Original Research Paper

Volume-9 | Issue-6 | June-2019 | PRINT ISSN No. 2249 - 555X

Endodontics

EFFECTIVENESS OF FIVE DIFFERENT SOLVENTS ON GUTTA-PERCHA- AN IN VITRO STUDY

Dr. Moksha Nayak MDS, PhD -Professor, Department of Conservative Dentistry and Endodontics, KVG Dental College and Hospital, Sullia, Dakshina Kannada. Karnataka, India. 574327

Dr Angeline jose* Post graduate student, Department of conservative dentistry and endodontics, KVG Dental College and Hospital, Sullia, Dakshina Kannada, Karnataka, India, 574327 *Corresponding Author

ABSTRACT The aim of this study was to evaluate the efficacy of xylene, chloroform, turpentine oil, thyme oil and orange oil to dissolve gutta-percha at three different immersion time intervals.

Three hundred and forty gutta-percha cones of ISO no.35 (Dentsply 0.06 taper) were taken as samples for the study. Gutta-percha cones were divided into five groups for immersion in the different solvents tested for 5,10 and 15minutes. The means of gutta-percha dissolution in the solvents were obtained by the difference between the pre-immersion original weight and the post-immersion weight in a digital analytical scale. Data were statistically analyzed by Analysis of Variance (ANOVA). The best solvency capacity to dissolve gutta-percha was showed by xylene and the least was shown by turpentine oil at all three-time intervals.

KEYWORDS : Endodontic retreatment; dissolving efficacy; gutta-percha; solvents

INTRODUCTION

Success rate of endodontically treated obturated with gutta-percha ranges from 60% to 96%.[1,2,3,4] Inappropriate mechanical debridement, persistence of bacteria in the canals, poor obturation quality, over and under extension of the root canal filling, coronal leakage and procedural errors are the common attributable causes for failure of endodontic therapy which can result in recurrence of clinical symptoms along with the presence of a periapical radiolucency.[5]

Gutta-percha is the most frequently used filling material for root canal obturation because of the least irritating and least toxic behaviour.[6]

Gutta-percha cones can be removed using mechanical, thermal, chemical or a combination of them and special instruments such as ultrasound instruments.[6,7,8,9,10] Organic solvents are a chemical class of compounds that are applied during retreatment to decrease the resistance of filling materials in the root canal thus facilitating their removal without damaging the tooth. [11] The most commonly used organic solvents in endodontics are: chloroform, xylene, halothane, eucalyptol, turpentine, tetrachloroethylene and orange oil.[7,9,10,12,13,14]

Xylene is considered as very toxic to tissues. Orange oil is a good alternative for use in endodontic retreatment, due to its lower toxicity compared to other substances.[6] Even though chloroform is considered as the gold standard it is classified as a group 2B carcinogen by the International Agency for Research of Cancer.[15]

Thyme essential oil because of its medicinal property has been used in various fields of medicine and dentistry as an antibacterial agent, antirheumatic agent, antifungal agent, antiseptic agent, expectorant and an analgesic.[16]

Solvency of gutta-percha has been studied using various chemical solvents such as xylene, chloroform, halothane, tetrachloroethylene and also using essential oils such as eucalyptol, turpentine and orange oil.[9,10,12,13] Gutta- percha solvency of thyme oil has not been studied.

Hence the purpose of this study was to comparatively evaluate the dissolving efficacy of different gutta-percha solvents at three different time intervals and to evaluate the most efficient solvent for the removal of the filling material from root canals during endodontic retreatment.

MATERIALS AND METHODS

Three hundred and forty gutta-percha cones were taken as samples for the study. Each gutta-percha cone was standardized to 20mm length by cutting the thinnest parts to avoid any breakage during experiment.

Gutta-percha cones were divided into five experimental groups of 66 cones each for immersion in xylene(group1), chloroform(group2), turpentine oil(group3), thyme oil(group4) and orange oil(group5) and were further divided into three subgroups (n=22) depending on the time interval used for immersion as 5 min, 10 min and 15 min. All the test samples were weighed in a digital analytical scale in grams (M_1) and were immersed in 20 ml of solvent to be tested at room temperature in an amber glass bottle.

Samples were removed from the glass bottle after the specified immersion period, washed in 100 ml of distilled water and was allowed to dry for 24 hours at 37°C in a humidifier. The samples were again weighed after immersion in the specific solvent on a digital analytical scale at different time intervals(M_2).

The extent of gutta-percha removed from the specimen (M) was calculated from the difference between the original weight of gutta-percha and its final weight expressed in grams was measured using the following equation:

$M=M_2-M_1$

Where:

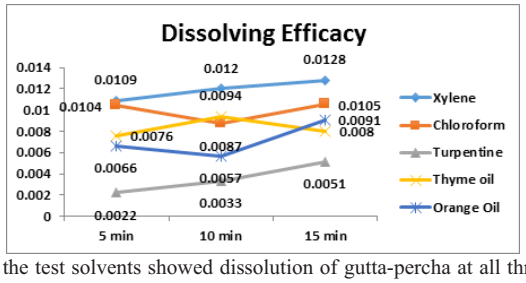
M_2=Post-immersion weight.

M_1=Pre-immersion weight.

Mean and standard deviation of percentage loss of weight were calculated at each time interval for each group. The difference in dissolution of gutta-percha along the different times tested was calculated by paired 't' test and one-way ANOVA test. Multiple comparisons were further performed to compare the effect of the different solvents in different times with the value of statistical significance set at 0.05.

RESULTS

The weight loss of gutta-percha in different solvents as a function of time is represented as Graph1a.



All the test solvents showed dissolution of gutta-percha at all three-time intervals. At 5 min xylene exhibited the best dissolving capacity of gutta-percha followed by chloroform, thyme oil, orange oil and turpentine oil. Maximum solvency at 10 min was shown by xylene followed by thyme oil, chloroform, orange oil and turpentine oil. Dissolving capacity of xylene, thyme oil and turpentine oil increased at 10 min while chloroform and orange oil showed decreased solvency. At 15 min, maximum dissolution was shown by xylene followed by chloroform, thyme oil, orange oil and turpentine oil.

DISCUSSION

The success of non-surgical endodontic retreatment is related to the complete removal of filling materials from the root canal system.[17]
The evaluation criteria for the amount of material dissolved was in accordance with study conducted by Tamse et al.[7] Maximum dissolution capacity of xylene in the present study is in supportive of studies conducted by Kaplowitz and Wong et al.[10,18] The excellent solvent capacity of xylene is due to its action on covalent bonds between the carbon atoms of gutta-percha. But it presents the most undesirable effects to the periapical tissues and is considered as carcinogenic and neurotoxic.[19]

In the present study chloroform was inferior to xylene at all three time inetrvals. Chloroform shows rapid evaporation and it dissolves rather than softens the gutta-percha.[13] This could be the reason for less solvency capacity in the present study.

Very strong solvents which were used previously are capable of softening the enamel and dentin,[20] which may promote canal transportation and chemical pericementitis if penetrated beyond the apex.[21] Orange essential oil extracted from the peel of sweet orange, *Citrus aurantium* is easy to obtain and suitable for rapid removal of gutta-percha from root canals.[22]

Present study shows that turpentine oil requires more time to soften gutta-percha than other organic solvents and also has anti-microbial properties. It is non-carcinogenic and biocompatible.[12]

Present study is in supportive of study conducted by Martos *et al*[21] who stated that dissolving capacity of orange oil is inferior to chloroform and xylene at 2 min and 10min. Orange oil and thyme oil have been shown to be more biocompatible than turpentine, xylene, chloroform, and halothane.

Thyme oil comes from *Thymus vulgaris*, is an antiseptic, antioxidant, antibacterial, antispasmodic, hypertensive and is considered as safe.[23] In the present study dissolving capacity of thyme oil was highest at 10min and thereafter its solvency decreased which could be attributed to its rapid degrading behaviour.[24]

Considering the existence of similarity in solvent capacity between essential oils and the other organic solvents investigated, we could clinically use thyme oil and orange oil to dissolve gutta-percha. The choice of an ideal solvent requires the establishment of a balance between the level of clinical safety, the level of toxicity to the tissues and the chemical capacity of dissolution.

The present study was done to compare the efficacy of different essential oils with the most efficacious organic solvents. Further research has to be done using different essential oils to obtain a solvent which has maximum dissolving capacity in a short period of time.

CONCLUSION

Thyme oil showed fastest dissolving capacity in 10 min. Thyme oil could be used as an alternative to toxic organic solvents when used as a gutta-percha solvent.

REFERENCES

1. Sjögren, U. L. F., Hägglund, B., Sundqvist, G., & Wing, K. (1990). Factors affecting the long-term results of endodontic treatment. Journal of endodontics, 16(10), 498-504.
2. Fonzar, F., Fonzar, A., Buttolo, P., Worthington, H. V., & Esposito, M. (2009). The prognosis of root canal therapy: a 10-year retrospective cohort study on 411 patients with 1175 endodontically treated teeth. Eur J Oral Implantol, 2(3), 201-208.
3. Çalişkan, M. K., Pehlivan, Y., Sepetçioğlu, F., Türkün, M., & Tuncer, S. Ş. (1995). Root canal morphology of human permanent teeth in a Turkish population. Journal of endodontics, 21(4), 200-204.
4. Strindberg, L. Z. (1956). The dependence of the results of pulp therapy on certain factors-an analytical study based on radiographic and clinical follow-up examination. Acta Odontol Scand, 14, 1-175.
5. Tabassum, S., & Khan, F. R. (2016). Failure of endodontic treatment: The usual suspects. European journal of dentistry, 10(1), 144.
6. Magalhães, B. S., Johann, J. E., Lund, R. G., Martos, J., & Del Pino, F. A. B. (2007). Dissolving efficacy of some organic solvents on gutta-percha. Brazilian oral research, 21(4), 303-307.
7. Gill, H. K., Chhabra, A., Jindal, V., Vats, A., & Grewal, G. S. (2013). Removal of Gutta-Percha from the Root Canals using Three Different Rotary Files. Dental Journal of Advance Studies, 1(03), 159-162.
8. Ingle, J. I., & Bakaland, L. K. (2002). Outcome of endodontic treatment and retreatment: Endodontics.
9. Ladley, R. W., Campbell, A. D., Hicks, M. L., & Li, S. H. (1991). Effectiveness of halothane used with ultrasonic or hand instrumentation to remove gutta-percha from the root canal. Journal of Endodontics, 17(5), 221-224.
10. Kaplowitz, G. J. (1990). Evaluation of gutta-percha solvents. Journal of endodontics, 16(11), 539-540.
11. Taşdemir, T., Yildirim, T., & Çelik, D. (2008). Comparative study of removal of current endodontic fillings. Journal of endodontics, 34(3), 326-329.
12. Emboava, J. D. P. J. C., & Barbin, S. E. L. (1993). In vitro study on the softening of gutta-percha cones in endodontic retreatment. Brazilian dental journal, 504(1), 43-47..
13. Tamse, A., Unger, U., Metzger, Z., & Rosenberg, M. (1986). Gutta-percha solvents—a comparative study. Journal of endodontics, 12(8), 337-339.
14. Spanó, J. C. E., Barbin, E. L., Bonini, A., & Pécora, J. D. (2010). Eficácia dos óleos essenciais na desobturação dos canais radiculares. Revista Odontológica do Brasil Central, 5(14).
15. Rehman, K., Khan, F. R., & Aman, N. (2013). Comparison of orange oil and chloroform as gutta-percha solvents in endodontic retreatment. The journal of contemporary dental practice, 14(3), 478.
16. Meeran, N., Fizur, M., Javed, H., Al Taee, H., Azimullah, S., & Ojha, S. K. (2017). Pharmacological properties and molecular mechanisms of thymol: prospects for its therapeutic potential and pharmaceutical development. Frontiers in pharmacology, 8, 380.
17. de Oliveira, D. P., Barbizam, J. V. B., Trope, M., & Teixeira, F. B. (2006). Comparison between gutta-percha and resilon removal using two different techniques in endodontic retreatment. Journal of endodontics, 32(4), 362-364.
18. Wong, R. (2004). Conventional endodontic failure and retreatment. Dental Clinics of North America, 48(1), 265-289.
19. Rotstein, I., Cohenca, N., Teperovich, E., Moshonov, J., Mor, C., Roman, I., & Gedalia, I. (1999). Effect of chloroform, xylene, and halothane on enamel and dentin microhardness of human teeth. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 87(3), 366-36
20. Wourms, D. J., Campbell, A. D., Hicks, M. L., & Pelleu, G. B. (1990). Alternative solvents to chloroform for gutta-percha removal. Journal of endodontics, 16(5), 224-226.
21. Martos, J., Gastal, M. T., Sommer, L., Lund, R. G., Del Pino, F. A. B., & Osinaga, P. W. R. (2006). Dissolving efficacy of organic solvents on root canal sealers. Clinical oral investigations, 10(1), 50-54.
22. Legrand, D., Pierce, A., Elass, E., Carpentier, M., Mariller, C., & Mazurier, J. (2008). Lactoferrin structure and functions. In Bioactive components of milk (pp. 163-194). Springer, New York, NY.
23. Borugă, O., Jianu, C., Mişcă, C., Goleţ, I., Gruia, A. T., & Horhat, F. G. (2014). Thymus vulgaris essential oil: chemical composition and antimicrobial activity. Journal of medicine and life, 7(Spec Iss 3), 56
24. Prasanth Reddy, V., Ravi Vital, K., Varsha, P. V., & Satyam, S. (2014). Review on Thymus vulgaris traditional uses and pharmacological properties. Med. Aromat Plants, 3, 164.