



Original Article

COMPARISON OF THE EFFECT OF DIFFERENT IRRIGANTS ON SMEAR LAYER REMOVAL DURING ROOT CANAL PREPARATION.

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Abstract

Background: Sodium hypochlorite (NaOCl) is the most widely used endodontic irrigant as it fulfills most of the requirements of an ideal irrigant. It has certain drawbacks, chiefly severe soft-tissue damage. Thus, this *in vitro* study was conducted to compare the effect of different irrigants on smear layer removal during root canal preparation. **Materials and methods:** Thirty single rooted human maxillary premolars were used and divided into three groups. Instrumentation was performed with K-Flex files with the crown-down technique; and divided in Group I: canal preparation was performed with 2.5% NaOCl mixed with 17% EDTA in the root canal. Group II: irrigation was performed alternately with 2.5% NaOCl and 17% EDTA. Group III: only 2.5% NaOCl was used during all instrumentation and EDTA for 3 min at the final. The mean scores for the smear layer by Scanning electron microscope after the use of each file were calculated and analysed. **Results:** There was no significant difference between Group I and Group II, but when both were compared with Group III there was a significant difference ($p < 0.05$). **Conclusion:** Our study concluded that there was no significant difference between the groups when NaOCl used with EDTA simultaneously in the canal and NaOCl alternated with EDTA. But, when Group I and Group II were compared with Group III i.e Instrumentation with NaOCl solution and final irrigation with EDTA for 3 mins, there was a significant difference

Keywords: Sodium hypochlorite, EDTA, smear layer

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INTRODUCTION

The elimination of microorganisms from the root canal is very important in the success of endodontic therapy. The colonisation of dentinal walls with biofilm, along with the anatomical complexity of the root canal and the possibility of invasion of dentinal tubules, can compromise the success of endodontic therapy.¹⁻³ The success of endodontic treatment is directly influenced by proper debridement of root canal including smear layer.⁴ Smear layer is an amorphous irregular layer on the root canal walls formed during biomechanical preparation of root canal⁵ and also post space.⁶ It includes a superficial 1 to 5 μ -thick layer with a weak bonding to dentine structure and 40- μ smear plugs packed inside the dentinal tubules.⁷ Smear layer acts as a barrier and prevents bacterial invasion of the dentinal tubules.⁸ However, bacteria might survive and multiply in the smear layer and can also penetrate into dentinal tubules. In addition, smear layer might decrease antimicrobial effectiveness of medicaments or sealing ability of root canal filling. Therefore, it becomes mandatory to remove smear layer from root canal for optimum success of treatment.⁹ Thus, this *in vitro* study was conducted to compare the effect of different irrigants on smear layer removal during root canal preparation.

MATERIALS AND METHODS:

In our study, sample of thirty freshly extracted permanent human premolars with a single root canal were used. The samples were divided into three groups of 10 teeth. The working length was established with the introduction of a #10 K file in the root canal. The apical preparation was extended up to a #45 K-file

following the crown-down technique and irrigation using an up-and-down motion was performed. The irrigants used in this study were a 2.5% sodium hypochlorite and a 17% ethylenediaminetetraacetic acid trisodium salt solution. The irrigation was performed with a plastic syringe and needles of #30 gauge. The solutions used for irrigation were divided as: Group I: NaOCl with EDTA simultaneously (at same time) in the canal. Group II: NaOCl alternated with EDTA. Group III: Instrumentation with NaOCl solution and final irrigation with EDTA for 3 mins. In all groups, the samples were subjected to SEM for analysis, but before that, they were irrigated with an additional final irrigation of 2 mL of saline solution to eliminate the waste from the irrigating substances. The hemi-section of each sample tooth was selected for SEM examination. The scoring criteria were based on the rating system developed by Rome et al.¹⁰ as follows: 0 - no smear layer, dentinal tubules open and free of debris; 1 - moderate smear layer, outline of dentinal tubules observable or partially filled with debris; and 2 - heavy smear layer, cannot distinguish outlines of tubules. Statistical analysis was done by using SPSS, version 15 (SPSS, Inc., Chicago, IL) and $p < 0.05$ was considered statistically significant.

RESULTS:

A sample of thirty freshly extracted permanent human premolars with a single root canal was used. The samples were divided into three groups of 10 teeth. The solutions used for irrigation were divided as: Group I: NaOCl with EDTA simultaneously (at same time) in the canal. Group II: NaOCl alternated with EDTA. Group III: Instrumentation with NaOCl solution and

final irrigation with EDTA for 3 mins. There was no significant difference between Group I and Group II, but when both were compared with Group III there was a

significant difference as shown in Table 1 (p < 0.05).

Groups	Mean			p-value
	Coronal	Middle	Apical	
Group I	2.86±0.26	2.87±0.24	3.98±0.01	<0.05
Group II	2.89±0.22	2.78±0.32	3.91±0.20	
Group III	1.04±0.00	1.21±0.12	3.29±0.34	

Table 1: Comparisons of extent of Smear layer removal with the different irrigant combinations used.

DISCUSSION

A sample of thirty freshly extracted permanent human premolars with a single root canal were used. The samples were divided into three groups of 10 teeth. The solutions used for irrigation were divided as: Group I: NaOCl with EDTA simultaneously (at same time) in the canal. Group II: NaOCl alternated with EDTA. Group III: Instrumentation with NaOCl solution and final irrigation with EDTA for 3 mins. Our study concluded that there was no significant difference between Group I and Group II, but when both were compared with Group III there was a significant difference (P < 0.05).

Prabhakaran P et al conducted a study to evaluate the Smear layer removing capacity of garlic extract as an alternative to 5% NaOCl. This study concluded that: *A. sativum* has a smear layer removal capacity, but it is less at the tested concentration when

compared to the EDTA and NaOCl groups.¹¹

O'Connell *et al.* showed that when the EDTA solutions were alternately used for root canal irrigation with 5.25% NaOCl, they completely removed the smear layer in the middle and coronal thirds of canal preparations, but were less effective in the apical third. EDTA with a pH of 4–6 has a capacity to chelate the calcium of the tooth and NaOCl with a pH of 10–10.5 has a capacity to dissolve the organic material.^{12,13} The combination of NaOCl and EDTA produces a synergistic effect, resulting in effective removal of the entire smear layer.^{14,15}

Prabhu SG et al concluded that NaOCl failed to remove the smear layer. Smear removing ability of maleic acid was significantly better than EDTA.¹⁶

It has been reported by Shih *et al.* that 5.25% NaOCl was strong enough to kill the bacteria commonly present in the canal;

however, this concentration was highly toxic and irritating.¹⁴

Silveira LF et al concluded that the alternate or mixed use of EDTA during instrumentation with 2.5% sodium hypochlorite was the most effective form of irrigation for the removal of smear layer on the cervical and middle thirds. No form of irrigation was sufficiently effective to remove the smear layer in the apical third.¹⁷

CONCLUSION:

Our study concluded that there was no significant difference between the groups when NaOCl used with EDTA simultaneously in the canal and NaOCl alternated with EDTA. But, when Group I and Group II were compared with Group III i.e Instrumentation with NaOCl solution and final irrigation with EDTA for 3 mins ,there was a significant difference.

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Conflict of Interest: None

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