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Comparative Evaluation of Protaper Universal, D-Race, R-Endo and Neoendo Ni-Ti Rotary Retreatment file Systems in the Removal of Guttapercha And Root Canal Sealer with or Without the Use of Solvent During Endodontic Retreatment: An In-Vitro Stereomicroscope Analysis Using Autocad Software.

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Dr. Srikumar G.P.V.1, Dr. Geeta Nishad2, Dr. Siddharth Bardia3, Dr. Megha Yadav4, Dr. Amisha Jain5, Dr. Kriti Dubey6

1 M.D.S. Professor and H.O.D. Department of Conservative Dentistry and Endodontics. Triveni Institute of Dental Sciences, Hospital and Research Centre. Bilaspur, Chhattisgarh, India.

2 M.D.S. Senior Lecturer. Department of Conservative Dentistry and Endodontics. Triveni Institute of Dental Sciences, Hospital and Research Centre. Bilaspur, Chhattisgarh, India.

3 M.D.S. Professor. Department of Conservative Dentistry and Endodontics. Bhabha College of Dental Sciences, Bhopal, Madhya Pradesh, India.

4 M.D.S. Senior Lecturer. Department of Conservative Dentistry and Endodontics. Bhabha College of Dental Sciences, Bhopal, Madhya Pradesh, India.

5 M.D.S. Reader. Department of Conservative Dentistry and Endodontics. Bhabha College of Dental Sciences, Bhopal, Madhya Pradesh, India.

6 M.D.S. Senior Lecturer. Department of Conservative Dentistry and Endodontics. People's Dental Academy. Bhopal, Madhya Pradesh, India.

Corresponding author: Dr. Srikumar G.P.V.

M.D.S. Professor and H.O.D. Department of Conservative Dentistry and Endodontics. Triveni Institute of Dental Sciences, Hospital and Research Centre. Bodri- 495220. Bilaspur, Chhattisgarh, India.

Phone number: +91 9685514220. e-mail address: drsrikumar2611@gmail.com.

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D-Race, Guttapercha, Neoendo, Protaper, R-Endo, Root canal filling material.

Abstract

Background: The purpose of this research is to compare the efficacy of several rotary retreatment file systems for cleaning out infected root canals. Methods and materials: Using Protaper rotary retreatment files, 120 removed mandibular premolar teeth were split into two groups: Group A (no solvent) and Group B (solvent). Group C (no solvent) and Group D (solvent) D-Race rotary retreatment files. Group E (non-solvent) and Group F (solvent) R-Endo rotary retreatment files. Group G (no solvent) and Group H (solvent) are two categories of neoendo rotary retreatment files. The roots were cut in half lengthwise, examined using a stereomicroscope, photographed, and analyzed in AutoCAD. Statistical tests performed included the one-way Anova, the Tukey post hoc, and the t-tests for independence. Root trenches were divided into thirds, with the coronal third separating groups A and C, the apical third separating groups A and C, the middle third separating groups B and H, and the distal third separating groups F and H. Results showed that, regardless of solubility, more root stream filling material was abandoned in the coronal, focal, and apical thirds of the root channel according to R-Endo retreatment records than according to D-Race retreatment data.

1. Introduction:

Inadequate root canal filling, incorrect coronal restorations, and insufficient root canal cleansing and disinfection are the most prevalent causes of needing endodontic retreatment.[1] After an initial root canal treatment has been completed, a root canal retreatment may be recommended for teeth that have developed or continued to show symptoms of apical periodontitis.[2] The American Association of Endodontists has

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compiled a glossary of endodontic terms, where the word "Endodontic Retreatment" may be found. It's the procedure when the root canal is cleaned, shaped, and sealed up after any prior fillings have been removed.[3] Root canal therapy has a 62-96% success rate during the previous several decades.[4]

Root canal therapy's failure leaves patients with a few options: a second attempt at a traditional root canal, peri-radicular surgery, or tooth extraction.[5,6] Endodontic retreatment is performed to restore access to the apical region of the root canal and to remove any residual germs in the area by fully removing the root canal filling material and sealer.[6,7] Guttapercha with a root canal sealer is the most common root canal filler material, however it must be removed in its entirety when a retreatment is required for a root canal.[7] About 20% of guttapercha serves as the matrix, while 66% is made up of zinc oxide, 11% is made up of heavy metal sulfates (a radioopacifier), and 3% is made up of waxes (a plasticizer). The two-paste method AH(Amine Hydroxy) Plus (Dentsply Sirona, Tulsa, OK, USA) includes an epoxy resin-based root canal sealant. Paste A has bisphenol A at 25–50% concentration, zirconium dioxide, calcium tungstate, and iron oxide at 10–25% concentration, and amantadine and N, N-dibenzyl-5-Oxanonandiamin-1 at 2.5–10% concentration. Root dentin tubules may be safely sealed using AH-Plus sealer since it is radiopaque, has a high adhesive strength, and does not off-gas formaldehyde while it cures. [8]

Root canal retreatment requires the removal of root canal filling materials so that the canals may be re-instrumented and disinfected using chemo-mechanical methods. It may be difficult and time-consuming to employ the numerous methods for removing root canal filling materials, such as endodontic hand files, solvents, ultrasonics, and hot pluggers.[9,10] RecentlyEndodontic retreatment necessitates the use of specialized turning Ni-Ti (Nickel-Titanium) documents, including as the ProTaper All-inclusive, D-Race, R-Endo, and Neoendo, to remove root channel filling materials.

There are three records (D1, D2, and D3) with a curved three-sided cross area and varying forms that make up the ProTaper general rotating Ni-Ti retreatment document framework (Dentsply Maillefer, The Ballaigues D1 record (size 30, 0.09 shape) comes in at 16 mm in length and is used to remove filler material from the root canal's coronal-third; the D2 record (size 25, 0.08 shape) comes in at 18 mm in length and is used to remove filler material from the middle third of the root canal. Up to one-third of the apical root trench, a 22-mm-long D3 record (size 20, tighten 0.07) is employed.[11]

DRace is a two-file method for rotational Ni-Ti retreatment from FKG Dentaire in Switzerland. The DR1 record (size 30, 0.10 form) has a functional cutting point for initiating entry and expelling of root waterway filling material in the coronal 33% of root trenches. Using a DR2 document (size 25, 0.04 shape), we are able to eradicate the top 66% of root channels. which has a non-cutting point. These two files have a common feature: a triangle cross-section with cutting edges that alternate in orientation.[12]

R-Endo rotation The five records (Rm, Re, R1, R2, and R3) in the Ni-Ti retreatment document framework (Miniature Mega, Basancon, France) are employed in a delicate in-and-out motion. First, the trailing record is prepared, and then a Rm of shape size 25, 0.04 is used to bore into the root stream filling material; finally, the last 2-3 mm of obturation are removed using a Re (size 25, 0.12 form). The R1 (size 25, 0.08 shape) and R2 (size 25, 0.06 shape) are then used to locate the top and lower third of the plant's root channel filling material, respectively.[13]

The three files of the Neoendo rotating Ni-Ti retreatment file system (Orikam Healthcare, India) are 16 mm, 18 mm, and 25 mm in length. Root canals are often cleaned in thirds: the coronal (with a N1 instrument, size 30) the intermediate (with a N2 instrument, size 25) and the apical (with a N3 instrument, size 20) sections.[13]

With the development of Endosolv (Septodont, France), a sealant for use in root canals Now the same solvent may be used to dissolve both resin and eugenol-based root canal sealers. Sealants Endosolv E (Eugenol) and Endosolv R (Resin) are produced by the French business Septodont. and formerly, two separate products were needed to remove root canal sealers. The powerful sealer-softening ingredients in Endosolv solvent include ethyl acetate, amyl acetate, and thymol.[14]

The effectiveness of these four Ni-Ti rotary retreatment file systems has only been compared in a

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small number of investigations. Using stereomicroscope analysis and Auto-CAD (Computer Aided Design) software, Four different rotating Ni-Ti retreatment file systems (ProTaper universal, D-Race, R-Endo, and Neoendo) were tested for their ability to remove guttapercha and root canal sealer during endodontic retreatment, both with and without the use of solvent.

2. Materials and Method:

In order to conduct this analysis, we received 120 freshly extracted human super durable mandibular first and second premolar teeth from the Oral and Maxillofacial Medical Procedure Division at Triveni Establishment of Dental Sciences, Emergency clinic, and Exploration Center in Bodri, Bilaspur, Chhattisgarh.

Criteria for inclusion: Teeth having no history of caries lesions, endodontic treatment, fracture, root surface cracks, resorptive defects, calcifications, or open root apices. Even teeth that were removed for orthodontics or because of periodontal disease were counted. Only teeth with root canal curvature 100 were included in the current investigation, which only included teeth with straight root canals without bi- or tri-furcation as determined radiographically.

Teeth that met the following exclusion criteria did not participate in the study: those that had endodontic treatment, had caries lesions, were fractured, had cracks on the root surfaces, had resorptive defects, had calcifications, had open root apices, had bi-furcated or tri-furcated root canals, or had root canal curvatures >100.

The samples were disinfected by submerging them in a 3% sodium hypochlorite solution for 5 days, They were cleaned in running water and kept in thymol at a concentration of 0.5% until use. In order to standardize the root length of each sample to roughly 16 mm, a jewel circle (DFS, Germany) was coupled with a slow speed contra-calculated handpiece (NSK, Japan) at the cemento-lacquer junction opposed to the long hub of the root. Each specimen had its pulp tissue removed using a Mani, Japan-made K(Kerr)-file no.10, and its root canal was then checked for patency all the way to the apical foramen. To find the working length, we took the measurement from the tip of the trial file to the apical foramen and subtracted 0.5 mm. So that root waterway instrumentation could be carried out with little disruption, each tooth was balanced out and transported in its own block of self-fix acrylic gum (DPI-RR Cold fix, Dental Outcomes India, Mumbai).

During root canal instrumentation and biomechanical preparation, we used K(Kerr)-file (Mani, Japan) ISO(International Organization for Standardization) nos. 15–35 as the master apical file. Neelkaanth Health Care Pvt Ltd of Ahmedabad, India supplied the root canal irrigation solution of 3% sodium hypochlorite and 17% EDTA (EthylineDiamineTetraAcetic Acid). After rinsing the root channels with normal saline and drying them with clean retentive paper focuses (Dia Gouge Worldwide, Korea), we used the expert apical record to direct a slight blend of AH(Amine Hydroxy) and root waterway sealer (Dentsply Maillefer, DeTray, Germany) to cover all of the prepared root channel walls.

Figure no.1: AH-Plus root canal sealer

Each specimen had an ISO no. 35 2% taper Guttapercha point (Dia Dent International, Korea) put into the apex of the root canals using a master apical cone covered with AH-Plus sealer. Using Guttapercha points and an ISO number, the root canals were obturated to a depth of 3 mm using the cold lateral condensation technique. The AH-Plus sealer is coated on the 30mm, 25mm, 20mm, and 15mm cones that are used as accessories. Using a viral finger Plugger (Mani, Japan), the guttapercha was extracted to a depth of 2 mm below the channel hole, and then densely packed upward. The apical extent and quality

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of root canal fillings were evaluated in the bucco-lingual and mesio-distal directions using digital radiography (Radiovisiography, Carestream Dental, Kodak 5200, France). The existence of consistent radiopacity that extended beyond the intended working length was regarded adequate for root canal obturations. In order to maintain a consistent number of samples, any guttapercha that was found to have radiographic voids was thrown out and replaced.

After applying Cavit-G cement (3M ESPE, Deutschland GmbH, Germany) to the canal orifices of each tooth, we placed them in an incubator at 370C and 100% relative humidity for 30 days to cure the root canal sealer. All of the specimens (n=120) had the Cavit G cement scraped off of them, and then they were divided at random into 8 groups of 15 specimens each.

Cluster A (n = 15): Waterway Star CL2 (Coltene Endo, Coltene Whaledent, Germany) force controlled endomotor handpiece and Protaper rotating broad retreatment documentation (Dentsply Maillefer, Ballaigues, Switzerland) were used to instrument the root trenches (Figure 2). No Endosolv solvent was utilized. We brushed and pushed laterally as we went from file to file, applying 3 Ncm of torque in a crown-down fashion. A D1 record was used at 500 rpm, a D2 record was used in the middle third, and a D3 record was used to its maximum working length in the apical third to aid in the early entry and outflow of root with canalling filling material. Similar root canal instrumentation techniques were used in Group B (n=15), with the exception that 1 ml of Endosolv solvent (Figure no. 3) was applied to each specimen, and two drops were injected into the root canal using a 24 gauge needle connected to a disposable syringe (Dispovan, Hindustan medical devices Ltd., India).

Figure no.2: Protaper universal rotary retreatment files

Figure no.3: Endosolv solvent

Group C (n=15) did not use any dissolved Endosolv during root trench instrumentation. Instead, they used a Waterway Ace CL2 force-controlled endomotor handpiece and D-Race rotating retreatment recordings (FKG Dentaire SA, Switzerland) (Figure no.4). In a crown-down procedure with light apical strain, use a DR1 record spinning at 1000rpm (cycles per minute) to remove root waterway filling material from the coronal-third of root channels, and a DR2 record spinning at 600rpm to remove root trench filling material from the apical two-thirds of root channels upto the full working length consecutively. Group D (n=15): Similar to Group C, D-Race revolving retreatment records were used for root trench instrumentation, with 1ml of Endosolv dissolvable per example and 2 drops of dissolvable placed into the

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root waterway with a 24 gauge needle joined to an expendable needle before the addition of each record.

Figure no.4: D-Race rotary retreatment files

Group E (n=15): As can be seen in Figure 5: using a Channel Genius CL2 force-controlled endomotor handpiece and R-Endo (Miniature Mega, Basancon, France) to record a retreatment process, no Endosolv solvent was utilized during root canal instrumentation. The Rm, Re, R1, R2, and R3 files were cycled in and out throughout time. An Rm file was used to create a passageway into the guttapercha, followed by a Re file to clean out the first 2–3 mm of the canal, followed by R1 and R2 files to clean out the middle and coronal thirds of the canal, and finally an R3 file to clean out the apical third. Group F (n=15) also had their root canals instrumented using R-Endo rotary retreatment files, like Group E (n=12). Each specimen had one milliliter of Endosolv solvent added to it, and two drops were injected into the canal using a 24-gauge needle on a disposable syringe.

Figure no.5: R-Endo rotary retreatment files

Group G (n=15): To perform root canal instrumentation without the use of Endosolv solvent, we followed product recommendations (speed of 350rpm, torque of 1.5NCm) and utilized a Canal Pro CL2 torque-controlled endomotor handpiece in conjunction with Neoendo rotary retreatment files (Orikam Healthcare, India; Figure no.6). Light apical pressure was utilized in a crown-down approach with successive N1, N2, and N3 files. Until the whole working length of the root canal was reached, the filling material was removed using progressively smaller records (N1 for the coronal third, N2 for the middle third, and N3 for the apical third). It's a lot like Group G, 15 participants in Group H had root trench instrumentation using Neoendo rotating retreatment procedures. with the addition of 1 ml Endosolv solvent per specimen and the placement of 2 drops of solvent into the root canal via a 24 gauge needle attached to a disposable syringe.

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Figure no.6: Neoendo rotary retreatment files

Before being reintroduced (or reinserted), all records of rotational retreatment were removed from the canal and cleansed of any clinging flotsam and jetsam, such as guttapercha or root channel sealant. Between uses, 1 cc of regular salt water was poured over the root channel documentation. After five root canal treatments, each rotational retreatment file was thrown away. When guttapercha or root waterway sealant rubbish wasn't found in the retreatment records and the trench walls were smooth, the records were considered complete. the procedure was considered complete.16 Each specimen was then freed from its block of acrylic resin. All endodontic operations were completed by the same person in order to minimize the potential for error amongst different doctors.

Using a diamond disc on a low-speed micromotar straight handpiece, we grooved each specimen in the bucco-lingual direction. Next, we wedged a fine chisel into the groove and twisted the tooth to separate it into two pieces. Each specimen was cut in half lengthwise, and the halves were compared. The halves that showed the most of the root canal were kept, while the other halves were thrown away.

After selecting appropriate samples, we examined them using a stereomicroscope (Figure no.7) at 20X magnification, analyzed the data using AutoCAD (Version 24) software and captured images using a digital camera (Nikon, Japan). No effort was made to identify the additional guttapercha and root waterway sealer that was present. A second examiner, also masked to group assignment, evaluated the quantity of remaining guttapercha or root canal sealer in the coronal, middle, and apical thirds of all specimens using a four-point scale created by Somma F. et al.17

0 = Root canals' dentinal surfaces often have no more than a trace amount of leftover guttapercha or root canal sealer (between 0% and 25%).

1 = Dentinal surface of root canals still carrying between 25 and 50 percent of the original guttapercha or root canal sealant.

2 = Root canal sealant or guttapercha residue on the dentin was moderately present (50%-75%).

3 = Guttapercha or a similar root canal sealer is used to coat the root canal's complete or almost full dentinal surface (75–100%).

Figure no.7: Stereomicroscope

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3. Results:

To conduct statistical analysis on the tabulated data, SPSS Version 24 was utilized with Analysis of Variance (One Way Anova) and Tukey's post hoc test to determine whether root canal filler material had been left behind. and t-test for independence. One-Way Anova examines the variance between the methods to see whether they are similar. The average amount of root canal filling material remaining after treatment was compared among groups, and a statistically significant difference was found with a P value of 0.05.

One-way analysis of variance revealed that Group C (D-Race without solvent) had the lowest levels of leftover root canal filling material (0.260.11), whereas Group D (D-Race with solvent) had the highest levels. For the presence of residual root canal filling material, Group E (R-Endo without solvent) had the greatest mean SD (2.460.13), whereas Group F (R-Endo with solvent) had the highest mean SD (3.000.00).

Group C (D-Race without solvent) and Group A (Protaper without solvent) both had significantly less root canal filling material remaining in the middle third of root canals (MeanSD, 0.200.10) and 0.530.13, respectively. The mean standard deviation for root canal filling material remnants was 3.00 in Group E (R-Endo without solvent) and 3.00 in Group F (R-Endo with solvent).

Group C (D-Race without solvent) had the lowest mean standard deviation for remaining root canal filling material in the apical third of root canals (0.130.09), followed by Group A (Protaper without solvent) (0.200.11). The highest levels of residual root canal filling material were found in Group E (R-Endo without solvent) with a MeanSD of 3.000.00 and in Group F (R-Endo with solvent) with a MeanSD of 2.460.13 (Tables 1 and 2).

Root canal level	No. of samples	Group A (Protaper)	Group C (D-Race)	Group E (R-Endo)	Group G (Neoendo)	P value
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Coronal-third	15	0.40± 0.13	0.26±0.11	2.46±0.13	0.40±0.13	0.000*
Middle-third	15	0.53±0.13	0.20±0.10	3.00±0.10	1.00± 0.10	0.000*
Apical-third	15	0.20±0.11	0.13±0.09	3.00±0.10	2.00±0.10	0.000*

Table no.1: Analysis of Variance (One Way ANOVA) was used to compare four retreatment file systems when filling material remained in the coronal, middle, and apical thirds of the root canal.

* The groups do indeed vary statistically (P 0.05).

P = Standard Deviation, SD = Probability

	No. of samples	Group B (Protaper)	Group D (D-Race)	Group F (R-Endo)	Group H (Neoendo)	P value

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Root canal level						
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Coronal-third	15	1.53±0.13	0.33±0.12	3.00±0.10	2.00±0.10	0.000*
Middle-third	15	2.06±0.26	1.00±0.10	3.00±0.10	2.46±0.13	0.000*
Apical-third	15	1.00±0.10	0.53±0.13	2.46±0.13	2.00±0.10	0.000*

"Table no.2: We compared four different retreatment record frames using one-way analysis of variance (ANOVA) to ensure that all root canal infill material was removed from the coronal, middle, and apical thirds of the root trenches.

* Significantly different groups were observed (P 0.05).

The proportion of root trench filling material that remained in the coronal, middle, and apical thirds of the root channel was measured, and Tukey's post-hoc test was performed to establish whether there was a statistically significant difference between the three regions. In the most distal third of the roots, Groups A and C were almost identical. Groups A and G in the middle third, Groups C and G in the upper third, and Groups A and G in the apical third of the roots, as shown by root waterways (retreatment papers without the use of dissolvable). There was no statistically significant difference (P > 0.05) between Group B and Group H or Group F and Group H in the central third of root canals.

Root canal level	**Groups**	**P value**
Coronal-third	A *vs* C	0.883
	A *vs* E	0.000*
	A *vs* G	1.000
	C *vs* E	0.000*
	C *vs* G	0.883
	E *vs* G	0.000*
Middle-third	A *vs* C	0.038*
	A *vs* E	0.000*
	A *vs* G	0.002*
	C *vs* E	0.000*

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	C *vs* G	0.000*
	E *vs* G	0.000*
Apical-third	A *vs* C	0.907
	A *vs* E	0.000*
	A *vs* G	0.000*
	C *vs* E	0.000*
	C *vs* G	0.000*
	E *vs* G	0.000*

Table no.3: When there is still filling material in the root canal's coronal, middle, or apical thirds, a Tukey post hoc test may be employed to compare the four retreatment file systems without the use of solvent.

*Statistically significant difference exists between the groups ($P \leq 0.05$), P: Probability"

Root canal level	**Groups**	**P value**
Coronal-third	B *vs* D	0.000*
	B *vs* F	0.000*
	B *vs* H	0.004*
	D *vs* F	0.000*
	D *vs* H	0.000*
	F *vs* H	0.000*
Middle-third	B *vs* D	0.000*
	B *vs* F	0.000*
	B *vs* H	0.241
	D *vs* F	0.000*
	D *vs* H	0.000*
	F *vs* H	0.066

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Apical-third	B *vs* D	0.005*
	B *vs* F	0.000*
	B *vs* H	0.000*
	D *vs* F	0.000*
	D *vs* H	0.000*
	F *vs* H	0.005*

Table no.4: Tukey Post-hoc test: Dissolvable within the sight of residual root trench filling material in the coronal-third, central-third, and apical-third of root channels; intragroup comparison across the four retreatment document frames.

*Statistically significant difference exists between the groups ($P \leq 0.05$), P: Probability

Groups A, C, E, and G (reprocessing files without solvent); Groups B, D, F, An independent t-test was performed to examine the mean amounts of residual root canal filler material discovered in the coronal, middle, and apical thirds of the root canal between and H (retreatment records with dissolvable). Bundle F had much more root channel infill material remaining in the coronal third of root trenches (Retreatment records with and without dissolvable) compared to the other seven groups. Bunch E, Bunch H, Bunch B, Bunch A, Bunch D, Bunch E, Bunch C, and Bunch D. Gathering F had the highest mean score and Bunch C had the highest un-mean score near the remnants of root canal filling material.

Group C had the lowest mean score when there was residual root canal filling material, followed by Groups E and F, Group H, Group B, and Groups D, G, A, and H. This was for all eight groups (Retreatment records with dissolvable and without dissolvable). Groups E and F obtained the greatest average scores when there was root canal filling material left behind. Root canals located in the top third of the remaining root canals in each of the eight groups (retreatment files with and without solvent); Group H got a higher mean score than Group A (Table 5), Group G than Group B, and Group E than Group F when it came to root canal filling material that had not completely dissolved.

Root canal level	**Retreatment files used**	**Comparison between groups**	**Sample size**	**Mean**	**± SD**	**P value**
Coronal-third	Protaper	Group A	15	0.40	0.13	0.000*
		Group B	15	1.53	0.13	
	D-Race	Group C	15	0.26	0.11	0.702
		Group D	15	0.33	0.12	
	R-Endo	Group E	15	2.46	0.13	0.001*
		Group F	15	3.00	0.10	

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	Neoendo	Group G	15	0.40	0.13	0.000*
		Group H	15	2.00	0.10	
Middle-third	Protaper	Group A	15	0.53	0.13	0.000*
		Group B	15	2.06	0.26	
	D-Race	Group C	15	0.20	0.10	0.000*
		Group D	15	1.00	0.10	
	R-Endo	Group E	15	3.00	0.10	NA
		Group F	15	3.00	0.10	
	Neoendo	Group G	15	1.00	0.10	0.000*
		Group H	15	2.46	0.13	
Apical-third	Protaper	Group A	15	0.20	0.11	0.000*
		Group B	15	1.00	0.10	
	D-Race	Group C	15	0.13	0.09	0.019*
		Group D	15	0.53	0.13	
	R-Endo	Group E	15	3.00	0.10	0.001*
		Group F	15	2.46	0.13	
	Neoendo	Group G	15	2.00	0.10	NA
		Group H	15	2.00	0.10	

Table no.5: Independent t-test: Comparison between four retreatment file systems without the use of solvent and with use of solvent.

P: Probability, SD: Standard Deviation

*Statistically significant difference exists between the groups ($P \leq 0.05$)

NA: Not Applicable – As, Group E with Group F (middle-third) and Group G with Group H (apical-third) of root canals have exactly similar Mean ± SD values.

The presence of residual guttapercha or root canal sealer was lowest (or lowest) in root canals that had undergone endodontic retreatment with rotary retreatment files without the use of solvent (Groups A,

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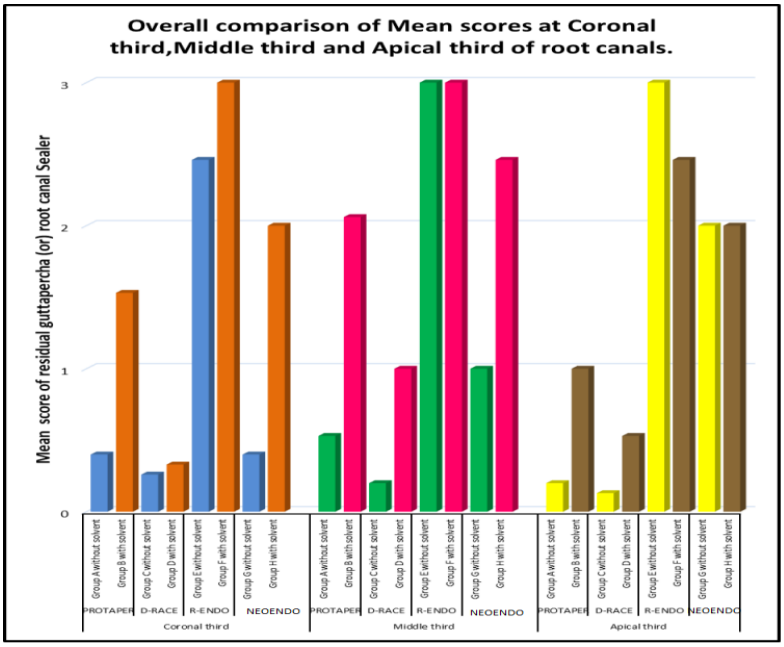
C, E, G; Figures 8, 9, 10, and 11). No significant difference was found between Groups C and D for residual guttapercha or root canal sealer in the coronal third of root canals, Groups A and G for the middle third, Groups G and H for the apical third, and Groups E and F for the apical third.



Graph no.1: Vertical bar graph. Comparison in the presence of residual guttapercha or root canal sealer of the four retreatment file systems used (with solvent and without solvent).

Figure no.8: Group C – Presence of residual root canal filling material post-instrumentation with rotary D-Race retreatment files without using solvent in apical-third of root canal.

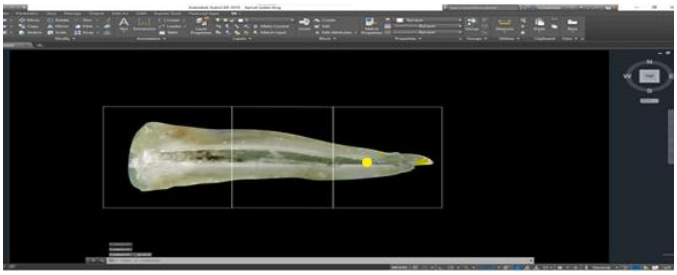


Figure no.9: Group D – Presence of residual root canal filling material post-instrumentation with rotary D-Race retreatment files using solvent in apical-third of root canal.

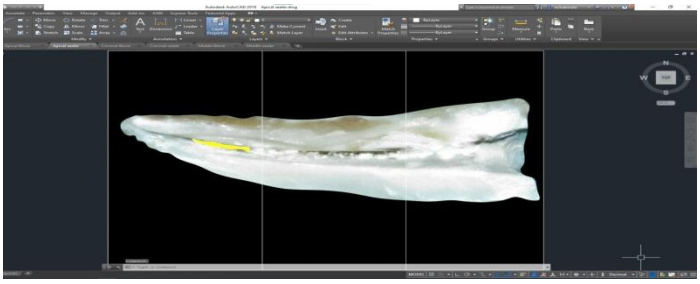


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Figure no.10: Group E – Presence of residual root canal filling material post-instrumentation with rotary R-Endo retreatment files without using solvent in apical-third of root canal.

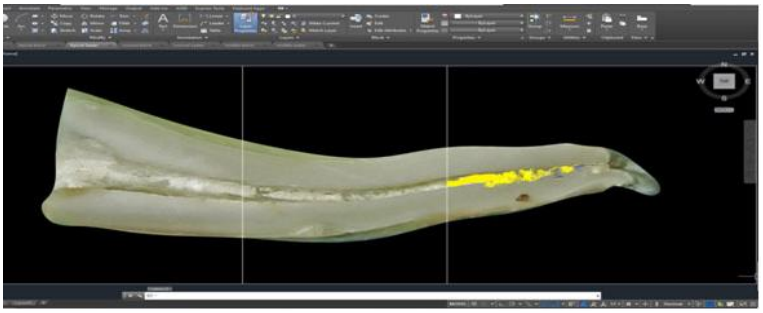
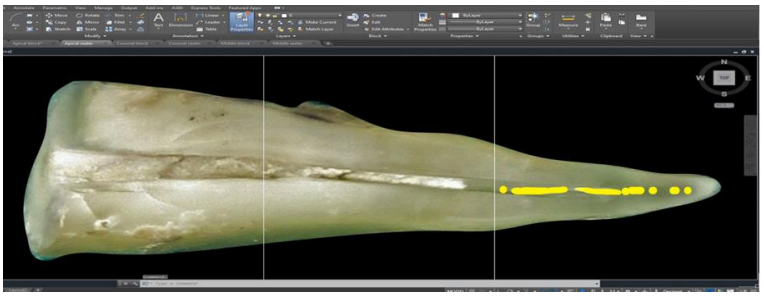


Figure no.11: Group F – Presence of residual root canal filling material post-instrumentation with rotary R-Endo retreatment files using solvent in apical-third of root canal.



4. Discussion:

An endodontic retreatment is done to improve the root canal's size and shape before it is sealed off from the outside world. The complete root canal filling is removed using gutta-percha and root canal sealant. Root retreatment requires as much guttapecha and root channel sealer removal as possible to expose any latent necrotic tissues or microorganisms that may have contributed to the failure of the previous endodontic treatment.[18]

A more reliable correlation of the proposed retreatment methods can be attained by normalizing examples by removing confounding factors like crown life structures and root trench length, which are not reflective of clinical circumstances when working on treatment outcomes via root waterway access.[19] Therefore, in this in-vitro investigation, all specimens were decoronated to produce a uniform working length of around 16 mm, and a consistent methodology for root canal preparation was used on each one.

Removal of guttapercha and root canal sealer with Ni-Ti rotary retreatment files is safer and faster than with other methods because of the files' active cutting tip, larger taper, faster innate speed, and a fluted, dynamically designed tool. Frictional heat produced by rotating files softens and plasticizes guttapercha, while also directing material into the canal openings.[20]

Ni-Ti rotary retreatment files have been used in certain cases, although their efficacy in removing root canal filler material has not been well studied. This investigation compared the effectiveness of four root canal filling removal file systems (R-Endo, Neoendo, Protaper, and D-Race) when used with and without a solvent.

Using your Ni-Ti rotating retreatment papers at the optimal rate and pressure will maximize their effectiveness. To increase the efficiency of rotary retreatment files, this study removed guttapercha and root canal sealant using a torque-controlled endodontic handpiece per the manufacturer's instructions. Each Ni-Ti rotary retreatment file in our research was only used for five root canals before being thrown away to prevent file fractures.

Splitting the root in half and examining it with CT, stereomicroscopic analysis, micro-CT, scanning electron microscopy, or clearing techniques has been used to assess the efficacy of removing residual

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guttapercha or root canal sealer in experimental studies.[21] In the present review, we utilized Stereomicroscopic examination alongside the utilization of Auto-computer aided design Programming; stereomicroscope was utilized to picture the lingering guttapercha and root trench sealer; pictures were caught utilizing advanced camera; recorded and moved into PC; and analyzed utilizing Auto-computer aided design Programming (Form 24), as this product gave the specific region of the three levels of root waterway and furthermore the pre-existing root trench sealer. This approach was deemed more precise than using an evaluation scale, which is an emotive procedure and hence prone to abstract errors.[19]

The current review found that the D-Race turning retreatment document without the use of Dissolvable (Group C) was the most effective at removing lingering guttapercha or root waterway sealer from the coronal-third, the middle-third, and the apical-third of root trenches. This is likely due to the higher rpm of 600-1000 used when following the manufacturer's instructions.

This review confirms the findings of Rodig et al.22 and Ring et al.23, who found that retreatment with D-Race records resulted in significantly less long-lasting obturation material and root waterway sealer than retreatment with Protaper records, and who also noted that the D-Race retreatment document framework utilizes just 2 documents at a generally higher rpm than the Protaper retreatment document framework's 3 record arrangement. The apical tip size of the DR2 file, which is used in D-Race, is 25 millimeters, whereas the apical tip size of the D3 file, which is used in Protaper, is 20 millimeters. Especially in the top third of root trenches, this distinction is crucial for removing guttapercha and root waterway sealant.

According to Ruddle et al[24] By increasing the rotational speed of the retreatment files, enough frictional force is generated to soften the guttapercha and root canal sealer, allowing for their easier removal. Unlike Protaper (with its three files) and R-Endo (with its five files), the D-Race retreatment file system consists of just two files (DR1, DR2). D-Race files prevent guttapercha from adhering to the file flutes because of their alternating cutting edges, which prevents the undesired screwing-in effect. These files' cutting effectiveness is greatly enhanced by their high sharpness, which is achieved in part by the smooth surface provided by a specific electrochemical treatment.[25]

Group A (Protaper retreatment files without the use of Solvent) in our research had the second-lowest levels of residual guttapercha or root canal sealer in the root canals' coronal, middle, and apical thirds. LV Betti et al.[26] Protaper retreatment files (D1, D2, and D3) have a progressive taper and varying tip sizes, which aids in cutting guttapecha and removing root canal sealant. These files have a unique flute design, and when used in a rotating motion, the guttapercha is drawn into the file flutes and guided into the canal opening. As the files rotate, the frictional heat they generate softens the guttapercha, making it more manageable to scrape off.

Da Silva BM et al[27] a wider portion of the root canal may be reached using Protaper retreatment files and tools (D1: 9% taper; D2: 8% taper; D3: 7% taper); this allows for more thorough removal of filling material. The Group of Gu LS.[28] The protaper retreatment files (D1, D2, and D3) are highly regarded for their efficiency in removing root canal sealer due to their gradual taper and design. These files may remove the root canal's outermost layer of dentin in addition to the guttapercha during a retreatment procedure.

When we examined the distribution of residual guttapercha and root canal sealer after using R-Endo retreatment files with and without solvent, we discovered that it was more concentrated in the coronal, middle, and apical thirds of root canals. The absence of radial lands and active tip on R-Endo retreatment files makes them ineffective for removing guttapercha and root canal sealant. The cross section of these files consists of three evenly spaced cutting edges.[29]

R. Ordinola-Zapata et al[30] Using the parallel building method of obturation, it was shown that the depth of penetration of root trench sealers into radicular dentinal tubules was least impacted by the apical third of the root channel. Adopting a sidelong building strategy for root channel obturation often leads to a more effective accumulation of obturating material.[31] The lateral condensation method was used for root canal obturation in this investigation. Fishel MA et al [32] It has been shown that AH Plus root canal sealer has improved adhesiveness to root canal dentin

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because of the sealer's open epoxide ring reacting with the amino groups in the collagen network of root canal dentin.

In the coronal, mesial, and apical thirds of root canals, our research found that using rotary retreatment files (Protaper, D-Race, R-Endo, Neoendo) without solvent was more efficient in removing guttapercha and root canal sealer. Our results mirrored those of Cirligeriu L.E et al.[33] when a result of the dissolvable's action, guttapercha is mellowed when it penetrates the dentinal tubules of radicular dentin, reducing the efficiency with which rotating retreatment recordings clear root canals of debris. Solvents, as observed by C.B. Moushmi et al.34, may dissolve guttapercha, transforming it into a more viscous and extremely sticky substance. Previous research by Yadav P et al. is supported by our findings.[35] Root canal retreatment is complicated by a layer of softened guttapercha that infiltrates the dentinal tubules, preventing a thorough cleaning and allowing microorganisms to remain in the root canal system.

5. Conclusion:

Based on the foregoing, we conclude that, when compared to D-Race documents with dissolvable and the wide range of different three revolving retreatment document frameworks (regardless of dissolvable), The coronal, central, and apical thirds of root waterways included the least leftover guttapercha or root channel sealer, according to data of D-Race retreatments performed without the use of dissolvable. R-Endo retreatment documentation showed that leftover guttapercha or root trench sealer was most common in the coronal, middle, and apical thirds of root channels. independent of the use of dissolvable.

Revolving retreatment papers without dissolvable were found to be more effective than revolving retreatment documents with dissolvable at all three levels of root waterways in removing residual guttapercha or root trench sealant. Therefore, further research is needed to connect the dots between the findings of this in-vitro study and the evaluation for an optimum rotating retreatment document framework for the full evacuation of residual guttapercha or root channel sealer in clinical settings.

Conflict of interests: The writers have assured us that they have no competing interests with this publication.

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References:

1. Suk M, Bago I, Katic M, Snjaric D, Munitic MS, Anic I. The efficacy of photon initiated photoacoustic streaming in the removal of calcium silicate-based filling remnants from the root canal after rotary retreatment. Lasers Med Sci 2017;32:2055-2062.
2. Bago I, Suk M, Katic M, Gabric D, Anic I. Comparison of the effectiveness of various rotary and reciprocating systems with different surface treatments to remove gutta-percha and an epoxy resin-based sealer from straight root canals. Int Endod J 2019;52:105-113.
3. American Association of Endodontists: “Glossary of endodontic terms”. 2012; Page No: 44.
4. Ralan Wong.Conventional endodontic failure and retreatment. Dent Clin North Am 2004; 48:265-289.
5. Saad AY, Al-Hadlaq SM, Al-Katheeri NH. Efficacy of two rotary NiTi instruments in the removal of gutta-percha during root canal retreatment. J Endod 2007;33:38–41.
6. Lovdahl PE. Endodontic retreatment. Dent Clin North Am 1992;36:473-488.
7. Laxmi Nidhi Rao, Priyadarshini Hegde, Mitra N Hegde.Rotary inretreatment. International Journal of Scienctific Research 2016; 5;6:16-18.
8. Mollo A, Botti G, Goldoni N P, Randellini E, Paragliola R, et al. Efficacy of two Ni-Ti systems and hand files for removing gutta-percha from root canals. Int Endod J 2012;45:1:1-6.
9. Bergenholtz G, Lekholm U, Milthon R. Retreatment of endodontic fillings. Scand J Dent Res 1979;87:217-224.
10. Wahane KD, Kulkarni SS, Daokar S, Patil K, Patel K, Thorat T. An assessment of the efficacy of a rotary and a reciprocating retreatment file system for removal of gutta-percha from root canals. An in vitro cone-beam computed tomography study. Endodontology 2021;33:20-24.
11. Das S, De Ida A, Das S, et al. Comparative evaluation of three different rotary instrumentation systems for removal of gutta-percha from root canal during endodontic retreatment: an in vitro study. J Conserv Dent 2017;20;5:311-316.

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

12. Akhavan H, Azdadi YK, Azimi S, et al. Comparing the efficacy of Mtwo and D-RaCe retreatment systems in removing residual gutta-percha and sealer in the root canal. Iran Endod J 2012;7:122-126.
13. Muraleedhar AV, Satish SV, Patil AM, et al. Comparative evaluation of efficacy of three different rotary retreatment systems with manual instrumentation in removing gutta-percha from root canals - an in vitro study. J Evolution Med Dent Sci 2021;10;14:1025-1029.
14. Sunil SM, Rajkumar B, Gupta V, Bhatt A, Paliwal P. A comparative evaluation of removal of gutta percha using two retreatment file system: An in vitro study. IP Indian J Conserv Endod 2020;5;1:53-57.
15. Schneider SW. A comparison of canal preparations in straight and curved root canals. Oral Surg Oral Med Oral Pathol 1971;32:271-275.
16. Zmener O, Pameijer CH, Banegas G. Retreatment efficacy of hand versus automated instrumentation in oval shaped root canals: an ex vivo study. Int Endod J 2006;39:521–526.
17. F. Somma, G. Cammarota, G. Plotino, NM. Grande, CH. Pameijer. The effectiveness of manual and mechanical instrumentation for the retreatment of three different root canal filling materials. J Endod 2008:34;4:466–469.
18. Sjogren U, Hagglund B, Sundqvist G, Wing K. Factors affecting the longterm results of endodontic treatment. J Endod 1990;16:498 – 504.
19. Barletta FB, Rahde NM, Limongi O, Moura AA et al. In vitro comparative analysis of 2 mechanical techniques for removing gutta-percha during retreatment. J Can Den Assoc 2007; 73:65-65.
20. Zanettini PR, Barletta FB, De Mello Rahde N. In vitro comparison of different reciprocating systems used during endodontic retreatment. Aust Endod J 2008;34:80–85.
21. Gu LS, Ling JQ, Wei X, Huang XY. Efficacy of ProTaper Universal rotary retreatment system for gutta-percha removal from root canals. Int Endod J 2008;41:288–295.
22. Rodig T, Hausdorfer T, Konietschke F, Dullin C, et al. Efficacy of D-Race and Protaper universal retreatment Ni-Ti instruments and hand files in removing guttapercha from curved root canals. A micro-computed tomography study. Int Endod J. 2012;45:580-589.
23. Ring J, Murray PE, Namerow KN, et al. Removing obturation materials: A comparison of rotary file system and re-treatment agents. J Am Dent Assoc2009;140:680-688.
24. Ruddle C. Removal of Obturation Materials. Advance Endodontics 2016.
25. 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;32:469–472.
26. Betti LV, Bramante. Quantec SC rotary instruments versus hand files for guttapercha removal in root canal retreatment. Int Endod J 2001;34:514–519.
27. Da Silva BM, Filho FB, Leonardi DP, et al. Effectiveness of ProTaper, D-Race and Mtwo retreatment files with and without supplementary instruments in the removal of root canal filling material. Int Endod J 2012;45;10:927–932.
28. Gu LS, Ling JQ, Wei X, Huang XY, et al. Efficacy of Protaper universal rotary retreatment system for guttapercha removal from root canals. Int Endod J 2008;41:288–295.
29. Tasdemir T, Er K, Yildirim T, Celik D, et al. Efficacy of three rotary NiTi instruments in removing gutta-percha from root canals. Int Endod J. 2008;41:191–196.
30. R. Ordinola-Zapata, C. M. Bramante, M. S. Graeffet al., Depth and percentage of penetration of endodontic sealers into dentinal tubules after root canal obturation using a lateral compaction technique. A confocal laser scanning microscopy study. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology 2009;108;3:450–457.
31. N.T. Nguyen. Obturation of the root canal system. Pathways of the Pulp, S. Cohen and R.C. Burns, 1994; Page no. 233, Mosby Year Book, St Louis, Mo, USA, 6th edition.
32. Fisher MA, Berzins DW, Bahcall JK. An in vitro comparison of bond strength of various obturation materials to root canal dentin using a push-out test design. J Endod 2007;33:856-858.
33. Cirligeriu Laura Elena, Nica Luminița Maria, Poparlan Florin, et al. The comparative efficacy of the Protaper universal retreatment and reciproc systems in the removal of guttapercha

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

from root canals. J. Research and Clinical Medicine 2020;4:8-13.

34. Moushmi C.B, Abhinav Diwan, S. Kusumvalli, et al. Efficacy of two rotary retreatment systems in removing gutta-percha and sealer during endodontic retreatment with or without solvent: A comparative in vitro study. J Conserv Dent 2017;20:12-16.
35. Yadav P, Bharath MJ, Sahadev CK, et al. An in vitro CT comparison of gutta-percha removal with two rotary systems and hedstrom files. Iran Endod J 2013;8;2:59-64.