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SEM study of the effect of passive ultrasonic irrigation on the cleanliness of dentinal tubules in endodontic retreatment

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***Abstract*---**Aim and Objective: Endodontic retreatment is indicated in the event of a failure of initial treatment of the root canal and of an initial treatment that looks to be correctable with retreatment. This in-vitro study was designed to assess the efficacy of passive ultrasonic

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irrigation in endodontic retreatment, by employing scanning electron microscopes, on the cleanliness of dentine tubules with and without solvent in curved root channels. Material and method: Sixty human maxillary molar teeth were treated endontically. The protaper rotary instrument was used in root canals in the crown down procedure under copious 3% NaOCl (2 ml) and Glyde irrigation. The saline solution (1 ml) was used for final rinsing. The 10 sample root surfaces of each group were evaluated for SEM pictures. Results: Amongst group I and II here were more open dentinal tubules that were statistically significant ($p<0.05$) in Group II without solvent group. Group IV demonstrated larger, statistically significant open dentinal tubules between group III and IV. The most dentinal open tubules were found in Group IV among the four groups. Conclusion: The utilisation of Endosolv-R solvents with rotary files of NiTi protaper during the non-surgical endodontic retreat on the curved radical channels of mesiobuchal and maxillary 1st and 2nd molar distobuchal roots shows that there are more gutta-percha and AH sealant rests on radical channel walls. No evidence of gutta percha/sealant remains could be removed from the root canal walls of bent roots irrespective of the techniques for instrumentation and irrigation applied.

***Keywords*---**SEM study, passive ultrasonic irrigation, cleanliness dentinal tubules, endodontic retreatment.

Introduction

Endodontic retreatment is indicated in the event of a failure of initial treatment of the root canal and of an initial treatment that looks to be correctable with retreatment. [1] Non-operational retreatment involves the removal of previously placed shutters, correct reasons for failure, clean/shaped and replenished. (AAE) Various reasons have been hypothesised for failures in root canal treatment, including apical percolation, root perforations, unfilled canals, co-existence of periodontal diseases and the expansion of gross filling materials. Due to loss of repair or recurrent decay, coronal leakage can potentially lead to endodontic failures.[2]

Ortho grade retreatment aims to re-access the apical foramen by removing the root filling material completely, so making it possible to adequately clean and shape the whole root-channel systems and final shutdown systems and to reseal all entry portals for the prevention of recurrence. [3] Although many materials for the shutting root channels have been suggested, gutta-percha together with a range of sealers are the most generally utilized materials principally zinc oxide and resin-built sealers.[4] Successful elimination of gutta-percha and sealant is a key phase in the recuperation process to detect leftover necrotic bacteria or tissues, which may be accountable of persistent diseases and allow for mechanical chemical re-instrumentation of root canal systems and redisinfection [3] Endodontic files, heat carrying equipment, ultrasonic or rotary titanium retrieval instruments such as Protaper, M2, R-Endo files, with and without solvents can be used for removal of gutta perfect. [3] It takes time to remove gutta percha with and without solvents, especially as the filler components are well condensed. The retraction of root fillers was also proposed with nickel- titanium rotary tools utilised successful in the cleaning and contouring of the root canal. They were more efficient and more secure than conventional files.[5]

More recently, the rotating system of Protaper NiTi has been modified to the universal repairing system of Protaper, including repair files. Results of several investigations have shown that, although none of the retreatment technologies have fully removed the filler materials from the root canal walls, gutta percha has been removed more efficiently and quickly compared with other retreatment procedures.[5] The gutta-percha solvents are used for the adaptation of the apical region of the master cone to the channel and the production of a wellta-percha paste which can be utilised for sealing and the removal of gutta-percha from the channel during retreatment.[6] Few research has shown that the use of dental solvents has a detrimental effect on adhesive cement bond strengths in dentin roots and leads to more dentinal gutta-percha and dentinal tubes inside the root canal walls However, solvents are still utilised to soften and dissolve gutta-percha in the root canal to make it easier and easier to remove guttapercha from the instrument.[6]

The application for the removal of resin based sealers like the AH Plus sealer was introduced using Endosolv-R solvent. This solver has showed its profound penetration into dentinal tubules and the unfulfilled resin sealer has been removed. To effectively disinfect and reseal root canal, the removal of sealing cements from canal walls and from anatomical ramifications is needed. The removal of the dentinal tubules from the root supply material seems crucial for the discovery of bacteria, which can eliminate the smear layer responsible for infections after treatment. In addition, residues of root filling material could impede adaptability and adhesion of sealants and cement for posts.

After instrumentation of an infected root duct space, micro-organisms lingering in the smaar layer can survive and reinfect the canal. For removal of the spray layer with different findings, the use of chemicals, ultrasonics and lasers in combinations or alone has been studied. Sodium hypochlorite has become, due to its tissue disintegrating and antimicrobial qualities, the most commonly utilised irrigation solution in endodontics. Passive UV activation may improve the efficiency of NaOCl in removing diseased tissue in the root canal system.. The improved effectivity of a solution for irrigation to remove diseased tissues by passive activation of ultrasound can be useful since ultrasound irrigation removes 86 percent of the root canal bacterian spores whereas manual irrigation removes just 62 percent of the spores.

The use of passive ultrasonic irrigation has been shown, as its capability for penetrating and distributing irrigation solution into apical third of canal and uninstrumentated areas has made the removal of Bacteria from the channel more efficient than hand instrumentation alone. The use of 1 minute of ultrasound irrigation after hand/rotary root cleaning has demonstrated that necrotic debris/smear layer removal canal and isthmus cleanliness are improved. No material on passive ultrasound irrigation has been available to far to evaluate cleanliness of dentinal tubules in endodontic retreatment after gutta-perch removal. This in-vitro study was designed to assess the efficacy of passive ultrasonic irrigation in endodontic retreatment, by employing scanning electron microscopes, on the cleanliness of dentine tubules with and without solvent in curved root channels.

Methodology

Sixty human maxillary molar teeth were chosen for the investigation (including first and second molars). The teeth were ultrasound purified for calculation and scrap removal. The mesiobuccal and distobuccal roots were separated with a flexible double-sided diamond disc after decoronation.

Selection criteria of teeth

36 of the above roots, whether mesiobucal or distobuccal, have been selected for the study to satisfy the following selection criteria: In this research, mesiobucal and distobuccal roots of maxilla molars with a curvature above 15to 30° (radiographic determined curvature){Schneider method}, teeth with no calcification, no resorption internally, no preceding root canal filling and fully formed apices were employed. The root picked was 16mm long on average. This analysis only included distobuccal and primary mesiobuccal waterways. This study has not taken into account the incidence of second mesiobucal ducts or any extra ducts. All 36 root samples with a 10 No:K file were inserted, until the apical foramen could be observed. The working length of this length was determined 1mm short.

Canal preparation

The protaper rotary instrument up to the dimensions F1 was used in root canals (distobuccal and major mesio-buccal) in the crown down procedure under copious 3% NaOCl (2 ml) and Glyde irrigation. The saline solution (1 ml) was used for final rinsing utilising the jet syrings and needles throughout the canals.

Canal obturation

All the roots were dried with paper dots and then sealed using a lateral condensing procedure by gutta-percha (2 per cent cones and Dentsply). For consistency, the amount of the radicular filling was limited to 14mm. In order to validate the adequate root filling, the gutta percha excess was removed and the roots radiographed. The entrance cavities were filled with the GIC type II (GC). All roots were stored in a 100% humidity at 37°centigrade 2 weeks before the retreatment programme was started.

Endodontic retreatment protocol
Random division of the 40 root samples into four groups of 10 samples each.
Group I (10 samples) (with Endosolv- R solvent)
Group II (10 samples) (without solvent)
Group III (10 samples) (With Endosolv-R solvent+ passive ultrasonic irrigation)
Group IV (10 samples) (without solvent+ passive ultrasonic irrigation)

Group 1
The 10 samples were instrumented with Protaper D1, D2 and D3 files using crown down technique for the removal of gutta-percha until they operated 0.5ml of Endosolv-R solvent (66.5 percent Formamide and 33.5 percent Phenylethelic acid). Two drops of solvent were utilised to soften the filler material between the retreatment files. The gutta-percha was removed at 500-700 rpm with a light apical pressure. 17 percent EDTA and 3 percent NaOCl were utilised as irrigant during instrumentation. The canals were watered with saline solution after the gutta percha was removed (1ml). Further instrumentation was done up to the working length with protaper rotating file size F2. Finally, paper points dried canals From the start of instrument use, the time was recorded until paper points to dry the canal were used.

Group II
The 10 samples were instrumented with Protaper D1, D2 and D3 files with the Crown Down technology in order to eliminate guttapercha till it works without any solvent. At 500-700 rpm, a lighter apical pressure eliminated the gutta-percha. 17% EDTA and 3% NaOCl were utilized as irrigants during the instrumentation. The canals were irrigated with saline solution after the removal of gutta percha (1ml). Additional device was used with rotating F2 file size protaper up to operating length. At last the channels with paper dots were dried. Time from the start was recorded until paper points were used for drying the channel.

Group III
The 10 samples were instrumented with Protaper D1, D2 and D3 files using a crown down technique for removing gutta-perch up to its workload, using the Endosolv-R solvent as Group 1. The nine samples of this group were irrigated using 3 percent NaOCl for irrigation by passive ultrasonic irrigation (Satelec Ultrasonic Unit).

Passive ultrasonic irrigation protocol

This investigation was performed with passive ultrasound irrigation with intermittent flow. Total NaOCl volume was used of 4 ml of 3%. Initially, the channels were ultrasound irrigated with a 1ml 3% NaOCl with K 15 files positioned 2mm above the apical end, for 1 minute. Then the canals have been irrigated using the disposable syringe and needle with 1ml of 3 percent NaOCl. Passive 1ml ultrasonic NaOCl irrigation for 1 minute and final 1ml 3 percent NaOCl irrigation using syringe and needle was done.

Group IV
The 10 samples were instrumented with Protaper D1, D2 and D3 files in crown-down procedure for removing gutta perch until it was working, without using solvents like group II. The nine samples in that group were next irrigated using 3% NaOCl as irrigant as in group III, with passive ultrasound irrigation.

Scanning electron microscope (SEM) evaluation

The 10 sample root surfaces of each group were shrunken horizontally from the anatomical apex at distances of 3,6 and 10 mm to determine the apical, central and coronal position for the SEM pictures. The roots were separated by secure flexible diamond discs longitudinally. The root halves were rinsed after splitting with 0.5ml of saline solution in order to eliminate any splitting debris. The SEM examination was conducted on a half of all split root specimens dehydrated for 7 days at 37 degrees C and sputtered with the gold (SCD 050 Sputter Coater), and on a standard 2000X standard magnification, the coronal middle and apical thirds of root halves were analysed by SEM. For the coronal, middle and apical thirds of each root half, the total numbers of dentinal tubules and the number of dentinal tubules were examined totally or partially filled with materials.

Parameters evaluated

1. Cleanliness of dentinal tubules in coronal, middle and apical root canals with and without Endosolv-R solvent following endodontic retreatments.
2. Cleanliness of dentinal tubules on coronary, middle, and apical canals with and without Endosolv-R solvent after endodontic retractment as well as following passive ultrasound irrigation.
3. In-minutes time (using a stop watch) required for endodontic retreatment gutta perch removal with or without Endosolv-R solvent. Universal repair files with protaper.

Statistical analysis

The ratio of the total number of dentinal tubules and the number of dentinal tubles were recorded for statistical analysis, either fully or partially filled with material in all 4 groups. It has also been assessed the mean time of gutta percha removal. In order to discover significant differences across all four groups, the parametric one-way analysed variance (ANOVA) test was utilised. Tukey's multi-range post-hoc test was employed to find out which group was significantly improving. All computations have been conducted with Proc combined with SPSS statistical software SPSS 9.1.2 repeated statement (USA). The mean level significance was $p < 0.05$.

Results

The mean and standards deviation from open dentinal tubules ratios for the four groups is shown in Table 1. Amongst group I and II here were more open dentinal tubules that were statistically significant ($p<0.05$) in Group II without solvent group. Group IV demonstrated larger, statistically significant open dentinal tubules between group III and IV. The most dentinal open tubules were found in Group IV among the four groups. In the middle third of the canal and lesser in the apical third of all four groups, the number of tubules open is also shown in Table 1. This is statistically significant ($p<0.05$). If we compare all four groups in Table 1, it is apparent that there are more open tubules in Group IV accordingly, followed by Group III, Group II & Group I. There were statistically significant differences in mean between all groups. ($p<0.05$)

Table 1: Estimated least square mean(mean) and standard deviationof the ratios evaluated in SEM (number of open tubules/total numberof tubules in mm^2) between groups

Groups	Region	Mean± SD
Group 1(solvent)	Coronal	.25±.07
	Middle	.30±.04
	Apical	.17±.02
	Total	.23±.09
Group11(without solvent)	Coronal	.37±.05
	Middle	.43±.05
	Apical	.24±.01
	Total	.32±.01
Group111(solvent+ passive ultrasonic irrigation)	Coronal	.44±.02
	Middle	.53±.03
	Apical	.28±.01
	Total	.41±.10
Group1V (without solvent + passive ultrasonic irrigation)	Coronal	.46±.06
	Middle	.64±.02
	Apical	.36±.01
	Total	.46±.09

The mean difference is significant at the .05 level.

Table 2 provides the ratio of open tubules numbers/total tubular number (multiple comparison) between coronal, apical and middle tubules among the groups. Statistically significant is the mean difference between the coronal, medium, or apical 3rd in each group. The middle third has more open tubules, indicating that dentine tubes are cleaner in the middle third.

Table 2: Estimated ratios of mean difference evaluated in SEM (number of open tubules/total number of tubules in mm^2) between coronal, middle and apical third of each group

Groups	Subgroup	Subgroups	Mean difference
Group 1(solvent)	Coronal	Middle Apical	-.05* .10*
	Middle	CoronalApical	.04* .14*
	Apical	Coronal Middle	-.12* -.18*
Group2(without solvent)	Coronal	MiddleApical	-.07* .15*
	Middle	CoronalApical	.08* .22*
	Apical	Coronal Middle	-.15* -.22*
Group3(solvent+passiv	Coronal	MiddleApical	-.15*

e ultrasonic irrigation)			.13*
	Middle	CoronalApical	.13* .22*
	Apical	Coronal Middle	-.11* -.24*
Group4 (without solvent+ passive ultrasonic irrigation)	Coronal	MiddleApical	-.13* .11*
	Middle	Coronal Apical	.15* .27*
	Apical	CoronalMiddle	-.11* -.26*

The mean difference is significant at the .05 level.

Table 3 illustrates the average time (in minutes), with and without Endosolv-R solvent, necessary to remove the gutta-percha and AH Plus sealer. For samples where Endosolv-R is not employed the retreat time was revealed to be less. Statistically significant is the time difference.

Table 3: Mean time required for removing gutta-percha andAH Plus sealer in minutes (T test)

Group	N	Mean±SD
Solvent	20	5.32±.22
Without solvent	20	4.22±.37

Discussion

The retreatment of the filled root teeth is indicated when the illness caused by micro-leakage, insufficient cleansing and shaping, technical defects or difficult anatomy persists. If non-operatory retreatment is recommended, it is necessary to remove the filled material efficiently from the root duct systems in order to guarantee a good outcome. [7] With curved root canals it is more difficult for filler materials to be removed and subsequently cleaned and shaped in comparison to direct channels. It may also lead to distortion of the instrument or separation of the instrument. However, the removal of root fillings in curved and narrow canals takes time, particularly when the filler material is fully condensed.[8] The literary study shows that the efficiency of root filling removal studies in curved root canals is limited.

Various materials such as the Gutta percha and Resilon are used to fill root canals, the most frequent of which is the intestinal percha with a range of sealants.[9] The spaces between the dentinal wall and the shuttering interface must have roots channel sealers. Sealers also cover the spaces and imperfections between the gutta-percha cones on the root canal, lateral and accessory pipes. Zinc oxide eugenol, calcium-sections, ionomers in the glass and resin-filled sealers 94 are among the most popular sellers. Resin-based sealer like AH Plus have a long history of application. They offer good sealing adherence in comparison to other sealants. [10] AH Plus is an epoxy-resin sealer that makes a high uniformity of polymerisation. The better adhesion to dentin's walls in roots filled with resin sealers makes removing from canal walls complicated and even a red heated plugger cannot usually penetrate the canal as far as possible in order to allow an insert of file next to the gutta perch that facilitates removal from canal walls.[11]

Endodontic hand files, thermal instruments, ultrasounds and rotary instruments with or without solvents can remove the root fillings from the root channels, or by combining any above-noted equipment. A number of different rotational systems have been examined for the root fill removal and for root channel re-instrumentation such as Profile, Quantec, GT Rotary, K3, Protaper, Race, R-endo, M-Two. Recently announced Universal Retreatment Files for Protaper (Dentsply, Tulsa), D1, D2 and D3 for a rotating NiTi system.

Irrigation is an essential part of root canal debridement in both endodontic treatment and non Cases of surgery because it allows cleaning over and above what can be accomplished only by root canal devices. Endodontic treatment needs to be delivered and agitated efficiently.[12] The efficient irrigation removes from the root canal system the vital and necrotic remnants of pulp tissues, microorganisms and microbial toxins. Current chemical and mechanical debridging reduces nutrition of the root canal biofilm, which can lessen apical periodontitis incidence and severity. (The Netherlands and others) Long before Richman introduced ultrasounds in endodontics as an instrument of channel debridging in 1957, ultrasonic appliances had been employed in periodontics. Ultrasonics are used in the endodontic process for — refining access, finding calcified canals and removing attached pulp blocks, removal of intrachannel blocks (separate tools, root canal stations, silver dots, and fractured metal stations), increased irrigative solution action, ultrasonic intestinal condensation (GTA), surgical endodontology,

There has not been a literature survey to date on the efficacy of ultrasound irrigation in non-root canal surgery. The aim of the present study was to assess the cleanliness of dentinal tubules with Endosolv-R solvents and without them and to determine the efficacy of passive ultrasonic irrigation in non-operational retreatment using universal protaper retreatment files. It also documented the time needed for deleting gutta-percha and AH Plus scales utilising protaper reprocessing files. In this study, the selection of the curved canals of maxillary molars (both primary messiobukcal, or distocal) without taking the incidence of other mesiobukal canals or any extra channels into consideration. The utilisation of curved tubes will also be of more clinical importance in this in vitro study. Most earlier retreatment investigations are conducted principally on single root teeth [13] and the retreatment studies in curved canals are quite few.[14] The efficiency of the protaper retreatment system on palatal roots of maxillary molars with a curvature lower than 5 degrees was studied by Reis et al. In curving root canals it is more difficult and likely to distort or break up the instrument to remove filling materials and further cleaning and shaping .[14]

AH plus sealer, which have a long history of use, adherence and sealing capability, has been used in this investigation. AH Plus is a resin sealer that turns into a polymer that is exceptionally rigid. With resin sealants, it is difficult to remove roots from the canal wall because they adhere better to the dentinal walls. In in vitro investigations do not fully recreate in vivo circumstances, and their therapeutic significance is further reduced by decoronation. Decoronation in the present study ensured that specimens were standardised since several factors were eliminated, such like coronary anatomy and root canals, which enabled retrieval technology to be more trustworthy comparison. [15]

Endosolv-R is employed as solvent in this investigation as it is especially suited for resin type softening filling. Tamse et al did a comparative investigation utilising various solvents and discovered Endosolv to dissolve gutta-percha.[16] Endosolv is more effective. Protaper Ni-Ti Universal Rotary Filesystem is utilised in this study to remove gutta-percha and AH Plus sealers. Gu et al established that the guttaper-percha retreatment system was less efficient than other traditional techniques and only left a lower percentage of the area that had guttapercha/sealer remains than was handled with other techniques.[5] NaOCl is the most efficient irrigant for mechanical removal of dentinal scrap during ultrasound activation in passive ultrasound irrigation (0.5%-5.25%).[17] This study used an intermittent flow of 3% NaOCl during ultrasonic irrigation for 4 minutes. 3 per cent of NaOCl was applied in this investigation, since 3 per cent of NaOCl is cooled at each minute, sufficient free chlorine may be present in the root canal to dissolve the organic component of the dentine debris and because a NaOCl cooling effect is sufficient to eliminate dentine waste.

In this investigation, a total of 4 minutes were employed for ultrasonic irrigation. Two different layers comprise the smear layer. The mouth of dentinal tubules is plugged in a superficial layer loosely linked to the dentin and the other layer, dentin/debris. Studies have demonstrated that the surface smear layer was removed for one minute by ultrasonic, but the dentinal tubules were sealed. The whole superficial smear layer and most dentinal plug layer have been eliminated for 3 minutes of ultrasound. All the debris in instrumented and uninstrumented areas was cleared for 4 minutes of ultrasonography, other from a few chips.

In this study, dentinal tubules demonstrated a cleaner dental retreatment without the use of solvents compared to the Endosolv-R solvent groups. This is because it dissolves the gutta percha and sealant when solvents are employed and a thin layer of soft gutta-percha and sealant is created. It sticks to the wall of the root canal and the canal walls cannot be removed completely. The use of solvents resulted in a thin coating of filler material being deposited on root canal walls, according to Wilcox&Juhlin. This is hard to remove. This layer alleviates the effect of intracanal antibacterial drugs and may hinder the adaptation to the root duct walls of the following filling material.[18]

The middle and coronal third tubules showed more open tubules than the apical third when assessing the cleansing of dentinal tubules in the coronal, middle and apical thirds following the retreat with or without a solvent. Due to the differing tapers and diameters of the D1, D2 and D3 and the apical D3 files diameter (size 20), the working length is achieved and a cleaning action is prevented in full. This finding was similar to the Guiliani et al investigation, in which retreatment records indicated greater debris in the apical part than in the middle and coronal thirds of channel It has also been found that a larger amount of filling material remained in the apical third of a retreat study (Masiero & Barletta Bueno et Al.) than in central and cervical thirds, regardless of the technique used.[19]

This investigation showed that the larger filling material was kept in the apical area than in the centre and third coronal areas. This is because the instrumentation in curved and narrow channels has an increased anatomical variability and difficulties. The curvature in many deep grooving planes and depressions in the apical third on dentin walls is also a cause of the development of less instrumental areas which make it impossible for protaper files to be placed on whole root canal walls. (Hulsmann&Bluhm).[14]

In addition, files placed on curved channels are displaced from their long axis, resulting in inequalities in cutting and cleaning efficiency depending on the pressure that the cutting instrument has contact with various root channel walls. This deviation of the instrument produces increased cutting effectiveness and cleaning effectiveness in the opposite direction to the curvature of instrument. [14]Thus, the middle third of the canal exhibited dentinal tubes more open than the apical third and the coronal third were followed. Schirrmeister et al. have shown that greater debris was discovered in apical areas due to decreased sizes of protaper files that decrease effectiveness in apical areas. [20]

In this study alone, endodontic reprocessing with protaper reconstruction files demonstrated less time for repair than the Endosolv-R solvents used in the groups. The reason is because protaper recovery files delete huge amount of gutta percha in the spirals surrounding the instrument than in small circles not attached to the devices. When solvents are used for removal of gutta percha and sceller, the time is longer necessary as more time for the solvent is necessary to supplement gutta percha. Moreover, a thin layer of smooth gutta percha is necessary to shape and stick to the root canal wall and can be removed from the canal walls completely. [4]. This means that the time taken to remove the gutta percha and AH Plus sealer has increased with the use of Endosolv-R solvent and this is similar with the earlier studies by Gu-et al and Takahashi et al. [5,7].

Although the adherence quality of resin-based sealants is believed to be sound, this substance may result in a weakened connection of the apical third to facilitate removal. Zmener et al described that the AH Plus sealer appeared to be quick and lead to early detachment from the root walls of the canal. The sealer still lacks moist-dentine adhesion. Furthermore, the polymerization stress may produce blank formation in the sealant (cohesive stress), between sealer or dentin, or between the sealant and gutta percha cones during the setting period of the material (adhesive stress). All these features explain why AH Plus may easily have been removed from canal walls, yet it is considered a sticky sealant during retreatment processes.

Nevertheless Reis et al. have assessed the efficacy of the rotary rotary protapheric reconstruction system and manual files, which were obturated with guttapercha and either a zinc oxide eugene sealing agent (Endo fill) or a resin-based sealer (AH plus sealer), using a technique of thermoplastic guttapercha.No retreat solvent has been used. Results reveal that waste has been left unrelated to retreatment process in all thirds of channel. The biggest difference was noted in the middle third between the technique and the sealers, with less debris in canals sealed with endofill and reinstrumented with handfiles.

Protaper and hand files both have the same cleaning efficacy in their apical third until the sealer is involved. Universal retreat files and files. This outcome is different from our research, where the centre third of the channel is cleaner. This is because the root of the palate is nearly straight and wide and instrumentation can be done until the apex, unlike the mesiobucal / distobukal canals featured here. The present study indicated improved results in passive ultrasonic irrigation compared with groups in which ultrasonic irrigation is not employed. The increased irrigation flow speeds achieved throughout the canal are attributable to this fact.

The other reason why passive ultrasound irrigation has a better influence is because an irrigant combined with ultrasound vibration provides continuous irrigation movement, directly connected with the effectiveness of root canal space cleansing. When aggregated with an ultrasound unit, the water temperature increases, increasing the impact of the NaOCl on both microorganisms and soft tissue. Any rise in temperature in any solution in a root canal in characteristics is considered beneficial since it improves chemical reactivity and therefore desinfects potential91

In this research it was not possible to remove the infill material completely from the canal walls, however passive ultrasonic irrigation decreases the debris from the walls better. There were more detritus in the apical third than in the coronal and the middle three in the study. The rationale for this investigation is the fact that the efficacy of ultrasonic irrigation is affected by curved molar roots with a root diameter. The greater strength in curved canals by which a tip reaches the walls of the Canal decreases its effectiveness. At least three contact points with the root canal walls will be positioned in a curved Canal.[3] The effective ultrasound irrigation is compromised by narrow and curved channels and, if files rotate into channels, the file is able to bond thus limiting its movement and purification efficacy. They need to be in direct touch with the surface to be effective for the irrigants. Irrigation solutions have trouble attaining apex in tiny root diameters and this also influences the effectiveness of passive ultrasound irrigation. More freely oscillating devices create more ultrasonic effects than one which adheres to the canal walls in the irrigating solution.

Another cause could be that putting the ultrasonic-activated instrument in the centre of the root channel is difficult to standardise and the amplitude of the displacement is modified as a minor restriction of the channel. This will directly affect the effectiveness of passive ultrasound irrigation. In addition, the phenomena of vapour lock should be considered while assessing irrigation in the apical third. By decomposing NaOCl organically in a carbon dioxide and ammonium bubble, the vapour locks are formed and the outcome is a gas trapping at apical 3. This vapour locking effect hinders the irrigation flow into the apical area and the canal system to adequately degrade. A Schoeffel et al investigation showed that acoustically streaming and cavitation become physically impossible when ultrasonic stimulated tips leave the irrigant and go into the appical vapour lock.[21]

The results are consistent with Al-Jadaa et al's study of how a stronger strength is observed in more curved canals that can lower ultrasound efficient by a tip contacting the canal walls. Research by Burleson et al., Cameron.J.A, Sluis et al., and Neto etc. showed promising results when passive ultrasonic watering was employed for cleaning of debris from root canals even though most research were performed in simulated direct canals that are not frequently found in actual teeth.[7]

The results of this study demonstrated that there were more open tubules after passive ultra-sonic irrigation in the middle third of the canals. This is because ultrasound files are placed 2mm apart from the apical end for the free oscillation of the file. The file vibrates like a sinewave in ultrasound equipment. A standing wave is equipped with maximum (anti-node) and non-displacement zones (nodes). A node is shown on the tip of the instrument. Acoustic streaming also creates small intensive, circular moving fluids surrounding the instrument (eddy flow). The eddying takes place nearer to the tip than the coronal end of file94. The channels are then cleaned up by the middle of the three rather than apical thirds since the file is 2mm away from the apical area and more files act on file tips as well as on the corónal end of files. In addition, when ultrasonic files are enabled in the channel, the file flushing action drives the irrigation agent in the direction of the apex during the initial file flush and the irrigation agent flushing away with cleared debris. Throughout this process, the debris will again build in the third coronal. These are the reasons why the coronal third in this study is not as clean as the middle third.

The present study proposes a more efficient removal of a gutta percha and AH Plus sealer in non-operative endodontic repair from protomic files without the use of any solvents. Endosolv-R has resulted in increased gutta percha or sealant on the walls of the root canal and within the dentinal tubules. The use of solvent in this investigation even showed that the removal of gutta percha and AH Plus sealant takes a lot of time.. During endodontic retractation, therefore, solvents should not be suggested. Additional steps of passive ultrasound irrigation in non-operative endodontic retreat after gutta-percha and sealant removal absolutely increase the smoothness of dentinal tube products. A further study should however be done to analyse the effect of the cleanliness of the dentinal tubules in endodontic retreatment using different irrigation techniques such as Endovac, Navitip, Max I Tests.

Conclusion

The utilisation of Endosolv-R solvents with rotary files of NiTi protaper during the non-surgical endodontic retreat on the curved radical channels of mesiobuchal and maxillary 1st and 2nd molar distobuchal roots shows that there are more gutta-percha and AH sealant rests on radical channel walls.Passive ultrasonic irrigation further increases the clearance of residual waste in the walls of the root canal, consequently revealing an increase in the number of open dentinal tubules compared to other experimental groups in the SEM studies.More open dentinal tubules were detected in the middle of the third, reduced in the coronal third and less apical third in all the experimental groups.Solvent is more time consuming when the gutta-percha / AH Plus scrubber is removed throughout the process.No evidence of gutta percha/sealant remains could be removed from the root canal walls of bent roots irrespective of the techniques for instrumentation and irrigation applied.

References

1. Amir, . F., Suhron, M., & Sulaihah, S. (2021). Family care model development in treating schizophrenia patients that have self-deficit nursing based system: Structural equation modeling analysis. *International Journal of Health & Medical Sciences*, *5*(1), 7-14. https://doi.org/10.21744/ijhms.v5n1.1808
2. Erdemir Ali, Eldeniz Ayce Unverdi, Belli Sema. Pashley H David Effect of solvents on bonding to root canal dentin Journal of Endodontics vol.30, no 8 August 2004, 589-592
3. Ezzie Elie, Fleury Alex, Solomon Eric, Spears Robert, He Jianing Efficacy of retreatment techniques for a resin –based root canal bturation material.
4. Gergi.R, Sabbagh. C, Effectiveness of two NiTi rotary instruments and a hand file for removing gutta-percha in severly curved root canals during retreatment: an ex vivo study.International Endodontic Journal (2007) vol.40.,532-537
5. Gregoria De Cesar, Estevez Roberto, Cisneros Rafel, Paranjpe Avina, Cohenco Nester, Efficacy of different irrigation and activation systems on the penetration of sodium hypochlorite into simulated lateral canals and up to working length: An In vitro study Journal of Endodontics vol 36, no 10 October 2010, 1-6
6. Gu L.S, Ling J.Q, Wei.X, Huang X.Y., Efficacy of protaper universal rotary retreatment system for gutta-percha removal from root canals International Endodontic Journal (2008) vol.41., 288-295
7. Gu Lisha, Kim Jong Ryul, Ling Junqi, Choi Kyung Kyu, Pashley H David, Tay R Franklin, Review of Contemporary Irrigant Agitation Techniques and Devices. Journal of Endodontics vol 35, no 6 .June 2009, 791-804
8. Horvath S.D, Altenburger .M.J.,Naumaan.M., Wolkewitz M, Schirrmeister.J.F., Cleanliness of dentinal tubules following gutta-percha removal with and without solvents: A SEM study International Endodontic Journal (2009) vol.42., 1032-1038
9. Hulsmann .M, Bluhm.V, Efficacy ,cleaning ability and safety of different rotary NiTi instruments in root canal retreatment International Endodontic Journal (2004) vol.37., 468-476
10. Hulsmann .M, Stotz.S Efficacy ,cleaning ability and safety of different devices for gutta-percha removal in root canal retreatment International Endodontic Journal (1997) vol.30., 227-233
11. Lim .Varawan.Sae, Lim Boon Kuan, Lee Hwee Leng Effectiveness of Profile .04 taper rotary instruments in endodontic retreatment. Journal of Endodontics vol 26, no 2, February 2000. 100-104
12. Lui Jeen Nee, Kuah Hong Guan, Chen Nah Chen , Effectof EDTA with and without surfactants or ultrasonics on removal of smear layer Journal of Endodontics vol 33, no 4, April 2007,. 472-475
13. Masiero.A.V, Barletta .F.B., Effectiveness of different techniques for removing gutta-percha during retreatment. International Endodontic Journal (2005) vol.38., 2-8

14. Oliveria Daniel Pinto , Barbizam Joao Vicenta Baroni, Trope Martin, Teixeira B Fabricio, Comparison betweengutta-percha and resilon removal using two different techniques in endodontic retreatment. Journal of Endodontics. Vol 32. No.4 April 2006, 362-365
15. Pathways of the pulp-Stephen Cohen, 9th edition Page:252,269,370,971
16. Pirani Chiara, Pelliccioni A Gian, Marchionni Silvia, Montebugnoli Lucio, Piana Gabriela, Prati Carlo Effectiveness of three different retreatment techniques in canals filled with compacted gutta-percha or Thermafil: A SEM study Journal of Endodontics. Vol 35.No.10,October2009,1433-1440
17. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Health and treatment of diabetes mellitus. *International Journal of Health Sciences*, *5*(1), i-v. https://doi.org/10.53730/ijhs.v5n1.2864
18. Takahashi. MC, Cunha.SR, De Sigrist A, Fontano. EC, Silveira. M.F.C, Bueno.S. E.Carlos In vitro evaluation of the effectiveness of protaper universal rotary retreatment system for gutta-percha removal with or without a solvent. Journal of Endodontics. Vol 35 No.11 November2009, 1580-1584
19. Tamse.A, Unger.U, Metzger.Z, Rosenberg.M, Guttapercha solvents- A Comparitive Study Journal of Endodontics vol 12, no 8 .August 1986, 337-340
20. Tasdemir.T, Yildirim.T, Celik.D, Efficacy of three rotary NiTi instruments in removing gutta-percha from root canals International Endodontic Journal (2008) vol.41. 191-196
21. Unal.G.Celik, Kaya.B.Ureyen, Kececi.A.D, Tac.A.G. A comparison of the efficacy of conventional and new retreatment instruments to remove gutta-percha in curved root canals.an ex vivo study International Endodontic Journal (2009) vol.42. 344-350
22. Wilcox.R.Lisa, Krell.V.Keith, Madison. Sandra, Rittman.Barry Endodontic retreatment:Evaluation OF gutta- percha and sealer removal and canal reinstrumentation Journal of Endodontics. Vol 13. No.9 September1987, 453-455
23. Wilcox.R.Lisa, Swift.L.Maureen Endodontic retreatment in large and small curved canals. Journal of Endodontics. Vol 17. No.7 July 1991, 313-316