# The Dissolving Capability Of Various Gutta-Percha Solvents

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**Abstract:** *The purpose of this in-vitro study was to compare and evaluate the efficiency of three types of chemical solvents; tetrachloroethylene, xylene and eucalyptol oil in softening gutta-percha and zinc oxide eugenol sealer. Thirty extracted human lower second premolars with single and straight canals were used in this study. All teeth had mature apices. The coronal portions of the experimental teeth were removed to standardize the length of the root (15 mm from apex to coronal end).Step-back instrumentation was performed to flare and enlarge the canals until size 45(master apical file). Lateral condensation technique was used to obturate the canals with gutta-percha and zinc oxide eugenol cement sealer, and then stored in 100% humidity at 37° for 7 days. Specimens were randomly divided into three experimental groups based on the solvent to be used (10 teeth for each group).A number 30 hedstrom file was used with a push-pull action to attempt penetration into the test sample with the addition of 0.02 ml increments of solvent. The times taken for the hedstrom file to penetrate the length of the canals were recorded.The results*

*showed that tetrachloethylene has statistically the lowest mean of penetration time, followed by xylene while eucalyptol oil has the highest mean of penetration time.*

***Keywords: Endodontic re-treatment, solvents, gutta-percha.***

## Introduction

Non-surgical endodontic retreatment is an attempt to re-establish healthy periapical tissues after inefficient treatment or re-infection of an obturated root canal system because of coronal or apical leakage. It requires regaining access to the entire root canal system through removal of the defective root canal filling, further cleaning and shaping if required and re-obturation[1]. Success rate of endodontically treated teeth range from 86 to 95% [2] and retreatment should be done for failure of root canal system. One of the disadvantages of gutta-percha as an obturating material is the lack of an effective seal [3]. However when the coronal restoration is defective or absent, the contamination with saliva may cause root canal sealer dissolution, thus providing a space for bacterial penetration that may contribute to the failure of the treatment [4].
The methods used to remove gutta-percha in re-treatment are mechanical, thermal, chemical, or even an association of them, and also special instruments such as ultrasonic instruments can be used [5,6]. Most often gutta-percha cones are composed of a vegetable resin, which lends its name to the product, and they are softened by chemical solvents [7].

Among the organic solvents more frequently used in endodontics are: chloroform, xylene, halothane, eucalyptol, tetrachloroethylene and orange oil [8, 9].

Nowadays, the procedures of re-treatment have become even more important in endodontics, replacing traditional surgical methods. Different solvents have been largely used to empty the root canal. Their properties should be taken in consideration especially regarding effectiveness in the dissolution of the endodontic filling material.

## Materials and Methods

Thirty sound human lower second premolars with single straight canals and completely formed apices were selected and stored in normal saline until use. The coronal portion of the teeth were removed to standardize the length of the root (15 mm from apex to the coronal end) and to facilitate canal instrumentation and obturation.

The pulpal tissue was removed by using medium size barbed broach. Canal patency was determined by passing number 10 file 1mm through the apical foramen. To determine the working length of the root canal, a number 15 K-file was passed into the canal until it was visible at the apical foramen; 1mm was subtracted from this length. Each root canal was serially prepared to size number 45 K-file at the apical seat and the rest of the canal was flared to size 70 K-file using a conventional step-back technique. Throughout instrumentation procedure 2.5% sodium hypo-chloride irrigating solution was used to flush out debris.

The canal of each tooth was obturated with gutta-percha and zinc oxide eugenol sealer using lateral condensation technique. All obturaed teeth were radiographed to determine if they are properly condensed.Then 2 mm of coronal gutta-percha was removed with a heated endodontic plugger to create a reservoir for the solvent. The access openings were sealed with zinc oxide eugenol temporary filling material, and the teeth were stored in 100% humidity at 37° for 7 days to allow sealer setting [10].

The obturated teeth were randomly divided into 3 groups based on the solvent to be used, ten samples for each group:

**Group I:** Teeth obturated with gutta-percha softened by eucalyptol oil.

**Group II:** Teeth obturated with gutta-percha softened by xylene.

**Group III:** Teeth obturated with gutta-percha softened by tetrachloroethylene.

The same investigator performed five tests per day. A one cc insulin syringe with 26 gauge short needle was loaded by second investigator with solvent and placed into the coronal access cavity.

Hand instrumentation with hedstrom file number 30 was used to penetrate root canal filling material in a push-pull action [8], with the use of a dental surveyor to determine the path of insertion. The addition of solvent in 0.02 ml increments was used whenever resistance to penetration was detected in order to continue the penetration [11]. The time required to penetrate the full working length was recorded in seconds.All experimental tests were performed at room temperature (25°C). The data obtained were statistically analyzed using student t-test.

## Results

The descriptive statistics (mean and standard deviation with minimum and maximum values) of the penetration time of each solvent are presented in table (I). The results showed that group III has the lowest mean of penetration time, followed by group II and then group I.

Statistical analysis of data by using a student t-test revealed that there is a statistically highly significant difference in comparing group I versus group II and group III, also there is

highly significant difference between group II and group III as shown in table (II).

**Table (I): Descriptive statistics of solvent penetration time (in seconds) for all groups.**

| Groups | Mean | Standard Deviation | Min. Value | Max. Value |
|---|---|---|---|---|
| I | 785.7 | 35.969 | 725 | 840 |
| II | 528.1 | 48.918 | 425 | 590 |
| III | 473.8 | 26.498 | 435 | 505 |

**Table (II): Student t-test between groups.**

| Groups | t-value | Degree of freedom | Significance (confidence level 0.05) |
|---|---|---|---|
| I versus II | 13.46 | 18 | Highly Significant |
| I versus III | 22.074 | 18 | Highly Significant |
| II versus III | 3.087 | 18 | Highly Significant |

## Discussion

Re-treatment of endodontic failure has been considered as a valid alternative to extraction. A greater desire of patients to retain their natural teeth and advances in endodontic therapy has resulted in endodontists becoming more aggressive in retreatment procedures. Although there has been increased interest in the use of implants, it can be observed that endodontic re-treatments are more biocompatible, less expensive and offer a reasonable prognosis [12].

The extracted human teeth test models, were used in this study in a manner in which they are used in clinical dentistry. This test model can be easily and directly correlated to solvent activity in vivo.

In this experimental study, hand instrumentation with a hedstrom file was used to penetrate the canal with filing action. A number 30 hedstrom file was used because it had resistance and was less likely to bend, and because hedstrom file cut in one direction only retraction and tended not to pack debris at the apex. Therefore, there is less apical extrusion of root canal filling material. Furthermore, the penetration of hedstrom file through root canal filling material would depend on the ability of the used solvent to dissolve gutta-percha.

The results of this study have indicated that tetrachloroethylene showed the lowest mean of penetration time in comparison with other solvents tested, which mean tetrachloroethylene has a strong dissolving action for gutta-percha. This finding is in agreement with that of Mushtaq et al. [13]who found a significant increase in dissolving capacity as the immersion time of gutta-percha in tetrachloroethylene was increased from 2 minutes to 5 minutes.

Xylene was relatively less efficient than tetrachloroethylene this could be due to slow dissolving action of xylene at 25°C because the kinetic energy of xylene molecules decrease and the collision of molecules would decrease also. So because of the slow action of xylene, it can be used as intra canal medicament for long term dissolution of gutta-percha between treatment sessions. Eucalyptol was significantly least effective with partially dissolve of gutta-percha than other solvents used; the major drawback of eucalyptol oil is that it must be heated to solubilize gutta-percha.

This in vitro study was restricted to single rooted teeth with completely formed apices, and recently obturated with well condensed gutta-percha. Unfortunately, such conditions are not always encountered in vivo. Clinically, teeth requiring endodontic retreatment may be multi-rooted, or have been obturated many years before. Such conditions may attribute the necessity to use an increased volume of solvent required to facilitate the removal of gutta-percha from the canal.

## Conclusion

The softening capability of tetrachloroethylene on gutta-percha and zinc oxide eugenol sealer is higher than that of other solvents tested, and the softening capability of xylene is higher than of eucalyptol oil.

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# قابلية ذوبان أنواع مختلفة من مذيبات حشوة الجذر (كتة - بيركة)

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**المستخلص:**

أن الغرض من هذه الدراسة المختبرية هو لمقارنة وتقييم كفائة ثلاثة أنواع من المذيبات الكيميائية: رباعي كلور الأثيلين, زايلين وزيت اليوكاليبتوس في أذابة حشوة قناة الجذر المكونة من كتة بيركة وأوكسيد الزنك والأيجينول كمادة ختم. يتكون النموذج المستخدم في هذه الدراسة من ثلاثون سن بشري مقلوع من الضواحك الثانوية السفلى ذوات قناة جذرية مستقيمة واحدة ومكتملة التكوين.

تم قطع الجزء التاجي لكل سن والأبقاء على جذر بطول 15 ملمتر, بعدها تم توسيع قنوات الجذور بأستخدام طريقة توسيع خطوة للخلف. أستخدمت طريقة الضغط الجانبي لعمل حشوات القنوات بمادة الكتة – بيركة وأوكسيد الزنك والأيجينول كمادة ختم وتم وضعها في حاضنة بدرجة حرارة 37 درجة مئوية ولمدة أسبوع. قسمت النتائج بطريقة عشوائية الى ثلاثة مجاميع أعتمادا على نوع المذيب المستخدم (كل مجموعة تحتوي على عشرة أسنان). أستخدم مبرد حجم 30 من نوع هيد ستروم لغرض أختراق مادة حشوة قناة الجذر مع أضافة 0,02 مللتر من المذيب الكيمياوي لغرض الأستمرار في الأختراق.

قيمت قابلية الأذابة لكل نوع من أنواع المذيبات عن طريق حساب الوقت اللازم للمبرد (هيد ستروم) لأختراق طول القناة بالكامل. أظهرت النتائج الأحصائية أن معدل الوقت الذي يستغرقه رباعي كلور الأثيلين للنفاذ هو الأقل ثم يليه الزايلين بينما يستغرق زيت اليوكاليبتوس أطول مدة للنفاذ.

**الكلمات الدليلية: أعادة علاج حشوة الجذر, المذيبات , كتة - بيركة.**