



## COMPARATIVE EVALUATION OF SMEAR LAYER REMOVAL ABILITY OF HERBAL ENDODONTIC IRRIGANTS - SEM STUDY

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### Abstract

**Objective:** The aim of this article is to compare the efficacy of Herbal irrigants versus Sodium hypochlorite (NaOCl) and Ethylene diamine tetra acetic acid (EDTA) on smear layer removal by using scanning electron microscope.

**Methods:** 40 extracted single rooted teeth were randomly divided into 4 groups. Different irrigants were used for each group. 17% EDTA & 3% NaOCl for group 1, Triphala for group 2, Azardirachta indica (Neem) for group 3 and Curcuma longa (Turmeric) for group 4. Teeth canal were flooded with 1ml irrigant of respective group. After instrumentation, final irrigation was also done with 2ml of respective irrigant for two minutes for smear layer removal followed by irrigation with 2ml of saline and dried. All samples were analyzed using SEM for smear layer removal. Efficacy of smear layer removal was calculated using median (Interquartile range).

**Results:** EDTA (17%) & NaOCl (3%) were most efficient in smear layer removal at all the levels with median (IQR) i.e. at coronal 1(0), middle 1(3) and apical level 3(1) respectively compared to Triphala, Turmeric and Neem. Kruskal–Wallis test revealed statistically significant difference in smear layer removal by root canal irrigants at coronal third but no significant difference at middle and apical third.

**Conclusion:** Triphala, Neem and Turmeric showed the potential to remove the smear layer. However EDTA and NaOCl showed the maximum efficacy in removing the smear layer.

**Keywords:** EDTA, NaOCl, Neem, Smear layer, Triphala, Turmeric

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**DOI:** 10.48047/ecb/2023.12.si10.00408

## Introduction

Successful Endodontic therapy requires cleaning and shaping of root canal system.<sup>1</sup> During canal preparation of infected teeth, special attention must be given to the elimination of bacteria, their toxins and smear layer removal from root canal system.<sup>2</sup> The presence of such a layer hinders root canal irrigants and the obturation material to flow into the dentinal tubules, which increases the risk of microleakage and bacterial re-infection.<sup>3</sup>

To increase the efficacy of mechanical preparation, microorganisms and removal of smear layer, instrumentation must be supplemented with irrigation (chemo mechanical preparation). Various chemical irrigants have been used for this purpose, among which scientific evidence suggests that NaOCl is currently the irrigant of choice, which has excellent properties of tissue dissolution and antimicrobial activity.<sup>4,5</sup> However, on the other side, it has several limitations. The weaknesses of NaOCl include unpleasant taste, toxicity, extrusion into periapical tissues, its inability to remove smear layer because of its lack of effect on inorganic material.<sup>6</sup>

The smear layer mainly consists of inorganic substances which are soluble in acids. Various types of chelating agents like Ethylene diamine tetra acetic acid (EDTA), Citric acid remove inorganic part of smear layer. Goldman et al. confirmed that a final flush with 17% EDTA followed by NaOCl will completely remove the smear layer.<sup>7,8</sup> However, irrigation with EDTA followed by NaOCl could demineralize the dentine and produce erosions in coronal as well as the middle part of the root canal.<sup>9</sup>

In endodontics because of the cytotoxic reactions of the most of the commercial intracanal medicaments used and their inability to eliminate bacteria from dentinal tubules, trend of recent medicine attends to use biologic medication extracted from natural plants. The advantages of using herbal extracts in endodontics are that they have few side effects, less expensive, better tolerated by patients and renewable in nature<sup>10</sup>.

Very few studies are present in the literature on efficacy of natural irrigants in removal of the smear layer. Comparing the efficacy of Triphala, Neem and Turmeric with EDTA & NaOCl was not reported. Hence the present study evaluates the efficacy of Triphala, Neem and Turmeric on the smear layer removal.

## Methodology-

Forty extracted human premolar teeth, indicated for extraction due to orthodontic/periodontal reasons were selected in the study. The teeth were cleaned using ultrasonic scaler followed by sterilization under autoclave.

To standardize canal instrumentation, the teeth were decoronated at cementoenamel junction to standard root length 15mm using a low speed carbide disc under water as a coolant.

The Working length were established by deducting 1mm from lengths recorded when the tips were visible at the apical foramen. The roots were sealed with melted modelling wax to close the apical foramen and embedded in modelling wax blocks. The aim was to prevent the irrigants from escaping through the apex in order to simulate in vivo conditions.

## Division of Samples into Groups

Group 1- 17% EDTA followed by 3% Sodium hypochlorite

Group 2- 5% Triphala

Group 3-7.5% Hydro alcoholic solution of Azardirachta indica (Neem)

Group 4-0.25% of Hydro alcoholic solution of Curcuma longa (Turmeric)

Root canals were prepared by maintaining the glide path till no.#20 k file) followed by Pro Taper Rotary files system. All the canals were prepared with crown down technique by using Pro Taper nickel-titanium rotary instruments (Dentsply Malliefer, Switzerland) according to manufacturer's manual. All samples were prepared till Pro Taper F3 file size. After the use of each instrument, the canals were irrigated with 1ml irrigant of the respective group.

**Group 1-** 1ml of freshly prepared 17% EDTA rinsed for 1 minute alternatively with 1ml of 3% NaOCl between each instrument.

**Group 2-** 1ml of 5% Triphala rinsed for 1 minute and in between each instrument.

**Group 3-** 1 ml of 7.5% Hydro alcoholic solution of for Neem 1 min and used in between each instrument.

**Group 4-** 1ml of 0.25% Hydro alcoholic solution of Turmeric for 1min and in between each instrument.

Ultrasonic system was used for activating the irrigating solution. After instrumentation was complete, final irrigation was done with 2ml of respective irrigant for 2min for the removal of smear layer. The irrigating solution was delivered

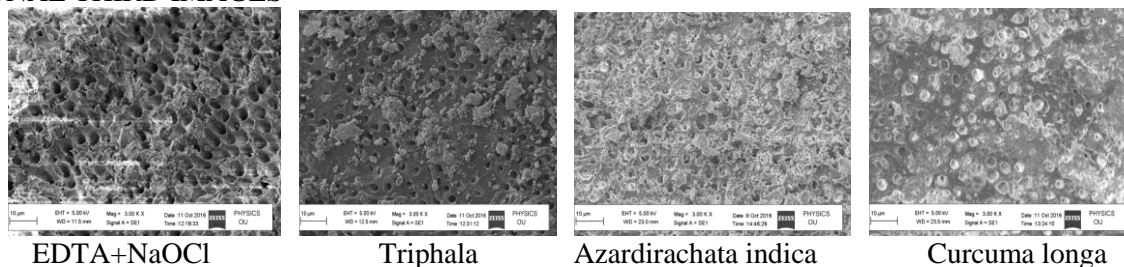
via syringe and needle. The canals were irrigated with 2ml of saline and dried with paper points. Sterilized cotton pellets were placed in the root canal orifices.

Longitudinal grooves were made on the buccal and lingual on each root by using a carbide disc at low speed without penetrating the canal. Osteotome was used to split the teeth along the grooves into two halves. For each root, the most visible part of the apex and best the total canal length were selected and coded. The coded specimens were secured on metal stubs, desiccated, sputter coated with 35 nm of gold and examined using a Scanning electron microscope.

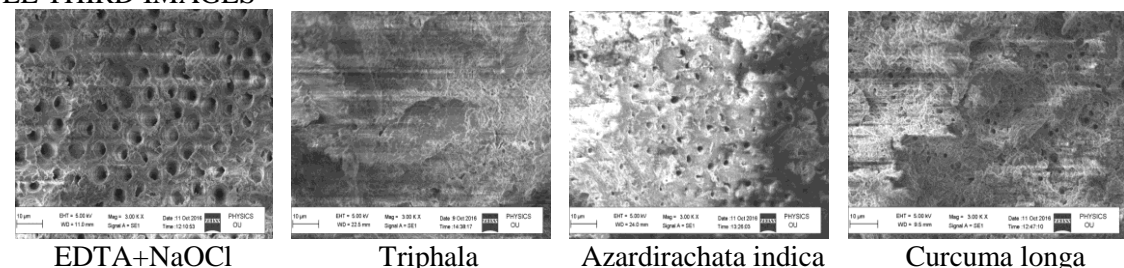
In the scanning electron microscope, photomicrographs at 3000x magnification were obtained at the apical third, middle third, and coronal third. Scoring of the smear layer removal was done according to the following criteria.

- Each field was graded from 0 to 3 as follows
- 0 = No smear layer with all dentinal tubules open.
  - 1 = Minimum smear layer >50% dentinal tubules open.
  - 2 = Moderate smear layer <50% dentinal tubules open
  - 3 = Heavy smear layer with all dentinal tubules obliterated.

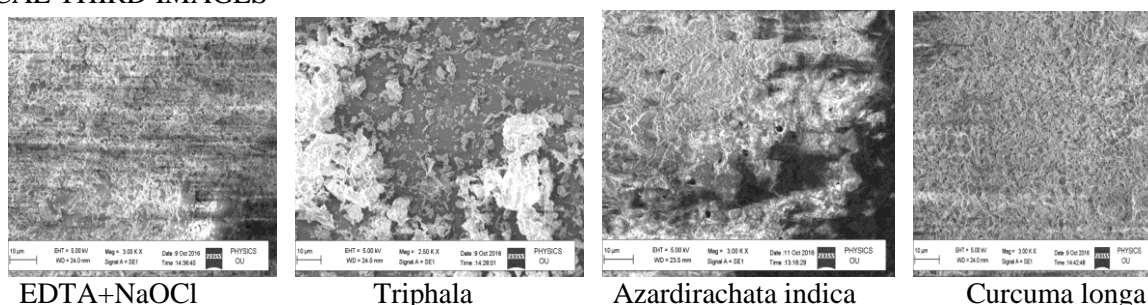
### SEM IMAGES OF SMEAR LAYER REMOVAL CORONAL THIRD IMAGES



### MIDDLE THIRD IMAGES



### APICAL THIRD IMAGES



Data analysis was performed using the non parametric tests i.e. Kruskal Wallis test and Mann Whitney U test.

### Results

Summarized data was presented using Tables and Graphs. Data was analysed using SPSS version 21). Data was not normally distributed as tested using the Shapiro-Wilk W test (p-value was less than 0.05). Therefore, analysis was performed using the non parametric tests i.e. Kruskal Wallis test (for comparing more than two groups) and Mann

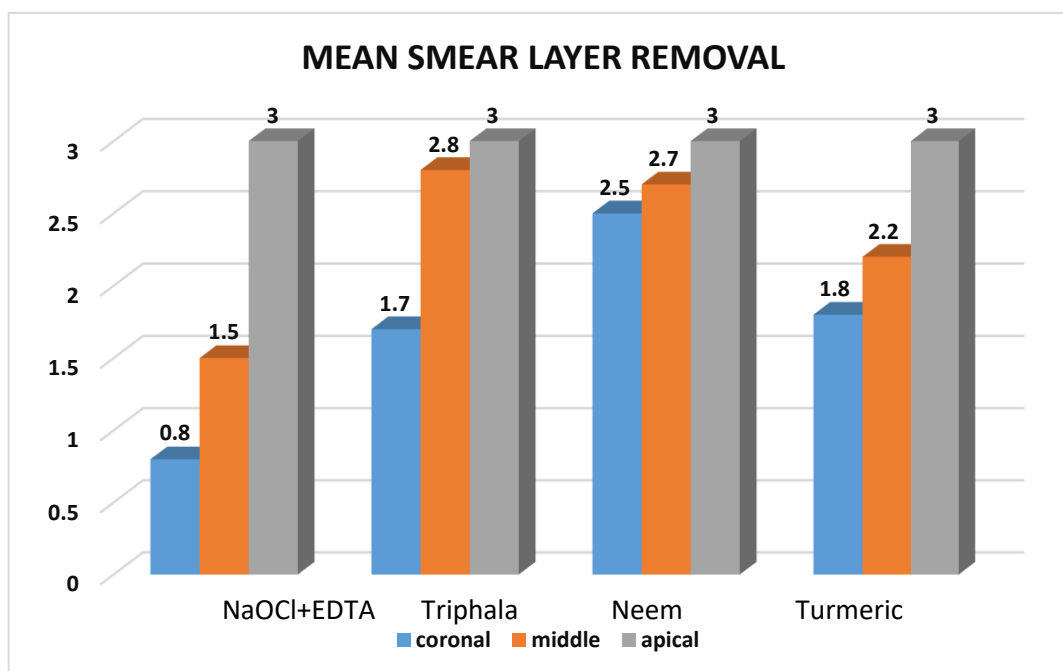
Whitney U test for post hoc pairwise comparison. Level of statistical significance was set at 0.05.

Mean smear layer removal by different irrigating solutions at coronal, middle, and apical levels 17%EDTA, 3%NAOCL showed the maximum smear layer removal at coronal ( $0.80 \pm 0.42$ ), middle

( $1.5 \pm 1.35$ ), and apical ( $3.00 \pm 0.00$ ) followed by Triphala, Turmeric and then Neem.

Neem showed the least smear layer removal at all the three levels. Statistical analysis by using

Kruskal–Wallis revealed statistically highly significant difference among the root canal irrigants at coronal and middle level but no statistical significant difference was found among root canal irrigants at apical level.



**Graph 1** shows the mean smear layer removal by different irrigants at different root levels.

## Discussion

Complete elimination of microorganisms from the root canal system and the prevention of re-infection is the main aim of endodontic treatment. For the achievement of this purpose removal of smear layer accounts to one of the most important step in root canal treatment. Presence of smear layer hinders the root canal irrigants and obturating material to flow into the dentinal tubules and this increases the risk of micro leakage and bacterial infection.

In the present study, Group 1- NaOCl & EDTA exhibited the highest amount of smear layer removal efficacy since these are gold standard irrigants and the ability of removal of both organic and inorganic part of smear layer compared to all the other groups in the present study.

To overcome the side effect of chemical irrigants and to meet the requirements of an ideal irrigant, Phytomedicines were discovered by researchers with several pharmacological activities and medicinal application. Interest on this substance is based on its properties like antibacterial, antifungal, antiviral, antioxidant, anti inflammatory, antipyretic, analgesic. Because of the easy availability and known medicinal values. Considering all these properties well-known herbal

products like Triphala, Neem and Turmeric, these three herbs were chosen for this study.

A recent systematic review and meta-analysis of in vitro leakage studies by Sharavan et al. (2007) concluded that smear layer removal improves the fluid-tight seal of the obturated root canal system.<sup>11</sup> Calt and Seper *et al* independently showed that the alternate use of EDTA and NaOCl is an efficient method for removal of the organic and inorganic parts of smear layer.<sup>12</sup>

Sodium hypochlorite is the gold standard root canal irrigant used in endodontic practice. Limitations include the unpleasant taste, toxicity, and its inability to remove the smear layer by itself, as it dissolves only organic material. Extrusion of NaOCl into periapical tissues can cause NaOCl accidents. Various studies were consistent with the toxicity of NaOCl concluded by Hales et al<sup>1</sup>, Gernhardt et al<sup>2</sup>.

Another important finding of study supports a well documented finding that coronal third of the root canal is the cleanest followed by the middle and the apical third<sup>5</sup> owing to the fact that this part of the root canal is easiest to instrument.

*Triphala* is an Indian herbal formulation containing dried and powdered fruits of *Amalaki*-*Embllica officinalis*, *Vibhitaki*-*Terminalia bellirica*, and *Haritaki*-*Terminalia chebula*. *Triphala* exhibits a broad-spectrum antimicrobial activity against all the microorganisms.<sup>13</sup> It is very good chelating agent, contains citric acid that may aid in removal of the smear layer (Prabhakar et al .Kamat S et al , Bhargava K et al ).<sup>14,15,16</sup> Comparable to our findings, various studies agreed that *Triphala* is as productive as other chemical irrigants in smear layer removal. Similar results were also demonstrated by other studies, which concluded that *Triphala* has a good cleaning efficacy compared to distilled water, green tea, and 2% hypochlorite. However, the most effective smear layer removal occurred with sodium hypochlorite with a final rinse of 17% EDTA, followed by *Triphala*. It has been established that *Triphala* is efficient against *Enterococcus faecalis* biofilms.

In this study, *Triphala* and *Curcuma longa* showed better smear layer removal compared to *Azadirachta indica*. Removal of smear layer might be because of presence of Curcumin which is responsible for biological activities of turmeric. Turmeric can also help to reduce smear layer and is a potential root canal irrigant that can be used in conjunction with other irrigating treatments to effectively remove smear layer. Study conducted by Indi et al suggested further investigation should be carried out to assess potential of Neem and Turmeric to be biocompatible and effectively disinfect the root canal system.<sup>17</sup>

*Azadirachta indica* popularly known as “Indian neem/Margosa tree” or “Indian lilac,” one of the most versatile medicinal plant having a wide spectrum of biological activity.

In this study, Neem showed potential to remove smear layer , this is according to the study bhargava et al : Neem ,*Triphala* and *Amla* all showed the potential to remove the smear layer ,where smear layer removing ability of *Amla* was found to be as good as EDTA.

However in this study, Neem showed lowest smear layer removal which might be because of least contact time of irrigant in the canal.

Use of Neem as an endodontic irrigant might be advantageous because it is a biocompatible antioxidant and thus not likely to cause the severe injuries to patients that occurs when NaOCl is used.<sup>10</sup> Bitter taste associated with this plant can be altered by different formulations due to addition of

sweeteners and flavors to increase the patient compliance.<sup>18</sup>

Recent study was done by Sebatni et al where Neem leaf extract exhibited significant smear layer removal when compared to those treated with Orange oil, Sodium hypochlorite, and Green tea extract. The highest amount of smear layer removal efficacy was seen in the canals treated by Neem leaf extract<sup>19</sup>.

### Conclusion

Herbal irrigants like *Triphala*, Neem, Turmeric may be encouraged and advocated in smear layer removal procedures due to their comparable efficacy to chemical irrigants and lesser side effects. Given the fact that the herbal irrigants used in the study showed the potential to remove smear layer this was comparable to chemical irrigants, incorporation of alternative herbal irrigants in routine root canal disinfection protocol could be considered. Further trends of study needs to investigate the effect of these herbal alternatives on root dentine.

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