Original Article

Comparative Evaluation of the Solubilizing Efficacy of Orange Oil, Eugenol and Tween 80 on Gutta Percha: An In-Vitro Study

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Abstract:

Background: The root canal along with its complex anatomic difficulties poses a challenge to the endodontist while approaching to remove the old obturating material held within its confines during re-treatment procedures. An ideal root canal solvent hastens this process of dissolution of Gutta Percha without causing procedural errors in the process.

Aim & Objective: To compare and evaluate the solubilizing efficacy of Orange Oil, Eugenol and Tween 80 on Gutta Percha.

Materials and Methods: A total of seventy-five conventional gutta percha cones having ISO size 30 and 4% taper were selected for the study. The Gutta Percha cones were then divided into three groups at random: Group I: Orange Oil; Group II: Eugenol; Group III: Tween 80. The cones were pre weighted using an electronic weighing balance and noted as the Pre immersion weight (M1). Following this they were immersed for 15min in clear glass vials containing 2ml of the solvents in each of them. The cones were then post weighted and noted (M2). The difference in weights of the gutta percha cones was evaluated.

Results: Orange oil showed the highest efficacy in solubilizing Gutta Percha. This was followed by Tween 80 which was a novel solvent used for dissolution. Eugenol proved to be least efficacious in dissolving.

Conclusion: Orange oil showed superior solubilizing efficacy when compared to Tween 80 and Eugenol.prone to develop CTS. Larger research is needed to understand how physical exercise causes CTS.

Keywords: orange oil, eugenol, tween 80, dissolution, gutta percha.

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Introduction:

Obturating the root canal space remains a critical part in achieving a hermetic seal from the coronal to the apical aspect of a tooth. A thorough biomechanical preparation and irrigation done before obturation allows the elimination of microbes. However not

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everytime, a broad and thorough debridement of root canal system is possible. An infinite amount of micro-organisms are iatrogenically pushed into the periapex owing to the complex anatomy variety of the apical part. This nevertheless creates an environment for persistent microbes to flourish and thrive.

Failure to remove these pathogens affects the prognosis of the tooth. This causes prolonged post-operative pain in the patient with failure of resolution of symptoms. Retreatment of the tooth then becomes the available choice of treatment.

Retreatment techniques in endodontic practice necessitate widespread and thorough elimination of the old root filling mass. Despite a number of advancements in obturating materials, Gutta-percha (GP) still remains the most common and popular core obturating material. [1,2] The techniques used for the removal of GP can be mechanical, thermal, chemical, or a combination of these.[3] Chemical method involves the use of various solvents to soften GP and facilitate its removal with hand or rotary instrument usage.[4]

Several techniques and agents have been experimented in the past to check for their role in GP dissolution, earliest ones being chloroform and xylene. However, chloroform being a carcinogenic substance is considered a life-threatening agent considered as a category 2B carcinogenic substance according to the International Agency for Research on Cancer [5]. Additionally, chloroform is regarded as a potential cytotoxic compound causing irreversible tissue damage. [6].

Thus the need has arisen for the introduction of a novel, biocompatible and equally efficacious solvent for solubilizing gutta percha without creation of iatrogenic mechanical errors. Gutta-percha RC solvent is a versatile agent used commercially in routine re-treatment procedures. There are still no available means of naturally obtaining this compound rather it is a synthetically prepared material. Main constituent of Orange Oil is d-Limonene (97%), chemically described as a mono-terpene constituting hydrocarbon manufactured for the dissolution of gallstones in the field of medicine. It has a detergent like action and is a non-polar liquid. The raw form of d-Limonene is regarded amongst the ideal solvent for effective GP dissolution. [7] Naturally available products comprising of d-Limonene constituents are found in orange oil and citrus oils; several investigations have been done to measure its compatitibility with human tissues as well as its effectiveness in removing the obturationg material.[8]

Clove (Syzygium aromaticum) is an honoured medicinal agent known for displaying excellent medicinal and therapeutic benefits; principally used to create an obtundant effect onto the inflamed tissue site to reduce pain and discomfort. The key phenolic ingredient of Clove oil is essentially eugenol & eugenyl acetate which is proved to be having an adverse effect on surface roughness. [9] Tween detergents are classified as non-ionic surfactants comprising of a ring of sorbitan, an alkyl group and twenty units of ethylene oxide. Tween 80 has a wide range of applications in biochemical industries including: solubilizing proteins, emulsifying and dispersing substances in medicinal and food processing products. To the contrary, it has been regarded as a compound having an adverse reaction on the antibacterial effects of methyl paraben and its related compounds. [10]

Based on these unique properties of materials, the aim of study was devised to compare the solubilizing efficacy of Orange Oil, Eugenol and Tween 80 on Gutta Percha.

Materials and Methods:

Sample Preparation:

A total of seventy five conventional Gutta Percha cones (Dentsply Maillefer, Baillaigues, Switzerland) of ISO size 30 and 4 % taper were incorporated in the study. GP cones were randomly distributed into three different groups (n=25) for immersion in three respective solvents.

- **Group I:** Orange oil (AvueSol, Gutta Percha Solvent),
- **Group II:** Eugenol (Eugenol Pure, Safe Plus),
- **Group III:** Tween 80 (Polysorbate 80, Purenso Select).

Dissolution:

The pre-weighing of gutta percha cones before placing them into the immersion solutions was done with the help of an electronic weighing balance and noted as pre immersion weight (M1). The samples were then immersed in glass vials each containing 2 ml of the solvent in each of them.

The specimens were then removed from glass vials after subjecting them to an immersion period of 15 minutes and rinsed thoroughly using distilled water. GP cones were then let out to dry for a duration of 24 hours at 37°C in a humidifier following which reweighing of specimens were done. This was noted as postimmersion weight (M2). The mass of GP dissolved from the samples were measured by the calculating the difference between the preweight of GP, and its weight post immersion as follows:

$$M = M2 - M1$$

Where, M2 = Postimmersion weight
M1 = Preimmersion weight

Statistical Analysis:

For each group, the mean & standard deviation were calculated from the samples. Statistical analysis was performed by using descriptive and inferential statistics with one way Anova to compare mean values between the three groups followed by Tukeys HSD post-hoc test for multiple comparisons. P-value less than 0.05 were considered to be significant at 95% confidence level. The statistical software SPSS version 21.0 was used in the analysis.

Results:

The overall assessment for solubilizing efficacy of the Gutta Percha revealed that Orange Oil contained in the Root canal solvent performed superior and displayed itself to be highly effectively. This was followed by the Tween 80 group which showed intermediate action. The least dissolving capacity was shown by Eugenol amongst all the groups tested.

Descriptive Statistics:

	n	Minimum	Maximum	Mean	Std. deviation	f value	p value
Group I :ORANGEOIL	25	0.010	0.020	0.015	0.0037	926.65	0.001
Group II: EUGENOL	25	0.042	0.048	0.046	0.0020		
Group III: TWEEN 80	25	0.037	0.041	0.037	0.0013		

Table 1: Mean and Standard Deviation of three groups.

DEPENDENT VARIABLE GROUPS	(I) group	(J) group	Mean Difference (I-J)	Std. Error	P- value
	Orange oil	Eugenol	-.0309	.0013	.001
		Tween 80	-.0226	.0013	.001
	Eugenol	Orange oil	.0309	.0013	.001
		Tween 80	.0083	.0013	.001

Table 2: Mean difference of Inter group Comparison.

The ANOVA results revealed that the Orange Oil had a highly significant influence (P < 0.001) on the solubilizing potential of Gutta percha on comparison with that of Eugenol subgroups. (Table 2) The statistical analysis of data revealed that Tween 80 had solubilizing potential on Gutta Percha. (P< 0.001; Figure 1).

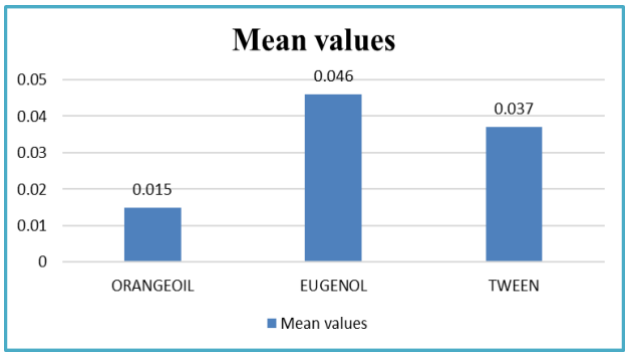

Figure 1: Bar Graph demonstration showing the mean values of the solvents.

Discussion:

Retreatment procedures in endodontics, requires efficient retrieval of the obturating material from the root canal spaces. This reinforces the fact too that the clinician needs to deliver the Gutta Percha solubilizing agent to the desired area in a relatively simple, cost effective and faster method.

To aid in this process, various inorganic and organic solvents have been tried and tested to assess their dissolution efficacy. Endodontic literature regarding the dissolution of conventional GP has been inconsistent with some reports suggesting orange oil to be a superior solvent [11]. The study was therefore done to draw a comparison as well as evaluate the efficacy of solubilizing Gutta Percha tested amongst the Gold standard material being Orange oil with Eugenol and novel Tween 80. This is the first of its kind to test Tween 80 as a root canal solvent.

Previous studies have been experimented in this regard. They utilised fabricated Gutta Percha discs created from moulds to check for its dissolving action [12] whereas some utilised sources of heat to soften gutta percha in the canals [13]. The current study determined the ability of Conventional GP to get dissolved as complete mechanical removal of GP is not possible from the intricacies of root canal system and dissolution by solvents may facilitate its removal more efficiently. The methods used in the present study were similar to the one employed by Mustaq et al., due to its simplicity and ease of reproducibility [14].

The results showed that Orange Oil significantly executed the best results in this in-vitro test condition. This finding is reliable and consistent with other similar previous researches, which also claim Orange Oil as the most effective root canal solvent. [15] The rationale of choosing Orange oil is based on its major constituent of d-Limonene which has the capability of breaking down the polymer chains present in the poly-isoprene units of Gutta Percha which is a rubber based compound. This leads to splitting -up polymer filaments detained together so the gutta-percha loses its integrity, softens and eventually dissolves. Complete dissolution of the cones is however dependant on the time of immersion in the solvent. Gutta percha immediately after immersion in the orange oil starts to lose its integrity and becomes fragile and soft as was observed in the study. However, the effectiveness is lesser than synthetic compounds as it is a nonpolar solvent retaining weaker dispersion forces between chain polymers. [16] Nevertheless, it can be stated that, higher the amount of Orange oil, greater is the ability to dissolve the obturating material.

No evidence of carcinogenicity or genotoxicity has been found in Orange Oil. Further, it is more biocompatible than eucalyptol oil and chloroform [17]. Tween 80 on the other hand being a synthetic derivative has the capacity of emulsifiying and degrading the polymeric strands present in the in the poly isoprene units of Gutta Percha. This characteristically reflects its limited and intermediate action seen in this study justifying the fact that this novel solvent can be utilised for solubilizing Gutta Percha. Tween 80 however lacks the antibacterial activity present in Eugenol.

Eugenol contains the compound eugenolate which is restricted for usage in infections of endodontic origin and in cases where pulp soothing or anodyne activity is needed. Its role in solubilizing Gutta Percha is minimal owing to the fact that it is a very weak non-polar organic solvent which lacks the property of dissolving root canal obturating materials. [18] This fact is further strengthened in this study. (Figure 1)

It is clearly evident from the results obtained in the study that Orange oil showed significant higher potential in solubilizing GP cones when compared to Eugenol and Tween 80. The difference in the preweight and postweight values ascertain that gutta percha is homogenously softened and dissolved faster in Orange oil. (Table 2)

Two different methods are available to check the dissolving ability. These are softening methods and dissolving methods. In this study, the method performed was the dissolving test. Not all solvents readily disintegrate in application of the solubilizing agents. The application quantity and mode of delivery of the agents into the desired area also plays a pivotal role in searching the ideal root canal solvent. However all groups and samples tested in this study were subjected to dissolution time of 15 minutes to standardize the procedure.

Conclusion:

Amongst the three essential oils, the efficacy of Orange Oil in solubilizing gutta-percha was found to be more effective when compared to that of Tween 80 and Eugenol. ($P < 0.05$)

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Ethical Approval: The study has been Approved by the Institutional Ethics Committee according to guidelines.

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