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# Comparative Evaluation of Shear Bond Strength of Conventional Type II Glass Ionomer Cement and Triclosan Incorporated Type II Glass Ionomer Cement: An in Vitro Study

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## ABSTRACT

**Aim:** To evaluate shear bond strength of conventional Type II glass ionomer cement with triclosan incorporated Type II glass ionomer cement.

**Materials and Method:** Forty extracted non-carious permanent molars were taken. Triclosan incorporated glass ionomer cement was prepared at a concentration of 2.5%. Specimens were divided into two groups of twenty teeth each. Group A was restored with conventional GIC whereas Group B with triclosan incorporated GIC. Thermocycling was done to simulate oral conditions. After 24 hours Groups A and B were checked for shear bond strength using Instron Universal testing Machine at crosshead speed of 0.5mm/min until fracture. Results were recorded.

**Results:** Data was statistically analyzed by student's t-test. Shear bond strength of triclosan incorporated GIC was higher than conventional GIC.

**Conclusion:** Triclosan incorporated GIC can be considered as an alternative to conventional GIC with enhanced antibacterial property.

**Keywords:** Dental bonding, Glass Ionomer Cement, Triclosan.

## INTRODUCTION

Glass ionomer cements are fast gaining popularity as the restorative material of choice in minimal intervention approaches such as atraumatic restorative treatment (ART)[1-3] where demineralized tooth tissue is removed using hand instruments and cavity is restored with adhesive restorative materials[3]. But if only hand instruments are used to remove carious lesion, some amount of micro-organisms remain viable for a period of two years under GIC restorations[1,2]. Thus, if conventional GIC was reinforced with an effective antibacterial agent, effective management of the carious lesion would have become possible in rural areas.

Many antimicrobial agents have been used, but they affected the various physical properties of the material[4-7]. So, in the present study, triclosan was added to glass ionomer cement as an antimicrobial agent to check if it had any effect on the physical properties of the material.

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When a restoration is placed in the oral cavity, it is subjected to various stresses and shear stress is one of those[8,9]. Shear bond strength assumes much importance to the restorative material clinically because of the fact that the major dislodging forces at the tooth restoration interface have shearing effect[10].

Considering the importance of an effective antimicrobial agent and reliable bond strength values of restorative materials, the purpose of the study undertaken was to compare the shear bond strength of conventional Type II glass ionomer cement with triclosan incorporated Type II glass ionomer cement.

## MATERIALS AND METHODS

Forty permanent extracted human molars with intact buccal or lingual surfaces were taken. Teeth were extracted either due to periodontal pathologies or traumatic injuries. Exclusion criteria were molar teeth with both buccal and lingual surfaces carious, crown of the tooth fractured during extraction and hypoplastic/ hypomineralized teeth. All the selected teeth were used within 3 months of extraction as per recommendations of Occupational Safety and Health Administration (OSHA).

### Preparation of 2.5% triclosan incorporated GIC

0.075 gms of triclosan powder was added to 2.925 gms of glass ionomer powder to obtain a desired 2.5% formulation of triclosan incorporated glass ionomer cement[3].

### Sample preparation

The teeth were cleaned using ultrasonic scaler and mounted upright on acrylic resin (Figure 1). After setting of the acrylic resin, the moulds were removed. The buccal or lingual enamel of teeth were removed to produce a flat dentin parallel to long axis of teeth with a carbide bur. To obtain a uniform flat surface, dentin was grounded with 400 number silicon carbide papers and rinsed with water. Specimens were divided into two groups of twenty teeth each. Group A was restored with conventional Type II glass ionomer cement (Figure 2) whereas Group B with Triclosan incorporated glass ionomer cement (Figure 3). Specimens were stored in distilled water at room temperature for 7 to 10 days to discriminate between those specimens that can and those that cannot withstand a wet environment. Restorations which were dislodged from the tooth structure were rejected. Thermocycling was done 500 times between 5 and 55 degrees with a dwell time of 15 seconds in each bath and a transfer time of 10 seconds to simulate oral conditions. After 24 hours, shear bond test was performed using Instron Universal Testing Machine (Figure 4) at a crosshead speed of 0.5mm/min until fracture. The specimens were placed in the middle assembly of the machine and force was applied until the GIC block got dislodged (Figure 5). This force was recorded. Results obtained were statistically analyzed.

**Table 1:** Distribution of mean ± S.D. of Shear Bond strength of Group A and Group B.

| Group | Sample size | Mean ±Std. Deviation | Std. Error Mean |
|---|---|---|---|
| GroupA Conventional glass ionomer cement | 20 | 2.508 ±0.0734544 | 0.0232283 |
| Group B Triclosan incorporated glass ionomer cement | 20 | 2.654 ±0.1195547 | 0.0378065 |

## RESULTS

Shear bond strength was calculated according to the following formula and expressed in MPa: Stress= Failure Load (N) / Surface Area ($mm^2$). The shear strength of all the samples was recorded. Mean and standard deviation was calculated (Table I and Graph I).

It was seen that mean± Standard deviation values for Group A i.e. conventional glass ionomer cement group was 2.50±0.0734544 whereas for Group B i.e Triclosan incorporated glass ionomer cement group was 2.654 ±0.1195547. Analysis of the data was done using student's t-test (Table II). On applying unpaired Student's t-test, it was found that the mean difference of Shear Bond strength between Triclosan incorporated glass ionomer cement group and Conventional group was 0.146 which was significant as $p<0.004$ ($p < 0.05$).

**Table 2:** Statistical evaluation of shear bond strength values using Student's t test.

| | t | D.F.* | p value | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Shear Bond Strength | 3.290 | 18 | 0.004 | 0.1460000 | 0.0443722 | 0.0527775 | 0.2392225 |

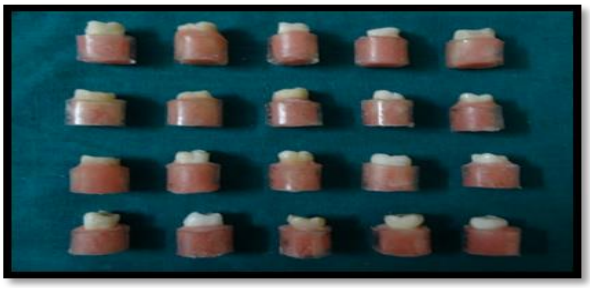


**Fig 1:** Specimens mounted in acrylic resin.

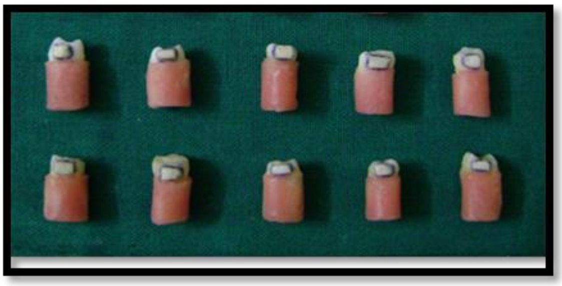


**Fig 2:** Group A samples restored with conventional GIC.

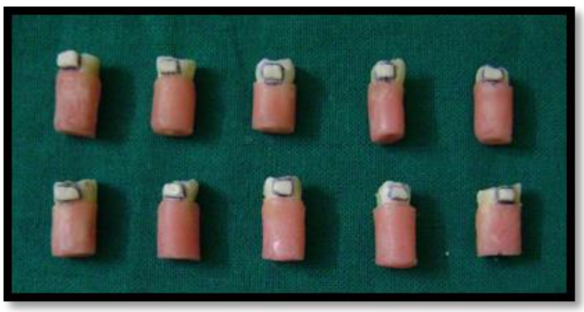


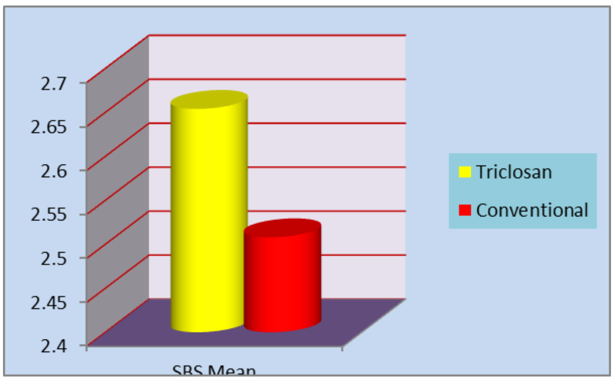
**Fig 3:** Group B - Samples restored with Triclosan Incorporated GIC.

## DISCUSSION

GICs have been used for more than 30 years, and it is well known that their major advantage is their potential to inhibit caries because of fluoride release and their clinical adhesion to dental hard tissues. McComb and Ericson, DeSchepper et al and Vermeersch and colleagues suggested that GICs are antimicrobial because of fluoride release. But the fluoride released from glass ionomer cement is maximum for first 24 hours and then it decreases exponentially in further days. Thus, addition of antibacterial agents to restorative materials is gaining popularity with the aim of suppressing the growth of bacteria under restoration to minimize the risk of caries.

**Fig 4:** Instron Universal Testing Machine.

**Fig 5:** Dislodgement of GIC block.




**Graph 1:** Bar diagram showing Shear Bond Strength of Group A and Group B.

Various antibacterial agents have been incorporated into glass ionomer cement to increase its antimicrobial efficacy. These agents include chlorhexidine hydrochloride, cetylpyridinium chloride, cetrimide and benzalkonium chloride[5-7].

Chlorhexidine incorporated glass ionomer cement has been reported to be effective against Streptococcus species. Chlorhexidine diacetate at a concentration of 2.5% has been established to be very effective for a long duration of time against L. acidophilus (60 days) and S. mutans (90 days). But the incorporation of chlorhexidine acetate and gluconate to glass ionomer cement may result in a dramatic decrease in the physico-mechanical properties of the cement[4]. When added in concentrations above 5%, the material tends to deteriorate rapidly, does not contribute to the formation of glass ionomer network, weakens the scaffold and compromises the mechanical properties of glass ionomer cement[1].

Antimicrobial agents like cetylpyridinium chloride, cetrimide and benzalkonium chloride when incorporated into glass ionomer cement affected the clinical performance of the material as they reduced the compressive strength, surface hardness, bond strength but slightly increased the setting time[5-,7].

Thus in the present study, triclosan was incorporated into glass ionomer cement to evaluate whether by adding an extra antimicrobial agent to glass ionomer cement had any effect on the physical properties of the material.

Triclosan is a broad-spectrum antibacterial agent[4]. It has been used since 1972, and is present in soaps (0.10-1.00%), deodorants, toothpastes, mouth washes and cleaning materials. It is incorporated into an increasing number of consumer products, such as kitchen utensils, toys, bedding, socks, and trash bags.

This organic compound is a white solid powder with a slight aromatic/phenolic odor. It is a chlorinated aromatic compound that has functional groups representative of both ethers and phenols. Phenols often show antibacterial properties. Triclosan is slightly soluble in water, but soluble in ethanol, methanol, diethyl ether, and strongly basic solutions such as a 1 M sodium hydroxide solution. It can be synthesized from 2,4-dichlorophenol.

Triclosan is effective in destroying both the microorganisms i.e. L.acidophilus and S. mutans. The primary site of action is the cytoplasmic membrane and uptake of Triclosan by the cell wall which is speculated to be by diffusion. It has been reported that the primary antimicrobial action of Triclosan is directed towards RNA and protein synthesis in bacteria and not against DNA. Triclosan is suggested to act on L.acidophilus by increasing the permeability of the bacterial cell wall whereas for S. mutans, it inhibits glucose metabolism[4].

Sainulabdin S et al studied the antibacterial effect of triclosan incorporated glass ionomer cement and concluded that 2.5% concentration of triclosan incorporated GIC provides optimum amount of antibacterial effect than 2.5% chlorhexidine[4]. Thus 2.5% concentration of triclosan incorporated glass ionomer cement was used in this study. When a restoration is placed in the oral cavity, it is subjected to various stresses like compressive stress, tensile stress and shear stress. Shear stress is a result of two forces directed parallel to each other. It is also defined as a stress that tends to resist a twisting motion or sliding of one portion of a body over another[8,9]. Shear bond strength is one of the important properties of a restorative material clinically because of the fact that the major dislodging forces at the tooth restoration interface have shearing effect. Therefore higher shear bond strength implies better bonding of the material to the tooth[10].

As a restorative material has to withstand various forms of stresses in the oral cavity, the efficacy of triclosan incorporated glass ionomer cement on shear bond strength was evaluated against conventional glass ionomer cement. On doing so, it was found that mean values of triclosan incorporated glass ionomer cement in terms of shear bond strength was higher than conventional glass ionomer cement (Table 1, Graph 1). On application of student's t-test (Table 2), difference between mean values was significant. Thus it was assumed in terms of shear bond strength, triclosan incorporated glass ionomer cement is better as compared to conventional glass ionomer cement.

The present study is only a preliminary study showing higher shear bond strength values for triclosan incorporated glass ionomer cement group than the conventional glass ionomer cement group. Also since, till date no study has been done on shear bond strength of Triclosan incorporated glass ionomer cement in comparison with conventional glass ionomer cement, so further studies with larger sample size is recommended in future. It is also recommended that further aspects of triclosan incorporated glass ionomer cement should also be researched before recommending it as an effective antimicrobial agent to conventional glass ionomer cement.

## CONCLUSION

The addition of triclosan to glass ionomer cement may improve the shear bond strength of the cement as compared to the conventional glass ionomer cement. This study suggested that triclosan incorporated glass ionomer cement can be successfully used in dentistry in terms of improved shear bond strength.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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