



EFFICACY OF HERBAL EXTRACTS IN REMOVAL OF SMEAR LAYER: AN IN-VITRO STUDY

Dental Science

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ABSTRACT

Aim: The aim of this study was to evaluate the smear layer removal efficacy of herbal extracts namely neem leaf extract, tulsi leaf extract, green tea extract used as endodontic irrigants and to compare their relative efficacy using scanning electron microscope analysis. **Methods and Material:** The samples were divided into four groups having ten teeth each ($n=10$); the groups were divided accordingly, Group A: sodium hypochlorite (control), Group B: green tea extract, Group C: tulsi leaf extract, Group D: neem leaf extract. Each tooth was then split longitudinally and prepared for examination under scanning electron microscope. **Results:** The canals treated by neem and tulsi exhibited significant smear layer removal when compared to those treated with green tea extract and sodium hypochlorite. **Conclusion:** Highest smear layer removal efficacy was seen with neem extract in canals treated.

KEYWORDS

Herbal Extracts, Irrigants, Smear Layer.

INTRODUCTION

The aim of root canal treatment is complete removal of microbes and to seal the root canal system three dimensionally. During root canal chemo-mechanical debridement is the most acknowledged method to achieve complete disinfection. Mechanical preparation leaves root canal with amorphous layer termed as the "smear layer" that is embedded with debris and microorganisms.¹

Smear layer may interfere with the penetration of intracanal medicaments and sealers into the dentinal tubules. Elimination of smear layer from root canal walls is highly desirable to achieve long-term endodontic success. Chelating agent such as Ethylene-Diamine Tetra Acetic acid (EDTA) is effective for smear layer removal. The major drawback of EDTA is that it reacts with calcium ions in dentine, produces calcium chelation, it promotes dentine decalcification at depths of 20-30 μ m within 5 minutes. EDTA decreases the dentin microhardness and it increased with increased time of application.² The most commonly used irrigating solution is sodium hypochlorite, which is tissue dissolvent. It is very useful in removal of organic debris however it is not found to be effective in removal of smear layer from the tubules.³

Chlorhexidine is another commonly used antimicrobial agent which is being used to irrigate the canals due to its wide spectrum antimicrobial activity, biocompatibility and ability to disinfect the infected root canals. However it does not have tissue dissolving capabilities and also has some undesirable effects as it may discolour the teeth, may lead to dryness of the oral cavity and may even cause burning sensation of the mouth.⁴ Herbal or natural products have also become more popular today due to their high antimicrobial activity, biocompatibility, anti-inflammatory and anti-oxidant properties. A wide variety of herbal products have been used in the past in medicine.⁵ Hence the aim of this study was to evaluate the smear layer removal efficacy of various herbal extracts used as endodontic irrigants.

MATERIALS AND METHODS

Preparation of the herbal extracts

For the preparation of green tea extract, green tea powder was weighed (15 g), mixed with distilled water (150 ml), and boiled at 100°C to get 15 ml of green tea extract. For the preparation of tulsi leaf extract, tulsi leaf powder was weighed (15 g), mixed with distilled water (150 ml), and boiled at 100°C to get 15 ml of tulsi leaf extract. For the preparation of neem leaf extract, neem leaf powder was weighed (15 g), mixed with distilled water (150 ml), and boiled at 100°C to get 15 ml of neem leaf extract. The prepared solutions were filtered using Whatman filter paper, and the final irrigating solutions were obtained and stored in opaque bottles.

Specimen preparation

Forty ($n = 40$) intact single-rooted human permanent teeth ($n = 40$) having a single canal and fully developed apices, indicated for extraction due to orthodontic/periodontal reasons, were selected for

this study. The teeth were then cleaned using an ultrasonic scaler followed by sterilization with autoclave. The teeth were then stored in distilled water until use. The working length was measured radiographically to be 1 mm short of the apical foramen. The glide path was established using a size 15 K-file (Mani Inc., Japan). All the samples were then randomly divided into four groups with each group having ten samples. The root canals were then prepared up to apical size 25, 0.06 taper using Rotary Protaper nickel-titanium files (Dentsply Tulsa), at specific speed and torque by manufacturer's instructions using the crown down preparation method.

During the instrumentation, the canals were irrigated using 5 ml of the prepared solution corresponding to the respective group. In all the groups, the study specimens were finally rinsed with sterile distilled water and dried using sterile absorbent paper points (DiaDent Group International). The samples were then stored at humidity. Thereafter, the teeth were decoronated at the cemento-enamel junction using the diamond disc to obtain standardized root length of 10 mm [Figure 1a]. One longitudinal groove was placed on the buccal and lingual surfaces of each root using the diamond disc, avoiding penetration into the canal. The roots were then split into two halves using a chisel and mallet [Figure 1b] and were then coded as A1, A2, and A3 according to respective groups.



Figure 1:(a) Decoronation of specimens

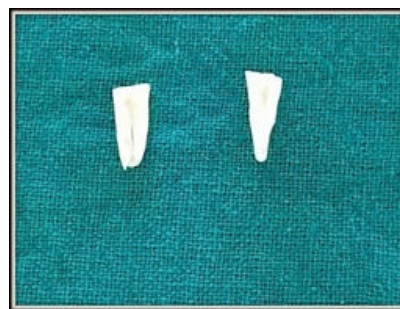


Figure 1:(b) Longitudinal sectioning

Scanning electron microscope evaluation

The coded specimens were then mounted onto metallic stubs with carbon strip backing and then subsequently viewed under the scanning electron microscope (SEM) [Figure 2 and 3]. After was then evaluated using the scoring system given by Rome *et al.* (1985) [Table 1].



Figure 2: Specimen ready for viewing under scanning electron microscope

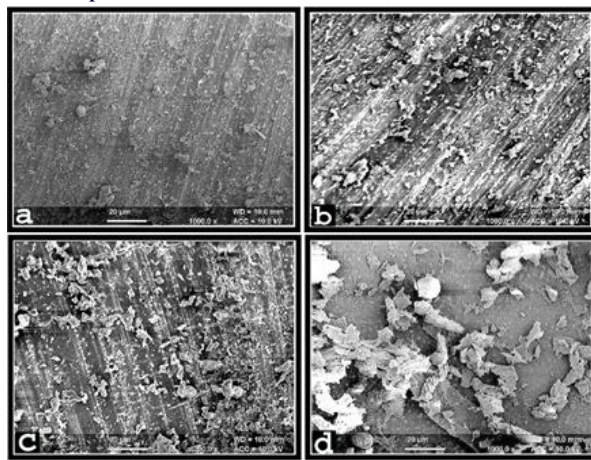


Figure 3: Scanning electron microscope images (x1000) depicting smear layer removal using (a) sodium hypochlorite (Group I), (b) green tea extract (Group II), (c) tulsi leaf extract (Group III), (d) neem leaf extract (Group IV) as irrigants

Statistical analysis

The collected data were subjected to one-way analysis of variance to compare the means of the groups. The Tukey's *post hoc* test was performed for the intergroup mean comparison between the groups. The data were considered to be statistically significant when $P < 0.05$.

RESULTS

The mean of the smear layer removal scores was calculated for all the four groups. On intergroup comparison, Group D showed the best outcome and exhibited statistically significant difference from other groups except Group C ($P < 0.005$) [Table 2]. There was statistically significant difference in smear layer removal efficacy among all the other groups [Table 3 and Figure 4].

Table 1: Smear layer removal scores (Rome *et al.* 1985)

Score	Interpretation
0	No smear layer
1	Smear layer present only in aperture of dentinal tubules
2	Thin smear layer covering the root canal surfaces and dentinal tubules apertures
3	Heavy smear layer masking dentinal tubule apertures

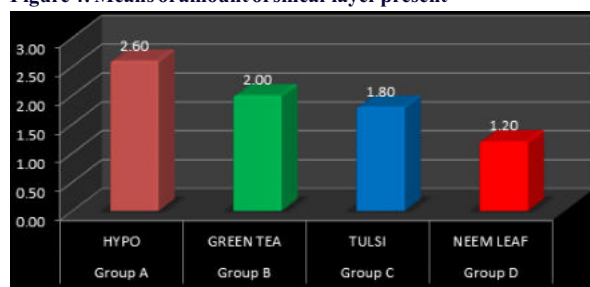
Table 2: Mean values of smear layer removal efficacy of the irrigants

Groups	Abbreviation	Mean	Std. Deviation	Order
Group A	HYPO	2.60	0.55	4th
Group B	GREEN TEA	2.00	0.71	3rd
Group C	TULSI	1.80	0.84	2nd
Group D	NEEM LEAF	1.20	0.45	1st

Table 3: Intergroup comparison of smear layer removal efficacy of the irrigants

HYPOa	GREEN TEAb	.60000	.485
	TULSIc	.80000	.251
	NEEM LEAFd	1.40000*	.017*
GREEN TEAb	HYPOa	-.60000	.485
	TULSIc	.20000	.961
	NEEM LEAFd	.80000	.251
TULSIc	HYPOa	-.80000	.251
	GREEN TEAb	-.20000	.961
	NEEM LEAFd	.60000	.485
NEEM LEAFd	HYPOa	-1.40000*	.017*
	GREEN TEAb	-.80000	.251
	TULSIc	-.60000	.485

Figure 4: Means of amount of smear layer present



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.⁶ Branches of neem are used as “chewing sticks” to keep the teeth and gum clean and healthy. Tulsi quoted as the “Queen of herbs” has been known for its remarkable healing properties.² Green tea extract has catechins (polyphenols) which has greater activity against a wide spectrum of microbes and also found to be a good chelating agent.¹ Because of the easy availability and known medicinal values of neem, tulsi and green tea, these three herbs were chosen for this study.

Scanning electron microscope which can detect accurate surface characteristics, was used to assess the effectiveness of various irrigants in the removal of smear layer.^{7,8}

In the present study, Group D (neem leaf extract) and Group C (tulsi leaf extract) exhibited the highest amount of smear layer removal efficacy due to presence of acid metabolites, flavanoids compared to all the other groups in the present study.⁹

Group B (green tea extract) was able to remove smear layer partially which might be due to absence of acid metabolites which is needed for the removal.¹⁰

Whereas Group A (sodium hypochlorite) has the ability to remove only the organic residues, hence results in lesser amount of smear layer.¹¹

CONCLUSION

Herbal alternatives are easy available, cost-effective, increased shelf-life, low toxicity, and lack of microbial resistance. The *in vitro* observations of herbal products appear promising, but preclinical and clinical trials are needed to evaluate the biocompatibility and safety factor before they can conclusively be recommended as intracanal irrigating solutions and medicaments. Hence, herbs can be used for treatment procedures that have been established to be effective and with minimal risk involved.

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