EVALUATION OF EFFECT OF ALLIUM SATIVUM ON SMEAR LAYER REMOVAL IN ROOT CANALS – AN EX VIVO STUDY

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ABSTRACT:
Background: Allium sativum was known to possess antibacterial activity because of the presence of allic acid in its bulbs. **Aim**: To compare and evaluate the smear layer removal capacity of 3% NaOCl, 2% Allium sativum, 17% EDTA and saline. **Methodology:** Forty one extracted teeth were collected and the root canals were instrumented with protaper till F3 size. During root canal preparation, irrigations were made with the different solutions being evaluated and the roots were cut in the buccolingual direction for SEM analysis, to ascertain the presence or absence of smear layer and debris. **Statistical analysis**: Pearson's chi-square test and fisher exact test were used. Results**:** In the coronal and middle thirds, Group I produced a synergistic effect, resulting in effective removal of the entire smear layer. Group II has good smear layer removal also. **Conclusion:** Allium sativum does have an effect on the removal of smear layer when used as endodontic irrigant.

KEYWORDS: Allium sativum; EDTA; Root canal irrigants; Smear layer; Sodium hypochlorite.

INTRODUCTION

One of the objectives of root canal treatment is debridement through instrumentation. Root canal instrumentation produces a smear layer that covers the surfaces of prepared canal walls. Smear layer contains infected debris that has to be removed for success of the treatment. Garlic with a pH of 4-6 is thought to have a capacity to remove the inorganic tissue and the presence of allic acid presents it with a good antibacterial capacity also[1]. Therefore the aim of the study was to evaluate the smear layer removing capacity of garlic as an alternative to the routinely used agents with their inherent disadvantages.

Methodology

Forty one extracted human teeth (**Fig.1**) were taken and externally cleaned. Decoronation was done till the CEJ(**Fig.2 and Fig.3**) and a radiograph was taken for the roots in the proximal view with the help of digital chest film (F**ig. 4)** to determine the existence of single canal. The roots were divided into 4 experimental groups of 10 roots each and one root as control group before root canal instrumentation.

Experimental groups were as follows:

- **Group I** - 1ml of 17% EDTA + 3ml of 3% NaOCl.
- **Group II** - 1ml of 2% Allium sativum + 3ml of saline.
- **Group III** - 1ml of 17% EDTA + 3ml of 2% Allium sativum.
- **Group IV** - 1ml of 2% Allium sativum + 3ml of 3% NaOCl.
- **Group V** – control group, saline irrigation.

Working lengths were established 0.5 mm short of the anatomical apex by visually identifying a no.10 file at the apical foramen. The roots were instrumented using protaper, up to F3 size. The above mentioned irrigation regimen was used in the respective groups in between instrumentation. After irrigation with the following regimen, 5ml of distilled water was used to wash out any precipitates or after effects of the chelating reaction. After the final irrigation, the root canals were dried with the paper points. After drying two sulci were made along the external surface of the teeth in the bucco-lingual direction of the roots (**Fig.5 and Fig.6**). Using a osteotome and mallet the roots were split into two halves to expose the root canal (**Fig.7 and Fig.8**). The roots were mounted on metallic studs, put in a vacuum chamber, sputter coated with gold of 20-25 nm thickness with a sputter coater to make it conductive. These specimens were loaded on to the SEM chamber for SEM evaluation(**Fig.9**).

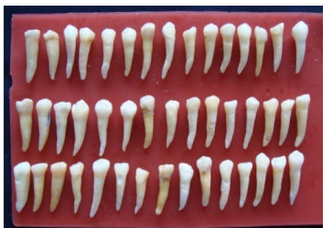


Fig.1. Extracted single rooted premolars

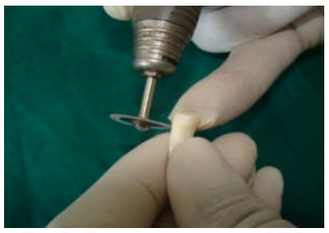


Fig.2. Tooth cut till the CEJ

Fig.3. Extracted teeth cut till the CEJ

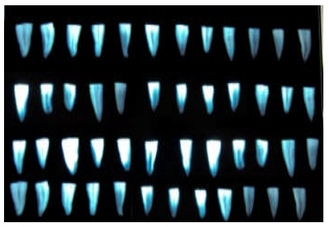


Fig.4. Radiograph of the extracted teeth after being cut till the CEJ

Fig.5. Sulci made on the external surface of the root after instrumentation and irrigation

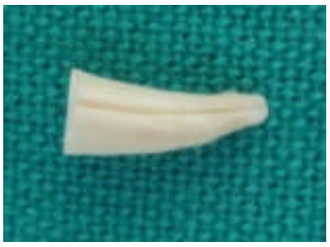


Fig.6. Sulcus seen on the surface of the root

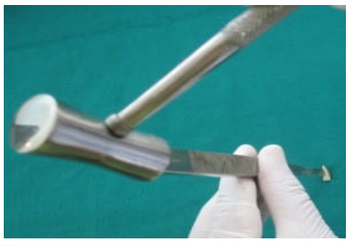


Fig.7. Tooth split with the chisel and mallet by placing the chisel in the sulcus

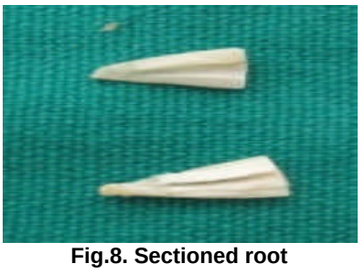


Fig.8. Sectioned root

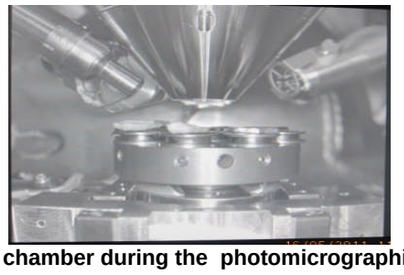


Fig.9. SEM chamber during the photomicrographic analysis.

Results

The coronal, middle and apical thirds of the root canal were evaluated at 1000x magnification. Standard photomicrographs representing each root third for each sample were taken for topographic evaluation of the root canal walls.

The amount of smear layer was graded as follows:

- **1** = No smear layer; no smear layer was detected on the surface of the root canal and all the tubules were clean and open.
- **2** = Moderate smear layer; no smear layer was seen on the surface of the root canal but the dentinal tubules contain debris.
- **3** = Heavy smear layer; smear layer covered the root canal surface and the tubules.

A total of 123 photomicrographs were taken from the coronal, middle and apical thirds of the root canals. SEM photomicrographic analysis was performed and scores were assigned and the scores were statistically evaluated using pearson's chi-square test and fisher exact test.

Group I Instrumentation of a root canal with 1ml of 17% EDTA as root canal irrigant and treatment with 3 ml of 3% NaOCl as a final rinse in the (a) coronal (b) middle and (c) apical portions of the root canal where coronal portion shows no smear layer (score 1), middle layer shows moderate smear layer (score 2) and apical portion shows heavy smear layer (score 3) (**Fig.10 A,B,C)**

Group II Instrumentation of a root canal with 1ml of 2% Allium sativum as root canal irrigant and treatment with 3 ml of saline as a final rinse in the (a) coronal, (b) middle and (c) apical portions of the root canal where coronal portion shows no smear layer (score 1), middle layer shows moderate smear layer (score 2) and apical portion shows heavy smear layer (score 3)(**Fig.11 A,B,C**)

Group III Instrumentation of a root canal with 1ml of 17% EDTA as root canal irrigant and treatment with 3 mL of 2% Allium sativum as a final rinse in the (a) coronal (b) middle and (c) apical portions of the root canal, where coronal portion shows moderate smear layer (score 2), middle layer shows heavy smear layer (score 3) and apical portion shows heavy smear layer (score 3) **(Fig.12 A,B,C)**

Group IV Instrumentation of a root canal with 1ml of 2% Allium sativum as root canal irrigant and treatment with 3 ml of 3% NaOCl as a final rinse in the (a) coronal, (b) middle and (c) apical portions of the root canal, where coronal portion shows moderate smear layer (score 2), middle layer shows moderate smear layer (score 2) and apical portion shows heavy smear layer (score 3)(**Fig.13 A,B,C)**

Discussion

Smear layer consists of both the infected organic and inorganic components and its removal is facilitated by the agents like sodium hypochlorite which dissolves the organic debris and inactivates the microorganisms by its antibacterial action and EDTA which dissolves the inorganic material of the tooth by forming the chelate,[1] which has to be washed out with saline. EDTA with a pH of 4-6 has a capacity to chelate the calcium of the tooth and NaOCl with a pH of 10 -10.5 has a capacity to dissolve the organic material. The pH of the medication plays a major concern on the inhibitory growth of the bacteria, and also the demineralizing effect on the tooth structure. The lower the pH (more acidic), higher the bacterial inhibitory effect and the more demineralizing effect on tooth structure [2].

Allium is a household antibacterial agent. There is a saying in Telugu literature *'Garlic does to your body of what a mother also cannot do'.* Since ages it was known for its various actions like anticholesterol, antidiabetic, antiseptic, antimicrobial, antifungal, antiviral activity[1,3]. In a study done to know the antibacterial efficacy of various plant products like allium, black plum, olive oil against the routinely used intracanal medicament, calcium hydroxide[4]. The study showed that garlic has greater antibacterial activity (against Staphylococcus, distilled water + Allium = 21.8mm, against Klebsiella, distilled water + Allium = 15.6 mm, against Pseudomonas, distilled water + Allium = 20.4 mm on the commonly found endodontic pathogens compared to the calcium hydroxide.

A bulb of garlic, (Allium sativum) has from four to sixteen or more cloves, depending on variety. In each of these cloves are cells containing the main compound of garlic, an amino acid called alliin. In separate cells an enzyme called alliinase resides. Whenever the cellular walls separating them are damaged, some of the enzyme comes into contact with the amino acid and this sets off a chemical reaction that causes sulfenic acid to form instantly. But sulfenic acid is unstable and reacts with itself and breaks down at a steady rate into another unstable compound called allicin, which has a strong antibiotic property. Allicin is the "magic bullet" in garlic from which its many benefits are derived but being unstable, it reacts with many things and breaks down into other compounds. Because garlic forms the active compound, allicin, steadily and in regular spurts rather than all at once it is better to let it set for a 15 minutes to an hour before using it in order to build up a greater amount of allicin. Allicin has a half-life in air of about 18 hours as it slowly deteriorates into other smelly, sulfurous things. Adding allicin to water somewhat stabilizes it and preserves its antibiotic properties and extends its half life to about two months.

Allicin from crushed raw garlic is a very strong antibiotic that kills MRSA staph on contact and staph cannot become immune to it because it kills bacteria by

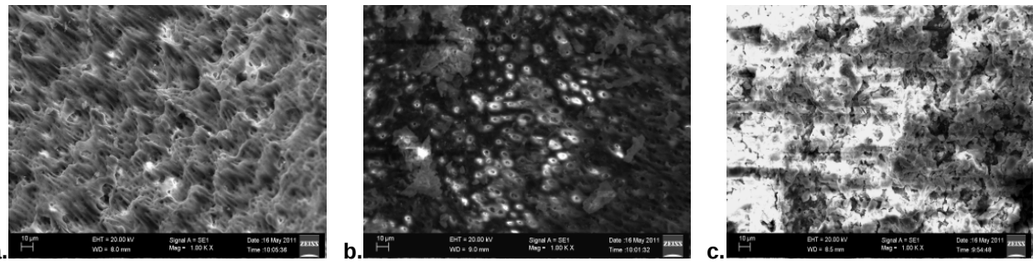


Fig.10 a,b,c : (a) coronal (b) middle and (c) apical portions of the root canal where coronal portion shows no smear layer (score 1), middle layer shows moderate smear layer (score 2) and apical portion shows heavy smear layer (score 3)

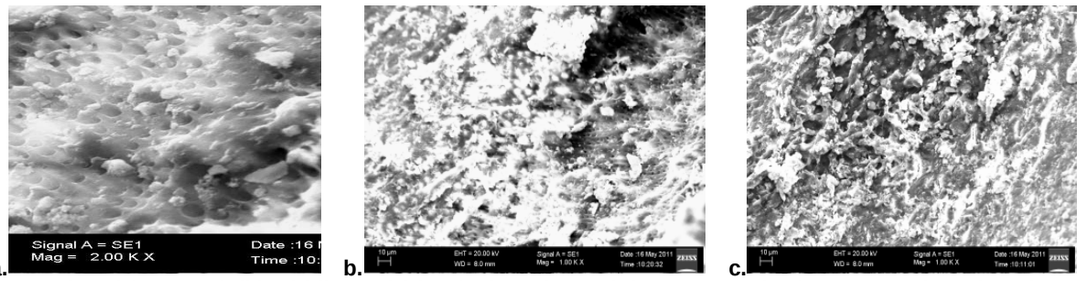


Fig.11 a,b,c; (a) coronal, (b) middle and (c) apical portions of the root canal where coronal portion shows no smear layer (score 1), middle layer shows moderate smear layer (score 2) and apical portion shows heavy smear layer (score 3)

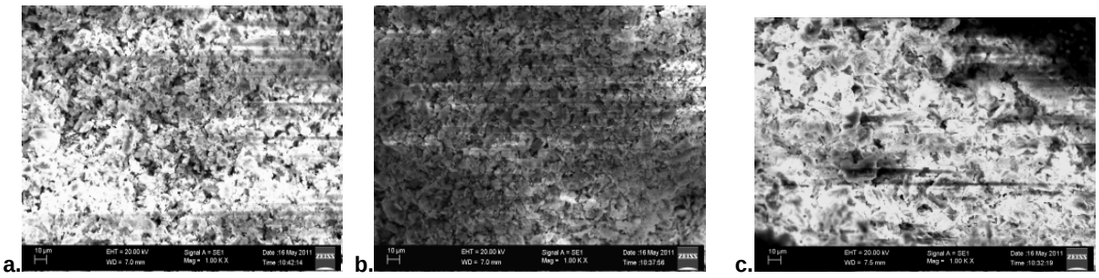


Fig.12 a,b,c : (a) coronal (b) middle and (c) apical portions of the root canal, where coronal portion shows moderate smear layer (score 2), middle layer shows heavy smear layer (score 3) and apical portion shows heavy smear layer (score 3)

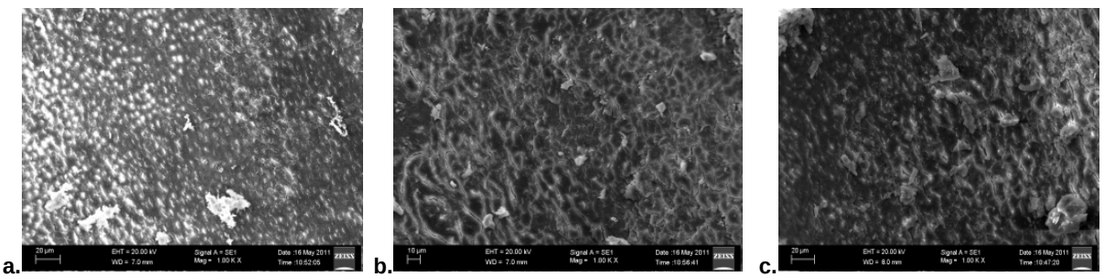
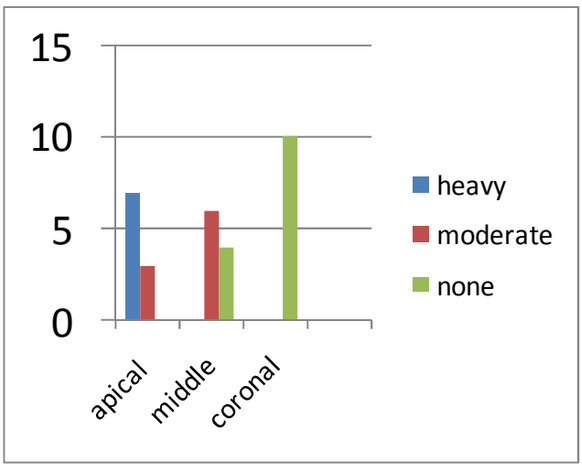
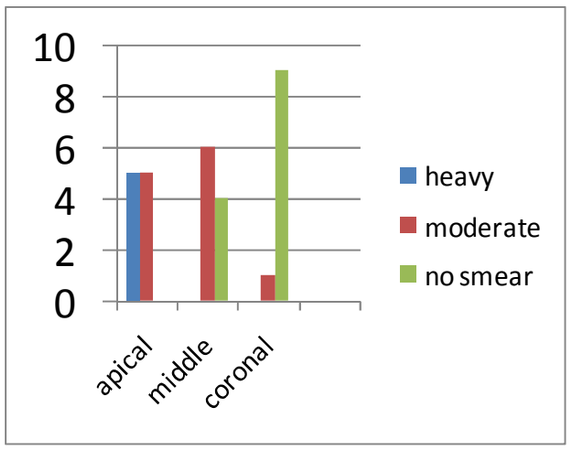


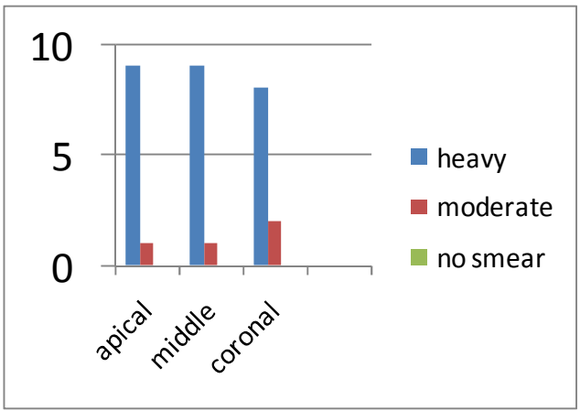
Fig.13 a,b,c: (a) coronal, (b) middle and (c) apical portions of the root canal, where coronal portion shows moderate smear layer (score 2), middle layer shows moderate smear layer(score 2) and apical portion shows heavy smear layer(score 3)



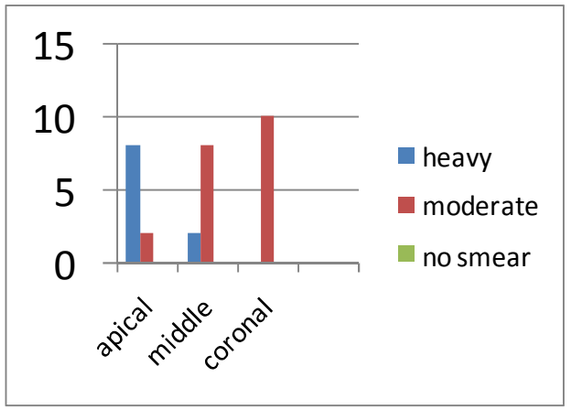
Graph.1.Depicting the amount of smear layer in the apical, middle and coronal portions for the 10 specimens tested with Group I (EDTA + NaOCl)



Graph.2. Depicting the amount of smear layer in the apical, middle and coronal portions for the 10 specimens tested with Group II (Allium + saline)



Graph.3. Depicting the amount of smear layer in the apical, middle and coronal portions for the 10 specimens tested with Group III (EDTA + Allium)



Graph.4 depicting the amount of smear layer in the apical, middle and coronal portions for the 10 specimens tested with Group IV (Allium + NaOCl)

causing their cells to swell and burst rather than blocking chemical receptors like pharmaceutical antibiotics do. One study (Walton, Herbold and Lendegren 1936-1938 - Journal of Food Science) even showed that the vapors alone from nearby crushed raw garlic could kill bacteria up to eight inches away in four hours [4].

In coronal and middle thirds, first group has good smear layer removing capability (**Fig.10 A,B and Graph 1**) and its P value being significant when compared to the second group. Group I has a good smear layer removal capacity because EDTA reacts with calcium ions of dentin and forms soluble calcium chelates. EDTA removed the inorganic portion and left an organic layer intact in the tubules.[5] Organic material inhibits the action of EDTA when used on its own, but when combined with sodium hypochlorite, the quantity of inorganic material becomes the limiting factor. The combination of sodium hypochlorite and EDTA produces a synergistic effect, resulting in effective removal of the entire smear layer[6]. Group I has a better smear layer removing capability and its P value

being significant when compared to Group IV. Group II has better smear layer removal in the coronal and middle thirds,(**Fig.11 A,B and Graph.2**) mostly because the chelates formed by the interaction of Allium with the root calcium was washed out by irrigation with saline and so a better smear layer removal than the Group IV(Allium +NaOCl). Group IV has the least smear layer removing capability and its P value being significant when compared to the Group III. Group IV has least smear layer removal in the coronal and middle third, **(Fig.13 A,B and Graph.4)** probably because the chelates formed by the interaction with the tooth substance is not removed completely and a thin layer over the tubules hampering the diffusion of NaOCl and thereby its action is hampered. Group III has no smear layer removal capability. **(Fig 12 A,B and Graph.3)** Because of the precipitated debris over the

surface of the root canal walls, probably because of the interaction of the Allium and EDTA to form a chelate which has to be clarified by further investigations.

In apical thirds, there is no smear layer removal for all the four groups tested and P value not significant among all the four groups in the apical third**.(Fig.10C, Fig.11C, Fig.12C, Fig.13C and Graphs.1,2,3,4).** Ineffective cleaning action in the apical third which will not expose the dentin to a higher volume of the irrigant which thereby decreases the smear layer removing efficiency.[7]

CONCLUSION

Allium sativum has a smear layer removal capacity but it is less at the tested concentration when compared to the EDTA and sodium hypochlorite group which is a routinely used and widely accepted. How the garlic solution interacts with the tooth structure to remove the smear layer, which is the kinetics of allium with the tooth structure are to be investigated further.

References

1. Marjorie Murphy Cowan**:** Plant Products as Antimicrobial Agents, Clinical Microbiology Reviews, 1999; 12: 4: 564 - 582.
2. Ingle's Endodontics, BC Decker Inc, Hamilton, 2008; pg no. 997 – 1001.
3. Gurgan S, Bolay S, Alacam R: Antibacterial activity of 10% carbamide peroxide bleaching agents. J Endodon 1996; 22:356. http://dx.doi.org/10.1016/S0099-2399(96)80217-2
4. Garlic Oils, Pills and Extracts, www.gourmetgarlicgardens. com/pill.htm Jump to Basic Health Benefits: A Basic Look at How Garlic Works. The physiological effects of eating garlic studies by competent multi-degreed
5. Hulsmann M, Heckendorff M, Lennon A: Chelating agents in root canal treatment: mode of action and indications for their use. Int.endo.journal 2003; 36: 810 - 830.
6. Haapasalo Markus, Irrigation in Endodontics; Dent Clin N Am 2010; 54: 291–312. http://dx.doi.org/10.1016/j.cden.2009.12.001
7. Takeda FH, Harashima T, Kimura Y, Matsumoto K. A comparative study of the removal of smear layer by three endodontic irrigants and two types of laser. Int Endod J 1999; 32:32 - 9. http://dx.doi.org/10.1046/j.1365-2591.1999.00182.x

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