Research Article

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Dissolving and Antimicrobial Efficacy of Different Organic Solvents on Gutta Percha at Different Immersion Time Intervals

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ABSTRACT

Background: The aim of this study was to compare and evaluate the dissolving capability of gutta-percha in various essential oils as endodontic solvents such as orange oil, tea tree oil and lemon grass oil at different immersion time intervals 2 minutes and 5 minutes.

Materials and Methods: 80 ISO no. 25 cones (0.06 taper) were taken as sample for the study. Samples were divided in to four experimental groups of 10 cones each at 2 different immersion time intervals at 2 and 5 min at room temperature to investigate the potential of these solvents for clinical use in dissolving gutta percha. Each sample was weighed initially before immersing in the solvent on a digital analytical scale. Distilled water as a control group. Samples were removed from the solvents after specified immersion time period and then washed in 100ml of distilled water and allowed to dry for 24h at 37*c. The extent of gutta percha removed from their respective solvents was calculated from the difference between original weight of gutta percha and its final weight. Means and standard deviations of percentage loss of weight were calculated at each time interval for each group of specimens.

Results: No significance in the amount of gutta percha dissolved at 2 and 5 minute immersion time intervals in all four groups ($p > 0.05$). There was a significant difference among the groups such as orange oil and tea tree oil ($p < 0.05$) except lemon grass oil and distilled water.

Conclusion: The results showed that tea tree oil has similar solvent effects as orange oil and better antimicrobial action than orange oil on softening gutta percha during retreatment.

Keywords: Endodontic retreatment, gutta percha, essential oils.

INTRODUCTION

Retreatment procedures in endodontic practice requires complete removal of root canal filling material, further cleaning, shaping and reobturation. Success rate of endodontically treated teeth ranges from 86 to 95% and retreatment has to be done for failed root canal treated teeth.[1] Gutta percha has been the most commonly used material for root canal obturation. The effectiveness of retreatment can be achieved by the complete removal of the total amount of gutta percha and sealer from an inadequately shaped and filled root canal system because it is critical for uncovering remnants of necrotic tissue or bacteria which have to be exposed to perform an efficient chemo-

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mechanical disinfection procedure[2,3]. Removal of gutta percha can be done with several techniques which includes the use of stainless-steel hand files, nickel-titanium rotary instruments, and ultrasonics in combination with heat or chemicals4. Solvents have also been used in the past to soften and dissolve gutta percha.[5]

Properties of an ideal endodontic solvent include, high solvent effect, low surface tension, low cytotoxicity, absence of carcinogenic effects, easy to use, fast acting and a long shelf life.5 Nonetheless, majority of solvents are known to be toxic to the periapical tissues and should be used with caution.5 In clinical practice, refined orange oil, tetrachloroethylene, xylene, chloroform and halothane are used for softening the gutta-percha during non-surgical endodontic retreatment.[6,7]

Orange oil (Citrus aurantium) is an essential oil, containing alpha pinene, myrcene, linalool, D-limonene. Limonene which is aliphatic hydrocarbon classified as monoterpene is the major component in the oils of citrus fruit peels. Several solvents have been tested so far for their ability to dissolve gutta percha but there are no studies done with tea tree oil and lemon grass oil as gutta percha solvent.

Tea tree oil (Melaleuca alternifolia) is an essential oil used as gutta percha solvent in this study because of its composition i.e., Terpinen-4-ol and Alpha-terpineol in which Terpinen-4-ol is the active ingredient with antibacterial and antifungal effect and has mild tissue solvent action[8]. Whereas, the main components of lemon grass oil (Cymbopogon citratus) are similar to that of orange essential oil i.e., citral, geraniol, methyleugenol, myrcene and citronella which exhibit antibacterial, antifungal and anti-inflammatory properties[8].

The purpose of this study was to compare and evaluate the dissolving capability of gutta-percha in various essential oils as endodontic solvents such as orange oil, tea tree oil and lemon grass oil at different immersion time intervals.

MATERIALS AND METHODS

80 ISO no. 25, 0.06 taper Gutta percha cones (Dentsply-maillefer, ballaigues, switzerland), were taken as samples for the study. They were divided in to four experimental groups of 20 cones each and they further divided in to 2 equal sub groups for 2 and 5-minute immersion time intervals with 10 cones each with 8 experimental groups at room temperature to investigate the potential of these solvents for clinical use in dissolving gutta-percha. Each sample was weighed on a digital analytical scale before immersing in their respective solvents and distilled water served as a control group.

The samples of solvents were prepared by taking 5ml of each solvent in a glass vial, now the gutta percha cone was immersed in the solvent and timing was started with a stop watch and the lid of the bottle was replaced. If the gutta percha sample stuck to the glass vial during experiment, it was dislodged with the vibrations of vortex shaker to prevent clumping of dissolved gutta percha. Samples were removed from the glass vial after specified immersion time period and washed in 100ml of distilled water and allowed to dry for 24h at 37*c in a humidifier. The samples were again weighed on a digital analytical scale after immersion in their respective solvents.

The extent of gutta-percha removed was calculated from the difference between the original weight of gutta percha and its final weight using the following equation:

M=M2-M1

Where M2= post immersion weight M1= pre immersion weight

Means and standard deviations of percentage loss of weight were calculated at each different immersion time interval s for each group. The values obtained were analysed by statistical tests using SPSS 17.0 software

RESULTS

Orange oil and Tea tree oil showed a statistically significant difference ($p<0.001$) in dissolving gutta percha as compared to other groups such as distilled water and lemon grass oil.

The weight loss of gutta percha in different solvents as a function of time showed that there was no significance in the amount of material dissolved at 2 and 5 min immersion time intervals in all groups.

Table 1: Mean comparison among the groups at 2 minutes immersion time interval.

VARIABLES		Sample size	MIN	MAX	MEAN	SD	P value
DISTILLED WATER	PRE	5	0.51	0.53	0.52	0	1 NOT SIGNIFICAN
	POST	5	0.51	0.53	0.52	0	
ORANGE OIL	PRE	5	0.51	0.55	0.53	0.02	<0.001 SIGNIFICAN
	POST	5	0.42	0.47	0.44	0.02	
TEA TREE OIL	PRE	5	0.50	0.53	0.52	0.01	<0.001 SIGNIFICAN
	POST	5	0.41	0.45	0.43	0.01	
LEMON GRASS OIL	PRE	5	0.51	0.55	0.53	0.02	0.834
	POST	5	0.51	0.55	0.52	0.02	

Graph 1: Comparison of solubility effect of different solvents on gutta percha at 2 min immersion time.

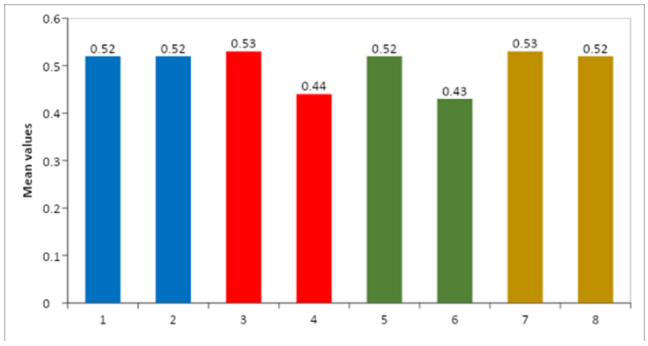
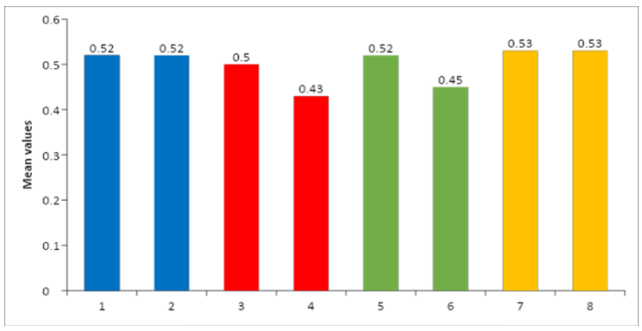


Table 2: Mean comparison among the groups at 5 minutes immersion time interval.

VARIABLES		Sample size	MIN	MAX	MEAN	SD	P value
DISTILLED WATER	PRE	5	0.50	0.55	0.52	0.02	1 NOT SIGNIFICAN
	POST	5	0.50	0.55	0.52	0.02	
ORANGE OIL	PRE	5	0.47	0.54	0.50	0.03	<0.001 SIGNIFICAN
	POST	5	0.40	0.47	0.43	0.03	
TEA TREE OIL	PRE	5	0.50	0.54	0.52	0.01	<0.001 SIGNIFICAN
	POST	5	0.43	0.47	0.45	0.01	
LEMON GRASS OIL	PRE	5	0.51	0.54	0.53	0.02	0.962
	POST	5	0.51	0.54	0.53	0.02	



Graph 2: Comparison of solubility effect of different solvents on gutta percha at 2 min immersion time.

DISCUSSION

Endodontic retreatment is a conservative clinical conduct in comparison with more radical procedures. Nonsurgical retreatment of previously filled root canal requires complete removal of GP and sealer from the root canal walls.9 Apical access in endodontic retreatment is gained through the removal of filling materials from the root canal.[7] Mechanical, thermal, or chemical techniques may be individually applied or combined for removal of filling materials during endodontic retreatment.[10,11]However, it is often impossible to achieve complete removal of existing obturating materials from the canals.

Most often Gutta-percha cones are composed of a vegetable resin, which lends its name to the product, and are softened with the help of chemical solvents.[12]Among the organic solvents more frequently used in endodontics are: chloroform, xylene, halothane, orange oil, turpentine oil, eucalyptol oil and tetrachloroethylene.[13]

Chloroform is an effective and widely used solvent for gutta-percha in clinical practice. Tamse et al. found that chloroform was the most effective solvent to dissolve all brands of gutta percha.[5] It is the strongest, most commonly used and a quickly effective solvent. Chloroform is classified as a group 2B carcinogen by the international agency for research on cancer, which points out that the material lacks adequate evidence of carcinogenicity in humans but, there is sufficient evidence of their carcinogenicity in animals.[14]Its rapid evaporation makes it a useful chairside material.[15]However, as it is identified as a potential carcinogen5, alternative solvents to chloroform have been researched.

Halothane, one of the alternatives to chloroform, is a fluorinated hydrocarbon used for induction anaesthesia and seems to be as effective as chloroform in dissolving gutta-percha.[16] Following repeated use of halothane induced anaesthesia, idiosyncratic hepatic necrosis develops which is a potential side effect[17]. The incidence of halothane hepatitis is in the order of one in 10,000 exposures. other alternatives like tetrachloroethylene are not hepatotoxic[18].Hence, it is considered as quite safe compared to chloroform and ethylene.

Xylene is impractical for use at the chair side because of its slow evaporation and considered poorer than chloroform regarding its dissolving efficacy. However, Xylene dissolves the gutta percha slowly, thus allowing a better control and removing softened rather than liquefied gutta percha. This process of softening and mechanical removal of gutta percha rather than dissolving it may prove to be not only efficient but also a biologically safer procedure.[19]

Essential oils are complex natural mixtures of volatile secondary metabolites, isolated from plants by hydro or steam distillation and by expression (citrus peel oils).[21]They cover a broad spectrum of activities. Various essential oils produce pharmacological effects, demonstrating anti-inflammatory, antioxidant and anti-cancerogenic properties. Essential oils act as biocides against a broad range of organisms such as bacteria, fungi, viruses, protozoa, insects and plants.[21]The use of essential oils in endodontics is growing because of their proved safety, biocompatibility and noncarcinogenicity.[14]

There are no studies reported using tea tree oil and lemon grass oil as removal of gutta percha. Tea tree oil is an essential oil with anti-inflammatory properties[22], steam distilled from the plant Melaleuca alternifolia (Narrow-leaved paperbark), native to southeast Queensland and the northeast coast of New South Wales, Australia

Tea tree oil was used as gutta percha solvent in this study because of its composition i.e., Terpinen-4-ol and Alpha-terpineol in which Terpinen-4-ol is the active ingredient with antibacterial and antifungal effect and has mild tissue solvent action. Whereas, the main components of lemon grass oil (Cymbopogon citratus) are similar to that of Orange essential oil i.e., Citral, geraniol, methyleugenol, myrcene and citronella which exhibit antibacterial, antifungal and anti-inflammatory properties.

TTO containing terpinen-4-ol and alpha-terpineol can suppress the production of inflammatory mediators in LPS-stimulated human macrophages[23].Mechanism of essential oil action towards microorganism is complex and has not yet been fully explained. Their antimicrobial action depends on the hydrophilic or lipophilic character.[24] Terpenoids may serve as an example of lipid soluble agents which effect the activities of membrane catalysed enzymes, for example their action on respiratory pathways. Few components of essential oils can act as uncouplers, which can interfere with proton translocation over a membrane vesicle and interrupt ADP phosphorylation i.e., primary energy metabolism. Certain terpenoids with functional groups, such as phenolic alcohols or aldehydes, also interfere with membrane integrated or associated enzyme proteins, stopping their production or activity.[21]

CONCLUSION

Within the limitations of the present study, it suggests that tea tree oil has the similar solvent effects as orange oil but with better antimicrobial action on softening Gutta percha during retreatment.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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