

# The Effect of Softening of Gutta-Percha Using Cajuput Oil in Root Canal Filling with Epoxy Resin and Glass Ionomer Cements Sealers

Erma Sofiani\*, Astri Bilqis Azizah

Clinical Department of Conservative Dentistry, School of Dentistry, Universitas Muhammadiyah Yogyakarta

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## ABSTRACT

**Background:** The failure of root canal treatment is non-hermetic obturation. It could be prevented with the use of sealer material. The sealer with an excellent bond to the dentin is epoxy resin and glass ionomer cement sealer. Eucalyptus oil is a natural substance that could dissolve gutta-percha because it has an antimicrobial effect and is biocompatible. **Objective:** To determine the effect of softening with Cajuput Oil on root canal filling with epoxy resin and glass ionomer cement sealers. **Methods:** The design of this study was pure laboratory experimental, 24 samples of single root canal block, each block was prepared with step back technique and obturation with lateral condensation. The samples were treated differently by the type of sealer used and incubation time. Group of treatment will be dripped with 0.1 ml of cajuput oil for 5 minutes. Compressive loading was performed apico-coronally by Universal testing machine using cylindrical stainless-steel plunger speed of 2 mm/min until softening occurred. The data were processed using a one-way ANOVA and Post-Hoc Tukey test with a significance level of 95% ( $p < 0,05$ ). **Results:** There was a significant effect of epoxy bisphenol resin sealer and Glass Ionomer Cement sealer in softening gutta-percha using cajuput oil. The epoxy resin sealer, which was incubated for 22 days after contact with cajuput oil for 5 minutes, had a higher softening value than others. **Conclusion:** Sealer epoxy bisphenol resin is easier to remove than the Glass Ionomer Cement sealer with cajuput oil solvent at 22 days after incubation.

**Keywords:** Cajuput oil solvent, Epoxy bisphenol resin sealer, Glass Ionomer Cement sealer, Softening gutta-percha

**Correspondence:** Erma Sofiani, School of Dentistry, Faculty of Medicine and Health Sciences, Jl. Brawijaya, Geblagan, Tamantirto, Kec. Kasihan, Bantul, Daerah Istimewa Yogyakarta 55183, +62 818-253-364, Email: [ermasofiani@umy.ac.id](mailto:ermasofiani@umy.ac.id)

## INTRODUCTION

Root canal re-treatment is an action which is taken because of inadequate initial treatment and persistent periapical lesions. The patient usually complains of spontaneous pain after initial treatment with varying intensity and is worsened when chewing food.<sup>1</sup> The most dominant cause of failure of root canal treatment is non-hermetic obturation.<sup>2</sup>

Non-hermetic obturation can trigger the presence of bacteria in the root canal, causing periapical abnormalities. These bacteria produce toxins that can irritate periodontal tissue through the apical foramen, lateral canal, and accessory canal.<sup>3</sup> Bacterial contamination can be prevented through good obturation of the root canal by coating the coronal and apical parts as a barrier to bacterial entry and application of sealer material. Sealer effect on obturation density. The sealer can fill empty spaces that are not filled with core material and cover the root canal wall surface during obturation.<sup>4</sup> The sealers that have a good bond with the dentin wall are Glass Ionomer Cement sealer and epoxy bisphenol resin sealer.<sup>5</sup>

The characteristic of the Glass Ionomer Cement sealer is that it can add root strength to fracture resistance, is biocompatible, and has molecular bonds to dentin.<sup>6</sup> Glass Ionomer Cement filling materials commonly used are Ketac-Endo (ESPE GmbH, Seefeld, Germany). Ketac-endo is the best filler compared to zinc oxide eugenol, Metapex, and AH Plus. Ketac-Endo can adapt well to root canal walls by forming chemical bonds.<sup>7</sup> The disadvantage of Ketac-Endo is that it will be difficult to clean when treating root canals and has the lowest bond to gutta-percha compared to the epoxy bisphenol resin sealer.<sup>5</sup>

One type of epoxy bisphenol resin sealer is AH Plus. AH Plus has a work time of 4 hours and average setting time of eight times greater than other types of epoxy-bis-phenol resin sealers seal. This sealer consists of two parts, they are base and catalyst.<sup>8</sup> The epoxy bisphenol resin sealer material that has been

approved by ISO Standard is AH Plus. AH Plus has an average hardening time value of eight times greater than other types of epoxy bisphenol resin sealer.<sup>9</sup>

In root canal retreatment, gutta-percha removal with a sealer can use a combination of heat techniques, mechanical instruments, and solvents. The solvent is used to dissolve gutta-percha in the apical part of the root canal. One of the solvents most often used to dissolve and take gutta-percha is chloroform. The use of chloroform was chosen because it can dissolve gutta-percha quickly, but it has been known that chloroform is toxic and group 2B carcinogen by International Agency for research on cancer.<sup>10,22</sup> Due to the toxic nature and carcinogenic potential of chloroform, a safer natural solvent is needed. One of the natural gutta-percha solvents is eucalyptus oil. Based on the results of previous studies, eucalyptus oil has antimicrobial, biocompatible effects so that it does not cause irritation and inflammation in the tissue and is recommended for use in root canal re-treatment.<sup>11</sup>

The aim of this study to determine the effect of softening with Cajuput Oil on root canal filling with epoxy resin and Glass Ionomer Cement sealer.

## MATERIALS AND METHODS

The sample in this study used a single root canal acrylic block. Samples used in the study were 24 root canal blocks that had been prepared with step back technique, with a working length of 13 mm, MAC #30, 2.5% NaOCl irrigation and obturation with lateral condensation and covered with temporary filling. Samples were divided into 2 groups namely using bisphenol epoxy resin sealer (AH Plus, Dentsply) and Glass Ionomer Cement (Fuji I luting and lining, GC Corp, Japan) according to the manufacturer's instructions. For both materials, sealer was coated with Lentulo spiral along the walls of the canal. Each group consisted of 12 root canal samples from acrylic blocks. Each group was left for 15 days, 22 days,

and 28 days in an incubator of 37 ° C to allow the materials to set completely.

Samples were randomly divided into two groups (n = 12) according to the endodontic sealer used and Each group were further subdivided into three subgroups :

Group I (4) : Obturation with epoxy resin sealer + stored in 15 days

Group II (4) : Obturation with epoxy resin sealer + stored in 22 days

Group III (4) : Obturation with epoxy resin sealer + stored in 28 days

Group IV (4) : Obturation with glass ionomer cement + stored in 15 days

Group V (4) : Obturation with glass ionomer cement + stored in 22 days

Group VI (4) : Obturation with glass ionomer cement + stored in 28 days

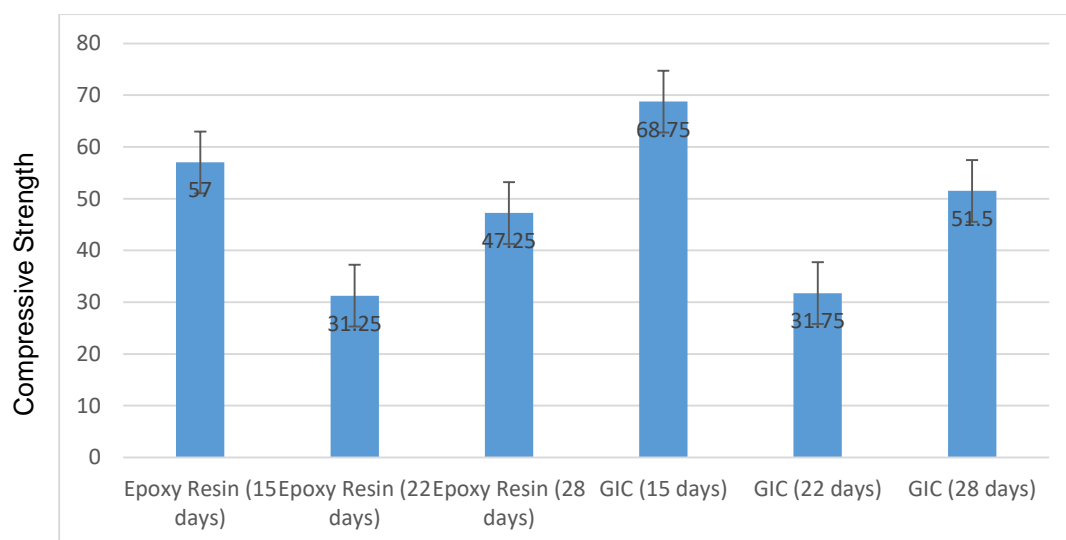
The next process is a temporary lift that is opened and gutta-percha at 2 mm cavity of the root canal surface is dropped with 0.1 ml of eucalyptus oil and allowed to stand for 5 minutes to obtain the effectiveness of softening gutta-percha.<sup>12</sup>

The last step is to test the compressive strength of plugger penetration on gutta-percha as deep as 5 mm at a speed of 5 mm/min using Universal Testing Machine (UTM) after reaching 5 mm (kgf). Data analysis test was carried out

using the One-Way ANOVA test with significance value of 0.000 ( $p < 0,05$ ). Post-Hoc test with Tukey was conducted to find out which variables had differences and which did not have significant differences.

## RESULTS

Research conducted on 24 single root canal blocks regarding the effect of epoxy bisphenol resin sealers and Glass Ionomer Cement on gutta-percha softening using cajuput oil has been completed. The result of the compressive and measurement tests of each treatment group is summarized in figure 1 showing the different compressive strength values in each treatment group with the average group I (57 kgf), group II (31.25 kgf), group III (47.25 kgf), group IV (68.75 kgf), group V (31.75 kgf) and group VI (51.5 kgf). The measurement results obtained were normally distributed data, so the data were analyzed by one-way ANOVA. Table 1 shows the lowest average value found in the SR 22 treatment of 31.25 kgf. This means that after settling for 22 days epoxy bisphenol resin with cajuput oil solvent has the highest softness value compared to other treatment groups.



**Figure 1.** Mean compressive strength between group

One-way ANOVA test that has been done on the data obtained shows a significance of 0,000 which means there is a significant difference between one group and another group or in this study it can be said that there is an effect of epoxy bisphenol resin sealer and Glass Ionomer Cement on gutta-percha use cajuput oil. Then the Post-Hoc test with Tukey was conducted to find out which variables had differences and which did not have significant differences.

Post-Hoc test result with Tukey in the treatment group SR 15 (I) and SR 22(II), SR 15 (I) and GIC 15 (IV), SR 15 (I) and GIC 22(V), SR 22 (II) and SR 28 (III), SR 22 (II) and GIC 15 (IV), SR 22 (II) and GIC 28 (VI), SR 28 (III) and GIC 15 (IV), SR 28 (III) and GIC 22 (V), GIC 15 (IV) and GIC 22(V), GIC 15 (IV) and GIC 28 (VI), GIC 22 (IV) and GIC 28 (VI) have significant differences, whereas in the other groups do not have significant differences because the significance value > 0.05 ( table 1).

**Table 1.** Post Hoc with Tukey Analysis

	SR 15 (I)	SR 22 (II)	SR 28 (III)	GIC 15 (IV)	GIC 22 (V)	GIC 28 (VI)
SR 15(I)	--	0.000*	0.128	0.045*	0.000*	0,661
SR 22(II)	--	--	0.004*	0.000*	1.000	0.000*
SR 28(III)	--	--	--	0.000*	0.005*	0.846
GIC 15(IV)	--	--	--	--	0.000*	0.002*
GIC 22(V)	--	--	--	--	--	0.000*
GIC 28(VI)	--	--	--	--	--	--

\*significant group

## DISCUSSION

Epoxy bisphenol resin sealer and Glass Ionomer Cement are root canal sealer used with gutta-percha when obturation of the root canal is performed. Based on the research that has been done, the result shows that there is a significant influence on epoxy bisphenol resin sealer and Glass Ionomer Cement on gutta-percha softening using cajuput oil. The result obtained following the hypothesis.

In the research of El Hawary et al (2015) using three kinds of gutta-percha solvents namely eucalyptus oil, orange oil, and chloroform and used vertical condensation filling techniques. Chloroform solvent was used as a control in the study. The results of the study obtained a significant difference between the sample of groups. The study did not look at the ability of eucalyptus oil and orange oil to dissolve root canal filling.<sup>12</sup> Essential oil such as cajuput oil can be an alternative in the re-treatment because it can dissolve most endodontic sealers. It has been reported to be safe,

biocompatible, noncarcinogenic, and valuable.<sup>16</sup> Therefore this study uses eucalyptus oil as a gutta-percha solvent with epoxy bisphenol resin and Glass Ionomer Cement as root canal sealers. The sample in this study was given a length of time for 15 days, 22 days, and 28 days to determine the level of softness of gutta-percha during a penetration test with UTM.

In the results of the average table shows the lowest mean value found in the treatment SR 22 of 31.25 kgf. This means that after settling for 22 days epoxy bisphenol resin with cajuput oil solvent has the highest softness value compared to other treatment groups. Because the epoxy resin sealer has brittle or brittle properties if left to stand for a long time, so this sealer is easier to clean from the root canal and this sealer at the dentin interface had the highest contact with dentin, voids at sealer interfaces are affected by the insertion rate of gutta-percha (GP) points coated with a sealer, the application method of sealer in the canal, the rheological properties of sealers, and atmospheric pressure.<sup>13,21</sup> Glass ionomer cement-based sealers only have a

chemical bond with dentin, while epoxy resin sealers can penetrate to dentinal tubules, promoting mechanic retention.<sup>25</sup>

The average test of each treatment group has different results. This is not in accordance with the desired results of this study, namely an increase in the value of softness in each treatment group with the assumption that the longer it is left the more difficult it is to clean.

In the result of this study, it can also be seen that the epoxy bisphenol resin sealer has a greater softening value than the Glass Ionomer Cement at each average comparison of the treatment time group. This is the following research conducted by Bodrumlu et al.<sup>14</sup> that the resin sealer (AH Plus) has a higher solubility rate compared to Glass Ionomer Cement type I (Ketac-endo) using cajuput oil and chloroform solvents after 10 minutes. Following research conducted by Komabayashi<sup>13</sup> that the resin sealer (AH 26) has brittle or brittle properties if left to stand for a long time, so this sealer is easier to clean from the root canal.

The one-way ANOVA test results, show the influence of epoxy bisphenol resin sealer and Glass Ionomer Cement on gutta-percha softening using cajuput oil. This is influenced by mechanical interlocking bonds by epoxy bisphenol resin sealer and chemical bonds of the polyacrylic acid matrix in the Glass Ionomer Cement into the dentin.<sup>11</sup> Glass Ionomer Cement sealer has a fast working time of 7 minutes and a hardening time of 24 minutes when applying materials, but this sealer produces a good seal on gutta-percha and tooth structure.<sup>13</sup> According to research Lee et. al<sup>5</sup>, Glass Ionomer Cement (Ketac-Endo) sealer is more difficult to clean when re-treatment. In line with research conducted by Moshonov, the Ketac-Endo sealer takes longer than AH 26 and Roth's 801 sealers when cleaned with Gates Glidden bur. This is likely due to the strong bond between the Ketac-Endo sealer and the dentinal wall. In this study using AH Plus sealer, there are differences in characteristics between AH 26 sealers and AH plus. In a previous study, AH 26 was an epoxy resin sealer with high radio-opacity, low

solubility, little shrinkage, and good tissue compatibility, but had detrimental properties, namely the tendency to discolouration and formaldehyde release and was removed with AH Plus. Another advantage of the AH Plus is the form of the application: a paste-on system, which ensures fast and clean mixing and is easier to clean in the case of retreatment.<sup>20</sup> AH Plus is an epoxy resin-based sealer used frequently as a reference material because of reduced solubility, long-term dimensional stability, and greater retention to root dentin.<sup>24</sup>

In the comparison group of Glass Ionomer Cement sealer that was allowed to stand for 15 days after contacting with cajuput oil for 5 minutes with epoxy bisphenol resin sealer which were allowed to stand for 15 days, 22 days and 28 days after contacting with cajuput oil for 5 minutes there was a significant difference, which means the epoxy bisphenol resin sealer which is allowed to stand for 15 days, 22 days, and 28 days after contacting with cajuput oil for 5 minutes has a greater softening ability when compared to the Glass Ionomer Cement sealer which is allowed to stand for 15 days after contacting with cajuput oil for 5 minutes. This is because the AH plus sealer based on epoxy sealer resin has good solubility levels ranging from 0.045% and 0.8%, low shrinkage, long term dimensional stability, bond to dentin and good sealing ability.<sup>15</sup>

A significant difference was also found between the comparison group among Glass Ionomer Cement sealer which was allowed to stand for 15 days after contacting cajuput oil for 5 minutes compared to being allowed to stand for 22 days and 28 days after contacting with cajuput oil for 5 minutes with  $p=0.000$  and  $p=0.002$ . The significance value indicates that the Glass Ionomer Cement sealer which is left in place for 22 days and 28 days after contacting with cajuput oil for 5 minutes has a greater softening ability than the Glass Ionomer Cement sealer which is left in place for 15 days after contacting with cajuput oil for 5 minutes. Glass Ionomer Cement Sealer has a low level of solubility in the oral cavity, is biocompatible, has



sufficient working time for 7 minutes and hardening time for 24 minutes.<sup>9</sup> In a previous study, it was stated that the microhardness of GIC is comparable to composite resin material after 24 hours to 15 days, this means that the longer time will increase the microhardness so that it will be a problem of removal in the event of retreatment.<sup>16,17,23</sup>

In the comparison group of epoxy bisphenol resin sealer which was allowed to stand for 15 days after contacting with cajuput oil for 5 minutes with epoxy bisphenol resin sealer which was allowed to stand for 22 days after contacting with cajuput oil for 5 minutes, there was a significant difference ( $p=0.000$ ), but it is inversely proportional to the bisphenol resin epoxy sealer which is allowed to stand for 28 days after contacting with cajuput oil for 5 minutes, with a significance value of  $p=0.128$ , which means that the epoxy bisphenol resin sealer is allowed to stand for 22 days after contacting with cajuput oil for 5 minutes has a greater softening ability when compared to epoxy bisphenol resin sealer which is allowed to stand for 15 days after contacting with cajuput oil for 5 minutes and has a smaller softening ability when compared to epoxy bisphenol resin sealer which is allowed to stand for 28 days after contact with cajuput oil for 5 minutes. This is in line with the statement that the sealer will experience an increase in solubility in a period of 28 days and a change in stability dimensions occurs after the first 4 weeks to 48 weeks.<sup>18</sup>

The limitation of this research are applying sealers on root canal acrylic blocks, moisture of acrylic block before sealer application, and volume of sealers. Based on previous research, the removal techniques are dependent on the anatomy of root canal, size of root canal and region of the root canal.<sup>19,21</sup>

## CONCLUSION

There was effect of softening with Cajuput Oil on root canal filling with epoxy resin and glass ionomer cement sealers at different times. Obturation with epoxy resin sealer and

allowed to stand for 22 days has a faster softening effect of gutta percha than epoxy resin sealer 28 days, glass ionomer cement sealer 15 days and 28 days.

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