



ESTIMATION OF EXTENT OF IRRIGANT PENETRATION IN ROOT CANALS WITH DIFFERENT IRRIGATION MODALITIES: A RADIOGRAPHIC ASSESSMENT.

Dental Science

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ABSTRACT

Introduction and Aim: The basis of an effective root canal treatment lies upon extensive debridement, thorough removal of smear layer and attaining a three-dimensional hermetic seal. The aim of the study was to assess radiographically the penetration depth of irrigant in root canals with three irrigation modalities: Conventional syringe, Side vented needle and Endoactivator.

Materials and Methods: Twenty-eight single rooted anterior teeth were used for study. Cleaning of teeth was done to remove superficial debris. Access openings were performed and determination of working length was done. Instrumentation was done with MTwo rotary files upto # 20 0.06% taper. Intermittent copious irrigation was carried out with 3%NaOCl (Septodont) and 17% EDTA. Samples were assigned randomly to experimental (Side vented needle and Endoactivator) groups and a control (Conventional syringe) group. Radiopaque contrast agent Iohexol (Omnipaque) was added to Sodium hypochlorite to visualise irrigant penetration inside the root canals during final rinse. Digital radiographs were secured for both experimental and control groups and radiographic analysis was performed.

Results: Sonic activation in the form of Endoactivator resulted in maximum irrigant penetration in root canals followed by Side vented needle. Minimum irrigant penetration is shown by Conventional syringe.

Conclusion: The irrigant penetration in root canals is enhanced by sonic activation allowing its spread in lateral and accessory canals hence resulting towards better treatment outcomes.

KEYWORDS

Sonic activation, Endoactivator, irrigant penetration.

Introduction

Endodontic treatment is a determined procedure in an effort to restore the carious dentition with pulpal exposure. The current protocol for treatment necessitates a thorough elimination of necrotic pulpal tissues and microbial flora from root canals. But owing to the complex internal morphology of root canals, mechanical instrumentation alone has shown to be ineffective.

Therefore, the role of irrigants and irrigation techniques is utmost important since these aid in dissolution of necrotic and vital pulpal tissues, removal of debris by mechanically flushing them out from the canals and bring about microbial count reduction.(1) There are numerous antimicrobial agents that had been suggested till date as intracanal irrigants. Some of them being Sodium hypochlorite used at varying concentrations, 2% CHX and MTAD.

Sodium hypochlorite acts primarily as pulpal tissue solvent and exhibits wide range of antimicrobial activity against pathogens. That is why it is considered gold standard in most of the irrigation regimes.(2) Both conventional as well as rotary instrumentation generates smear layer in considerable amounts. The smear layer primarily comprises of dense aggregation of bacteria coalesced with dentin which occludes the tubular orifice and spreads to varying distance inside the dentinal tubules.(3,4)

This adherent layer limits the access of irrigating solutions as well as intracanal medicaments to dentin surface and also provides nourishment to the existing microbial colonies.

Several irrigation techniques had been devised for cleaning the complex root canal systems. Some of them are commonly used: conventional syringe irrigation, side-vented needle, Endovac, Endoactivator, PIPS and many more.

The conventional syringe used during irrigation has been reported as the most frequently used technique till date. It is effective in delivering

the irrigant fluid only till the middle thirds of root canals.(5) The penetration depth of needle in root canals directly influences the cleaning effectiveness at the apical portion because of considerable parameters such as anatomical variations and predominance of lateral canals as well as apical deltas.(6) Apart from these, the vapour lock phenomenon also results in diminished exchange of irrigant in apical thirds of canals thus affecting the debridement efficacy.(7)

The side vented needle for irrigating samples are modifications of the conventional needle. Design features of needle consist of the lateral slot that account for irrigant flow for appropriate debridement of canal walls and minimise build up of higher pressures while irrigation. (8) This is further coupled with greater flexibility to follow root curvatures and safety tip of needle prevents binding to canal walls. (9)

The sonic instrumentation in endodontic speciality was introduced by Tronstad in 1985.(10) Endoactivator (Dentsply, Tulsa OK) is an instrument working on sonic agitation. The components of Endoactivator includes three polymer tips which are disposable possessing high flexibility and in varying sizes that get attached to a handpiece. The tips are safe ended and hence do not result in cutting of root dentin.(11) These tips generate sonic vibrations that when agitated up and down create hydrodynamic phenomenon.

In order to accomplish complete disinfection of root canals, it is imperative that the irrigant must penetrate root canals at apical thirds.

The aim of this study, therefore, was to compare radiographically the extent of penetration of irrigant solutions in canals using different irrigation techniques: Conventional syringe, Side Vented needle and Endoactivator.

Materials and Methods

Twenty-eight freshly extracted single rooted anterior teeth were obtained for the study. The teeth selected were extremely mobile due to periodontal involvement. The extracted teeth were cleaned to remove

superficial debris and preserved in 0.1% Thymol solution which is a fungicide and preservative. The teeth selected had straight and well-formed roots and were free of any caries and resorptions. Also, there was absence of any of dilaceration and root fractures.

Access openings were performed with Endo access and Endo Z burs (Dentsply, Malliefer, Ballaigues, Switzerland) followed by extirpation of necrotic pulp using barbed broches. The working length with the help of #10 K-file was determined with the tip of file seen at apical foramen. The file was then gently retracted to the corrected working length. Glide path preparation was done upto # 25 K-file (Dentsply Malliefer).

Chemomechanical debridement was performed alternately with 3%NaOCl (Septodont) and 17% EDTA used as intermittent irrigation during cleaning and shaping procedures.

Instrumentation was completed upto #20 MTwo (VDW, Munich, Germany) rotary files with a taper of 0.06 which was also the master apical file. The canals were dried with absorbent points.

Random distribution of samples was done to three different groups (n= 10) based on different irrigation modes as Conventional needle (Fig. 1), Side vented needle (Fig. 2) and Endoactivator (Fig. 3) for a time period of 30 sec.

10 ml. of radiopaque contrast agent Iohexol (Omnipaque) was mixed with hypochlorite (Fig. 4) and used as final irrigant with various modalities (Conventional syringe, side vented needle and Endoactivator) and evaluated radiographically for the extent of irrigant penetration in root canals.

Digital radiographs (Digora) were obtained for both groups before and after irrigation to estimate irrigant penetration depth.



Fig.1 Conventional syringe



Fig.2 Side vented needle



Fig. 3 Endoactivator handpiece



Fig. 4 Omnipaque contrast agent mixed with hypochlorite

Result

The distance from the canal orifice to the maximum point of irrigant penetration in the root canals was determined qualitatively among various groups. The extent of irrigant penetration radiographically was analysed by three blind observers for all the groups.

The results of the study showed statistically significant difference (p<0.05) between all the groups. The longest distance from the orifice to the point of maximum irrigant penetration was observed in

EndoActivator followed by Side vented needle group.

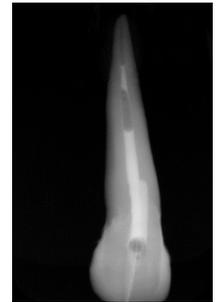
Shortest distance was observed in case of conventional syringe group.

Group A: Conventional syringe



Irrigation with 5% NaOCl

(Control group)



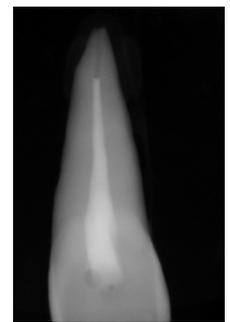
Irrigation with Omnipaque

(Experimental group)

Group B: Side vented needle



Control group



Experimental group

Group C: Endo activator group



Control group



Experimental group

Discussion

In the present study, maximum penetrability of endodontic irrigant in the root canals was observed with Endoactivator than other irrigation systems.

Various modes of root canal irrigation are available now- a-days which enhance the rates of success in endodontic therapy.

In our study, mechanical shaping of root canals was done using M Two rotary files using crown down technique and preparation was completed with #20 and 0.06 taper. Intermittent irrigation was performed alternately with 3% Sodium hypochlorite and 17% EDTA with an objective to flush out inorganic debris and necrotic tissue remnants.

Sodium hypochlorite was advocated as endodontic irrigant pertaining to its tissue solvent property and widespread antimicrobial activity.⁽¹²⁾ The alternate irrigation of EDTA with hypochlorite facilitated the opening of dentinal tubules and therefore, resulted in better irrigant penetration by evacuating layer of debris and inorganic smear layer from the canals.

In the present study, conventional syringe was taken as control group,

Side vented needle and Endoactivator were experimental groups.

Conventional irrigation is performed usually with the aid of 27 G needle. In our study we used this needle for the delivery of irrigants as well as radiographic contrast agent to estimate the flow in apical portion of root canals.

In the earlier studies, root canal debridement efficacy under in vivo conditions was compared between Endovac and conventional syringe 1 mm from apex. The results obtained in the study showed that the amount of debris was predominant while using Conventional syringe than Endovac.⁽¹³⁾

It is an established fact that with the use of conventional 27G needle, irrigant penetrates only 0-1.1 mm beyond the tip of the needle.⁽¹⁴⁾ These findings are in agreement with results of our study where the flow of radiographic contrast was restricted to the middle thirds of canals.

In another study, comparison of conventional and side-vented needle in terms of different parameters such as irrigant flow velocity, flow pattern and apical wall pressure was done. It was found that the apical pressure exerted with conventional syringe was greater as compared to side vented needles.⁽¹⁵⁾

In our study, maximal irrigant penetration depth with side vented needle was observed in between the middle and apical thirds of root canals.

Side vented syringe bears the advantage of irrigating and cleaning the intricacies of root canals. It also accounts for the lateral shunting of irrigant directing it towards the canal walls instead of apical portion. At the same time it also prevents the apical extrusion of irrigant due to hydrodynamic pressure generated.⁽¹⁶⁾

Endoactivator is the powered sonic agitation device that creates acoustic streaming in the irrigant fluid thereby displacing the smear layer and debris from the canals.

The Endoactivator handpiece was operated after filling the canals with irrigant and contrast mixture upto the level of canal orifice at a frequency of 10,000 cps for 30 sec. The results of the study demonstrated enhanced penetrability of irrigants to the apical thirds of canals.

This might be related to the mechanical agitation generated by Endoactivator resulting in improved flushing action following sonic activation of irrigant.

Advantage of Endoactivator lies in cleaning of lateral canals and dislodgement of biofilms from the curved canals.⁽¹⁷⁾ The drawback of Endoactivator tips is their radiolucent nature that after separation becomes difficult to identify inside the canals.⁽¹⁸⁾

Additionally, the extrusion of irrigant fluids apically is also minimised with Endoactivator use than conventional syringes that may produce very high apical pressure.

The use of radiographic contrast Iohexol (Omnipaque) in this study depicted the flow of irrigant in canals on imaging. The Omnipaque is a low osmolar radiopaque agent that had been utilised in the imaging of salivary glands.⁽¹⁹⁾

The advantages of Omnipaque over other contrast agents are its optimum water solubility and non-ionic, monomeric structure. Its viscosity and density closely resembles that of 5.25% NaOCl.⁽²⁰⁾

Other applications of Omnipaque are locating extra canals and establishing fine details of canal morphology due to edge enhancement effect which enables improved visualisation.

The results of the study can be summarised as maximum penetrability of irrigants was observed with Endoactivator (Group 3) > Side vented needle (Group 2) > Conventional syringe (Group 1)

Conclusion

Within the limitations of the study it can be concluded that maximal irrigant penetration depth was observed in the order: Endoactivator >

Side vented needle > Conventional syringe.

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