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Original Research Paper

Endontics

COMPARATIVE EVALUATION OF PASSIVE ULTRASONIC IRRIGATION SYSTEM AND ENDOVAC IRRIGATION SYSTEM IN REMOVAL OF THE INTRACANAL SMEAR LAYER: AN EX VIVO SCANNING ELECTRON MICROSCOPE STUDY.

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ABSTRACT

AIM This ex vivo study was designed to evaluate and compare passive ultrasonic irrigation and endovac irrigation systems for removal of intracanal smear layer.

METHODOLOGY Thirty recently extracted, non-carious human intact single rooted premolars were selected and divided into Three groups (n=10) according to the root canal irrigation systems; syringe and needle irrigation, passive ultrasonic irrigation (PUI) and EndoVac irrigation system. All groups were prepared to apical size F4. Each sample was subjected to final irrigation by using different irrigation systems. After splitting the samples, one half of each root was selected for examination under scanning electron microscope. The irrigation systems were compared using the Fisher's exact test with significance set at $p < 0.05$.

RESULTS In the coronal part there was no difference among the groups. In the mid-root section the results of the PUI, EndoVac tended to be better than syringe and needle irrigation, but the difference was not significant. The apical part of the canal the Endovac system seemed to be cleaner than those of the PUI group.

CONCLUSIONS Within the limitations of the present study, Endovac system cleaned the apical part of the canal more efficiently than PUI and syringe and needle irrigation.

KEYWORDS : EndoVac irrigation system; passive ultrasonic irrigation; smear layer.

INTRODUCTION

Three-dimensional cleaning, shaping, and a proper obturation with adequate seal of the root canal system are the main goals of root canal treatment. Complete debridement, with smear layer removal is an asset and could help to achieve a successful outcome of the root canal treatment. Smear layer contains both organic and inorganic components.[1] The smear layer has been recommended to be removed as it may be having mixture of bacteria and their byproducts.[2,3] Also it may prevent the penetration of irrigants and intracanal medicaments into the dentinal tubules and prevent the close adaptation and adherence of sealer cement onto canal walls.[1]

Manual delivery and agitation techniques and machine-assisted agitation devices are two main divisions in root canal irrigation systems.[4] Manual irrigation includes positive pressure irrigation, commonly performed with a syringe and a side-vented needle. On the other hand, machine-assisted irrigation techniques include sonic and ultrasonic as well as newer systems like apical negative pressure irrigation and the plastic rotary file.[5] Cul-de-sac configuration present a special challenge in the apical third of root canal and several studies have indicated that syringe and needle irrigation tends to leave this part of the canal covered with smear layer and debris.[6]

The objective of this ex vivo study was to evaluate and compare conventional syringe and needle irrigation, PUI, EndoVac irrigation system for removal of intracanal smear layer.

MATERIALS AND METHODS

A total of Thirty recently extracted, non carious human intact premolars were selected. Endodontic access was obtained with round diamond bur and #15 K file was introduced into the root canal until the tip was just visible at the apical foramen. Working lengths were set by deducting 1 mm from lengths of the files when they extruded just beyond the apical foramina. Crowns were sectioned using diamond disc to obtain a standard working length of 16 mm for all samples. To simulate clinical conditions, apices were sealed with hot glue.

Thirty teeth were instrumented with a rotary nickel titanium files using crown down technique till F4. These roots were randomly divided into 3 groups of 10 roots each.

Then each sample was subjected to final irrigation by using different irrigation systems with 5 mL 5.25% NaOCl, followed by 5mL of 17% EDTA, followed by 5 mL 5.25% NaOCl and 0.9% normal saline.[6]

Grouping:

After the completion of preparation, a total of 30 samples were distributed into 3 groups of 10 teeth each.

Final Syringe and Needle Irrigation: Final irrigation was done with 5 mL 5.25% NaOCl, followed by 5 mL of 17% EDTA, followed by 5 mL 5.25% NaOCl. Irrigation was done using syringe (Unolock, Hindustan syringes, Faridabad, India) adapted with 26 gauge monojet endodontic irrigation needle (Tyco Healthcare, Gosport, UK); no activation was applied in this group, which served as control.[7]

Final Irrigation with Ultrasonic Activation: Final irrigation was conducted with passive ultrasonic activation of the irrigants, using Minipiezon ultrasonic irrigation system (EMS, Nyon, Switzerland), adapted with a # 20 Irrisafe ultrasonic files (Satelec, Acteon, Merignac, France). The ultrasonic file was placed into the canal 1 mm short of working length without touching the walls and was activated at power setting of 4.

The final irrigation consisted of 5 mL of 5.25 % NaOCl with 1 min of activation. This was followed by 5 mL 17% EDTA, with 1 min activation and then by 5 mL of 5.25% NaOCl which was also activated for 1 min.[8]

Final Irrigation with the EndoVac System: Final irrigation was conducted with the EndoVac (Discuss dental, Culver City, CA) which was used according to manufacturer's instructions. The procedure consisted of 4 cycles of irrigation, each beginning with 30 sec of vacuum assisted irrigation followed by 30 sec of "soaking" (leaving the solution in the canal with no action). The first cycle was done using the macrocannula which was inserted to 1 mm from working length while the three following cycles were performed with the microcannula which was inserted to 9 mm from working length. In the first and second cycles 5.25% NaOCl was used. In the third cycle 17% EDTA was used which was followed by the forth cycle in

which 5.25% NaOCl was used again.[9]
At the end all groups were irrigated with 5 mL 0.9% normal saline and dried with absorbent paper points.

Splitting the Samples: Deep grooves were made on the buccal and palatal surfaces of the roots, using diamond discs, without perforating into the canal. The roots were then split longitudinally using a chisel. One half of each root was selected for examination under scanning electron microscope.[8]

Scanning Electron Microscope Evaluation:
After assembly on coded stubs, the specimens were platinum sputtered (JEOL, *JFC-1600 Auto Fine Coater,* Tokyo, *Japan*) and examined under a scanning electron microscope at x1000 magnification (*JEOL, JSM-7600F,* Tokyo, Japan). The dentinal wall of the coronal, middle & apical thirds was observed for the presence/absence of smear layer and visualization of the entrance to the dentinal tubules and representing photomicrographs were taken.

The images were examined and scored according to the criteria given by Hulsmann M *et al.* (1997)[10]

Score 1: Dentinal tubules completely open
Score 2: More than 50% of dentinal tubules open
Score 3: Less than 50% of dentinal tubules open
Score 4: Almost all dentinal tubules covered with smear layer.

Scoring was done by three independent examiners who were blinded as to the group to which each specimen belonged. Inter-examiner agreement was 95% for the smear layer removal (Kappa test).When disagreement occurred as to the score of a given specimen (rarely), the issue was discussed and agreement reached.

RESULTS:

The Three groups were compared to each other at the coronal, mid-root and apical part of the canal. Fisher's exact test for nonparametric values was used for this comparison with significance set at 0.05. For purpose of this analysis the scores were grouped in two groups (Table 1): "clean or almost clean" which included scores "1" and "2" and "covered with smear layer" which included scores "3" and "4".

Table 1. Scanning electron microscopy analysis of root canal walls

	Score	Grouped	Syringe &Needle		PUI		EndoVac	
Coronal	1	Clean& Almost Clean	0 *	** 90%	0	90%	1	100%
	2		9		9		9	
	3	Covered with Smear Layer	1	10%	1	10%	0	0
	4		0		0		0	
Midroot	1	Clean& Almost Clean	0	70%	0	80%	1	90%
	2		7		^		8	
	3	Covered with Smear Layer	3	30%	2	20%	1	10%
	4		0		0		0	
Apical	1	Clean& Almost Clean	0	0	0	0	0	60%
	2		0		0		6	
	3	Covered with Smear Layer	0	100%	^	100%	4	40%
	4		10		3		0	

1 to 4 – scores according by Hulsmann M *et al.* (1997)[10]
*Number of samples showing with a given score, **Percent samples showing with a given grouped score

The results of the SEM evaluation are presented in Table 1. In the coronal part there was no difference among the groups (Figure 1). In the mid-root section the results of the PUI, EndoVac tended to be better than syringe and needle irrigation, but the difference was not significant. At apical third region,none of the groups presented with dentin surface totally devoid of smear layer (Score "1",Table 1) but in the EndoVac groups the dentin surface at the apical part of the canal were cleaner and presented with "clean and almost clean" score in 60% of the cases, which differed significantly from the other groups (p= 0.011 and p= 0.001, respectively).

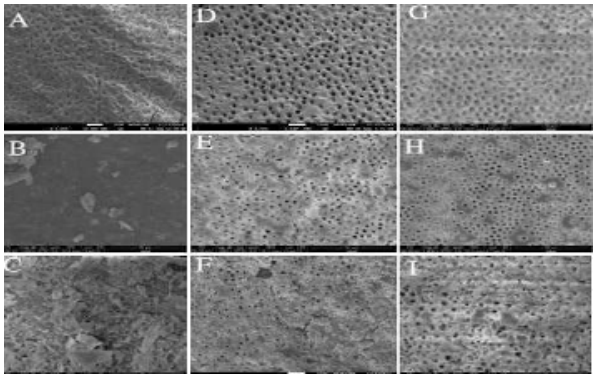

Figure -1

(A) Syringe and needle irrigation at coronal third level, (B) Syringe and needle irrigation at mid-root level, (C) Syringe and needle irrigation at apical third level, (D) PUI at coronal third level, (E) PUI at mid-root level, (F) PUI at apical third level, (G) EndoVac at coronal third level, (H) EndoVac at mid-root level, (I) EndoVac at apical third level,

DISCUSSION

The protocols suggested for the studied irrigation/activation systems differ substantially from each other, so when designing this study exact similarity between the groups was not possible. The protocol for each group was made as similar as possible to the other groups and as similar as possible to the way each irrigation system is applied clinically.

Activation of the irrigant in the EndoVac group has been shown to be more effective than PUI and syringe and needle irrigation system. For EndoVac group the apical negative pressure pulls the irrigant down the canal walls towards the apex, creating a rapid turbulent current force towards the terminus of the microcannula. The orifices of the microcannula evacuate debris from the closed end of the canal systems. This mechanism helps to overcome the vapor lock, thus enabling effective irrigation.[11]

Saber and Hashem [1] in their study also found that EndoVac was significantly better in removing debris than NaviTip in the apical third of the root canal. EndoVac system cleaned the apical part of the canal more efficiently than ultrasonic and syringe and needle irrigation.[12]

The results of this study have several clinical implications. Most importantly, conventional syringe and needle irrigation system does not provide adequate cleaning of the canal system, especially in the apical third region. This is concerning because only 45% of endodontists utilize adjunctive ultrasonic or sonic activation, with 55% using only conventional syringe and needle irrigation system. The study's results also suggest that the use of ultrasonic irrigant activation removes more smear layer than conventional syringe and needle irrigation system. [13]

In the present study the conventional syringe and needle irrigation system showed larger amount of debris and smear layer at apical, middle and coronal level than any other system because flushing action of syringe irrigation is relatively weak and dependent not only on the anatomy of the root canal but also on the depth of placement and the diameter of the needle. It has been shown that irrigants can only progress 1 mm beyond the tip of the needle.[14]

CONCLUSION

It can be concluded that none of the irrigation techniques completely removed all the smear layer from root canal walls at the apical part of the canal. In the present study the EndoVac group showed significantly better cleaning than ultrasonic and syringe and needle irrigation.

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