

**Original article:**

**Apical extrusion of sodium hypochlorite irrigation during root canal treatment using monoject or hypodermic irrigation needle**

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**Abstract**

**Objective:** Sodium hypochlorite has been routinely delivered into the pulp canal via irrigation needle. The study aimed at to determine the advantage and disadvantage of apical extrusion of sodium hypochlorite using monoject or hypodermic irrigation needle in root canal treatment.

**Materials and Methods:** Eighty single rooted teeth with closed apices were used in this *in vitro* study to determine apical extrusion of sodium hypochlorite using the gel diffusion technique. Extracted human anterior teeth were used as study samples. Monoject (size 27G) and hypodermic (27G× ½, 0.40×13mm, Terumo Needle) irrigation needle were used. The highest concentration of 5.25% hypochlorite solution was used for irrigation. To standardize the time diffusion of the dye, the gel was photographed at exactly 20 minutes after the initial irrigation with sodium hypochlorite. **Results:** A total of 36 out of 40 (90%) teeth in the hypodermic needle group showed positive apical extrusion compared to 14 of 40 teeth (35%) in the monoject group regardless of apical size. The discoloration of agar was clearly obtained after the sample tooth had been irrigated with sodium hypochlorite indicating the sign of apical extrusion. It is therefore; recommend that monoject irrigation needle should be used by students regardless of costs during root canal treatment in the polyclinic or dental clinic due to its safety in order to prevent sodium hypochlorite accident. **Conclusion:** Monoject needle showed significantly less sodium hypochlorite extrusion compared to hypodermic needle

**Keywords:** Apical extrusion; root canal, irrigation needle; sodium hypochlorite

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**Introduction**

Pulp space consists of many branches, fins, and accessory canals apically. It is difficult to clean and disinfect the infected root canal due to the complexity of the system<sup>1</sup>. Sodium hypochlorite irrigation is a gold standard protocol for endodontic irrigation. It facilitates the debridement and disinfection of the canal, and dissolves infected tissue debris, hence

essential for successful endodontic treatment. The normal accepted used concentration for root canal treatment ranges from 0.5% to 5.25%<sup>2</sup>.

At the Universiti Kebangsaan Malaysia (UKM) dental students' polyclinic, hypodermic irrigation needle is used in the endodontic practices. In contrast, monoject irrigation needle is used at the UKM Endodontic Specialist Clinic. The needle differs in terms of the

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design at the tip opening. The hypodermic irrigation needle is sharp and pointed which opens at the end of the tip. The monoject irrigation needle, however, is a side-venting needle, which opens at the side of the needle tip. Both irrigation systems have their own advantages and disadvantages, and the effects of apical extrusion using both irrigation needles. Strict regulations have been adhered to the use of sodium hypochlorite during root canal treatment at the polyclinic. It is compulsory to use rubber dam isolation for the intended tooth. The technique that is taught during use is that the irrigation needle must not bind in the canal. The needle is gently placed into the pulp chamber, with standardized concentration of 2.5% of sodium hypochlorite for students use. Furthermore, the needle needs to be agitated within the canal and the use of index finger is strongly emphasized to gently push the plunger in during irrigation.

Despite strict regulation imposed, sodium hypochlorite accident occurs during treatment, even at UKM dental clinics although the incidence rate is low. The possible complications that have been reported are: post operation pain, soft tissue necrosis, delayed healing, and periapical inflammation<sup>3</sup>. Previously an attempt to investigate the extent of apical extrusion has been made by direct measurement<sup>4</sup>. In this study, sodium hypochlorite extrusion is measured indirectly via the extent of color changes via the gel diffusion technique photographed using a digital camera. The number of pixels or the percentage of diffusion between two different needle systems and different apical canal sizes were calculated on extracted upper anterior human teeth.

### **Materials and Methods**

Eighty single rooted teeth with closed apices were used in this *in vitro* study to determine apical extrusion of sodium hypochlorite (NaOCl). Extracted human anterior teeth were used as study samples. Criteria for tooth selection included: single rooted canal, no visible root caries, fractures or cracks on examination with a microscope (Omni Pico Carl Zeiss) at x 0.8 magnification. The root must have a completely formed apex with no lateral exit of the apical foramen. Preoperative radiograph at the mesiodistal and buccolingual views were taken to confirm a straight canal. The teeth were stored at room temperature in phosphate-buffered saline. Flat occlusal surfaces were made at the coronal part of the teeth as a reference for determining the working length (WL). The WL was ascertained as the point in

which a #15 file was just visible at the root end with  $\times 20$  magnification. The length of teeth was measured for 15 mm from the apical tip to the coronal upper third of the root.

Each of the teeth was prepared by using ProTaper® hand files. The coronal enlargement was carried out using Sx, S1 file followed by S2. Once the WL was determined, apical preparation was carried out using S1, S2, and F1 and F2 depending on the size of the canal gauged. In between the preparation, root canal lubricating paste (RC prep®) was used during canal instrumentation. Apical patency was maintained by passing a #10 file only up to WL in between files. Normal saline irrigation solution was used during the root preparation at this stage. A gutta percha (GP) was placed in the canal to prevent the 0.2% agarose coloured acid gel from getting into canals. The roots were rigidly fixed and secured to a modified flat sided clear plastic container with dimensions of 2 cm width  $\times$  4cm length  $\times$  2cm height and embedded in the red gel.

Once prepared, forty roots were randomly assigned to either the monoject (size 27G ) group and another forty to the hypodermic(27G $\times$  ½, 0.40 $\times$ 13mm, Terumo Needle) irrigation needle group. The two groups of needle systems were further divided into 2 groups of 20 specimen each, which were prepared either to F1 (0.20mm) or F2 (0.25mm) apical sizes. The needle for each group was placed 2mm short of the working length. Irrigation needle was constantly moved in an up and down movement within 30 seconds. The highest concentration of 5.25% hypochlorite solution was used.

To standardize the time diffusion of the dye, the gel was photographed at exactly 20 minutes after the initial irrigation with sodium hypochlorite. The gel was positioned in front of a light box for trans-illumination and digitally photographed in a buccal/lingual direction by using a camera (Nikon Digital Single Lens Reflex, DSLR; D700 with 12.1 megapixels; in an auto focus mode for magnification) at a fixed distance of 30 cm. The standardized photograph was analyzed by using Adobe Photoshop 7 to determine the area of the color change expressed in pixels. Data were analyzed using statistical package for the social science (SPSS) Program Version 19.

### **Results**

The discoloration of agar was clearly obtained after the sample tooth had been irrigated with 5.25% sodium hypochlorite indicating the sign of apical extrusion. A total of 36 out of 40 (90%) teeth in the

hypodermic needle group showed positive apical extrusion compared to 14 of 40 teeth (35%) in the monoject group regardless of apical size. It was found that the number of pixels between 2 types of needle showed a difference with more teeth exhibited statistically significant higher number of pixels colour changed with value of  $p < 0.001$  (Partial Eta Square of 0.131 with large observed power 91.7%) from the agar dye in the hypodermic group ( $1.733 \times 10^4$  pixels) compared to the monoject group ( $0.497 \times 10^4$  pixels).

As for the different apical canal size between F1 (0.20mm) and F2 (0.25mm) ProTaper® sizes did not show any significant difference in the number of mean pixels ( $p > 0.5$ ). However, both apical canal sizes (F1 and F2 canal sizes) showed higher number of apical extrusion in the hypodermic irrigation needle system compared to monoject irrigation needle system. The highest number of mean pixel with the score of  $1.75 \times 10^4$  came from the F2 canal apical size group of the hypodermic needle system. While the least number of mean pixel score of  $0.27 \times 10^4$  derived from the F2 group from the monoject system. Moreover, monoject irrigation needle system also showed that the F2 canal size group showed less apical extrusion than F1 canal size.

### **Discussion**

The results in this study are in accordance with Boutsoukias et al 2010<sup>6</sup>, in that the monoject system showed significantly lower apical pressure via computational dynamic model method. Our study showed that a few teeth demonstrated small number of apical extrusion depicted as pixels in the monoject system compared to the hypodermic using colored-agar discoloration technique. This may be due to low apical pressure produced by the side venting needle as opposed to apical opening. Therefore, the apical extrusion effect for monoject irrigation needle is far less, compared to the hypodermic irrigation needle. More recent irrigation venting system such as the

Endo Vac system has been introduced; however this is far too costly to be implemented at a dental school. Besides, many dental schools throughout Asia use the simple irrigation needle technique.

### **The use of needle irrigation system**

It was interesting to find that although there was less number of apical extrusion in the monoject needle system, larger apical canal size (F2; 0.25mm) showed even less number of mean pixel compared to F1 (0.20mm) group. This plausible explanation can be due to the fact that the larger apical canal size along with larger coronal taper of the F2 ProTaper systems group provided extra space for the irrigant to flow and flush in an upward direction rather than to be extruded apically towards the gel causing discolouration of the dye.

In this regard extensive research carried out by Mitchell et al.<sup>7-8</sup>, the authors explained that the frequency of apical extrusion of sodium hypochloride was dependent on the type of root canal irrigation system and apical preparation size. They further pointed that the extent of extrusion depended on the irrigation system, with syringe and slotted-needle irrigation resulting in the greatest extent of extrusion.

Thus, the use of monoject needle and perhaps preparation to a larger apical canal size than 0.20mm should be encouraged to reduce further the tendency of sodium accident during treatment.

In view of this finding, we strongly recommend that monoject irrigation needle should be used by students regardless of costs during root canal treatment in the polyclinic or dental clinic due to its safety in order to prevent sodium hypochlorite accident.

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