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Evaluation of efficacy of ProTaper files, HERO SHAPER GOLD files, ProTaper Universal retreatment files and R-Endo retreatment files with and without use of passive ultrasonic irrigation using Irrisafe file for the removal of Gutta-percha and AH plus sealer from the root canals under dental operating microscope

K. Dattasai Kiran[1], N. Upendranatha Reddy[2] ,M. Gopikrishna Reddy[3] ,

E. Sujayeendranatha[4] , S. Nagalakshmi Reddy[5]

Y. Anusha[6]

1. Sr.lecturer, G Pulla Reddy Dental College And Hospital

2,3. Professor, G Pulla Reddy Dental College And Hospital

4,5. Reader, G Pulla Reddy Dental College And Hospital

6. Professor And Head of the Department, G Pulla Reddy Dental College And Hospital

EMAIL: mmdcdentalomfp@gmail.com

CORRESPONDING AUTHOR: Y. Anusha, Reader, G. Pulla Reddy Dental College And Hospital. India

ABSTRACT

Background: Purpose of the present study is to evaluate the efficacy of four different rotary NiTi files ProTaper files, HERO SHAPER GOLD files, ProTaper Universal retreatment files and R- Endo files to remove GP and sealer from root canals with or

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without use of passive ultrasonic irrigation using Irrisafe file under DOMS. Hypothesis of this study is that the use of PUI could result in better cleanliness of root canals after instrumentation for removal of GP and sealer. **Materials And Methods:** The present in vitro study was conducted in the department of Conservative dentistry and Endodontics, G. Pulla Reddy Dental College & Hospital, Kurnool, Andhra Pradesh. The study samples comprised of 100 extracted single rooted human maxillary anterior teeth and were collected from Department of Oral and Maxillofacial Surgery, G. Pulla Reddy Dental College & Hospital, Kurnool. **Results:** The t Test shows that there was statistical significance difference between individual Sub groups of Groups I,II & IV ($p<0.05$). And no statistical significance difference between Subgroups of Group III ($p>0.05$) but with percentage of remaining GP and sealer in the root canals after retreatment was comparatively greater in Sub group A than in Sub group B. **Discussion:** Under the experimental conditions, all the retreatment files left some amount of GP and sealer in the root canals and there was no significant difference between them. However, R- Endo to be better following ProTaper Universal retreatment system proved, Protaper files and HERO SHAPER GOLD files. Further use of passive passive ultrasonic irrigation with Irrisafe file resulted in better cleanliness of root canal wall after retreatment.

KEYWORDS: endodontics; dental; files; irrigation; root canal; microscope.

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Evaluación de eficacia de las limas ProTaper, limas HERO SHAPER GOLD, ProTaper Universal limas de retratamiento y limas de retratamiento R-Endo con y sin uso de irrigación ultrasónica pasiva mediante lima Irrisafe para la eliminación de Gutapercha y Sellador AH plus de los conductos radiculares bajo el microscopio quirúrgico dental

RESUMEN

Antecedentes: El propósito del presente estudio es evaluar la eficacia de cuatro diferentes limas rotativas de NiTi, limas ProTaper, limas HERO SHAPER GOLD, limas de retratamiento ProTaper Universal y limas R-Endo para eliminar GP y sellador de los conductos radiculares con o sin uso de irrigación ultrasónica pasiva mediante lima Irrisafe bajo DOMS. La hipótesis de este estudio es que el uso de PUI podría dar como resultado una mejor limpieza de los conductos radiculares después de la instrumentación para la eliminación del GP y el sellador. **Materiales y métodos**: El presente estudio in vitro se realizó en el departamento de Odontología Conservadora y Endodoncia, G. Pulla. Facultad y hospital dental Reddy, Kurnool, Andhra Pradesh. Las muestras del estudio comprendieron 100 dientes anteriores maxilares humanos de raíz única extraídos y se recolectaron del Departamento de Cirugía Oral y Maxilofacial, G. Pulla Reddy Dental College & Hospital, Kurnool. **Resultados:** La prueba t muestra que hubo una diferencia estadísticamente significativa entre los Sub individuales grupos de los Grupos I,II y IV ($p<0,05$). Y no hubo diferencia estadísticamente significativa entre los subgrupos del grupo

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III (p>0,05), pero el porcentaje de GP restante y sellador en los conductos radiculares después del retratamiento fue comparativamente mayor en el subgrupo A que en el subgrupo B. **Discusión:** Bajo las condiciones experimentales, todos las limas de retratamiento dejaron cierta cantidad de GP y sellador en los conductos radiculares y no hubo diferencias significativas entre ellos. Sin embargo, R-Endo es mejor siguiendo el sistema de retratamiento ProTaper Universal, las limas Protaper y las limas HERO SHAPER GOLD. El uso adicional de irrigación ultrasónica pasiva con lima Irrisafe dio como resultado una mejor limpieza de la pared del conducto radicular después del retratamiento.

PALABRAS CLAVE: endodoncia; odontología; limas; irrigación; tratamiento de conducto; microscopio.

INTRODUCTION

Recently, rotary NiTi files specifically designed for removal of GP and other RC filling materials[1,2,3,4,5,6,7] have been introduced into the market, claiming rapid and effective in removal of RC filling material.[8,9,10,11,12,13] Few of them are ProTaper Universal retreatment files (Dentsply Maillefer), R-Endo retreatment system (Micro Mega), Mtwo retreatment files (VDW, Munich, Germany), D-RaCe retreatment system (FKG Dentaire, La Chaux-de-Fonds, Switzerland). The use of passive ultrasonic irrigation (PUI) after instrumentation of RC has improved effect in removal of residual debris and smear layer.[14] Purpose of the present study is to evaluate the efficacy of four different rotary NiTi files ProTaper files, HERO SHAPER GOLD files, ProTaper Universal retreatment files and R- Endo

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files to remove GP and sealer from root canals with or without use of passive ultrasonic irrigation using Irrisafe file under DOMS. Hypothesis of this study is that the use of PUI could result in better cleanliness of root canals after instrumentation for removal of GP and sealer.

MATERIALS AND METHODS

The present in vitro study was conducted in the department of Conservative dentistry and Endodontics, G. Pulla Reddy Dental College & Hospital, Kurnool, Andhra Pradesh. The study samples comprised of 100 extracted single rooted human maxillary anterior teeth and were collected from Department of Oral and Maxillofacial Surgery, G. Pulla Reddy Dental College & Hospital, Kurnool. The criteria for the selection of teeth were: Inclusion criteria: 1) Free of restorations. 2) With straight roots. 3) Complete root formation. Exclusion criteria: 1) Carious tooth. 2) Crack. 3) Fractured tooth.

INSTRUMENTS

Micro motor hand piece. (NSK, Japan) Airotor hand piece. (NSK, Japan)Endo Access bur no. 1 (Dentsply Maillefer)Diamond discs. (Horico)Size 10, 15, 20 K file. (Mani)Endodontic torque controlled Rotary. (16:1 , X-Smart, Dentsply Maillefer)Warm thermo plasticizing obturation device. (E & Q plus, Meta Biomed, Korea)Hand pluggers. (Dentsply Maillefer)X ray machine .(Bluex, Intra OS 70, Confident)Dental Operating microscope. (Labomed)Protaper rotary files. (Dentsply Maillefer)K3 XF files. (Sybron Endo)Protaper universal retreatment files. (Dentsply Maillefer)R-Endo files. (Micro Mega)Piezoelectronic unit. (Satelec, P5 Newtron XS)Ultrasonic endodontic file – Irrisafe File. (Satelec)Stereomicroscope. (Lynx, Lawrence & Mayo) Digital camera. (Nikon)

MATERIALS USED

3% sodium hypochlorite. (Vishal Dento Care Pvt. Ltd.)Normal saline. (nirlife, Nirma limited)Distilled water.

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(Sreemanenterprise)Irrigation syringes and needles. (Ultradent)Paper points. (Meta Biomed) AH plus sealer. (Dentsply De Trey)Gutta-percha cones and pellets. (Dentsply Maillefer)Radiographs. (Carestream, E-Speed)Radiographic Developer & Fixer solution.CavitG. (3M ESPE)5% nitric acid. (SDFCL, SD Fine Chem Ltd.)Ethyl alcohol of 80%, 90%, 100%. (CS, Chinachangshu Yangyuan Chemicals)Methyl salicylate. (Himedia Laboratories Pvt Ltd.)

METHOD:

Specimen preparation: Teeth were stored in 3% sodium hypochlorite (NaOCL) for 24 hours to remove soft tissue debris and mechanically removed the calculus from tooth surface using ultrasonic scaler. Teeth were stored in distilled water until use.Access preparation was made on each tooth using high speed diamond bur using airotor hand piece with water coolant. A size 10 K-file was introduced into the canal until it was visible at the apical foramen. The working length was determined by subtracting 1mm from this measurement. The crowns were decoronated with a diamond disk and straight hand piece to standardized length to 16mm.

Root Canal Treatment: After establishment of glide path with no. 10 to no. 20 K files, RC biomechanical preparation was carried out with ProTaper rotary files as per manufacture recommendations. Root canals were shaped using S1 to reach working length followed by Sx for coronal flaring then S2 to reach working length. Followed by finishing of root canals using F1, F2, F3 to reach working length. At each change of instruments, root canals were irrigated using 28 guage needles with 2 mL of 3% NaOCl. After completion of instrumentation, root canals were finally irrigated with 5 mL of normal saline and 5 mL of distilled water. The root canals were dried with paper points. Plugger was selected for each specimen which was taken to depth of approximately 3mm short of working length. Master cone was selected 1 to 2mm short of working

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length and was checked for tight apical tug back. Paste A and Paste B of AH plus sealer was mixed in equal proportion on mixing pad and coated to RC walls using paper points. Obturation was done with GP and AH plus sealer using continuous wave of condensation technique using E & Q plus. After placement of master cone in to RC, down pack was carried out using selected plugger attached to Pen of E & Q plus unit with continuous heat until plugger touches canal walls in the apical portion. Plugger was held in position for about 15 seconds to cool down the GP then again heat was activated to plugger for 1 second and withdrawn from the RC. Remaining portion of RC was back filled with thermo plasticized GP using Gun of E & Q plus unit set at 200^0C. The injecting needle was positioned in the canal, preheated GP is then passively injected, the needle backs out of the canal and hand pluggers were used to compact the GP. The coronal access cavities were then sealed with Cavit G. Root canals of 100 teeth specimens after prepared and obturated they were radiographically evaluated in both mesio-distal (MD) and bucco-lingual (BL) direction for apical extent of obturation and for any internal voids. Out of which 80 teeth presents better adaptation RC filling material with no internal voids and were selected for further retreatment. All 80 selected obturated teeth were stored at 100% humidity and 37OC for a period of 30 days to allow complete setting of sealer.

Retreatment Technique: The teeth were randomly divided into 4 groups with 20 specimens each. (n=20) Each group was divided in to two subgroups, A and B with 10 specimens each. Entire retreatment procedure was performed under Dental Operating Microscope.

GROUP I – ProTaper Rotary File (DentsplyMaillefer)

Sub Group I A: Rotary ProTaper NiTi files in an electric motor (X Smart), with a constant speed of 300 rpm were used with light apical pressure by the

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following sequence; Finishing files #3 (size 30, taper 0.09), #2 (size 25, taper 0.08), and #1 (size 20, taper 0.07) in a crown-down technique to remove the GP and sealer until the working length was reached. Finishing files #2 and #3 were used again to the working length to complete GP and sealer removal from the canal walls.

Sub Group I B: Specimens of Sub Group I B were subjected to retreatment procedure with rotary ProTaper NiTi files as mentioned in Sub group I A along with passive ultrasonic irrigation was done withIrrisafe file (size 20) for 2 minutes at power setting ‘‘yellow 4’’ by Satelec, P5 Newtron XS piezoelectronic unit.

GROUP II – HERO SHAPER GOLD Rotary files

Sub Group II A: Rotary HERO SHAPER GOLD NiTi files with the electric motor (X Smart) at a constant speed of 300 rpm were used with a light apical pressure using the following sequence: Size 25 (taper 0.10), size 25 (0.08 taper), and size 20 (0.06 taper) in a crown-down technique to remove the GP and sealer until the working length was reached. Completion of GP removal and cleaning of canal walls was done using size 25 (0.06 taper) followed by size 30 (0.06 taper) to the working length.

Sub Group II B: Specimens of Sub Group II B were subjected to retreatment procedure with rotary HERO SHAPER GOLD NiTi files as mentioned in Sub group II A along with passive ultrasonic irrigation was done with Irrisafe file (size 20) for 2 minutes at power setting ‘‘yellow 4’’ by Satelec, P5 Newtron XS piezoelectronic unit.

GROUP III - ProTaper Universal Rotary Retreatment files (DentsplyMaillefer)

Sub Group III A: Rotary ProTaper Universal Retreatment files were used with an electric motor (X Smart) at a constant speed of 500 rpm. D1 with tip 30 and taper 0.09, D2 with tip 25 and taper

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0.08 and D3 with tip 20 and taper 0.07 were used sequentially, applying a crown-down technique to remove GP and sealer, until the working length was reached.

Sub Group III B: Specimens of Sub Group III B were subjected to retreatment procedure with rotary ProTaper Universal Retreatment NiTi files as mentioned in Sub group III A along with passive ultrasonic irrigation was done with Irrisafe file (size 20) for 2 minutes at power setting ‘‘yellow 4’’ by Satelec, P5 Newtron XS piezoelectronic unit.

GROUP IV - R-Endo System (Micro – Mega)

Sub Group IV A: Rotary R- Endo NiTi files were used for removal of GP and sealer with electric motor (X Smart) at a speed of 300 rpm. Rm stainless steel manual file (no.25, 4% taper) was used first to disrupt GP and center the NiTi files. It was followed by NiTi rotary files Re(no. 25, 12% taper), R1(no. 25, 8% taper), R2(no. 25, 6% taper), R3(no. 25, 4% taper) in crown down technique to reach working length.

Sub Group IV B: Specimens of Sub Group IV B were subjected to retreatment procedure with rotary R-Endo NiTi files as mentioned in Sub group IV A along with passive ultrasonic irrigation was done with Irrisafe file (size 20) for 2 minutes at power setting ‘‘yellow 4’’ by Satelec, P5 Newtron XS piezoelectronic unit.The files were cleaned regularly using gauze to remove any obturated material and debris before being reintroduced in the root canal. Each file was discarded after being used in 5 specimens. During retreatment procedure Irrigation was performed with 28 guage needle using 2 mL of 3% NaOCl at each instrument change. Retreatment was considered complete for all the groups when no filling material was observed on the instruments. Root canals were finally irrigated with 5 mL of normal saline and 5 mL distilled water.

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Evaluation of remaining gutta-percha and sealer: All the specimens were rendered transparent according to the clearing technique described by Don Robertson et al. Specimens were decalcified in 5 % nitric acid for 72 hours and then washed for 4 hours in running water and dehydrated in increasing concentrations of ethyl alcohol 80 % for 12 hours, 90 % for 1 hour and 100% for 1 hours. The specimens were then cleared by placing in methyl salicylate solution until they become transparent. The amount of GP and sealer on the canal walls were estimated using stereomicroscope by capturing images of transparent specimens in both MD and BL directions using digital camera at 8X magnification. The images were analyzed using using Auto CAD 2004 software for area of residual filling materials in square millimeters (mm^2). **Statistical Analysis:** All the data was analyzed using SPSS 21.0 version. Cleanliness of Root canals were analyzed using One way ANOVA with Turkeys multiple post-hoc test for Inter-group comparison and t test for Intra-group comparison. A p-value of < 0.05 was considered statistically significant

Figure 1& 2: Extracted Maxillary Anterior teeth used in the study

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Figure 3: Decoronated Teeth Samples

Figure 4: Armamentarium used in the study

Figure 5: Materials used in the study

Figure 6: E & Q Plus (Meta Biomed)

Figure 7 & 8: X ray Machine and Developer, Fixer solutions

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Figure 9: Radiographs of Obturated study samples in MD and BL Direction

Figure 10: Dental Operating Microscope (Labomed)

Figure 11: Operating on Dental Operating Microscope

<u>Rotary NiTi files used in Retreatment</u>

Figure 12: Protaper files (DentsplyMaillefer)

Figure 13:HERO SHAPER GOLDfiles (Shanghai Carejoy Medical Co., Ltd.**)**

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HERO SHAPER GOLDfiles
(Shanghai Carejoy Medical Co., Ltd.**)**

Figure 14: Protaper Universal Retreatment files (Dentsply Maillefer)

Figure 15: R- Endo files (Micro Mega)

Figure 16: Satelec, P5 Newtron XS, Piezoelectronic unit

Figure 17: Irrisafe file (Satelec)

Figure 18: Materials used for decalcification of specimens

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Figure 19: Nitric Acid Decalcification

Figure 20 & 21: Stereomicroscope (Lynx, Lawrence & Mayo) and Digital Camera (Nikon)

AutoCAD analysis of transparent tooth specimens

White lines indicates division of root canal into Coronal, Middle & Apical thirds, Blue markings indicates total root canal area, Green markings indicates area of residual Guttapercha and sealer

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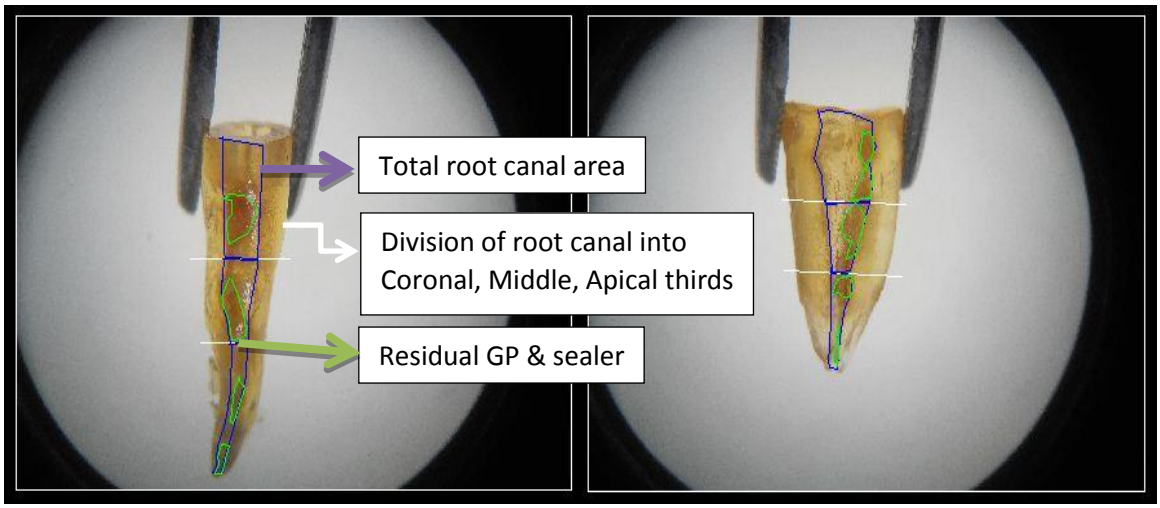

Figure 22: Sub Group I A

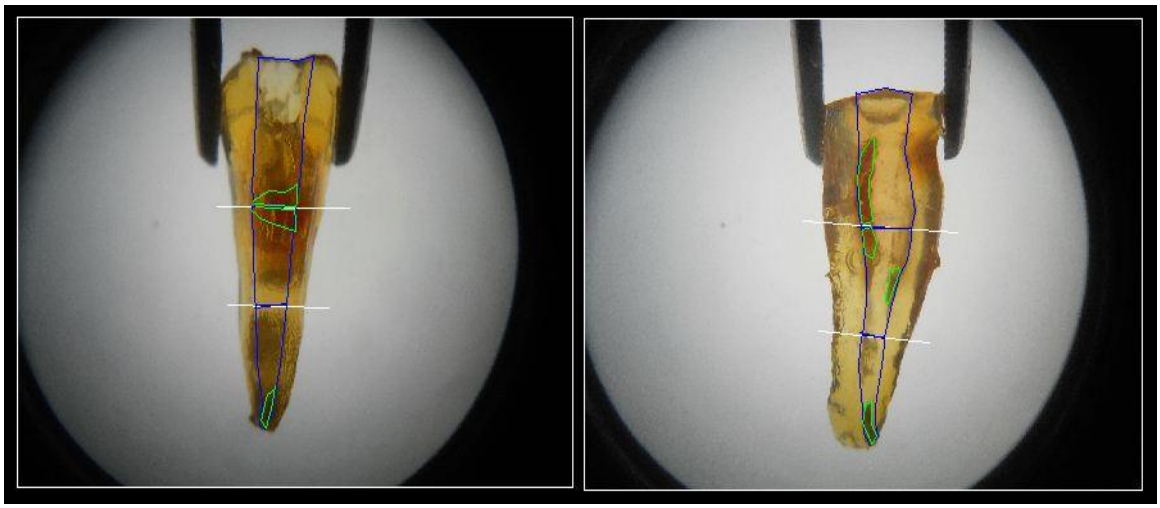

Figure 23: Sub Group I B

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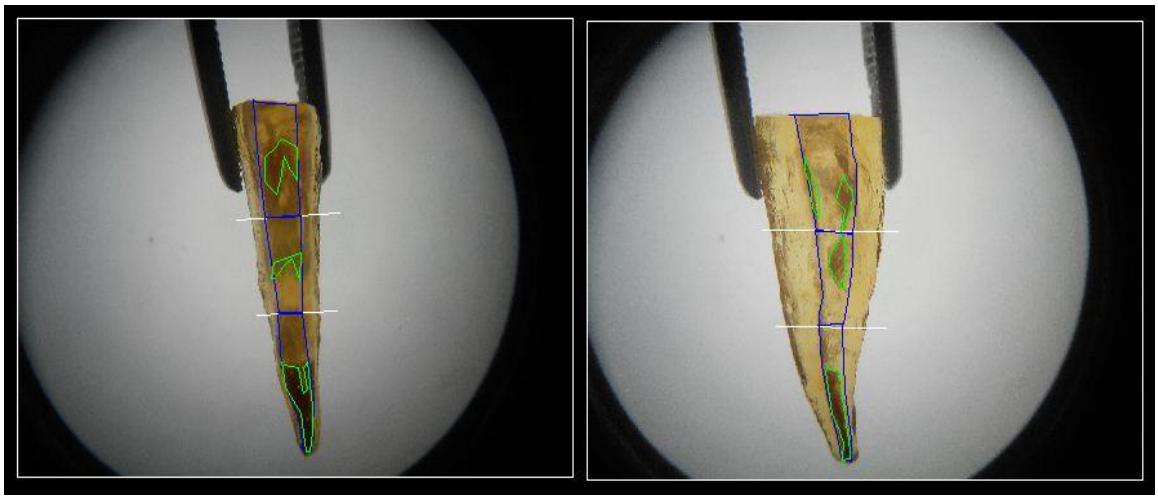

Figure 24: Sub Group I B

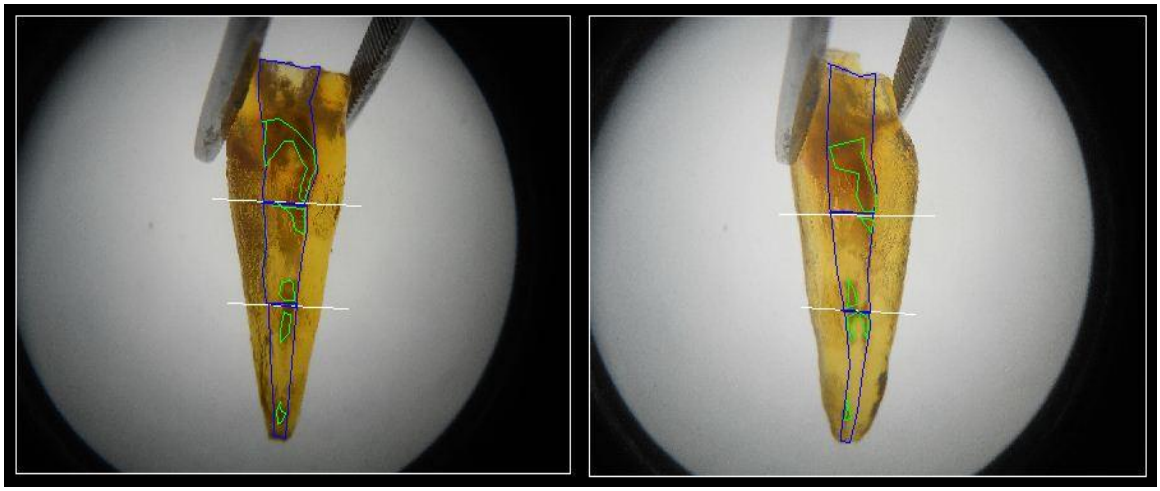

Figure 25: Sub Group II B

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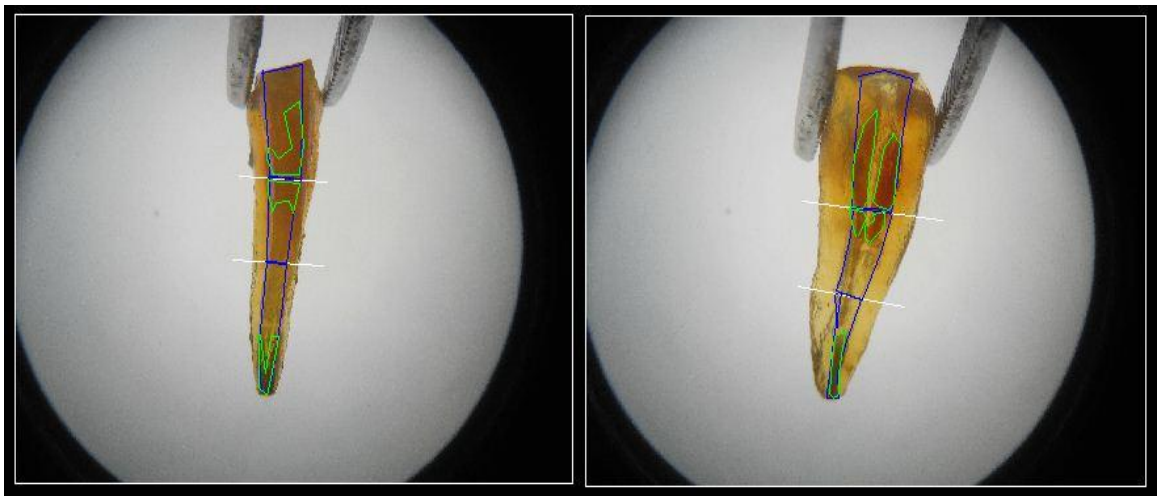

Figure 26: Sub Group III A

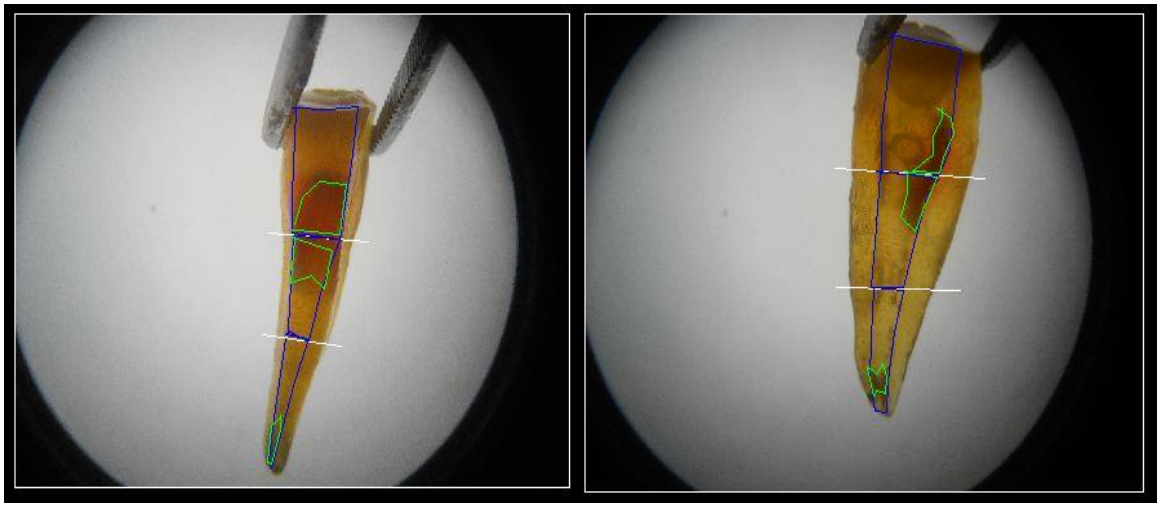

Figure 27: Sub Group III B

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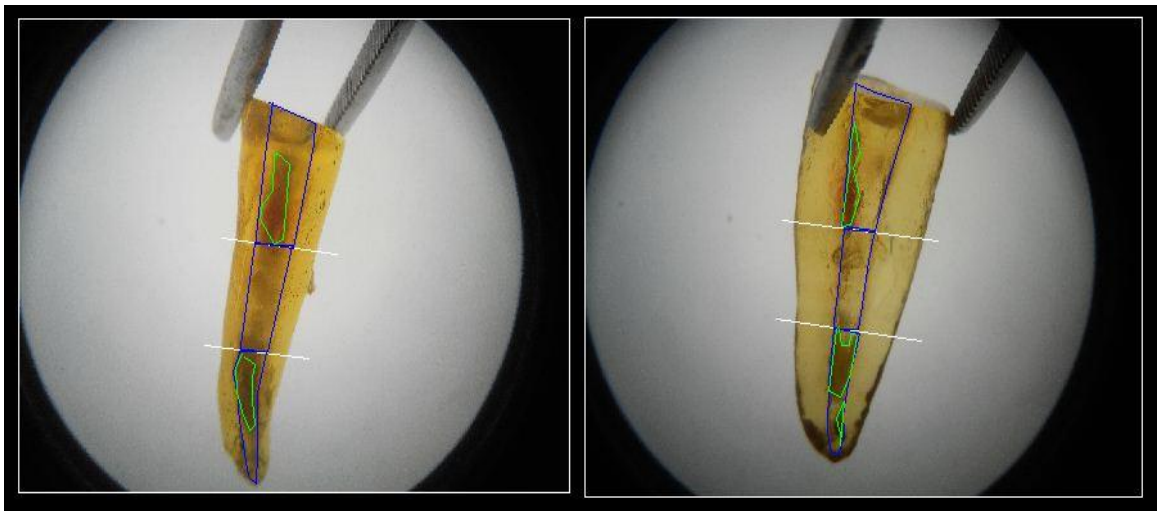

Figure 28: Sub Group IV A

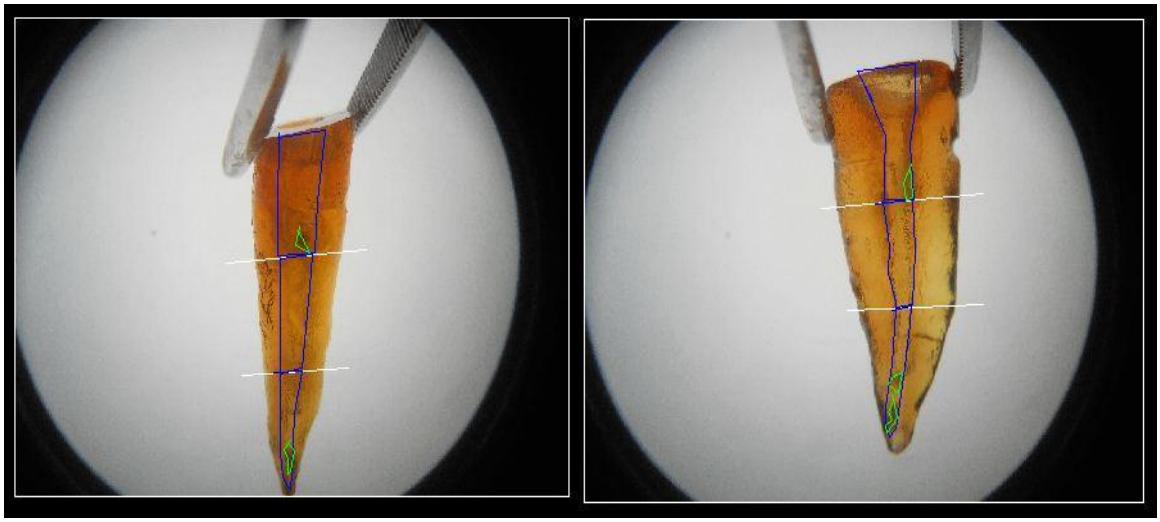

Figure 29: Sub Group IV B

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OBSERVATIONS AND RESULTS

The obtained data were statistically analysed using One way ANOVA with Turkeys multiple post hoc test for inter Group comparison and t test for intra group comparison ($P<0.05$).In the present study four different rotary NiTi files ProTaper files HERO SHAPER GOLD, files, ProTaper Universal retreatment files and R- Endo files were used for removal of GP and sealer with or without use of PUI using Irrisafe file. The results for ***Canal Wall Cleanliness*** in present study have been discussed as follows

INTER GROUP COMPARISON BETWEEN:

i. Group I Vs. Group II / Group I Vs. Group III / Group I Vs. Group IV / Group II Vs. Group III / Group II Vs. Group IV / Group III Vs Group IV

INTRA GROUP COMPARISON BETWEEN:

i. Sub Group I A Vs. Sub Group I B / Sub Group II A Vs. Sub Group II B / Sub Group III A Vs. Sub Group III B / Sub Group IV A Vs. Sub Group IV B

FROM TABLE 1 AND TABLE 2 FOLLOWING DATA WERE ANALYSED:

- Group I has a mean percentage of remaining guttapercha and sealer of about 28.84% when specimens viewed in MD direction and of about 22.94% when specimens viewed in BL direction.
- Group II has a mean percentage of remaining guttapercha and sealer of about 27.86% when specimens viewed in MD direction and of about 26.31% when specimens viewed in BL direction.
- Group II has a mean percentage of remaining guttapercha and sealer of about 23.14% when specimens viewed in MD direction and of about 20.95% when specimens viewed in BL direction.

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- Group II has a mean percentage of remaining guttapercha and sealer of about 21.81% when specimens viewed in MD direction and of about 17.49% when specimens viewed in BL direction.
- The percentage of remaining guttapercha and sealer in coronal, middle and apical thirds' were comparative more in middle and apical thirds' than in coronal thirds'. No significance difference in coronal, middle and apical thirds compared to other groups. But Significance difference between Group I vs IV = p=0.0495, Group II vs IV = p=0.0105(Specimens viewed in BL direction) observed in respect to coronal third. (Table II)

INTER GROUP COMPARISON: (Table 1 & 2, Graph 1 & 2) Using One way ANOVA with Turkeys multiple post hoc test.

i. Comparison between Group I and Group II: There was no statistical significance difference (p>0.05) between Group I and Group II specimens viewed in MD & BL direction with p=0.9961 & 0.8839 respectively.
ii. Comparison between Group I and Group III: There was no statistical significance difference (p>0.05) between Group I and Group III specimens viewed in MD & BL direction with p=0.5625 & 0.9728 respectively.
iii. Comparison between Group I and Group IV: There was no statistical significance difference (p>0.05) between Group I and Group IV specimens viewed in MD & BL direction with p=0.3782 & 0.6382 respectively.
iv. Comparison between Group II and Group III: There was no statistical significance difference (p>0.05) between Group II and Group III specimens viewed in MD & BL

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direction with p=0.7018 & 0.6509 respectively.

v. Comparison between Group II and Group IV: There was no statistical significance difference (p>0.05) between Group II and Group IV specimens viewed in MD & BL direction with p=0.5106 & 0.2296 respectively.

vi. Comparison between Group III and Group IV: There was no statistical significance difference (p>0.05) between Group III and Group IV specimens viewed in MD & BL direction with p=0.9900 & 0.8754 respectively.

INTRA GROUP COMPARISON: Using t test.

i. Sub Group I A and Sub Group I B: (Table 3, Graph 3) There was statistical significance difference (p<0.05) between Sub Group I A and Sub Group I B specimens viewed in MD & BL direction with p=0.0203 & 0.0491 respectively.

ii. Sub Group II A and Sub Group II B: (Table 4, Graph 4) There was statistical significance difference (p<0.05) between Sub Group II A and Sub Group II B specimens viewed in MD & BL direction with p=0.4841 & 0.0I65 respectively.

iii. Sub Group III A and Sub Group III B: (Table 5, Graph 5) There was statistical no significance difference (p>0.05) between Sub Group III A and Sub Group III B specimens viewed in MD & BL direction with p=06242 & 0.5541 respectively.

iv. Sub Group IV A and Sub Group IV B: (Table 6, Graph 6) There was statistical significance difference (p<0.05) between Sub Group IV A and Sub Group IV B specimens viewed in MD & BL direction with p=0.0074 & 0.0201 respectively.

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	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group I	25.81	16.67	27.90	26.62	28.62	17.40	28.84	15.35
Group II	26.09	18.83	30.84	24.58	26.67	14.50	27.86	15.14
Group III	18.04	15.46	28.78	26.35	32.56	16.24	23.14	13.55
Group IV	14.94	15.96	24.92	23.59	31.51	20.22	21.81	10.65
F- Value	2.2348		0.1891		0.4882		1.2574	
p-value	0.0910		0.9035		0.6915		0.2951	
Pair wise comparison of groups by Tukeys multiple posthoc procedures								
Group I Vs II	P=0.9999		p=0.9830		p=0.9843		p=0.9961	
Group I Vs III	p=0.4641		p=0.9996		p=0.8875		p=0.5625	
Group I Vs IV	p=0.1795		p=0.9822		p=0.9512		p=0.3782	
Group II Vs III	p=0.4324		p=0.9940		p=0.7023		p=0.7018	
Group II Vs IV	p=0.1618		p=0.8804		p=0.8106		p=0.5106	
Group III Vs IV	p=0.9364		p=0.9626		p=0.9975		p=0.9900	

Table 1: Inter Group Comparison of Mesio Distal specimens by one way ANOVA *p < 0.05

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	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group I	21.74	16.10	22.64	25.98	25.74	18.48	22.94	16.71
Group II	24.50	18.02	30.10	25.45	25.07	17.54	26.31	16.02
Group III	16.67	15.50	25.23	23.83	22.30	16.98	20.95	13.87
Group IV	9.04	10.34	24.45	25.57	29.66	20.19	17.49	10.93
F- Value	3.9611		0.3191		0.5476		1.2876	
p-value	0.0111*		0.8115		0.6513		0.2848	
Pair wise comparison of groups by Tukeys multiple posthoc procedures								
Group I Vs II	p=0.9397		p=0.7862		p=0.9995		p=0.8839	
Group I Vs III	p=0.7209		p=0.9882		p=0.9341		p=0.9728	
Group I Vs IV	p=0.0495*		p=0.9959		p=0.9059		p=0.6382	
Group II Vs III	p=0.3719		p=0.9284		p=0.9639		p=0.6509	
Group II Vs IV	p=0.0105*		p=0.8937		p=0.8583		p=0.2296	
Group III Vs IV	p=0.3950		p=0.9997		p=0.5855		p=0.8754	

Table 2: Inter Group Comparison of Bucco Lingual specimens by one way ANOVA *p < 0.05

Table 3: Intra Group Comparison of Group I by t test

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		Sub group A		Sub group B		t-value	p-value
		Mean	SD	Mean	SD		
Mesio Distal	Coronal	31.61	14.10	20.01	17.70	1.6218	0.1222
	Middle	38.63	32.45	17.18	13.68	1.9264	0.0700
	Apical	37.24	17.82	20.00	12.51	2.5039	0.0221*
	Total	36.54	14.81	21.14	12.11	2.5448	0.0203*
Bucco Lingual	Coronal	23.76	15.15	19.71	17.58	0.5521	0.5877
	Middle	33.83	32.66	11.46	8.97	2.0991	0.0500*
	Apical	36.31	20.11	15.17	8.29	3.0727	0.0066*
	Total	29.21	20.12	16.68	9.86	1.7688	0.0491*

***p < 0.05**

Table 4: Intra Group Comparison of Group II by t test

		Sub group A		**Sub group B**		**t-value**	**p-value**
		Mean	SD	Mean	SD		
Mesio Distal	Coronal	23.34	20.08	28.84	18.12	-0.6429	0.5284
	Middle	46.45	20.33	15.24	17.91	3.6425	0.0019*
	Apical	33.73	16.64	19.62	7.49	2.4469	0.0249*
	Total	32.08	15.70	23.64	14.06	1.2666	0.4841*
Bucco Lingual	Coronal	26.21	20.01	22.80	16.70	0.4136	0.6841
	Middle	48.95	20.57	11.25	12.42	4.9631	0.0001*
	Apical	35.10	18.12	15.04	9.89	3.0727	0.0066*
	Total	34.57	16.48	18.05	10.91	2.6435	0.0165*

***p < 0.05**

Table 5: Intra Group Comparison of Group III by t test

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		Sub group A		Sub group B		t-value	p-value
		Mean	SD	Mean	SD		
Mesio Distal	Coronal	13.83	11.81	22.25	18.04	-1.2359	0.2324
	Middle	37.91	22.30	19.66	27.99	1.6122	0.1243
	Apical	38.74	14.96	26.38	15.75	1.7997	0.0887
	Total	24.68	11.10	21.60	16.09	0.4985	0.6242
Bucco Lingual	Coronal	14.84	13.76	18.51	17.61	-0.5196	0.6097
	Middle	32.04	21.81	18.42	24.90	1.3012	0.2096
	Apical	29.25	17.69	15.35	13.73	1.9630	0.0653
	Total	22.85	12.20	19.05	15.78	0.6030	0.5541

***p < 0.05**

Table 6: Intra Group Comparison of Group IV by t test

		Sub group A		Sub group B		t-value	p-value
		Mean	SD	Mean	SD		
Mesio Distal	Coronal	21.79	15.02	8.08	14.41	2.0899	0.0500*****
	Middle	25.94	24.69	23.89	23.72	0.1901	0.8514
	Apical	42.01	16.80	21.02	18.34	2.6704	0.0156*
	Total	27.82	10.21	15.79	7.40	3.0157	0.0074*****
Bucco Lingual	Coronal	13.22	11.83	4.86	6.86	1.9339	0.0690
	Middle	27.93	28.49	20.98	23.28	0.5979	0.5574
	Apical	41.66	18.28	17.66	14.39	3.2622	0.0043*****
	Total	22.98	12.03	12.00	6.36	2.5510	0.0201*****

***p < 0.05**

Graph 1: Inter Group Comparison of Mesio Distal specimens

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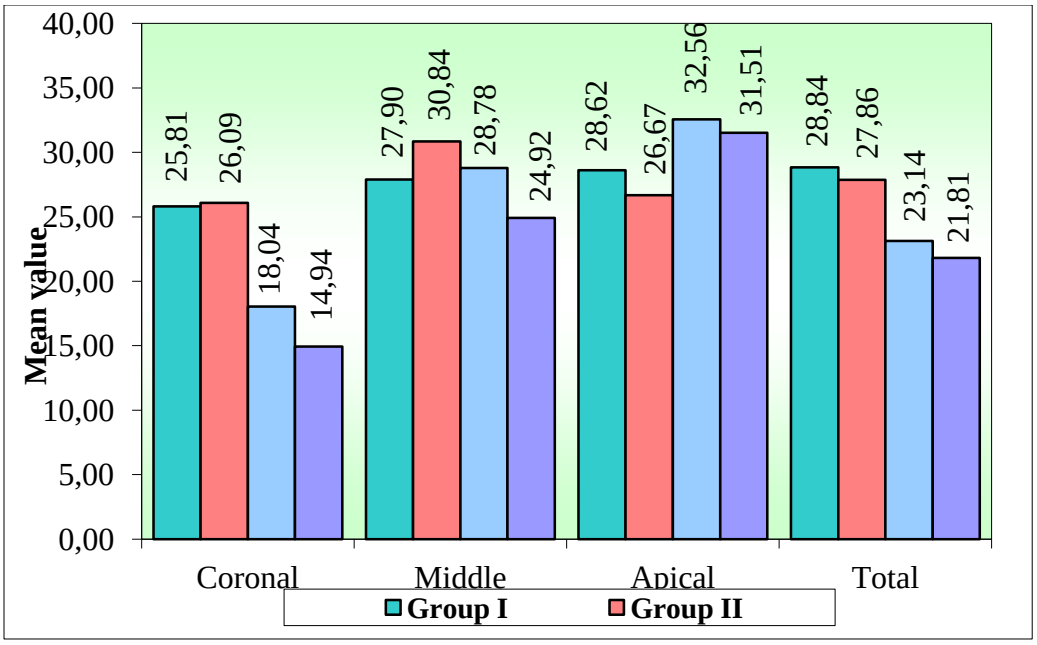
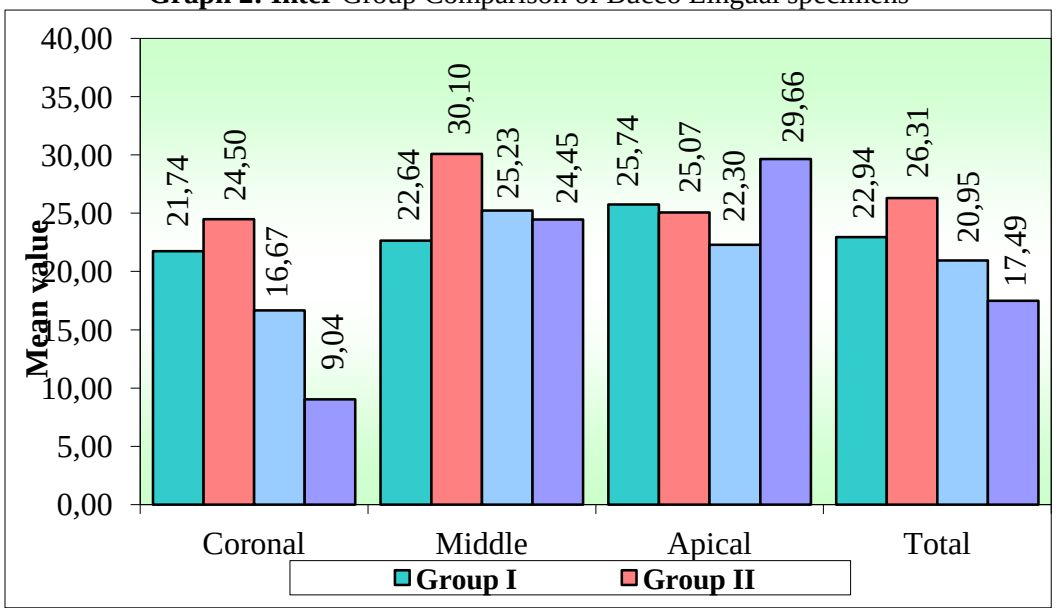


Graph 2: Inter Group Comparison of Bucco Lingual specimens



Graph 3: Intra group comparison of Group I

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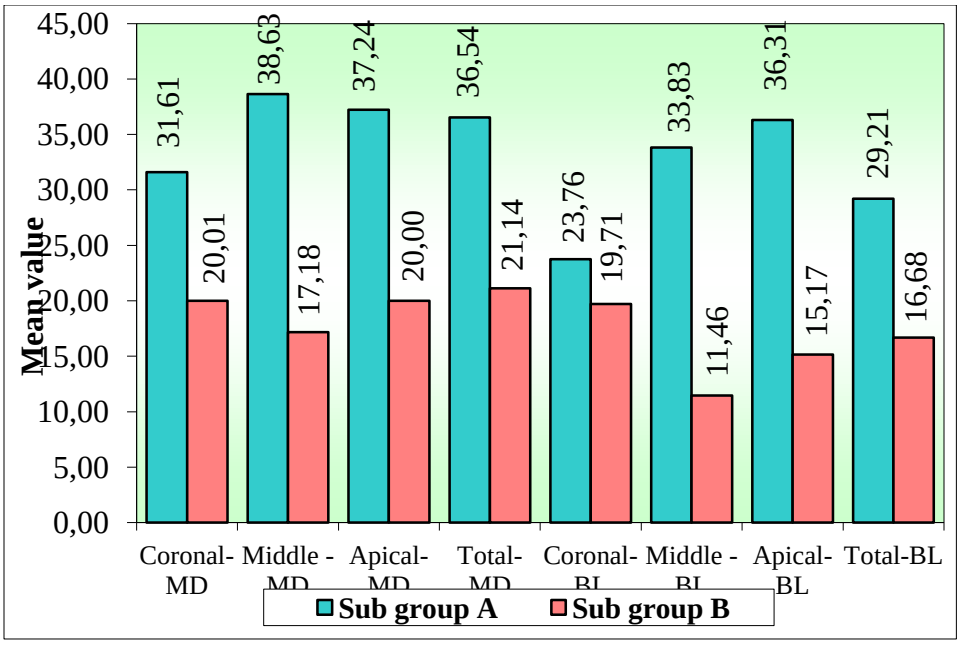
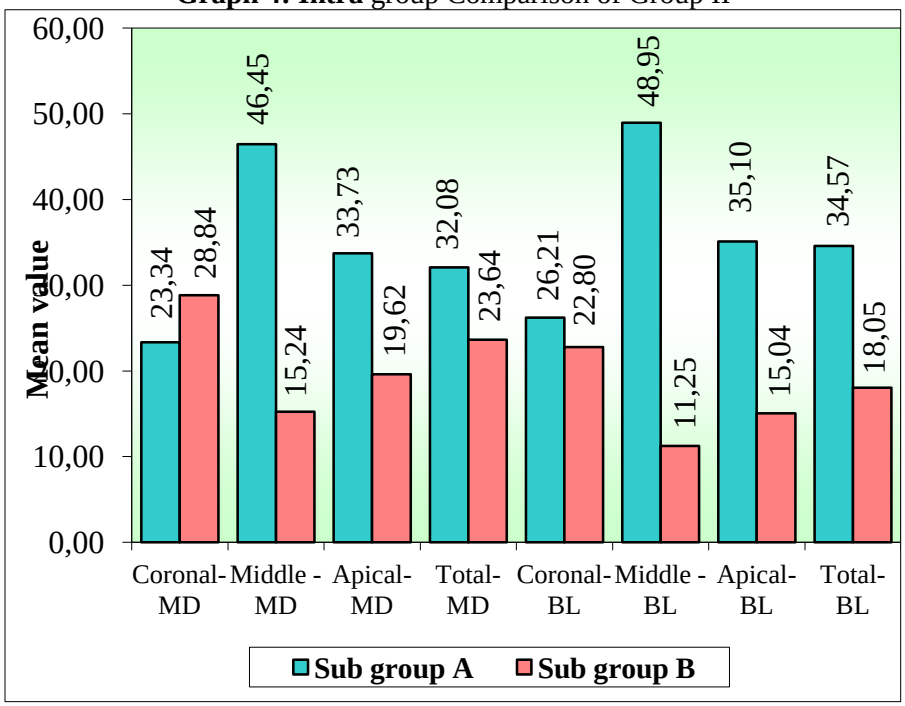


Graph 4: Intra group Comparison of Group II



Graph 5: Intra group Comparison of Group III

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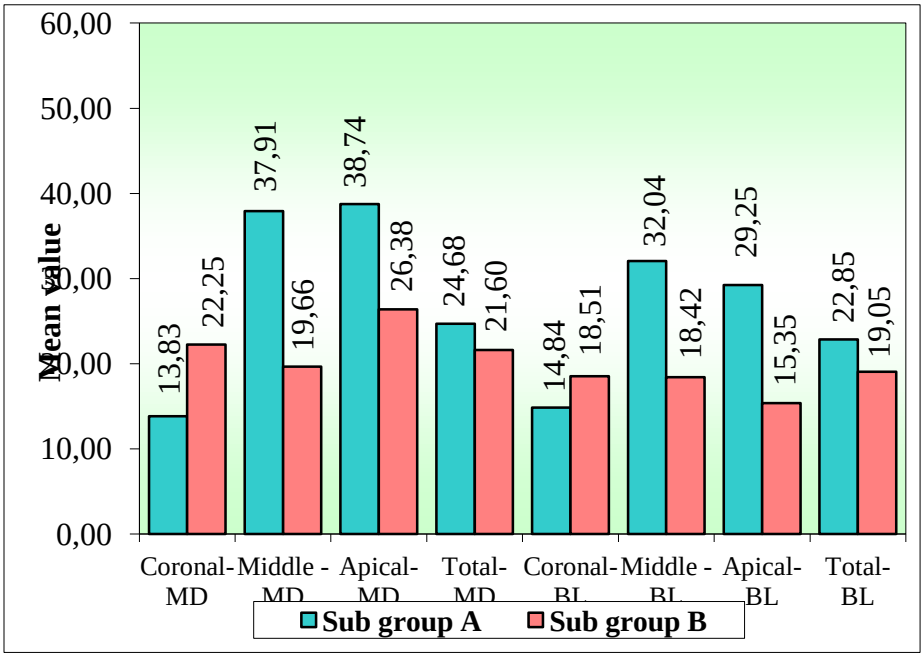
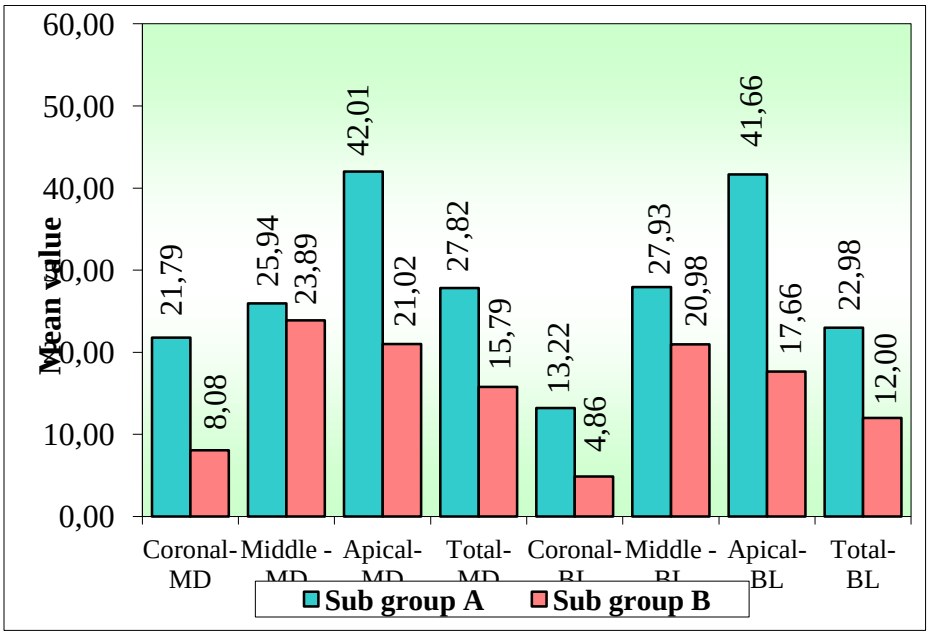


Graph 6: Intra group Comparison of Group IV



Summary of results:

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- None of the retreatment techniques completely removed the root canal filling material from root canals. One way ANOVA with Turkeys multiple post hoc test shows that there was no statistical significance difference between the groups ($p>0.05$), but with difference in the mean values. The order of Groups with lesser to higher mean percentage of remaining GP and sealer in the root canals after retreatment was as follows Group IV, Group III, Group I & Group II.(**Group IV < III < I < II**).The difference in the mean percentage of remaining GP and sealer in the root canals after retreatment between Group II and Group IV is about 6.05% when viewed in MD direction and 8.82% when viewed in BL direction.t Test shows that there was statistical significance difference between individual Sub groups of Groups I,II & IV ($p<0.05$). And no statistical significance difference between Subgroups of Group III ($p>0.05$) but with percentage of remaining GP and sealer in the root canals after retreatment was comparatively greater in Sub group A than in Sub group B.

Table 7: Comparison of coronal, middle and apical thirds of root canals in MD direction in group I, II, III, IV of sub group A by one way ANOVA

	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coronal	31.61	14.10	23.34	20.08	13.83	11.81	21.79	15.02
Middle	38.63	32.45	46.45	20.33	37.91	22.30	25.94	24.69
Apical	37.24	17.82	33.73	16.64	38.74	14.96	42.01	16.80
F-value	0.2640		3.6751		6.9790		3.0624	
p-value	0.7699		0.0388*		0.0036*		0.0633	
Pair wise comparison of sides by Tukeys multiple post hoc procedures								
Coronal Vs Middle	p=0.7736		p=0.0304*		p=0.0101*		p=0.8808	
Coronal Vs Apical	p=0.8473		p=0.4536		p=0.0077*		p=0.0668	

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Middle Vs Apical	p=0.9900	p=0.3118	p=0.9934	p=0.1694

*p<0.05

Table 8: Comparison of coronal, middle and apical thirds of root canals in MD in group I, II, III, IV of sub group B by one way ANOVA

	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coronal	20.01	17.70	28.84	18.12	22.25	18.04	8.08	14.41
Middle	17.18	13.68	15.24	17.91	19.66	27.99	23.89	23.72
Apical	20.00	12.51	19.62	7.49	26.38	15.75	21.02	18.34
F-value	0.1217		2.0504		0.2536		1.9215	
p-value	0.8859		0.1482		0.7779		0.1659	
Pair wise comparison of sides by Tukeys multiple post hoc procedures								
Coronal Vs Middle	p=0.9045		p=0.1358		p=0.9600		p=0.1760	
Coronal Vs Apical	P=0.9999		p=0.3833		p=0.9020		p=0.3042	
Middle Vs Apical	p=0.9049		p=0.8007		p=0.7621		p=0.9405	

Table 9: Comparison of coronal, middle and apical thirds of root canals in BL specimens in group I, II, III, IV of sub group A by one way ANOVA

	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coronal	23.76	15.15	26.21	20.01	14.84	13.76	13.22	11.83
Middle	33.83	32.66	48.95	20.57	32.04	21.81	27.93	28.49
Apical	36.31	20.11	35.10	18.12	29.25	17.69	41.66	18.28
F-value	0.7786		3.4226		2.6151		4.7192	
p-value	0.4691		0.0473*		0.0916		0.0175*	
Pair wise comparison of sides by Tukeys multiple post hoc procedures								
Coronal Vs Middle	p=0.6170		p=0.0389*		p=0.1025		p=0.2676	
Coronal Vs Apical	p=0.4762		p=0.5741		p=0.1937		p=0.0130*	
Middle Vs Apical	p=0.9707		p=0.2710		p=0.9366		p=0.3150	

*p<0.05

Table 10: Comparison of coronal, middle and apical thirds of root canals in BL specimens in group I, II, III, IV of sub group B by one way ANOVA

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	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coronal	19.71	17.58	22.80	16.70	18.51	17.61	4.86	6.86
Middle	11.46	8.97	11.25	12.42	18.42	24.90	20.98	23.28
Apical	15.17	8.29	15.04	9.89	15.35	13.73	17.66	14.39
F-value	1.1176		1.9594		0.0865		2.7313	
p-value	0.3417		0.1605		0.9174		0.0831	
Pair wise comparison of sides by Tukeys multiple post hoc procedures								
Coronal Vs Middle	p=0.9045		p=0.1358		p=0.9600		p=0.1760	
Coronal Vs Apical	P=0.9999		p=0.3833		p=0.9020		p=0.3042	
Middle Vs Apical	p=0.9049		p=0.8007		p=0.7621		p=0.9405	

The present in vitro study was done to compare the efficacy of rotary NiTi files ProtTaper files, files and retreatment systems ProTaper Universal retreatment system and R- Endo retreatment system in removal of gutta-percha and AH plus sealer with or without use of passive ultrasonic irrigation with Irrisafe file, under Dental Operating Microscope and subjects were evaluated using clearing technique underthe stereomicroscope and photographs [4,6,.23.3565,68.69,7,70,71,72,20,25,35]In the present study RC specimens were obturated using continuous wave of condensation. (E & Q plus). [3,4,6,7,8,9,10,15,16,17,18,193435, 20, 21, 22, 23,30,31,36,39,4143,44, 48,50, 51, 54, 57,73,74,75,76,77

Group I Vs. II: MD viewed specimens (p=0.9961) & BL viewed specimens (p=0.8839); Group I Vs. III: MD viewed specimens (p=0.5625) & BL viewed specimens (p=0.9728); Group I Vs. IV: MD viewed specimens (p=0.3782) & BL viewed specimens (p=0.6382); Group II Vs. III: MD viewed specimens (p=0.7018) & BL viewed specimens (p=0.6509); Group II Vs. IV: MD viewed specimens (p=0.5106) &BL viewed specimens (p=0.2296); Group III Vs. IV:MD viewed specimens (p=0.9900) & BL viewed specimens (p=0.8754).

Though there was no significance difference between the groups, the order of sequence of groups with less to higher

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left over residual GP and sealer in RCs is Group IV- R – Endo retreatment system, Group III- Protaper universal retreatment system, Group I- Protaper files and Group II – HERO SHAPER GOLD files.There was a significance ($p<0.05$) difference in between the individual group that is intra group comparison, with or without the use of passive ultrasonic irrigation. Sub Group I A Vs. Sub Group I B: MD viewed specimens ($p=0.0203$*) & BL viewed specimens ($p=0.0491$*); Sub Group II A Vs. Sub Group II B: MD viewed specimens ($p=0.4841$*) & BL viewed specimens ($p=0.0165$*); Sub Group III A Vs. Sub Group III B: MD viewed specimens ($p=0.6242$) & BL viewed specimens ($p=0.5541$); Sub Group IV A Vs. Sub Group IV B: MD viewed specimens ($p=0.0074$*) & BL viewed specimens ($p=0.0201$*).Remaining filling material distribution in coronal, middle and apical thirds of root canals, much of remaining filling material was observed in the middle and apical thirds. The reason could be because in most of present retreatment techniques followed crown down technique for removal of GP and sealer and files used for coronal third of root canals have greater taper than used for middle and apical thirds. But there is no significance difference in distribution of remaining filling materials in respect to thirds in all the groups with $p>0.05$. From results of present study it was shown that the residual GP and sealer are more in the specimens when viewed in BL direction. This is due to the fact that though RCs were standardized with same biomechanical preparation in all specimens, RCs of maxillary anteriors are more or less oval in shape and files used for retreatment purpose are mostly round in shape.R-Endo files are comparatively effective than ProTaper Universal retreatment files, ProTaper files and HERO SHAPER GOLD Files. The reason could be in R – Endo system it was provided Re file with a taper of 0.12, tip size 25 of 10 mm length. It has aggressive cutting edges and aid in removal of root canal filling material. Hence in the R – Endo group presents lesser filling material in coronal and

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middle thirds compared to other groups. Signinicance difference between Group I vs IV = p=0.0495, Group II vs IV = p=0.0105 observed in respect to coronal third. But there is no significance difference in middle and apical thirds compared to other groups. The results showed that no significant difference was observed between the filling materials on terms of their removal. Manual instrumentation left more filling debris on the root canal walls when compared to HERO SHAPER GOLD and ProTaper.[8] Results showed that there was no statistically significant difference among the others techniques: ProFile, ProTaper and HERO SHAPER GOLD when compared with GT. Rotary files GT, ProFile, ProTaper and HERO SHAPER GOLD were more effective in removing gutta-percha than manual and Hero instruments.[44] The results showed that no significant differences were observed between the rotary systems in terms of the area of filling material left within the canals. There were statistically significant differences between the filling materials: Mtwo Retreatment files were more rapid when removing filling material than ProTaper Retreatment files and Twisted Files.[43] Results showed that all instrumentation techniques left gutta-percha and sealer remnants inside the root canals. R-Endo instrumentation was significantly more effective ($P < 0.05$) than MTwo retreatment files in removing gutta-percha from the middle and apical thirds.[48] Results of this study can be correlate with present study where R – Endo is showed as efficient compared to others retreatment techniques. ProTaper Universal rotary retreatment system without chloroform was faster and effective.[37] Most remnants were found in the apical third of the canals.[46] Which is comparable to present study that most of filling material left was mostly present in apical third of the canals.In present study AH plus is used as root canal sealer and present more root canal filling debris than other studies where zinc oxide and calcium hydroxide based sealers are used.[21,23,46] Results showed that remaining filling material was observed

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in all specimens. The mean volume of remaining material was higher in the continuous wave of condensation groups than in the cold lateral condensation groups, especially in the apical portions of the root canals [58,72] The results showed significant differences between the two removal techniques. Gutta-percha was more efficiently removed by using hand K-files compared to ProTaper universal retreatment files. Reason explained for this finding was that all canals were enlarged to a size F3 ProTaper file, which has a tip size of 30 and 9% taper, whereas the D3 ProTaper retreatment file has a tip size of 20 and 7% taper, which meant the D3 file tip did not engage with the canal walls.[6] However, the high degree of filling material remaining in this study could be because of the constant size of retreatment files (size 25) rather than the instruments used during root canal preparation (size 30). Further enlargement of root canals beyond the canal dimension at the time of removal of root filling could have resulted in a significant reduction in material and in cleaner walls.[39] This study was correlative to present study in the aspect of method of evaluation of residual RC filling material using clearing technique. And after removal of RC filling material, further RCs were instrumented with Protaper rotary instruments. Results showed ProTaper Universal rotary retreatment system and with further canal repreparation accomplished with ProTaper rotary comparatively left less residual GP.[34]. The results showed that residues present after the use of the ProTaper Universal rotary files iscomparatively more than following the supplementary application of the SAF. It was concluded that the use of the SAF after rotary instrumentation using ProTaper Universal retreatment files resulted in a significant reduction in the amount of filling residue in curved canals of mandibular molars.[50] Results revealed that ultrasound/xylol led to lower percentages of remaining sealer, significantly different from the Protaper retreatment, Protaper retreatment /xylol and ultrasound which were similar.

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Ultrasound/xylol led to significantly lower percentages of remaining sealer on the canal walls when compared to other groups.[65] these results can be correlate with present study where PUI was used in presence of NaoCl instead of RC solvents, Xylol.[64] Results showed that there were no significant differences between the groups or among the root canal thirds within each group. PUI with Endosolv R was not effective in the removal of filling debris from root canal walls.[14] These results supports the present study in which passive ultrasonic instrumentation has negative out come during root canal retreatment with the use of RC solvents, hence instead of RC solvents NaoCl was used during PUI.. The results showed average percentage of remaining gutta-percha/sealer was higher in convetional technique than convetional technique in combination with burs, solvent, ultrasonics plus clinical operating microscope showing a statistically significant difference. The use of the DOMS and ultrasonic tips removed the filling material from root canal walls better.[12] The root canal cleanliness is best achieved when retreatment is performed under a DOMS.[53] The results of present study demonstrate that under the experimental conditions, all the retreatment files left some amount of GP and sealer in the root canals and there was no significant difference between them.

CONCLUSION

The R-Endo retreatment system and ProTaper Universal rotary retreatment system have advantages over other retreatment files No need of solvents, minimizes smearing of GP and sealer on RC walls. Time saving or faster. Instrument design specially designed for retreatment of root canals.

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