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The Effect of Addition of Triclosan Antibacterial Agent on The Setting Time of Glass Ionomer Cement

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Abstract

Glass ionomer cement (GIC), restorative material in dentistry, are composed of glass powders and polyacrylic acid. GIC can release fluoride that acts as an antibacterial. Various study had been conducted to improve that antibacterial properties, but it can affect the physical and mechanical properties of GIC. The purpose of this study was to determine the effect of addition of triclosan antibacterial agent on the setting time of GIC. To obtain 2.5 % triclosan, 0,25 gram of triclosan powder was mixed into 9,75 gram of GIC powder. The sample was divided into 2 groups: control group (n=16) and treatment group (n=16). The setting time was measured using gilmore needle, by penetrating a needle to the surface of specimens with an interval of 10 seconds until the needle left no traces on the surface of specimens. Statistical analysis was done by T-test. The result showed that p value > 0,05. The conclusion is the addition of triclosan antibacterial agent do not affect the setting time of GIC.

Keyword: *triclosan, antibacterial, glassionomer*

Introduction

Glass ionomer cement (GIC) composed of glass powder and polyacrylic acid were developed in 1970s. The GICs are classified as Type I for luting crowns, bridges, and orthodontic brackets, Type IIa for esthetic restorative cements, Type IIb for reinforced restorative cements, and Type III for lining cements and base. The chemistry of GICs is essentially the same for all three types, with variations in powder composition and particle size to achieve the desired function. The consistency of the mixed GIC varies widely among manufacturers, from low to very high viscosity as influenced, by their use of various particle size distributions and the P/L ratio.¹

Advantages of GIC include the ability to bond chemically to tooth structure, excellent biocompatibility, and have the potential to increase tooth's resistance to secondary caries due to fluoride release.² The evaluation of fluoride release showed that the maximum release of fluoride occurred within the first 24 hours and gradually decreased over time. However, the antibacterial activity test showed that conventional GICs possessed no antibacterial activity against *S mutans* or *L casei*.³

Many studies have been conducted to increase the antibacterial properties of GICs by incorporating antibacterial agents. Prabhakar et al. in their study showed that the addition of antibiotics at 1 % and 2 % enhanced fluoride release of GIC, but at 2 % concentration the physical properties of GIC were adversely affect.³ A study conducted to assess the antibacterial action of the GIC containing chlorhexidine at different concentrations showed a promoted inhibition of bacterial growth. However, the addition of 2 % chlorhexidine resulted in statistically significant decrease in mechanical properties and increasing the setting time of GIC.⁴ Other antibacterial agents also have been used, such as cetrimide, cetylpyridinium chloride, and benzalkonium chloride, and the resulting cements had reduced hardness.⁵ Triclosan, belongs to a class of compounds

known as hydroxydiphenyl ethers, is an antimicrobial that is incorporated into many skin care products, toothpastes, etc. It is an anionic, lipophilic compound that is very poorly soluble in water.⁶ The use of triclosan as antibacterial agent is regulated by U.S. Food and Drug Administration (FDA) and European Union. Sainulabdeen S et al. compared the antibacterial effect of triclosan and chlorhexidine incorporated GIC and concluded that 2.5% concentration of triclosan incorporated GIC showed more antimicrobial activity than 2.5% chlorhexidine incorporated GIC against *Lactobacillus acidophilus* and *Streptococcus mutans*.⁷

It has been shown that any alteration to the formulation of glass ionomer may have influence to mechanical and physical characteristic of GICs. The purpose of this study is to determine the influence of the addition of 2.5 % triclosan on the setting time of commercially available conventional GIC.

Material and methods

The material used in this study was a conventional hand-mixed GIC (Fuji II Universal Restorative, GC, Japan). Rectangular-shaped fiber glass (7cm x 7cm x 1 cm) with 16 disk-shaped specimen wells (10mm in diameter and 1mm in thickness) were used to prepare a total of 32 GICs specimens, which divided into 2 groups. Group A (n= 16) served as control and were prepared by mixing the powder and liquid manually according to the manufacturer's instruction. Group B was experimental group which were prepared by incorporating triclosan powder at 2.5 % concentration into the powder of conventional GIC. To obtain the desired concentration, 0.25 g triclosan was added to 9.75 g of GIC powder and were mixed using mortar and pestle until the mixture is homogeneous. For each specimen in group B, triclosan incorporated GIC powder were mixed with liquid according to manufacturer's instruction.

Freshly mixed cements were placed into the fiber glass moulds by using plastic

instrument and then covered with celluloid strip. The surface of the specimens were slightly pressed by glass slide, the excess cement was removed, and the specimens were directly placed under the Gillmore needle for setting time measurement. Gillmore needle was placed perpendicular to the surface of specimens and left there for 5 s, repeatedly at 10 s intervals. The marks left by the needle on the surface were examined. The setting time was determined when the marks were no longer observed (ISO 6876/2001).

Results

The values of setting of GIC determined by Gillmore needle for each group, with or without the addition of triclosan, are depicted in figure 1. The results showed that triclosan incorporated GIC (Group B) have longer setting time compared to conventional GIC (Group A).

The statistical analysis revealed that there was no significant difference between the setting time of Group A and Group B as the P value was 0.080 (table 1), which is more than 0.05.

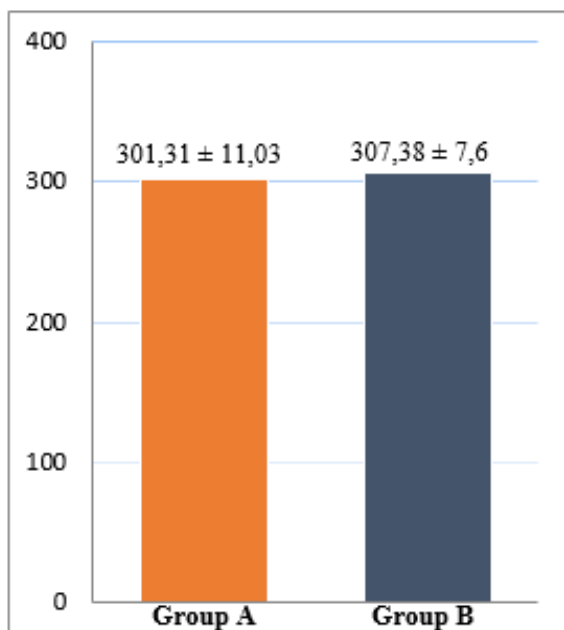


Figure 1. Comparison of average values of setting time (sec) between Group A (control group) and Group B (treatment group)

Table 1. Statistical analysis of the average values of setting time between control and treatment group.

	Sig.
Group A	0,080
Group B	

Independent T-Test, p=0,05

Discussion

GICs are capable of releasing fluoride, which contributes to some reduction in the number of residual bacteria in cavities, however such amounts of fluoride are too small to exhibit antibacterial effects as demonstrated by Takahashi et al. The researchers also confirmed that incorporation of chlorhexidine diacetate as antibacterial agent promoted antibacterial activities of GIC.⁸ This findings is in accordance with study conducted by Marti et al. who found that adding chlorhexidine promoted inhibition of bacterial growth, being more effective for *L. Casei* than *S. mutans*.⁴

Previous study have revealed that 2.5 % triclosan added to GIC showed more antimicrobial activity than 2.5% chlorhexidine incorporated GIC against *Lactobacillus acidophilus* and *Streptococcus mutans*.⁷ Other study showed that 2.5 % triclosan incorporated GIC group have higher shear bond strength values than the conventional GIC group.⁹ In the present study, 2.5 % triclosan was incorporated into conventional Fuji II.

The samples in this study were prepared manually, and the setting time is determined as the time from completion of the mixing process to the hardening of the cement. In general, the initial setting time of GIC restorative is 6 to 8 minutes but it continues for up to 24 hours in order to achieve optimum physical properties, and this reaction may last over a period of weeks or even months.¹⁰ Normal setting time of conventional Fuji II according to the manufacturer is 5 minutes and 30 seconds (330 s), while the setting time of conventional GIC in this study is shorter which falls within range between 4 minutes and 40 seconds up

to 5 minutes and 15 seconds. The speed of the hardening reaction and ultimate strength of a GIC formulation depends on powder/liquid ratio of the components.¹⁰ Therefore slight modification in powder/liquid ratios by adding triclosan may have influences on setting time of conventional GIC. From this present experiment, it was found that the experimental group with 2.5 % triclosan showed longer setting time compared to control group, although the differences was not statistically significant.

In their study, Pawluk found that experimental GIC containing cationic quaternary ammonium compounds, i.e benzalkonium chloride and cetyl pyridinium chloride, exhibited longer working time than the control group. Triclosan also increased the working time but the value was the lowest.¹¹ A significant increase of setting time of the GIC was also found with the addition of chlorhexidine.^{4,8} Cationic properties may have interfered with setting mechanisms such as proton-attack and leaching of ions from glasses.¹¹ Unlike chlorhexidine, triclosan is an anionic compound. This indicate that the type of ionic charge can influence the kinetics of the setting time and maturation reactions in slightly different ways.¹¹ Within the in vitro limitations of this study, it can be concluded that the addition of 2.5 % triclosan as antibacterial agent did not affect the setting time of conventional Fuji II.

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