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**COMPARISON OF APICAL LEAKAGE VALUE BETWEEN EUCALYPTOL AND ORANGE OIL AS GUTTA PERCHA SOLVENT**

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**ABSTRACT**

**Background:** The success or failure of root canal treatment is influenced by anatomical factors of the root canal, bacterial infection that causes inadequate hygiene, formation and filling of root canals, iatrogenic factors and several other factors. The average success of root canal treatment is 86-95%, while the failure of canal treatment ranges from 5-14%. Root canal re-treatment can be performed in the event of failure of root canal treatment. The method that can be used is gutta percha solvent. The gutta percha solvents used were Chloroform, Eucalyptol, Orange Oil, and Xylene, but chloroform has been categorized as a carcinogenic substance. Guta percha solvent can cause the intercrystalline distance to be larger, so that it can damage the apical density at obturation. This can create a gap between the gutta percha and the sealer which can cause apical leakage. **Objective:** To compare the value of apical leakage after root canal re-treatment between gutta percha solvent eucalyptol and orange oil. **Method:** The research method used is True Experimental with post-test only with control group design. A minimum sample of 8 teeth in a group. Total samples from all groups were 24 teeth. The teeth were stained using methylene blue and measured using stereomicroscopes. **Results:** the highest mean apical leakage was eucalyptol ( $4.55 \pm 2.59$ ), xylene ( $2.77 \pm 1.94$ ), and the lowest was citrus oil ( $2.20 \pm 1.06$ ). The results of One-Way ANOVA test showed that there were no significant differences between orange oil, eucalyptol, and xylene (positive control). **Conclusion:** Eucalyptol has a higher average apical leakage value compared to orange oil and Xylene after root canal re-treatment as a gutta percha solvent. There was no significant difference between orange oil, Eucalyptol, and Xylene.

**Keywords:** Apical leakage, eucalyptol, orange oil

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**INTRODUCTION**

Root canal treatment is a procedure performed to eliminate pulp and peri-radicular disease.<sup>1</sup> The success or failure of root canal treatment is influenced by anatomical factors of the root canal, bacterial infection leading to inadequate hygiene, formation and filling of the root canal, iatrogenic factors or re-infection of the root canal when coronal seal disappears after root canal treatment.<sup>2</sup> The average success rate for root canal treatment is 86-95%, while failure of root canal treatment can range from 5-14%.<sup>3</sup> Root canal re-treatment can be performed if the failure of root canal treatment occurs. Root canal re-treatment is a procedure to remove obturating material from the root canal followed by cleaning, shaping, and obturation.<sup>2</sup>

The most commonly used root canal obturating material is gutta percha. Root canal filler can be removed using a variety of techniques including endodontic rotary files system,

endodontic hand files, ultrasonic endodontics, which can be combined with heat or chemical substances (gutta percha solvent). One method of removing gutta percha from root canals using gutta-percha solvent is widely used by dentists because it is easy and practical. The solvents that may be used are chloroform (CHCL<sub>3</sub>), eucalyptol (C<sub>10</sub>H<sub>18</sub>O), xylene (C<sub>8</sub>H<sub>10</sub>), halothane (C<sub>2</sub>HBrClF<sub>3</sub>), orange oil, turpentine oil, and peppermint oil.<sup>2,3</sup> Chloroform has been categorized as a carcinogenic substance. The International Agency of Research on Cancer chloroform is classified in group 2B in terms of carcinogenicity.<sup>4</sup> Xylene can be used for clinical use because it is not a carcinogenic group, but can be toxic to tissues.<sup>5</sup>

Eucalyptol is less irritating material to tissue compared to chloroform; however, it may cause tissue reaction when it is leaked through the apex.<sup>6</sup> According to a study by Kumar et al. (2017), turpentine oil is a gutta percha solvent that is more effective than Eucalyptol. Turpentine oil is a less

toxic solvent than chloroform and xylene but has the same efficiency as xylene and better than eucalyptol and peppermint oil.

Research conducted by Tanujaya et al. (2020) mentioned that citrus oil is a material with better biocompatibility than chloroform and eucalyptol. Orange oil has no harmful effects, has low solubility in water, and is soluble in alcohol. Orange oil is also in the pharmaceutical field for anti-tumor effect, fragrance and food flavoring.<sup>7</sup> Orange oil has the same ability as xylene in softening gutta percha. Xylene is the strongest material for softening gutta percha followed by citrus oil, eucalyptus oil, halothane, and chloroform.

Research conducted by Dagna et al. (2017) revealed that gutta percha removal using chloroform can increase the porosity and permeability of dentin. Chloroform may as well increase the distance of intercrystalline so that it can damage the apical density at obturation. Gutta-percha solvents such as chloroform, eucalyptol, and xylene can reduce the viscosity of gutta-percha in the more liquid state and increase its plasticity more than the plasticity in the thermoplastic state. This change allows gutta percha to flow into small, curved canals.<sup>9</sup>

Research conducted by Yadav et al. (2016) from observations using a stereomicroscope with a magnification of 60 times, it can be seen visually that the morphological changes of the remaining 5 mm of apical become reduced in density, besides that there is a gap between the gutta percha and the sealer, causing apical leakage. after root canal preparation using gutta percha solvent combined with reamer. Based on the explanation above, this study was conducted to compare the value of apical leakage in root canal re-treatment between gutta percha eucalyptol solvent and citrus oil.

## MATERIALS AND METHODS

This research was conducted at Microbiology Laboratory and Clinical Pathology Laboratory, Faculty of Medicine, University of Lambung Mangkurat. This research was initiated by obtaining ethical clearance from the Ethics Committee of the Faculty of Dentistry, Lambung Mangkurat University No. 080/KEPKG-FKGULM/EC/XII/2018. The materials used in this study were extracted mandibular 1st or 2nd premolars, gutta percha, paper point, sealer (ADSEAL), eucalyptol, orange oil, xylene, 2.5% NaOCl, 17% EDTA, 0.2% chlorhexidine, methylene blue, nail polish, saline (NaCl) 0.9%, and glass ionomer cement (GIC) fuji IX.

The method used in this research is true experimental with post-test only and control group design. The minimum sample was 8 teeth per group. The total sample from all groups was 24

teeth. Initial preparation comprised of the cleaning, washing, and storing of the teeth in 0.9% saline (NaCl) solution. After the tooth was immersed in saline solution for 24 hours, then the tooth was cut using a diamond cutting wheels bur to the Cemento-Enamel Junction. The tooth was then treated with a root canal treatment using conventional techniques and obturated using the single cone technique. After that the teeth were divided into 3 groups. Group 1, teeth subjected to re-root canal treatment using Eucalyptol as a gutta-percha solvent. Group 2, teeth subjected to re-root canal treatment using citrus oil as a gutta-percha solvent. Group 3, a positive control using xylene as a gutta-percha solvent. Gutta percha was removed using a gates gliden drill. After the completion of gutta-percha removal, irrigation was carried out with 2.5% NaOCl solution, 17% EDTA, and 0.2% chlorhexidine using a hypodermic needle and syringe to remove the remaining gutta-percha residue and minimize the organic components of the root canal.

The teeth were then proceeded with the staining process. Teeth were coated with 2-layered nail polish except for 2 mm in the apical part. The teeth from the three groups were then placed in a separate glass beaker containing 2% methylene Blue and stored in an incubator at 37°C for 48 hours. Nail polish at the apical tooth was then washed and removed with nail polish remover. Subsequently, the teeth were cut longitudinally to produce buccal and lingual sections.

Leakage was observed only in one section of the root with the longest penetration of methylene blue and was measured using a stereomicroscope with a magnification of 60 times, calibration 0.12 mm per strip from the apical foramen to the longest penetration of methylene blue. The penetration of methylene blue is measured by reading the number printed on the stereomicroscope, then the result is multiplied by 0.12 to convert the micrometer to millimeter units.

Data were analysed using a parametric test, namely One Way ANOVA at 95% confidence level, then continued with Post Hoc LSD if there was a significant difference.

## RESULTS

The results for the average value comparison of apical leakage after root canal re-treatment between gutta percha eucalyptol solvent and orange oil are presented in Table 1:

**Table 1.** Average (Mean) Value of Apical Leakage After Root Canal Retreatment Between Gutta Percha Eucalyptol, Citrus Oil and Xylene

Group	Mean± SD (mm)
Orange oil	2.20 ±1.06
Eucalyptol	4.55±2.59
Xylene	2.77±1.94

The highest average apical leakage value was observed in the eucalyptol group ( $4.55 \pm 2.59$  mm) while the lowest apical leakage value was observed in the citrus oil group ( $2.20 \pm 1.06$  mm). The control group, xylene ( $2.77 \pm 1.94$  mm), had a lower apical leakage value than eucalyptol group ( $4.55 \pm 2.59$  mm) and higher than orange oil group ( $2.20 \pm 1.06$  mm).

The results of parametric test, namely One Way ANOVA, are presented in Table 2.

**Table 2.** One Way ANOVA Test Results Apical Leakage Value After Root Canal Retreatment between Guta Percha Eucalyptol, Citrus Oil, and Xylene (Control Group).

Group	Df.	Sig.
Orange oil	8	
Eucalyptol	8	0.06
Xylene	8	

## DISCUSSION

According to Kazi et al. (2018), root canal dentin was exposed to gutta percha solvent during root canal re-treatment. Gutta percha solvents can generate physical and mechanical changes to the dentin. Gutta percha solvents can also reduce the amount of residual material. The apical microhardness of dentin decreased due to an increase in the number of exposed dentinal tubules and a decrease in the microhardness of the peritubular space around the pulp. The research of Khedmat et al. (2015) discovered that gutta percha solvent can soften enamel and dentin. Microscopic analysis demonstrated that the use of organic solvents can increase the residue of gutta percha and sealer on the walls of the root canal and dentinal tubules.<sup>2</sup>

According to the study of Mudrakola (2018), there was no significant difference between dentinal tubules that were free from root canal filling after the removal using gutta-percha chloroform, eucalyptol, and orange oil as solvents. The apical third presented dentinal tubules that were free of filling material compared to the centre of the root canal.<sup>11</sup> This study aligns with the study of Palhais et al. (2016) who investigated the effect of solvents on the bonding strength of resin sealers

on intra-radicular dentin after root canal re-treatment, showing the  $\mu$ CT analysis results that solvent utilization had increased the effectiveness of root canal cleanliness. On examination, it was found that the remaining obturating material was found in the apical third of the tooth in which xylene and orange oil was applied. The use of eucalyptol presented the residue only in one third of the crown.<sup>12</sup>

This study used gates glided drill (GGD) as a tool combined with eucalyptol, orange oil, and xylene as solvents. This can also affect the value of apical leakage. According to Virdee and Thomas (2017), gutta-percha extraction using a heated plugger, gates glidden drill (GGD), and chloroform showed that chloroform and GGD had a higher apical leakage value than the use of a heated plugger.<sup>13</sup> The use of GGD during preparation can cut the root canal wall, causing the accumulation of debris which promote the formation of smear layer. The smear layer contains organic and inorganic components, causing apical leakage. Friction when the GGD rotates can also generate heat which can soften gutta percha and change the density between the filling material and the root canal wall.

This study used root canal irrigation, including 2.5% NaOCl, 17% EDTA, and 0.2% chlorhexidine without any intermediate flushes. This can also foster the occurrence of apical leakage because Silva et al (2017) who examined the effect of intermediate flushes reported that a higher apical leak was observed without the use of intermediate flush than those with an intermediate flush. This is due to the accumulation of smear layer at the apical of the teeth.<sup>15</sup> Based on the result of this study, it can be concluded that the gutta percha Eucalyptol solvent has a higher average value of apical leakage compared to Citrus Oil and Xylene after root canal re-treatment. There is no significant difference between Orange Oil, Eucalyptol, and Xylene.

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