Comparative Evaluation of Shear Bond Value of Conventional Glass Ionomer Cement and New Ceramic Reinforced Glass Ionomer Cement: An In-Vitro Study

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Abstract: To evaluate of shear bond value of conventional glass ionomer cement and new ceramic reinforced glass ionomer cement.

Material and Method: In present in-vitro study total 30 deciduous molars with intact buccal or lingual surfaces were included. Samples were randomly divided into two groups, i.e., groups A, B and were restored with conventional type II GIC, new ceramic reinforced glass ionomer cement (Amalgomer CR), respectively. Thermocycling was done to simulate oral conditions. Using a universal testing machine with a crosshead speed of 0.5 mm per minute, shear bond strength was assessed after 24 hours until breakage. The outcomes were tallied and statistically evaluated.

Result: It was observed from the result that the SBS value of amalgomer CR was 7.49 ± 0.74 MPa which was significantly higher than conventional GIC 4.02 ± 0.49 MPa. **Conclusion:** It was found that Amalgomer CR had a better shear bond value to primary teeth than traditional type II GIC within the confines of the current in vitro study. Consequently, we

can draw the conclusion that Amalgomer CR can be used as a restorative material in pediatric dentistry.

Keywords: GIC, Amalgomer CR, Shear Bond Strength

Introduction: Dental caries is a pathological process that has been around since ancient times. It is among the most prevalent chronic diseases in the world.[1] Hard tissues' shape and functionality are impacted by the harm that caries causes to them. Therefore, preserving the tooth's residual tooth structure is essential to ensuring the tooth's long life. Thus, the use of fluoride-releasing restorations and procedures that cause the least amount of enamel and dentin loss during caries removal must be incorporated into the first therapeutic strategy.[2,3]

The world has witnessed a paradigm shift in the use of restorative materials ranging from traditional opaque metal alloys, amalgam, gold, and ceramics to much newer tooth-colored dental cement. Materials comprised of calcium or strontium alumina fluorosilicate glass powder (base) mixed with a water-soluble polymer are known as glass polyalkenoate cements (acid).[4] Such materials were referred to by Kent as "glass ionomer" cements, and that term has since entered the dental glossary.[5,6] It has a number of benefits, including the release of fluoride, a thermal expansion coefficient and elastic modulus that are similar to those of tooth structure, the capacity to chemically attach to calcified enamel and dentin, biocompatibility, and simplicity of handling. Albeit, conventional GICs are plagued by their limitations which include brittleness, poor fracture toughness, prolonged setting time, sensitivity to moisture, dehydration, etc.[7,8] To overcome these shortcomings, advancements were made in the past and are continually being so by incorporating filler components in powder such as silver-amalgam particles, zirconia, glass fibers, and hydroxyapatite. Liquids have inclusions of more polyacids along with pretreatment of the glass surface and modified glass compositions.[9]

Current restorative techniques take into account the adhesiveness of restorative materials to tooth structure.[10] It shields the pulp from pulpal damage, secondary caries, marginal discolorations, and micro leaks. Removal of healthy dentin for retentive undercuts is no longer essential with efficient adhesion. Recently, introduced amalgomer CR (ceramic reinforced glass ionomer) combines the high strength of a metallic restorative, esthetics and other advantages of glass ionomers, which not only complies with the international standards of GIC but with the

standard for amalgam. The ceramic also helps in imparting excellent wear and erosion resistance and also enhances the radiopacity and all-round strength of the cement.[11,12] Various mechanical tests have been recommended for assessment of the bonding performance of restorative materials. SBS testing is an important clinical property, since the majority of dislodging forces have a shearing effect at the tooth restoration interface. Hence the present study was conducted to evaluate of shear bond value of conventional glass ionomer cement and new ceramic reinforced glass ionomer cement (Amalgomer CR).

Material and Method:

Selection of Samples: Totally, 30 human deciduous non-carious primary molars that had been extracted for therapeutic purposes were collected, cleaned and stored in distilled water at room temperature.

- **Inclusion Criteria:** Healthy, non carious intact tooth
- **Exclusion Criteria:** Teeth that were carious, hypoplastic and cracked were excluded from the study.

Sampling Samples were divided into three groups of 15 teeth each

- **Group A:** Conventional Type II GIC (Fuji II GIC, GC, Tokyo, Japan) - **Group B:** Amalgomer CR (Advanced Health Care, Ltd., Tonbridge, UK) **Preparation of Sample:** The specimens were placed in uniform, acrylic resin-filled, autoclavable Teflon moulds. A fissure diamond bur was used to make a 1.5mm-deep groove from the enamel surface to help each sample's dentin reach the same depth. In order to attach the restorative material to the buccal or lingual surface of each tooth, auto polymerizing acrylic resin was then used to embed each tooth. **(Figure 1)**

Restoration of Samples: Surface was cleaned with pumice and rubber cup as it was found that polishing the dentin surface with pumice slurry reduced the layer of surface debris and did not affect the bond strength to dentine significantly. Teeth were rinsed and dried. The flattened dentin surface of all the specimens was treated with dentin conditioner for 20s, rinsed thoroughly with water and dried using absorbent paper. Restorative materials i.e. Conventional GIC and ceramic reinforced glass ionomer (Amalgomer CR) were manipulated according to manufacturer's instructions and placed on the smoothened buccal surface of the respective

samples using a template bearing a hole measuring 3 mm diameter and 2 mm depth. The excess material was removed, and the restoration was coated by dental varnish.

Evaluation of Shear Bond Value: Restored samples were stored in distilled water for 2 weeks, and then subjected to shear bond strength testing using the universal testing machine at a crosshead speed of 0.5 mm/min. The data was statistically analyzed using independent t-test, and Statistical significance was taken as $p < 0.05$.

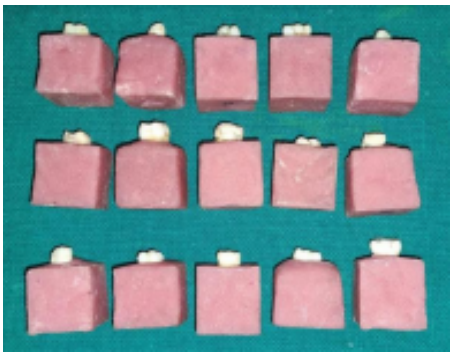

Fig 1: Sample Embedded in Acrylic Resin

Result: It was observed from the result that the SBS value of amalgomer CR was 7.49 ± 0.74 MPa which was significantly higher than conventional GIC 4.02 ± 0.49 MPa. **(Table 1)**

Table 1: Mean Value of Shear Bond Strength

Group	**Mean Value of Shear Bond Strength**
Group A Conventional GlC (*n* = 15)	4.02 ± 0.49 MPa
Group B Amalgomer CR (*n* = 15)	7.49 ± 0.74 MPa
P value	$p \leq 0.05$

Discussion: The amount of the caries, the patient's age, and the restoration's aesthetic and functional requirements are only a few of the variables that influence the choice of restorative material.[13] Finding the optimal restorative substance is a never-ending challenge. Development and interest in cosmetic dentistry have grown recently. The field of cosmetic dentistry has been

substantially broadened by adhesive procedures. Modern dentistry has undergone a revolution thanks to the creation of composite resins by Dr. Bowen and the advent of glass ionomers by Wilson and Kent. Glass ionomer's poor wear characteristics, aesthetics, and protracted setting reaction have been significantly altered, and the more recent materials now exhibit characteristics that are comparable to those of composite resin materials.[14]

Because they include polyalkenoic acids and have a coefficient of thermal expansion that is nearly comparable to that of tooth material, traditional glass ionomer cements can physico chemically bond to the cavity's surface. As the restoration hardens, the glass particles in these kinds of cement release fluoride, providing an anticariogenic effect around the cavity borders.[15]

Glass ionomer cement is brittle, has poor mechanical strength, and is moisture sensitive, among other drawbacks.[6] As a result, a number of modifiers have been added to traditional GICs to further improve their mechanical properties. One such material is Amalgomer, which offers the advantages of GIC as well as the strength of amalgam due to ceramic reinforcement in the glass ionomer cement.[16] The manufacturer suggests using this tooth-colored product to combine the high strength of a metallic restorative with the aesthetics and other benefits of glass ionomers.[17]

The ability of restorative materials to adhere well to the dentinal surface and withstand the numerous dislodging forces operating within the mouth cavity is essential for clinical success.[18] Compressive strength, tensile strength, and shear strength are used to quantify these stresses. The resistance to forces that push restorative material past tooth structure is known as shear bond strength. Because the main dislodging pressures at the tooth restoration contact have a shearing impact, it takes significant clinical significance for the restorative material. Higher shear bond strength hence indicates better material to tooth bonding.[19] Hence the present study was conducted to evaluate of shear bond value of conventional glass ionomer cement and new ceramic reinforced glass ionomer cement. In the present study, the mean value of shear bond strength was found to be higher for amalgomer CR and was lowest for conventional GIC.

The results are in accordance with the study done by Murthy SS et al. (2015) where they found that Amalgomer CR exhibited SBS of 6.38 MPa, which is significantly higher than that of miracle mix (metal admixed) and ketac molar (high viscosity GIC).[20]

The lower bond strength values in our investigation could be explained by the fact that the maximal bond strength for glass ionomers is only attained after the cement has gone through its maturation phase and some GICs take several months to stabilise. By the time the cement at the interface has fully matured, it will have developed a thick viscosity and been closely adapted to the tooth substrate.[21]

Similarly present study showed higher SBS value for amalgomer CR this could be due to the ceramic reinforcement where the ceramic filler in the powder component would react partially with the matrix and forms an altered polysalt matrix thereby enhancing the all round strength of the cement.[11] Despite the fact that the current study's findings indicated that the SBS of amalgomer CR to primary teeth is much higher than that of conventional GIC. If the outcomes of in vitro laboratory studies coincide with in vivo experience, only extensive clinical trials can make this determination.

Clinical Significance: In the current investigation, specimens repaired in primary molar teeth using the test materials were used to test in vitro models. Before doing clinical studies on patients, it is crucial to carry out preliminary and safety investigations in vitro since they would provide conclusive proof for the clinical application of the restorative materials. It is important to use caution when extrapolating in vitro results to clinical situations and keep in mind the limitations of in vitro research.

Conclusion: It was found that Amalgomer CR had a better shear bond value to primary teeth than traditional type II GIC within the confines of the current in vitro study. Consequently, we can draw the conclusion that Amalgomer CR can be used as a restorative material in pediatric dentistry.

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