

Original Research

Comparison of new irrigating solutions on smear layer removal and calcium ions chelation from the root canal

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ABSTRACT

Background: The successful endodontic treatment depends on comprehensive cleaning and shaping of root canal system. The present study was conducted to compare new irrigating solutions on smear layer removal and calcium ions chelation from the root canal. **Materials & Methods:** 60 human maxillary canines which were selected and prepared and the final irrigation was performed to quantify the concentration of calcium ions released with 0.2% chitosan, apple cider vinegar, and 15% ethylenediaminetetraacetic acid (EDTA), as in group I (n = 20), 15% EDTA was used, group II (n = 20) 0.2% chitosan (for preparation of the 0.2% chitosan solution, 0.2 g of chitosan material was diluted in 1% acetic acid of 100 ml, and then the sample was stirred using a magnetic stirrer for 2 h), and in group III (n = 20) apple cider vinegar was used. **Results:** The mean calcium ion concentration of the solutions in group I was 0.013 mg/L, in group II was 0.074 mg/L and in group III was 0.16 mg/L. The difference was significant (P < 0.05). The mean score of smear layer removal in middle third in group I was 1.4 mg/L, in group II was 2.5 mg/L and in group III was 3.8 mg/L. The difference was significant (P < 0.05). The mean score of smear layer removal in apical third in group I was 1.7 mg/L, in group II was 2.8 mg/L and in group III was 2.0 mg/L. The difference was significant (P < 0.05). **Conclusion:** 6% citric acid removed the smear layer more efficiently than other test irrigants in primary root canals.

Key words: Apple cider vinegar, Chitosan, Smear layer

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INTRODUCTION

The successful endodontic treatment depends on comprehensive cleaning and shaping of root canal system. After the root canal treatment, more than 35% of the root canal surface can be left without preparing with the help of advanced technology such as nickel titanium files.¹ Thus, it is critical to have an irrigation system or intervention as part of the conventional root canal treatment. The main objective of the irrigation is for cleansing that does not take place with biomechanical preparation.²

Keeping or removing the smear layer is a highly controversial issue, as presence of smear layer itself may be infected and could harbor bacteria within the dentinal tubules. This is significant in teeth with

infected root canal system where the outcome of the endodontic treatment depends on the elimination of bacteria and their byproducts from the root canal system.³

Chitosan is a natural polysaccharide, which has gained popularity in the field of dentistry because of its properties (biodegradability, biocompatibility, bioadhesion, and no toxicity etc). The preparation of root canal using the most widely used irrigant for smear layer removal is ethylenediaminetetraacetic acid (EDTA) which is achieved by acting on an inorganic material.⁴

Apple cider vinegar has proven antimicrobial action, reduces dentinal microhardness, in addition to removing the smear layer.⁵ It is a combination of

acetic, citric, formic, lactic, succinic (succinate), and tartaric acids with a lesser amount of alcohol, helps in reducing the surface tension of the solution.⁶The present study was conducted to compare new irrigating solutions on smear layer removal and calcium ions chelation from the root canal.

ethylenediaminetetraacetic acid (EDTA), as in group I (n = 20), 15% EDTA was used, Group II (n = 20) 0.2% chitosan (for preparation of the 0.2% chitosan solution, 0.2 g of chitosan material was diluted in 1% acetic acid of 100 ml, and then the sample was stirred using a magnetic stirrer for 2 h), and in Group III (n = 20) apple cider vinegar was used. Samples were then composed and analyzed using atomic absorption spectrometry. From the middle and apical thirds of the root canal, the smear layer removal was evaluated using SEM. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

MATERIALS & METHODS

The present invitro study consisted of 60 human maxillary canines which were selected and prepared and the final irrigation was performed to quantify the concentration of calcium ions released with 0.2% chitosan, apple cider vinegar, and 15%

RESULTS

Table I: Assessment of calcium ion concentration of the solutions (mg/L)

Groups	Mean	P value
Group I	0.013	0.01
Group II	0.074	
Group III	0.16	

Table I shows that mean calcium ion concentration of the solutions in group I was 0.013 mg/L, in group II was 0.074 mg/L and in group III was 0.16 mg/L. The difference was significant (P< 0.05).

Table II: Smear layer removal in middle third

Groups	Mean	P value
Group I	1.4	0.01
Group II	2.5	
Group III	3.8	

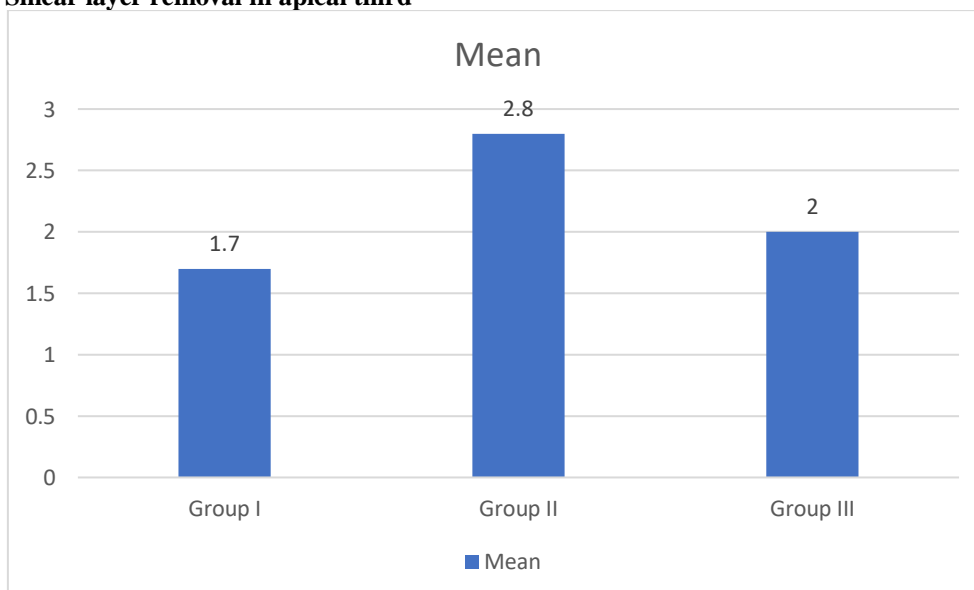
Table II shows that mean score of smear layer removal in middle third in group I was 1.4 mg/L, in group II was 2.5 mg/L and in group III was 3.8 mg/L. The difference was significant (P< 0.05).

Table III: Smear layer removal in apical third

Groups	Mean	P value
Group I	1.7	0.05
Group II	2.8	
Group III	2.0	

Table III, graph I shows that mean score of smear layer removal in apical third in group I was 1.7 mg/L, in group II was 2.8 mg/L and in group III was 2.0 mg/L. The difference was significant (P< 0.05).

Graph I: Smear layer removal in apical third



DISCUSSION

The rationale behind the root canal therapy in infected teeth is the elimination of debris, toxins and microorganisms by chemomechanical preparation.^{7,8} Conversely, even after cleaning and shaping, total sterilization of the root canal system remains questionable.⁹ It has been known that root canal instrumentation produces a smear layer that covers the surfaces of root canal walls containing both inorganic and organic materials.^{10,11} The present study was conducted to compare new irrigating solutions on smear layer removal and calcium ions chelation from the root canal.

We found that the mean calcium ion concentration of the solutions in group I was 0.013 mg/L, in group II was 0.074 mg/L and in group III was 0.16 mg/L. The mean score of smear layer removal in middle third in group I was 1.4 mg/L, in group II was 2.5 mg/L and in group III was 3.8 mg/L. Vallabhaneni et al¹² compare the efficacy of four irrigating solutions in removing the smear layer in primary root canals after hand instrumentation. A total number of 40 human primary incisors were decoronated and split longitudinally. The specimens were divided randomly into four groups (n=10): group I: 5.25% sodium hypochloride (NaOCl), group II: 6% citric acid solution, group III: smear clear and group IV: 0.2% chitosan. Scanning electron microscopic analysis was performed to assess the presence or absence of smear layer at the coronal, middle and the apical portion of each canal. The pictures from the scanning electron microscopy showed that group II exhibited better efficacy in removing smear layer without altering the normal dentinal structures with lowest mean scores followed by group III, group IV and group I. The presence of debris was more evident in the apical third rather than in the middle and the coronal part of the root canal.

We found that the mean score of smear layer removal in apical third in group I was 1.7 mg/L, in group II was 2.8 mg/L and in group III was 2.0 mg/L. Mittal et al¹³ assessed the effectiveness of smear layer removal from the root canal wall using various final irrigating solutions, and to quantify, the concentration of calcium ions in these solutions after irrigation using atomic absorption spectrophotometry with flame. Forty human maxillary canines were selected and prepared and the final irrigation was performed to quantify the concentration of calcium ions released with 0.2% chitosan, apple cider vinegar, and 15% ethylenediaminetetraacetic acid (EDTA), which were then composed and analyzed using atomic absorption spectrometry. From the middle and apical thirds of the root canal, the smear layer removal was evaluated using SEM. There was statistically significant difference between 0.2% chitosan and the other solutions with regard to smear layer removal. The highest concentrations of calcium ions were obtained with apple cider vinegar followed by 0.2% chitosan and 15% EDTA.

In a study conducted by Silva et al¹⁴, the evaluation of calcium ion concentrations in the chelating solutions, which are used for final irrigation after root canal instrumentation (15% EDTA, 0.2% chitosan, 10% citric acid, and 1% acetic acid), revealed greater values of 15% EDTA and 0.2% chitosan than 10% citric acid, which showed higher calcium ion concentration values than 1% acetic acid.

The limitation the study is small sample size.

CONCLUSION

Authors found that 6% citric acid removed the smear layer more efficiently than other test irrigants in primary root canals.

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