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Comparative Evaluation Of Canal Cleanliness Using Different Irrigation Protocol By Field Emission Scanning Electron Microscopy: An *In-Vitro* Study.

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ABSTRACT

The primary etiological factor in development of pulpal and periapical infection is the presence of smear layer within the dentinal tubules which makes irrigating solution inaccessible to the microorganisms within the root canal system[1]. Hence the aim of the present study was to determine the effect of activation devices Endoactivator and passive ultrasonic activation on smear layer removal on the apical third of the root canal system. Material and method: Thirty single rooted mandibular premolar was used in the study and prepared upto protaper size F2. The prepared tooth were randomly divided into three groups (n=10), 17%EDTA +Sodium hypochlorite (Group I), 17%EDTA +Sodium hypochlorite along with Endoactivator, 17%EDTA +Sodium hypochlorite along with passive ultrasonic irrigation. Scanning electron microscopic analysis was done to analyse the smear layer removal from the root canal wall. Result: Statistical analysis was done using Kruskal wallis analysis and intergroup comparison was done using Mann Whitney u test and showed a significant among of difference among the three group .Conclusion :Endoactivator showed a better smear layer removal in the apical third of the root canal compared to that of passive ultrasonic activation and the results were statistically significant .

Keywords: Smear Layer, Endoactivator, Passive ultrasonic irrigation.

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INTRODUCTION

Success of endodontic treatment depend on thorough disinfection of the root canal system using proper instrumentation and irrigation techniques.Smear layer is a thin layer of amorphous substance which is present within the root canal system consisting necrotic debris ,odontoblastic process ,dentin particles and bacteria [2].The presence of smear layer occludes the dentinal tubules hence prevents the penetration of irrigants, sealers and any medicaments .Therefore removal of the smear layer using proper irrigation protocol during and after instrumentation helps to provide a fluid tight seal within the root canal .in addition the apical area of the root canal contain lateral canal, accessory canals , which cannot be cleaned by instrumentation alone hence the judicious use of irrigating solution and devices plays a vital role in cleaning and shaping of the root canal system [3].

Sodium hypochlorite (Vansons India)a deproteinizing agent is widely been used as a irrigating agent in endodontics which has good antimicrobial activity, tissue dissolving capacity and acts as a organic solvent for vital and necrotic tissues[4].Ethylene diaminetetraacetic acid (EDTA) (Smear clear ,Kerr)is the most accepted chelating agent which removes the smear layer and helps in better adhesion of the filling material to the root canal walls[5].

The traditional syringe method of delivery of irrigants will not be able to deliver the solution beyond its needle tip hence there might be air entrapment within the apical third of root canal system leading to the vapour lock effect and insufficient debridement and cleaning. Recent advancement in the irrigation delivery devices will help the irrigants to flow into the complex anatomy of the root canal system. A source of agitation of the irrigants within the root canal system will act as an adjunctive method in enhancing the debridement[6].

Endoactivator (Dentsply Sirona)is a sonic activation device which has got a hand piece and three types of disposable polymer tips used for continuous agitation of the irrigant within the root canal system. Passive ultrasonic irrigation uses a small file which works on the mechanism of cavitation and acoustic microstreaming[7].

Hence the aim of the study is to compare the smear layer removal efficacy of sodium hypochlorite and EDTA along with Endoactivator and passive ultrasonic activation in the apical third of the root canal system with the null hypothesis that none of them will be able to clean the root canal better.

MATERIAL AND METHODS

Thirty non carious single rooted mandibular premolars were selected for the study. Grossly decayed tooth ,teeth with blunderbuss canal, cracked tooth, apical root resorption were excluded in the study .The teeth were disinfected according to the OSHA Regulation .crowns of the teeth were transversely sectioned at the level of CEJ using high speed diamond disc .working length determination was done using size 15 K file(Dentsply Sirona) with the help of digital radiograph technique. Cleaning and shaping of the root canal was done using Protaper universal rotary system (Dentsply Sirona)till file size F2 using crown down technique .3% sodium hypochlorite (Vansons India)was used as a irrigating solution before and after each instrumentation. After the biomechanical preparation the samples were divided into three experimental groups based on the irrigation.

The irrigation protocol followed was

Group I(N=10) - 1 ml of 17% EDTA(Smear clear , Kerr) for 1min was flushed into the root canal followed by irrigation with 5 ml 3%sodium hypochlorite(Vansons India) using 27 gauge needle placed 1-2 mm short of the working length without binding for 60secs

Group II (N =10)-1 ml of 17% EDTA for 1min was flushed into the root canal followed by irrigation with 5 ml 3% sodium hypochlorite Left in the canal for 1min and agitated with Endoactivator (Dentsply Sirona)with tip size 25 for 60 secs .

Group III (N=10)-1 ml of 17% EDTA for 1min was flushed into the root canal followed by irrigation with 3% sodium hypochlorite Left in the canal for 1min and agitated with irrisafe irrigation tips size 20 (Satellac acteon) driven by an ultrasonic device for 60 secs.

The specimens were longitudinally sectioned and the cleanliness of the apical 3mm was checked using scanning electron microscope. The root segments were placed on an aluminium stub, coated with gold atom and subjected for SEM analysis. The presence, quality and distribution of smear layer was analysed using 5-score index system by Hulsmann et al .

Score1-Open dentinal tubule with absence of smear layer
Score 2 –Small amount of smear layer with some dentinal tubule open
Score 3 –Homogenous smear layer covering the root canal wall with few dentinal tubules open
Score 4-Homogenous smear layer covering complete root canal wall with no dentinal tubules open
Score 5- Complete root canal wall covered with non homogenous smear layer

Statistical analysis was done using Kruskal wallis analysis and intergroup comparison was done using Mann Whitney u test.

RESULTS

Table 1: Descriptive Statistics

Group	Mean	Standard deviation	Percentiles		
			25^{th}	50^{th} (Median)	75^{th}
Group I	3.30	0.94	2.75	3	4
Group II	1.00	0.29	0.00	1.00	1.25
Group III	1.8	0.63	1.00	2.00	2.00

Table 1 denotes the descriptive statistics for mean and standard deviation for smear layer scores for all the groups

Kruskal Wallis Analysis

Group	Mean Rank	Degree of freedom	Significance valve
Group I	24.00	2.00	0.00^{*}
Group II	8.3		
Group III	14.20		

Table 2: Kruskal wallis analysis to determine the significance level among all the experimental groups.

Mann Whitney test

Group		Asym.significance (two tailed)	Exact significance (one tailed)
Group I	Group II	0.001	0.000_a
	Group III	0.002	0.002_a
Group II	Group III	0.031	0.043_a

Table 3 : Intergroup comparison of smear layer removal capacity three group.

On the basis of scanning electron microscopic photographic images the scores were given for all the samples and the mean, standard deviation were calculated for all the groups. Kruskal wallis analysis was done with the significance value of 0.05 to analyse the significant difference among the groups. The p value was found to be 0.00 which was <0.05 hence there showed a highly significant difference among all the three given

groups. Hence MannWhitney's U test was done for intergroup comparison with the p value of 0.01 .According to this test there showed a significant amount of difference between group I i.e. sodium hypochlorite and EDTA compared with group II with Endoactivator and group III with PUI , p value of 0.000 and 0.002 respectively which was considered to be highly significant . Group II showed better smear layer removal compared to that of and Group III with the p value of 0.043 which was < 0.01 hence considered significant.

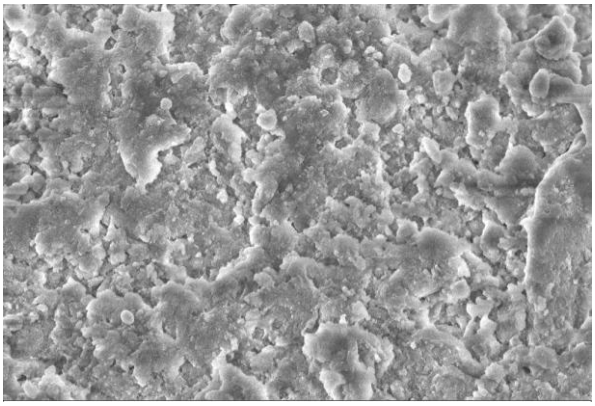

Figure 1 : Group I showing the presence of non homogenous smear layer present in complete root canal

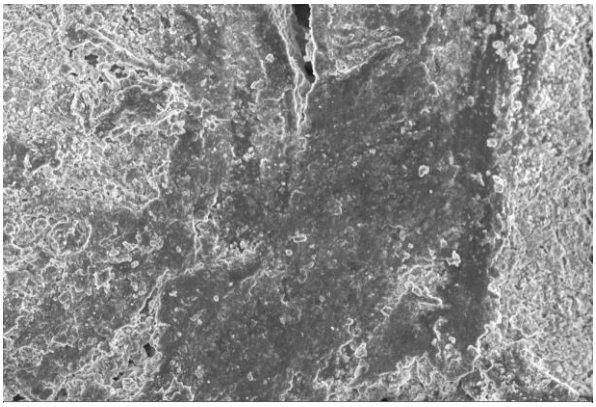

Figure 2: Group II showing the absence of smear layer

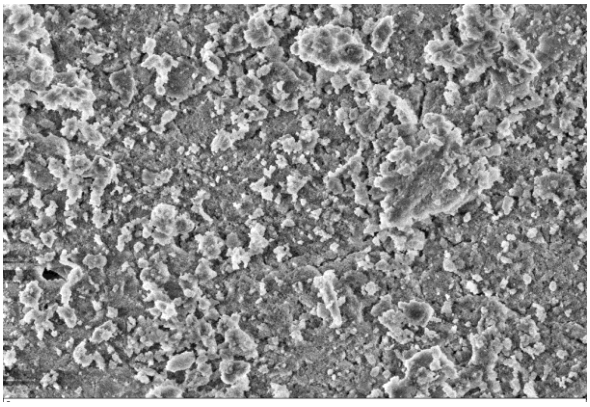

Figure 3: Group III showing the presence of small amount of smear layer

DISCUSSION

Smear layer present in the root canal wall contains microorganism and the presence of these pathogens can lead to failure of root canal treatment. Therefore the aim of the present study is to evaluate the efficiency of irrigation devices in removal of smear layer from apical third of the root canal wall .The irrigants used in the root canal should dissolve the organic and inorganic components of the smear layer .The inorganic portion of smear layer can be best removed by using an acid and most commonly used is EDTA .the ideal irrigants used for removal of smear layer is a final rinse with 15-17% EDTA and 1-6% sodium hypochlorite .In the present study instrumentation was done with NI-TI rotary instruments which produced sufficient amount of smear layer in the root canal wall[8].

The simple and most commonly used irrigation device is the use of syringe of 27 or 30 .However the limitation of using syringe method includes the presence of stagnation plane , difficulty in penetration of irrigants , shear stress on the canal wall and in curved canals its difficult for the needle to reach the apical area hence agitation of the irrigants is required to remove the debris[9].

Passive ultrasonic irrigation was introduced by Weller et al who used a small oscillating file or a smooth wire for transmission of acoustic ultrasonic waves which induces acoustic streaming and cavitation of the irrigants . A new sonic hand driven instrument named Endoactivator operates at frequency between 1-10 KHz which is lower compared that of passive ultrasonic instrument which is 25-30 KHz. The ultrasonic files have multiple nodes and antinodes along the length of the file compared to that of endoactivator which has one node near the attachment and one antinode at the tip of the file[10].

In the present study group II (table 2 and table 3) showed a better result compared to other groups because they contain flexible polymer tips which adapts well to the root canal wall and helps in easy removal of debris from the canal (fig 1 and fig 2) . Similar results were shown by Rodig et al ie a greater removal of smear layer was shown with Endoactivator compared to ultrasonic and canal brush activation systems. The use of a calcium chelating agent creates a demineralised collagen matrix on the canal wall which along with the vigorous vibration of the non cutting tips would mechanically remove the smear layer. The use of calcium chelators make the debris particle lighter in weight by dissolving minerals and pushes it outward along with the flow rather than accumulating below in the demineralised collagen matrix[11].

Passive ultrasonic irrigation showed more smear layer compared to that of Endoactivator(table 3, fig 3) because the file tip can come in contact with the canal wall due to its resonance behaviour which makes the acoustic streaming ineffective .This was in accordance with the study done by Martin and Cunningham who's results showed that passive ultrasonic irrigation along with sodium hypochlorite did not was not effective in removal of smear layer[12] .

Within the limitations of this study sonic activation of the root canal with Endoactivator showed a better smear layer removal capacity compared to that of other with the statistical significant difference.

CONCLUSION

The present study shows that combination of irrigants along with a activation device will aid in the better cleaning of the apical third of the root canal system .Hence the use of Endoactivator can better remove the smear layer from the root canal wall.

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