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RESEARCH ARTICLE

COMPARISON OF APICAL EXTRUSION OF SODIUM HYPOCHLORITE USING 3 DIFFERENT ROOT CANAL IRRIGATION TECHNIQUES

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ABSTRACT

Introduction: We compared the apical extrusion of sodium hypochlorite delivered with a conventional needle irrigation, passive ultrasonic irrigation and sonically driven system during the irrigation of root canals.
Methods: Sixty single-canal teeth were divided into 3 groups. Teeth were embedded in 0.2% agarose gel (pH = 7.4) containing 1 mL 0.1% mCresol purple (titan media), which changes color at a pH level of 9.0. Root canals were irrigated with sodium hypochlorite using 3 different techniques, and the amount of irrigant was controlled. Standardized digital photographs were taken 20 minutes after the first irrigant was used and were analyzed to determine the amount of extrusion (expressed as a percentage of total pixels).
Results: The amounts of apical extrusion obtained were 50% (10/20), 40% (8/20), 20% (4/20) for needle irrigation group, passive ultrasonic irrigation and sonically driven system respectively. The sonically driven system and passive ultrasonic irrigation showed significantly lower extrusion values than the needle irrigation techniques in terms of the number of teeth and pixels.
Conclusion: The risk of apical extrusion is significantly lower with the sonically driven system and passive ultrasonic irrigation in comparison with the needle irrigation techniques.

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INTRODUCTION

Successful endodontic treatment depends on the efficacy of root canal debridement by means of instrumentation procedures, intracanal medication, and copious irrigation (Bystrom and Sundqvist, 1981) Because of its antibacterial and lubricating properties, and its ability to dissolve pulp remnants, sodium hypochlorite is the most widely accepted endodontic irrigating solution. (Ruddle, 2002; Baugh and Wallace, 2005) However, the extrusion of sodium hypochlorite through the root canal foramen into periapical tissue can lead to extensive soft tissue or nerve damage, as well as airway compromise.

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After inadvertent NaOCl extrusion, patients have experienced immediate severe pain, swelling, and ecchymosis, which is referred to as a NaOCl accident. Therefore, the possibility of accidental extrusion of NaOCl solution beyond the apical constriction must be considered during root canal irrigation. (Clegg *et al*., 2006) The first use of ultrasonics in endodontic practice was described by Richman PUI was first described by Weller *et al*, During PUI, a small file or smooth wire (e.g., size 15) that is placed at the center of the root canal after shaping the canal, and when this file or wire is activated ultrasonically, "acoustic streaming" occurs. Acoustic streaming creates small, intense, circular fluid movement (i.e., eddy flow) around the instruments. The eddying occurs closer to the tip than in the coronal end of the file, with an apically directed flow at the tip.

Because the root canal is enlarged, the file or wire can vibrate freely in a way to enable acoustic streaming, and it transfers its energy to the irrigant inside the canal. This acoustic streaming, which is created by the instrument passively activated with ultrasonic energy, increases the cleaning effect of the irrigant inside the canal by means of hydrodynamic cutting power. (Dunavant *et al*., 2006) Recently, with its gradually increasing popularity, passive ultrasonic activation of endodontic instruments has been suggested as a means to improve canal debridement, canal disinfection and canal sealing. PUI also has been recommended for removing $Ca(OH)_2$ from the root canal. (Svec and Harrison, 1977) The sonic irrigation device with flexible polymer tips designed to hydrodynamically activate intracanal irrigants. Hydrodynamically activate intracanal irrigants are an effective method to disinfect the root canal. The purpose of this study was to measure the amount sodium hypochlorite apically extruded from root canals prepared using the EndoActivator, passive ultrasonic irrigation or the conventional irrigation technique. (Salzgeber and Brilliant, 1977)

MATERIALS AND METHODS

A Total sixty freshly extracted human permanent anteriors with straight root canal were selected for the study.

Specimen grouping

Sr. No.	Group	Sample	Method Of Irrigation
1	Group A	Twenty	Needle irrigation
2	Group B	Twenty	Passive ultrasonic irrigation
3	Group C	Twenty	Sonically driven system

A flat occlusal surface was made as a reference on incisal edge for determining the working Length. Standardized access cavity was prepared with a #2 round bur. The Working Length was determined as the point in which a size 15K file (Dentsply) was just visible at the root end with x20 magnification.Working length was confirm by radiographic method.Biomechanical preparation was done with crown down technique using rotary protaper (Dentsply Malliefer) system till #30 master apical file. The teeth were fixed rigidly and secured to a modified flat-sided clear plastic container and were embedded in a Agarose gel (Himedia). A size15K file (Dentsply) was placed at the Working length in each canal to prevent the 0.2% Agarose gel (Himedia) containing 1mL 0.1% Cresol purple (Himedia) from getting into the canals. Cresol purple (Himedia) has a pH-sensitive color change (from yellow at pH = 7.4 to purple at pH = 9). A color change to purple indicated the extrusion of NaOCl (pH = 11.4) into the gel To standardize the time for diffusion of the dye, the gel was photographed at precisely 20 minutes after the irrigation with 3% NaOCl. The gel was photographed digitally using a camera at a fixed distance. The standardized photographs were analyzed using Adobe Photoshop 7 to determine the area of the color change (expressed in pixels). Root canals will be irrigated using 2 ml of 3% NaOCl between all instrument changes. The data was then analyzed using the Kruskal-Wallis, Mann-Whitney U test with the P value set at <0.05.

RESULTS

Table 1 and 2 showed that group I had maximum amount of apical extrusion as compared to group II, group III which was statistically significant with a p value of 0.001 ($p<0.05$) which is highly significant. Group II showed higher amount of apical extrusion comparable to group III but there was no statistically significant difference between group II and group III.

DISCUSSION

Thorough cleaning of the root canal depends on effective irrigant delivery, solution agitation (Metzger *et al*., 2010), and its direct contact with the entire canal wall, particularly in the apical third. A sufficient volume of irrigant should be supplied to a mechanically instrumented space. However, it is difficult to irrigate the apical portion of the root canal system sufficiently to achieve satisfactory root canal debridement.

Table 1. Number of teeth showing apical extrusion according to the irrigation technique using chi-square test

Group	Extrusion		Total N (%)	p-value
	Absent N (%)	Present N (%)		
Needle irrigation	10 (50%)	10 (50%)	20 (100%)	0.023*
Passive ultrasonic irrigation	12 (60%)	8 (40%)	20 (100%)	
Sonically driven system	16 (80%)	4 (20%)	20 (100%)	

* p<0 .05; significant

Table 2. Comparision of mean pixel among various irrigation techniques using Kruskal Wallis ANOVA test

Group	N	Mean	Std. Deviation	Std. Error	p-value
I	10	211094.0000	16887.00319	5340.13929	0.001*
II	8	52357.2500	2701.06644	954.97120	
III	4	35458.0000	2275.97334	1137.98667	
I			II		0.001*
			III		0.001*
II			III		0.610

* p<0 .05; significant

Consequence, apical extrusion. It is generally accepted that passive ultrasonic irrigation is more effective than conventional syringe and needle irrigation in eliminating pulp tissue and dentin debris. The difference may be caused by the fact that ultrasound creates a higher irrigant flow rate in the canal during irrigation, eliminating more debris and improving access by the chemical product to the accessory canals. (Walters *et al*., 2002) Our results showed that, in addition to these positive attributes, but showed less apical extrusion than the conventional needle irrigation technique. Each technique produces a different pattern of fluid movement inside the root canal. The sonically driven system produces a powerful hydrodynamic force. The rate of vibration can be adjusted from 33 Hz (mode 1) to 166 Hz (mode 3).

Used during the irrigation, the EndoActivator tip vibrates back and forth, producing a wave of energy along the entire length of the tip. (Mitchell *et al*., 2010) Irrigant is not replenished while the tip is in motion, thus irrigant tends to circulate inside the root canal with less apical pressure. In the needle and syringe technique, the use of an up and down while replenishing the irrigant generates pressure at the apical foramen. (Chow, 1983) In our study, the amount of NaOCl extruded from apices prepared to a size #30 was significantly less than that of the needle group. Further studies should be done to assess other aspects of root canal debridement outcome such as cleanliness and canal penetration and relate them to the apical extrusion of irrigant. (Becking, 1991)

Conclusion

Within the limitations of the study, it can be concluded that currently irrigation systems, like sonically driven system have a clinical advantage over other irrigation techniques of minimal apical extrusion; thus, proving that sonic activation of instruments not only removes debris but also has minimal apical extrusion of sodium hypochlorite as compared to all available irrigation systems.

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