



INFLUENCE OF ROUTINELY USED ROOT CANAL IRRIGANTS VS HERBAL EXTRACTS ON FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH.

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ABSTRACT

Aim of this study was to evaluate the effect of routinely used irrigating solutions and herbal extracts on fracture resistance of endodontically treated teeth. **Material & Methods:** A total of 60 mandibular incisors were acquired and instrumented using ProTaper nickel-titanium (Dentsply- Maillefer) rotary files till size apical size 30 (F3). These instrumented samples were then randomly divided (n=10), and different irrigating solutions were used; Group I NORMAL SALINE as negative control, Group II 5% NaOCl as positive control, Group III 2% CHLORHEXIDINE, Group IV 3% NaOCl, Group V 10% NEEM extract, Group VI 10% turmeric extract. Thereafter, the root canals were filled by using single gutta-percha cone (size/percentage of taper) and AH Plus (company name, city, country) root canal sealer. The specimens were then prepared and loaded vertically at 1 mm/min crosshead speed until vertical root fracture occurred. Results were evaluated statistically with 1-way analysis of variance and Student's t test. **Results:** Statistically significant differences were detected among the groups ($P < .05$). The highest mean fracture resistance was obtained from the group treated with 5% NaOCl for 5 minutes followed by 3% NaOCl, 10% Neem, 2% CHX, 0.9% Normal Saline, 10% Turmeric. **Conclusions:** The fracture resistance of endodontically treated roots were found to be differently affected by the various irrigating solution. **Clinical significance:** root canal irrigants also play important role in fracture resistance of teeth.

KEYWORDS : Chlorhexidine, fracture resistance, herbal extract, neem, sodium hypochlorite, turmeric.

Introduction

Endodontic therapy deals with successful preservation and meticulous restoration of teeth which are pulpally and periapically involved, so as to best maintain functions, esthetics and arch integrity. Usually vital tooth in its normal anatomical form, contacts, contours and surface characteristics is considered to be strongest component of dental arch. However once any tooth is affected by caries or any other tooth defect, its function is not only compromised, but also affects aesthetics, arch integrity and considered to be weak unit of dental arch.¹

Decrease in fracture resistance of endodontically treated teeth is related to greater loss of tooth structure caused by caries, chemo mechanical preparation and access cavity preparation that removes bulk of dentin and is also due to decrease in moisture.² Although chemo mechanical preparation decreases fracture resistance of endodontically treated teeth but it is one of the most important procedure for debridement and disinfection of canals.¹ Different irrigating solutions used for chemo mechanical preparation may alter the chemical and structural composition of dentin, thereby altering its solubility and permeability characteristics.^{3,4} Hence affecting the adhesion of obturating materials to the dentin surface. The most popular irrigating solution is sodium hypochlorite (NaOCl). It is an effective antimicrobial agent and an excellent organic solvent for vital, necrotic and fixed tissues. However because of limited antimicrobial activity, potential cytotoxicity and weakening effect on dentine there is need to find an alternative to these irrigants.^{5,6} Various natural plant extracts *Curcuma longa* (turmeric), *Azadiracta indica* (neem) which are biocompatible and have antimicrobial and therapeutic effects suggesting its potential to be used as an endodontic irrigant.⁷ However the effect of these irrigants on alteration of properties of dentine and interaction between sealer and dentinal tubules is not evidently reported, which may ultimately affect fracture resistance of teeth.

Many studies have been reported to compare the antimicrobial efficacy of herbal irrigants with routinely used irrigants. However studies correlating their effect on fracture resistance of

endodontically treated teeth so far have not been reported extensively. Hence, the current study was designed to compare the effect of herbal extracts on the fracture resistance of endodontically treated teeth, compared to routinely used root canal irrigants.

Materials and Method

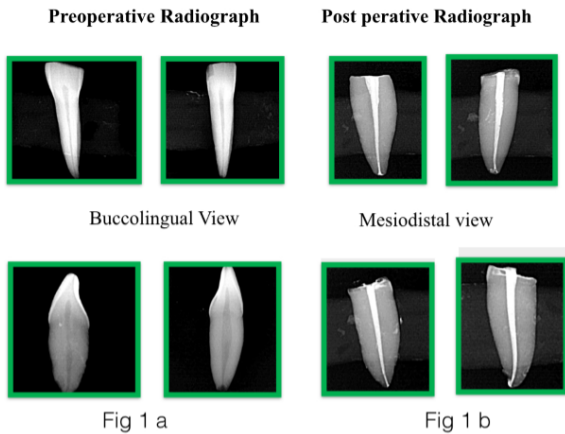
Tooth selection

Human mandibular incisors were acquired from a pool of freshly extracted teeth stored in an aqueous solution of 0.5% chloramine-T at 4°C before use. The crowns of the sample were sectioned at live of CEJ for 16 mm root length segments, and later inspected for cracks and craze lines under surgical operating microscope magnification and fiberoptic light. Teeth with single canal were selected which was evaluated using radiograph. (Fig1a). Defective specimens were eliminated. For standardization, mesiodistal and buccolingual diameters of the coronal planes were measured with a digital caliper and mean dimensions were obtained. Roots presenting a difference of 20% from the mean were discarded leaving a total of 60 mandibular incisor roots.

Specimen Preparation

The working length of each root was determined to be 1 mm less than the length of a #10 K-file (Dentsply-Maillefer, Ballaigues, Switzerland) just exiting the foramen. The root canals were prepared to apical size 30 (F3) using ProTaper nickel-titanium rotary instruments (Dentsply- Maillefer), and then divided into 6 groups which received different irrigants as final; group I NORMAL SALINE as negative control, group II 5% NaOCl as positive control, group III 2% CHLORHEXIDINE, group IV 3% NaOCl, group V 10% neem extract, group VI 10% turmeric extract. The irrigation solutions were delivered via 27-gauge needles that penetrated to within 2 mm of the working length. Throughout the biomechanical preparation between each file instrumentation irrigation was done with 1ml respective irrigant for one minute. The total irrigation time was 5 minutes. In all the groups except group I final irrigation with 1 ml of 17% EDTA for 1 min was done. Thereafter, roots were filled with ProTaper F3 gutta-percha and AH26 (Dentsply DeTrey, Konstanz, Switzerland) epoxy resin-based root canal sealer by using a single-

cone technique. post obturation radiograph was taken to assess quality of obturation. (Fig1b)Excessive coronal gutta-percha was removed, and samples were stored in 100% humidity for 7 days to allow the sealer to set.



All the samples were mounted in acrylic blocks to check fracture resistance of endodontically treated teeth(Fig2a), irrigated with different irrigants and loaded under universal testing machine. (Fig2b,c,d)Samples were evaluated for fracture lines.(Fig2e,f)

Preparation of 10% neem extract:

Mature fresh Azadirachta indica leaves after taxonomical identification were collected from the medicinal garden of Government Dental College and Hospital Mumbai. Leaves were washed in sterilized distilled water and weighed to 25gms in sterile disposable cup, later added to 50 ml of absolute ethanol and mixture was macerated for 1-2 min, extract was filtered with muslin cloth for coarse residue. Ex-traction process was repeated again using coarse residue and 25 ml ethanol. Both the extracts were pooled together and filtered through fast filter paper. (Fig3a)Alcohol part was removed from the ex-tract on water bath till the volume was about 25ml. Extract was kept ready and stored in airtight con-tainer.8



Fig 3a (Preparation of 10% neem extract)



Fig 3b (Preparation of 10% turmeric extract)

Preparation of Extract of Turmeric:

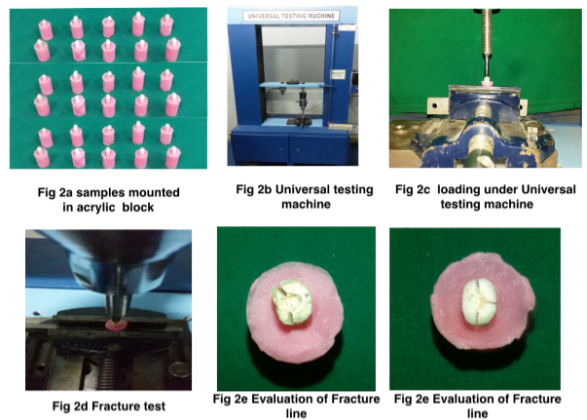
The rhizomes of Curcuma longa were identified, washed with distilled water and dried before use. They were then cut into irregular large pieces and dried in an oven by tray drying process at a temperature of 45±5 C for a period of about 9 -10 days till they were completely moisture-free, later ground to form a coarse powder. Maceration process of extraction was then performed on this coarse powder of the rhizomes. 500 gms of coarsely ground powder of the Curcuma longa rhizomes was placed in a large glass chambers. To a glass chamber 2500 ml of sterile distilled water was

added to prepare the aqueous extract approximately 1550 ml of water was added in a 70:30 ratio of water and alcohol to get a hydro-alcoholic extract. Both the glass chambers were closed with a glass lid to prevent evapora-tion of the menstruum and this system was allowed to stand for 7 days with occasional stirring.

The menstruum liquid was then strained and clarified by filtration in a beaker using a Whatman's filter paper. (Fig3b)The liquid was placed on a water bath to get a thick dark brown colored sticky mass , later stored in a dark colored pre-sterilized airtight container in a refrigerator at 4 C.8

Fracture Test

The apical 5 mm of roots were embedded along the long axis in self-curing acrylic blocks, with 9 mm of each root exposed. The specimens were then mounted in a universal testing machine . A custom stainless steel loading fixture with a round tip (r = 2 mm) was centred over the canal opening, and a compressive force was applied at a crosshead speed of 1 mm/min until a fracture occurred.9 The forc-es necessary to fracture each root were recorded in newtons (N). representative specimens from each group were evaluated



Statistical Analysis

The data were analyzed by using 1-way analysis of variance and Student's t test. A P value <0.05 was considered significant.

Results

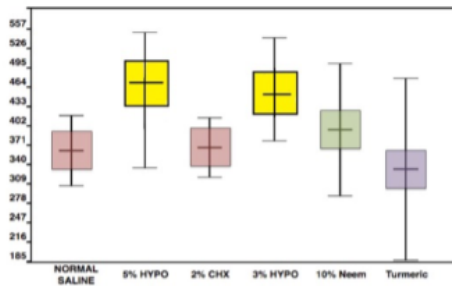
The fracture resistance values (N) are presented in Table 1 (a,b,c) as mean standard deviation (SD). The data were analysed statistically using one-way analysis of variance (ANOVA) (P < .05), and the comparison of means was conducted using Tukey multiple comparison test. The highest mean fracture resistance was obtained from the group treated with 5% NAOCL for 5 minutes followed by 3% NAOCL, 10 % Neem, 2% CHX, 0.9% Normal Saline, 10 % Turmeric, as shown in Graph 1.

	NORMAL SALINE	5% HYPO	2% CHX	3% HYPO	10% Neem	Turmeric
1	348.27	334.46	309.18	679.15	313.94	653.95
2	316.81	412.41	320.17	322.26	383.49	331.02
3	404.8	528.83	352.39	427.23	479.83	365.46
4	415.76	416.22	427.35	414.87	593.26	501.57
5	308.24	456.22	366.58	458.28	315.47	243.5
6	299.45	572.86	356.16	585.9	259.92	224.33
7	308.68	497.88	427.12	409.56	381.34	233.78
8	412.27	576.12	303.07	356.21	433.16	329.83
9	352.01	355.15	425.24	348.92	512.06	166.43
10	467.5	465.11	389.05	439.53	297.87	279.1
n	10	10	10	10	10	10
\bar{x}	363.359	461.526	367.631	444.191	397.034	332.897
s	58.076	83.896	48.402	110.322	106.727	146.366
\bar{x}_{avg}	394.440					

Table 1a(Mean Fracture Resistance)

Discussion

Root canal irrigating solutions are used to remove pulp remnants (inaccessible to instrumenting file), debris formed after biomechanical preparation, and to open the dentinal tubules in order to clean canal thoroughly and obtain a better condition for adhesion and canal obturation.¹⁰ Sodium hypochlorite is the gold standard root



Graph 1 Comparison of Fracture Resistance

canal irrigant used in endodontic practice due to its antimicrobial nature and excellent tissue dissolving properties. But the drawbacks of sodium hypochlorite includes unpleasant taste, toxicity and may have weakening effect on dentin. So to overcome this side effect and to meet the requirements of an ideal irrigant, Herbal irrigants were discovered by researchers. Herbal extracts such as neem, turmeric, aloe vera and honey have an antimicrobial, anti-fungal, anti-inflammatory, antioxidant, antipyretic, analgesic properties also they are less expensive hypoallergenic easily available, better tolerated and renewable in nature. considering these properties Interest has been gained to use these herbal extract as an root canal irrigant. Along with herbal irrigants CHX was used as it has broad-spectrum antimicrobial activity, destroying bacterial species resistant to Ca(OH)₂. Mandibular incisors are generally the smallest teeth in the adult dentition, with relatively small thicknesses of enamel and dentin.¹¹ The roots of these teeth are more prone to fracture because root cross-sections are usually ovoid in shape.¹² In the present study, mandibular incisors were used for evaluating the effect of different irrigants on the fracture resistance because of their weak structure.

It was the aim of the current study to assess the impact of different irrigation regimes on root dentin mechanical properties. The hypothesis tested here was that NaOCl can dissolve organic content of dentin which would affect mechanical integrity of root dentin thereby reducing the fracture resistance of teeth as compared to other groups. various studies support that by exposing the dentin surface to NaOCl or EDTA, the surface structure is degraded, which might explain the decrease in flexure strength and ultimately fracture resistance.¹³ But remarkably results in our study were found to be different, it was noted that fracture resistance of teeth irrigated with 5% NaOCl and 3% NaOCl to be higher than other groups. Possible explanation behind high fracture resistance of 5% NaOCl and 3% NaOCl could be its ability to remove organic content of smear layer. And removal of inorganic content by final irrigation with 17% EDTA.¹⁴

The adhesion between root dentin and root canal sealer is one of the important factor for reinforcement of the remaining tooth/root structure, therefore removal of smear layer may allow better penetration of sealer inside dentinal tubules thereby increasing adhesion. The increased adhesion not only add to strengthen the tooth but also increase the fracture resistance by compensating for the thickness of dentin and sealing the cracks formed during the biomechanical preparation.¹⁵ Since Resin sealer have resiliency similar to root dentin may allow better absorption of stresses thereby increasing fracture resistance of tooth.

Fracture resistance of teeth irrigated with 2% CHX, 10 % Neem extract, 10 % turmeric extract and Sterile Saline solution was found

to be in the range of 300 – 400 newton's, which was less than 5% & 3% NaOCl. Although similar irrigation protocol of final rinse with 17% EDTA followed which removed the inorganic content but the above mentioned irrigants have no effect on organic content of smear layer which has affected the bond strength and ultimately fracture resistance. The ability of NaOCl to dissolve organic tissues is well known and increases with high concentration and temperature. However, its capacity to remove smear layer from the instrumented root canal walls has been found to be lacking. Due to the fact that NaOCl has an influence upon only organic components of smear layer, it should be used with demineralising agents, which can remove the inorganic component of smear layer.

EDTA is a chelating agent, capable of removing the inorganic content, therefore alone it cannot remove smear layer. Yilmaz et al reported that the use of low- surface-tension EDTA compounds alone or in combination with NaOCl increased the wettability of root canal dentin.¹⁶ The combination of sodium hypochlorite and EDTA can be used effectively to remove smear layer. Removal of smear layer allows root canal sealers to penetrate into the dentinal tubules, thereby increasing the strength of roots. AH Plus resin sealer has good

adhesion capability to dentin and gutta-percha, Fisher et al. used sealers for evaluating their bond strength to the smear-free root dentin and found that AH Plus resin sealer had significantly higher bond strength compared with the other sealers available.¹⁷

Although herbal irrigants have an excellent biocompatibility and comparable antimicrobial properties as sodium hypochlorite but its ability to remove smear layer is still lacking further studies with respect to this limitation is still need to be carried out to use the herbal extract as potential endodontic irrigant. Review of literature suggest that there is as such no data available on effect of herbal irrigants on fracture resistance of teeth, so this study was carried out to know the effect of herbal irrigants on fracture resistance of teeth.

CONCLUSION

Within the limitations of this study, it could be concluded that 3% and 5% NaOCl with 17% EDTA can 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. Further studies are needed to investigate the effect of different irrigants on bond strength of sealers and vertical root fracture resistance.

Clinical significance: Although irrigation of the root canal is the most important determinant in the healing of the periapical tissues. but the other important properties which might affect the fracture resistance of teeth should not be overlooked. Further studies are needed to investigate the effect of different irrigants on bond strength of sealers and vertical root fracture resistance.

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