



COMPARATIVE EVALUATION OF DIFFERENT CONCENTRATIONS OF ETHYLENE DIAMINE TETRA ACETIC ACID (EDTA) SOLUTION IN SMEAR LAYER REMOVAL USING SCANNING ELECTRON MICROSCOPE (SEM) - AN IN VITRO STUDY

Endodontics

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ABSTRACT

(2277-8179)Ethylene Diamine Tetra Acetic Acid (EDTA) is a commonly used chelating agent in endodontics to aid in smear layer removal. Effective smear layer removal is crucial for ensuring the success of root canal treatment. To evaluate and compare the efficacy of two different concentrations of EDTA solutions 17% EDTA and 24% EDTA in smear layer removal using Scanning Electron Microscope (SEM). Thirty single-rooted mandibular premolar teeth were decoronated to 15 mm length, prepared with Hyflex-CM rotary files, and divided into 3 groups: Group 1- Normal saline (Control), Group 2- 17% EDTA, Group 3- 24% EDTA. All samples underwent final irrigation with their respective solutions, sonic agitation, and distilled water flush. Teeth were split longitudinally, gold sputter-coated, and examined under SEM. Smear layer scores were assessed. 24% EDTA demonstrated better smear layer removal than 17% EDTA, particularly in the apical third. Both EDTA groups performed significantly better than saline. 24% EDTA was the most effective, but further studies are required to assess biocompatibility and clinical safety.

KEYWORDS

Smear layer, EDTA, root canal irrigation, Scanning Electron Microscope (SEM), chelating agent, smear layer removal.

INTRODUCTION

Complete removal of the smear layer is essential to ensure successful endodontic treatment by enabling proper sealing of the root canal system. The smear layer, formed during mechanical instrumentation, consists of organic and inorganic debris that covers dentinal tubules and impairs sealer penetration. Among various irrigates, EDTA stands out as an effective chelating agent capable of removing the inorganic component of the smear layer. While 17% EDTA is the most commonly used concentration, there is limited literature on the efficacy of higher concentrations like 24% EDTA.

AIM

This study aims to compare the effectiveness of 17% and 24% EDTA in smear layer removal using SEM analysis.

MATERIALS AND METHODS

Sample Selection and Preparation

- Thirty mandibular premolars with single roots and mature apices were selected.
- Multi-rooted teeth, teeth with cracks, fractures, or dilacerations were excluded.

Standardization: Teeth were decoronated to a uniform length of 15 mm using a diamond disc. Patency was established using a #15 K-file. Working length was determined 1 mm short of the apex under magnification.

Cleaning and Shaping

- Hyflex-CM rotary files were used up to size 30/4% taper.
- Intermittent irrigation was performed using 3% sodium hypochlorite.

Group Allocation

- Group 1: Normal saline (Control)
- Group 2: 17% EDTA
- Group 3: 24% EDTA

Each sample was irrigated with 5 ml of the respective irritant for 1 minute, followed by 1 minute of sonic agitation. A final rinse with 3 ml distilled water was done to remove residual precipitate, and canals were dried with paper points.

SEM Preparation

- Longitudinal grooves were prepared on buccal and lingual surfaces without perforating the canal.
- Roots were split, and one half of each tooth was selected.
- Samples were gold sputter-coated.

RESULTS

The Kruskal-Wallis test showed a significant difference in smear layer removal among groups in all thirds ($p < 0.05$).
Coronal Third Comparison (Mann-Whitney U Test)

- 17% EDTA vs. 24% EDTA: No significant difference ($p = 0.012$)
- Both EDTA groups were significantly better than saline ($p < 0.05$)

Middle Third Comparison (Mann-Whitney U Test)

- 24% EDTA significantly better than 17% EDTA ($p = 0.009$) and saline ($p = 0.000$).
- 17% EDTA significantly better than saline ($p = 0.007$).

Apical Third Comparison (Mann-Whitney U Test)

- 24% EDTA significantly better than 17% EDTA ($p = 0.007$) and saline ($p = 0.000$).
- 17% EDTA significantly better than saline ($p = 0.000$).

Smear layer removal was most effective with 24% EDTA in all thirds.

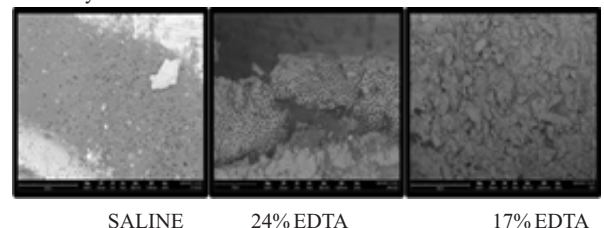


Figure 1: Results Table or SEM

DISCUSSION

EDTA is a well-documented chelating agent known for its ability to remove the inorganic component of the smear layer. In this study, both

17% and 24% EDTA solutions were effective in smear layer removal, with 24% EDTA performing better, particularly in the apical third where smear layer removal is most challenging. The improved efficacy of 24% EDTA could be attributed to its higher chelation power, enhancing smear layer dissolution.

However, higher concentrations may have detrimental effects on dentin microhardness and bond strength, necessitating further studies to evaluate the long-term clinical implications. The combination of EDTA irrigation with sonic agitation enhances penetration into dentinal tubules, optimizing smear layer removal. This underscores the importance of activation techniques during final irrigation to maximize chelating action. While the study confirms the superior performance of 24% EDTA, further research is necessary to determine its biocompatibility, impact on dentin properties, and long-term clinical safety.

CONCLUSION

The present study demonstrated that both 17% and 24% EDTA solutions effectively removed the smear layer. However, 24% EDTA exhibited superior performance, particularly in the apical third. Despite its efficacy, future studies should focus on the effect of higher EDTA concentrations on dentin microhardness, sealing ability, and long-term clinical outcomes.

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