Original Research

A comparative evaluation of efficacy of chloroform, xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil as GuttaPercha solvent: An in vitro study.

Kumar A, Pandey KR, Mishra A

Abstract: Objective: To compare the efficacy of chloroform, xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil as Guttapercha solvent. **Material & Methods:** The solubility of guttapercha was tested in 2ml quantity of each five solvent independently for time period of 5 minutes, 8 minutes, and 10 minutes (chloroform, xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil). Distilled water was used a control. The difference in weight before and after dissolution was recorded in order to calculate the solubilizing efficacy expressed in terms of decrease in weight, for each solvent. **Results:** Mean percentage decrease in weight of guttapercha showed by chloroform, xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil were 38.87±0.73, 28.30± 0.97, 25.86±0.89, 18.27±0.85, 1.76±0.76 respectively. Distilled water showed not alternation in guttapercha weight. **Conclusion:** Chloroform was found to be most effective in solubilizing guttapercha followed by xylene, rectified white turpentine oil, eucalyptus oil. Peppermint oil showed minimal response as a guttapercha solvent.

Key words: Gutta-percha; Endodontics; Retreatment; Solubility; Solvents.

INTRODUCTION

The rationale for a root canal treatment is to completely debride, fill and seal the root canals. Success rate of endodontically treated teeth ranges from 86 to 95%.[1] A few cases may not respond to the initial treatment and demands re-intervention. The primary causes of the failure are inadequate debridement of root canals, procedural errors, lack to achieve a proper hermetic seal leading to multiplication of bacteria inside dentinal tubules, apical ramifications, accessory and secondary canals.[2,3]

The non-surgical endodontic intervention requires regaining the access to the root canal system, removal of the defective root canal fillings, reshaping of the canals if needed followed by re-obturation. Over the decades Guttapercha is the most commonly used root canal filling material made up of Zinc Oxide and gutta-percha which exhibits biocompatibility, dimensional stability and ease of removal during retreatment.[4] However, evidence based literature reveals that complete removal of guttapercha from the root canals, independent of the retreatment technique and sealer type, is difficult to achieve.[5] To facilitate complete removal of the filling material, a combination of conventional mechanical/rotary cleaning and dissolving liquids allows a higher degree of apical third cleansing. [6]

Chloroform has been used as a solvent for gutta-percha since 1910 and the dissolution effect of chloroform is well established.[7] In spite of its superior properties as solvent, Chloroform has been banned by the U.S. Food and Drug Administration in 1976 due to its carcinogenic potential and toxicity to the tissues.[8,9] Due to the carcinogenic effects of chloroform, alternative solvents has been developed and tested for its efficacy and clinical uses. Xylene (dimethylbenzene) is an aromatic compound and has been reported to be a very efficient solvent for root canal obturating materials. Although it is toxic, its toxicity is inferior to benzene and chloroform.[10] Also, essential oils such as, Rectified white turpentine oil, Eucalyptus oil, Peppermint oil because of their solvent properties are currently used as a viable alternative to chloroform and xylene, The purpose of the present study was to evaluate the efficacy of chloroform, xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil in solubilizing guttapercha.

MATERIAL AND METHODS

Solvents capable of dissolving guttapercha were confirmed in a pilot study. Each solvent was tested at room temperature (25^0C) to determine its chemical potential for softening guttapercha. The solubility of guttapercha was tested in 2ml quantity of each five solvent independently for time

period of 5 minutes, 8 minutes, and 10 minutes. Distilled water was used a control. The difference in weight before and after dissolution was recorded in order to calculate the solubilizing efficacy expressed in terms of decrease in weight, for each solvent. Solvent included in the present study were Chloroform, Xylene, Rectified white turpentine oil, Eucalyptus oil, Peppermint oil and were used in their absolute form of concentration.

All guttapercha samples were selected from the same lot with of same manufacturer (Dentsply, Germany) and same inspection dates as to avoid any variation in its chemical composition. Ten guttapercha samples were taken for each group of solvents. An additional group of ten samples were taken to serve as a control group. These samples were tested in 2 mm of distilled water.

A. Weighing before exposure to the solvents: Each sample of the guttapercha was kept into a glass vial and the weight was recorded. The glass vial should be flat bottomed and preweighted in a digital analytical scale. Each vial was marked for their respective solvents with the object of weighing.

B. Exposure to the solvents: Two millimeter of the solvent was introduced into each glass vial containing guttapercha with the help of glass syringe. This volume of solvent was sufficient to completely cover the guttapercha. Now the cap was fitted to the glass vial followed by vigorous shaking of the vials for two minutes.

C. Decantation of solvents: The caps of the vials were removed after proper shaking and then the vails were decanted.

D. Allowing for the evaporation of solvents: The solvent left over guttapercha and walls of the vials were allowed to evaporate by keeping the vials open under the fan.

E. Weighing after evaporation of the solvents: Each vial containing the undissolved portion of guttapercha were weighed at 5 minutes, 8 minutes and 10 minutes subsequently in a digital analytical scale and the weights were recorded to find out the difference in the weight of guttapercha.

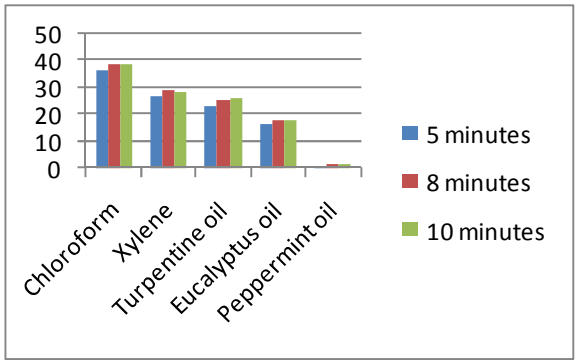
Means and standard deviations of percentage loss of weight were calculated at each time interval for each group of specimens. The values were compared by statistical parametric tests using the STATISTICA software (Windows version 6.0, DELL software, Texas, USA). Student t test was used to determine whether a significant difference exists between the mean values of two set of observations.

RESULTS

The mean percentage decrease in the weight of gutta percha by different solvents at different time intervals is shown in table 1. The weight loss of gutta-percha as a function of time is presented in Graph 1.

Table 1: Mean percentage decrease in weight of Guttapercha

Solvents	After 5 minutes	After 8 minutes	After 10 minutes
Chloroform	36.42±0.82	38.87±0.73	38.87±0.73
Xylene	26.84±0.94	28.94±0.94	28.30±0.97
Turpentine oil	23.09±0.80	25.20±0.90	25.86±0.89
Eucalyptus oil	16.24±0.83	17.80±0.91	18.27±0.85
Peppermint oil	0.96±0.47	1.39±0.70	1.76±0.76



Graph 1: *Mean percentage decrease in weight of guttapercha showed by various solvent.*

The mean value went on increasing with the passage of time due to evaporation of the residual solvents. The mean percentage decrease in weight of gutta percha increases with a lapse of time from 5 to 8 minutes till 10 minutes as no further changes in weight of gutta percha was observed after this time. Chloroform among the all solvents showed maximum dissolution of gutta-percha followed by xylene, turpentine oil, eucalyptus oil. The least dissolution ability for gutta-percha was found in peppermint oil. Mean percentage decrease in weight of guttapercha was high in chloroform (38.87±0.73), followed by xylene (28.30±

0.97), rectified white turpentine oil (25.86±0.89), eucalyptus oil (18.27±0.85) and peppermint oil (1.76±0.76) respectively (Table 1 & Graph 1). Distilled water showed not alternation in guttapercha weight. A highly significant difference (P<**0.05)** was observed between the different solvents (Table 2).

Table 2: Inter group Comparison using t test

Groups	**t value**	**P value (<0.05)**
Chloroform Vs Xylene	24.28	HS
Chloroform Vs Turpentine oil	36.79	HS
Xylene Vs Turpentine oil	9.60	HS
Eucalyptus oil Vs Chloroform	54.69	HS
Eucalyptus oil Vs Xylene	26.73	HS
Eucalyptus oil Vs Turpentine oil	18.71	HS
Eucalyptus oil Vs Peppermint oil	50.65	HS
Peppermint oil Vs Chloroform	118.64	HS
Peppermint oil Vs Xylene	77.87	HS
Peppermint oil Vs Turpentine oil	75.42	HS
Peppermint oil Vs Eucalyptus oil	50.65	HS

HS-highly significant

The best solvent capacity was obtained with chloroform, followed by xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil. Distilled water did not showed any alterations in the guttapercha.

DISCUSSION

Conservative management is the primary choice of treatment modalities over radical procedures such as periapical surgeries in cases of failed root canal treatment. Removal of coronal portion of the gutta-percha can be achieved with heat carriers such as Touch N. Heat, System, Gates-Glidden burs, Nickel Titanium rotary file.[11]The sequential technique involves creating a reservoir and refilling it in the canal orifice with the drops of solvent and picking into the dissolving gutta-percha while filing with a size 10, 15 and 20 stainless steel files. This is done until the apical one third of the root is negotiated after which all the solvents should be discontinued. Sequentially larger K-type files are then inserted into the canal until all the gutta-percha mass is removed from the root canal.

Chloroform is the most effective and most widely used solvent for gutta-percha.[12]This is in agreement with the findings of the present study as chloroform showed maximum dissolution of the guttapercha followed by xylene when compared with other test groups. Xylene and chloroform are classified as the solvents with major capacity of dissolution of gutta-percha and also as those which present the most undesirable effects to the periapical tissues,[13] as well as being considered potentially carcinogenic and neurotoxic.[14] Therefore, degree of toxicity is of prime importance when selecting a solvent in the clinical environment.

With the increase in concern over patient safety and toxic potentials of the solvents, the use of essential oils in endodontics is growing because of their non-toxic, biocompatibility, and non - carcinogenic potential. Eucalyptus oil is the distilled oil obtained from the leaves of *Eucalyptus globulus* Its major constituent is 1,8-cineole, which exhibits antibacterial and anti-inflammatory properties.[15] It has a potential of dissolution of gutta-percha which increases significantly when heated,[16] if not heated, it dissolves the material more slowly. Rectified white turpentine oil has anti-microbial properties, is non-carcinogenic and biocompatible to the soft tissues. In the present study rectified white turpentine oil showed higher rate of dissolution of guttapercha when compared with eucalyptus oil. This finding is in concurrence with the findings of previous studies.[17] However, no significant difference (p>0.05) was found between dissolution rate of Xylene and Rectified white turpentine oil. Peppermint oil in contrast to other solvents was found to be a weak solvent in the present study. Therefore, it does not appear to be a useful solvent for dissolving guttapercha.

In view of the existence of similarity in solvent capacity between essential oils and the other chemical solvents studied, clinically use of rectified white turpentine oil and eucalyptus oil for a longer time can be advocated. This clinical practice will ward off the side effects which might occur due to use of chloroform and xylene as a guttapercha solvent. Also, the uncontrollable

miscibility and penetration depth of xylene and chloroform reaches the periapical areas of tooth and causing a chemical peri-cementitis and damage to periapical tissues.[15] An ideal guttapercha solvent should depict a balance between clinical efficacy and level of toxicity. Within the limitations of the present study rectified white turpentine oil was found to be most effective solvent followed by eucalyptus oil.

Author affiliations: 1. Dr. Anil Kumar, MDS, Medical Officer, Lucknow, India. 2. Prof. Dr. Ramesh Kumar Pandey, MDS, HOD, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, King George Medical University, Lucknow, India. 3. Dr. Apurva Mishra, MDS, Senior Resident, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, King George Medical University, Lucknow, India.

CONCLUSION: In view of findings of the present study it can be concluded that chloroform and xylene showed to have highest dissolving efficacy as a guttapercha solvent. Rectified white turpentine oil, a less toxic solvent comparable to chloroform and xylene showed efficacy similar to xylene and superior to eucalyptus oil and peppermint oil.

REFERENCES

1. Ingle JI, Bakaland LK. Outcome of endodontic treatment and retreatment: Endodontics, 5th ed. Hamilton: BC Decker Inc; 2002. p. 747-68
2. Martos J, Gastal MT, Sommer L, Lund RGL, Del Pino FAB, Osinaga PWR. Dissolving efficacy of organic solvents on root canal sealers. Clin Oral Invest. 2006; 10:50-54.
3. Schäfer E, Zandbiglari T. A comparison of the effectiveness of chloroform and eucalyptus oil in dissolving root canal sealers. Oral Surg Oral Med Oral Pathol Oral RadolEndod. 2002; 93:611-616.
4. Miner MR, Berzins DW, Bahcall JK. A comparison of thermal properties between gutta-percha and a synthetic polymer based root canal filling material (Resilon). J Endod. 2006; 32(7):683-686.
5. Kosti E, Lambrianidis T, Economides N, Neofitou C. Ex vivo study of the efficacy of H-files and rotary Ni-Ti instruments to remove gutta-percha and four types of sealer. IntEndod J.2006; 39(1):48-54.
6. Bodrumlu E, Uzun O, Topuz O, Semiz M. Efficacy of 3 techniques in removing root canal filling material. J Can Dent Assoc. 2008; 74(8):721.
7. Karatas E, Kol E, Bayrakdar IS, Arslan H. The effect of chloroform, orange oil and eucalyptol on root canal transportation in endodontic retreatment. Aust Endod J. 2016;42:37–40.
8. Whitworth JM, Boursin EM. Dissolution of root canal sealer cements in volatile solvents. IntEndod J. 2000;33:19–24.
9. Schäfer E, Zandbiglari T. A comparison of the effectiveness of chloroform and eucalyptus oil in dissolving root canal sealers. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2002;93:611–616.
10. Duncan HF, Chong BS. Removal of root filling materials: Root filling removal. Endod Topics. 2008;19:33–57.
11. Wong R. Conventional endodontic failure and retreatment. Dent Clin N Am 2004;48:265-89.
12. Tamse A, Unger U, Metzger Z, Rosenberg M. Guttapercha solvents – a comparative study. J Endod 1986;12:337-339.
13. Spangberg L, Langeland K. Biologic effects of dental materials. 1. Toxicity of root canal filling materials on HeLa cells *in vitro*. Oral Surg Oral Med Oral Pathol. 1973;35(3):402-414.
14. Wourms DJ, Campbell AD, Hicks ML, Pelleu GB Jr. Alternative solvents to chloroform for gutta-percha removal. J Endod. 1990;16(5):224-226.
15. Magalhães BS, Johann JE, Lund RG, Martos J, Del Pino FA. Dissolving efficacy of some organic solvents on gutta-percha. Braz Oral Res. 2007;21:303–307.
16. Oyama KON, Siqueira EL, Santos M. In vitro study of effect of solvent on root canal retreatment. Braz Dent J. 2002;13(3):208-211.
17. Jesus Djalma PÉCORA Júlio César Emboava SPANÓ Eduardo Luiz Barbin. In Vitro Study on the Softening of Gutta-Percha Cones in Endodontic Retreatment. Brazilian Dental Journal.1993; 504(1): 43-47.

Corresponding Author:
Prof. Dr. Ramesh Kumar Pandey,
HOD, Department of Paediatric and Preventive Dentistry, Faculty of Dental Sciences, King George Medical University, Lucknow, India.
Contact no: 91-9415087376
Email:rameshpandey99@gmail.com

How to cite this article: Kumar A, Pandey KR, Mishra A. A comparative evaluation of efficacy of chloroform, xylene, rectified white turpentine oil, eucalyptus oil and peppermint oil as GuttaPercha solvent: An in vitro study. Rama Univ J Dent Sci 2017 Mar;4(1):6-9.

Sources of support: Nil **Conflict of Interest**: None declared