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Original Research

A comparative study of ethylenediaminetetraacetic acid, maleic acid, and peracetic acid in smear layer removal

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ABSTRACT:

Background: Microorganisms in the root canal system are considered to play a major role in the pathogenesis of apical periodontitis. The present study was conducted to compared ethylenediaminetetraacetic acid, maleic acid, and peracetic acid in smear layer removal from instrumented root canal system. **Materials & Methods:** 40 non-carious human anterior teeth with single root were divided in groups. Group I was maleic acid group: 07%, group II was PAA group: 0.5%, group III was the EDTA group: 17% and group IV was the control group: 0.9% saline. These teeth were then evaluated using SEM analysis for the absence or presence of smear layer. **Results:** At coronal third, score 1 in group I was seen in 100%, 15% in group II, 100% in group III and 12% in group IV. Score 2 was seen in 85% in group II and 88% in group IV. Score 3 was not seen in any groups. At middle third, score 1 in group I was seen in 75%, 50% in group II, 65% in group III and 0% in group IV. Score 2 was seen in 25% in group I, 35% in group II, 35% in group III and 30% in group IV. Score 3 was seen in 15% in group II and 70% in group IV. At apical third, score 1 in group I was seen in 62%, 0% in group II, 60% in group III and 12% in group IV. Score 2 was seen in 38% in group I, 62% in group II, 25% in group III and 0% in group IV. Score 3 was seen in 38% in group II and 15% in group III and 100% in group IV. The difference was significant (P< 0.05). **Conclusion: 7**% maleic acid as a final irrigant is highly efficacious for the removal of smear layer when used in the apical third of the root canal system.

Key words: Maleic acid, Irrigant, Smear layer

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INTRODUCTION

Microorganisms in the root canal system are considered to play a major role in the pathogenesis of apical periodontitis. The complete obliteration of root canal space with an inert filling material and creation of a fluid tight seal are the goals for successful endodontic therapy.[1] It is imperative for the endodontic filling material to adhere closely to the tooth structure for the creation of this seal.[2] This, however, is impaired by the formation of smear layer after mechanical instrumentation of the root canal. The endodontic smear layer which is amorphous and irregular in structure contains organic components such as microorganisms and their metabolic products, necrotic debris, pulp tissue, and odontoblastic processes as well as inorganic components like dentin debris.[3]

In endodontic therapy, the smear layer formation results from root canal preparation and is mainly composed of inorganic components (dentin debris) and organic materials, such as pulp tissue remnants, bacteria, and blood cells.[4] During the last decade, several research studies focus on the influence of smear layer on root canal obturation and especially on root canal sealers. However, the available information

is insufficient regarding the effect of the smear layer on the sealing ability of sealers over time.[5] Ethylenediaminetetraacetic acid (EDTA), a calcium chelating agent is used routinely in endodontics for the removal of smear layer. Maleic acid is used as an acid conditioner in adhesive dentistry. Peracetic acid (PAA) is one of the most potent disinfectants. It has been used as a single endodontic irrigant in the former. German democratic republic. It has antibacterial, sporicidal, antifungal, and antiviral effects.[6] The present study was conducted to compared ethylenediaminetetraacetic acid, maleic acid, and peracetic acid in smear layer removal from instrumented root canal system.

MATERIALS & METHODS

The present study comprised of 40 non-carious human anterior teeth with single roots were selected for the study. Chemo-mechanical preparation was done using crown down technique with irrigation of 2.5% NaOCl after every instrument use. Based on the final irrigation solution, the samples were divided into 4 groups of 10 each. Group I was maleic acid group: 7%, group II was PAA group: 0.5%, group III was the EDTA group: 17% and group IV was the control group: 0.9% saline. These teeth were then evaluated using SEM analysis for the absence or presence of smear layer, thereby analyzing their cleaning effectiveness in the coronal, middle, and apical thirds of the root canal system. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of teeth

Groups	Group I	Group II	Group III	Group IV
Materials	0.7% maleic acid	0.5% PAA	17% EDTA	0.9% saline
Number	10	10	10	10

Table I shows that teeth were divided into 4 groups based on materials used. Each group had 10 teeth.

Table II Smear layer removal in all groups at coronal third

Score	Groups	Percentage	P value
1	Group I	100%	0.02
	Group II	15%	
	Group III	100%	
	Group IV	12%	
2	Group I	0	0.90
	Group II	85%	
	Group III	0	
	Group IV	88%	
3	Group I	0	-
	Group II	0	
	Group III	0	
	Group IV	0	

Table II, graph I shows that at coronal third, score 1 in group I was seen in 100%, 15% in group II, 100% in group III and 12% in group IV. Score 2 was seen in 85% in group II and 88% in group IV. Score 3 was not seen in any groups. The difference was significant (P< 0.05).

Graph I Smear layer removal in all groups at coronal third

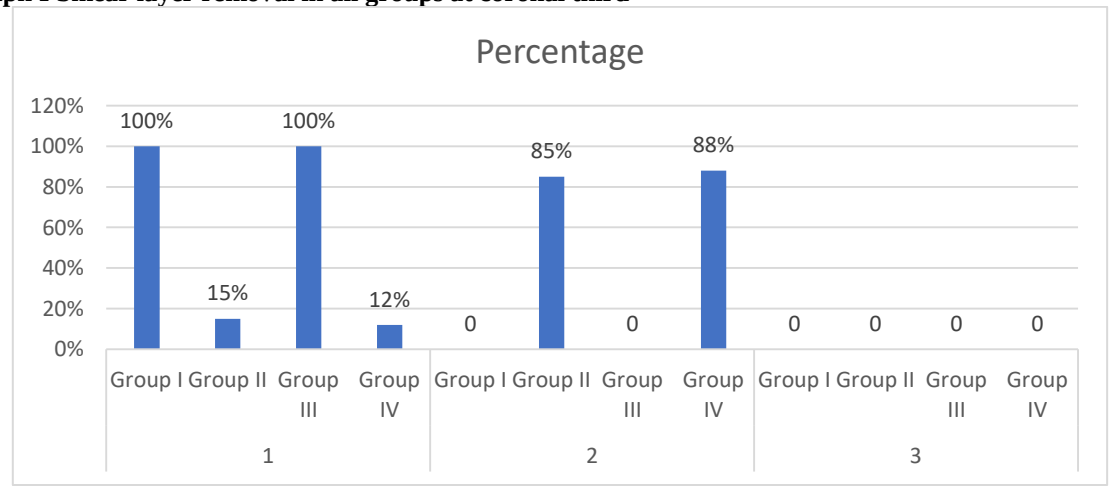

Table III Smear layer removal in all groups at middle third

Score	Groups	Percentage	P value
1	Group I	75%	0.81
	Group II	50%	
	Group III	65%	
	Group IV	0	
2	Group I	25%	0.94
	Group II	35%	
	Group III	35%	
	Group IV	30%	
3	Group I	0	0.01
	Group II	15%	
	Group III	0	
	Group IV	70%	

Table III shows that at middle third, score 1 in group I was seen in 75%, 50% in group II, 65% in group III and 0% in group IV. Score 2 was seen in 25% in group I, 35% in group II, 35% in group III and 30% in group IV. Score 3 was seen in 15% in group II and 70% in group IV. The difference was significant (P< 0.05).

Table IV Smear layer removal in all groups at apical third

Score	Groups	Percentage	P value
1	Group I	62%	0.93
	Group II	0%	
	Group III	60%	
	Group IV	12%	
2	Group I	38%	0.90
	Group II	62%	
	Group III	25%	
	Group IV	0	
3	Group I	0	0.05
	Group II	38%	
	Group III	15%	
	Group IV	100%	

Table III shows that at apical third, score 1 in group I was seen in 62%, 0% in group II, 60% in group III and 12% in group IV. Score 2 was seen in 38% in group I, 62% in group II, 25% in group III and 0% in group IV. Score 3 was seen in 38% in group II and 15% in group III and 100% in group IV. The difference was significant (P< 0.05).

DISCUSSION

There have been controversial reports over the maintenance or removal of this endodontic smear layer.[7] While some suggest that its persistence will alter dentinal permeability by blocking the dentinal tubules thus limiting bacterial or toxin penetration, others believe that it can harbor bacteria and cause leakage thus necessitating its entire removal from the root canal walls.[8] This loosely adherent structure is also known to prevent adaptation of endodontic sealers to canal walls as well as interfere with penetration of irrigants and intracanal medicaments into the dentinal tubules.[9]

We observed that at coronal third, score 1 in group I was seen in 100%, 15% in group II, 100% in group III and 12% in group IV. Score 2 was seen in 85% in group II and 88% in group IV. Score 3 was not seen in any groups. Economides et al[10] examined the effect of the smear layer on apical microleakage over 16 wk. One hundred and four extracted human teeth were assigned to four groups treated as follows: group Al-smear layer was left intact and canals were obturated with gutta-percha and Roth 811; group A2-smear layer was left intact and canals were obturated with gutta-percha and AH26; group Bl-smear layer was removed and canals were obturated with gutta-percha and Roth 811; and group B2-smear layer was removed and canals were obturated with gutta-percha and AH26. Microleakage was measured by the electro-chemical method. In parallel, 12 teeth were examined under a scanning electron microscope. The results indicated that the smear layer removal resulted in a statistically significant reduction of microleakage values in groups obturated with AH26. The presence or absence of smear layer had no significant effect on the sealing ability of Roth 811.

We found that at coronal third, score 1 in group I was seen in 75%, 50% in group II, 65% in group III and 0% in group IV. Score 2 was seen in 25% in group I, 35% in group II, 35% in group III and 30% in group IV. Score 3 was seen in 15% in group II and 70% in group IV. Butala et al[11] assessed the ability of 7% maleic acid, 0.5% peracetic acid (PAA), and 17% ethylenediaminetetraacetic acid (EDTA) in removing

smear layer from root canal system of human teeth using scanning electron microscopic analysis (SEM). In the coronal thirds of the root canal, there was no statistically significant difference between the EDTA and the maleic acid groups when evaluated for their efficacy at smear layer removal. Whereas, maleic acid performed significantly better than PAA and EDTA in removing smear layer from middle and apical thirds of the root canal system.

We found that at apical third, score 1 in group I was seen in 62%, 0% in group II, 60% in group III and 12% in group IV. Score 2 was seen in 38% in group I, 62% in group II, 25% in group III and 0% in group IV. Score 3 was seen in 38% in group II and 15% in group III and 100% in group IV. De-Deus et al[12] indicated that PAA solutions in various concentrations could dissolve the smear layer as quickly as 17% EDTA solutions. It may be due to acetic acid present in the PAA. They also found dentin erosion after the use of 2.25% PAA solutions in the root canals.

CONCLUSION

Authors found that **7**% maleic acid as a final irrigant is highly efficacious for the removal of smear layer when used in the apical third of the root canal system.

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