International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Efficacy of Chemical and Herbal Endodontic Irrigants in Smear Layer Removal from Root Dentin - A Comparative in-Vitro Sem Study

Sumapriya Sulgante[1], Ratnakar P[2], Veerendra Patil[3], Surabhi G Rairam[4]

[1]Postgraduate Student, Department of Conservative Dentistry and Endodontics, H.K.E. Society's S. Nijalingappa Institute of Dental Sciences and Research, Kalaburgi, Karnataka

[2]Professor and Head, Department of Conservative Dentistry and Endodontics, H.K.E. Society's S. Nijalingappa Institute of Dental Sciences and Research, Kalaburgi, Karnataka

[3]Reader, Department of Conservative Dentistry and Endodontics, H.K.E. Society's S. Nijalingappa Institute of Dental Sciences and Research, Kalaburgi, Karnataka

[4]Reader, Department of Conservative Dentistry and Endodontics, H.K.E. Society's S. Nijalingappa Institute of Dental Sciences and Research, Kalaburgi, Karnataka

Abstract: ***Aim: The study was conducted to compare efficacy of chemical v/s herbal endodontic irrigants on smear layer removal using Scanning electron microscope. Methodology: Extracted single rooted premolars (n=30) were decoronated, cut to uniform length of 15mm and were divided into 3 groups of 10 teeth each. Different irrigants were used for each group. 17% EDTA & 3%NaOCl for group 1, 10% Citric acid for group 2 and 0.25% Curcuma longa (Turmeric) for group 3. 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 citric acid and turmeric. 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: All three irrigants showed the potential to remove smear layer, however EDTA & NAOCL showed maximum efficacy. Turmeric, being a biocompatible agent, can be considered as a beneficial alternative to the routinely used chemical irrigants.***

Keywords: Smear layer, EDTA, NaOCl, Turmeric

1. Introduction

Complete elimination of microorganisms from the root canal system and the prevention of re- infection is the main aim of endodontic treatment. To achieve this objective, removal of smear layer accounts to one of the crucial steps in root canal treatment as its presence hinders root canal irrigants and the obturation material to flow into the dentinal tubules increasing the risk of micro leakage and bacterial re-infection.[1, 2]

Various methods employed to remove the smear layer include use of chemical or organic acids irrigants, ultrasonic and lasers,[2] of which irrigants have been used in present study. The ideal irrigant or combination of irrigants should kill bacteria, dissolve necrotic tissue, lubricate the canal, remove the smear layer and should not irritate healthy peri-apical tissues. [3]

Several studies have shown that chemical irrigants like NaOCl, EDTA and their combinations are highly effective in smear layer removal however they are associated with certain side effects[4]. Sodium hypochlorite is the gold standard root canal irrigant used in endodontic practice, but it is associated with certain drawbacks such as unpleasant taste, toxicity and cause hypochlorite accidents.[5, 6] To overcome these problems, the use of herbal root canal irrigants is gaining interest. [7]Thus in our study, we used herbal irrigant (turmeric) for smear layer removal and compared its efficacy with other chemical endodontic irrigants currently in use.

2. Methodology

The study was conducted in Department of Conservative Dentistry and Endodontics at H.K.E.S S. Nijalingappa Institute of Dental Sciences and Research, Kalaburgi during May 2017 to August 2017.

Thirty single rooted, single canalled, mature human premolar teeth with fully developed apices and curvatures between 0 to 10 degrees extracted for orthodontic and/or periodontal reasons were collected from the Department of Oral and Maxillofacial Surgery at H.K.E.S S. Nijalingappa Institute of Dental Sciences and Research, Kalaburgi. Those with caries or root cracks, previous endodontic treatment, posts, core or crowns, open apex, calcified canals, complex canal anatomy, dilacerations and severe root curvatures were excluded.

Teeth were cleaned of deposits using an ultrasonic cleaner and stored in physiological saline. Teeth were decoronated at CEJ to standard root length 15mm. The working length was established by deducting 1mm from lengths recorded when the tips of #10 k file was visible at the apical foramina. The

root canals were initially prepared using 2% hand files (upto #20k file) followed by ProTaper rotary files system. All the canals were prepared till ProTaper F2 file size. After the use of each instrument, the canal was flooded with 1ml irrigant of the respective group.

Group 1 specimens were irrigated with 17%EDTA & 3%NaOCl, Group 2 specimens with 10% Citric acid and Group 3 specimens with Turmeric. After instrumentation completed, the canal was irrigated with 2ml of respective irrigant for 2 minutes for the removal of smear layer. The irrigating solution was delivered via syringe and needle. Ultrasonic system was used for activating the irrigating solution. The canal was irrigated with 2ml of saline and dried with paper points.

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 of the total canal length were selected and coded. The coded specimens were secured on metal stubs, desiccated, sputter coated with 35nm of gold and examined using a Scanning electron microscope (SEM).

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

Smear layer removal was expressed as median and Interquartile range (IQR). Data was not normally distributed as tested using the Shaperio-Wilk W test (p-value <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 pair wise comparison. Level of statistical significance was less than 0.05.

3. Results

NaOCl+EDTA showed the best smear layer removing ability compared to citric acid and turmeric at all the three levels. However, the difference found in smear layer removal by three irrigants is only significant in coronal region and not in middle and apical region (Table 1).

At apical third, all the irrigating solutions showed least smear layer removing ability. In middle third, turmeric was least effective, while EDTA + NaOCl and 10% citric acid showed better and comparable smear layer removing ability. The efficacy of removing smear layer at coronal third using turmeric was found to be better than 10% citric acid, however it was not statistically significant. While EDTA + NaOCl showed significant smear removal ability at coronal third compared to other two irrigants (Table 2).

Table 1: Smear layer removal by different irrigating solutions at coronal, middle and apical levels

Irrigating solutions	Coronal Median (IQR)	Middle Median (IQR)	Apical Median (IQR)
17%EDTA & 3%NAOCL	1 (0)	1(3)	3 (1)
10% Citric acid	2(1)	1(3)	3 (1)
Turmeric	1.50 (2)	2.50(2)	3 (0)
p^a Value	0.004 S	0.054 NS	0.283 NS

p^a- p value for Kruskal wallis test; S -significant p<0.05; NS – Not significant

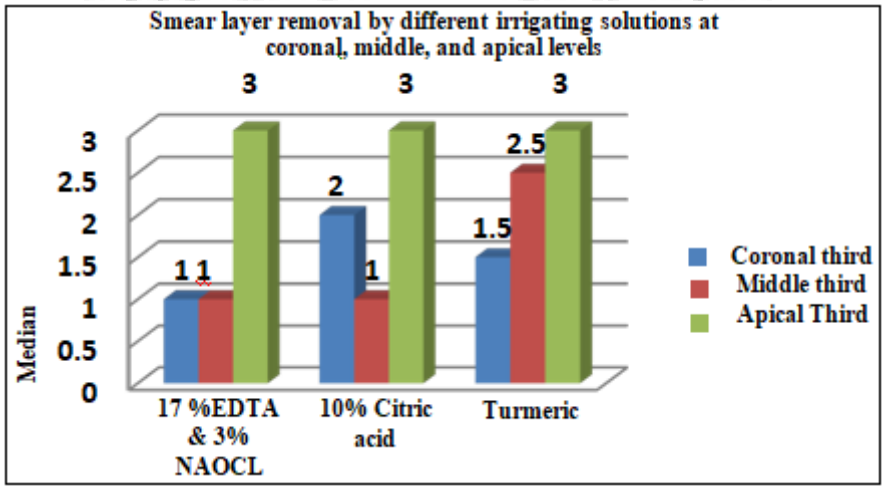

Figure 1: Smear layer removal by different irrigating solutions at coronal, middle, and apical levels

Table 2: Inter group comparison of smear layer removal at coronal, middle and apical third by different irrigants

Levels	Inter group comparision between smear layer removal score by different chemical irrigants	Mann Whitney U	P^b value
Coronal	17%EDTA, 3%NAOCL v/s 10% Citric acid	12.00	0.003 S
	17%EDTA, 3%NAOCL v/s Turmeric	20.00	0.023 S
	10% Citric acid v/s Turmeric	49.5	0.971 NS
Middle	17%EDTA, 3%NAOCL v/s 10% Citric acid	24.00	0.052 NS
	17%EDTA, 3%NAOCL v/s Turmeric	34.50	0.247 NS
	10% Citric acid v/s Turmeric	32.00	0.197 NS
Apical	17%EDTA, 3%NAOCL v/s 10% Citric acid	40.00	0.487 NS
	17%EDTA, 3%NAOCL v/s Turmeric	35.00	0.280 NS
	10% Citric acid v/s Turmeric	45.00	0.739 NS

P^b- p value for Mann whitney U test; S -significant p<0.05; NS – Not significant

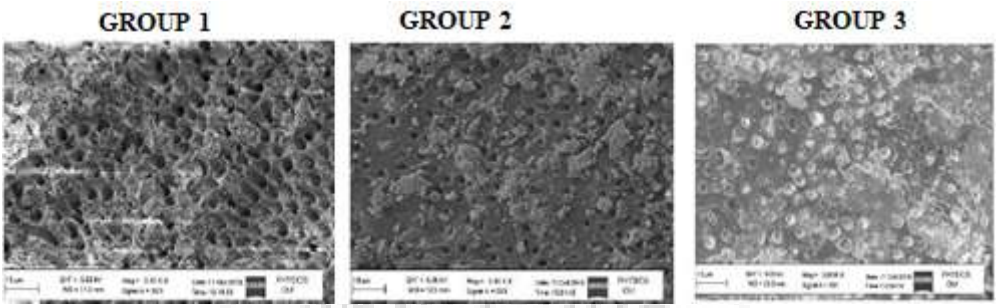

Figure 1: (a) SEM image of group 1, 2 and 3 at coronal third after irrigation

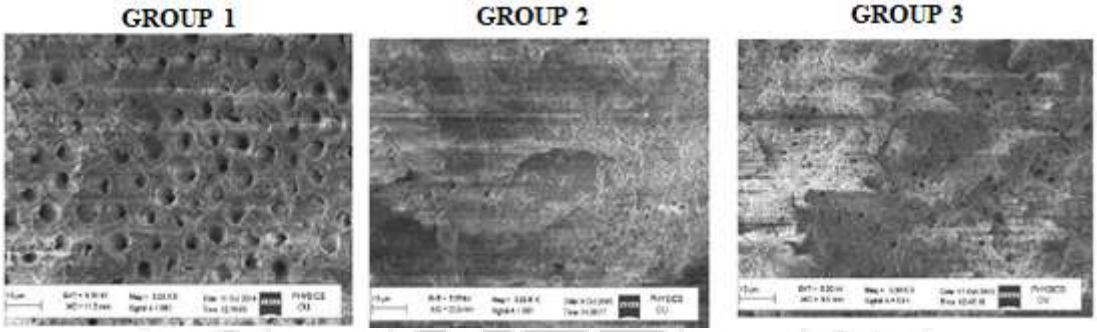

Figure 1: (b) SEM image of group 1, 2 and 3 at middle third after irrigation

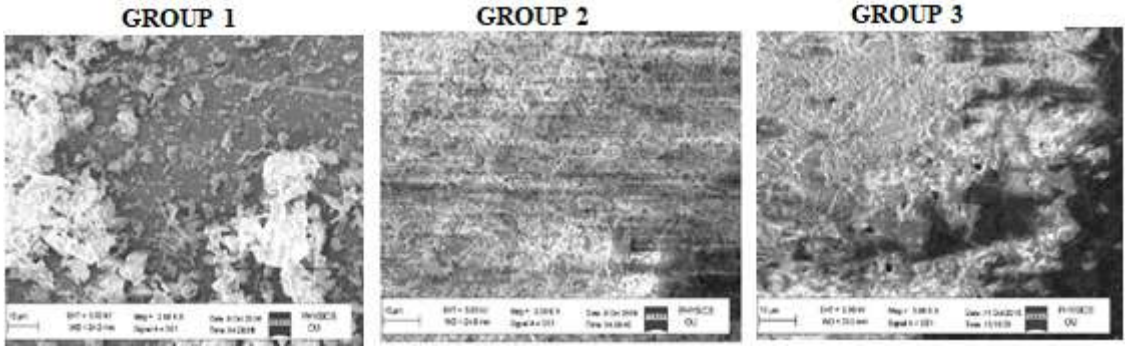

Figure 1: (c) SEM image of group 1, 2 and 3 at apical third after irrigation

4. Discussion

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.[8]

Although research is on the rise in this field, very few studies are done to evaluate the efficacy of herbal irrigants on the removal of endodontic smear layer. Many antimicrobial studies are done, but to our best knowledge not even a single study is done on removal of smear layer using curcuma longa. Smear layer must be removed as it has an unpredictable thickness and volume. It contains bacteria, their by-products and necrotic tissue. Bacteria may survive and multiply and can proliferate into the dentinal tubules, which may serve as a reservoir of microbial irritants. It may act as a substrate for bacteria, allowing their deeper penetration in the dentinal tubules. It may limit the optimum penetration of disinfecting agents. Bacteria may be found deep within dentinal tubules and smear layer may block the effect of disinfectants. It can act as a barrier between filling materials and the canal wall and therefore compromise the formation of a satisfactory seal. It is a loosely adherent structure and a potential avenue for leakage and bacterial Contamination.[9]

Hence it was proposed to carry out the study to compare efficacy of 17% EDTA and 3% Sodium hypochlorite, 10% citric acid with Turmeric. In the present study, best significant efficacy in removing smear layer was noticed with EDTA and NaOCl followed by citric acid and turmeric at coronal third. At middle and apical third no significant difference was observed in appreciating the efficacy of different irrigating solutions (Table 1). Turmeric is found to be least efficacious when compared with other irrigating solutions used in the present study.

Turmeric has a wide spectrum of biological actions such as anti-inflammatory, antioxidant, antifungal and antibacterial activities. [10] According to a study by N Niamsa, turmeric has shown weak antimicrobial efficacy against E. faecalis. But the aqueous extract of Curcuma longa (turmeric) showed good inhibitory activity against Candida Albicans. [11]In present study as well turmeric showed diffused but satisfactory antimicrobial activity against E. faecalis.

Paque et al. reported that dentin in the apical third of the root canal is sclerosed, hence irrigating solutions may not have such a pronounced action on sclerosed dentin in apical third. [12] This could be the reason for inability of irrigating solutions to remove smear layer effectively at apical region as seen even in our study. Prasanna et al. conducted an in vitro study to evaluate the antimicrobial efficacy of curcumin (turmeric) against E. faecalis considering sodium hypochlorite (3%) as reference for comparison. The result of his study revealed that turmeric had significant antibacterial activity against E. faecalis[13].

Vahdaty et al. concluded that the antibacterial activity of curcumin was similar to sodium hypochlorite and thus herbal medicine can be used in endodontics for root canal failure[14]. However our study did not find similar effect of turmeric.

The present study was performed in vitro conditions, so the results of the present study do not allow any certain actions of the tested substances in situ. Blood at operating site, tissue remnants, and many other variables may affect the actions of different irrigating solutions in the root canal system. Morphologically curved canals are comparatively more challenging while cleaning to remove debris during root canal preparation. Deeper penetration of the needle is easy in the single-rooted premolar tooth because of morphologically wider canals; therefore, efficacy of various irrigant solutions may vary in posterior teeth with narrow canals. Nevertheless, further long-term clinical studies are necessary to confirm these results and evaluate their relevance to treatment outcome. The limitation of our study was that selection of larger sample of tooth extracts for evaluating efficacy would have given better conclusive results.

5. Conclusion

Sodium hypochlorite is so far the best irrigating solution in removing smear layer but because of its proven side-effect its use is limiting in dentistry. Thus within the limitations of this study it can be suggested that Turmeric is also effective in reducing smear layer and is a potential root canal irrigant and can be used in combinations with other irrigating solutions to remove smear layer effectively.

References

[1] Lui JN, Kuah HG, Chen NN, Effect of EDTA with and without surfactants or ultrasonics on removal of smear layer. J Endod. 2007 Apr;33(4):472-5.
[2] L.F.Machado-Silveiro, S.Gonzalez-Lopez and M.P.Gonzalez-Rodriguez Decalcification of root canal dentine by citric acid, EDTA and sodium citrate. IEJ:2004;365-9.
[3] Torabinejad M,Handysiced R , Khademi AA, Bakland LK. Clinical implications of smear layer in endodontics; a review.oral surg oral med oral pathol oral Radiol Endod 2002; 94:658-66.
[4] Siqueira JF Jr, Rocas IN, Faveria A , Lima KC. Chemicomechanical reduction of the bacterial population in the root canal after instrumentation and irrigation with sodium hypochlorite. J Endod 2002;26:331-34.
[5] Xiangjun Guo ,Hui Miao,Lei Li,Shasha Zhang ,Dongyan Zhou,Yan Lu and Liegeng Wu. Efficacy of four different irrigation techniques combined with 600 C 3% sodium hypochlorite and 17% EDTA in smear layer removal.BMC Oral Health 2014;114:14.
[6] Spanberg L, Engstrom B, Langland K. Biologic effects of endodontic antiseptics invitro . Oral Surg Oral Med Oral pathol Oral Radiol Endod 1073;36:856-71.
[7] Kamat S,Rajeev K,Saraf P.Role of Herbs in Endodontics:an update.Endodontology 2011;23(1):96-100.
[8] Yamada RS, Armas A, Goldman M. Lin P. A Scanning Electron Microscopic Comparison of a High Volume Final Flush with Several Irrigating Solutions: Part 3. J Endod 1983: 9: 137-142.
[9] D. R. Violich & N. P. Chandler.. The smear layer in endodontics – a review. IEJ .2010; 43: 2–15.
[10] Amalraj A, Pius A, Gopi S, Gopi S: Biological activities of curcuminoids, other biomolecules from turmeric and their derivatives: A review. J Trad Comp Med 2017;7:205–233.
[11] Niamsa N, Sittiwet C. Antimicrobial activity of curcuma longa aqueous extract. Journal of Pharmacology and Toxicology. 2009;4(4):173–77.
[12] Paque F, Luder HU, Sener B, Zehnder M. Tubular sclerosis rather than the smear layer impedes dye penetration into the dentin of endodontically instrumented root canals. Int Endod J 2006;39:18-25.
[13] Neelakantan P, Subbarao C, Subbarao CV. Analysis of antibacterial activity of curcumin against Enterococcus faecalis. International Journal of Current Research and Review. 2011;3(9):37–41.
[14] Vahdaty A, Pitt Ford TR, Wilson RF. Efficacy of chlorhexidine in disinfecting dentinal tubules in vitro. Endodontics and Dental Traumatology .1993;9:243–8.