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Original Research

A comparative study of conventional needle irrigation, sonic and ultrasonic irrigation in smear layer removal using scanning electron microscopy

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ABSTRACT:
Background: Primary endodontic infections are caused by necrotic pulp tissue colonized by microorganisms. The ultimate goal of endodontic treatment is to control microbial factor in complex root canal anatomy, especially in the apical third. The present study was conducted to compare conventional needle irrigation, sonic, ultrasonic irrigation in efficacy of intracanal smear layer removal using scanning electron microscopy (SEM). **Materials & Methods:** 30 non- carious single rooted premolarswere divided into 3 groups of 10 each. Group I were subjected to syringe and needle irrigation, group II with sonic irrigation and group III with passive ultrasonic irrigation (PUI), having standard irrigation protocol.After splitting the samples, one half of each root was selected for examination under scanning electron microscope (SEM). **Results:** In the coronal part there was no difference among the groups. In the mid-root section, the results of the PUI were better than syringe and needle and sonic activation groups, but the difference was not significant (P> 0.05).In the apical part, PUI have shown the best results. **Conclusion:** Passive ultrasonic irrigation was superior in cleaning canal system and removing smear layer.
Key words: Passive ultrasonic irrigation, sonic irrigation, syringe and needle irrigation

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INTRODUCTION

Primary endodontic infections are caused by necrotic pulp tissue colonized by microorganisms. The ultimate goal of endodontic treatment is to control microbial factor in complex root canal anatomy, especially in the apical third.[1] The smear layer is potentially infected, and its removal allows more efficient penetration of intracanal medications into dentinal tubules and a better interface between the filling material and root canal walls.[2] Success of endodontic treatment depends on complete disinfection and debridement of the root canal. Instrumentation alone cannot achieve total elimination of bacteria and debris in all canals due to which effective irrigation is mandatory. The main goal of endodontic therapy is to bring the involved teeth to a state of health and function.[3]

Cleaning and shaping of the root canal system is recognized as being one of the most important stages in root canal treatment. Irrigants can augment mechanical debridement by flushing out debris, dissolving tissue, and disinfecting the root canal system.[4]An effective irrigation delivery system is required for the irrigants to reach the working length. Such a delivery system should have adequate flow and deliver sufficient volume of irrigant all the way to

working length to be effective in debriding the complete canal system.[5]Machine-assisted irrigation techniques include sonic and ultrasonic as well as newer systems like apical negative pressure irrigation and the plastic rotary file. Sonic irrigation is different from ultra-sonic irrigation in that it operates at a lower frequency (1-6 kHz) and produces smaller shear stresses.[6]The present study was conducted to compare conventional needle irrigation, sonic, ultrasonic irrigation in efficacy of intracanal smear layer removal using scanning electron microscopy (SEM).

MATERIALS & METHODS

The present study comprised of 30 non- carious single rooted premolars. Endodontic access was obtained and biomechanical preparation was done till Protaper F4, file size following standard irrigation protocol of 5ml of Naocl, 5ml of saline and final irrigant was 5ml of 17% EDTA . Teeth were divided into 3 groups of 10 each. Group I were subjected to syringe and needle irrigation, group II with sonic irrigation and group III with passive ultrasonic irrigation (PUI).Each irrigation system was used in accordance with the manufacture instructions. PUI group was activated for 1minute,GP(III), sonic group samples were activated for 30 seconds,GP(II), while manual dynamic agitation was done in group I, using F4 GP points at the speed of 100 cycles/minute. The dentinal wall of the coronal, middle and 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. After splitting the samples, one half of each root was selected for examination under scanning electron microscope (SEM). Results were analysed statistically. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of samples

Groups	Group I	Group II	Group III
Method	Syringe and needle irrigation	Sonic irrigation	Passive ultrasonic irrigation (PUI)
Number	10	10	10

Table I shows that each group had 10 samples.

Table II Evaluation of canal walls by scanning electron microscopy

Area	Score	Groups	Group I	Group II	Group III	P value
Coronal	A	Clean and almost clean	85%	85%	95%	0.15
	B	Partially Cleaned	05%	05%	03%	
	C	Covered with Smear Layer	10%	10%	02%	
Mid-root	A	Clean and almost clean	55%	70%	85%	
	B	Partially Cleaned	20%	15%	05%	
	C	Covered with Smear Layer	25%	15%	10%	
Apical	A	Clean and almost clean	00%	10%	20%	
	B	Partially Cleaned	00%	25%	30%	
	C	Covered with Smear Layer	100%	100%	100%	

Table II shows that in the coronal part there was no difference among the groups. In the mid-root section, apical section the results of the PUI were better than syringe and needle and sonic activation groups, but the difference was not significant (P> 0.05).

DISCUSSION

The sonic energy also generates significantly higher amplitude or greater back-and-forth tip movement. Ultrasonic devices had long been used in periodontics before Richman introduced ultrasound to endodontics as a means of canal debridement in 1957. Compared with sonic energy, ultrasonic energy produces high frequencies with low amplitudes.[7]The files are designed to oscillate at ultrasonic frequencies of 25-30 kHz. Activation of irrigants proved to enhance the efficacy of root canal irrigants, not only within the root canal but also in anatomical complexities of the root canal system and dentinal tubules. As per various studies, sonics, ultrasonics, and lasers are widely researched as irrigant activation methods.[8]

Passive ultrasonic irrigation (PUI) utilizes ultrasonic wave energy that is transmitted from a tip or file to the irrigant.Cavitation and acoustic streaming significantly improve the disruption of the smear layer and biofilm.[9] One single positive and negative node along the polymer-based tips is observed in sonic and subsonic activation, while multiple positive and negative nodes along the length of a metal instrument are observed in ultrasonics.[10] Greater extrusion of debris is due to the high frequency generated by ultrasound. The efficiency of a sonic protocol is achieved by moving tip up and down in short vertical strokes along with vibration that synergistically produces a hydrodynamic phenomenon.[11]The present study was conducted to compare conventional needle irrigation, sonic, ultrasonic irrigation in efficacy of intracanal smear layer removal using scanning electron microscopy (SEM).

The results of present study are in accordance with the research done byKarade et al[12], who has evaluated and compared different endodontic irrigation and activation systems for removal of the intracanal smear layer. Forty recently extracted, non-carious human intact single rooted premolars were selected and divided into five groups (*n*=10) according to the root canal irrigation systems; syringe and needle irrigation (CTR), sonic irrigation, passive ultrasonic irrigation (PUI) and EndoVac irrigation system. All groups were prepared to #40 apical size with K-files. Each sample was subjected to final irrigation by using four different irrigation/activation systems. After splitting the samples, one half of each root was selected for examination under scanning electron microscope (SEM). The four groups did not differ from each other in the coronal and mid-root parts of the canal. In the apical part of the canal none of the methods could completely remove all the smear layer but EndoVac system showed significantly better removal of smear layer and debris than the other methods.

We found that in the coronal part there was no difference among the groups. In the mid-root section, and apical third ,the results of the PUI were better than syringe and needle and sonic activation groups, but the difference was not significant (P> 0.05).

Another factor which can be taken into account Mancini et al[13] in their study sixty-five extracted single-rooted human mandibular premolars were decoronated to a standardized length of 16 mm. Specimens were shaped to ProTaper F4 and irrigated with 5.25% NaOCl at 37degree C. Teeth were divided into 5 groups (2 control groups [n = 10] and 3 test groups [n = 15]) according to the final irrigant activation/delivering technique (ie, sonic irrigation, passive ultrasonic irrigation [PUI], or apical negative pressure). Root canals were then split longitudinally and observed by field emission scanning electron microscopy. The presence of debris and a smear layer at 1, 3, 5, and 8 mm from the apex was evaluated. The EndoActivator System (Dentsply Tulsa Dental Specialties, Tulsa, OK) was significantly more efficient than PUI and the control groups in removing the smear layer at 3, 5, and 8 mm from the apex. The EndoVac System removed statistically significantly more smear layer than all groups at 1, 3, 5, and 8 mm from the apex. At 5 and 8 mm from the apex, PUI and the EndoVac did not differ statistically significantly, but both performed statistically better than the control groups.

Abraham et al[14] in their study a total of 40 mandibular premolars were decoronated to establish a working length of 12 mm and shaped with ProTaper rotary files up to size F3. In Group A, canals were irrigated with 1 ml of 0.2% chitosan. In Group B, canals were initially irrigated with 0.8 ml of 0.2% chitosan and the remaining 0.2 ml was activated with diode laser. In Group C, canals were irrigated with 1 ml of 0.2% chitosan which was activated with endoActivator. In Group D, canals were irrigated with 0.2% chitosan and activated with passive ultrasonics. All samples were finally flushed with 3 ml of distilled water. The percentage of smear layer removal was analyzed with a scanning electron microscope examination at ×1000 and ×3000. The mean value for Group B when compared to Group C for the removal of smear layer was higher, but there was no statistically significant difference between the two groups ($P < 0.068$ and $P < 0.295$). Both Group B and Group C showed a statistically significant difference ($P < 0.001$) when compared to Group A and Group D for the removal of smear layer.

CONCLUSION

Within in the limitations of the current study, authors found thatnone of the cleaning methods were able to clean the root canal system completely, however, passive ultrasonic irrigation was superior in cleaning canal system and removing smear layer.

For the future prespective, more number of In-Vivo researchs should be encouraged

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