

Solubilizing efficiency of different gutta-percha solvents: A comparative study

M. Ömer Görduysus¹, Fügen Taşman¹, Serdar Tuncer² and İlker Etikan³

Department of Endodontics¹, Faculty of Dentistry, Hacettepe University, Ankara, Turkey

Departments of Microbiology² and Biostatistics³, Faculty of Medicine, Hacettepe University, Ankara, Turkey

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Abstract: A study was conducted to comparatively evaluate the efficiency of different solvents for dissolving gutta-percha. Halothane, chloroform, xylene, acetone, isopropyl alcohol, turpentine, oil of mela-leuca and eucalyptol were used as solvents for dissolving standardized gutta-percha discs. Halothane, chloroform and xylene were markedly superior solvents of gutta-percha in comparison with the others. There was no significant difference among the three ($p > 0.05$). Eucalyptol, turpentine and oil of melaleuca were relatively less efficient. Acetone and isopropyl alcohol did not dissolve gutta-percha, being similar in this respect to distilled water.

Key words: gutta-percha solvents; halothane; chloroform; xylene.

Introduction

Gutta-percha solvents are used in miscellaneous endodontic procedures such as solvent-softened gutta percha or customized master cone filling, or for total removal of root canal fillings for retreatment and partial removal of root canal filling for preparing a post space (1). Gutta-percha is the most commonly used and the dominant material for root canal obturation, and the use of an organic solvent greatly facilitates its removal (2).

The methods used to remove gutta-percha are thermal, mechanical, chemical or a combination of the three (3). Chemical methods for removing gutta-percha have been used for years, but the most effective chemicals are toxic or otherwise perilous (4). For instance, chloroform and xylene are the two most commonly used solvents, but chloroform is prohibited by the U.S. Food and Drug Administration because of its potential carcinogenicity (5,6). Xylene is available today for clinical use, and is not considered a potential carcinogen, but is very toxic to tissues (4,7).

Eucalyptol and halothane are also known solvents of gutta-percha which are applicable for clinical use and not considered potential carcinogens (7). Halothane, a commonly used inhalation anesthetic, is nearly as effective as

chloroform for dissolving gutta-percha, and is also not irritating, explosive or flammable (8). Eucalyptus oil must be heated in order to solubilize gutta-percha, and the unheated oil dissolves gutta-percha only slowly, thus significantly prolonging the chairside time required (9).

Turpentine is another solvent that have been suggested and utilized for the same purpose, but has higher toxicity than chloroform and halothane, and in addition is not very effective solvent (10,11). Gutta-percha is also soluble in essential oils, some of which have been reported to be safe and useful for this purpose (4,12).

The purpose of this study was to comparatively evaluate the dissolution efficiency of different gutta-percha solvents.

Materials and Methods

Gutta-percha discs 10 mm in diameter and 2 mm thick were prepared by heating from master cones of Zipperer (United Dental Manufacturers Inc. Art no: 525, 0 - 9402) until a uniform mass had formed, and afterwards this warm mass was condensed into a standard metal mould (13). The average disc weight was 0.34 (± 0.04) g. The weight of the gutta-percha discs was standardized using a Mettler balance. All gutta-percha used in this study came from the same lot, manufacturer and package.

One milliliter of solvent (at 37°C which was maintained by use of a water bath) was added to a preweighted glass vial (T. S. Cam Sanayi A. Ş. Turkey) containing a gutta-percha disc, and mixed by a vortex shaker for 60 s. The solvents containing the dissolved gutta-percha were immediately decanted, and vials containing undissolved gutta-percha were left to stand to allow solvent evaporation. Afterwards, each vial was weighed at 2, 24 and 48 h. Evaporation ceased completely at 48 h, and no weight change was recorded thereafter.

Halothane (Hoechst AG, Germany), chloroform (Merck), xylene (Merck), acetone (Merck), isopropyl alcohol (Merck), turpentine (Staffollens, England), oil of melaleuca (Ankara University, Faculty of Pharmacy, Turkey) and eucalyptol (Dehe Co. AG, Dresden, Germany) were tested in this study as different groups. Distilled water was used in the control group. Gutta-percha is known not to dissolve in distilled water. Experiments were performed in triplicate for each group, 8 discs in each group ($n = 8$).

Data within the groups were analysed by Kruskal-

Correspondence to Dr. M. Ömer Görduysus, Department of Endodontics, Faculty of Dentistry, Hacettepe University, Yenışehir, Ankara, Turkey 06100

Wallis analysis of variance. The inter-groups data were compared by Mann-Whitney U test.

Results

Results for gutta-percha solubilization by the various solvents are presented in Fig. 1. The solvents were found to differ in their solubility efficiency ($\chi^2 = 31.6959$, $p = 0.0000$). As a group halothane, chloroform and xylene had markedly superior ability to dissolve gutta-percha in comparison with the others.

Halothane 6.12 % (± 2.34), chloroform 5.43 % (± 0.82) and xylene 8.03 % (± 3.13) dissolved the standard-

ized gutta-percha discs, and the differences among them were not statistically significant ($p > 0.05$). Turpentine 1.8 % (± 1.14), eucalyptol 1.88 % (± 0.83) and oil of melaleuca 0.78 % (± 0.54) dissolved the gutta-percha. The differences between turpentine, eucalyptol and oil of melaleuca were not statistically significant ($p > 0.05$). However, the difference between eucalyptol and oil of melaleuca was significant ($p < 0.05$) (Table 1).

Acetone and isopropyl alcohol did not dissolve gutta-percha; discs weights in both solvents were the same before and after the experiments (data not shown). In the distilled water control group, none of the gutta-percha discs were dissolved (data not shown).

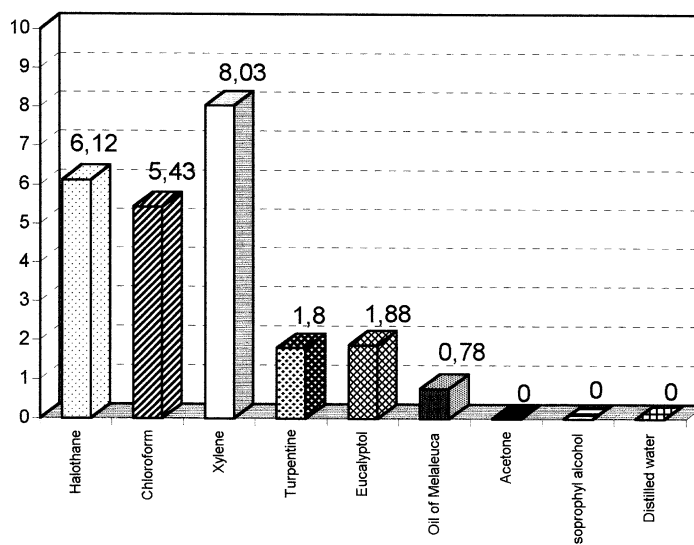


Fig. 1 Gutta-percha solubility. Solubility is expressed as percentage weight loss. Each bar represents the mean.

Table 1 Gutta-percha solubility. Means and standard deviations.

SOLVENTS	Mean (%)	Standard Deviation (+ or -)
Halothane	6.12	2.34
Chloroform	5.43	0.82
Xylene	8.03	3.13
Turpentine	1.80	1.14
Eucalyptol	1.88	0.83
Oil of Melaleuca	0.78	0.54
Acetone	0	-
Isopropyl alcohol	0	-
Distilled water	0	-

* Statistically equivalent ($p=0.00$ Kruskal -Wallis Analysis of Variance Test) $n=8$

Discussion

Our results indicated that chloroform, halothane and xylene showed the highest dissolution effectiveness as a group in comparison with the others, and that none was particularly superior other. Eucalyptol, turpentine and oil of melaleuca, an essential oil, demonstrated significantly less dissolution efficiency, respectively, in comparison with chloroform, halothane and xylene. Acetone and isopropyl alcohol both showed no dissolution ability similar to distilled water.

Halothane is a volatile, nonflammable and relatively nontoxic hydrocarbon which is used as an inhalation anesthetic and is also approved by the U.S. Food and Drug Administration (4,14). Halothane appears to be the most promising agent because it is as effective as chloroform and xylene and about twice as effective as eucalyptol in dissolving gutta-percha (14). Wilcox (15) reported that there was no significant difference between chloroform and halothane treatment for removing gutta-percha from the root canal, but that chloroform was significantly faster than halothane. Although chloroform is a faster solvent, we also concluded in this study that halothane is as efficient as chloroform, but safer. We believe that the safer choice has to be the first choice.

However, the volatile character of halothane creates problems with clinical use due to evaporation before the clinician utilize its softening effect, even though it is not considered as a potential carcinogen and it not a respiratory irritant. It has a sweet odor, is slightly more soluble in tissues than other agents and is minimally soluble in blood. On the otherhand chloroform is already banned in the U.S. because of its potential carcinogenicity (5,6).

Today, retreatment procedures are becoming more and more important in endodontics, rather than surgical methods. Naturally, different solvents are being used more widely, and we have to consider their properties such as dissolution efficiency. Based on our present results, we wish to emphasize that chloroform is not the only alternative for clinical use and that halothane is another suitable and safer option.

Conclusions

The results of this study indicate that halothane is an appropriate, equal and acceptable alternative to chloroform and xylene, with similar ability to dissolve gutta-percha. Moreover, safer use of halothane during retreatment procedures is another of its advantage.

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