“INVITRO EVALUATION OF FOUR DIFFERENT TECHNIQUES IN GP REMOVAL”

A dissertation submitted

in partial fulfillment of the requirements

for the degree of

MASTER OF DENTAL SURGERY

BRANCH IV

CONSERVATIVE DENTISTRY AND ENDODONTICS

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI – 600032

2015 - 2018

DECLARATION BY THE CANDIDATE

I hereby declare that this Dissertation titled **''IN VITRO EVALUATION OF FOUR DIFFERENT TECHNIQUES IN GP REMOVAL"** is a bonafide and genuine research work done by me under the guidance of **Dr.P.Hemalatha, M.D.S., Professor and Head of the Department,** Department of Conservative Dentistry and Endodontics, Best Dental Science College, Madurai -625104.

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“ Knowledge is in the end based on acknowledgement”

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This agreement herein after the "Agreement" is entered into on this day ~~Dec 2017~~, 22/01/2018 between the Best Dental Science College represented by its **Principal** having address at Best Dental Science College, Madurai – 625104, (hereafter referred to as, 'the College')

And

MISS.Dr. HEMALATHA.P aged 39years working as **Professor** in Department of Conservative Dentistry&Endodontics at the College, having residence address at4/66, SappaniKoil Lane, North MasiSreet, Madurai-625001 (herein after referred to as the 'Principal Investigator')

And

Dr.MOHAMEDE ISMAIL.I aged 29years currently studying as **Post Graduate student** in Department of Conservative Dentistry & Endodontics, Best Dental Science College, Madurai-625104 (herein after referred to as the ' PG/Research student and Co-Investigator')

Whereas the PG/Research student as part of her curriculum undertakes to research on**''IN VITRO EVALUATION OF FOUR DIFFERENT TECHNIQUES IN GP REMOVAL''**

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LIST OF ABBREVIATION USED

(IN ALPHABETICAL ORDER)

ABBREVATION	WORD EXPLANATION
AAE	American association of Endodontists
ANOVA	Analysis of variance
CT	Computed tomography
GP	Guttapercha
H-files	Hedstrom - files
NiTi	Nickel-titanium
NSRCT	Non-surgical retreatment
Naocl	Sodium hypochloride
PUI	Passive ultrasonic irrigation
PTUS	ProTaper universal Retreatment System
S.D	Standard deviation
SS	Stainless steel
WL	Working length

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INTRODUCTION

The success of rootcanal therapy depends upon proper working length determination, complete chemo mechanical debridement and three dimensional obturation. The Washington study by Ingle in 1951, evaluated a total population of 3678 patients for the success and failure of endodontic treatment, on a recall basis at 6 months, 1year, 2 years and 5 years. The statistically significant two year recall analysis showed that there was a better success rate for non surgical treatment which was assessed on the basis of improvement of the periradicular health. The overall success rate for primary endodontic treatment is 94%[1]

Myriad of factors have been implicated in the failure of endodontic treatment. The usual factors which can be attributed to endodontic failure are: persistence of microorganisms in root canals, persistence of pulp tissue and remnants, deficiency in obturation, overextension of obturating materials, improper coronal seal, untreated canals, iatrogenic procedural errors such as poor access cavity design, complications of instrumentation like ledges, perforations, or separated instruments.[2]

Endodontic retreatment is a procedure performed on a tooth that has received prior attempted definitive treatment resulting in a condition requiring further endodontic treatment to achieve successful results. As defined by the American association of endodontists (AAE), retreatment is the removal of rootcanal filling materials from the tooth, followed by cleaning, shaping and obturating the canals.[3]

Non-surgical retreatment should be considered as the first treatment option even in cases of persistant periapical lesions, as it has been reported to have the success rate of 65% to 80%.[4] It is also mandatory to assure the restorability of the tooth to facilitate its function.

When the choice is non surgical endodontic retreatment, the goal is to access the pulp chamber and remove materials from the root canal space and if present address deficiencies or

repair the defects that are pathologic or iatrogenic in origin. In cases with obstructions within the root canal system that make nonsurgical retreatment impossible, then surgical retreatment can be the option that is preferred/recommended.[5]

According to Ingle, "Non-surgical retreatment (NSRCT) are disassembly and corrective procedures which are performed to potentially enable the clinician to properly clean, shape and seal the root canal system".[5]

The major goal of nonsurgical retreatment is to re-establish healthy periapical tissues following ineffective root canal treatment and reinfection.[6]Root canal retreatment requires complete removal of root filling material, inorder to uncover remaining necrotic tissues or bacteria that may be responsible for periapical inflammation and post treatment disease.[7,8]

Removing of sealer and gutta-percha from inadequately prepared and obturated root canal systems is critical in order to uncover remnants of necrotic tissue or bacteria that may be responsible for periapical inflammation and failure . GP removal will be settled by endodontic hand files, heat-carrying instruments, ultrasonics, rotary instruments with or while not the help of solvents.[9]

Many techniques are projected to get rid of remove filling materials from root canal system, together with the utilization of endodontic hand files, Gates Glidden burs, heated instrument, ultrasonic instruments, Nickel Titanium rotary instruments, laser and use of adjunctive solvents like chloroform, halothane, eucalyptus oil, xylene, orange oil, turpentine oil and whitepine oil.[10]

Conventionally, the removal of gutta-percha using manual files with or without solvent can be a tedious, time-consuming process, especially when the root filling material is well condensed. Hence, rotary nickel-titanium (NiTi) instruments are used to get rid of filling

materials from root canal walls & varied studies reported their efficaciousness, cleansing ability and safety.[11]

Hand files are employed in the retreatment procedures. Initially H-files with the single helix, tear drop shaped cross sectional design and positive rake angle were the instruments designed for the removal of filling materials. Unal et al. found K-files and H-files to be more effective in removing filling material than ProTaper and R-Endo instruments in curved canals.[12]

Later rotary NiTi systems have been introduced for retreatment which resulted in reduction in the treatment time when compared with hand instrumentation. Softening of gutta-percha during rotary instrumentation caused by frictional heat results in easier penetration and removal of the filling material is the main reason for this observation.

The cleaning ability of Protaper universal retreatment files depend on the characteristics of the convex triangular cross sectional design of the instruments. The negative cutting angle and the absence of radial lands permit a cutting action rather than a planning action. Protaper-R file D1 incorporates a cutting tip to facilitate initial penetration into the filling material. D2 and D3 each have non cutting tips and are used to take away material from the middle and apical thirds.

RaCe NiTi instruments has a triangular cross section, variable and alternated helical angle with non active tip. The alternate cutting edges and electro polished smooth surface attributes to its effective removal of GP.

R-Endo retreatment instruments have a triangular cross section with three equally spaced cutting edges; the instruments have neither radial land nor an active tip. This system comprises of a stainless steel Rm hand file used to break the hard layer of root filling material and four NiTi rotary instruments in continous rotation for flaring (Re) and progressive shaping of

the three rootcanal areas (R1,R2,R3). Hence H-file, Protaper universal retreatment file, D-Race file and R-Endo file have been taken for this study to evaluate the efficacy of removal of GP and sealer.

Variety of chemical solvents like chloroform, xylol, eucalyptol, orange oil, halothane are used for solubilization of gutta-percha and sealer inorder to facilitate easy removal of filling material without damage to the tooth. Solvents acts as adjunct in the removal of the gutta-percha. Hand or rotary files must be used to complete the removal of the entire filling material.

With the benefit of education and experience, one should be able to choose the proper cases for endodontic retreatment and reject those that will obviously fail, but it is not always possible. The reported success of retreatment is 87.9% .The lower success rate of secondary treatment may be due to the incomplete elimination of certain microorganisms which are known to be common in such cases, for example, E. faecalis, the elimination of this microbe could be difficult because of its resistance to some disinfectants used during the treatment, particularly calcium hydroxide. It has been postulated that E. faecalis may be able to invade the dentinal tubules and adhere to collagen in the presence of human serum.[14]

The aim of this study was to compare the efficiency of different retreatment instrumentation techniques to remove the filling material from the root canal walls, during retreatment procedure and also to assess the percentage of remaining filling materials on root canal walls using Stereomicroscope.

AIM AND OBJECTIVES

AIM:

The aim of this study was to compare the efficiency of different retreatment instrumentation techniques to remove the filling material from the root canal walls, during retreatment procedure and also to evaluate the percentage of remaining filling materials on root canal walls using Stereomicroscope.

OBJECTIVES:

1) To compare the Efficiency of different files during retreatment instrumentation techniques in removal of the filling material from the root canal walls during retreatment, under stereo microscope.

2) To evaluate the Percentage of remaining filling material in coronal, middle and apical portions of root canal walls.

REVIEW OF LITERATURE

Abramovitz .I et al (2012)[1]checked the efficacy of a two- stage retreatment method in which the self-adjusting file (SAF) is used to remove root canal filling residue left in the canal after using protaper universal retreatment files. The study concluded no system removed the root filling material entirely. After rotary instrumentation using protaper universal retreatment files followed by use of SAF resulted in a significant reduction in the amount of filling residue in curved canals.

Akhavan et al (2012)[2]compared the ability concerning Mtwo and D-RaCe retreatment systems to put off residual gutta-percha and sealer in the root canal after retreatment. Group 1 become retreated with Mtwo and Group 2 with D-RaCe. Both groups have been then divided into two subgroups retreated either without or with solvent. Teeth were then vertically sectioned for evaluation of residual filling materials on the canal walls. In this study he concluded a negative effect of solvent on removal of gutta-percha and sealer in both the Mtwo and D-RaCe systems.

Asheibi et al (2014)[3]compared the effectiveness of ProTaper rotary files with ProTaper-R and K-files in the removal of Resilon or guttapercha (GP) from canals filled either by cold lateral condensation or thermal obturation using micro-CT. Group-1 was filled with GP/AH-Plus and Group-2 with Resilon/RealSeal using cold lateral condensation. Group-3 was filled with GP/AH-Plus and Group-4 with Resilon/RealSeal using System Band Obtura II. The roots were scanned by micro-CT. Each group was divided into two subgroups (n=12): A, retreated using ProTaper files and B, using ProTaper-R and K-files. He concluded that obturation using thermal technique resulted in significantly less remaining material than cold condensation except Resilon retreated using ProTaper-R and K-files.

Barletta et al (2007)[5]compared the capacity of a reciprocating system (Endo-Gripper) and a rotary system (Profile .04) for mechanical removal of root-filling material from curved root canals. Eighty canals (40 mesiobuccal and 40 mesiolingual) from mandibular first molars were instrumented and filled. After 6 months, the volume of root-filling mass was measured by computed tomography (CT). Root fillings were removed by either the reciprocating system with K-type files or the rotary system with NiTi files. The volume of filling debris remaining after the removal procedures was assessed by CT. He concluded there were no significant differences between the reciprocating and rotary systems with regard to the volume of filling material left inside the canals after mechanical instrumentation.

Betti .L .V et al (2001)[6] study was to compare Quantec SC rotary instruments and hand files for removal of gutta-percha during retreatment. The time for root filling removal was significantly less when Quantec SC was used. Although Quantec SC instruments took less time, hand instruments and solvent cleaned canals more effectively.

Bernardes RA et al (2015)[7]used micro-CT to quantitatively measure the number of residual filling material after using numerous techniques to get rid of root filling with and without ultrasonic activation and to analyze the cleanliness of the root canal walls and dentine tubules with scanning electron microscopy (SEM).The method used for removing the root filling: G1-Reciproc (using only instrument R50), G2-Protaper Universal Retreatment System, and G3-Manual (Hand Files and Gates Glidden burs). None of the methods were able to completely remove root filling material. Ultrasonic activation stepped forward the removal of root filling material in all group.

Bodrumlu E et al (2008)[8]compared the retreatment of a root canal within the case of infection needs get rid off previous rootcanal filling material. This study analyse the efficaciousness of three techniques in removing laterally compacted Resilon/Epiphany and GP/AH Plus from straight and curved canals throughout retreatment.

Clovis Monteiro Bramante et al (2010)[9] ex vivo study evaluated the warmth release, time needed, and clean up effectivity of MTwo (VDW, Munich, Germany) and ProTaper Universal Retreatment systems (Dentsply/Maillefer, Ballaigues, Switzerland) and hand instrumentation in the removal of filling material. ProTaper UR and MTwo R caused the greatest and lowest temperature increase on root surface, respectively; regardless of the type of instrument, more heat was released in the cervical third. Pro Taper UR needed less time to remove fillings than MTwo R. All techniques left filling debris in the root canals.

Carlos Eduardo da Silveira Bueno et al (2006)[10] assessed in vitro the efficacy of nickel-titanium K3 rotary files and hand files for removal of guttapercha and sealer from obturated root canals using either chloroform or chlorhexidine as solvents Group I: size 3 Gates-Glidden drills plus size 30 hand K-files and Hedstrom files and chloroform; Group II: K3 NiTi rotary files and chloroform; and Group III: K3 NiTi rotary files and 2% chlorhexidine gel. The findings of this study showed that, despite the technique used for removal of filling material, none of the retreated canals were completely free of gutta-percha and sealer remnants. The use of stainless steel hand files resulted in a lesser amount of filling debris than the use of nickel-titanium rotary instruments.

Rodrigo Sanches Cunha et al (2007)[11] evaluated the filling material removal and reinstrumentation operating time of canals which was filled with Resilon/Real Seal in comparison with canals filled with gutta-percha/AH Plus. When compared with GP cones and the AH plus cement ,Resilon/Real Seal system was removed in higher quantities from the canal walls. Time was not a big issue. Under scanning electron microscopy analysis, the teeth given material remnants in the 3 analyzed thirds. Resilon was higher off from the canal than the gutta-percha cones and the AH Plus.

De carvalhomaciel .A.C et al (2006)[14] compared automated and manual instrumentation techniques for removing filling material from root canal walls during root canal retreatment. He concluded that a photo micrographic method by epiluminescence was more effective than the radiographic method to evaluate filling debris. There was no significant difference between the filling materials in terms of their removal. K3 and ProTaper were more efficient than manual instrumentation.

De Mello Junior JE et al (2009)[15]compared the efficacy of guttapercha/sealer removal from endodontically treated extracted human teeth with and without the aid of a clinical operating microscope/ultrasonic instruments. Teeth were divided into 2 groups: group I, re-treated using a conventional technique with burs and solvent; and group II, re-treated using a conventional technique with burs and solvent plus clinical operating microscope/ultrasonic tips. The use of the dental operating microscope and ultrasonic tips removed the filling material from root canal walls higher, however all examined teeth, in each groups, had remaining filling material on canal walls.

Duarte et al (2010)[17] evaluate the effectiveness of manual and rotary instrumentation techniques for removing root fillings after different storage times. 24 canals from palatal roots of human maxillary molars were instrumented and filled with gutta-percha and zinc-oxide eugenol-based sealer (Endofill), and were hold on in saline for 6 years. Non-aged control specimens were treated in the same manner and hold on for 1 week. All canals were retreated using hand files or ProTaper Universal NiTi rotary system. The roots were vertically split, the halves were examined with a clinical microscope and the obtained images were digitized. There was no statistically significant difference between the manual and rotary techniques for filling material removal regardless the ageing effect on endodontic sealers. He concluded that all canals presented residual filling material after endodontic retreatment procedures.

Ersev .H et al (2012)[18] evaluated residual root filling material following removal of three newly developed root canal sealers used with a matched-taper single cone root filling technique and to compare the efficiency of protaper universal rotary retreatment instruments with conventional manual technique. When using a gross radiographic criteria, the Activ GP used to be greater efficaciously eliminated from root canals than AH plus together with hand instrumentation. Hybrid root seal, Endosequence BC sealer and AH plus has been eliminated to a comparable extent. Protaper universal retreatment instruments and hand instruments were same as safe and effective in reaching the working length.

Fenoul .G et al (2010)[20]evaluated the effectiveness of the R-Endo rotary nickel titanium instrumentation system and hand instrumentation to take away gutta-percha or Resilon from root canals. No vital variations occurred between thirds, material or removal technique concerning remaining filling debris. However, time to reach the working length and

for removal of filling were lower with R-Endo than with Hedstrom files. Both instrumentation techniques left filling material inside the root canal and mainly in the apical third. There was no difference between the instrumentation techniques.

Gergi et al (2007)[21]evaluated ex vivo the effectiveness of hand files, ProTaper and R-Endo rotary instruments when removing gutta-percha from curved root canals. All instruments left filling material inside the root canal. ProTaper and R-Endo rotary instruments were inadequate for the complete removal of filling material from the root canal system.

Valentina Giuliani et al (2008)[22] study was to judge the efficaciousness of the ProTaper Universal System rotary retreatment system and of Profile 0.06 and hand instruments (K-file) in the removal of root filling materials. The ProTaper-R files and ProFile rotary instruments worked considerably quicker than the K-file. The ProTaper-R files left cleaner root canal walls than the hand instruments K-fies and the ProFile Rotary instruments, although none of the devices used guaranteed to get rid off filling materials. The rotary NiTi system proved to be faster than hand instruments in removing root filling materials.

Gu L.S et al (2008)[25]evaluated the efficiency of the protaper-R system for GP removal from root canals. In Group A GP removal completed with the protaper universal rotary retreatment system and with additional canal repreparation accomplished with protaper universal rotary instruments, Group B –GP removal was completed using Gates Glidden drills and Hedstrom files with chloroform as a solvent, followed with additional canal repreparation with protaper universal rotary instruments, Group C identical as group B for GP removal with further canal preparation with stainless steel K flex files. He concluded that all techniques left GP/sealer remnants within the root canal. Thus it is proved that the efficient method of removing

GP and sealer from maxillary anterior teeth is by the protaper universal rotary retreatment system.

Haapasallo M et al (2012)[26]used micro-computed tomography to evaluate the amount of remaining root filling material in oval canals filled by using 2 obturation techniques after retreatment with the ProTaper Universal Retreatment with or without solvent. He concluded that none of the retreatment techniques were able to completely remove all gutta-percha/sealer from the oval canals. More root filling material was left in the root canals filled by using the continuous wave condensation technique than those filled by using the cold lateral condensation technique after retreatment. In the non solvent groups, less time was needed to achieve satisfactory gutta-percha removal and root canal refinement than in the solvent groups.

Hammad et al (2008)[27]study was to compare the percentage of 3D volume of remaining filling materials in canals filled with realseal, endorez, guttaflow and gutta-percha after retreatment with endodontic manual files and retreatment with endodontic manual files and retreatment protaper rotary files by using micro computed tomography. The study showed that, by using hand and rotary files were not completely removed all tested filling materials during retreatment. Guttapercha was more efficiently removed by using hand K files. In future,a combination of a pair of techniques, hand files and protaper-R files, might result in more efficient removal of material.

Hassanloo et al (2007)[29]assessed the efficaciousness of retreatment of canals filled with the epiphany system with and without solvent, with particular reference to the extent of canal enlargement during retreatment. He concluded that epiphany system was retreatable with

and without chloroform, with lesser efficacy than guttapercha and AH plus sealer. The major amount of residues were present in the apical segments of canals were removed before retreatment which is enhanced by apical enlargement beyond the diameter of the canal .

Horvath D et al (2009)[29] determined the influence of solvents on gutta-percha and sealer remaining on root canal walls and in dentinal tubules Removal of root fillings was undertaken after 2 weeks using Gates Glidden burs and hand files without solvent (group 2), with eucalyptol (60 microL; group 3) and with chloroform (60 microL; group 4) to size 50 Solvents led to more gutta-percha and sealer remnants on root canal walls and inside dentinal tubules.

Hulsmann .M et al (2004)[31] evaluated the efficacy, cleaning ability and safety of three different rotary nickel-titanium instruments with and without a solvent (eucalyptol) versus hand files in the removal of gutta-percha root fillings. GP removal was performed with the following devices and techniques: FlexMaster, GTRotary, ProTaper and Hedstrom files. Flex-Master and ProTaper NiTi instruments proved to be efficient and timesaving devices for the removal of gutta-percha. The use of eucalyptol as a solvent shortened the time to reach the working length and to remove the gutta-percha, but this was not significant.

Imura. N et al (2000)[32]study was to quantify the quantity of remaining gutta-percha/sealer on the walls of root canals once two engine-driven instruments (Quantec and ProFile) and two hand instruments (K-file and Hedstrom file) were used to remove these materials. The number of apically extruded debris and the time needed for treatment were also noted. The results showed that overall, all instruments may leave root canal filling

material inside the root canal. Throughout the retreatment procedure there is a risk for instrument breakage, particularly rotary instruments.

EmreIriboz et al (2014)[33]evaluated the effectiveness of the protaper and Mtwo retreatment systems for removal of resin based obturation techniques during retreatment. In the present study, in teeth obturated using the Resilon-Epiphany technique, less remnant filling material was observed with the other techniques. Teeth prepared with Mtwo instruments contained significantly more remaining filling material than those prepared with protaper. The time required to remove gutta-percha+AHplus was significantly less than that required for the other obturation techniques The retreatment time of the teeth prepared with protaper was significantly reduced compared to that of those prepared with Mtwo.

Jamie Ring et al (2009)[34]compared the effectiveness and working time of two rotary instrumentation file systems with two solvents for the removal of gutta-percha (GP) (ProTaper Universal, Dentsply Tulsa Dental,Tulsa, Okla.) or resin-based composite (RBC) (RealSeal 1 Bonded Obturator, SybronEndo, Orange, Calif.) endodontic obturation material Re-treatment with EndoSequence rotary files was quicker than re-treatment with ProTaper Universal re-treatment files (Dentsply Tulsa Dental). However, in this study, the file systems were similarly effective in removing GP and RBC. Orange solvent was as effective as chloroform in removing obturation materials, but its use is less time-consuming.

Kefah .M et al (2002)[38]compared the cleanliness of the root canal walls after retreatment using nickel titanium (NiTi) rotary and stainless steel (SS) files. Also compared were time of retreatment and canal deviation. Results showed that the mean percentage of wall coverage by remaining obturating material in the SS group was 13.6% and

was 15.2% for the NiTi group. There was no statistically significant difference (p = 0.361). No severe canal deviation occurred with either retreatment method. Mean retreatment time for the SS group and NiTi roup was 6.3 min and 7.9 min ; the difference was statistically important ('t' test p < 0.001). Lastly, NiTi rotary and SS hand files were similar in removing filling material remaining after retreatment, however SS hand files was a small amount quicker

Fir .A .K et al (2012)[39]compared the ability over five techniques for the elimination of root filling material yet to test the hypothesis that radiographs fail to represent the real extent of remaining material on canal walls. As a whole, 11–26% of the canal wall remained covered with filling material; no significant variation was found among the groups. The mechanized methods were faster than manual removal of filling material. The use of solvent did not speed up the mechanized procedures. Radiographic evaluation did not thoroughly and reliably detect the quantity of filling material remaining on the canal walls, which was later determined by microscopic analysis. He concluded that all methods left root canal filling material on the canal walls. Radiographic evaluation failed to detect the extent of remaining root filling material, which could only be detected using microscopy of mandibular molars.

Khalilak Z et al (2013)[40]assess the effectiveness of H-File and ProTaper-R with or without chloroform in the elimination of filling material GP during retreatment of mandibular premolars. Removal of GP was performed with H-File and ProTaper. All techniques were used with or without chloroform. The treated teeth were split longitudinally and the area of remaining gutta-percha/sealer on the root canal wall was explored under stereomicroscope. In all groups, no significant difference was found in remaining gutta-percha and sealer with or without using chloroform, but chloroform

reduced the time of retreatment. ProTaper left significantly less remaining filling materials than H-File in canals with no or slight curvature. Retreatment time was significantly different between the studied groups. ProTaper Ni-Ti instruments proved to be more efficient and time-saving devices for removal of gutta-percha compared to H-File in canals with no or slight curvature.

Kok D et al (2014)[41]assessed the penetrability of two sealers (MTA Fillapex and AH plus) into dentinal tubules, which was submitted to rootcanal treatment and sooner or later to rootcanal retreatment. There was no significant difference was observed among the two experimental groups ($P > 0.05$). On the other hand, the sealers in the control group were not capable to penetrate into dentinal tubules after endodontic treatment ($P > 0.05$). In retreatment cases, no sealers would be able to penetrate into dentin tubules . It can be concluded that sealer penetrability is high in rootcanal treatment. But, MTA Fillapex and AH Plus do no longer penetrate into dentinal tubules after rootcanal retreatment.

Kosti .E et al (2006)[42]compared the efficacy of ProFile rotary Nickel–Titanium (Ni–Ti) instruments and Hedstrom - files (H-files) combined with Gates-Glidden (GG) drills during removal of gutta-percha root fillings used in combination with one of the four representative sealers. Sealer remnants were observed with both techniques mainly in the middle and apical third of the root canal. The ProFile system and the H-files were associated with similar amounts of remaining filling material. In the cervical third of the root canal all sealer remnants were removed with both techniques. In the middle and apical third AH26 was associated with a statistically significant greater quantity of remnants on the root canal walls with both removal techniques .He concluded that None of the methods used for

the removal of root fillings was totally effective, especially in the apical third of the root canal.

Marciano. M et al (2010)[44]reported that Confocal laser scanning microscopy will be employed in laboratory research to get a series of optical XY images through the thickness of the dentin of endodontically treated teeth. With this information the study of the resin/dentin interface of root canal fillings is attainable. By comparing SEM and Confocal microscopy, confocal microscopy has the advantage of providing accurate information and one of the easy method to see the variation and distribution of sealers within dentinal tubules in non-dehydrated samples through the use of Rhodamine-marked sealers. 3D reconstructions can also be generated with the digital data. In this work, some examples which includes epoxy and methacrylate resin sealers are given in relation to the sealer/dentin interface for different endodontic materials .

Marcus Vinícius Reis Só et al (2008)[45] evaluated the efficacy of ProTaper - R system and hand files for removal of filling material during retreatment and the influence of sealer type on the presence of filling debris in the reinstrumented canals. G1, EndoFill/hand files; G2, AH Plus/hand files; G3, EndoFill/ProTaper; G4, AH Plus/ProTaper. He concluded that all techniques were similar in the apical third. All groups presented filling debris in the 3 canal thirds after reinstrumentation.

Marcus Vinícius Reis SO (2012)[46] evaluated the effectiveness of ProTaper Universal rotary retreatment system and also the influence of sealer type on the presence of filling debris within the reinstrumented canals viewed in an operative clinical microscope.

Remnants was left in all canal thirds, irrespective of the retreatment technique. The greatest differences between techniques and sealers were found within the cervical third.

Marfisi .K et al (2010)[47] evaluated the efficaciousness of protaper-R files, Mtwo retreatment files and twisted files for removal of guttapercha and resilon in straight root canals. He concluded that none of the system entirely removed the root filling material . Mtwo retreatment files needed less time to get rid of root filling material than the alternative instruments. Resilon was removed considerably higher from the canal walls than guttapercha, irrespective of the rotary instruments used.

Marques da silva B.et al (2012)[48]assessed the efficacy of different retreatment rotary files in removing guttapercha and endodontic sealer from canals. Group I – protaper universal retreatment group, Group II – protaper universal retreatment group+protaper F4,Group III- D-Race retreatment group, Group IV- D-Race retreatment group+Race size 40..04 taper, Group V-Mtwo retreatment group, Group VI – Mtwo retreatment group +Mtwo size 40..04 taper. The study concluded that none of the systems completely removed filling material from the root canal. Amongst groups in which additional instrumentation was sued, the PTUR was the most effective system, especially when compared with D-Race. There were no differences in outcomes between groups with the use of additional instrumentation.

Martos .J et al (2011)[49]evaluated the solubility of five root canal sealers in orange oil, eucalyptol, xylol and chloroform solvents. The study concluded that xylol was the most effective solvent followed by the chloroform and the essential oils. Orange oil behaved in a similar way to eucalyptus oil.

Masiero .A.V (2005)[50]evaluated the effectiveness of various techniques for removing filling material from root canals in vitro. The apical third had the most remaining material, whilst the cervical and middle thirds were significantly cleaner. Comparison of the techniques revealed that teeth instrumented with K3 rotary instruments had a lower ratio of remaining filling material in the apical third. In the apical third, K3 rotary instruments were more efficient in removing gutta-percha filling material than the other techniques, which were equally effective for the other thirds.

Mollo .A et al (2012)[51] compared the effectiveness of two NiTi systems and hand files for removing guttapercha and sealer from root canals. He concluded None of the techniques was able to remove guttapercha and sealer completely from the root canal. NiTi engine driven rotary instruments were significantly faster and more effective in removing guttapercha than hand files.

Müller GG et al (2013)[52]investigated whether a final rinse with Endosolv R solvent and ultrasound resulted in cleaner root canal walls during endodontic retreatment. A total of 56 extracted premolar teeth were manually instrumented using a step-back flare technique and filled with gutta-percha and AH Plus sealer. After 9 months, the canals were retreated by using ProTaper Universal Retreatment rotary instrument up to an F5 file to remove gutta percha and sealer . As a final step, the teeth were randomly divided in 4 groups (n=14) and were subjected to passive ultrasonic irrigation (PUI) with either Endosolv R or distilled water. In the control groups, the irrigants were left undisturbed. All groups presented filling debris in the three root canal thirds after retreatment. There were no significant differences between the groups or among the root canal thirds within each group. He

concluded PUI with Endosolv R was not effective in the removal of filling debris from root canal walls.

Ronald Ordinola - Zapata et al (2009)[53] compared the percentage and depth of penetration of sealer into dentinal tubules during rootcanal obturation using Guttaflow, sealer 26 or seal apex in root canals filled with the lateral compaction technique using confocal microscopy. The study concluded that depth of penetration of root canal sealers into dentinal tubules using the lateral compaction technique is influenced by the type of sealer and by the root canal level, with penetration decreasing apically. Sealapex showed deeper penetration into the dentinal tubules. Neverthless, the percentage of sealer adaptation into the root canal walls was similar in the 3 sealers.

Pirani C et al (2009)[55] evaluated the root canal wall morphology below scanning electron microscopy magnification when removal of 2 forms of root canal fillings by using ultrasonic tips, nickel-titanium (NiTi) rotary instruments, and hand K-files. Retreatment was completed by using K-files , M-Two NiTi rotary instruments , or ESI ultrasonic tips (group1,2,or3) in 12 roots each respectively. He concluded that all retreatment techniques showed similar performances in terms of smear layer morphology, debris, and surface profile. None of the above instruments completely removed filling material debris from dentinal tubules of apical third.

Rached-junior F.J.A et al (2014)[57]evaluated the bond strength of a resin based sealer (AH plus) to root canal dentine after the elimination of a zinc oxide-eugenol based sealer (Endofill), using distinct retreatment techniques. He concluded that operating microscope was associated with higher bond strength values for filling material to root canals. The zinc

oxide eugenol based sealer negatively affected the bond strength of AH plus to root canal walls, irrespective of the retreatment technique

Robert W. Ladley et al (1991)[59]compared halothane and chloroform used with hand or ultrasonic instrumentation to remove gutta-percha and sealer from root canals, apically extruded debris, residual debris, time for filling removal and amount of solvent used were determined. The extruded apical debris and radiographically visible residual debris were not significant. Ultrasonic instrumentation required significantly less time to remove the root canal filling than did hand instrumentation. The only significant difference in the amount of solvent used occurred when the ultrasonic-chloroform group compared with the hand instrumentation-chloroform group. Halothane was found to be an acceptable alternative to chloroform for removing gutta-percha and sealer from obturated root canal.

Rodig .T et al (2012)[60] compared the efficacy of two rotary NiTi retreatment systems and Hedstrom files in removing filling material from curved root canals. The root fillings were removed with D-RaCe instruments, ProTaper Universal Retreatment instruments or Hedstrom files. He concluded that D-RaCe instruments were associated with significantly less residual filling material as compared to ProTaper Universal Retreatment instruments and hand files. Hedstrom files removed significantly less dentine than both rotary NiTi systems. Retreatment with rotary NiTi systems resulted in a high incidence of procedural errors.

Roggendorf .M.J et al (2010)[62] evaluated the efficiency of removing Activ GP or GuttaFlow from root canals using nickel titanium instruments. He concluded that both obturations with ActivGP and GuttaFlow were removed with NiTi instruments. Canal

enlargement up to two sizes beyond the pre-retreatment size was necessary to minimize the amount of seale Roggendorf .M.J et al (2010)[62] evaluated the efficiency of removing Activ GP or GuttaFlow from root canals using nickel titanium instruments. He concluded that both obturations with ActivGP and GuttaFlow were removed with NiTi instruments. Canal enlargement up to two sizes beyond the pre-retreatment size was necessary to minimize the amount of sealer remaining.

Varawan Sae – Lim et al (2000)[63] investigated the retreatment effectiveness of 0.04 taper nickel titanium rotary profiles. Retreatment for group A done using profile alone, group B using profile and chloroform ,and group C using hand files with chloroform. The results showed that the mean scores in group A and B were typically less than group C .Mean scores of apical thirds tended to be higher than the middle and the cervical third, except group A .Profile with or without chloroform appeared to be a viable various retreatment methodology.

Schirrmeister .J. F. et al (2006)[65]also compared the detectability of residual Epiphany and gutta-percha after root canal retreatment using a dental operating microscope and radiographic examination with the residual area measured after rendering the roots transparent. He concluded that especially for remaining gutta-percha, the operating microscopes provided better detection of residual root filling material in retreated maxillary incisor teeth.

Schirrmeister .J .F et al (2006)[66]assess the effecaciousness of hand and rotary instrumentation for removal of vertically compacted Epiphany and GP during retreatment. He concluded that vertically compacted Epiphany in combination with Epiphany Root Canal

Sealant was removed more effectively than gutta-percha and AH Plus sealer. Hedstrom files were more rapid than RaCe rotary instruments.

Silva et al (2015)[68]compared the effectiveness of reciprocating and rotary techniques to get rid off gutta-percha and sealer from root canals. Two experimental retreatment groups: ProTaper Retreatment System (PTRS) and WaveOne System (WS). The percentage of residual material was calculated .No system completely removed the root filling material from the root canal. No significant differences were observed between the systems, in terms of residual filling material in any tested third. WS was faster in removing filling material than PTRS. He concluded that although no differences were observed in the efficacy of PTRS and WS for removing root filling material, WS was faster than PTRS

Francesco Somma et al (2008)[69]compared the effectiveness of the Mtwo R (Sweden & Martina, Padova, Italy), ProTaper- R files (Dentsply-Maillefer, Ballaigues, Switzerland), and a H files manual technique in the removal of three different filling materials (gutta-percha, Resilon [Resilon Research LLC, Madison, CT], and EndoRez [UltradentProductsInc, South Jordan, UT]) during retreatment. In conclusion, all instruments left residues of filling material and debris on the root canal walls irrespective of the root filling material used. Both the engine-driven NiTi rotary systems proved to be safe and fast devices for the removal of endodontic filling material.

Takahashi et al (2009)[70]evaluated the efficacy of a NiTi rotary instrument system with or while not a solvent versus SS hand files for GP removal. They were divided into 4 groups: GatesGlidden and K-files, Gates-Glidden and K-files with chloroform, ProTaper Universal rotary retreatment system, and ProTaper Universal rotary retreatment

system with chloroform. He ended that all techniques proved useful for the removal filling material, and that they were similar in material remaining after retreatment, however the ProTaper-R without chloroform was quicker.

Tesdemir T et al (2008)[71] studied the ability of three rotary NiTi instruments and hand instruments to remove GP and sealer. The ProTaper group had less filling material within the root canals than the other groups, however a major distinction was found between solely the ProTaper and Mtwo groups. The retreatment time for Mtwo and ProTaper was considerably shorter when compared with R-Endo and manual instrumentation Hedstrom files. R-Endo was considerably quicker than manual instrumentation. Under the experimental conditions, ProTaper left considerably less GP and sealer than Mtwo instruments. Complete removal of GP and sealer did not occur with any of the instrument systems.

CelikUnal G et al (2009)[72]compared the efficaciousness of standard and new retreatment instruments once removing gutta-percha root fillings in curved root canals. Within the bucco-lingual direction, the remaining filling material was considerably less following manual instrumentation than R-Endo and ProTaper instrumentation. Within the proximal view, it had been considerably less following manual and ProFile instrumentation than R-Endo. Complete removal of filling material occurred solely in three specimens (with manual instruments). Manual instruments were significantly faster than R-Endo and ProFile. More procedural errors (five fractured instruments and two perforations) were noted when using ProTaper. The laboratory study in curved molar roots shows that ProTaper - R and R-Endo instruments were less effective in removing filling material from canal walls than manual and ProFile instruments.

Lisa R. Wilcox et al (1987)[73]examined the appearance of root canal walls after retreatment. Four techniques were used to remove gutta-percha and sealer: method 1-heat and files; method 2-heat, files, and Cavi-Endo; method 3-chloroform and files; and method 4-chloroform, files, and Cavi-Endo. The results showed that no technique removed all debris. When AH26 was the sealer, method 4 was significantly less effective. When Roth's 801 was the sealer, method 1 was significantly less effective. Teeth obturated using Roth's 801 sealer were significantly cleaner after reinstrumentation.

Lisa R. Wilcox et al (1989)[74]studied forty extracted teeth were instrumented using a step-back flare technique and obturated with guttapercha and either AH26 or ROTH'S 801 sealer. After 3 months the canals were retreated by removing gutta-percha and sealer with hot instruments followed by chloroform and files. As a final step, the teeth were instrumented using ultrasonics with either chloroform or with NaOcl. Most teeth were well cleaned. No significant differences were found between sealer groups or between the two irrigants as to the ability to remove gutta-percha/sealer.

Li lixu et al (2012)[76]aimed to assess variation in the incidence and depth of residual filling material in dentinal tubules after gutta-percha removal with H files, the protaper universal system and Sybron endo K3 system. He concluded that the protaper universal system and Sybron endo K3 system left filling material in a greater proportion of dentinal tubules than did H files.

MATERIALS AND METHODS

MATERIALS

S.no	Material used	Brand name/ Manufacturer details
1.	Human maxillary Anteriors	n=100
2.	Round diamond burs	Mani, Japan
3.	Airotor highspeed handpiece	NSK, Japan
4.	X Smart Endomotor	Dentsply Maillefer
5.	Safe side Diamond disc	Mani Inc, Japan
6.	Sodium hypochloride 3%	Prime Dental Products PVT
7.	17% EDTA solution	Desmer
8.	2.5 ml disposable syringes	Hindustan syringes & Medical Services Ltd
9.	K files 15 size – 21 mm	Mani, Japan
10.	Protaper universal rotary retreatment files	Dentsply Maillefer
11.	R-Endo rotary files	VDW.Germany
12.	D-Race rotary files	FKG
13.	H-Files	Mani, Japan
14.	Zinc oxide eugenol	Prime dental products Pvt.Ltd

15.	Spreaders-21mm	Mani, Japan
16.	2% taper GP points	Dentsply Maillfiller
17.	Normal saline	Claris Otsuka Private Ltd, India
18.	Micro motor handpiece	NSK pana-max plus, Nakanishi International, Tokyo
19.	Stereo microscope	Chongqing optec Instrument Co.Ltd,China

METHODS

SAMPLE SELECTION:

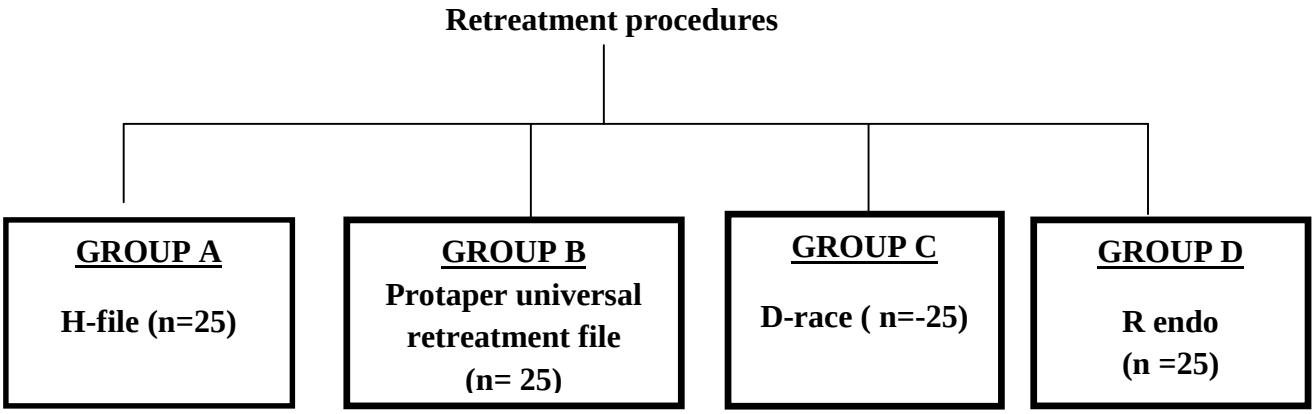
This study was approved by Institutional Ethical Committee / Institutional Review Board. A total of 100 extracted maxillary anteriors were selected. Teeth with fully formed apices, absence of calcifications and straight root canal were collected, cleaned and stored in saline with 0.1% thymol and washed under running water.

SAMPLE PREPARATION:

Access cavities were prepared and 15 size K-file was placed into the canal until it was visible at the apical foramen and the working length was established 1 mm short of this length. The crowns were removed at the CEJ using a diamond-coated high-speed bur with air-water spray coolants. The roots were ground coronally to establish a uniform 16-mm working length for all teeth. Instrumentation of all rootcanals was performed by a single operator. The coronal thirds of all root canals were enlarged with size 1, 2 and 3 Gates-Glidden drills . The apical two-thirds were enlarged to working length using K-files up to size50 with a balanced-force technique (Roane et al. 1985). At each instrument change, 2 ml of 2.5% NaOCl was used for irrigation. The root canals were dried with paper points and filled using laterally compacted gutta-percha, spreaders and zinc oxide eugenol. After completion of the procedure, a heated plugger was used to remove the excess gutta-percha to a level 2 mm short of the canal orifice followed by vertical compaction with a cold plugger. The coronal orifice of each canal was sealed with a temporary filling material , and the teeth were stored at 37^0C in 100% humidity for 1 week to allow complete setting of the sealer. Teeth were radiographed in B-L and M-D directions to confirm the radiographic adequacy of root filling, using the following criteria: reaching working length, uniform radiopacity and no voids.

Retreatment procedures

The temporary fillings were removed, and a 5-mm coronal portion of each root canal filling was removed using number 2 and 3 Gates -Glidden drills. All specimens were then coded and randomly assigned to four groups of 25 specimens each.



Group I-H files

The obturating material was removed with H-files of sizes 20, 25 and 30 in a circumferential quarter turn push and pull motion until working length was achieved.

Group II-Protaper Universal Retreatment File

The D1 file was used to remove sealer and gutta-percha from the coronal third of the root canal. The D2 file was used in the coronal two thirds of the root canal. The D3 file was used with mild apical pressure in the WL. The instruments were used at 500 rpm.

Group III- D-RaCe

DR1 was used to remove sealer and gutta-percha from the coronal third of the root canal at 1000 rpm. DR2 was used at 600 rpm to remove sealer and gutta-percha from the middle and apical third of the root canal.

Group IV- R-Endo

RM file was used to locate the canal orifice and to create a pathway. Then RE file was used to a depth of 1-3 mm towards to the apex with circumferential filing. Following this the R1 instrument was used for the coronal third, R2 was used for the middle and R3 was used for the apical third. All instruments were used to remove filling material in a brushing circumferential movement. The instruments were used at a speed of 300 rpm.

The preparation was complete when no more obturation material was observed sticking to the retreatment instruments. After the retreatment procedure, all roots were radiographed in B-L orientation to verify the removal of filling material by various removal technique . Root canals were irrigated in between all instrument changes using 2ml of 3% NaOCl and a final irrigation with 2ml of 17% EDTA and 5ml of distilled water.

After instrumentation, the roots were split vertically on the buccal and lingual surfaces, using a water‑cooled diamond disk and taking care to avoid touching the root canal. They were then split into halves longitudinally with a chisel and mallet and each half then split into coronal, middle and apical third. The cleanliness of the canal wall was evaluated through an optical stereomicroscope with 20x magnification and photographs were taken by a digital Camera.

One blinded reviewer categorized Stereomicroscope images according to the following criteria by Somma *et al*. A 4‑point grading system was used with respect to residual obturation material and debris at the coronal, middle and apical third of each canal. Variation in the scoring occurred rarely, and when discrepancy was observed, an average of the scores was considered and rounded.

- 0: 0%–25% of the dentin surface covered with obturation debris.
- 1:<50% of the dentin surface covered with obturation debris
- 2: 50%–75% of the dentin surface covered with obturation debris
- 3: 75%–100% of the dentin surface covered with obturation debris.

Flowchart 1

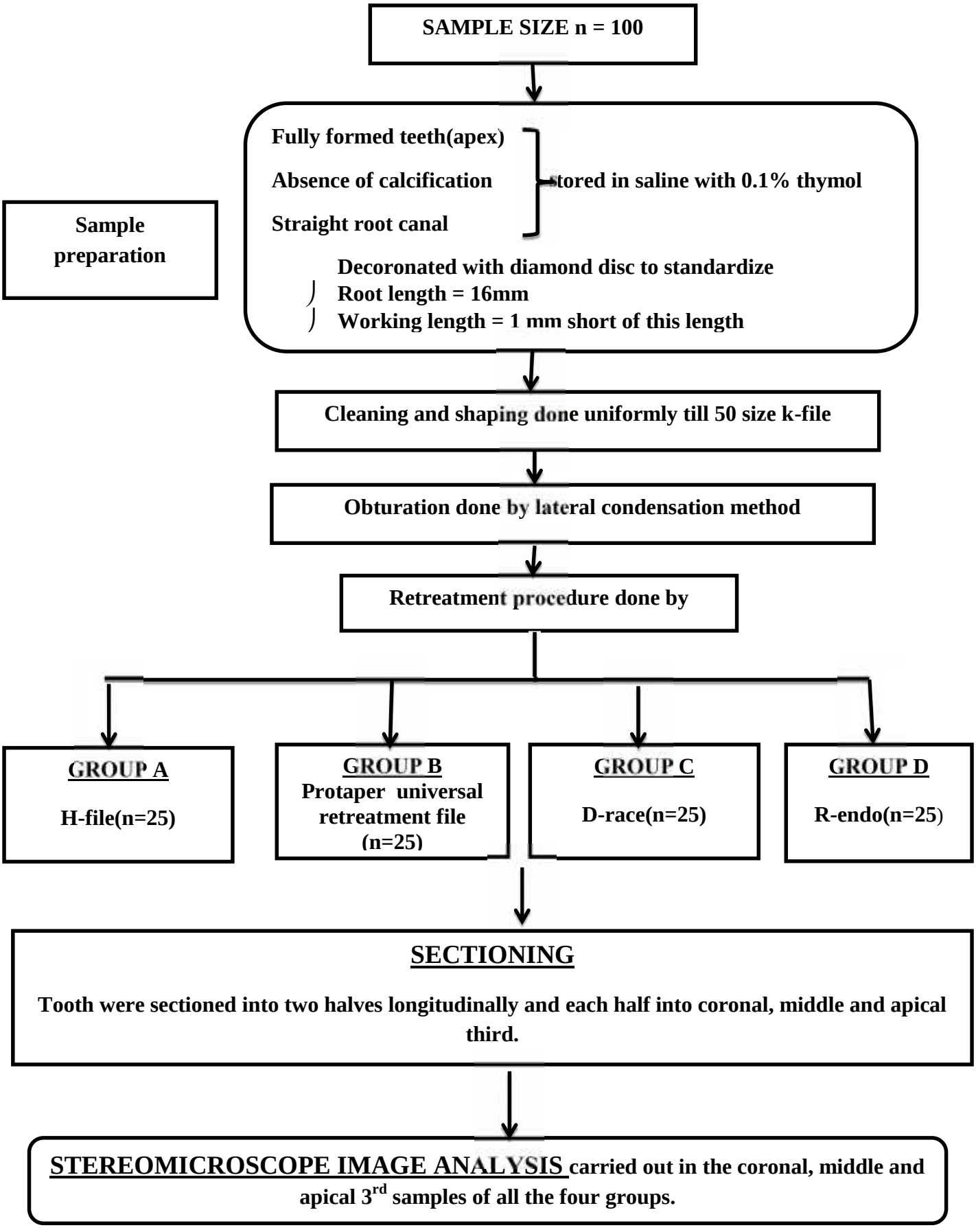

SAMPLE SIZE n = 100
Sample preparation
Fully formed teeth(apex)
Absence of calcification
Straight root canal
stored in saline with 0.1% thymol
Decoronated with diamond disc to standardize
Root length = 16mm
Working length = 1 mm short of this length
Cleaning and shaping done uniformly till 50 size k-file
Obturation done by lateral condensation method
Retreatment procedure done by
GROUP A
H-file(n=25)
GROUP B
Protaper universal retreatment file (n=25)
GROUP C
D-race(n=25)
GROUP D
R-endo(n=25)
SECTIONING
Tooth were sectioned into two halves longitudinally and each half into coronal, middle and apical third.
STEREOMICROSCOPE IMAGE ANALYSIS carried out in the coronal, middle and apical 3rd samples of all the four groups.

Fig.1: Extracted human maxillary anteriors

Fig.2: Armamentarium

Fig. 3: Decoranation of the teeth near CEJ

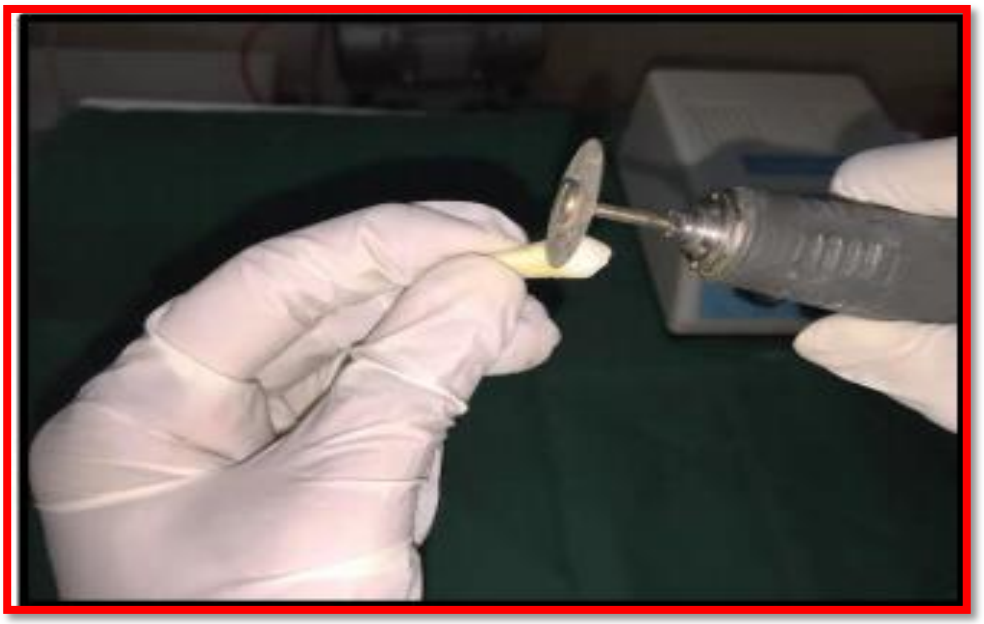


Fig 4: Decoronated maxillary anteriors

Fig.5: Cleaning and shaping by using k-files

Fig.6: Irrigation done by using 2ml of 3% Naocl and Post-operative radiograph

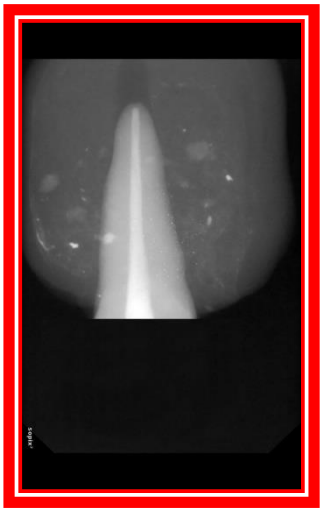


Fig.7: Retreatment done with H- File

Fig 8: Retreatment done with protaper universal retreatment file

Fig.9: Retreatment done with D-race file

Fig.10: Retreatment done with R-endo file

Fig.11: Vertically splitted tooth

Fig.12: Coronal portion

Fig.13: Middle portion

Fig.14: Apical portion

Fig.15: Stereo microscope

RESULTS

TABLE 1 : PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN CORONAL AREA

Presence of obturating material and debris	Number of cases in							
	Group A H-file(n=25)		Group B Protaper(n=25)		Group C D-race(n=25)		Group D R-endo(n=25)	
	No.	%	No.	%	No.	%	No.	%
None to slight presence	12	48.0	10	40.0	16	64.0	9	36.0
Some presence	10	40.0	13	52.0	9	36.0	10	40.0
Moderate presence	3	12.0	2	8.0	0	0	6	24.0
Heavy presence	0	0	0	0	0	0	0	0
Mean Score	0.64		0.68		0.36		0.88	
S.D.	0.7		0.63		0.49		0.78	
'p' value between								
Groups A,B,C & D	0.053 Not significant							
Groups A & B	0.4 Not Significant							
Groups A & C	0.108 Not significant							
Groups A & D	0.258 Not significant							
Groups B & C	0.05 Not significant							
Groups B & D	0.323 Not significant							
Groups C & D	**0.007 Significant**							

***p > 0.05**

TABLE 2 : PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN MIDDLE AREA

Presence of obturating material and debris	Number of cases in							
	Group A H-file(n=25)		Group B Protaper(n=25)		Group C D-race(n=25)		Group D R-endo(n=25)	
	No.	%	No.	%	No.	%	No.	%
None to slight presence	13	52.0	10	40.0	14	56.0	7	28.0
Some presence	8	32.0	10	40.0	9	36.0	11	44.0
Moderate presence	4	16.0	5	20.0	2	8.0	6	24.0
Heavy presence	0	0	0	0	0	0	1	4.0
Mean Score	0.64		0.8		0.52		1.04	
S.D.	0.76		0.76		0.65		0.84	
'p' value between								
Groups A,B,C & D	0.093 Not significant							
Groups A & B	0.461 Not Significant							
Groups A & C	0.551 Not significant							
Groups A & D	0.083 Not significant							
Groups B & C	0.17 Not significant							
Groups B & D	0.296 Not significant							
Groups C & D	**0.018 Significant***							

***p > 0.05**

TABLE 3 : PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN APICAL AREA

Presence of obturating material and debris	Number of cases in							
	Group A H-file(n=25)		Group B Protaper(n=25)		Group C D-race(n=25)		Group D R-endo(n=25)	
	No.	%	No.	%	No.	%	No.	%
None to slight presence	10	40.0	8	32.0	10	40.0	8	32.0
Some presence	7	28.0	8	32.0	10	40.0	6	24.0
Moderate presence	6	24.0	6	24.0	4	16.0	6	24.0
Heavy presence	2	8.0	3	12.0	1	4.0	5	20.0
Mean Score	1.0		1.16		0.84		1.32	
S.D.	1.0		1.03		0.85		1.15	
'p' value between								
Groups A,B,C & D	0.391 Not significant							
Groups A & B	0.58 Not Significant							
Groups A & C	0.545 Not significant							
Groups A & D	0.298 Not significant							
Groups B & C	0.236 Not significant							
Groups B & D	0.605 Not significant							
Groups C & D	0.099 Not Significant							

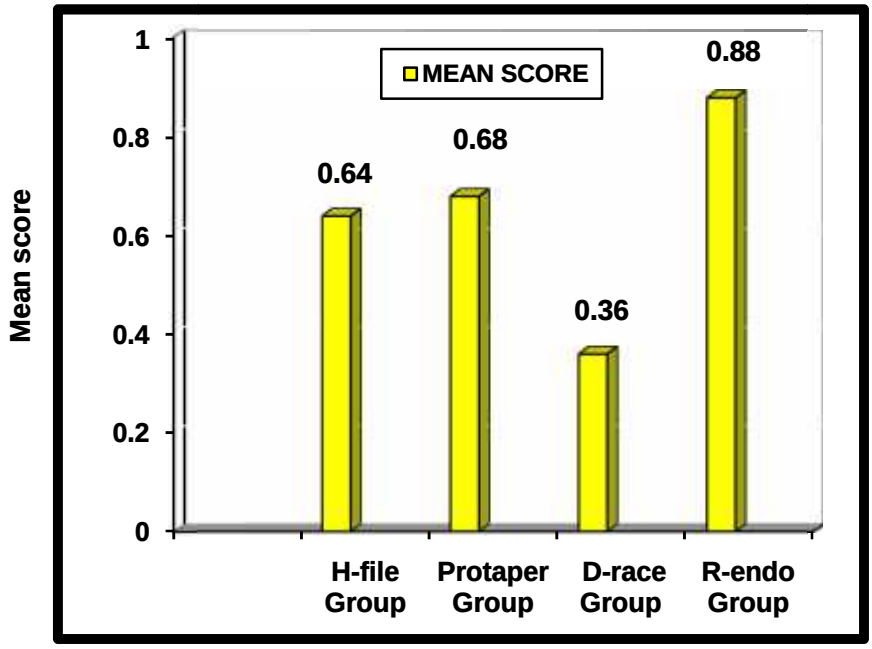
***p > 0.05**

TABLE 4 : COMPARISON OF OBTURATING MATERIAL IN DIFFERENT AREAS

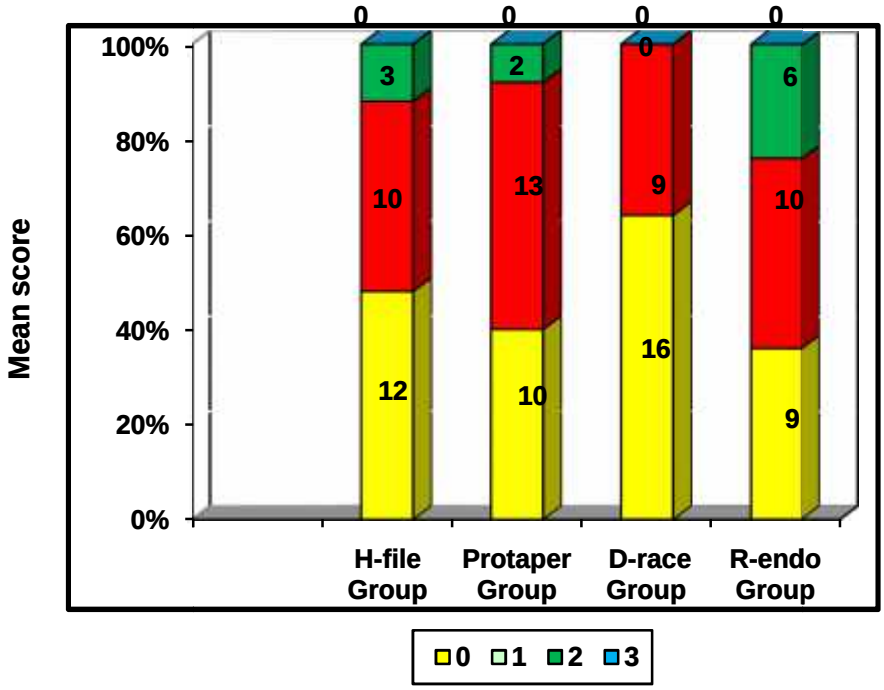
Area	Score	
	Mean	**S.D.**
Coronal	0.64	0.67
Middle	0.75	0.77
Apical	1.08	1.01
'p' value between		
Coronal, Middle & Apical	**< 0.001 Significant***	
Coronal & Middle	0.284 Not significant	
Coronal & Apical	**< 0.001 Significant***	
Middle & Apical	**0..01 Significant***	

***p > 0.05**

GRAPH 1: PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN CORONAL AREA

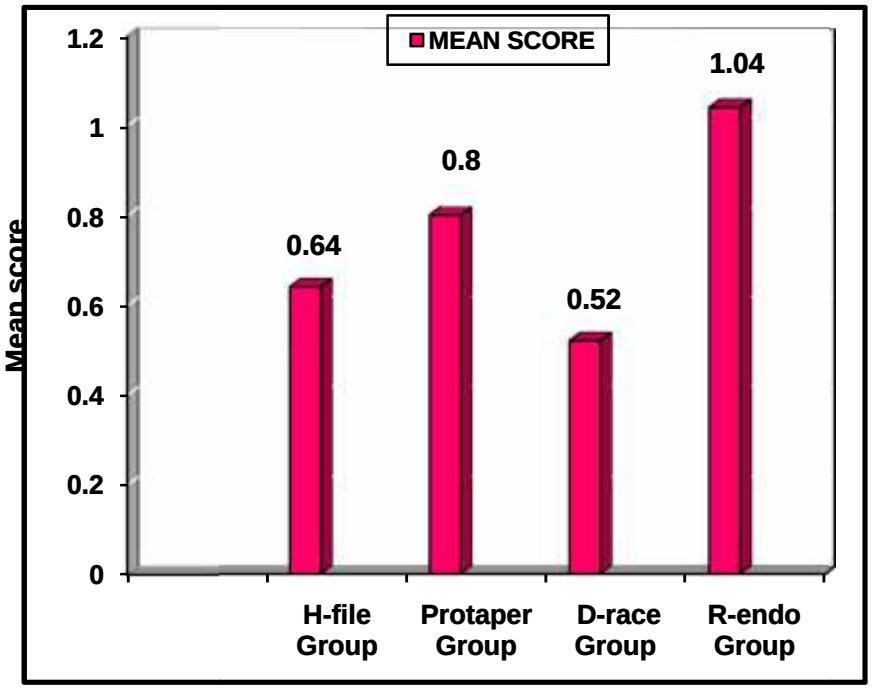


GRAPH 2 : COMPARISON OF GRADING OF FOUR GROUPS WITH IN THE CORONAL AREA

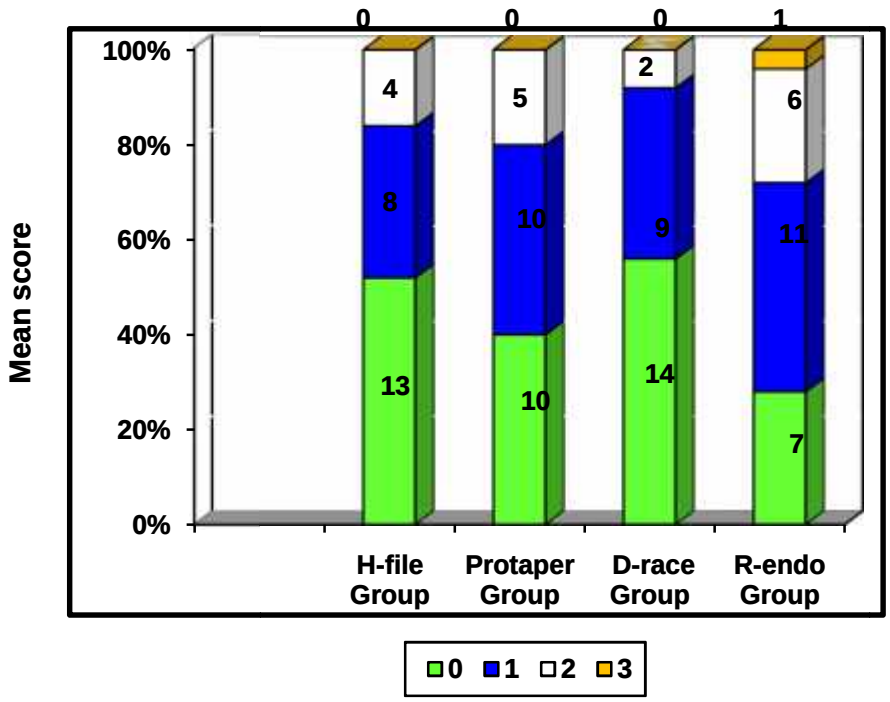


- 0: 0%–25% of the dentin surface covered with obturation debris.
- 1:<50% of the dentin surface covered with obturation debris
- 2: 50%–75% of the dentin surface covered with obturation debris
- 3: 75%–100% of the dentin surface covered with obturation debris.

GRAPH 3 :PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN MIDDLE AREA

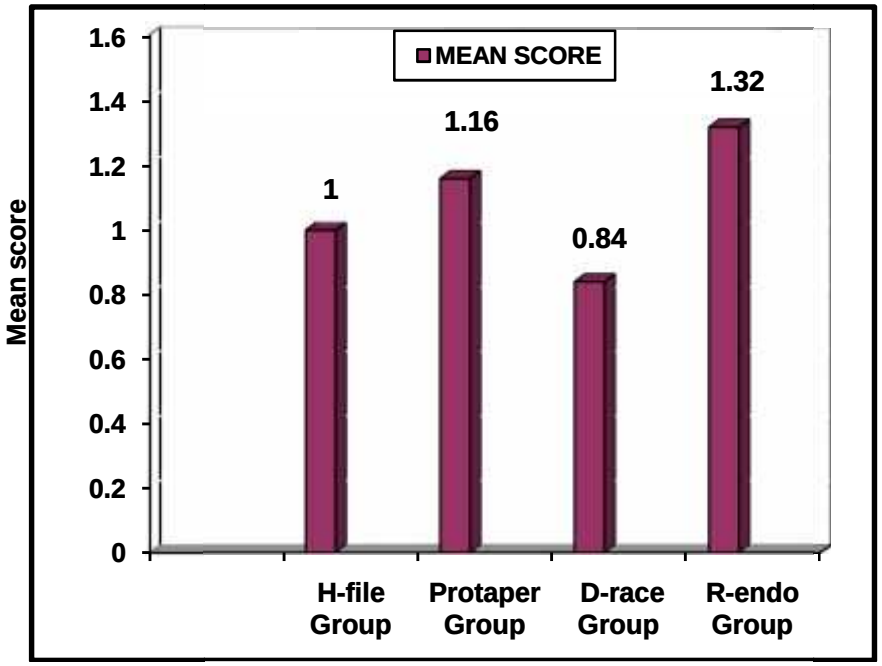


GRAPH 4: COMPARISON OF GRADING OF FOUR GROUPS WITH IN THE MIDDLE AREA

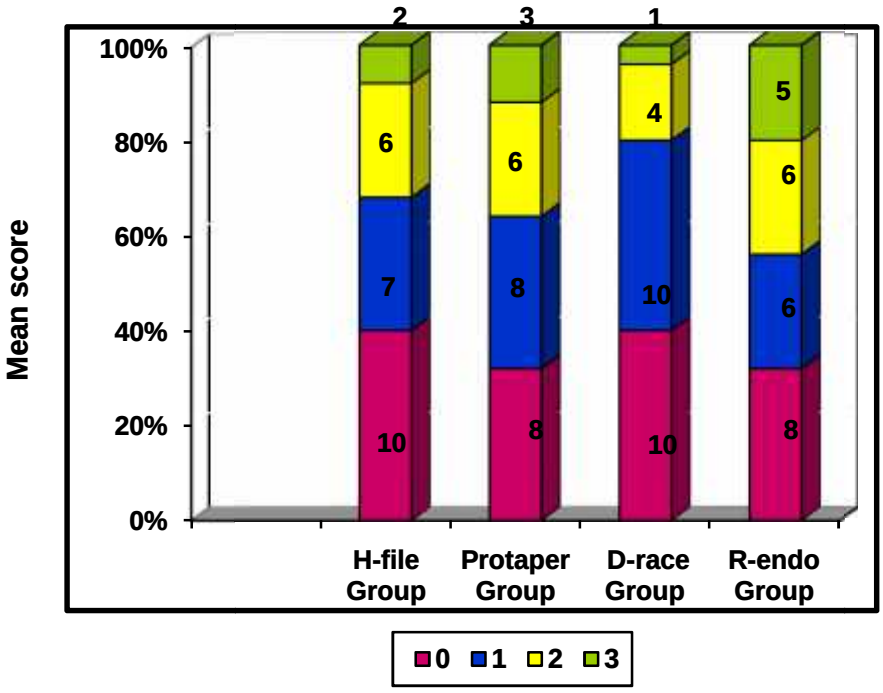


- 0: 0%–25% of the dentin surface covered with obturation debris.
- 1:<50% of the dentin surface covered with obturation debris
- 2: 50%–75% of the dentin surface covered with obturation debris
- 3: 75%–100% of the dentin surface covered with obturation debris.

GRAPH 5: PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN APICAL AREA



GRAPH 6: COMPARISON OF GRADING OF FOUR GROUPS WITH IN THE APICAL AREA



- 0: 0%–25% of the dentin surface covered with obturation debris.
- 1:<50% of the dentin surface covered with obturation debris
- 2: 50%–75% of the dentin surface covered with obturation debris
- 3: 75%–100% of the dentin surface covered with obturation debris.

GRAPH 7: COMPARISON OF OBTURATING MATERIAL IN DIFFERENT AREAS

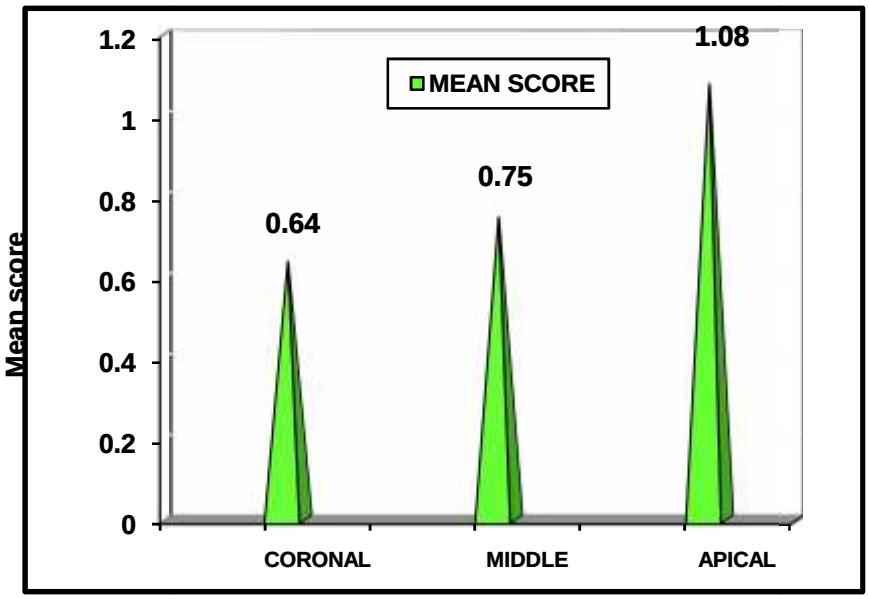


TABLE 1 : PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN CORONAL AREA

Table 1 shows by using unpaired test, minimum mean value in Group C (Mean =0.36) indicates that more efficient to remove the obturating material in the coronal area of dentin surface. By using ANOVA, by comparing Group C and Group D, p value is statistically significant (p>0.05). It means that when comparing Group C (Mean =0.36) and Group D (Mean =0.88), the mean score is minimum in Group C.

TABLE 2 : PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN MIDDLE AREA

Table 2 shows by using unpaired test, minimum mean value in Group C (Mean =0.52) indicates that more efficient to remove the obturating material in the middle area of dentin surface. By using ANOVA, by comparing Group C and Group D, p value is statistically significant (p>0.05). It means that when comparing Group C (Mean =0.52) and Group D (Mean =1.04), the mean score is minimum in Group C.

TABLE 3 : PRESENCE OF REMAINING OBTURATING MATERIAL AND DEBRIS ON THE DENTIN SURFACE AFTER RETREATMENT IN APICAL AREA

Table 3 shows by using unpaired test, minimum mean value in Group C (Mean =0.84) indicates that more efficient to remove the obturating material in the apical area of dentin surface. By using ANOVA, by comparing between the groups, p value is not

statistically significant (p>0.05). It means that less amount of obturating material was removed in the apical area.

TABLE 4 : COMPARISON OF OBTURATING MATERIAL IN DIFFERENT AREAS

Table 4 shows by using unpaired test, minimum mean value in coronal area (Mean =0.64) indicates that more efficient to remove the obturating material in the coronal area of dentin surface. By using ANOVA, by comparing all the three areas (coronal, middle and apical), p value is statistically significant (p>0.05).

While comparing between the groups, statistical significance was found between the coronal and apical region, the middle and apical region when the mean percentage of residual material was measured. In overall comparison of the four groups, when viewed steromicroscopically; D-Race was found to be the best followed by H-file, Protaper universal retreatment file and then lastly R-Endo file at 5% significance level for total percentage of remnant material.

DISCUSSION

The main aim of retreatment is to regain access to the apical foramen by complete removal of the root canal filling material. Biomaterial-centered biofilm formed in rootcanal obturating material in failed endodontic cases, necrotic tissue and microorganisms coated by obturating material, is also to blame for periapical inflammation. The obturating material should be removed to cut back the quantity of microorganisms within the canal.

Removing the most quantity of filling material from inadequately prepared or filled root canal systems appears to be essential so as to uncover remaining necrotic tissue or microorganisms that is responsible for the persistent disease and enable thorough chemomechanical disinfection and reinstrumentation of the root canal system to promote the healing of periradicular tissue.[15,16] Moreover the residual filling material may interfere with the adhesion and adaptation of root filling in subsequent treatment which may affect the success rate.[16]Hence complete removal of GP & sealer is mandatory for the successful retreatment. So the study has been designed to evaluate the efficacy of four different instruments in complete removal of GP and sealer

With reference to the standardization protocol proposed by Al-Omari & Dummer in 1995,in this study, the crowns of the teeth were removed and the length was standardized at 16 mm to allow better visualization of root canal morphology, and to eliminate any coronal interferences during canal preparation and retreatment.

Many obturating materials, techniques, and sealers have been developed. Lateral compaction of gutta-percha introduced by Callahan in 1914, is the commonly used method for obturation and is regarded as a reference when considering other obturation techniques. So, lateral condensation has been followed for obturation.

Gutta-percha, the most commonly used root filling material, are easily retrievable from the root canal walls using hand files, rotary files, ultrasonic files and recently by laser irradiation.[18,19] Further more gutta-percha removal can also be facilitated by the use of heat carrying instruments, solvent such as chloroform, xylol, eucalyptol, halothane or essential oils.[21,22]

Conventionally, by using hand files with or without solvent in removing GP can be a tedious, long method, particularly when the root canal filling material is well condensed. Therefore, the utilization of rotary instruments in root canal retreatment procedure could reduce patient and operator fatigue.

Gates Glidden drills are advocated to get rid of gutta-percha in the cervical parts. They have been shown to supply a cleaner canal once gutta-percha removal. The use of Gates Glidden drills could be a standard technique for gutta-percha removal from the coronal and middle parts of the root canal. Zakariasen *et al* in 1990 and Hulsmann & Stotz in1997 showed that root canals were completely cleaned by using GG drills.[23]

Friedman et al in 1992 & 1993 studied the retreatment efficacy in canals obturated with laterally condensed GP and sealer. The results showed largest amount of residual debris in the apical levels of all the canals. From the total of 100 samples, 54 samples showed remaining obturation material in the apical third and 46 samples showed clean canal walls. Although there were no statistically significant differences, the Hedström group had a larger number of samples with remaining filling material (68%), followed by the ProFile (56%),Quantec (52%) and K-type (40%) groups. On the other hand, amongst samples with debris, the length of filling material left inside the canal in the Hedström group was significantly less than the Quantec group.

In the current era of Ni-Ti rotary files, specially designed retreatment file system are used and have been reported to reveal high success rate. All these rotary instruments have been proved to be more efficient than hand files in removal of gutta-percha from the root canals.[23,24]Newer rotary retreatment system like Protaper universal retreatment file, D-Race, R-endo has been introduced in the market to help in easier penetration of the root filling to facilitate the gutta-percha and sealer removal. The claimed advantages of rotary instruments are maintenance of canal shape and shorter working time.[25] Eventhough rotary instruments advance or assist faster root filling removal, its use should be judicious, since the amount of dentin removal was greater than compared with manual instruments.[26]Hence, enormous dentin removal be avoided to minimize root weakening and hence the incidence of perforations and radicular fractures.

ProTaper D series, containing three flexible instruments, are designed for root filling material removal from different thirds of the canal. They should each work at special torque and speed according to the manufacturer in electric motor controllers.[27] Gu *et al*. suggested that better performance of ProTaper D series in straight canals was due to the progressive taper and length of these files. The better performance of ProTaper Universal retreatment instruments may be attributable to their design. The design features could alter the retreatment instruments to chop not only, GP however additionally the superficial layer of dentine throughout root filling removal. Moreover, the precise flute design and rotary motion of the ProTaper Universal retreatment instruments tend to pull GP into the file flutes and direct it towards the orifice. Furthermore, it is possible that the rotary movements of engine-driven files produce a certain degree of frictional heat which could plasticize GP. The plasticized GP would thus present less resistance and be easier to get rid of. Thus the previous study terminated that the

ProTaper Universal rotary retreatment system removed GP more efficiently compared with alternative ancient techniques in maxillary anterior teeth. Hence Protaper rotary retreatment file has selected one among the four groups.[27]

Schirrmeister et al in 2006, evaluated that the conventional RaCe NiTi system is an efficient device for gutta-percha removal in curved root canals. This finding may be attributed to the alternating cutting edges and the smooth instrument surface created by a special electrochemical treatment, which might also contribute to the superior sharpness of these instruments.[28] Hence D- Race file has selected one among the four groups.

R-Endo instrumentation has been shown to be as efficient as a manual instrumentation in removing filling material in straight and curved root canals. The manufacturer of R-Endo instruments claims that instrument is designed especially for retreatment as are machined into a round blank and they have a triangular cross-section with three equally spaced cutting edges; the instrument has neither radial land nor an active tip. This system has sufficient rigidity to remove material from the root canal.[29] Hence R-Endo file has selected one among the four groups.

The amount of filling material remaining inside the canal after the retreatment procedure was assessed radiographically or the roots were split longitudinally and the residual gutta-percha and sealer were measured linearly or using a scoring system. In addition, computed tomography, Sand operating microscopes have been used for this purpose. In the stereomicroscope method the remaining debris is visualized three dimensionally and the error is minimized compared to radiographic technique where only the two-dimensional view is possible.

According to Somma et al, a 4 point grading system was used with respect to residual obturation material and debris at the coronal, middle and apical third of each canal.[29]

- Score 0: 0%–25% of the dentin surface covered with obturation debris
- Score 1:<50% of the dentin surface covered with obturation debris
- Score 2: 50%–75% of the dentin surface covered with obturation debris
- Score 3: 75%–100% of the dentin surface covered with obturation debris.

In the present invitro study, four different instruments, one manual (H-file) and three rotary (PUTS, D-Race, R-Endo) were used for endodontic retreatment. As previously observed by Hulsmann and Bluhm in 2004, the variations in the results concerning the retreatment cleaning ability of NiTi rotary files could depend on the characteristics of the cross sectional design of the instruments.

From the results, it was observed that all four retreatment instrumentation techniques had varying percentage of remaining filling material in the canal wall. In the coronal third, Group A- H file showed a mean value of 0.64, Group B- PTUS showed a mean value of 0.68, Group C- D Race showed a mean value of 0.36 and Group D- R Endo showed a mean value of 0.88. There was statistical significant difference in the values (0.007) between groups C and D.

In the middle third, Group A showed a mean value of 0.64, Group B showed a mean value of 0.80,Group C showed a mean value of 0.52 and Group D showed a mean value of 1.04.There was statistically significant difference in the values (0.018) between Groups C and D.

In the apical third, Group A showed a mean value of 1.0, Group B showed a mean value of 1.16,Group C showed a mean value of 0.84 and Group D showed a mean value of 1.32. There was no statistically significant difference observed in the apical area.

On comparing the results in the coronal, middle and apical third it is well-evident that the presence of gutta percha and debris on the dentin surface is found to be more in the apical region with the mean value of 1.08 than the middle third (0.75) and coronal third(0.64)

In the all three regions- coronal, middle and apical third, Group C instrumented with D-Race NiTi rotary retreatment file system showed lesser mean values of 0.36,0.52,0.84 respectively when compared to other three groups in this study.

On comparing the four groups of instruments in this study, the superior performance of D-Race instruments may be attributed to their simple triangular cross-section that is associated with a high cutting ability. Moreover, they have alternating cutting edges that prevent the screw effect, favoring the penetration into the filling material. The flute area of these instruments allows coronal extrusion of filling material.

The use of H-files facilitates identification and removal of gutta-percha residues owing to their superior tactile sense. Also the conventional removal of gutta-percha using hand files with or without solvent can be a tedious, time-consuming process, especially when the root filling material is well condensed. Hence, the use of Hedstrom files in root canal retreatment might increase patient and operator fatigue .

The Protaper- R instruments present a negative cutting angle, that might yield better results in terms of working length and root canal cleanliness than manual instrument. But in this study, ProTaper- R files were less effective than manual instrumentation in terms of the amount of remaining filling material inside the canal after retreatment. This might be due to the fact that the last instrument designed to reach the working length does not permit complete cleansing action at the apical portion.[29] (D 3 – Size 20)

R-Endo system has sufficient rigidity to remove material from the root canal and also the instrument design with the round blank and triangular cross section with neither a radial land nor an active tip are attributed to the inferior performance when compared to other retreatment files.[30]

From the results, it was observed that all four retreatment instrumentation techniques had varying percentage of remaining filling material in the canal wall, which is in accordance to previous studies by Gu et al, Takahashi et al, Giuliani et al. Analysis of the results at various levels revealed that, the amount of filling material in the coronal third was significantly less compared to middle and apical third. This finding was attributed by dental anatomy in cervical region and speed of rotary instruments as suggested by Zanettini et al and difficulty of instrumentation of the apical third and its anatomical variations.

The degree of root canal cleanliness was less satisfactory in the apical third of the canal, has been attributed to the increased anatomical variability as well as the difficulty of instrumentation in this region which is in agreement with the investigations done by Teplitsky et al in 1992, Zuolo et al in 1996 and Ferreira et al in 2001.[30]

In the current study, there was no incidence of fracture of NiTi rotary retreatment files have been observed. This may be attributed to the use of low torque motor with better control, following manufactures instructions and small sample size. However, studies with more sample size are required to confirm this observation. The present study was carried out on maxillary incisors with straight canals. Hence, further studies has to be directed in teeth with complicated anatomy and curved root canals to evaluate the efficiency, maintenance of canal morphology and safety of Retreatment NiTi rotary files.

SUMMARY

Conventional retreatment procedure requires the removal of the existing root filling, further instrumentation, disinfection and refilling. Removing the maximum amount of filling material from inadequately prepared and filled root canal systems appears to be essential in order to uncover remaining necrotic tissue or bacteria that is responsible for the persistent disease and enable thorough chemomechanical disinfection and reinstrumentation of the root canal system to promote the healing of periradicular tissue.

The removal of root filling material and sealer was carried out in earlier days using stainless steel hand instruments with solvents. In the current era of Ni-Ti rotary files, specially designed retreatment file system are used and have been reported to reveal high success rate. Henceforth, the purpose of this study was to compare the Efficiency of different retreatment instrumentation techniques to remove the filling material (GP and sealer) from the root canal walls, during retreatment procedure and to assess the remaining filling material using Stereomicroscope.

In this invitro study, a total of 100 extracted maxillary anterior teeth with fully formed apices, absence of calcifications and straight root canal were selected. Access cavities were prepared and the working length was established 1 mm short of this length. The teeth were decoronated at the CEJ using a diamond-coated high-speed bur with air-water spray coolants. The roots were ground coronally to establish a uniform 16-mm working length for all teeth. Bio mechanical preparation was done with K-files up to size50 with a balanced-force technique. 2 ml of 2.5% NaOCl and Normal Saline were used for irrigation.

The root canals were dried with paper points and filled using laterally compacted gutta-percha, spreaders and zinc oxide eugenol. The coronal orifice of each canal was sealed

with a temporary filling material , and the teeth were stored at 37^0C in 100% humidity for 1 week to allow complete setting of the sealer.

The temporary fillings were removed, and a 5-mm coronal portion of each root canal filling was removed using number 2 and 3 Gates -Glidden drills. All specimens were then coded and randomly assigned to four groups of 25 specimens each. The four retreatment instrumentation groups with 25 teeth each were categorized into Group A- H-file , Group B- Protaper -R, Group- C: D-RaCe, Group D- R Endo. In between all instrument changes root canals were irrigated by using 2ml of 3% NaOCl and a final irrigation with 2ml of 17% EDTA and 5ml of distilled water.

After instrumentation, the roots were split vertically on the buccal and lingual surfaces, using a water-cooled diamond disk . They were then split into halves longitudinally with a chisel and mallet and each half then split into coronal, middle and apical third. The cleanliness of the canal wall was evaluated through an optical stereomicroscopy with 20x magnification and photographs were taken by a digital Camera.

One blinded reviewer categorized Stereomicroscope images according to the following criteria by Somma *et al*. A 4‑point grading system was used with respect to residual obturation material and debris at the coronal, middle and apical third of each canal .The values of percentage of remaining filling material were calculated that were further subjected to statistical analysis, ONE WAY-ANOVA AND POST HOC TUKEY HSD TEST.

Within the limitations of this in vitro study it can be concluded that the percentage of remaining filling material in the root canal wall following retreatment was minimum in D- race file succeded by H- file, Protaper Universal retreatment file and R-endo file being the maximum. The percentage of remaining filling material after retreatment found to be minimum

in coronal area succeded by middle and apical area. In the present study, no NiTi instrument intra canal failure was observed. This can be attributed to the fact that, each instrument was discarded after retreating five canals thus reducing substantially the possibility of instrument breakage.

CONCLUSION

With in the limitations of this in vitro study it can be concluded that:

1. The percentage of remaining filling material in the root canal wall following retreatment was minimum in D race file succeded by H- file, Protaper Universal retreatment file and R endo file being the maximum.
2. The percentage of remaining filling material after retreatment found to be minimum in coronal area succeded by middle and apical area.

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ANNEXURE

INSTITUTIONAL ETHICAL COMMITTEE

Best Dental Science College and Hospital

Ultra Nagar, Madurai - 625 104.

RECOGNIZED BY DENTAL COUNCIL OF INDIA, NEW DELHI
AFFLIATED TO THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI)

IRB/IEC Reference No: 2016-STU-BrIV-MIL-02

Project title: Invitro evaluation of four different techniques in GP removal

Principal Investigator: Dr. Mohamed Ismail.I, PG student

Review: New/Revised/Expedited

Date of Review: 27/09/2016

Date of previous review, if revised application:

Decision of the IEC/IRB:

- Provisional approval to conduct the study is being given
- The results of this study, along with summary are to be submitted for obtaining final approval

Recommended time period: one year (28-09-17)

PRINCIPAL
BEST DENTAL SCIENCE COLLEGE
MADURAI-625104

ETHICS COMMITTEE SIGN DATE BDSC

INSTITUTIONAL REVIEW BOARD SIGN. DATE

Signature of Member Secretary

NB:

- Inform IRB/IEC immediately in case of any issue(s)/adverse events
- Inform IRB/IEC in case of any change of study procedure, site and investigator
- This permission is only for the period mentioned above
- Annual report to be submitted to IEC/IRB
- Members of IEC/IRB have right to monitor the trail with prior intimation