SCANNING ELECTRON MICROSCOPY EVALUATION OF THE EFFICIENCY OF THREE NEWER IRRIGATION NEEDLES ON DEBRIS REMOVAL FROM ROOT CANAL WALL – AN EX VIVO STUDY

Dissertation submitted to

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

In partial fulfillment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH IV

CONSERVATIVE DENTISTRY AND ENDODONTICS

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CERTIFICATE

This is to certify that this dissertation titled "**SCANNING ELECTRON MICROSCOPY EVALUATION OF THE EFFICIENCY OF THREE NEWER IRRIGATION NEEDLES ON DEBRIS REMOVAL FROM ROOT CANAL WALL – AN EX VIVO STUDY**" is a bonafide record work done by **GOWTHAM.K** under our guidance during the study period between 2008-2011

This dissertation is submitted to **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY** in partial fulfillment for the degree of **MASTER OF DENTAL SURGERY – CONSERVATIVE DENTISTRY AND ENDODONTICS, BRANCH IV.** It has not been (submitted partially or full) for the award of any other degree or diploma

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INTRODUCTION

The success of root canal therapy depends on several factors: proper case selection, accurate diagnosis, proper cleaning and shaping, quality root canal filling, and proper coronal seal. Although many factors affect the success of root canal treatment, presence or absence of infection is the main etiologic factor for pulp and periradicular pathologic processes. Therefore, it is logical to characterize debridement and neutralization of tissue, bacteria, and inflammatory products within the root canal system as the most important component of therapy.[43]

Schilder defined cleaning and shaping as the removal of all contents of the root canal system that could possibly serve as substrate for bacterial growth or as a source of periapical inflammation and the establishment of a specific cavity form that will facilitate root canal filling.[43]

Debris was defined as dentin chips and residual vital and necrotic pulp tissue loosely attached to the root canal wall, that in most cases is infected. The removal of debris and smear layer from the root canal system prior to obturation with an appropriate filling is one of the primary aims of endodontic treatment. Smear layer differs from the `dusty' pattern of superficial debris in that it is a layer of `muddy' material, composed of an amorphous layer of organic and inorganic debris, and sometimes bacteria, which is compacted against the dentine walls as a result of the rasping action of endodontic instruments. Ideally, root canal irrigants should flush out debris dissolve organic tissue, kill microbes, destroy microbial byproducts and remove the smear layer. To accomplish these objectives there must be effective delivery system. [36]

Thorough debridement is essential because any tissue or debris left in the canal can contain bacteria, serve as a bacterial substrate & can cause periradicular inflammation. Further, debris remaining on the canal wall can also prevent close adaptation of the obturating material. Since poor adaptation may lead to leakage, the opportunity for failure may increase because of poor canal debridement. Therefore debris should be totally removed.

To aid in root canal debris removal, a few attempts have been described that use cotton wrapped around an endodontic file or a broach or the use of an Endobrush . The former study indicated that a cotton wrapped around a file or broach was not able to clean the canal properly especially the irregularities, whereas, the later study demonstrated a better cleaning effect when the Endobrush was used with hand instrumentation compared with that of instrumentation alone. Recently, few irrigation devices have been introduced in the market NaviTip FX, (Ultradent) Max I probe, (Dentsply) Endo eze (Ultradent).[6] A literature survey revealed that no studies have been reported on the use of Endo Eze needle in endodontic therapy.

An improved delivery system for root canal irrigation is highly desirable to facilitate effective debridement of the canal.

AIM

The aim of the present study was to investigate the effect of three newer irrigation needles on debris removal from root canal wall.

The objectives of this study were:

1. To evaluate the canal cleanliness with newer irrigating devices at various levels of root canal with and without passive ultrasonic irrigation under scanning electron microscopy

2. To compare cleaning efficiency of newer irrigating devices with and without passive ultrasonic irrigation under scanning electron microscopy.

REVIEW OF LITERATURE

Coffae et al (1975)[26] Comparison of traditional methods of root canal preparation with serial type of preparation that include use of rotary instruments. In which serial preparation were significantly more effective than non-serial preparation in removal of tissue at different levels in root canals of extracted mandibular molars.

Baker et al (1975)[8] stated that no apparent differences in the effectiveness of the various Irrigating solutions. In removing root canal debris microorganisms, the removal of debris and microorganisms seemed to be a function of the quantity of irrigating solution rather than the type of solution used in extracted single rooted teeth which were mechanically instrumented until clean .

Mc Comb et al (1975)[32] examined the effects of different instrumentation technique, different irrigating solutions, various chemical treatments which were used after instrumentation, and stated that most standard Instrumentation technique, produced a canal wall that was smeared and often packed with debris and that the use of EDTA preparation as an irrigant or as a chemical treatment produced the cleanest canal walls free of a smeared layer.

Svec et al (1977)[47] evaluated the effectiveness of Chemo Mechanical removal of pulpal and dentinal debris with sodium Hypochlorite & H_2O_2 Vs normal saline solution and concluded that combination of NaOCl & H_2O_2 was significantly more effective in cleansing the system at different levels from apex. At 5 mm level normal saline was equally effective as an irrigant.

Ram (1977)[38] found that when root canals were being enlarged, repeated irrigation was mandatory. Under the conditions of this study, the most significant factor in obtaining maximum results in root canal irrigation was the diameter of the canals. The removal of debris seems to be a function of canal diameter rather than the type of solution used.

Rass et al (1982)[1] evaluated the effectiveness of four clinical irrigation methods on the removal of root canal debris in extracted tooth with narrow canals and concluded that the needle delivering the irrigant must come in close proximity to the material being removed. In order to be more effective, the use of alternating solution of H_2O_2 & NaOcl was no more effective than the use of tap H_2O or anesthetic solution.

Cunningham et al (1982)[15] evaluated root canal debridement by the endosonic ultrasonic synergistic system. The endosonic ultrasonic synergistic system was compared to conventional hand-filing and irrigating techniques for its ability to débride the root canal system. Extracted human teeth were endodontically prepared by conventional and ultrasonic techniques. The roots were cross sectioned and evaluated microscopically at the 1, 3, and 5 mm. levels from the apex for cleanliness. The endosonically prepared canals were significantly cleaner at all levels.

Chow et al in (1983)[13] evaluated the effectiveness of root canal irrigation using hypodermic needle & syringe and he stated that there was little flushing and displacement of particles much beyond the tip of the needle. He concluded that the clinical extent of effectiveness of irrigation is a function of the depth of insertion of the needle and small bore needles were more effective than larger ones.

Goodman et al (1985)[5] has compared the efficacy of the step back technique Vs a step back/ultrasonic Technique on the tissue removal from the Mesial root canal of Mandibular molars and concluded 1) that the step back / ultrasonic Preparation significantly cleaned Isthumus at both levels & canals at 1mm level more effectively that the step- back preparation. 2) No significant difference in canal clean lines at the 3 mm level between both the groups.

Teplitsky et al (1987)[49] compared syringe irrigation with endosonic-facilitated irrigation and they concluded that that endosonics was significantly superior to syringe irrigation alone, particularly in canals prepared apically to a diameter of 0 3 mm or less without coronal flaring.

Ahmad et al (1987)[2] investigated the phenomena of cavitation and acoustic streaming in an ultrasonic endodontic kit. A comparison between the cleaning efficiency ultrasonic and hand instruments using either tap water or 2.5% sodium hypochlorite was made by scanning electron microscopy. With the use of a sensitive image intensification system, no light transmission, indicative of transient cavitation, was observed. However, examination of the surface of water containing polystyrene spheres near the vibrating file indicated intense acoustic streaming. Under scanning electron microscopy no difference of the surface debris was observed between the two techniques, although less smear was apparent in the ultrasonic groups. Canals instrumented with sodium hypochlorite exhibited less debris regardless of the techniques used. It is concluded that transient cavitation does not play a role in canal cleaning; However, acoustic streaming does appear to be the main mechanism involved. The findings with sodium hypochlorite reemphasized its usefulness as an irrigant.

Baker et al (1988)[7] compared Ultrasonics with hand instrumentation under SEM which was done in extracted maxillary central incisors, stated on the basis of remaining debris, smear layer and potency of dentinal tubules and concluded that no significant difference between the two methods was found at apical or coronal level of the root canal. At the mid- level of the canal, hand instrumentation produced significantly cleaner canal walls.

Cameron et al (1988)[11] carried out ultrasonic endodontics, with either a continuous flow of irrigant or an intermittent irrigant flush, on teeth with a mature or immature root canal wall. Temperature changes were measured with thermocouples placed inside the root canal and on the external root surface. A continuous flow of irrigant caused the external temperature to fall from 37~ to 32~ In the intermittent technique a temperature peak of 45~ was recorded intemally and 40~ at the external root surface. The thickness of the root canal wall had an effect on the rate of temperature change rather than the final temperature.

Ahmad (1988)[3] investigated two physical mechanisms of ultrasound, cavitation and acoustic streaming in an ultrasonic endodontic unit. In addition, the potential of ultrasonic instrumentation for disruption of Bacteroides intermedius was examined at various time intervals. The ultrasonic file could not generate cavitation within the recommended power settings indicated for endodontic purposes. However, there was evidence of acoustic streaming. The latter phenomenon resulted in destruction of 21.6%, 30.4% and 92.9% of test bacteria after 1, 5 and 15 min cavitation respectively. It appears that ultrasonic instrumentation of root canals had little bactericidal effect.

Keir et al (1990)[27] had evaluated the effectiveness of a brush in removing debris in the root canal after endodontic instrumentation in extracted human maxillary first molars and concluded that Instrumentation with brushing was significantly better than instrumentation alone in debriding the root canal.

Ahmad (1990)[4] evaluated the temperature rise of irrigant in root canals during free vibration of the ultrasonic file was studied in vitro in 10 human teeth. The mean temperature rise was found to be 0.6°C. He found that the minimal temperature increase may not significantly contribute to the effectiveness of ultrasonic root canal instrumentation.

Hulsmann et al (1997)[24] compared root canal cleanliness after preparation with difference endodontic Hand pieces and hand instruments under SEM and Concluded 1) that completely clean root canal walls could be achieved with none of the different technique devices 2) Ultrasonics resulted in the cleanest root canal walls, although the difference between the other technique were not significant.

Peters et al (2000)[37] evaluated the effects of irrigation on debris & smear layer on canal wall preparation by two rotary technique. Light Speed & Profile and irrigants used were tap water, 5.25% NaOcl & 17% EDTA. After post instrumentation the roots were split and enameled at difference levels for debris and the smear layer using 5 step scale and concluded that neither technique was superior in removing debris, but larger canal preparation obtained in the study, Light Speed enabled a more effective removal of the smear layer in the EDTA – NaOcl Group.

Schafer et al (2000)[18] compared the cleaning effectiveness of automated & Manual root canal instrumentation using SEM. Hand instrumentation was performed with K-flexo files used in reaming working motion and according to the step – back technique with H-files using in filing motion. Automated preparation was performed light speed Endo flash device using F-flexo as well as the profile system and concluded that both the methods resulted in an equivalent degree of canal cleaning, complete cleanliness was not achieved by any of the technique

Mayer et al (2002)[31] compared the effects of rotary instruments and ultrasonic irrigation on debris and smear layer scores: a scanning electron microscopic study and they concluded that Ultrasonically activated irrigants did not reduce debris or smear layer scores

Estrela (2002)[19] reviewed the mechanism of action of sodium hypochlorite based on its antimicrobial and physio-chemical properties. The choice of an irrigating solution for use in infected root canals requires previous knowledge of the microorganisms responsible for the infectious process as well as the properties of different irrigating solutions. Complex internal anatomy, host defenses and microorganism virulence are important factors in the treatment of teeth with asymptomatic apical periodontitis. Irrigating solutions must have expressive antimicrobial action and tissue dissolution capacity. Sodium hypochlorite is the most used irrigating solution in endodontics, because its mechanism of action causes biosynthetic alterations in cellular metabolism and phospholipid destruction, formation of chloramines that interfere in cellular metabolism, oxidative action with irreversible enzymatic inactivation in bacteria, and lipid and fatty acid degradation.

Setlock et al (2003)[43] evaluated canal cleanliness and smear layer removal after use of the Quantec-E irrigation system and to compare the system with traditional irrigation and he concluded that Irrigation with the Quantec-E irrigation pump resulted in cleaner canal walls, less debris, and more complete removal of the smear layer within the coronal one third, when compared with syringe irrigation, however no difference was observed in the middle and apical one thirds of the root canal.

Spoleti et al (2003)[45] evaluated the influence of passive ultrasonic activation on root canal disinfection and bacteriological identification of surviving colonies was carried out and concluded that surviving colonies were higher when ultrasonics was not used .

Lee et al (2004)[29] compared the efficacy of ultrasonic irrigation to remove artificially placed dentine debris from different-sized simulated plastic root canals and they concluded that In simulated plastic root canals, the diameter and taper of root canal influenced the effectiveness of ultrasonic irrigation to remove artificially placed dentine debris.

Usman et al (2004)[50] compared an in situ model the efficacy of root canal debridement in the apical 3 mm when instrumenting to a GT size 20 or a GT size 40 at working length and he concluded that No differences were found between each level within each apex size group however, the GT size 20 group left significantly more debris in the apical third compared with the GT size 40 group.

Vander Sluis et al (2005)[52] compared the efficacy of ultrasonic irrigation to remove artificially placed dentine debris from human root canals prepared using instruments of varying taper and they concluded that ultrasonic irrigation was more effective in removing artificially placed dentine debris from simulated canal extensions from canals with greater tapers.

Gutarts et al (2005)[22] compared the in vivo debridement efficacy of hand/rotary canal preparation versus a hand/rotary/ultrasound technique in mesial root canals of vital mandibular molars and concluded that the 1 min use of the ultrasonic needle after hand/rotary instrumentation resulted in significantly cleaner canals and isthmuses in the mesial roots of mandibular molars.

Vander Sluis et al (2006)[51] compared the influence of volume, type of irrigant and flushing method on removing artificially placed dentine debris from the apical root canal during passive ultrasonic irrigation and they concluded that Syringe delivery of 2% NaOCl (6 and 12 mL) was as effective as a continuous flow of 2% NaOCl (50 mL). Water was not effective in removing dentine debris from grooves in the apical portion of root canals.

Neto et al (2006)[35] evaluated of endodontic debris removal as obtained by rotary instrumentation coupled with ultrasonic irrigation and they concluded rotary instrumentation using Ni-Ti files associated with final irrigation of 1% NaOCl energised by ultrasound leads to better debris removal from the apical third of mesio-distally flattened root canal.

Medici et al (2006)[34] evaluated the effectiveness of endodontic irrigants in removing the smear layer from instrumented root canal walls using Scanning Electron Microscopy (SEM). The endodontic irrigants used were: 1% sodium hypochlorite (NaOCl); 1% NaOCl mixed to 17% EDTAC; 2% chlorhexidine gel; and *Ricinus communis* gel and concluded that the mixture of sodium hypochlorite and EDTAC completely removed the smear layer from dentinal walls. The other endodontic irrigants were not as efficient in cleansing the root canals.

Solaiman et al (2006)[6] evaluated the cleaning efficacy of a new brush-covered irrigation needle, the NaviTip FX and concluded that the NaviTip FX produced cleaner coronal thirds of instrumented root canals compared to the control group.

Benjamin et al (2007)[36] compared the efficacy of the EndoVac irrigation system and needle irrigation to debride root canals at 1 and 3 mm from working length and conclude that at the 1-mm level, significantly less debris was found in the EndoVac group . At the 3-mm level, there was no significant difference between groups. Significantly more irrigant was delivered with the EndoVac . This study showed significantly better debridement at 1 mm from working length by using the EndoVac compared with needle irrigation.

Boutsioukis et al (2007)[10] evaluated the clinical relevance of standardization of endodontic irrigation needle dimensions according to ISO 9626:1991/And 1:2001 specification and concluded that exact knowledge of the tip's external diameter is crucial for the appropriate size irrigation probe during endodontic treatment. Units of the widely used gauge system cannot be directly extrapolated to clinical practice. Adoption of millimetre as the standard unit , already recommended by ISO, should be corrected.

Ferreira et al (2008)[20] compared the Effectiveness of root canal debris removal using passive ultrasound irrigation with chlorhexidine digluconate or sodium hypochlorite individually or in combination as irrigants and they concluded that There is no additional benefit in terms of debris removal from root canal walls by irrigating with the filtrate obtained from the combination of NaOCl and CHX when compared to using NaOCl alone.

Yang et al (2008)[53] evaluation of debris and smear layer remaining following use of ProTaper and Hero Shaper instruments in combination with NaOCl and EDTA irrigation and they concluded that both instruments in combination with NaOCl and EDTA irrigation produced a clean and debris-free canal surface in the coronal and middle thirds, but were unable to produce a canal surface free from debris and smear layer in the apical third. However, the canals prepared with ProTaper instruments showed smaller amounts of debris and smear layer remaining in the apical region

Deus et al (2009)[17] evaluated the influence of the NiTi rotary system on the debridement quality of the root canal space and concluded that the variable amount of remaining pulp tissue for all experimental groups. Remaining pulp tissue existed in every specimen. He did not find a significant difference in the quality of canal debridement between different NiTi rotary systems, because an adequate tapered shape is obtained.

Goel et al (2009)[21] compared the effect of continuous, intermittent passive ultrasonic irrigation (PUI) and active scrubbing of irrigants with NaviTip FX (Ultradent, South Jordan, UT) in removing smear layer and he concluded that NaviTip FX and intermittent PUI showed significantly lower smear score than other groups at the 3 mm level . Both brush and intermittent ultrasonic activation were effective in the removal of smear layer from the apical third.

Zmener et al (2009)[54] evaluated the effectiveness of the NaviTip FX , a 30-gauge brush-covered irrigation needle, in removing debris and smear layer and concluded that In moderately curved root canals, a NaviTip FX used with 5.25% NaOCL and 17% EDTA solution with manual brushing was the most effective cleaning.

Klyn et al (2010)[28] compared the debris removal efficacy of the EndoActivatorTM system, the F fileTM, ultrasonic irrigation, or 6% NaOCl irrigation alone in human mandibular molars after hand-rotary instrumentation and they concluded that no statistically significant difference in canal or isthmus cleanliness among the 4 groups, but there was a statistically significant difference in canal cleanliness between the 1-mm level versus the 3-mm and 5-mm levels for all of the groups.

Rödig, et al (2010)[39] compared the efficiency of a sonic device (Vibringe), syringe irrigation, and passive ultrasonic irrigation in the removal of debris from simulated root canal irregularities and they concluded that Passive ultrasonic irrigation is more effective than the

Vibringe System or syringe irrigation in removing debris. The sonic device demonstrated significantly better results than syringe irrigation in the apical root canal third.

Rödig et al (2010)[40] compared the efficacy of syringe irrigation, RinsEndo® and passive ultrasonic irrigation (PUI) in the removal of dentinal debris from simulated irregularities in root canals with different apical sizes and they concluded that Passive ultrasonic irrigation removed debris significantly better from the artificial canal irregularities than RinsEndo® and syringe irrigation irrespective of the root canal diameter.

Tay et al (2010)[48] compared effect of vapor lock on root canal debridement by using a side-vented needle for positive-pressure irrigant delivery and concluded that presence of an apical vapor lock effect adversely affects debridement efficacy.

Salman et al (2010)[42] evaluated the efficacy of Sonicare CanalBrush irrigation for root canal cleaning and they concluded that Irrigation by agitation with the Sonicare CanalBrush improved root canal debridement in the coronal, middle and particularly the apical thirds of the root canal.

Shin et al (2010)[46] evaluated the efficacy of EndoVac system in comparison with that of a conventional needle irrigation method when the root canals were enlarged to various sizes and concluded that endoVac left significantly less debris behind than the conventional needle irrigation methods.

Haapasalo et al (2010)[23] stated that the success of endodontic treatment depends on the eradication of microbes from the root canal system and prevention of reinfection. And that there is no single irrigating solution that alone sufficiently covers all of the functions required from an irrigant.

MATERIALS

- Sixty four extracted intact human mandibular 1st premolar
- Normal saline
- Sodium hypochlorite 3 %
- 17% EDTA (Glyde)
- Irrigation tips :
    1. NaviTip FX (Ultradent)
    2. Max I probe (Dentsply)
    3. Endo –Eze (Ultradent)
    4. Syringe needle
- Sterile bottles
- Diamond disc
- Hand Gloves
- Face mask

ARMAMENTARIUM

- Airoter hand piece (NSK)
- Endo access bur (Dentsply)
- K files 10-25 (Mani)
- Rotary protaper files (Dentsply)
- Ultrasonic tips (Satelec)
- Torque controlled hand piece X- Smart (Dentsply)
- Chisel and mallet
- Ultrasonic scaler (Satelec)
- Scanning electron microscopy (Hitachi ,S 3400)
- Gold sputter machine

METHODOLOGY

Sixty four freshly extracted intact human mandibular 1st pre molars were selected for the study

Selection criteria of teeth

Mandibular 1st pre molars having curvature between 15 -20 degrees curvature determined by 64 slice CT scan were selected for the study.

Teeth with no calcification, no internal resorption, no previous root canal filling, and fully formed apices were used in this study.

All 64 tooth samples were instrumented with 10 no. k file until it could be seen at the apical foramen. Crowns were decoronated and root length was standardized to 15mm.

The teeth were then randomly divided into two groups, 32 each.

Group I: with passive ultrasonic irrigation and

Group II : without passive ultrasonic irrigation.

A : Control group: conventional syringe needle

B : NaviTip FX (Ultradent)

C : Max I probe (Dentsply)

D : Endo-eze needle (Ultradent)

A : Control group: conventional syringe needle

Instrumentation of root canal was done apically till 25 size k file followed by Protaper rotary instrument (S1,S2, F1,F2) in a crown down technique. The canal was irrigated with 3% NaOCl (2ml) and 17% EDTA as lubricant after each instrument with conventional syringe needle and final rinse using normal saline solution.

B : NaviTip FX (Ultradent)

Instrumentation of root canal was done apically till 25 size k file followed by Protaper rotary instrument (S1,S2, F1,F2) in a crown down technique. The canal was irrigated with 3% NaOCl (2ml) and 17% EDTA as lubricant after each instrument with NaviTip FX in active scrubbing in and out motion according to the manufacturer’s instruction and final rinse using normal saline solution.

C : Max I probe (Dentsply)

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D : Endo-Eze needle (Ultradent)

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Each subgroup was stored in a separate sterile box

The teeth were grooved vertically with a flexible diamond disc on the buccal and lingual surfaces.

The teeth were then cleaned and dried before splitting them into two halves with a chisel and mallet.

The split half of the tooth in which apex was most visible was used for SEM evaluation, and each tooth was marked with two lines using marker pen at 5 and 10mm from the coronal end to denote it into three parts (coronal, middle and apical).

SCANNING ELECTRON MICROSCOPE EVALUATION

For SEM analysis , the specimens were dehydrated at 37 degree C for 7 days and sputtered with gold (SCD 050 Sputter Coater) and the coronal, middle and apical thirds of root halves were examined using SEM (Hitachi ,S 3400) and at a standard magnification of 200x.

Debris on the canal wall was evaluated using Hulsmann's scoring system

Score 1: Clean root canal, only few small debris particles.

Score 2: Few small isles of debris covering less than 25% of the root canal wall.

Score 3: Many accumulations of debris covering more than 25% but less than 50% of the root canal wall.

Score 4: More than 50% of the root canal wall covered by debris.

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B : NaviTip FX (Ultradent)

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C : Max I probe (Dentsply)

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D : Endo-Eze needle (Ultradent)

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Debris on the canal wall was evaluated using Hulsmann's scoring system

Score 1: Clean root canal, only few small debris particles.

Score 2: Few small isles of debris covering less than 25% of the root canal wall.

Score 3: Many accumulations of debris covering more than 25% but less than 50% of the root canal wall.

Score 4: More than 50% of the root canal wall covered by debris.

Fig.1: MANDIBULAR FIRST PREMOLARS

Fig.2: ARMAMENTARIUM USED FOR TOOTH PREPARATION

Fig.3a: NAVITIP-FX

Fig.3b: MAX I PROBE

Fig.3c: ENDO-EZE

Fig.3d: SYRINGE NEEDLE

Fig. 4: 64-SLICE CT SCANNER

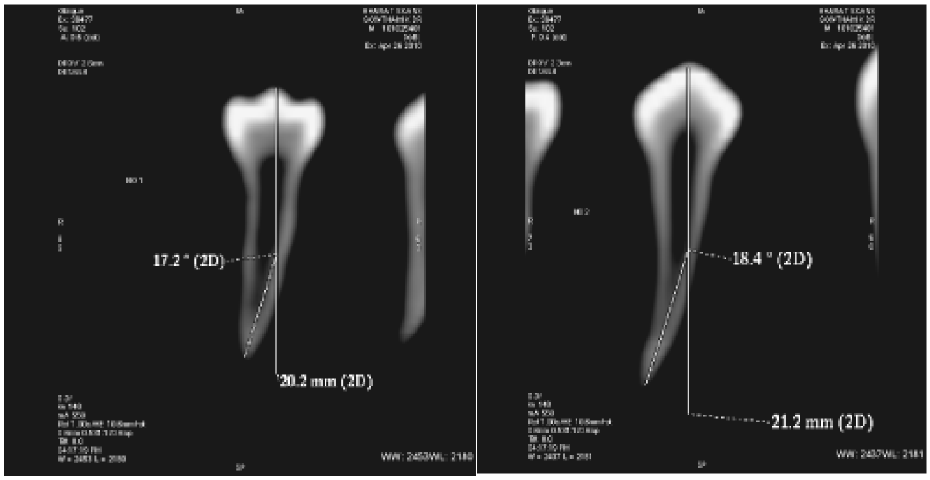


Fig.5: 64 SLICE CT SCAN IMAGES DETERMINING DEGREE OF CURVATURE

Fig.6: ULTRASONIC SCALER UNIT(SATELEC)

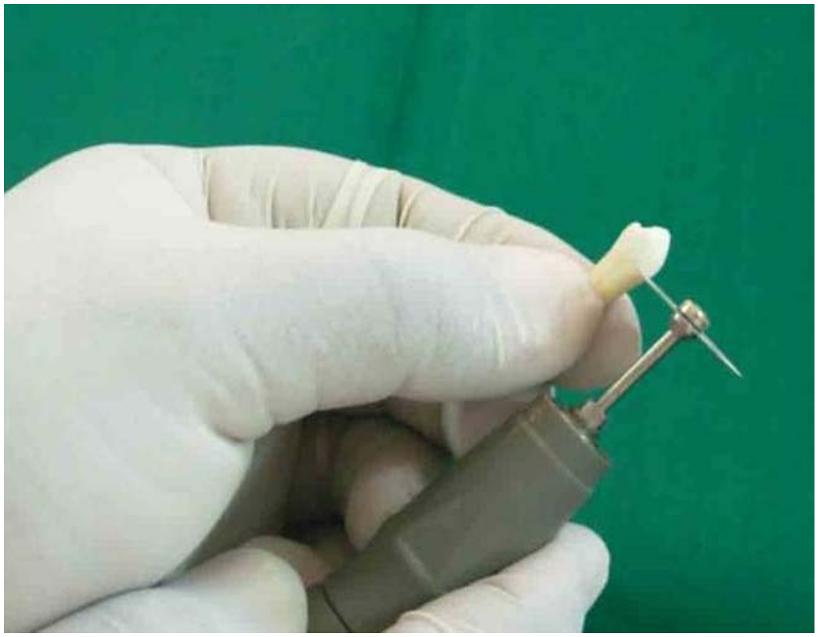


Fig.7:DECORONATION

Fig.8: PRELIMINARY PREPARATION OF THE TOOTH

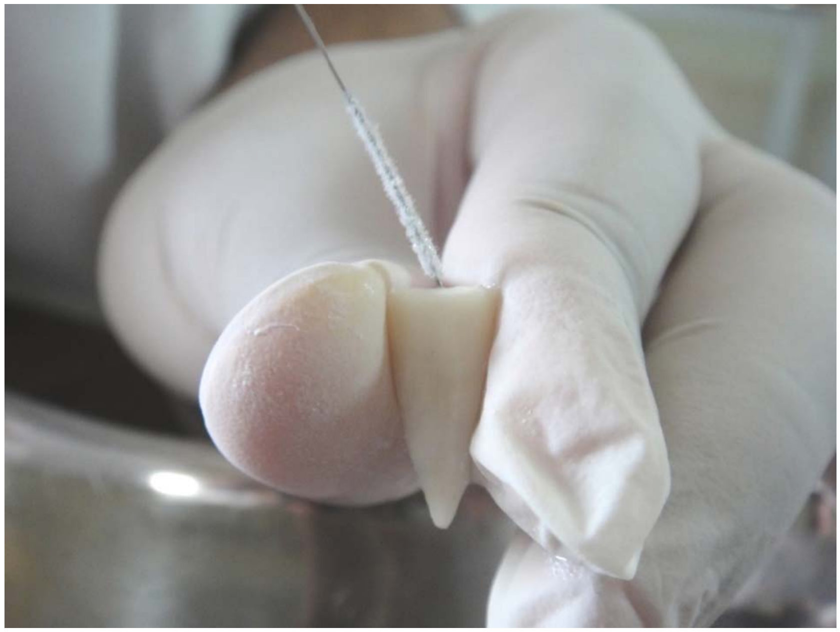


Fig.9: IRRIGATION WITH NAVITIP-FX

Fig.10: IRRIGATION WITH MAX I PROBE

Fig.11: IRRIGATION WITH ENDO EZE

Fig.12: IRRIGATION WITH SYRINGE NEEDLE

Fig.13: PREPARATION OF TOOTH SAMPLES WITH PROTAPER ROTARY SYSTEM

Fig. 14: PASSIVE ULTRASONIC IRRIGATION USING 15 SIZE K FILE

Fig.15 : GOLD SPUTTERING UNIT (HITACHI)

Fig.16: GOLD SPUTTERED TEETH SAMPLES

Fig.17: SCANNING ELECTRON MICROSCOPY

RESULTS

The results of the present study were subjected to statistical analysis to interpret the significant differences among various needles and dentinal debris removal between the groups. One way ANOVA, post hoc tukey tests were used for statistical analysis in the present study .

One way analysis of variance (ANOVA) is used to study the over all variance within groups. It is the extension of the between groups t-test to the situation in which more than two groups are compared simultaneously.However, it is not possible to identify the difference between the various subgroups with the help of the P values obtained from ANOVA. Therefore a specific statistical test was used for intra-group comparison. Hence, the post hoc Tukey is done in order to determine which groups differ from each other. The Post hoc Tukey Test Honestly significant difference or HSD test is a post hoc test designed to perform a pair wise comparison of the means to identify the specific sup groups in which sidnificant difference expression occurs.

Unpaired t-test is applied to unpaired data of independent observation made on individuals of two different or separate groups or samples drawn from two populations.

In this study One way ANOVA followed by Tukey HSD test showed statistically significant difference among various subgroup concerning the discrepancy in the dentinal debris removal at various levels in each group.

Fig. 18 & 19 shows the representative SEM images of all the two groups in this study. The SEM images showed in Group I (Irrigation combined with passive ultrasonic irrigation) had shown less debris when compared with Group II (Irrigation without passive ultrasonic irrigation). None of the group had completely removed debris from the root canal wall.

Table 1 demonstrates the mean and standard deviation values of debris score for middle, apical and coronal section in Group I (Irrigation combined with passive ultrasonic irrigation) A) Coronal and middle (2.50±0.534) had significantly less debris than those of apical(3.00±0.00). B) Coronal (1.75±0.463) had significantly less debris than those of apical (1.88±0.354) and middle (2.13±0.354). C) Apical (1.63±0.518) had significantly less debris than those of middle (2.25±0.463) and coronal (2.28±0.641) D) Coronal (1.75±0.707) had significantly less debris than those of middle (2.50±0.756) and apical (3.88±0.354).

Table 2 demonstrates the mean and standard deviation values of debris score for middle, apical and coronal section in Group II (Irrigation without passive ultrasonic irrigation). A) Coronal

(3.25±0.463) had significantly less debris than those of middle (3.38±0.518) and apical (3.88±0.354). B) Coronal (1.88±0.354) had significantly less debris than those of middle (2.38±0.518) and apical (3.25±0.463).C) Apical (1.75±0.463) had significantly less debris than of middle (2.50±0.535) and coronal (3.00±0.756). D) Coronal (2.13±0.641) had significantly less debris than those of middle (2.50±0.756) and apical (3.88±0.354).

Table 3 demonstrates comparing the mean and standard deviation debris score between apical,middle and coronal among Group I and Group II. When IA is compared with IIA, IA had significantly less debris than IIA in all the levels (apical, middle and coronal) of root canal wall (P-value<0.05)

When IB is compared with IIB, IB had significantly less debris than IIB in all the levels (apical, middle and coronal) of root canal wall (P-value<0.05)

When IC is compared with IIC, IC had significantly less debris than IIC in all the levels (apical, middle and coronal) of root canal wall (P-value<0.05)

When ID is compared with IID, ID had significantly less debris than IID in all the levels (apical, middle and coronal) of root canal wall (P-value<0.05)

Fig. 19:SEM IMAGES FOR APICAL, MIDDLE AND CORONAL SECTIONS IN GROUP II

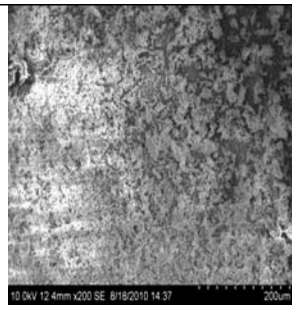
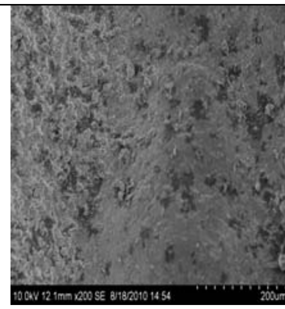
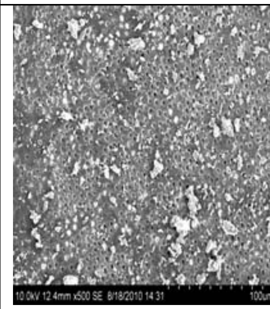
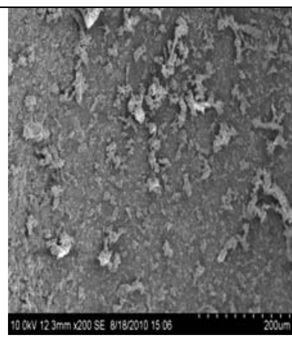
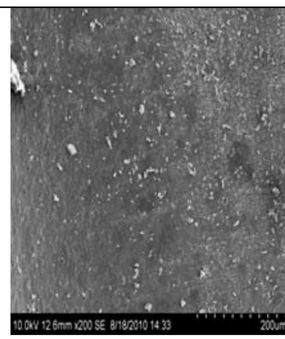
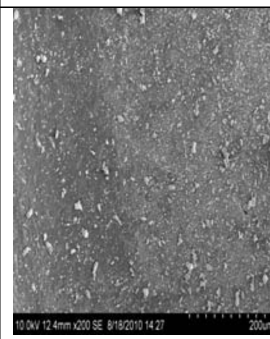
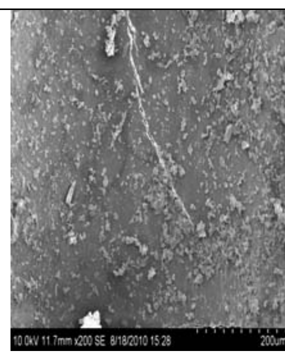
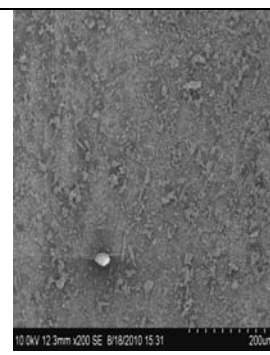
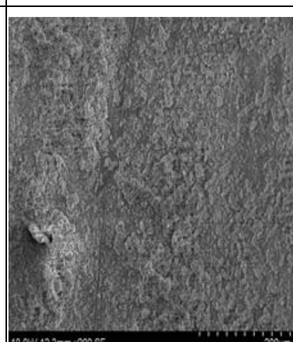
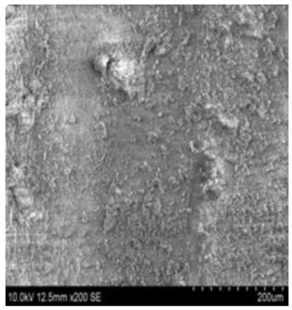
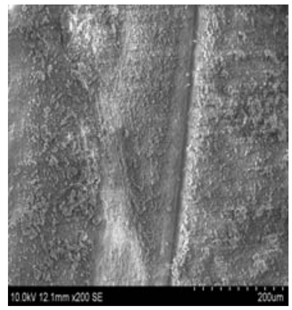
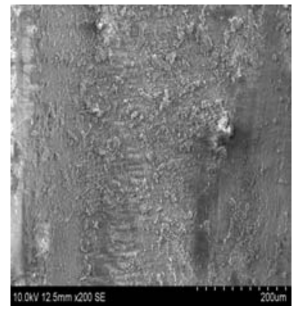
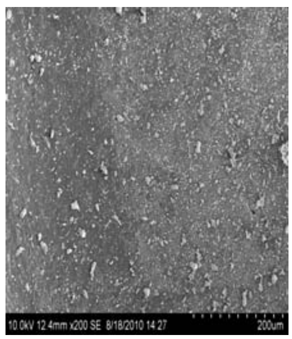
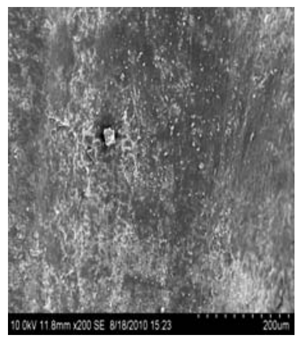
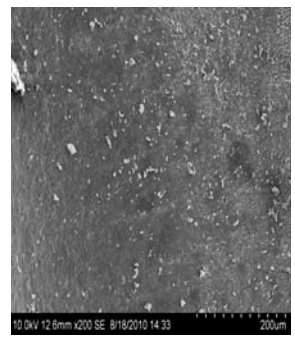
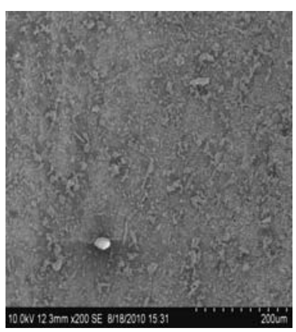
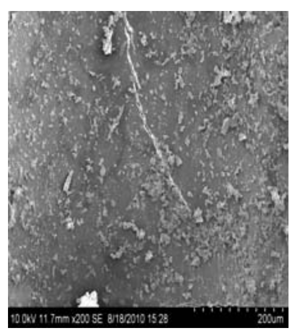
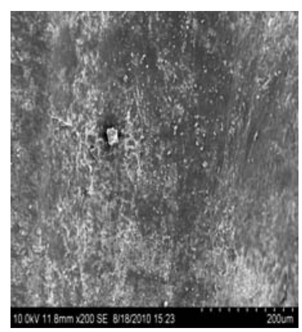
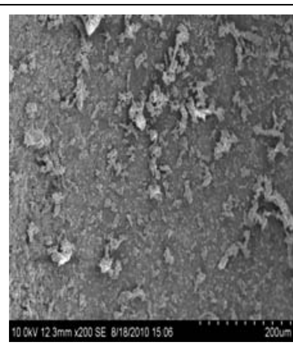
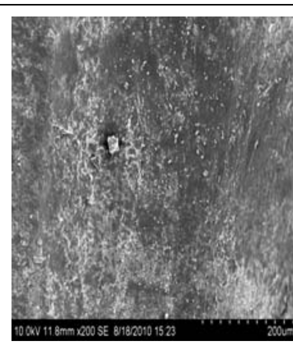
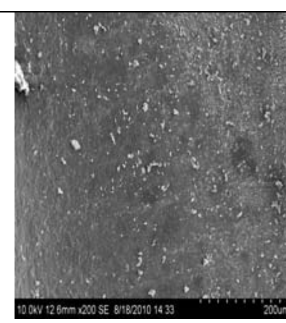
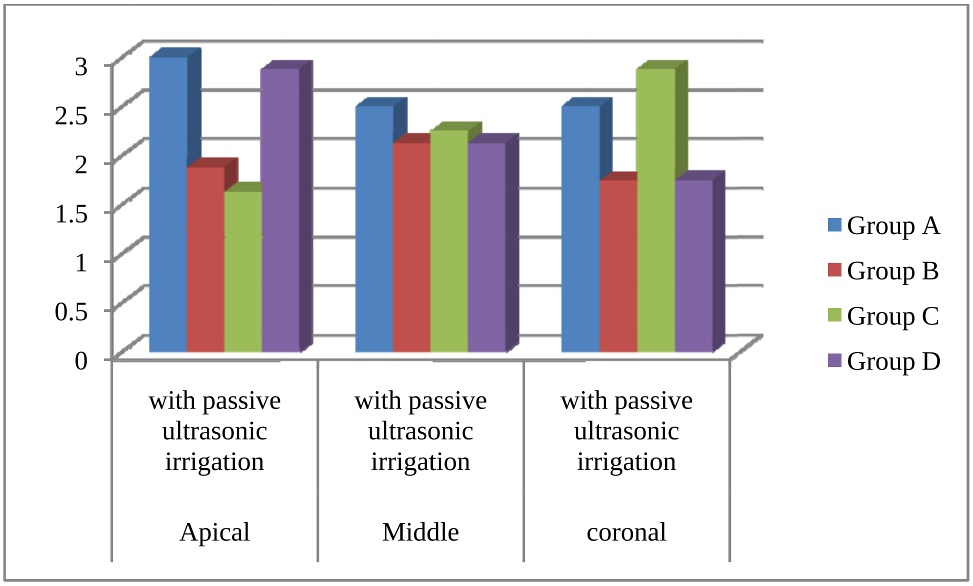
GROUP	APICAL	MIDDLE	CORONAL
IIA			
IIB			
IIC			
IID			

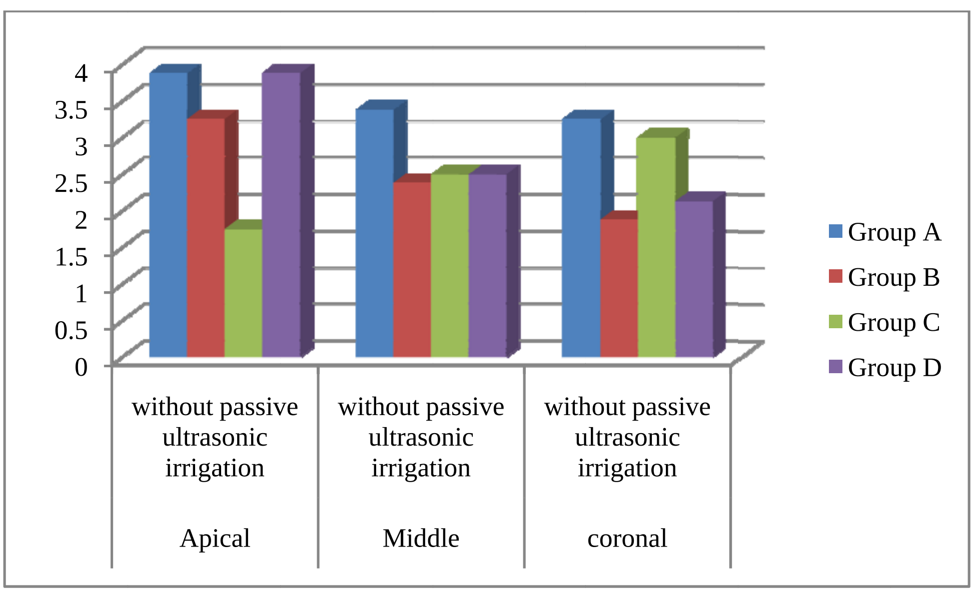
Fig. 18:SEM IMAGES FOR APICAL, MIDDLE AND CORONAL SECTIONS IN GROUP I

GROUP	APICAL	MIDDLE	CORONAL
IA			
IB			
IC			
ID			

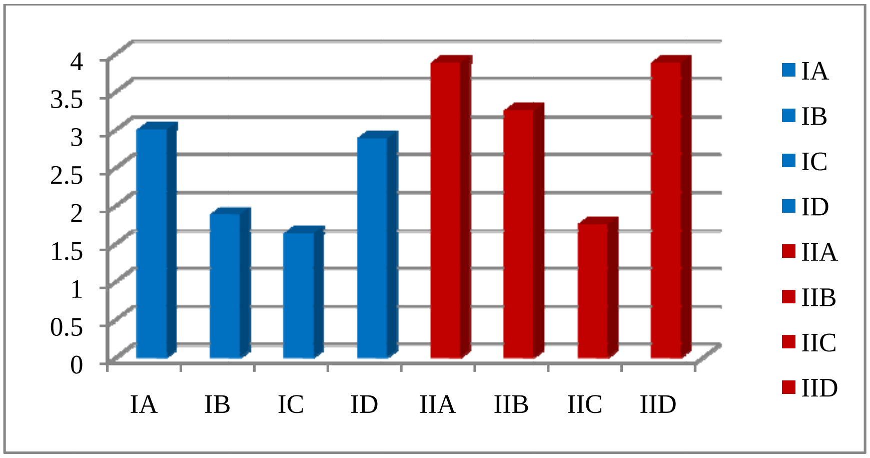
Graph 1: Mean values of debris score for Apical, Middle and Coronal sections in Group I



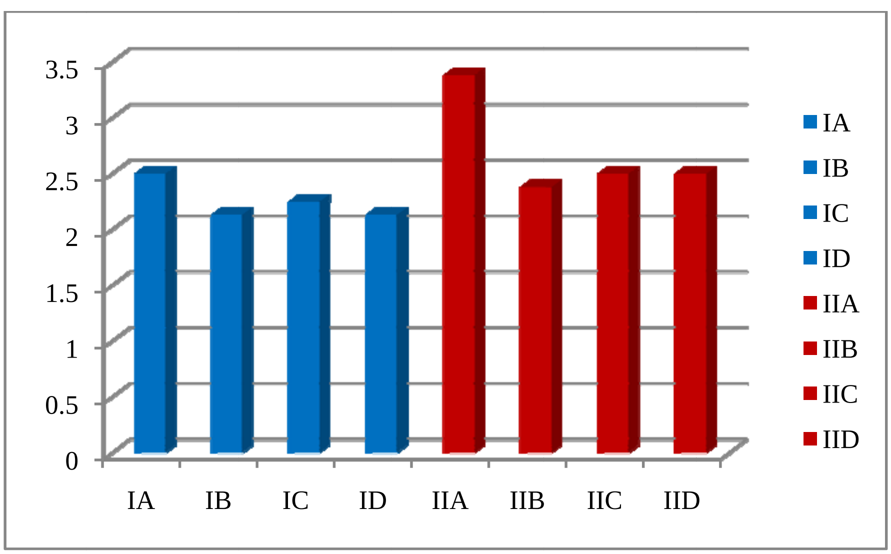
Graph 2 : Mean values of debris score for Apical, Middle and Coronal sections in Group II



Graph 3 : Comparing mean debris score for Apical section among Group I and Group II



Graph 4 : Comparing mean debris score for Middle section among Group I and Group II



Graph – 5 : Comparing mean debris score for Coronal section among Group I and Group II

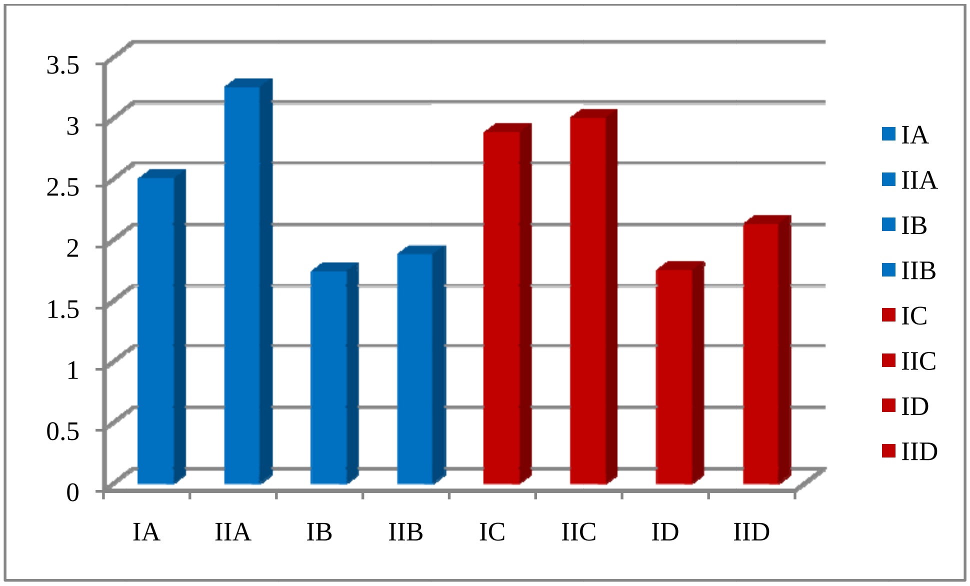


Table 1: Mean values of debris score for Apical, Middle and Coronal sections in Group I

Groups	Apical	Middle	Coronal
IA	3.00±0.000	2.50±0.535	2.50±0.535
IB	1.88±0.354	2.13±0.354	1.74±0.463
IC	1.63±0.518	2.25±0.463	2.88±0.354
ID	2.88±0.354	2.13±0.354	1.75±0.707

Table 2: Mean values of debris score for Apical, Middle and Coronal sections in Group II

Groups	Apical	Middle	Coronal
IIA	3.88±0.354	3.38±0.518	3.25±0.463
IIB	3.25±0.463	2.38±0.518	1.88±0.354
IIC	1.75±0.463	2.50±0.535	3.00±0.756
IID	3.88±0.354	2.50±0.756	2.13±0.641

Table 3: Comparing the mean and standard deviation debris score between Apical, Middle and Coronal between Group I and Group II

WITH P.U.I GROUP I		Mean	SD	WITHOUT P.U.I GROUP II		Mean	SD	p-value
IA	Apical	3.00	0.000	IIA	Apical	3.88	0.354	0.354
	Middle	2.50	0.535		Middle	3.38	0.518	0.506
	Coronal	2.50	0.535		Coronal	3.25	0.463	0.149
IB	Apical	1.88	0.354	IIB	Apical	3.25	0.463	0.230
	Middle	2.13	0.354		Middle	2.38	0.518	0.031
	Coronal	1.74	0.463		Coronal	1.88	0.354	0.230
IC	Apical	1.63	0.518	IIC	Apical	1.75	0.463	0.334
	Middle	2.25	0.463		Middle	2.50	0.535	0.149
	Coronal	2.88	0.354		Coronal	3.00	0.756	0.204
ID	Apical	2.88	0.354	IID	Apical	3.88	0.354	1.000
	Middle	2.13	0.354		Middle	2.50	0.756	0.021
	Coronal	1.75	0.707		Coronal	2.13	0.641	0.548

Table :4 Comparing the mean debris score among apical middle and coronal in Group I

Groups	p- value		
	Apical	Middle	Coronal
IA X IB	0.000**	0.327	0.040*
IA X IC	0.000**	0.660	0.501
IA X ID	0.898	0.327	0.040*
IB X IC	0.516	0.938	0.001**
IB X ID	0.000**	1.000	1.000
IC X ID	0.000**	0.938	0.001**

* denotes significance at 5% level

** denotes significance at 1% level

Table :5 Comparing the mean debris score among apical middle and coronal in Group II

Groups	p- value		
	Apical	Middle	Coronal
IIA X IIB	0.025*	0.11	0.000**
IIA X IIC	0.000**	0.029*	0.820
IIA X IID	1.000	0.029*	0.003**
IIB X IIC	0.000**	0.974	0.003**
IIB X IID	0.025*	0.974	0.820
IIC X IID	0.000**	1.000	0.024*

* denotes significance at 5% level

** denotes significance at 1% level

DISCUSSION

Chemomechanical debridement is an important part of endodontic treatment. Elimination of pulpal tissue, microbiota and their by-products, and organic and inorganic debris removal by using instruments and intracanal irrigants are objectives of this important phase of treatment.

Schilder defined cleaning and shaping as the removal of all contents of the root canal system that could possibly serve as substrate for bacterial growth or as a source of periapical inflammation and the establishment of a specific cavity form that will facilitate root canal filling.[43]

It is generally accepted that one of the main causes of periapical disease is the bacterial infection of the root canal system. It has been shown that human root canals have numerous anatomical complexities, eg: fins, accessory canals and isthmuses. These areas are not always accessible for instrument enlargement, and irrigants may not easily reach these areas. Conventionally eradicaion of bacteria is accomplished by chemo-mechanical debridement of the root canal system.(Huque et al).[25] Chemo-mechanical debridement and obturation effectively reduce the bacterial load in the root canal system and allow periapical healing in about 80 % of cases (Sjogren et al) even though the apical bacterial biofilm survives in 88 % (Nair et al).[41]

Debris is defined as dentin chips or residual vital or necrotic pulp tissue attached to the root canal wall. This debris may be compacted along the surface of canal wall and prevents the efficient removal of microorganisms from the root canal system, one of the basic purposes of thorough debridement of the root canal system, increasing the risk for bacterial contamination. Moreover, debris may occupy part of the root canal space, preventing complete obturation of the root canal. Therefore, debris should be totally removed.[53]

Irrigation has a central role in endodontic treatment. During and after instrumentation, the irrigants facilitate removal of microorganisms, tissue remnants, and dentin chips from the root canal through a flushing mechanism. Irrigants can also help prevent packing of the hard and soft tissue in the apical root canal and extrusion of infected material into the periapical area. Some irrigating solutions dissolve either organic or inorganic tissue in the root canal. In addition, several irrigating solutions have antimicrobial activity and actively kill bacteria and yeasts when introduced in direct contact with the microorganisms.

Conventional irrigation with syringes has been advocated as an efficient method of irrigant delivery before the advent of passive ultrasonic activation . This technique is still widely accepted by both general practitioners and endodontists. The technique involves dispensing of an irrigant into a canal through needles/cannulas of variable gauges, either passively or with agitation. The latter is achieved by moving the needle up and down the canal space. Some of these needles are designed to dispense an irrigant through their most distal ends, whereas others are designed to deliver an irrigant laterally through closed-ended, side-vented channels . The latter design has been proposed to improve the hydrodynamic activation of an irrigant and reduce the chance of apical extrusion . It is crucial that the needle/cannula should remain loose inside the canal during irrigation. This allows the irrigant to reflux and causes more debris to be displaced coronally, while avoiding the inadvertent expression of the irrigant into periapical tissues. One of the advantages of syringe irrigation is that it allows comparatively easy control of the depth of needle penetration within the canal and the volume of irrigant that is flushed through the canal.[16]

Nevertheless, the mechanical flushing action created by conventional hand-held syringe needle irrigation is relatively weak. After conventional syringe needle irrigation, inaccessible canal extensions and irregularities are likely to harbour debris and bacteria, thereby making thorough canal debridement difficult.[16]

Smaller-gauge needles/cannulas might be chosen to achieve deeper and more efficient irrigant replacement and debridement. However, the closer the needle tip is positioned to the apical tissue, the greater is the chance of apical extrusion of the irrigant. Slow irrigant delivery in combination with continuous hand movement will minimize NaOCl accidents.[16]

Past studies have shown that current irrigation methods are effective at cleaning root canals coronal but less effective apically.

Thus, it would be advantageous to develop improved delivery systems that increase dentin tubular penetration depths. This ensures more thorough debridement of the prepared canals, while minimizing apical extrusion to eliminate the cytotoxic effects of canal irrigants such as NaOCl on the periapical tissues.

It has been demonstrated that an irrigant in conjunction with ultrasonic vibration, which generates a continuous movement of the irrigant, is directly associated with the effectiveness of the cleaning of the root canal space.

Ultrasonic devices had long been used in periodontics before Richman introduced ultrasound to endodontics as a means of canal debridement in 1957. In 1980, an ultrasonic unit designed by Martin et al became commercially available for endodontic use. Compared with sonic energy, ultrasonic energy produces high frequencies but low amplitudes. The files are designed to oscillate at ultrasonic frequencies of 25–30 kHz, which are beyond the limit of human auditory perception (>20 kHz). They operate in a transverse vibration, setting up a characteristic pattern of nodes and antinodes along their length.[16]

A study by Ram has shown that when conventional syringe needle irrigation was used, the irrigating solution was delivered only 1 mm deeper than the tip of the needle . This is a disturbing issue because the needle tip is often located in the coronal third of a narrow canal or, at best, the middle third of a wide canal . The penetration depth of the irrigating solution and its ability to disinfect dentinal tubules are therefore limited. The efficacy of syringe needle irrigation in such canals has been challenged.[38]

Passive ultrasonic irrigation in root canal removed more debris from the oval extensions or irregularities and also passive ultrasonic irrigation removes more smear layer from the canal walls. When oval extensions or irregularities of the root canal wall are free of debris they can be filled ,which is likely to result in a better seal of the root fillings with probability of reduced or no coronal leakage.

According to the study by Lui et al at 2mm from the apex, specimens irrigated with EDTA and ultrasonics scored significantly better than specimens irrigated with EDTA and NaOCl without ultrasonics for debris and smear layer removal. This may be attributed to the ability of ultrasonics to deliver irrigants to the apical region of the root canal because it employs an acoustic streaming effect with small oscillating files ,which transports irrigants into the apical parts of the root canal.[30]

In Ultrasonic irrigation (0.5% - 5.25%) NaOCl is the most efficient irrigant for mechanical removal of dentine debris during Ultrasonic activation.[30] During ultrasonic irrigation different processes can occur when NaOCl is used as irrigant. When NaOCl is agitated in root canal with ultrasonic irrigation tip, the temperature of NaOCl increases and decompose to split into sodium cation(Na^+), hypochlorite anion (ClO^-), sodium hydroxide(NaOH), hypochlorous acid, chlorine ,oxygen or sodium chlorite. During cavitation oscillating bubbles will form in the irrigant that will contain dissolved gas. When the bubble is in expansion phase, gas will diffuse into the bubble; conversely, when the bubble is in the compression phase, gas will diffuse out of the bubble. Chlorine could have an influence effect on this process by diffusing in the bubble. Bubbles can transport gas during cavitation .This could have an effect on the spread of chlorine through the irrigant. Bubbles formed in salt water like NaOCl tend to produce numerous and small bubbles and they are less prone to coalescence than bubbles in fresh water.[44]

Passive ultrasonic irrigation can be done by either continous flush technique or intermittent flush method. during continous flow of irrigants it is not known how much irrigant actually enters the root canal and flows through the apical part. Also too many variables are involved which are impossible to standardize because the irrigant is always delivered outside the root canal. These variables include the placement of the suction tube, the width of irrigant jet and the location and dimension of the root canal orifice. In the intermittent flush technique, the irrigant is injected into the root canal by a syringe and replenished several times after each ultrasonic activation cycle. The amount of irrigant flowing through the apical region of the canal can be controlled because both the depth of syringe penetration and the volume of irrigant administered are known. This is not possible with the use of the continuous flush regime. Both flushing methods have been shown to be equally effective in removing dentin debris from the root canal in an ex vivo model when the irrigation time was set at 3 minutes.Sluis et al also proved that syringe delivery of irrigant during ultrasonic is as effective as continous flow of irrigant in the removal of dentine debris from extensions and irregularities in the apical third.[44]

So in this present study a intermittent flow of 3% NaOCl was used for 4minutes during ultrasonic irrigation.

When 3% NaOCl is refreshed every minute it is possible that sufficient free chlorine is present in the root canal to dissolve the organic component of the dentine debris and that one refreshment of NaOCl has enough flushing effect to remove the inorganic component of dentine debris.

A total of 4 minute use of Passive ultrasonic irrigation was used in this study. The smear layer consists of two separate layers. A superficial layer which is loosely attached to dentine and the other layer which is dentin/debris plugs in the mouth of dentinal tubules. Studies have shown that one minute of ultrasound removed the superficial smear layer, but left the dentinal tubules sealed off. 3 minutes of ultrasound removed all of the superficial smear layer and most of the dentinal tubule plug layer. A 4 minutes of ultrasound removed all debris in instrumented and uninstrumented areas except for a few dentin chips.[12]

Recent studies used light microscope, visual inspection, and other techniques such as clearing and optical evaluation, computer image analysis programme or photomicrographic method by epiluminescence for measuring the amount of debris, gutta-percha and sealer on the root inner dentin surface. But scanning microscope allowed observation of smear layer morphology, the presence of debris inside dentinal tubules and root canal orifices and the morphology of intertubular dentin.

The main advantage of SEM is that it allows evaluation of both halves of the canal wall along their entire length. However only the surface can be examined, and the depth cannot be determined precisely. Preparation of the specimen may also induce artefacts. Moreover ,there are practical limitations during evaluation of results.[9]

In the present study to standardize the area examined for each sample, the technique described by Paque was used and the samples were scanned at 200x magnification, central beam of the SEM was directed to the centre of each third of the root canal by the SEM under 10x magnification then the magnification was increased to 200x and the area of the wall captured on the screen.[6]

Conventional irrigation with syringes has been advocated as an efficient method of irrigant delivery before the advent of newer techniques. Irrigation with syringes is still widely accepted by both general practitioners and endodontists. The technique involves dispensing an irrigant into a cannula through needles/cannula of variable gauges, either passively or with agitation.[16]

Recently, a 30 gauge irrigation needle covered with brush NaviTip FX has been introduced in the market. The design of the NaviTip FX allows it to reach upto the apex and at the same time can be used to actively scrub the canal wall while concomitantly delivering the irrigant. A review of literature revealed that study reported by Goel et al[21] showed almost complete removal of smear layer and debris at the apical third with no significant difference between the apical, middle and coronal thirds.

A 30 gauge irrigation needle with side vented and close ended Max-I-Probe was used in this study, which delivers the irrigant laterally. A review of literature revealed that study reported by

Hauser et al, have advocated that such a design improves the hydrodynamic activation of an irrigant and reduces the chances of apical extrusion.

Recently, a 30 gauge irrigation needle with side and bottom vented needle the Endo-Eze has been introduced in the market. The unique feature of this is its flexibility which allows better penetration of the needle into curved canals. A review of literature revealed that no studies have been reported on this flexible needle in endodontics ,therefore the efficacy of this needle in removing the dentinal debris from the canal was explored in this study.

Hence, the aim of the present study was to investigate the effect of three newer irrigation needles on debris removal from root canal wall with and without passive ultrasonic irrigation under SEM study.

64 intact human mandibular premolar teeth with fully formed apices were selected for this study.Teeth selection criteria were with single canal and 15-20º curvature which was seen mostly in mandibular first premolar and ease of availability due to orthodontic extractions.

The root samples selected for this study had curvature of 15 - 20˚ which was determined by 64 slice CT scan.

All 64 tooth samples were instrumented with 10 no:k file until it could be seen at the apical foramen and then 1mm substracted from this to determine the working length.

The crown were decoronated and root length was standardized to 15 mm.

The teeth were then randomly divided into two groups, 32 each.

Group I: with passive ultrasonic irrigation and

Group II : without passive ultrasonic irrigation.

A : Control group: conventional syringe needle

Instrumentation of root canal was done apically till 25 size k file followed by Protaper rotary instrument (S1,S2, F1,F2) in a crown down technique. The canal was irrigated with 3% NaOCl (2ml) and 17% EDTA as lubricant after each instrument with conventional syringe needle and final rinse using normal saline solution.

B : NaviTip FX (Ultradent)

Instrumentation of root canal was done apically till 25 size k file followed by Protaper rotary instrument (S1,S2, F1,F2) in a crown down technique. The canal was irrigated with 3% NaOCl (2ml) and 17% EDTA as lubricant after each instrument with NaviTip FX in active scrubbing in and out motion according to the manufacturer's instruction and final rinse using normal saline solution.

C : Max I probe (Dentsply)

Instrumentation of root canal was done apically till 25 size k file followed by Protaper rotary instrument (S1,S2, F1,F2) in a crown down technique. The canal was irrigated with 3% NaOCl (2ml) and 17% EDTA as lubricant after each instrument with Max I probe and final rinse using normal saline solution.

D : Endo-Eze needle (Ultradent)

Instrumentation of root canal was done apically till 25 size k file followed by Protaper rotary instrument (S1,S2, F1,F2) in a crown down technique. The canal was irrigated with 3% NaOCl (2ml) and 17% EDTA as lubricant after each instrument with Endo-Eze needle and final rinse using normal saline solution.

Instrumentation of root canal were done with protaper rotary instrument upto size F2 in a crown down technique under copious irrigation with 17% EDTA (Glyde) and 3% NaOCl (2ml) after each instrument use and then final rinse was done with saline solution .

The teeth were grooved vertically with a safe sided flexible diamond disc on the buccal and lingual surfaces and were splitted into two halves with a chisel and mallet.

The split half of the tooth in which apex was most visible was used for SEM evaluation .

Results showed that among the groups using irrigation combined with passive ultrasonic irrigation, Max I probe (1.63±0.518) had better cleaning efficacy in the apical 1/3 when compared to conventional syringe needle (3.00±0.000), Navitip Fx (1.88±0.354)and Endo Eze(2.88±0.354). In the middle third Navitip Fx (2.13±.354)and Endo Eze (2.13± 0.354)showed better cleaning efficacy among the groups. Whereas in the coronal 3rd Navitip Fx (1.75±0.463)seemed to have better cleaning efficacy among the groups.

When irrigation without passive ultrasonic irrigation was administered, Max I Probe (1.75±0.463) showed better cleaning efficacy in the apical third among the experimental groups used in this study. In the middle third and coronal third Navitip FX (2.38±0.518) (1.88±0.354) showed better cleaning efficacy than the other groups.

The canal cleanliness proved to be superior with newer irrigating devices combined with passive ultrasonic irrigation than the group without Passive ultrasonic irrigation

Ultrasonic irrigation contributed to a better cleaning of the root canal system than needle irrigation or hand instrumentation alone. [23] This can be attributed to higher velocity of irrigant flow that are created within the canal during ultrasonic irrigation.

The other reason for better effect of passive ultrasonic irrigation is that, an irrigant in conjuction with ultrasonic vibration, which generates a continuous movement of the irrigant which is directly associated with the effectiveness of the cleaning of the root canal space. The temperature of irrigant increases when aggitated with ultrasonic unit which increases the NaOCl action both against microbes as well a soft tissue. A temperature increase in any solution inside a root canal is considered desirable in properties because it enhances chemical reactivity and hence disinfecting potential[91]

When considering the canal cleanliness, in the apical, middle and coronal third, Max I Probe showed better cleaning efficacy in the apical third among the experimental groups. The reason can be attributed to its design, closed- ended, side vented channel, which tends to deliver the irrigant laterally. Hausan et al , had advocated that such a design improves the hydrodynamic activation of an irrigant and reduces the chances of apical extrusion.

The probable reason for Navitip FX to be less efficient in the apical third can be due to its arrangement of the brush, which ends 2mm ahead of the needle tip, thus cleaning the middle and coronal third better than apical 3rd.

The cleaning efficacy of Endo Eze in apical 3rd was comparatively lower than Navitip Fx and Max I Probe due to its side and bottom open ended design.

In the middle and coronal third Navitip Fx proved to clean the canal better than other experimental groups.

The reason can be due to its brush design, which tends to scrub the debris actively with in and out motion,from the canal wall while concomitantly delivering the irrigant.

This present study suggests that Max I Probe combined with passive ultrasonic irrigation had better canal cleanliness in apical third. In the middle and coronal 3^{rd} Navitip Fx in combination with passive ultrasonic irrigation proved to clean the canal walls better.

Therefore, the use of passive ultrasonic irrigation has to be recommended as an adjuvant along with newer irrigation needles in order to enhance the canal cleanliness. However, further investigations are necessary to evaluate the combination of these irrigation needles in invivo scenario for improved cleanliness of the canal wall during chemomechanical preparation.

This will help in better more efficient, cleaning, shaping the root canals, reaching difficult or inaccessible areas of the canals due to irrigant action, thereby facilitating better and closure obturation and enhancing endodontic success.

SUMMARY

The purpose of this ex vivo study was to investigate the effect of three newer irrigation needles on debris removal from root canal wall with and without passive ultrasonic irrigation under scanning electron microscope. 64 intact mandibular first premolars were used in this study. The teeth were divided into two groups 32 each. Group I: irrigation combined with passive ultrasonic irrigation group II: irrigation without passive ultrasonic irrigation. A: Conventional syringe needle. B: NaviTip-FX, C: Max-I Probe, D: Endo-Eze.

Crowns were decoronated root length was standardized to 15mm. Irrigants used was 3% sodium hypochlorite with 17% EDTA as a lubricant and final irrigant was saline solution. Root canal were instrumented apically till 25 K file followed by protaper rotary instrument till size F2 then teeth were grooved with the help of flexible diamond disc, split with chisel and mallet. The split half of the tooth in which apex was most visible was used for SEM evaluation .

The results showed that in Group I Max-I Probe needle revealed most effective cleanliness of the canal in apical 1/3rd , followed by Navitip FX in coronal, middle and apical 1/3rd ,

Endo-eze in middle and coronal and least effective was syringe needle.

Group II: Navitip FX needle revealed most effective cleanliness of the canal in coronal and middle $1/3^{rd}$,whereas in apical $1/3^{rd}$ Max I Probe was effective in cleanliness of the canal followed by Endo Eze and least effective was syringe needle.

CONCLUSION

Under the limitations of the present study it can be concluded that:

1. All three newer irrigation needles have been found to be effective in cleaning the root canal walls.
2. Canal cleanliness with newer irrigation needles and also syringe needle at various levels was effective with passive ultrasonic irrigation.(than without passive ultrasonic irrigation)
3. Among the three irrigation needles at coronal third, most effective was NaviTip-FX, at middle third NaviTip-FX and at apical third Max - I Probe

This suggests that to ensure through debris removal of the canal it may be prudent to use Max I Probe combined with passive ultrasonic irrigation during cleaning and shaping procedures.

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