ORIGINAL ARTICLE

Stereomicroscopic Evaluation Of Irrigant Penetration Upto The Working Length By Using Different Irrigation Techniques

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ABSTRACT

Introduction: Successful endodontic treatment requires effective irrigant delivery and agitation. Endodontic success requires the removal of microorganisms, microbial toxins and necrotic remnants of pulp tissues. Aim of the study was to evaluate the effect of conventional needle irrigation, manual dynamic irrigation, passive ultrasonic irrigation system, apical negative pressure system on the penetration of the irrigating contrast solution up to the working length.

Materials & Methods: The root canals of 40 single rooted teeth were instrumented using the protaper rotary system. Samples were randomly assigned into 4 experimental groups (n=10) Group 1: conventional needle irrigation; Group II:manual dynamic irrigation; Group III : passive ultrasonic irrigation; Group IV : apical negative pressure irrigation. Chi-Square test is used to analyze the depth of penetration of contrast solution up to the working length.

Results: The apical negative pressure irrigation is able to achieve irrigating contrast solution penetration up to the working length

Conclusion: The apical negative pressure was the only group able to achieve irrigating contrast solution penetration upto the working length followed by manual dynamic irrigation with no statistical difference between them.

Keywords: Root canal irrigation, Apical negative pressure, Manual dynamic agitation, Passive ultrasonic irrigation

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INTRODUCTION

Successful endodontic treatment requires effective irrigant delivery and agitation. Endodontic success requires the removal of microorganisms, microbial toxins and necrotic remnants of pulp tissues.[1-3] Because of the complex nature of root canal anatomy, it is impossible to shape and clean the root canal completely particularly in the apical third [4-6]. For effective action of irrigants, the irrigant must come in direct contact with the root canal wall [7]. It is influenced by many factors of which the irrigant delivery method is most important.[8]

Currently available Nickel- titanium instruments act only on the central body of the canal leaving most areas of the canal untouched even after completion of the preparation.[9,10] Therefore instrumentation must be combined with adequate irrigation because it allows for cleaning beyond what might be achieved by root canal instrumentation alone. Although, most of the clinicians use conventional needle irrigation, it does not allow the delivery of solutions beyond the tip of the irrigation needle.[11]

To make root canals more effective in removing debris and bacteria from the root canal system, various methods have been proposed. These

methods can be classified into manual and rotary agitation. As the current solutions and techniques cannot completely remove all irritants, dissolve all organic tissue or remove the smear layer, several methods have been employed to deliver irrigants more effectively to the working length.
Manual dynamic agitation is used to transfer irrigating solutions to the apical end of the canal system, whereas apical negative pressure is used to deliver irrigating solutions to the apical end of the canal system and suction out debris by apical negative pressure. Therefore the aim of the present study is to compare the irrigant penetration up to working length using different irrigating techniques.

MATERIAL AND METHODS

Sample selection

40 extracted human permanent maxillary incisor teeth were selected. The teeth were placed in 4% NaOCl for 2 hours and then any visible calculus was removed ultrasonically and then kept in saline until preparation.

Specimen preparation

No. 2 Endodontic access bur (Dentsply Maillefer, Switzerland) was used to prepare the access cavity. Working length was established by subtracting 1mm from the original length. Gates Glidden Drills (Mani. Inc.) of size 1-3 was used to flare the coronal portion of the canal. All teeth were instrumented using the Pro Taper rotary system (Dentsply Maillefer, Switzerland) in the sequence of S1, S2, F1, F2 and F3. Recapitulation to the working length was accomplished using a 15 k – file to confirm patency. Between the shaping procedure , 3ml of 5.25% NaOCl was delivered using a 27 guage irrigation needle.
After the shaping procedure completed, the teeth were subjected to clearing procedure as described previously by Robertson and Leeb[12] and de Gregorio et al[13]. The teeth were placed in 5% nitric acid for 36 hours, and the acid should be renewed for every 8 hours. After decalcification, the samples were placed under tap water for 3 minutes and finally dehydrated in ascending grades of ethyl alcohol (60%,80%, 98%). After this procedure, the samples were submerged in 99.9% methyl salicylate for clearing and re hardening. All the samples were coated with wax at the apical foramen to resemble a closed system.

Contrast solution

A contrast solution was prepared by mixing 60% of sodium hypochlorite (5%) with 40% of Indian ink in the ratio 3:2 and delivered to the prepared root canals.[14]

Grouping

The samples were randomly divided into 4 experimental groups according to the irrigation technique used.

Group I

Conventional needle irrigation:
Conventional needle irrigation is performed by using 25mm, 30 Guage Navitip (Ultradent) the tip being placed 2mm short of the working length and a total of 2 ml of contrast solution was delivered for a period of 30 seconds.
Group II:
Manual dynamic agitation:
It is performed by moving a well fitting gutta percha master cone up and down in short 2-3mm strokes. In this method a total of 2 ml of contrast solution was used per 30 seconds.
Group III:
Passive ultrasonic Irrigation:
It is performed by using a stainless steel , non cutting ultrasonic Irrisafe file of size 20(Satelec, Acteon group, Merignac, France). The file was placed 1 mm short of the working length and 2 ml of contrast solution was activated for a period of 30 sec by using a power setting of five.
Group IV:
Apical negative pressure irrigation:
In this group, Endovac (SybronEndo, Orange, CA) is used where the master delivery tip delivers 2ml of contrast solution into the access and simultaneously, the micro cannula was placed up to the working length and moved up and down in the canal for a period of 30 seconds.
Evaluation criteria:
All the samples were photographed under stereomicroscope with 20X magnification.
The samples were scored on the basis of depth of penetration of contrast solution up to the working

length. Contrast solution penetration up to the working length – Yes/No

STATISTICAL ANALYSIS

Chi square test was used to compare the contrast solution penetration up to the working length with p value at and below 0.05 to indicate statistical significance.

RESULTS

Figure-1 shows percentage of samples showing contrast solution penetration up to working length. In group IV the contrast solution penetration up to the working length was 100% followed by group II (90%) which was significantly greater than group I and III. Sample of each group was selected and shown in fig 2a, 2b, 2c & 2d. Table-1 shows pair wise comparison among 4 groups and shows that there is no significant difference between apical negative pressure irrigation and manual dynamic agitation.

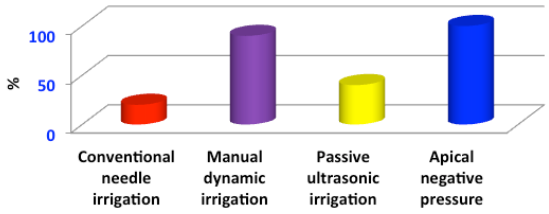

Figure -1: Percentage of samples showing contrast solution penetration.

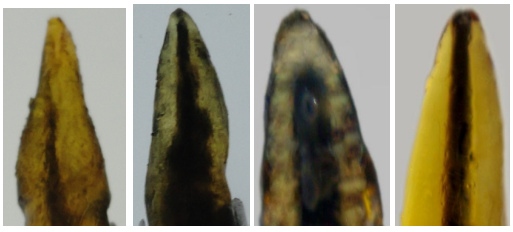

Figure-2a: Positive pressure irrigation; **Figure-2b:** Manual dynamic agitation; **Figure-2c:** Passive ultrasonic irrigation; **Figure-2d:** Apical negative pressure irrigation

DISCUSSION

In endodontic treatment irrigation has a central role as it facilitate removal of microorganisms, tissue remnants, dentin chips through a flushing mechanism. Regardless of the delivery method and type of irrigant, the irrigant should penetrate to the full extent of the root canal system for mechanical and chemical action of irrigation solutions on microbes, pulp tissue remnants and dentine debris.

		Chi-square value	P value
Conventional needle irrigation	Manual dynamic irrigation	9.89898	0.00165 Significant
Conventional needle irrigation	Passive ultrasonic irrigation	6.9523	0.01911 Significant
Conventional needle irrigation	Apical negative pressure	13.3333	0.00041 Significant
Manual dynamic irrigation	Passive ultrasonic irrigation	5.4945	0.01907 Significant
Manual dynamic irrigation	Apical negative pressure	2.2222	0.09413 No Sig.
Passive ultrasonic irrigation	Apical negative pressure	8.3815	0.00531 Significant

Table-1: Pair wise Comparison among 4 groups

As the endodontic triad composed of instrumentation, disinfection and obturation, instrumentation alone does not prepare the canal system for obturation and hence has to be combined with disinfection which is achieved through flushing the canal system with irrigating solution.

Clearing of teeth and injection of an opaque material was one of the classic laboratory techniques used for the evaluation of root canal anatomy and irrigant distribution.[15,16] Hence in the present study, clearing the tooth and staining using contrast solution was used to assess the irrigant penetration up to the working length.

For the penetration of irrigants within the root canals viscosity and surface tension play an important role. In this study, India Ink was used, because previous studies shown that the viscosity of contrast solution was similar to that of plain NaOCl.[17]

The results of the present study shows that apical negative pressure irrigation and manual dynamic agitation resulted in irrigant penetration up to the working length with no statistical difference

between them. The results are in accordance with the previous study by Saber and Hashem who concluded that apical negative pressure and manual dynamic agitation resulted in better removal of the smear layer in the apical third with no statistical difference between them.[18] This might be due to that both techniques reach the full working length and allow adequate irrigant replacement which is not possible or recommended with conventional needle irrigation/ ultrasonic devices.

In group I only 20 % of the samples showed contrast solution penetration up to the working length. This might be due to placement of needle 2mm short of the working length as this is the position where the needle was placed in previous studies.[19] The failure of the conventional needle irrigation to deliver the contrast solution up to the working length might be due to presence of apical vapor lock effect, which adversely affects the debridement efficacy.[20] Previous studies conducted by de Gregorio and Estevez showed none of the samples achived irrigant penetration up to the working length with conventional needle irrigation.

In passive ultrasonic irrigation group, 40% of the samples showed contrast solution penetration up to the working length. In this group the Irrisafe tip is placed 1 mm short of the working length as per manufacturer's instructions and in accordance with previous studies.[21] This might be the reason where few of the samples showed contrast solution penetration up to the working length.

In group II, manual dynamic agitation 90% of the samples showed contrast solution penetration up to the working length. The reason might be due that the master gutta percha cone is placed up to the working length and moving up and down in short 2-3mm strokes can produce an effective hydrodynamic effect and improve the displacement and exchange of irrigant.[22,23] The positive results of manual dynamic agitation could have been attributed by several factors. 1) the push pull motion of a well fitting gutta percha cone 2) the frequency of push pull motion of gutta percha cone (100 strokes per 30 seconds).[24]

In group IV, apical negative pressure irrigation 100 % of the samples showed contrast solution penetration up to the working length. This might be due to placement of microcannula up to the working length where it exerts a apical negative pressure that pulls the irrigant delivered by master delivery tip into the access. By this there is constant exchange of irrigant is maintained, which eliminates the apical vapour lock effect. Previous studies also shown that predictable irrigation of the entire canal up to the working length could be achieved using the apical negative pressure irrigation system.[25]

The only group that was able to penetrate the contrast solution up to the working length was apical negative pressure irrigation followed by manual dynamic agitation with no statistical difference between them.

CONCLUSION

Within the limitations of the study it has been concluded that the Apical negative pressure irrigation was the only group able to achieve contrast solution penetration up to the working length followed by manual dynamic agitation with no statistical difference between them.

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