

Efficacy of EDTA With or Without Surfactant in Smear Layer Removal: SEM Study

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Abstract:

Aim: to compare the efficacy of 17% EDTA & 15% EDTAC in smear layer removal in coronal, middle & apical level of root canal in vitro.

Method: For study, 50 single rooted mandibular premolars were taken. After access cavity preparation and working length determination, all teeth were prepared upto F3 with proTaper universal system. Final irrigation done in group I(n=20) with EDTAC , group II(n=20) with EDTA and group III(n=10) as a control group for 1 min. Samples were longitudinally cut and observed under scanning electron microscope at $\times 2000$ magnification.

Result: at coronal level no statistical significant difference seen in both the groups. But at middle and apical third EDTAC removed more smear layer than EDTA.

Conclusion: EDTAC is better than EDTA at middle and apical third level of root canal system.

I. Introduction

Root canal treatment can be summarized as a series of procedures for cleaning, shaping and filling the root canal system. One of the most important procedures during treatment is the chemo-mechanical preparation of the root canal, based on the correct use of instruments and irrigating solutions.¹

One of the greatest challenges of root canal treatment is the complete cleaning of the root canal in order to eliminate pulp remnants, bacteria, smear layer, predentine and other organic material.

Smear layer is amorphous layer composed of organic and inorganic material formed during instrumentation in mechanical preparation. The presence of smear layer leads to increased leakage and acts as a provision of substrate for bacterial growth and ingress.²

Smear layer removal in the apical region is less predictable as compared with the coronal and middle third of the root. This could be attributed to comparatively smaller apical canal dimensions hindering the penetration of irrigants resulting in limited contact between canal walls and the irrigants. A possible method to increase the penetration of irrigant into the apical third of root canal and dentinal tubules is the addition of surfactants. Surfactants reduce the surface tension and fluid viscosity, thus enabling the chelating solution to be carried more easily to the full depth of the canal.³

Various smear layer removal agents such as citric acid, phosphoric acid, EDTA, EDTAC, maleic acid , chlorine dioxide, sodium hypochlorite etc are available.

The purpose of this study is to compare and contrast the efficacy of 17%EDTA & 15% EDTAC in removal of smear layer from the prepared root canal with the help of scanning electron microscope.

II. Materials and methods

Fifty freshly extracted single rooted mandibular premolars teeth were selected. Teeth was devoid of caries and endodontic treatment with no canal curvature.

III. Methodology

After access cavity preparation, Working length determination was done .for standardization purpose, it was in between 21-25 mm. Then subtracting 0.5mm from length recorded when the tip of #10K-file was visible at apical foramina .Two layers of utility wax was applied over the root tips to prevent irrigating solution from passing through apical foramina. The sequential use of instruments was initiated with conventional hand files up to #20 and followed by proTaper rotary files from S1 to F3 with crown down technique. The root canals were

flushed with 2ml of 2% NaOCl by 30-gauge needle positioned in apical third of canal without binding. At the end of the preparation, samples were divided into three group i.e. 20 in each and 10 in control group. **Group I** was irrigated with 5ml of 15% EDTAC, for 1 min followed by 5ml distilled water for 1 min; & **Group II** was irrigated with 5ml of 17% EDTA for 1 min followed by 5ml of distilled water for 1 min. **Group III** was irrigated with 5ml of 5.25% NaOCl, for 1 min followed by 5ml of distilled water for 1 min.

To assess the degree of smear layer removal, roots were split into two halves using chisel & stored in distilled water at 37°C until SEM analysis.

SEM Evaluation:

Specimens were dried, mounted on metallic stubs, gold sputtered and evaluated at magnifications of 2000x at coronal, middle and apical levels. Dentinal wall was observed for the presence/absence of smear layer and the entrance to the dentinal tubules. Photomicrographs of the canal walls were taken for each specimen at coronal, middle and apical third.

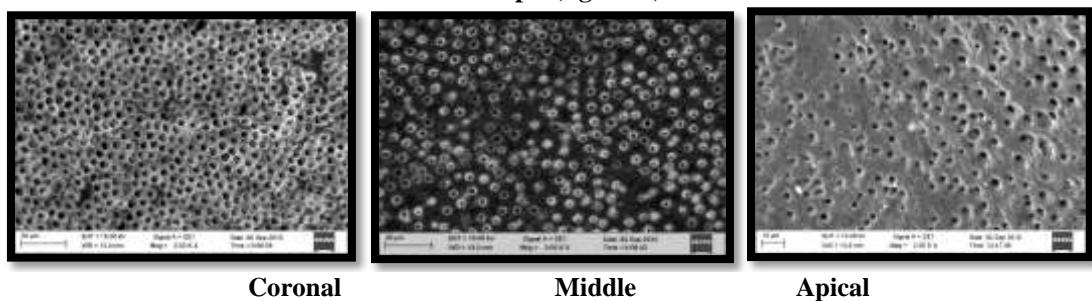
Remaining smear layer was calibrated according to the following criteria;

- 1) **Score 1:** clean root canal wall, only few small debris and particles
- 2) **Score 2:** few small agglomerations of debris
- 3) **Score 3:** many agglomerations of debris covering less than 50% of root canal wall
- 4) **Score 4:** more than 50% of the root canal wall covered by debris
- 5) **Score 5:** complete or nearly complete root canal wall covered by debris

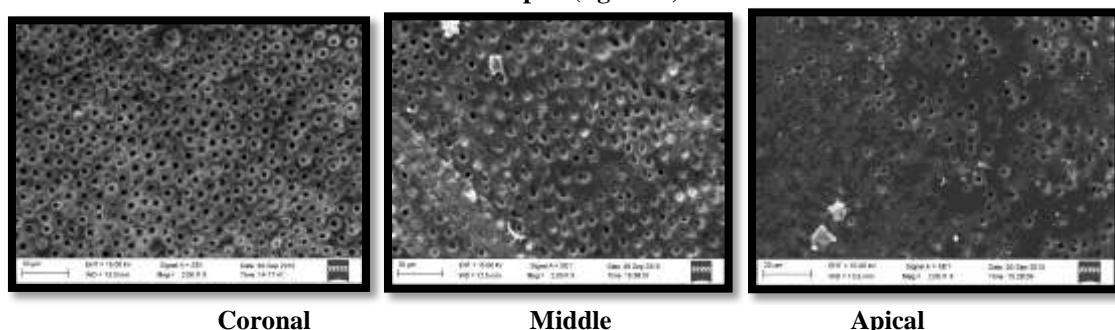
Three independent examiners analyzed in a blind manner. Observation table made independently with the help of the scoring criteria. Samples were subjected to statistical analysis.

Observations:

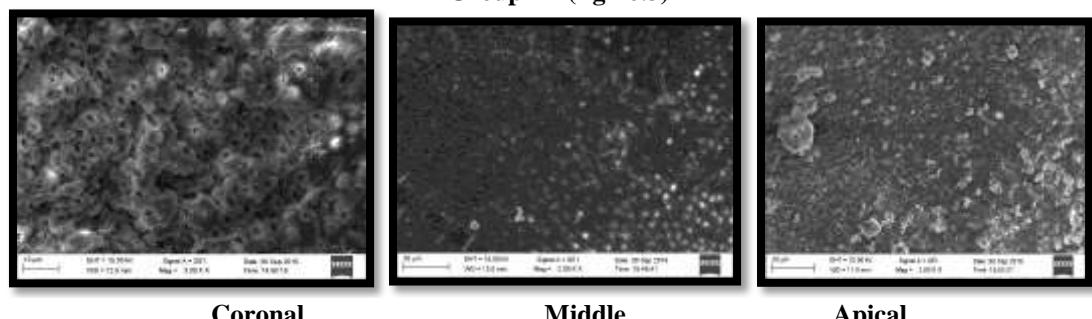
Group I (fig no. 1)



Group II (fig no. 2)



Group III (fig no.3)



IV. Result

No statistical difference seen at coronal level. But at middle and apical level mean score was statistically significant in which group II (EDTAC) was better than group II (EDTA) in smear layer removal by one way ANNOVA test. Group III (saline) fails to remove smear layer removal at all the levels of root canal system. (Table no. 1)

V. Discussion

The aim of the study was to evaluate the effectiveness of EDTAC and EDTA as a final irrigant to remove smear layer compared with saline. When irrigating a root canal the purpose is twofold: to remove the organic component, the debris originating from pulp tissue and microorganisms, and the mostly inorganic component, the smear layer. As there is no single solution which has the ability to dissolve organic tissues and to demineralize the smear layer, the sequential use of organic and inorganic solvents has been recommended.

Table no :1 Estimated means smear layer scores

Group	N	Area	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Group I	20	coronal	1.13	0.35	0.09	0.93	1.32	1.00	2.00
		middle	1.26	0.45	0.11	1.01	1.52	1.00	2.00
		apical	1.20	0.41	0.10	0.97	1.42	1.00	2.00
Group II	20	coronal	1.26	0.45	0.11	1.01	1.52	1.00	2.00
		middle	2.33	0.48	0.12	2.06	2.60	2.00	3.00
		apical	3.13	0.35	0.09	2.93	3.32	3.00	4.00
Group III	10	coronal	4.20	0.44	0.20	3.64	4.75	4.00	5.00
		middle	4.20	0.44	0.20	3.64	4.75	4.00	5.00
		apical	5.00	0.00	0.00	5.00	5.00	5.00	5.00

- Krushkall Wallis Chisquare Test:

χ^2 -value=37.35,p-value=0.0001, S,p<0.05

Crown down technique was used in this study because it allows better flow of the solution and, hence improves the efficiency of smear layer removal.⁴

Surface tension may be defined as the force between molecules that produces a tendency for the surface area of the liquid to decrease. This force tends to inhibit the spread of a liquid over a surface or limit its ability to penetrate a capillary tube⁵. Reducing surface tension of endodontic solutions improves their dentine wetting ability and improves their flow into narrow root canals.⁶ It may be speculated that reduction of surface tension of an endodontic irrigating solution by addition of surfactants should improve its efficacy in the narrow apical region of the root canal. In this study, this may be the reason for better smear layer removal in Group I which was irrigated with EDTAC at middle third and apical third area (fig no. 1), when compared with Group II with EDTA alone (fig no.2).

VI. Conclusion

Within the limitations, this study concludes that, no significant result was observed at coronal third but middle & apical third showed significant result with EDTAC as compared to EDTA due to presence of surfactant.

Scope: It can be used as an adjunct to routine chemo-mechanical debridement.

Limitation: Effectiveness should be evaluated with curved canal and infected root canals.

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