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# An in Vitro Comparative Evaluation of Smear Layer Removal Using Chlorhexidine, 5%Naocl, 17%EDTA And Chloroquick Solution As A Final Rinse- A Scanning Electron Microscopic Study

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***Abstract**:One of the fundamental aims of root canal treatment is to clean the root canals as thoroughly as possible to eliminate debris and microorganisms and achieve perfect obturation without leakage. However, after preparation of the root canals, an amorphous, irregular layer is formed on the root canal walls smear layer.Presence of smear layer prevents penetration of intracanal medicaments & complete adaptation of obturation materials to the prepared root canal surfaces. Various organic acids, EDTA, ultrasonic instruments have been used to remove the smear layer. Presently a new irrigating solution (chloroquick) containing a mixture of sodium hypochlorite (buffer) and hydroxyethanediphosphonic acid (HEDP) is used in instrumented root canals for removal of smear layer.[1]*

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## I. Introduction

Root canal treatment usually involves the chemo-mechanical removal of bacteria and infected dentine from within the root canals. The process is often followed by an intracanal dressing and a root filling. Amongst important factors affecting the prognosis of root canal treatment is the seal created by the filling against the walls of the canal. Considerable effort has been made to understand the effect of the smear layer on the apical and coronal seal.[2] Cameron (1983)[3] discussed the smear material in two parts: first superficial smear layer and second, the material packed into the dentinal tubules. Packing of smear debris was present in the tubules to a depth of 40 micrometer. A systematic review and meta-analysis by Shahravan et al. (2007)[3] set out to determine whether smear layer removal reduced leakage of root filled teeth ex vivo. They concluded that smear layer removal improved the fluid-tight seal of the root canal system, whereas other factors such as filling technique or the type of sealer did not produce significant effects.A number of chemicals have been investigated as irrigants to remove the smear layer example sodium hypochlorite, chelating agents (EDTA,REDTA), Tetracyclines , organic acids, combinations such as EDTA+Sodium hypochlorite etc. However several invitro and in vivo studies have shown that NaOCl does not effectively remove the smear layer. The most widely used chelating agent for the removal of smear layer is ethylene diamine tetraacetic acid (EDTA) and it was initially used in root canal therapy by Nygaard-Ostby in 1957. EDTA is mainly used as a final flush at a concentration varying from 15% to 17% and as a disodium salt solution. It removes minerals from the dentinal wall by chelation[4]. However, it has been found to be less efficient in narrow portions of the canal, requires a long application time for optimum results and can seriously damage the dentin causing erosion of the dentinal tubules [3, 4].Recently an alternative endodontic irrigant CHLOROQUICK a combination solution of stabilized SodiumHypochlorite solution with buffer and HEDP with detergent and system activator along with other excepients. CHLOROQUICK has been reported to be effective in removing endodontic smear layers, eliminating microbes that are resistant to conventional endodontic irrigants and providing sustained antimicrobial activity. Thus, an invitro study was carried out to evaluate the effect of various irrigants on removal of smear layer & dentinal erosion in instrumented root canals.

## II. Materials And Method

Sixty permanent human single rooted teeth with complete, mature root apices without any anatomic variation having straight patent root canal extracted for periodontal cause, were included in the present study. The teeth were divided into 4 groups of fifteen teeth each according to the irrigant used during instrumentation. Group1- Chlorhexedine (CHX), Group2- 5%Sodium hypochlorite, Group3- 17%EDTA, Group4- (CHLOROQUICK).The samples were cleaned to remove debris, calculus and rinsed with sodium hypochlorite

to remove organictissue and then stored in distilled water. Conventional access cavities were prepared using Endo access (DentsplyMaillefer) and Endo-Z (DentsplyMaillefer) burs. The apical end of the root was sealed with rubber base impression material to prevent escape of irrigating solution through the apical foramen during root canal preparation and were mounted into wax mould. The samples were prepared using PROTAPER NEXT files and with the help of X-smart endomotorincreasing the canal size as per sequence upto file size X3 (30/07) of PROTAPER NEXT. After using each file usage and before proceeding to the next file, the root canal were irrigated with 3 ml of the respective irrigant as per the group. After cleaning and shaping the root canals were finally flushed with 5 ml of distilled water to terminate the action of the irrigating solution. The teeth were placed in an incubator for 24hours at 100% humidity and at room temperature. After 24 hours the teeth were taken out, dried and prepared for scanning electron microscope (SEM) examination.Samples were then mounted on aluminum stubs and coated with 25µm thick layer of gold palladium and viewed under a scanning electron microscope at x3000 magnification. Photomicrographs were obtained from coronal, middle & apical levels of each root canal and were qualitatively evaluated according to Gutmann rating system[5] of smear layer removing scores given as follows:

**Score 1.** Little or no smear layer; covering<25% of the specimen; most tubules were visible and patent,
**Score 2.** Little to moderate or patchy mounts of smear layer; covering 25–50% of the specimen; many tubules visible and patent
**Score 3.** Moderate amounts of scattered of aggregated smear layer; covering 50–75% of the specimen; minimal to no tubule visibility or patency
**Score 4.** Heavy smear layer covering>75% of the specimen; no tubule orifices were visible or patent.
Statistical analysis was performed using Mann-Whitney test to assess the significant difference between the groups for mean scores of smear removal.

## III. Results

The Mean debris scores in the cervical, middle and apical third levels among the four groups at different magnifications are presented in Tables 1-3. There were consistent showing of significant differences between the degreeof cleanliness at different canal levels within each group, though there was a trend of a higher debris score at the apical third. In addition, it was observed that the degree of cleanliness between EDTA group and CHLOROQUICK groups was not significantlydifferent at coronal and middle canal level.However EDTA and CHLOROQUICK groups were significantly cleaner than NaOCl group.From Photomicrographs obtained from coronal, middle and apical levels of each root canal were qualitatively evaluated which depicted the following observationsComparison of smear layer removal scores among various groups for the

**Coronal Area**

| Groups | N | Median | Inter Quartile Range (IQR) | Mean Rank |
|---|---|---|---|---|
| Group I | 15 | 4.00 | 1.00 | 42.50 |
| Group II | 15 | 3.00 | 1.00 | 41.00 |
| Group III | 15 | 2.00 | 1.00 | 14.00 |
| Group IV | 15 | 3.00 | 1.00 | 24.50 |
| Kruskal Wallis Chi Sq Statistic | | | 32.78 | |
| p - Value | | | <0.001 | |

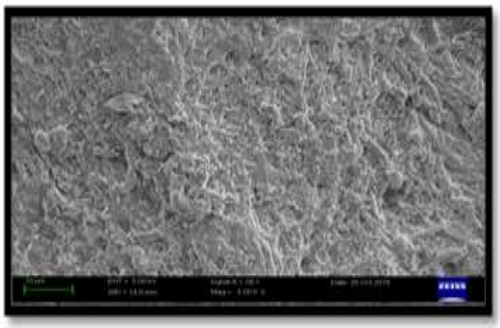
**Middle Third**

| Groups | N | Median | Inter Quartile Range (IQR) | Mean Rank |
|---|---|---|---|---|
| Group I | 15 | 3.00 | 1.00 | 47.93 |
| Group II | 15 | 3.00 | 1.00 | 33.47 |
| Group III | 15 | 2.00 | 1.00 | 22.03 |
| Group IV | 15 | 2.00 | 2.00 | 18.57 |
| Kruskal Wallis Chi Sq Statistic | | | 30.2 | |
| p - Value | | | <0.001 | |

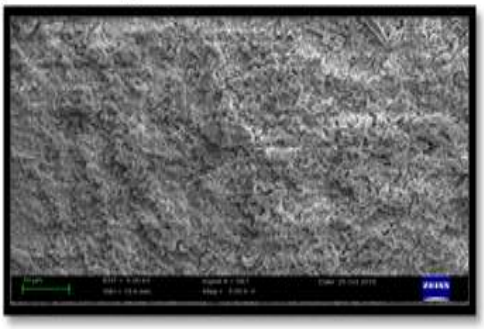
**Apical Third**

| Groups | N | Median | Inter Quartile Range (IQR) | Mean Rank |
|---|---|---|---|---|
| Group I | 15 | 2.00 | 1.00 | 40.93 |
| Group II | 15 | 1.00 | 1.00 | 10.13 |
| Group III | 15 | 3.00 | 2.00 | 40.40 |
| Group IV | 15 | 2.00 | 1.00 | 30.53 |
| Kruskal Wallis Chi Sq Statistic | | | 34.00 | |
| p - Value | | | <0.001 | |

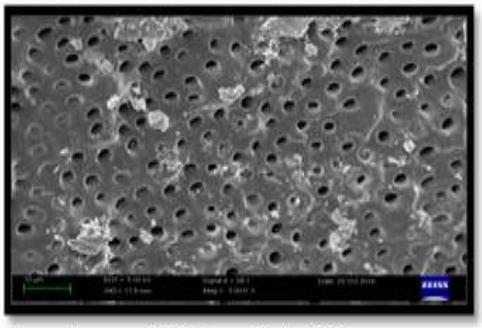
Smear Layer Removal Scores Among Various Groups- Coronal Third



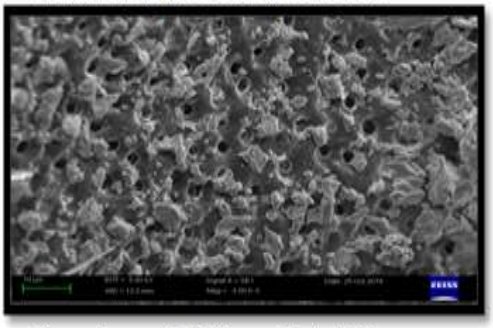
Photomicrograph Of Group I At 3000x



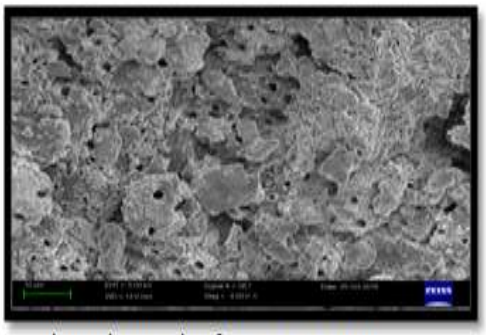
Photomicrograph Of Group Ii At 3000x



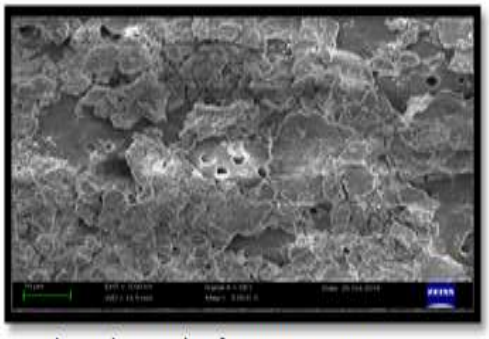
Photomicrograph Of Group Iii At 3000x



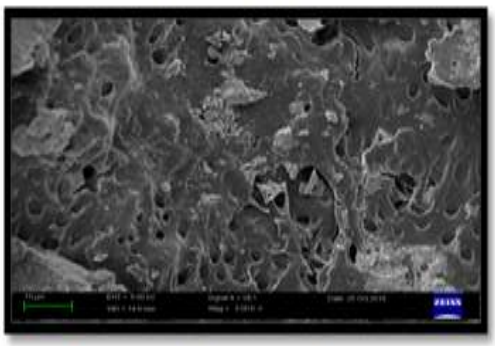
Photomicrograph Of Group Vi At 3000x



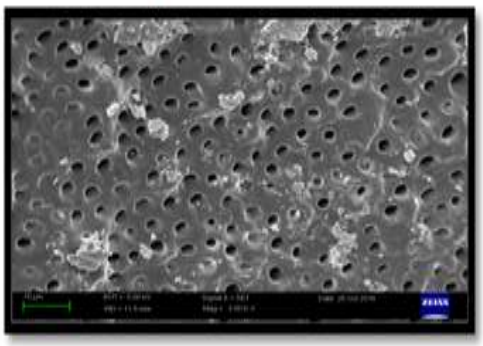
Photomicrograph Of Group I At 3000x



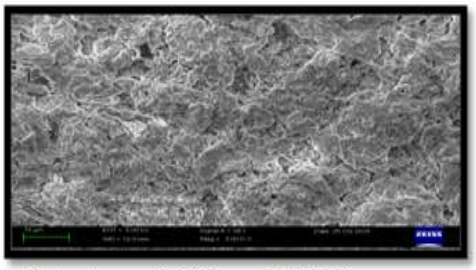
Photomicrograph Of Group V At 3000x



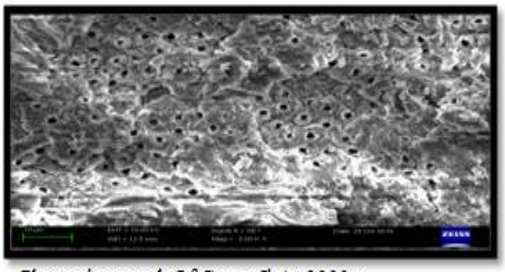
Photomicrograph Of Group Iii At 3000x



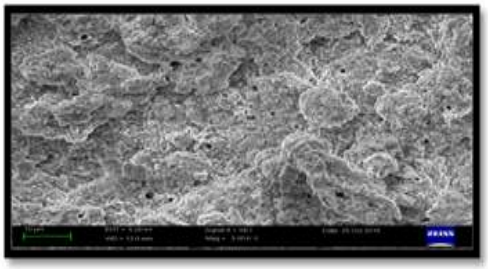
Photomicrograph Of Group Iv At 3000x



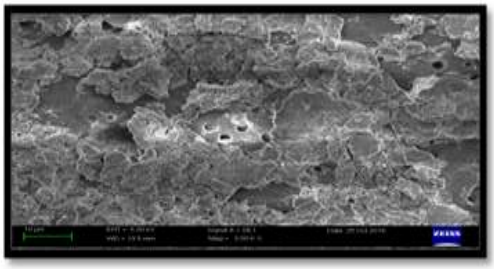
Photomicrograph Of Group I At 3000x



Photomicrograph Of Group Ii At 3000x



Photomicrograph Of Group Iii At 3000x



Photomicrograph Of Group Iv At 3000x

## IV. Discussion

One of the greatest challenges of the root canal treatment is the effective chemomechanical preparation of the root canal in order to eliminate pulp remnants, bacteria, smear layer, predentine and other organic material and achieve an adequate obturation.[1] Ideal root canal irrigant should prevent formation of smear layer during instrumentation ordissolve the latter once it has formed, have a broad antimicrobial spectrum, allow penetration of antimicrobial agents present in solution into the dentinal tubules and have minimal effect on physical properties of the tooth in addition to dissolving necrotic pulp tissue remnants and disinfecting root canal system and dentinal tubules [5].In the present study, sodium hypochlorite and EDTA was used although large number of agents have been used as root canal irrigants in the past, including acids like citric and phosphoric acid, alkaline solutions like sodium hypochlorite and sodium hydroxide, oxidative agents like hydrogen peroxide and glyoxide, saline, local anaesthetic solutions, ultrasonics and lasers, none of which have been totally effective or have received totalacceptance.Sodium hypochlorite is used in endodontics for two main purposes: (i) to dissolve pulp tissue, and (ii) to destroy bacteria. In endodontics, concentrations of 0.5% to 5.25% are regularly used. Even a 0.5% concentration isconsidered by some to be too toxic for wound care. There was no significant difference in the ability of the three different concentrations to kill bacteria.[6] The higher the concentration of sodium hypochlorite, the greater would be the deleterious effects on dentine like reduction of the elastic modulus and the flexural strength.[7]Ethylenediaminetetraacetic acid (EDTA) is a irrigant commonly used to remove the smear layer atthe end of root canal preparation. McComb andSmith were the first investigators to show thatREDTA (a commercial brand of EDTA) can removethe smear layer.[8] Goldman et al showed that whenused alone, REDTA removed the inorganic portionand left an organic layer intact in the tubules.[9]The common concentrations used are 15–17%disodium EDTA.10 With use of 15% EDTA at pH7.3, with an added detergent, there was 20–30 µmpenetration by EDTA as shown by a zone ofdemineralisation using polarised light microscopy,after only five minutes. This zone of demineralization did not increase beyond 50 µm, even when used overa long period. There was a clear demarcation line.This shows that EDTA did not diffusely penetrateinto tubules but rather there was a self-limitingreaction. A 5-minute exposure of the root canal to EDTA would remove the smear layer and open thedentinal tubules to a depth of 20–30 µm.[10]

This study evaluated the effectiveness of smear layerremoval associated with the use of Chlorhexidine, 5%NaoCl, 17%EDTAAndChloroquick Solution as a final rinse.

For optimalcomparison of the efficiency of different irrigationregimes, measures were taken in the inclusion criteriaand the study designed to ensure standardized canalsize and canal curvature and the extent of canalenlargement, as well as the volume of irrigantdelivered using a conventional needle.

EDTA in liquid form showed greater effectivenessin the removal of the smear layer. The best cleansingat all levels of the canal was achieved in those groups of teeth in which fluid EDTA was used. The use ofviscous

substances to facilitate chemo−mechanicalshaping of the canals proved to be advantageous inthe coronal and middle regions of the canal

## V. Conclusion

Based on the results of this study, it seems that Choloroquick is an effective solution for the removal of smear layer. It does not significantly change the structure of the dentinal when used as a irrigant.
However, further studies and clinical trials are necessary to substantiate the results of this study

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