

Original Research Article

Efficacy of gutta-percha solvents used in endodontic retreatments

Fábio de Almeida Gomes¹
Ana Paula Barros Daniel¹
Rodrigo Arraes Nunes¹
Anna Lygia Nunes Fernandes¹
Claudio Maniglia-Ferreira¹
Humberto Ramah Meneses de Matos¹
Taffarel Canuto Nepomuceno¹

Corresponding author:

Fábio de Almeida Gomes
Rua Paula Ney, n. 925, apto. 501 – Aldeota
CEP 60140-200 – Fortaleza – CE – Brasil
E-mail: fabiogomesce@yahoo.com.br

¹ Department of Endodontics, University of Fortaleza – Fortaleza – CE – Brazil.

Received for publication: March 10, 2013. Accepted for publication: June 24, 2013.

Keywords: root canal, retreatment; solvents; gutta-percha.

Abstract

Introduction and Objective: The aim of this study was to evaluate the effectiveness of four different solvents and classify them according to their potential of action. **Material and methods:** Four solvents were tested: xylene, eucalyptol, orange oil and chloroform. Twelve gutta-percha points (medium-large), sectioned at 10 mm were used and divided into four groups, resulting in three samples for each solvent. The gutta-percha points were weighed on an analytical balance before being subjected to the action of solvents and subsequently put onto watch glasses that were immersed into the solutions for the following times: 1, 2, 3, 4 and 5 minutes. The percentage of mass loss was registered through weighing after every minute of action of the solvent on the points. **Results:** All solvents showed the first minute of action as the period of greatest power of dissolution because they act only on the gutta-percha itself and not on the other components of the point, suggesting that at the remaining minutes there would be a lower percentage of dissolution because there was a smaller amount of gutta-percha within the points. **Conclusion:** Chloroform and xylene showed similar results regarding the rate of dissolution of gutta-percha, yet they were statistically significant higher than eucalyptol and orange oil from 1 to 5 minutes.

Introduction

Recently, it has been understood that the endodontic treatment success is directly related to many factors associated as links in a chain so that one is broken, the probability of treatment failure markedly increases. Among these factors, it can be mentioned the accurate diagnosis, maintenance of the aseptic chain, knowledge of tooth morphology, correct chemical-mechanical preparation and tridimensional filling of the root canal system. Possible faults in any of these steps will lead to endodontic treatment failure [9].

The clinical diagnosis of the pulp and periapical pathologies based on knowledge, expertise, semiological and radiographic data, and mainly on the clinical judgment of the dentist will enable the effective planning of the procedure, allowing a favorable prognosis of the endodontic treatment [1].

In cases of endodontic failure, the first treatment of choice is root canal retreatment comprising the removal of the filling material from the root canals which is one of the most important steps of this approach [3]. Many techniques, instruments and substances have been employed aiming to remove gutta-percha. Among them, the use of hand instruments either without or with solvents are emphasized [6], because the latter decrease the risks of damaging to the tooth structure during the gutta-percha removal [15].

Among the chemical solvents, xylene, eucalyptol, orange oil and chloroform have been some of the options more commonly employed [5, 7, 8, 12]. According to Stabhous and Friedman [15], the use of solvents is essential for filling material removal within dentinal tubules and ramifications, therefore making easy the biomechanical preparation and the penetration of the irrigant solutions and intracanal medications [3, 17]. On the other hand, some studies have demonstrated that regardless of the instrumentation and removal technique employed, it is not possible to obtain a root canal system free of debris and residual infection [6, 18].

Despite of the easy gutta-percha removal obtained with the chemical solvents, these substances may show different degrees of dissolution and removal of the filling material from root canal and because of their toxic potential they may provoke damage to the patient [10].

Trying to balance the effectiveness and toxicity of the solvent, many authors have employed eucalyptol because it is a substance largely used to flavor and perfume and unharmed to health. However, Wennberg and Orstavik [16], aiming

to test the capacity of action of some solvents alternative to chloroform, through the use of a device measuring the penetration depth onto a gutta-percha disc covered by the test solution at many time periods, concluded that at the environment temperature eucalyptol exhibited the least dissolution than the other solvents tested. Zakariasn *et al.* [20], described a retreatment technique without chloroform and observed that heated eucalyptol had its solvent power increased.

In 1992 Pécora *et al.* [13] displayed the orange oil as a solvent for zinc oxide cement. In the following year, Pécora *et al.* [12] studied the softening power of gutta-percha points in endodontic retreatment through a penetrometer that reproduces the force of an endodontic file within a simulated root canal which had been previously filled and covered with the test solvent. These authors concluded that the orange oil exhibited a softening action similar to that of xylene. Additionally to show good solvency feature, this substance has the advantages of lacking of deleterious effects, having expectorant action and pleasant odor, and being pharmaceutically used to flavor and perfume.

The aim of this study was to evaluate the dissolution capacity of four solvents: chloroform, xylene, eucalyptol and orange oil and to compare their capacity to obtain the most efficient regarding to the removal of the filling material from root canals during endodontic retreatment.

Material and methods

This was a comparative and laboratorial study employing structurally sound gutta-percha points (Odous de Deus ML, Batch 3, Belo Horizonte, MG, Brazil), within expiration date. The points were randomly divided into four experimental groups (table I).

Table I - Experimental groups

Group	Solvent	Specimens
Group I	Eucalyptol	3
Group II	Citrol	3
Group III	Xylene	3
Group IV	Chloroform	3

Firstly, each point was standardized in 10 mm by cutting the point's top and also the thinnest parts to avoid that they broke during the experiment. After that, the points were weighed in an analytical balance (Marte, model AY 220) and the values were

recorded considering four decimal places after the decimal point to identify the baseline weights of each specimen prior to the solvent action.

Then, each gutta-percha point was immersed for 1 minute into the solvent of the group it had been assigned (figure 1). After that, the point was immersed into 80 ml of distilled water for 30 minutes so that a gradual loss of dissolution capacity occurred over time. Following, the point was dried with the aid of Whatman no.1 filter paper (Lab-Line Comércio e Produtos para Laboratório, Piracicaba, SP, Brazil) and stored. A new weighing was carried out both to compare and calculate the percentage of weight loss. These procedures were repeated at 2, 3, 4 and 5 minutes of immersion in each solvent. At every minute of evaluation 1 ml of the solvent solution was renewed.

The results were displayed as the means of weight loss for each solvent. All results were tabulated and statistically analyzed through SPSS 12.0 software for Windows (SPSS Inco., Chicago, USA), and the most suitable statistical test was applied according to the characteristics of the sampling data.



Figure 1 - Gutta-percha point standardized at 10 mm before and after the solvent application

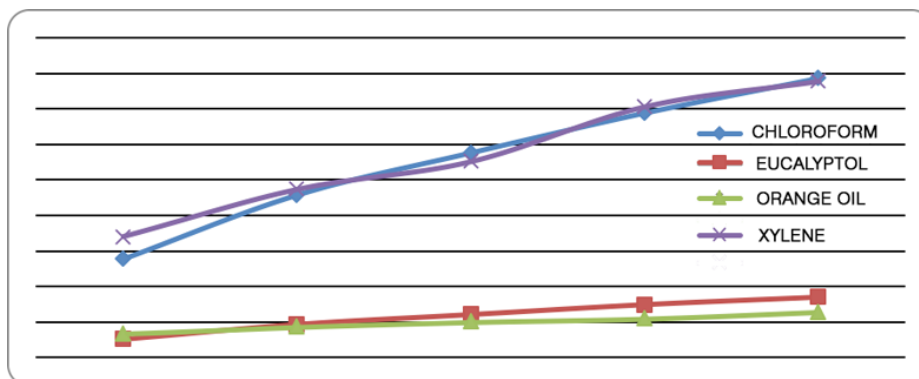
Results

Based on the methodology employed, it was possible to identify the solvents with higher power of dissolving gutta-percha within the periods evaluated. With regards to the percentage of weight loss provoked by each solvent at 5 minutes, chloroform showed the greatest weight loss (39.36%), followed by xylene (38.9%), eucalyptol (8.56%) and Orange oil (6.49%). The results of the loss at each minute are seen in table II and graph 1.

Table II - Percentage of weight loss of gutta-percha points at 1 to 5 minutes

	1'	2'	3'	4'	5'
Chloroform	13.92%	22.94%	28.88%	34.48%	39.36%
Eucalyptol	2.63%	4.72%	6.11%	7.51%	8.56%
Orange oil	3.36%	4.38%	5.07%	5.54%	6.49%
Xylene	17%	23.71%	27.62%	35.32%	38.9%

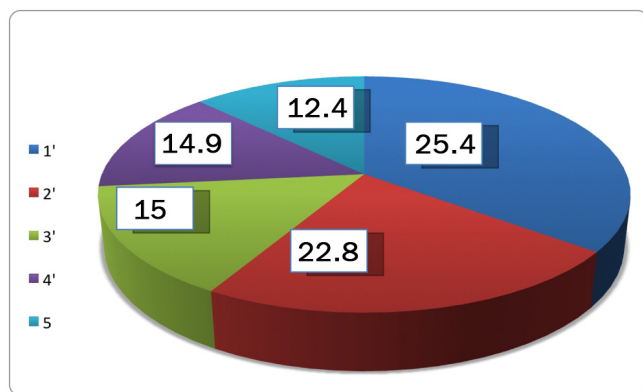
Turkey test $p < 0.01$



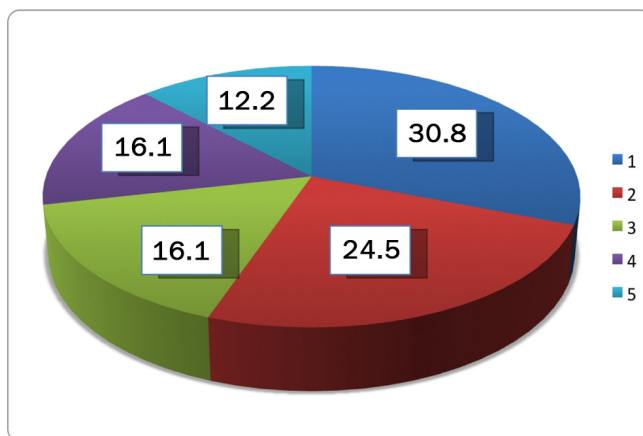
Graph 1 - Percentage of weight loss of gutta-percha points at to 5 minutes

Taking into consideration these results, chloroform and xylene exhibited the greatest percentage of dissolution than that of eucalyptol and orange oil at 1 and 5 minutes, with statistically significant difference (Turkey test $p < 0.01$). After the comparison of the values from the first and fifth minute, this later showed the highest dissolution with statistically significant difference ($p = 0.0152$).

Considering the total weight loss provoked by each solvent, all solutions caused the highest dissolution of gutta-percha at the first minute. The chloroform exhibited the greatest dissolution peak at the first minute, followed by the second, third, fourth and fifth minute (graph 2). A similar result was achieved by eucalyptol, but the third and fourth minutes displayed equal values (graph 3).

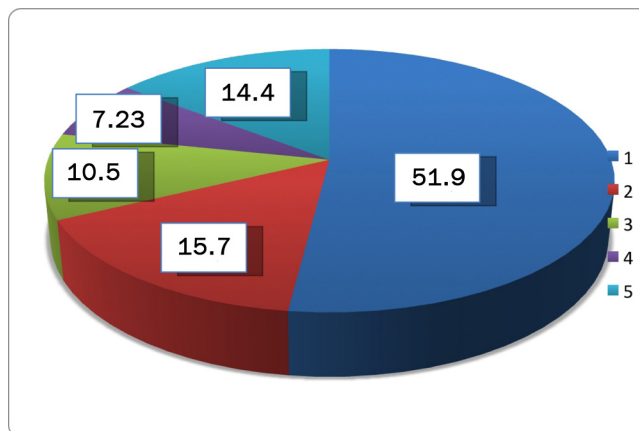


Graph 2 - Percentage of gutta-percha dissolution per minute of chloroform

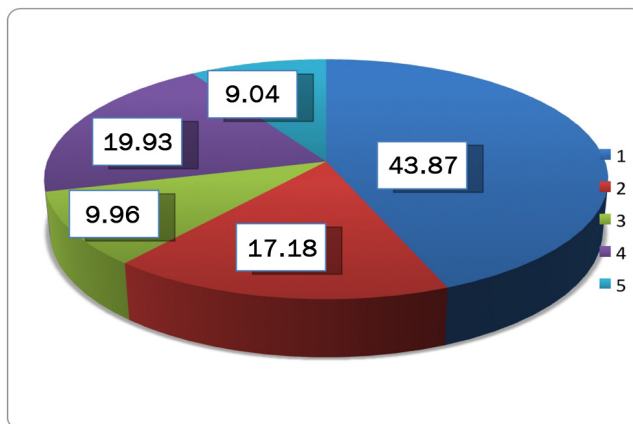


Graph 3 - Percentage of gutta-percha dissolution per minute of eucalyptol

The orange oil also showed the highest dissolution value at the first minute, followed by the second, fifth, third and fourth minutes (graph 4). The xylene obtained the highest dissolution value at the first minute followed by the fourth, second, third, and fifth minutes (graph 5).



Graph 4 - Percentage gutta-percha dissolution per minute of orange oil



Graph 5 - Percentage of gutta-percha dissolution per minute of xylene

Discussion

Mechanical, thermal and chemical techniques can be either individually applied or combined to remove filling materials during endodontic retreatment, despite the fact that in some cases the complete removal of the filling material is impracticable [2, 4].

The results of this present study demonstrated that xylene and chloroform had the highest potential of gutta-percha dissolution than that of eucalyptol and orange oil ($p < 0.01$), which is similar to the findings of the studies of Oyama *et al.* [14] and Tanomaru-Filho *et al.* [16], but disagrees with those of Martos *et al.* [11], who found similar results between orange oil and xylene.

In this present study, all solvents exhibited the greatest percentage of dissolution at the first minute. It is important to emphasize that gutta-percha points are composed by gutta-percha itself, zinc oxide, waxes, resins and barium sulfate, but the solvents only act on gutta-percha. Accordingly, it seems that this greatest percentage of dissolution occurred at the first minute because at the remaining minutes there would be a smaller amount of gutta-percha within the point so that there was a smaller area of action for the solvent.

Other result found was that after five minutes the solvents exhibited a higher dissolution value than that after only one minute, suggesting that the solution must be used for at least five minutes.

Based on the methodology employed and the results obtained, it was concluded that the xylene and chloroform exhibited higher dissolution values than those of orange oil and eucalyptol. Further studies are necessary to evaluate the cytotoxicity to indicate the best solvent to be employed in endodontic retreatment.

Conclusion

Considering the results obtained and the methodology employed, it can be concluded that chloroform was the most effective solution in dissolving gutta-percha points, followed by xylene. However, both solutions present cytotoxic effects and may cause damage to the patient. There were no statistically significant differences between the solvency power of eucalyptol and orange oil, confirming that orange oil can be used as an alternative solution to aid in endodontic retreatment.

References

- Allgayer S, Vanni JR. Remoção e núcleo intrarradicular seguida de retratamento endodôntico: 13 anos de preservação. RSBO. 2010 Sep;8(1):108-13.
- Bueno CE, Delboni MG, Araújo RA, Carrara HJ, Cunha RS. Effectiveness of rotary and hand files in gutta-percha and sealer removal using chloroform or chlorhexidine gel. Braz Dent J. 2006;17(2):139-43.
- Ezzie E, Fleury A, Solomon E, Spears R, He J. Efficacy of retreatment techniques for a resin-based root canal obturation material. J Endod. 2006 Apr;32(4):341-4.
- Hassanloo A. Retreatment efficacy of the Epiphany soft resin obturation system. J Endod. 2007 Aug;40(8):633-43.
- Hunter KR, Doblecki W, Pelleu GB. Halothane and Eucalyptol as alternatives to chloroform for softening gutta-percha. J Endod. 1991 Jul;17(7):310-2.
- Imura N, Zuolo ML, Ferreira MO, Novo NF. Effectiveness of the canal finder and hand instrumentation in removal of gutta-percha root fillings during root canal retreatment. J Endod. 1996 Nov;29(6):382-6.
- Kaplowitz GJ. Evaluation of the ability of essential oils to dissolve gutta-percha. J Endod. 1991 Sep;17(9):448-9.
- Ladley RW, Campbell AD, Hicks ML, Li SH. Effectiveness of halothane used with ultrasonic or hand instrumentation to remove gutta-percha from the root canal. J Endod. 1991 May;17(5):221-4.
- Limongi O, Troian C, Viegas AP, Filho FB, Irala LE, Maia SMAS. Desobturação do canal radicular: o desempenho dos solventes óleo de laranja e eucaliptol. Revista Gaúcha de Odontologia. 2004 Oct-Dec;53(4):341-5.
- Magalhães BS, Johann JE, Lund RG, Martos J, Del Pino FA. Dissolving efficacy of some organic solvents on gutta-percha. Braz Oral Res. 2007 Oct-Dec;21(4):303-7.
- Martos J, Gastral MT, Sommer L, Lund RG, Del Pino FA, Osinaga PW. Dissolving efficacy of organic solvents on root canal sealers. Clin Oral Invest. 2006 Mar;10(1):50-4.
- Pécora JD, Spanó JCE, Barbin EL. In vitro study on the softening of gutta-percha cones in endodontic retreatment. Braz Dent J. 1993 Feb;4(1):43-7.

13. Pécora JD, Costa WF, Santos Filho O, Sarti SJ. Apresentação de um óleo especial obtido através do citrus amantium, eficaz na desintegração do cimento de óxido de zinco eugenol, do interior do canal radicular. *J Odonto.* 1992 Jan-Feb;1(5):130-2.
14. Oyama, KO, Siqueira, EL, Santos, M. In vitro study of effect of solvent on root canal retreatment. *Braz Dent J.* 2002 Feb;13(3):208-11.
15. Stabholz A, Friedman S. Endodontic retreatment - case selection and technique. Part 2: treatment planning for retreatment. *J Endod.* 1988 Dec;14(12):607-14.
16. Tanomaru-Filho M, Orlando TA, Bortoluzzi EA, Silva GF, Tanomaru JMG. Solvent capacity of different substances on gutta-percha and resilon. *Braz Dent J.* 2010 Oct;21(1):46-9.
17. Wennberg A, Orstavik D. Evaluation of alternatives to chloroform in endodontic practice. *Endod. Dental Traumatology.* 1989 Mar;5(4-6):234-7.
18. Whitworth JM, Boursin EM. Dissolution of root canal sealer cements in volatile solvents. *J Endo.* 2000 Jan;33(1):19-24.
19. Wilcox LR, Krell KV, Madison S, Rittman B. Endodontic retreatment: evaluation of gutta-percha and sealer removal and canal reinstrumentation. *J Endod.* 1987 Sep;13(9):453-7.
20. Zakariasn KL, Brayton SM, Collinson DM. Efficient and effective root canal retreatment without chloroform. *J Canad Dent Assoc.* 1990 Jun;56(6):509-12.