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A comparative study on smear layer removal with three different herbal irrigants and fracture resistance of endodontically treated teeth

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Abstract

Background: This study aimed to compare the effect of chemical and herbal irrigant on smear layer removal by using scanning electron microscopy and fracture resistance of tooth using Universal testing machine.

Objectives: To evaluate the efficiency of chemical and different herbal irrigant on smear layer removal and to compare the effect of NaOCl, Neem extract, Greentea extract and Turmeric as irrigants on the fracture resistance of root-filled teeth.

Methods: 120 single rooted mandibular 1st premolar teeth, after decoronation and establishing the working length were biomechanically prepared and randomly divided into four groups based on the irrigantion protocol used. The groups are Group I: 5% Sodium Hypochlorite (Control) (N=30), Group II: 10% Neem Extract (N=30) ,Group-III: 10% Turmeric Extract (N=30) ,Group IV: 5% Green Tea (N=30) . In all the group final irrigation with 1 ml of 17% EDTA for 1 min will be done. The samples were prepared up to file size F3 using ProTaper Universal rotary instruments. 15 Samples from each group is taken and were cut longitudinally into equal two halves, is taken for SEM evaluation. The results were subjected to Kruskal Wallis

test followed by Mann Whitney Post hoc analysis to compare the mean smear layer removal scores between different irrigants. Other half 15 samples from each group is taken and obturated with Pro Taper F3 guttapercha and AH Plus sealer using a single-cone technique were attached to the lower plate of a universal testing machine to measure the fracture resistance in Newtons(N). One-way ANOVA test followed by Tukey's Post hoc analysis was used to compare the mean Fracture Resistance (in N) between 04 groups.

Results: The test results for smear layer showed that NaOCl group showed significantly lesser Smear Layer Removal Scores followed by Neem group followed Green Tea and Turmeric groups. However, no significant differences in the mean Smear Layer Removal Scores were noted between NaOCl and Neem group and also between Green Tea & Turmeric group. For fracture resistance test results showed that NaOCl group showed significantly higher Fracture Resistance followed next by Neem group. This in turn, followed by next with Green Tea showing significantly higher mean fracture resistance as compared to Turmeric group. However, no significant differences in the mean Fracture Resistance value were noted between NaOCl and Neem group.

Conclusion: Within the limitations of this study, it could be concluded that 5% NaOCl and 10% Neem can equally remove smear layer thereby allowing penetration of sealer inside dentinal tubules and sealing the crack, which increase the bond strength between sealer and dentinal surface and ultimately the fracture resistance of tooth.

Keywords: AH Plus, Fracture Resistance, Green tea, NaOCl, Neem, Smear Layer, Turmeric

Introduction

Bacteria have long been recognized as the primary etiological factor in the development of pulp and periapical lesions. Successful root canal therapy depends on thorough debridement of pulpal tissue, dentin debris, and infective microorganisms. Currently, it is impossible to eradicate intraradicular infection with mechanical instrumentation alone. Therefore, irrigants are required to complete this task.[1]

Endodontic infections are characterized by being polymicrobial with the domination of obligate anaerobic bacteria.[2] . The micro-organisms in the oral cavity are most often opportunistic pathogens. They have the ability to invade and establish an infectious process. Longer the duration of root canal infection, greater the number of facultative anaerobes. Biofilm around the bacteria helps in resisting the destruction by making them a thousand times more resistant to phagocytosis, antibodies and antimicrobial agents. Biofilms also participate in gene exchange via horizontal gene transfer leading to spread of antibiotic resistance genes between different clinically relevant species, thus the micro-organisms have the ability to survive chemomechanical preparation.[3]

The most important step in an endodontic treatment is to eliminate the micro-organism from the root canal system, which can be done by using the appropriate instruments and effective irrigants during the root canal treatment. However, due to the extremely complex anatomy of the root canal pulp space, these methods are not successful if employed alone. Therefore, ideal endodontic irrigants must have additional properties, such as the ability to dissolve organic and inorganic tissues, antibacterial effects, and biocompatibility with the tissues.[4]

McComb& Smith (1975) were the initial investigators to show the presence of a smear layer in instrumented root canals. The smear layer is an amorphous structure composed of inorganic and organic substances. The presence of this smear layer prevents penetration of intracanal medication into the irregularities of the root canal system and the dentinal tubules and also prevents complete adaptation of obturation materials to the prepared root canal surfaces.[5]

Therefore, endodontic treatment should not be limited to the removal of pulp remnants and the widening of root canals, but should also focus on smear layer removal. [6]

A large number of substances have been used as root canal irrigants, including acids (citric and phosphoric), chelating agent (ethylene diaminetetraacetic acid EDTA), proteolytic enzymes, alkaline solutions (sodium hypochlorite, sodium hydroxide, urea, and potassium hydroxide), oxidative agents (hydrogen peroxide and Gly-Oxide), local anesthetic solutions, and normal saline. The most widely used endodontic irrigant is 0.5% to 6.0% sodium hypochlorite (NaOCl), because of its bactericidal activity and ability to dissolve vital and necrotic organic tissue. However, NaOCl solutions exert no effects on inorganic components of smear layer. Chelant and acid solutions have been recommended for removing the smear layer from instrumented root canals, including ethylene diaminetetraacetic acid (EDTA), citric acid, and phosphoric acid.[7]

The above mentioned irrigants, though effective against the pathogens, have undesirable properties. For example, NaOCl is toxic to the periradicular tissues, causes a reduction in dentin strength due to its proteolytic effect, has allergic potential and has an unacceptable taste and odour. CHX can cause staining of the tooth and forms precipitates with NaOCl.[8]

Recently, several in vitro studies have shown that contemporary chemical agents [both proteolytic and acidic] have other disadvantages like that there is a detrimental effect on dentin elasticity and flexural strength on long-term exposure of dentin to high concentrations, can lead to weakening of the tooth structure, predisposing tooth fracture .All these drawbacks along with resistant strains being reported have prompted researchers to look for herbal alternatives.[9,10]

The search for more biocompatible and dentin friendly irrigants that can overcome the limitations of these chemical antimicrobial irrigants is on the rise. Herbal products are gaining popularity in every field of medicine, mainly due to their biocompatibility. The herbal extracts also possess high medicinal properties such as anti-oxidant, antimicrobial, and anti-inflammatory properties which have favoured their use in Endodontics for canal disinfection.[8]

Many herbal extracts have been found to be of potential use in endodontics and also with minimal incidences of complication.[10] The natural products derived from medicinal plants such as neem, tulsi, amla, dhatura, nimbu. turmeric, green tea etc., have proven to be abundant source of biologically active compounds, many of which have become the basis for the development of new lead chemicals for pharmaceuticals[11]

There is a clinical impression that endodontically treated teeth are more friable and fracture easily thus may have to be removed.[12]It has been seen that the effect of irrigants on the dentin influences the interaction between the sealer and the dentin which in turn affects the fracture resistance of the tooth.13Moreover, it has to be considered that the use of different irrigants during root canal treatment will also result in chemical interactions between the irrigants as well as in cumulative effects on

the root dentin including microhardness, elasticity, and flexural strength. They also alter the bond strength of root canal filling materials to root canal dentin, which is effective in the wettability of residual root canal dentin. Removal of the smear layer may allow root canal filling materials and root canal sealers to contact the canal wall and penetrate into the dentinal tubules , which may increase the strength of the roots.. They also alter the bond strength of root canal filling materials to root canal dentin, which is effective in the wettability of residual root canal dentin . Hence, fracture resistance of the teeth may be affected by the use of irrigation solution.14,15

Therefore this study was to compare the smear layer removal of three different herbal irrigants and fracture resistance of endodontically treated teeth.

Materials and Methodology

120 single rooted mandibular 1st premolar teeth that are caries free, indicated for extraction due to orthodontic reasons and periodontal problems were collected. The study samples were decoronated apical to the cement enamel junction to standardize the canal length to 16 mm measured from the tip of the root to the cement-enamel junction with a diamond disc under water coolant mounted on a straight micro motor handpiece. The canal patency was determined by passively placing a no. 8 size k-file in narrow canals and10 k-file in medium sized root canals until the tip of the file was visible at the apical foramen using a magnifying loupe and adjusted to the apical foramen. Those teeth with wider apical patency were discarded and replaced with appropriate teeth. Working lengths were established by subtracting 1mm from the measurement obtained when a size 10 file was placed into the canal until its tip was visible at the apex namely working length of 15mm. Initial negotiation of root canal space was performed using a size 15 manual K-file used in a watch-winding motion to assure the presence of a glide path. The apical foramen of each root is sealed externally with casting wax, numbered, labelled and randomly divided into four equal groups, (n=30) according to the irrigation protocol used: The groups are as follows:

GROUP I: 5% SODIUM HYPOCHLORITE (CONTROL) (n=30)

GROUP II: 10% NEEM EXTRACT (n=30)

GROUP-III: 5% GREEN TEA (n=30)

GROUP IV: 10% TURMERIC EXTRACT (n=30)

The irrigation solutions will be delivered via 30-gauge needles that penetrated to within 2 mm of the working length. Throughout the biomechanical preparation between each file instrumentation, irrigation will be done with 1ml respective irrigant for one minute. The total irrigation time will be 5 minutes. In all the group final irrigation with 1 ml of 17% EDTA for 1 min will be done. The samples were prepared up to file size F3 using ProTaper Universal rotary instruments at a rotation of 300 r.p.m.

Sem evaluation

After final irrigation, the canals were dried with absorbent paper points, and the entrance to each of the canals was protected with a cotton pellet. 15 teeth from each Group I, Group II, and Group III & Group IV will be taken, using carborundun discs, deep grooves were cut on the buccal and palatal surfaces of the roots, without perforating the root canal. The roots were then split with a chisel and a mallet. One half of each tooth is selected and prepared for SEM examination. After assembly on coded stubs, the specimens were placed in a vacuum chamber and sputter-coated with a 300 A˚ gold layer (Bal-Tec SCD 005; Bal-Tec Co., Balzers, Liechtenstein). The surface was marked as coronal , middle and apical portion. The specimens were then analysed using a Zeiss EVO SEM XL 30 (Carl Zeiss

Microscopy). The dentinal wall of the apical thirds of roots were observed at magnifications of up to X1000 for the presence or absence of smear layer and the visualization of the entrance to dentinal tubules. Photomicrographs (X1000) of those areas representative of the predominant condition on apical thirds of the tooth were taken for assessment [Figure 1-4]. The smear layer was scored according to the criteria given by Hulssman et al.

Score 1: Dentinal tubules completely opened;

Score 2: More than 50% of dentinal tubules opened;

Score 3: <50% of dentinal tubules opened

Score 4: Nearly, all of the dentinal tubules covered with smear layer.

Score 5: thick non-homogeneous smear layer covering the surface.

Kruskal Wallis test followed by Mann Whitney Post hoc analysis was used for statistical analysis.

Figure 1

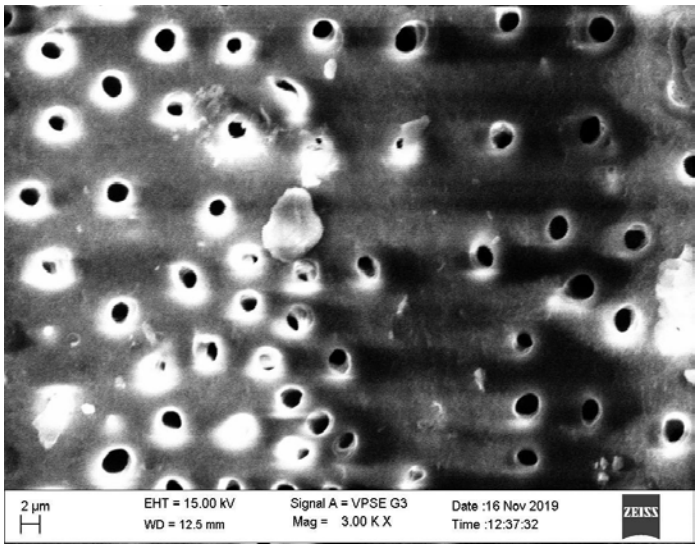


Figure 2

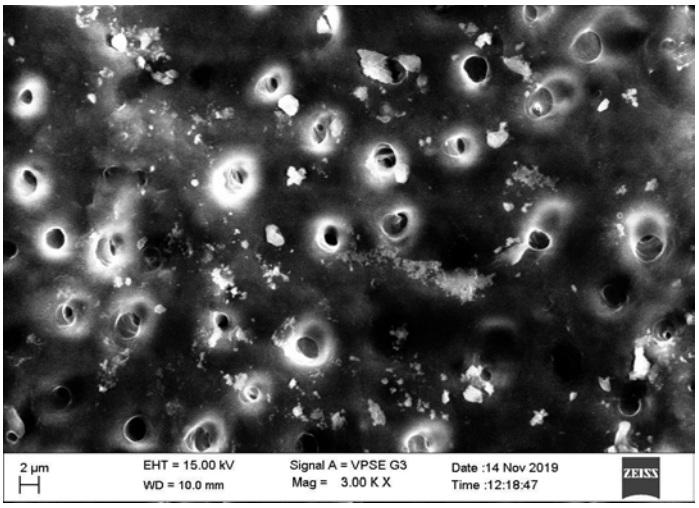


Figure 3

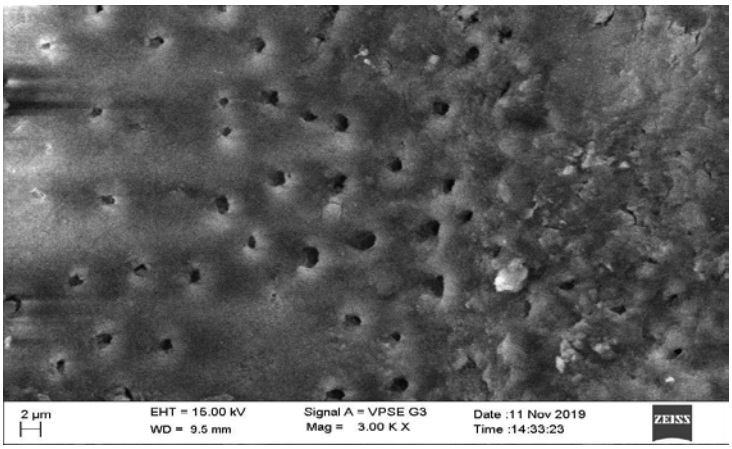
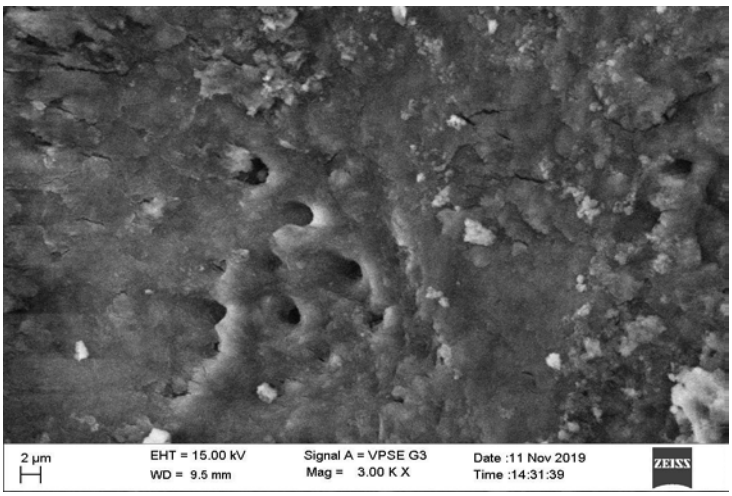


Figure 4



Preparation for the Fracture Resistance Test

After irrigation procedures, 15 samples from each groups taken and canals were dried with paper points and then filled with Pro Taper F3 gutta-percha following

single-cone technique using epoxy resin-based root canal sealer. The exposed area of obturating material was covered with a layer of Cavit. All specimens were stored in an incubator at 37°C in 100% humidity for 24hrs.Specimens from each group were wrapped in one layer of plastic film and embedded in self-curing acrylic resin covering the apical 9mm of each root. After curing of the acrylic resin, the teeth and plastic film were removed from the resin blocks. A light body silicone was mixed and injected into the resin blocks and the teeth were reinserted carefully to mimic the periodontal ligament. The fracture resistance test was conducted in the Department of Centre for Nano Science and Engineering in The Indian Institute of Science, Bangalore. The specimens were attached to the lower plate of a universal testing machine with a jig. A needle with a tip diameter of 2mm attached to the upper plate of the machine was lowered vertically parallel to the long axis of the teeth and compressive loading was applied vertically at a speed of 1mm/min until a fracture occurs. The forces necessary to fracture each root were recorded in Newtons (N) on the monitor.

Results

Inferential Statistics: Kruskal Wallis test followed by Mann Whitney's post hoc test was used to compare the mean Smear Layer Removal scores between different study groups. One-way ANOVA test followed by Tukey's post hoc test was used to compare the Fracture Resistance between different study groups.

The level of significance was set at P<0.05.

Table 1 illustrates the comparison of mean Smear Layer Removal Scores between 4 groups. The test results demonstrate that the mean Smear Layer Removal Scores for NaoCl group was 2.60 ± 0.63, for Neem group was 2.67 ± 0.72, for Green Tea groupwas 3.33 ± 0.72 and for Turmeric group it was 3.40 ± 0.63. This mean difference in the Smear Layer Removal Scores between 4 groups was statistically significant at P=0.003. [**Refer Graph no. 1**]

Table 1: Comparison of mean Smear Layer Removal Scores between 4 groups using Kruskal Wallis Test

Groups	N	Mean	SD	Min	Max	P-Value
NaoCl	15	2.60	0.63	2	4	0.003*
Neem	15	2.67	0.72	2	4	
Green Tea	15	3.33	0.72	2	4	
Turmeric	15	3.40	0.63	2	4	

*** - Statistically Significant**

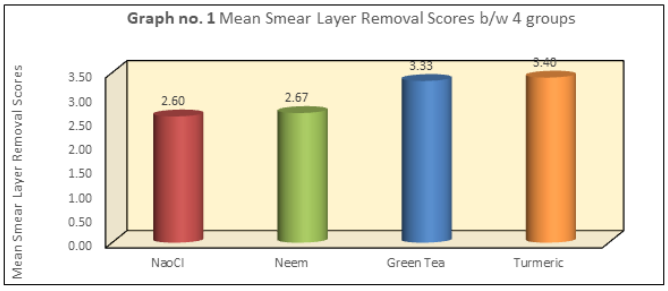


Table 2 illustrates the multiple comparison of mean differences in Smear Layer Removal Scores between 4 groups. The test results showed that NaoCl group showed significantly lesser Smear Layer Removal Scores as compared to Green Tea and Turmeric groups at P=0.02 & P=0.009 respectively. This was followed next by Neem group showing significantly lesser mean as compared to Green Tea and Turmeric groups at P=0.04& P=0.02 respectively. However, no significant differences in the mean Smear Layer Removal Scores were noted between NaoCl and Neem group and also between Green Tea & Turmeric group both at P=0.85.

Table 2: Multiple comparison of mean difference in Smear Layer Removal Scores b/w 4 groups using Mann Whitney's Post hoc Test

(I) Groups	(J) Groups	Mean Diff.(I-J)	95% CI for the Diff.		P-Value
			Lower	Upper	
NaoCl	Neem	-0.07	-0.72	0.59	0.85
	Green Tea	-0.73	-1.39	-0.08	0.02*
	Turmeric	-0.80	-1.46	-0.14	0.009*
Neem	Green Tea	-0.67	-1.32	-0.01	0.04*
	Turmeric	-0.73	-1.39	-0.08	0.02*
Green Tea	Turmeric	-0.07	-0.72	0.59	0.85

*** - Statistically Significant**

Table 3 illustrates the comparison of mean Fracture Resistance value between 4 groups.

The test results demonstrate that the mean Fracture Resistance value for NaoCl group was831.59 ± 60.66, for Neem group was810.54 ± 89.71, for Green Tea group was 723.11 ± 85.21 and for Turmeric group it was 639.84 ± 55.49. This mean difference in the Fracture Resistance value between 4 groups was statistically significant at P<0.001 [**Refer Graph no. 2**]

Table 3: Comparison of mean Fracture Resistance (in N) between 4 groups using One-way ANOVA Test

Groups	N	Mean	SD	Min	Max	P-Value
NaoCl	15	831.59	60.66	713.8	915.4	<0.001*
Neem	15	810.54	89.71	639.9	985.5	
Green Tea	15	723.11	85.21	605.8	867.7	
Turmeric	15	639.84	55.49	547.6	760.4	

*** - Statistically Significant**

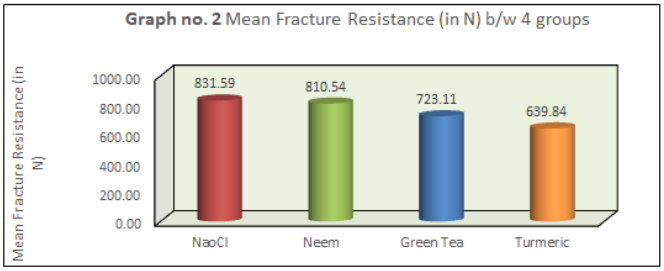


Table 4 illustrates the multiple comparison of mean differences in Fracture Resistance values between 4 groups. The test results showed that NaoCl group showed significantly higher Fracture Resistance value as compared to Green Tea and Turmeric groups at P=0.001& P<0.001 respectively. This was followed next by Neem group showing significantly lesser mean as compared to Green Tea and Turmeric groups at P=0.01& P<0.001 respectively. This in turn, followed by next with Green Tea showing significantly higher mean fracture resistance as compared to Turmeric group at P=0.02. However, no significant differences in the mean Fracture Resistance value was noted between NaoCl and Neem group [P=0.87].

Table 4: Multiple comparison of mean difference in Fracture Resistance (in N) b/w 4 groups using Tukey's Post hoc Test

(I) Groups	(J) Groups	Mean Diff.(I-J)	95% CI for the Diff.		P-Value
			Lower	Upper	
NaoCl	Neem	21.05	-50.76	92.87	0.87
	Green Tea	108.49	36.67	180.30	0.001*
	Turmeric	191.75	119.94	263.57	<0.001*
Neem	Green Tea	87.43	15.62	159.25	0.01*
	Turmeric	170.70	98.89	242.51	<0.001*
Green Tea	Turmeric	83.27	11.45	155.08	0.02*

*** - Statistically Significant**

Discussion

Root canal morphology is complex by nature with lot of variations in the anatomy, dealing with such complexities is challenging as it hampers the ability to achieve thorough disinfection of the pulp cavity. Chemo-mechanical debridement of the root canal space with the aid of instruments and irrigating solutions and intracanal medicaments decides the outcome of endodontic therapy.[17]

In this present study, Group I ,the canals were irrigated between each instrumentation with 2 ml of 5% of NaOCl using a 30 gauge needle according to Tuncer et al[19] Studies done by Baumgartner et al on efficacy of several concentrations of sodium hypochlorite for root canal irrigation have shown that irrigation with 3 ml of NaOCl after each instrument in the study did an excellent job of removing superficial debris whether delivered with an endodontic irrigation needle or the ultrasonic device[20] . In Group II, the canals were irrigated between each instrumentation with Azadirachtaindica / Neem extract. Neem is considered as age old medication for medical and dental problems. Several researchers have proven their efficacy as root canal irrigant. Neem extract has found to possess anti-adherence property of bacterial cells and this antimicrobial property is important for decreasing bacterial load.[21]The isoprenoid group of neem leaf and its constituents have shown anti-

inflammatory, immune-modulatory, antibacterial, antifungal, antiviral, antioxidant, and anti-carcinogenic properties.[22]

Camellia sinensis also known as green tea is a member of Family Theaceae. It is widely consumed by people in the world due to its relaxing effects on mind and body. Tea mainly comprises of polyphenolic compounds about 60-80% that makes up 30% of the dry weight of flush. There is good evidence that the catechin compounds of green tea are responsible for the observed antibacterial activity and that EGC, EGCg and ECg constitute the most important antibacterial agents (Yam et al.1997;Hara 2001). According to Syed Abrar Ali at el the irrigation with the extract of lemon grass & green tea are effective in removing smear layers. These inferences are in accordance with the work of Rathakrishnan M et al &Chhabra N et al.[23] Thus Green Tea was used as Group III irrigant.

In Group IV, the canals were irrigated between each instrumentation with Turmeric/Curcuma longa. It has been used in traditional medicine for the treatment of numerous diseases. Components of turmeric are named curcuminoids [curcumin [diferuloyl methane], demethoxycurcumin, and bisdemethoxycurcumin]. These components are polyphenols with a strong antioxidant function (Chattopadhyay et al., 2004).[24]It has a wide spectrum of biological actions, including antimicrobial,anti-inflammatory and antioxidant activities (Neelakantan, Subbarao, &Subbarao, 2011). In an in vitro study conducted by Neelakantan (Neelakantan,Subbarao, &Subbarao, 2011), [25] it has been shown that curcumin has significant anti-bacterial activity against E. faecalis and can be used as an alternative to sodium hypochlorite for root canal irrigation. Thus, this herb can be used especially in endodontics for root canal failure cases. All studies evaluating the effect of turmeric on endodontic bacteria are in vitro to date and its efficacy in vivo has yet to be determined.[26]

In study, final irrigation of all group is done by EDTA. EDTA is a polyaminocarboxylic acid and a colorless, water-soluble solid. [27]EDTA is normally used in a concentration of 17% and can remove the smear layers when in direct contact with the root canal wall for less than 1 minute according to Doumani et al [28]. SemraÇalt et al [29]on the study on time-dependent effects of EDTA on dentin structures found out that EDTA followed by NaOCl completely removed the smear layer in 1 min. In turn when EDTA is applied for 10 min, excessive erosive effects were observed with dissolution of peritubular and intertubular dentin. According to that study findings, to inhibit the erosion on dentin, EDTA solution must not be applied for no longer than 1 min. Hence with this concept, EDTA was used for 1 min in this study so that sufficient time is available for EDTA to act in apical third and at same time erosion of the dentinal tubules does not take place.

According to a study conducted by Gupta A et al [30], the herbal plant extracts were ineffective in removal of smear layer when used alone. They are more effective in cleaning root canal walls when combine with EDTA.

Adhesive strength is one of the most important considerations in the selection of endodontic sealers. Epoxy resin-based sealers have been considered to have better adhesion due to their ability to react with any exposed amino groups in collagen to form covalent bonds between the resin and collagen when the epoxide ring opens[31].In a study by Fisher et al.[32] , AH plus sealer, an epoxy resin-based sealer, with Gutta-percha showed the highest push-out bond strength compared to methacrylate, resin-based sealer. Therefore, the sealer used in this study was AH Plus, which has shown to

have better sealing properties than other resin-based sealers available. [33]After the final irrigation protocol, half of specimens in all the groups were obturated with ProTaper F3 gutta-percha using AH Plus sealer.

The results of this present study have shown that none of specimens were completely free of smear layer under scanning electron microscope. This was also evident in other study conducted by Guerisoli et al [34]who concluded that , it is impossible to remove the smear layer completely with any type of root canal instrumentation techniques or root canal irrigants at the apical third of the root canal .

In Group I which was irrigated with 5% sodium hypochlorite showed a slightly higher amount of smear layer removal when compared Group II (NEEM) . This is mainly because smear layer is composed of organic and inorganic materials and sodium hypochlorite can remove the organic potion of the smear layer. Inorganic component predominately removed with the help of EDTA. Ethylenediaminetetraacetic acid improves the action of sodium hypochlorite, by chelating calcium ions in dentine and which makes instrumentation of the root canal easier, especially in narrow canals and helps better removal of smear layer in apical region.[34] This result was in accordance with the study done by Karan YashBhargava et al[35] who compared the efficacy of combination of NaOCl and EDTA, Neem alone and other two herbal extracts as final irrigant in smear layer removal and the results showed that NaOCl+EDTA showed the best smear layer removing ability followed by Neem . This result is also accordance with the study conducted by Dr. Vamsee Krishna et al[36] it was shown that NaOCl with EDTA was more effective than Azadirachtaindica extract with EDTA on smear layer removal. In case of NaOCl with EDTA group, both NaOCl and EDTA play a role in removing smear layer. NaOCl dissolves the organic portion and EDTA removesthe inorganic portion by chelation, thereby smear layer is effectively removed. This action of NaOCl and EDTA was in accordance with the previous studies of Zehnder[37], M. S. Sadr Lahijaniet al.[38]

Group II which shows slightly lower smear layer removal than Group I but not statistically significant. A similar result was seen in a study done by Sebatni and Kumar where Neem showed the similar amount of smear layer removal in comparison to sodium hypochlorite.[39]Neem was regarded as “a tree for solving global problems” by the US National Academy of Sciences due to its efficacy in various applications.[40] The anti-inflammatory, antibacterial, antifungal, and immunomodulatory properties make it a potential endodontic irrigant and medicament. The greater efficacy of Neem may be due to the various active phytoconstituents such as acid metabolites, flavonoids, isoprenoids, alkaloids, glycosides, steroids, and tannins which makes it a material of choice for root canal irrigation and also an alternative to harmful chemical irrigants such as sodium hypochlorite. The smear layer removal efficacy of Azadirachtaindica extract was due to its active constituents such asNimbin, nimbidin and nimbidol.[41]

This result is also accordance with Ranjitha G.R et al [43]showed that the Neem has a similar amount of smear layer removal when compared to sodium hypochlorite. It is also shown to be effective against various microorganisms found in the oral micro flora such as Enterococcus faecalis and Candida albicans. As compared to sodium hypochlorite (hypochlorite accidents) Neem is less likely to cause severe harm to patients due to its high biocompatibility. Thus, it can be used as an effective herbal alternative to the more commonlyusedirrigant sodium hypochlorite. However,

the major drawback of Neem is Nimbidin's characteristic bitter taste which has to be overcome by the addition of sweeteners. [35] Group III shows statistically significant difference from Group I and Group II but slightly higher than Group IV. This is accordance with Syed Abrar Ali et el[23] showed that the irrigation with the extract of green tea are effective in removing smear layers.. This result is accordance with Sebatni and Kumar[39] that green tea extract exhibited the least amount of smear layer removal efficacy which might be due to the absence of acid metabolites which is needed for the removal than Neem extract and NaOCl. A study conducted by Kartik Sharma and RajanDhawan also showed the same result that highest smear layer removal efficacy was seen withneem when compared greentea.[44] Green Tea contains polyphenols and flavins which result in denaturation of proteins as well as enhances the anti-oxidant effect of green tea. It is also found to be a good chelating agent. In vitro studies done on green tea have proven that green tea has significant antimicrobial activity on E. Faecalis after agar well test and after evaluation of colony forming unit. [45]

Group IV Turmeric which shows least amount of smear layer removal but not statistically significant with Group III. According to UdayNandkishorji Soni[46], Turmeric is a good anti-oxidant and helps in smear layer removal when use as an irrigant. Major component of Turmeric is Curcumin .Effectiveness of Curcumin against E. faecalis biofilm in root canals are studied and compared to that with sodium hypochlorite, Curcumin over comes the disadvantage of NaOCl like unpleasant taste ,toxicity , in ability to remove smearlayer and limited anti-bacterial activity, detrimental effect on dentin macrophages structural integrity, elasticity and flexural strength. Future scope and research is needed so that Curcumin can be used as an irrigant and intra canal medicament.[46]According to John Paul[47] because of its anti inflammatory, anti oxidant, anti microbial and anti cancer activity, turmeric can be used especially in endodontics for root canal failure cases.

In the present study fracture resistance of each group evaluated and the results showed that there is difference in the mean fracture resistance (in Newton) between 04 groups was statistically significant at PG2>G3>G4.

In this study, NaOCl shows slightly higher fracture resistance than NEEM, The hypothesis tested, NaOCl breaks down to sodium chloride and oxygen, oxidizing some components in the dentin matrix and decreasing the elastic modulus and flexural strength of dentin, which might lead to decrease in fracture resistance.[48] In the current study, results were found to be different, it was noted that fracture resistance of teeth irrigated with 5% NAOCL showed highest result. Possible explanation behind high fracture resistance of 5% NAOCL could be its ability to remove the organic content of smear layer and removal of inorganic content by 17% EDTA and the organic portion of dentin were not sufficiently affected by the proteolytic action of NaOCl because EDTA was the final irrigant and NaOCl was not used again. The adhesion between root dentin and sealer is one of the important factor for reinforcement of the remaining tooth structure, therefore removal of smear layer may allow better penetration of sealer inside dentinal tubules thereby increasing adhesion. The increased adhesion not only adds strength to the tooth but also increase the fracture resistance by compensating the thickness of dentin and sealing the cracks formed during the biomechanical preparation.[52] This result is accordance with the study conducted by Dr. SangeetaAmbhore et al[51] that the highest mean fracture resistance was obtained from the group treated with 5% NAOCL

followed by 3% NaOCl, 10 % Neem, 2% CHX, 10 % Turmeric.

Neem shows lesser fracture resistance than NaOCl but it is statically insignificant. In a study done by Bhargava et al[51] on efficacy of three anti-oxidants (Neem, Tripala, Amla) versus NaOCl and EDTA as root canal irrigant on smear layer removal showed that Naocl + EDTA has the best smear layer removing ability followed by Neem and it has proven that neem has the potential to remove smear layer, thus might lead to the increased fracture resistance. In studies done by Dr Rasana Puthan Veettilet al[52] it was seen that Neem has low surface energy which increase the wettability of root canal dentin that helps the sealer to bind with the dentin better and increase bond strength. As it has been demonstrated that there is formation of covalent bonds between epoxide rings of AH Plus and naked amino groups in the collagen structure of dentine which determines the bond strength of AH Plus to dentine, increasing the wettability of the dentin to sealer will in turn increase the bond strength and fracture resistance of the root canal treated teeth.

Greentea and Turmeric showed minimum amount of fracture resistance. This is because this agents does not remove the smear layer fully and as the smear layer remains intact, there is no penetration and interaction of sealer with the root dentin. This leads to poor bond strength between sealer and dentin and hence poor fracture resistance. This result is accordance with the study conducted by Dr. SangeetaAmbhoreet al[50], where turmeric showed the lesser amount of fracture resistance when compared to other irrigating solutions. Herbal irrigants have shown superior biocompatibility and antimicrobial properties almost equal to sodium hypochlorite but their action on smear layer removal is not fully known. Further studies are required to evaluate the effect of chemical irrigant and herbal irrigants on the smear layer removal and fracture resistance of tooth. However, other factors like residual toothstructure, coronal restoration, occlusion, and parafunctional habits also affect the fracture resistance of endodontically treated teethstructure, coronal restoration, occlusion, and parafunctional habits also affect the fracture resistance of endodontically treated teeth.

Conclusion

Within the limitations of this study, it could be concluded that 5% NAOCL and 10% NEEM can equally remove smear layer thereby allowing penetration of sealer inside dentinal tubules and sealing the crack, which increase the bond strength between sealer and dentinal surface and ultimately the fracture resistance of tooth. However herbal alternatives are easily available, are cost-effective, have 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 medicament .Hence, herb extracts can be used for treatment procedures that have been established to be effective and with minimal risk involved.

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