both groups, had remaining filling material on canal walls.

Keywords: microscope, retreatment, ultrasonic

INTRODUCTION:

Persistent or secondary intraradicular infection is a major cause of endodontic failures. [1,2]

There are many causes for “failure” of initial endodontic therapy that have been described in the endodontic literature. These include iatrogenic procedural errors such as poor access cavity design, untreated canals (both major and accessory), canals that are poorly cleaned and obturated, complications of instrumentation (ledges, perforations, or separated instruments), and overextensions of root filling materials. Coronal leakage has also been blamed for post-treatment disease,

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as has persistent intracanal and extracanal infection and radicular cysts [3].

Endodontic therapy failure presents clinically through signs and symptoms such as pain to percussion, thermal sensitivity, recurrent abscesses, fistulas, and radiographically visible periapical lesions [4,5,6,7].

The most commonly used root canal filling material is gutta-percha in conjunction with a sealer. The proper removal of these materials from inadequately prepared and filled canals is the major part of most root canal retreatments [8].

Developments in technology help attaining high levels of tooth retention. The dental operating microscope, nickel-titanium instruments, apex locators, enhanced irrigation protocols using ultrasonics are examples of improvements that allow clinicians to predictably manage a greater range of treatment and retreatment options [9].

Many techniques have been employed for removing root filling materials, including stainless steel hand files [10,11], solvents [12,13] and/or ultrasonics [14,15], and nickel-titanium (NiTi) rotary systems [16,17].

The ProTaper Universal system which includes three retreatment instruments (D1, D2 and D3) designed for removing filling materials from root canals. They have various tapers and diameters at the tip, which are size 30, 0.09 taper, size 25, 0.08 taper and size 20, 0.07 taper. The full lengths of these retreatment files are 16 mm for D1, 18 mm for D2 and 22 mm for D3. D1, D2 and D3 are recommended to remove filling materials from the coronal, middle and apical portions of canals respectively [17].

Ultrasonic instrumentation has become an essential technology for removal of metallic obstructions within the root canal space, such as post removal for retreatment and separated instrument retrievals [18].

Qualitative improvement of ultrasonic units and the increased availability of new tips goes hand in hand with the developments of endodontic techniques [19].

In recent years, predictability of surgical and nonsurgical endodontic procedures has benefited from coaxial lighting and improved optics for magnification provided by the clinical operating microscope used together with specially designed ultrasonic tips. Protocols using both devices have been proposed for endodontic retreatment cases, because clarity and details of the observed field can improve precision during gutta-percha removal [20,21,22].

The advent of nonsurgical ultrasonic tips has opened up a new horizon in endodontic treatment.

Despite the positive impact and spreading enthusiasm for this new technology, there are only a few laboratory and clinical studies reported

in the literature. Therefore, to objectively assess the efficacy of this new protocol, the present study compared the effectiveness of gutta-percha and sealer removal from endodontically treated extracted human teeth with and without the aid of a clinical operating microscope and ultrasonic instruments. The main purpose of this study was to determine the best removal technique based on material left on root canals.

MATERIALS AND METHODS:

Specimen preparation:

Forty single straight rooted, extracted human mandibular premolars were selected and stored in saline before use. Teeth were radiographed at two directions buccal-lingual and mesial-distal to assure that the canals are straight (less than 15°). To avoid anatomical variation and to standardize the measurements in this study, the teeth were decoronated to a standardized root length of 14 mm. The working length was determined visually 1 mm short of the apical foramen with K-file 10# (MANI,INC,Japan).

Canal preparation:

The coronal third of the root canal was flared with Gates Glidden #3, #4 (MANI,INC,Japan). The root canals were instrumented using K-files in the traditional technique to the size of 40. Root canals were irrigated between each two instruments with 5mL of 2.5% NaOCl solution. After root canal preparation, the canals were irrigated with 2mL of 17% EDTA (META Biome Co Lid, Korea) for 1 minute and then finally rinsed with 5mL of saline solution. Canals were dried with paper points.

Root canal obturation:

A zinc oxide– eugenol– based sealer (Kemdent,LTD,UK) was mixed according to manufacturer's instructions until it reached a thick consistency. A size 40 master gutta-percha cone (META Biome Co Lid, Korea) and root canal sealer was placed in the canal. Lateral condensation was accomplished using finger spreaders and gutta-percha accessory points with sealer until the canal was completely filled. The obturation was judged to be complete when a spreader could not penetrate more than 3 mm into the gutta-percha mass. A heated instrument was used to cut the gutta-percha off at the entrance of the canal.

Teeth were radiographed to confirm quality control of root filling. Accesses were sealed with temporary filling material (META Biome Co Lid, Korea), and teeth stored under 100% humidity at 37°C for 30 days to allow the root canal filling to set completely.

Then, the teeth were randomly divided into four groups (n=10).

Group 1 (n1=10): **Retreatment with H-files with Eucaliptol:**

Eucaliptol (0.5 mL per tooth) and Gates Glidden drills (#4) were used to remove coronal third of the root canal material and create a reservoir for the solvent. 0.1mL eucaliptol (Maquira , LTD, Brasil)

was introduced into the root canal to soften the gutta-percha. The root canals were reinstrumented to the original working length with H-files in a reaming motion until the root canal walls became smooth and there was no evidence of gutta-percha/ sealer on the instruments.

Group 2 (n2=10): **Retreatment with H-files with Eucaliptol, followed by microscope with ultrasonic tip:**

After following the same steps in group1. Each tooth was observed with the aid of a clinical operating microscope (DENTA 300/ Mueller-Wedel,Germany) using coaxial illumination and X8 magnification and xenon illumination of 35 Watt. Canals were inspected for gutta-percha/sealer remnants by the microscope. When debris was detected, a smooth ultrasonic tip, Ni-Ti U-files (25#) attached to E2 ultrasound stainless-steal tip (Woodpecker Medial Instrument Co Ltd, China) which mounted on a hand piece powered by an ultrasonic unit was used to remove filling remnants without simultaneous irrigation.

Irrigation with 3 mL 2.5% sodium hypochlorite, 2 mL 17% aqueous EDTA solution () followed. Canals were dried with capillary tips (). The procedure was repeated until no gutta-percha/sealer debris could be seen in the canal walls. All procedures were done by the same operator.

Group 3 (n3=10): **Retreatment with Rotary Universal Protaper system with Eucaliptol:**

0.1mL eucalyptol (Maquira , LTD, Brasil) was introduced into the root canal to soften the gutta-percha. Rotary Universal Protaper system was used at a constant speed of 250 rpm according to manufacturer's instructions (Dentsply Maillefer, Switzerland).

Files were used to remove the filling material according to the manufactures' instructions as follows: D1 (16mm, Iso 030-9%) for the cervical third, D2 for the middle third (18mm, Iso 025-8%), and D3 (22mm, Iso 020-7%) for the apical third until the WL was reached.

Group 4 (n4=10) : **Retreatment with Rotary Universal Protaper system with Eucaliptol followed by microscope with ultrasonic tip:**

After following the same steps in group 3. Each tooth was observed with the aid of a clinical operating microscope (DENTA 300/ Mueller-Wedel,Germany) using coaxial illumination and X8 magnification and xenon illumination of 35 Watt.

Canals were inspected for gutta-percha/sealer remnants to the extent permitted by the microscope. When debris was detected, a smooth ultrasonic tip E2 (Woodpecker Medial Instrument Co Ltd, China), Ni-Ti U-files (25#) attached to E2 ultrasound stainless-steal tip (woodpecker Middle Instrument Co Ltd, China) which mounted on a hand piece powered by an ultrasonic unit was used to remove filling remnants without simultaneous irrigation.

With each file change, the root canal was irrigated with 2 mL of 5.25% NaOCl. At the end, 2 mL of 17% EDTA (META Biome Co Lid, Korea) were applied for 1 minute, followed by a final rinse with 5 mL of Saline. Eucalyptol sometimes was reused after irrigation.

Retreatment was completed when the working length was achieved and no more gutta-percha debris were on the instruments.

All procedures were done by the same operator.

Group	Removal Technique	No.specimens
1	H-files + eucalyptol	10
2	H-files + eucalyptol+ (microscope+ultrasonics)	10
3	PUR + eucalyptol	10
4	PUR + eucalyptol + (micrpscope+ ultrasonics)	10

Evaluation

Teeth were split longitudinally on the buccal and lingual surfaces using steel discs and examined at 8× magnification in a stereomicroscope, and photographed with a digital camera.

The specimens were scored for remaining root canal filling material using the

following scale, according to Hulsmann and Stotz [23]:

I No root canal filling material

II One to 3 small isles (< 2 mm²) of root canal filling material

III More than 3 small isles (< 2 mm²) of root canal filling material

IV One large piece (> 2 mm²) of root canal filling material

V Root canal filling material > 5 mm²

VI Several isles of root canal filling material, one of them> 2 mm²

Photos were analyzed with AutoCad 2010 software.

Statistical analyses were carried out using the Kruskal– Wallis and Mann–Whitney U test (SPSS statistical package, Version19, IBM Corporation 1, Armonk, NY, USA). Significance level was set at a = 0.05.

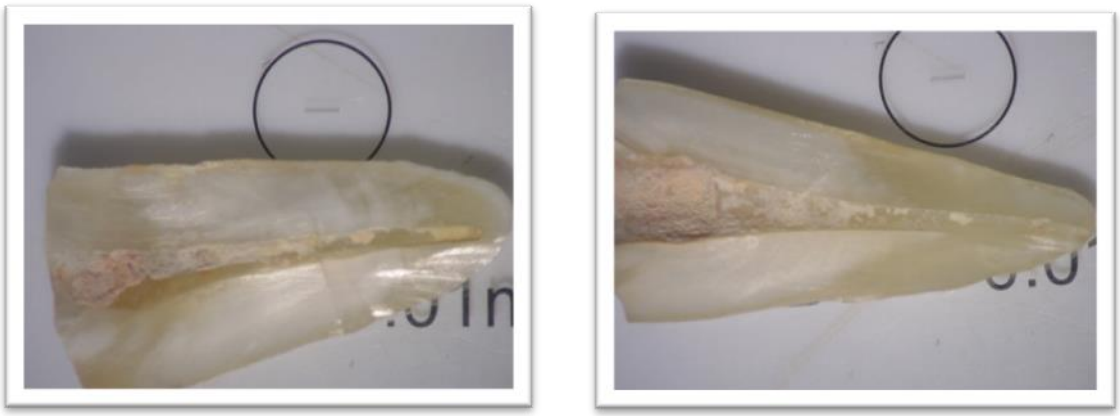

Figure 1: Example of group 1 and 3 from right to left

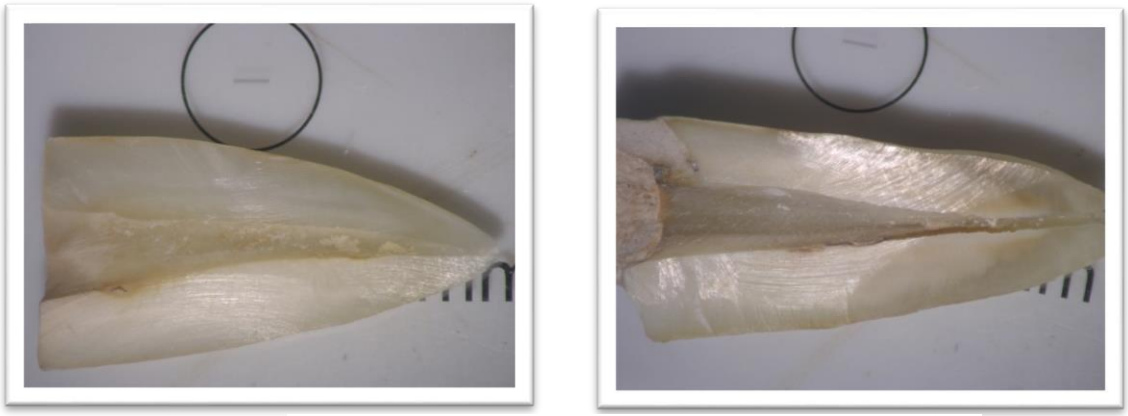

Figure 2: Example of group 2 and 4 from right to left

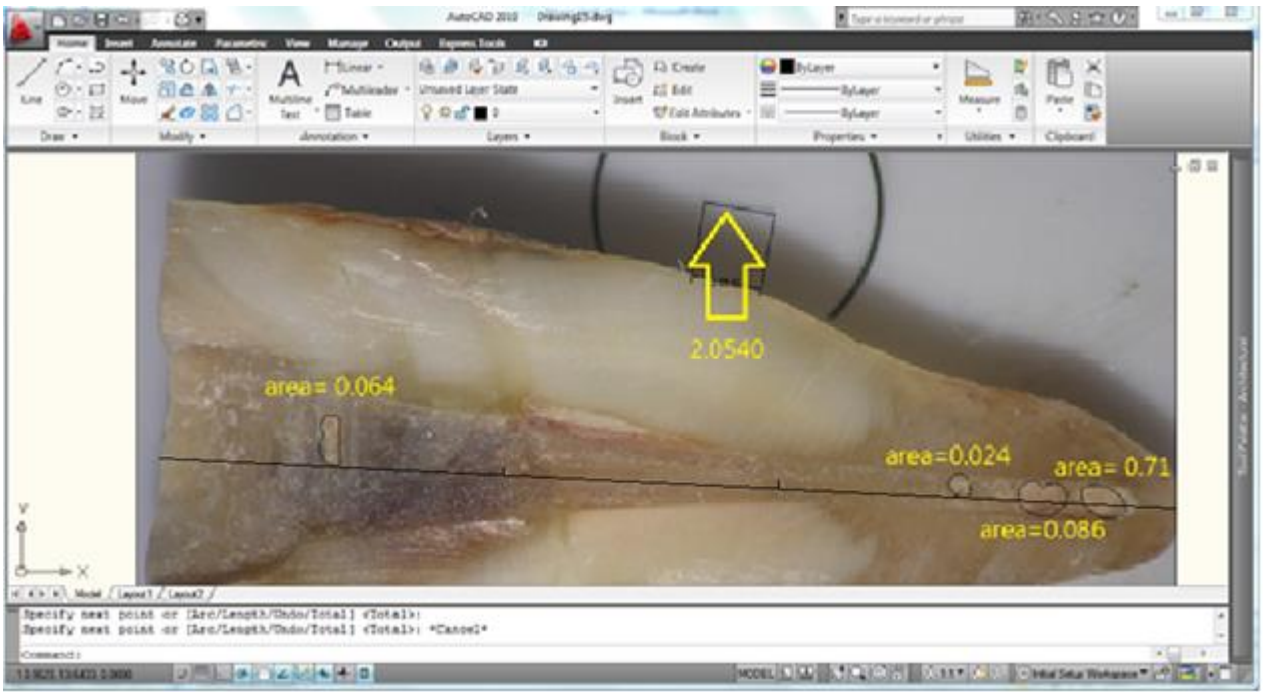

Figure 3: Analizing the photoes with AutoCad 2010

RESULTS:

Cleanliness of Root Canal Walls:

When considering the root canal in its entirety, Table 1 shows the root canal wall cleanliness scores for all groups.

Table 1: Results when considering the root canal in its entirety:

Group	Removal Technique	I	II	III	IV	V	
1	**H-files + eucalyptol**	_	1	4	_	_	5
2	**H-files + eucalyptol+ (microscope+ultrasonics)**	2	5	1	_	_	2
3	**PUR + eucalyptol**	_	1	2	_		7
4	**PUR + eucalyptol + (micrpscope+ ultrasonics)**	2	6	1	_	_	1

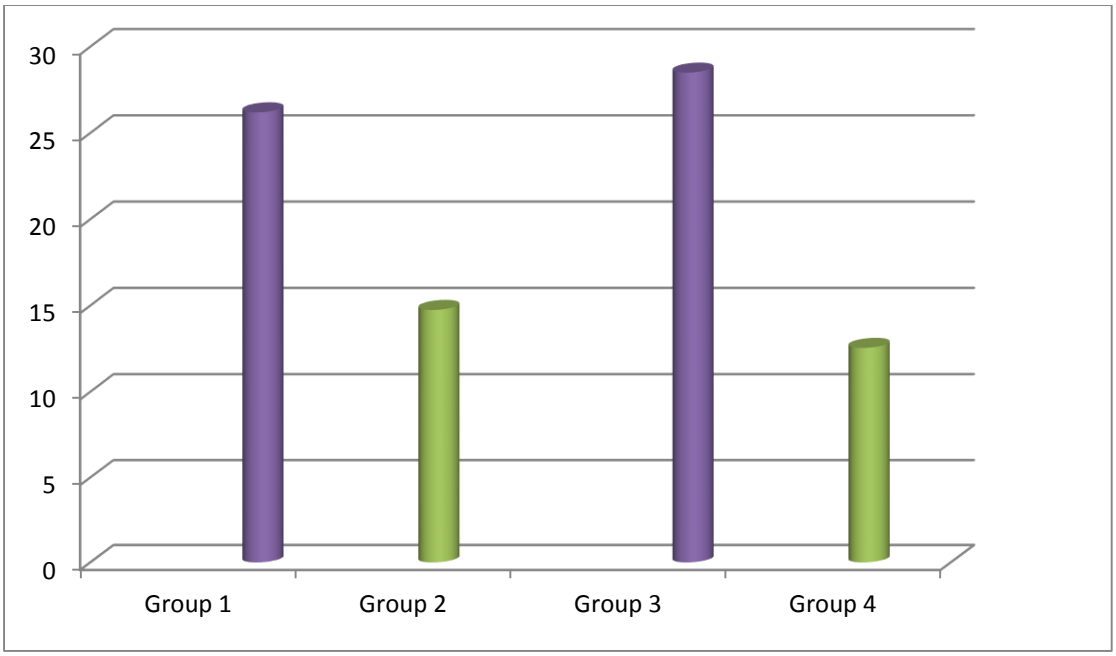

Chart 1: Mean ranks of results of derbies in the entire root canal of the four groups

When analyzing there was a statistically significant difference between the four groups.

There was a statistically significant difference between groups 1,3 and groups 2,4 ($p \leq 0.05$). Specimens retreated without using ultrasonics and microscope (groups 1, 3) retained significantly more obturation material than specimens retreated with ultrasonics and microscope (groups 2, 4) ($p \leq 0.05$). (Chart 1)

But when the canal walls are divided into three thirds (cervical, middle, Apical), table 2 shows the results.

Table 2: Results when dividing the root canals into three thirds:

Group	Thirds	I	II	III	IV	V	VI
1	Cervical	-	5	4	1	-	-
	Middle	2	3	3	2	-	-
	Apical	1	3	1	1	-	2
2	Cervical	8	1	1	-	-	2
	Middle	7	2	-	1	-	-
	Apical	2	4	2	1	-	1
3	Cervical	2	4	2	2	-	-
	Middle	1	2	4	3	-	-
	Apical	2	3	1	4	-	-
4	Cervical	8	2	-	-	-	-
	Middle	8	2	-	-	-	-
	Apical	2	7	-	1	-	-

There was a statistically significant difference between groups in the cervical and middle thirds, but the only statistically significant difference in the apical third was found between 3 and 4 groups.

Table 6 shows exactly where was the difference, between group 1 and 2 in the cervical third. And between 2 and 4, 3 and 4 in the middle third. But in the apical third the difference was statistically significant between 3 and 4.

When using ultrasonics and microscope the less remnants were at the cervical and middle thirds, when the apical third had the most remnants.

We found that there was no difference when removing gutta-percha with H-files (groups 1 and 3) or with ProTaper Universal Retreatment System (groups 2 and 4).

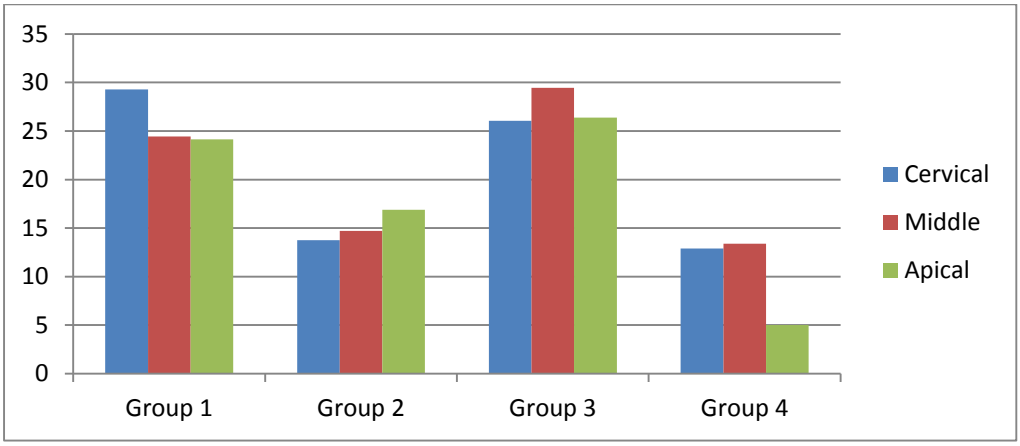

Chart 2: Mean ranks of results of remnants when dividing the root canals into three thirds

DISCUSSION:

Removal of gutta-percha and sealer from inadequately prepared root canals is a major part of most endodontic retreatments. It is important to remove as much filling material as possible to uncover remnants of necrotic tissue or bacteria which may be responsible for endodontic failure. [17,24]

But depending only on the dentist tactile sensation in the black hole of the canal is not satisfied enough to get it clean, therefor it was necessary to get light with a good magnification down there so details can be seen easily and problems can be solved with a high expectations, that's what microscope can do.

Visualization of the root canal under a microscope during retreatment increases the ability of the operator to remove remaining obturation material. [25]

It is important to remove as much filling material as possible to uncover remnants of necrotic tissue or bacteria which may be responsible for endodontic failure. Previous studies found that none of the retreatment techniques allowed complete removal of filling material [26,27,28,29].

Our results corroborate the clinical impression that benefits provided by intense coaxial lighting and magnification coupled with the use of ultrasonic tips can improve precision when removing filling debris from canal walls. Groups 2 and 4 in which this protocol was used, had significantly cleaner canal walls compared with the control groups 1 and 3, which did not make use of this new technology (Table I, 2).

Our results agreed with J. Junior et al 2009 who found a significant difference when using the ultrasonics with the aid of microscope in endodontic retreatment after removing gutta-percha and sealer from root canals using burs and solvents [14].

In contrast, Baldassari-Cruz and Wilcox 1999 founded that there was no significant difference when using the microscope to remove gutta-percha from the canals. Discrepancies between their study and our results may be attributed to the fact that they did not use an ultrasonic tip to remove the filling material remnants [30].

In similar to them Pirani et al concluded that using ultrasonics didn't improved the cleanliness of root canal walls, it maybe because they didn't use ultrasonics with microscope [15].

Schwerz et al found that ProTaper Universal Retreatment system promoted better cleansing compared with hand instrumentation. It maybe because they used microscope without using ultrasonics. But they agreed with our results when they found that apical third was less clean than the coronal and middle thirds [31].

We found no difference when removing gutta-percha with hand files or with ProTaper Universal Retreatment System,

and the most remnants was at the apical third, which agreed with Queiroz et at, Só MV. 2008, Gergi R & Sabbagh C 2007 and Schirrmeister et al 2006 [32,33,34,35].

But disagreed with Xu LL et al 2012, Hammad 2008 which they found that hand files promoted cleaner walls than ProTaper Universal Retreatment System [27,36].

And in the opposite Khalilak et al 2013 and GU. Et al 2008 Found that ProTaper Universal Retreatment System showed cleaner walls than hand files [17,37].

Root canal filling remnants was found in all groups in the three thirds. Other researches should be done to study the efficiency of operating microscope in roots with different shapes and diameters with different ultrasonic tips, also it is important to do further researches to evaluate this new technology clinically.

CONCLUSION:

We recommend using ultrasonics with the aid of microscope to remove the filling material from root canal walls in endodontic retreatments. Under the conditions of this *in vitro* study, specimens in all groups had remaining filling material on canal walls. But Using ultrasonics with the aid of microscope helped to get better cleaning of the canal walls.

REFERENCES:

1. Wong R. Conventional endodontic failure and retreatment. Dent Clin North Am 2004;48:265-89.
2. Siqueira JF Jr. Aetiology of root canal treatment failure: why well-treated teeth can fail. Int Endod J 2001;34:1-10.
3. Kenneth. M. Cohen S: Cohen's Pathways of the Pulp, Mosby, St. Louis, 10th edition Ch: 25, P: 890-891
4. Cunha RS, De Martin AS, Barros PP, Silva FM, Jacinto RC, Bueno CS. In vitro evaluation of the cleansing working time and analysis of the amount of gutta-percha or Resilon remnants in the root canal walls after instrumentation for endodontic retreatment. J Endod. 2007;33(12):1426-8.
5. Kvist T, Reit C. Results of endodontic retreatment: a randomized clinical study comparing surgical and nonsurgical procedures. J Endod. 1999;25(12):814-7.
6. Mickel AK, Chogle S, Liddle J, Huffaker K, Jones JJ. The role of apical size determination and enlargement in the reduction of intracanal bacteria. J Endod. 2007;33(1):21-3.
7. Zmener O, Pameijer CH, Banegas G. Effectiveness in cleaning oval-shaped root canals using Anatomic Endodontic Technology, ProFile and manual instrumentation: a scanning electron microscopic study. Int Endod J. 2005;38(6):356-63.
8. Kratchman SI. Obturation of the root canal system. Dent Clin North Am. 2004 Jan;48(1):203-15
9. ENDODONTICS: Colleagues for Excellence. Treatment Planning: Retention of the Natural Dentition

and the Replacement of Missing Teeth. American Association of Endodontists. Spring 2015
10. Bramante CM, Fidelis NS, Assumpção TS, Bernardineli N, Garcia RB, BRAMANTE AS, et al. Heat release, time required, and cleaning ability of MTwo R and ProTaper Universal retreatment systems in the removal of filling material. J Endod. 2010 Nov;36(1):1870-3.
11. Takahashi CM, Cunha RS, De Martin AS, Fontana CE, Silveira CFM, Bueno CES. In vitro evaluation of the effectiveness of ProTaper Universal rotary retreatment system for gutta-percha removal with or without a solvent. J Endod. 2009 Nov;35(11):1580-3.
12. Gomes, et al. Efficacy of gutta-percha solvents used in endodontic retreatments. RSBO. 2013 Oct-Dec;10(4):356-61
13. Ramzi, H. et al. Efficacy of Three Different Methods in the Retreatment of Root Canals Filled with Resilon/Epiphany SE. IEJ. Fall 2010; 5(4):161-166
14. Junior, et al. Retreatment Efficacy Of Gutta-Percha Removal Using A Clinical Microscope And Ultrasonic Instruments: Part I--An Ex Vivo Study. 2009 Jul;108(1):e59-62.
15. Pirani et al. Effectiveness Of Three Different Retreatment Techniques In Canals Filled With Compacted Gutta-Percha Or Thermafil: A Scanning Electron Microscope Study. J Endod. 2010 May;36(5):925.
16. Dadresanfar. B. et al. Efficacy of Two Rotary NiTi Instruments in Removal of Resilon/Epiphany Obturants. IEJ Iranian Endodontic Journal 2012;7(4):183-188
17. Gu LS, Ling JQ, Wei X, et al. Efficacy of ProTaper Universal rotary retreatment system for gutta-percha removal from root canals. Int Endod J 2008;41:288–95
18. Bindal D. Endodontic non-surgical retreatment techniques- A review :, India 2012;3(1):32-40
19. American Association of Endodontists and the AAE Foundation. Endodontics: Colleagues for Excellence. The Standard of Practice in Contemporary Endodontics. Fall 2014
20. Carr GB. Microscopes in endodontics. J Calif Dent Assoc 1992;20:55-61.
21. Castellucci A. Magnification in endodontics: the use of the operating microscope. Pract Proced Aesthet Dent 2003;15: 377-86.
22. Iqbal MK. Nonsurgical endodontic instruments. Dent Clin North Am 2004;48:19-34.
23. Hülsmann M, Stotz S. Efficacy, cleaning ability and safety of different devices for gutta-percha removal in root canal retreatment. Int Endod J 1997;30(4):227–33.
24. Mollo A, Botti G, Prinicipi Goldoni N, et al. Efficacy of two Ni-Ti systems and hand files for removing gutta-percha from root canals. IntEndod J 2012;45:1–6
25. Chauhan R. et al. Detection of residual obturation material after root canal retreatment with three different techniques using a dental operating microscope and a stereomicroscope: An in vitro comparative evaluation. J Conserv Dent. 2012 Jul-Sep; 15(3): 218–222.
26. Silva, E. et al. Effectiveness of rotatory and reciprocating movements in root canalfilling

material removal. Braz Oral Res. 2015;29(1):1-6
27. Xu LL, Zhang L, Zhou XD,Wang R, Deng YH, Huang DM. Residual filling material in dentinal tubules after gutta-percha removal observed with scanning electron microscopy. J Endod. 2012 Mar;38(3):293-6
28. Rios MA, Villela AM, Cunha RS, Velasco RC, De Martin AS, Kato AS, et al. Efficacy of 2 reciprocating systems compared with a rotary retreatment system for gutta-percha removal. JEndod. 2014 Apr;40(4):543-6
29. Zuolo AS, Mello Junior JE, Cunha RS, Zuolo ML, Bueno CE. Efficacy of reciprocating and rotary techniques for removing filling material during root canal retreatment. IntEndod J.2013. Oct;46(10):947-53
30. Baldassari-Cruz LA, Wilcox LR. Effectiveness Of Gutta-Percharemoval With And Without The Microscope. J Endod 1999;25:627-8.
31. Schwerz, L. et. al. Comparison of the effectiveness of the protaper system versus hand instrumentation in endodontic retreatment: a scanning electron microscopy study. RSBO. 2012 Oct-Dec;9(4):368-74
32. Queiróz, MLP. et al. Analysis of two different endodontic desobturation techniques through clearing teeth technique. RSBO. 2012 Jan-Mar;9(1):44-9
33. Só MV. et al. Efficacy of ProTaper retreatment system in root canals filled with gutta-percha and two endodontic sealers. J Endod. 2008 Oct;34(10):1223-5
34. Gergi R, Sabbagh C. Effectiveness of two nickel-titanium rotary instruments and a hand file for removing gutta-percha in severely curved root canals during retreatment: an ex vivo study. IntEndod J. 2007 Jul;40(7):532-7
35. Schirrmeister JF, Wrbas KT, Meyer KM, Altenburger MJ, Hellwig E. Efficacy of different rotary instruments for gutta-percha removal in root canal retreatment. J Endod. 2006 May;32(5):469-72
36. Hammad M, Qualtrough A, Silikas N. Three-dimensional evaluation of effectiveness of hand and rotary instrumentation for retreatment of canals filled with different materials. J Endod. 2008 Nov;34(11):1370-3
37. Khalilak Z. et al. In Vitro Comparison of Gutta-Percha Removal with H-File and ProTaper with or without Chloroform. Iran Endod J. 2013 Winter; 8(1): 6–9.