Revision of the Endodontic Filling with Solvents Eucalyptol, Halothane and Orange Oil

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Summary

Chloroform was the most frequently used solvent for removing gutta-percha from the root canal. However, dispute with regard to its safety prompted the use of new solvents. The aim of this study was to compare the time required for dissolving gutta-percha by eucalyptol, halothane and orange oil. Seventy single rooted teeth were sterilised, treated by conventional "step-back" technique and filled by cold lateral condensation technique, and stored in 0.9% NaCl solvent for 180 days. After which revision of the root filler was performed. The revision was considered complete when no signs of gutta-percha and the filler were visible on the metallic instruments and paper sticks. In view of the distribution of data on key variables, ANOVA, with "post hoc" tests was applied during the analysis of results. Statistically reliable difference was determined between the speed of dissolvability with eucalyptol and the speed with halothane and orange oil.

Key words: *endodontic revision, gutta-percha, eucalyptol, halothane, orange oil.*

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Introduction

Endodontic revision is indicated when the root canal filling does not satisfy the standards of endodontic treatment. In such cases it is essential to carry out its revision. The filling usually consists of gutta-percha and filler. Numerous investigations have attempted to discover a means to effectively remove gutta-percha, and at the same time to have as little effect as possible on the tissue surrounding the tooth root and on the organism of the patient and medical staff. For revision of the filling of the root canal with gutta-percha and filler metallic endodontic instruments are most frequently used in combination with a solvent. Chloroform has been the most frequently used means for dissolving gutta-percha, and has remained in practice for a long time due to its availability, price and effectiveness (1). Scientific

investigations have shown that it is not harmless (2,3). It was found to induce the occurrence of tumours in experimental animals, and is therefore possibly dangerous for man (4,5,6). It was consequently proclaimed a potential cancerogenic (4,5,6). Because of the above facts attempts have been made to find and use other solvents for removing filling from the root canal. Today, eucalyptol and halothane are clinically acceptable solvents, and are not considered potentially cancerogenic or cytotoxic, although sceptical reports have been published on the safety of halothane (2,3,7,8,9,10).

Materials and methods

For the experiment 70 premolars from the mandibula were used from similar endodontic areas. The samples were cleaned mechanically and sterilised in Kavoklav (Ka Vo, Biberach, Germany) at a temperature of 120°C and pressure of 300 kPa for 15 minutes. The length of the root canal was determined by inserting a K-file # 15 (Maillefer, Ballaigures, Switzerland) into the canal. The samples were mechanically treated by conventional "step--back" technique and rinsed with 10 ml 2.5% solution of sodium hypochlorite. All the samples were treated up to the internal foramen with a K-file # 40 (ISO # 40), while the coronary third was treated up to the K-file # 80 (ISO # 80). The openings of the root canals were enlarged by up to one third with Gates-Glidden drills # 3 and # 4. Finally the canals were circularly treated with root files # 40 (Maillefer, Ballaigues, Switzerland), rinsed with 2 ml NaOCl and dried with paper (sticks) # 40 (Kerr, Romulus, MI, USA). The samples were filled by the cold lateral condensation technique and utilisation of standardised gutta-percha sticks (Kerr, Romulus, MI, USA) and polyketonic resin (Diaket (ESPE, Seefeld, Germany). The primary gutta-percha stick (master cone) was # 40, and for lateral condensation additional standardised gutta-percha # 25 were used. The samples were stored in 0.9% solution of NaCl at a thermostat temperature of 37°C. After 180 days the samples were taken out and air-dried. The teeth were divided by random selection into three groups of 20 teeth each. The remaining 10 samples served as the control group, of which five were a positive and five a negative control. In the first group eucalyptol (Kemig d.o.o. Zagreb, Croatia) was used as the solvent. In the second group halothane (Zeneca, Macclesfield, Cheshire, Great Britain) and in the third group orange oil (Aromara, Zagreb, Croatia). In the control group distilled water was used for the negative control and chloroform for the positive control. The manual instruments used were K-file (Maillefer, Ballagius, Switzerland) and root files (Hedstrom file) (Maillefer, Ballagius, Switzerland). Gates Glidden drills (Maillefer, Ballagius, Switzerland) were mounted on the handpiece.

A small reservoir was made by Gates Glidden drills # 3 at the opening to the canal for inserting the first 0.2 ml solution into the root canal. After placing the solvent in the reservoir of the root canal a K--file # 15 was inserted with which a space was made for the flow of the solvent towards the apex. The procedure was repeated up to K-file # 40. The softened gutta-percha was extracted from the root canal by a root file # 40. As needed the solvent was added into the root canal by means of a syringe up to 0.8 ml chloroform and halothane, and 0.4 ml eucalyptus and orange oil. The procedure was considered complete when there were no longer visible traces of gutta-percha and filler on the instruments and paper sticks, or if the procedure had lasted for more than 20 minutes (negative control). The marginal time period was determined in accordance with literature reports, in which revision lasting longer than 20 minutes were not reported (11, 12,13). The duration of the revision for the examined solvents (eucalyptol, halothane, organge oil) and for positive (chloroform) and negative control (distilled water) was measured in seconds. The experiment was stopped after 1200 seconds. As expected, during this period of time it was impossible to revise the samples of the negative control and thus the results for this group were not included in further statistical analysis.

In the analysis the methods used were suitable for the distribution of the data for key variables (ANOVA with "post hoc" tests), because intragroup testing of the distribution "to normal" by Kolmogorov-Smirnov test showed no statistically significant deviation from normal distribution. Because of the statistically significant results of ANOVA, the rigorous "post hoc" Scheffe test was applied of

the intergroup differences, and Dunnett's test of comparison with the control group (14).

Results

Table 1 shows the time in which a revision of endodontic filling was performed for a group in which eucalyptol, halothane, orange oil and chloroform were used as solvents. It was determined that the average time required for revision of an endodontic filling was the shortest in the group treated with eucalyptol, followed by the group treated with chloroform (positive control), and then the group treated with halothane, and finally orange oil. In the open population it can be anticipated that, with 95% probability, the average time required for revision of an endodontic filling will range from 382.73s to 490.87s for a group treated with eucalyptol, 535.43 to 675.97 for a group treated with halothane, and 554.69 to 714.11 for a group treated with orange oil, and from 311.20 to 572.00 for a group treated with chloroform.

Table 2 shows the results of intergroup comparison of the time required for revision of an endodontic filling. Intergroup comparison indicates statistically high significant differences in the average values of the observed variables.

Table 3 shows the results of Scheffe's test of intergroup differences at 1% significance level. Statistically significant difference can be seen in the time required for revision of the groups treated with halothane and orange oil compared to the group treated with eucalyptol.

Discussion

The results obtained confirm statistically reliable difference in the time required for revision between the three different solvents. Eucalyptus oil proved to be a significantly faster dissolver of gutta-percha compared to orange oil and halothane. Although there were no reliable differences in the time required for revision of the positive control (with chloroform) compared to halothane and orange oil. This agrees with the results published by Ladley et al. (11). In their study they compared halothane and chloroform and also did not obtain difference in the time between the two solvents. A similar result was obtained by Ibarolla et al (15) who examined the effectiveness of solvents by Thermafil plastic carriers. This indicates the fact that solvents can alternate, as previously reported by Wourms et al (1). On the other hand, in their investigation Wilcox et al (12) obtained significantly longer time working with halothane than with chloroform, and thus demonstrated that halothane is effective, although a significantly slower dissolver of gutta-percha. The differences in results can be explained by the prolonged period of time between filling and revision, which is similar to actual clinical conditions. This explanation could also be accepted in the present case. Namely, in this study the methodology used was almost identical to that used by Karlović et al (13) for revision of an endodontic filling with chloroform and eucalyptol, where the measured times were less than in this study. However, the samples were revised seven days after filling, while in this study they were revised 180 days after filling. If the time required for revision with chloroform and halothane are examined separately then it is similar to that obtained by Wilcox et al (12).

In their study Hunter et al (16) determined statistically reliably faster dissolvability with chloroform, which they explained by the high level of volatility of halothane. On the other hand, Wourms et al (1) demonstrated identical activity of halothane and chloroform, and found halothane to be twice as effective compared to eucalyptol. The difference in results occurred because in their investigation Wourms et al (1) made a small reservoir for the solvent, which prevented evaporation of the solvent. In the present study revision was also performed in such a way that prior to the use of the solvent a small reservoir was made by Gates Glidden drills, so that the root canal was continually exposed to the effect of solvent and its evaporation was reduced. However, the amount of the solvent was restricted in order to reduce as much as possible saturation with the solvent during the revision. During work with etheric oils a volume of 0.2 ml solvent was applied on two occasions at the most, which was more than sufficient for good revision. This amount was nowhere near enough in the case of halothane, because of its volatility (16), and consequently the

number of insertions of a volume of 0.2 ml solvent was restricted to 4 times. However, it seemed as though even that amount (twice as much as etheric oils) was not sufficient for faster revision of the filling. This might also explain the similar results of the time required for revision between halothane and orange oil, and the shorter time when using eucalyptol. These results are contrary to those of Wourms et al (1), (probably because of the restricted amount of halothane), although a reservoir was used for the solvent and twice the amount of halothane.

In view of the fact that there are still no ideal means for revising the endodontic filling, which would meet all requirements (short working time, effectiveness, biocompatibility), studies will continue in an effort to find the best solution. So far the effect of oil of the needle and white pine, and malaleuke oil has been found to be effective. They also have a relatively low level of toxicity and high level of biocompatibility (1). However, until this or some other means are accepted in clinical use, eucalyptol should be the first choice for dissolving gutta-percha in the root canal.