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Comparative Analysis of Three Different Irrigants on Extruded Debris During Root Canal Treatment: An In Vitro Study

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ABSTRACT

Background: The use of irrigant is one of the major steps in chemo-mechanical preparation for the removal of debris, necrotic tissue and microorganism. Forty extracted single-rooted human mandibular premolar teeth with straight root canals were used. The teeth were randomly divided into 1control group and 3 experimental groups of 10teeth each. Protaper universal was used for root canal preparation in all teeth, and 3 different irrigants were used (group A Normal Saline; group B 17% EDTA, Group C 2% Chlorhexidine Gluconate; Group D 3% sodium hypochlorite). Debris extruded from the apical foramen during root canal preparation was collected into pre weighed Eppendorf tubes. The weight of the dry extruded debris was established by subtracting the pre instrumentation and post instrumentation weight of the Eppendorf tubes for each group. The data obtained were analyzed by using one-way analysis of variance and Tukey honestly significant difference. Group D (sodium hypochlorite 3%) had the highest amount of extruded debris, which was significantly different from the other groups ($P < .05$). The type of irrigant used can affect the amount of apically extruded debris. The 3 solution of sodium hypochlorite had the greatest amount of debris.

Keywords: Apical extrusion, EDTA, Chlorhexidine, Sodium hypochlorite, debris, irrigation.

INTRODUCTION

Thorough root canal cleaning and shaping is the key to successful endodontic treatment. The use of irrigant is one of the major steps in chemo-mechanical preparation for the removal of debris, necrotic tissue and microorganism[1]. The common and inevitable complication encountered during this process is the pushing of canal contents and debris through the apical foramen which carries the potential for postoperative pain, swelling and delayed healing[2]. Debris extrusion could be because of canal anatomy, instrumentation technique, type of instrument used, needle tip design and of course the type of irrigant used[3,4,5].

The extruded material has been referred to as a worm of necrotic debris and has been cited as a major cause of mid-treatment flare-ups. Vande Visse and Brilliant were the first to quantify the amount of debris extruded apically. Studies have shown that irritants along with instruments produce apical debris to some extent[6,7]. So adequate knowledge of irritant, its use, advantages, disadvantages, adverse effect should help clinician provide a proper treatment. The objective is (1) To quantitatively compare the amount of debris extruded apically from root canals with the use of three different irrigants – 3% Sodium Hypochlorite, 17% EDTA, 2% Chlorhexidine Gluconate and with control group i.e. 0.9% normal saline. (2) The

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second objective is to show that different root canal irrigants can produce different amount of apically extruded debris with same root canal preparation technique and instruments used.

MATERIALS AND METHOD

In this study 40 freshly extracted human mandibular second premolar teeth were used. The inclusion criteria were single-rooted mandibular second premolar teeth with 1 root canal and 1 apical foramen, root curvature between 0–10 degree[2], no signs of cracks, internal resorption, external resorption, root caries, root canal calcification and open apices. To assess internal resorption, root canal calcification, and curvature of the root canals, radiographs (Dentus E-speed, Agfa, Germany) were taken from both buccolingual and mesiodistal directions. The degree of root curvature was calculated from the buccolingual radiographs by using the method of Schneider. The teeth were randomly divided into 1 control group (group A, n = 10) and 3 experimental groups (groups B-D) with 10 teeth each. Group A consist of 0.9% Normal Saline (NIRLIFE, GUJARAT), group B consist of 17% Ethylene di-amine tetra acetic acid (SMEAR CLEAR, SYBRON ENDO) group C consist of 2% Chlor hexidine Gluconate (NEELKANTH, INDIA), group D consist of 3% Sodium Hypochlorite (NEELKANTH, INDIA). The external tooth surfaces were cleaned to remove debris and soft tissue remnants, and then they were stored in phosphate-buffered saline solution. To have similar tooth lengths, all teeth were measured before mounting. One Eppendorf tube for each tooth was weighed with a 0.001 graduation electronic weighing machine, 3 consecutive measurements were done, and the mean measurement for each tube was considered to be its weight. If these 3 consecutive measurements showed very different numbers, the process of weighing was continued until 3 similar measurements were obtained that only differed in the last digit by 1–2. The electronic weighing machine was placed in a room without any windows, and the door of the room was carefully closed during weighing of the tubes. Only 2 persons who were seated and had no movement during the process were present in the room. The teeth were then fixed inside the Eppendorf tubes with self-curing acrylic resin. A 27-gauge needle was inserted into each Eppendorf tube cover to balance the air pressure between inside and outside of the tube. The whole apparatus was then placed in a stable stand of boron silicate glass jar(Fig 1). The access opening is done with endo access bur and then patency is established with 10 no. k-files (DENTSPLY, MAILLEFER) the radiograph is taken 1mm short of the apex. Tooth is prepared with 20no. K-file and then protaper rotary (DENTSPLY, MAILLEFER) is used till F2 using different irrigants of same amount (5 ml) for each group. The torque and speed of the endomotor was kept as instructed by the manufacturer. On completion of the root canal preparation, the canals were dried with paper points (META BIOMED, KOREA) and the teeth were removed from the Eppendorf tubes. The apical part of each tooth was washed with distilled water to collect any apically extruded debris that was adhered to the root(Fig 2). All of the tubes with apically extruded debris(Fig 3) were weighed 3 times and then incubated at 68◦C for 2 days to get the dry weight(Fig 4). The mean of these measurements was considered to be the new weight of the tubes. The unit of measure was microgram. The differences between the first and the second mean weights were calculated and analyzed by one-way analysis of variance and Tukey honest significant difference. The level of significance was set at .05.

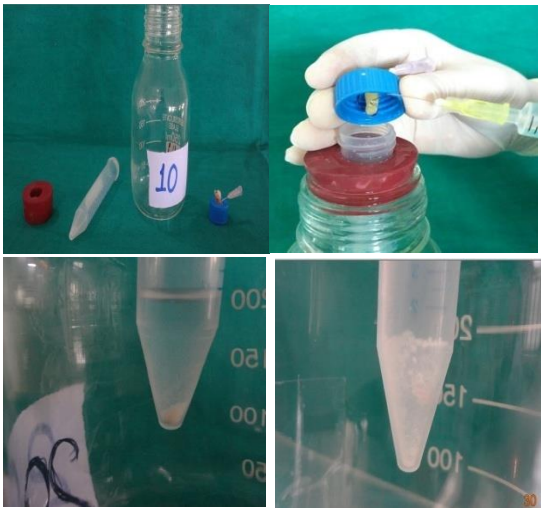


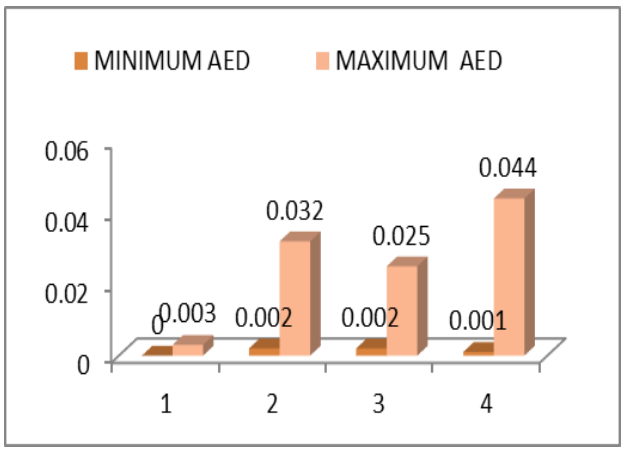
Fig 1: Rubber cork, Eppendorf tube, glass jar and tooth mounted in cap with needle
Fig 2: Representing debris collection from root tip
Fig 3: Representing debris collected in Eppendorf tube
Fig 4: Dried out debris

RESULT

Average of apically extruded debris in four different group was calculated and NaOCl 3%, was seen to have highest amount of extrusion. The representation of table with graph is illustrated below (Table No. 1 and Graph No. 1). On the basis of ANOVA and post hoc TUKEY test the calculated result of Apically Extruded Debris of four different groups: (A- Normal saline, B- EDTA 17%, C- CHX 2%, D- NaOCl 3%) are: There were no significant differences between the 4 measurements of the debris A vs C, B vs C , B vs D, C vs D($P > .05$). But when A vs B was calculated p value was ($p<0.05$) and when A vs D was compared p value was ($p<0.01$). Thus A vs D was more significant compared to A vs B (Table 2).

Table 1: Average of AED in Different Groups

	Apically extruded debris (AED; mg)		
	Minimum	Maximum	Average
Normal saline	0.000	0.003	0.001
EDTA: 17%	0.002	0.032	0.017
CHX: 2%	0.002	0.025	0.013
NaOCl: 3%	0.001	0.044	0.022



Graph 1: Showing Average of AED in Different Groups.

Table 2: Tukey HSD Result

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	3.9745	0.0380846	* p<0.05
A vs C	3.5598	0.0742231	insignificant
A vs D	7.2924	0.0010053	** p<0.01
B vs C	0.4147	0.8999947	insignificant
B vs D	3.3179	0.1065552	insignificant
C vs D	3.7326	0.0565489	insignificant

DISCUSSION

The present study showed that different root canal irrigants can produce different amounts of apical extruded debris with the same root canal preparation technique and instruments. NaOCl is one of the irrigant used in our study, laboratory research has shown that a concentration of 5.25% significantly decreased the elastic modulus and the flexural strength of human dentin as well as is undesirable because it is an irritant to periapical tissues. At the concentration of 1%NaOCl, microorganisms such as *E. faecalis* are resistant. Therefore considering above effects, 3% concentrations of NaOCl has been used in the present study and the highest amount of debris was extruded from this irrigant [8,9].

In the present study, the root canals in group 1 were prepared with using normal saline as an irrigant. No significant difference was observed before and after root canal preparation in these samples because of inability of normal saline in dissolving organic debris[10]. A survey in the United States has shown that the most popular concentration of CHX used by endodontists was 2%[11]. Therefore, this same concentration of 2% CHX was used in the present study and it produced third highest amount of debris although the amount is not significant. To see the efficacy of 17% EDTA alone in the extrusion of debris it is used in the present study as it is the most common concentration used according to the study done by Markus Haapasalo and in my study this irrigant produced the second highest amount of debris.

To increase the probability that the amount of dentinal debris produced was a result of irrigation, a standardized tooth model was used to decrease the number of variables. In the present investigation, there was no pulp tissue inside the root canal as well as no periapical tissues that might act as a barrier against apical extruded debris. However, it has been reported that periapical tissue might act to either reduce or increase the amount of apical extruded debris[12]. It was also seen that the side vented needles produced less extrusion compared to normal needles, therefore the selection of needle also affect the debris extrusion[13].

Therefore the whole study has been done to analyses which irrigant produce what amount of debris, as higher the extrusion so is its ill effect.

CONCLUSION

It was concluded from my study that 3% NaOCl produced highest amount of debris followed by 17% EDTA, 2% CHX, .9% Normal Saline and debris was produced in every group more or less. Thus, there is periapical extrusion of debris whatever the type of irrigant is but of course different irrigant produced different amount of debris which is going to affect the prognosis.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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