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In-vitro Study Comparing the Shear Bond Values of Zirconia-reinforced Glass Ionomer Cement and Conventional Glass Ionomer Cement

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Abstract

The goal of the current study was to compare the shear bond values of zirconia-reinforced glass ionomer cement and conventional glass ionomer cement. A collection of 20 extracted premolars with unbroken buccal or lingual surfaces was made. The whole sample was randomly split into two groups: Group A (n=10) which was Conventional Glass Ionomer Cement and Group B (n=10) which was Zirconia Reinforced Glass Ionomer Cement (Zirconomer). The process of thermocycling was used to mimic oral conditions. Using a universal testing machine, the shear bond strength (SBS) was measured after 24 hours at a

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crosshead speed of 0.5 mm/minute until fracture. After tabulating the results, statistical analysis was done. The findings indicated that Zirconomer exhibited a statistically significant ($p \leq 0.05$) higher shear bond strength when compared to traditional glass ionomer cement.

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1. INTRODUCTION

The goal of developing glass ionomer cement (GIC) was to create a restorative material that would have the advantageous qualities of polycarboxylate cement and silicate cements. Because of a few characteristics, conventional GICs are a good choice for restorative materials. However, a few drawbacks, such as moisture attack during the first setting period, short working time, extended setting and maturation time, low fracture toughness, and reduced wear resistance, have restricted their application to non-masticatory stress areas.[1]

Recently, Zirconomer—a novel biomaterial that preserves and combines the benefits of amalgam and conventional GIC—was developed to rectify the drawbacks of tooth-colored restorative materials that were previously in use. Zirconium oxide, glass powder, polyacrylic acid (20–50%), tartaric acid (1–10%), and deionized water are all present. It is claimed that zirconomer provides a longer-lasting release of fluoride and has remarkable strength and endurance.[2]

Restorative materials must have strong tooth surface adhesion and resilience to different dislodging forces present in the oral cavity in order to perform well in clinical settings. Shear bond strength is the ability of restoration material to withstand forces that push it past tooth structure. It is believed to be of greater clinical significance because most dislodging pressures at the tooth-restoration interface have a shearing effect. Consequently, a higher SBS denotes a stronger bond between the restorative material and the tooth.[3] Hence the aim of present In-vitro Study is to evaluate of shear bond value of conventional glass ionomer cement and zirconia reinforced glass ionomer cement.

2. MATERIAL AND METHOD

Twenty extracted premolars that still had their buccal or lingual surfaces intact were gathered. Following extraction, the teeth were cleaned with running water and an ultrasonic scaler was used to remove any blood or adherent tissues. The study excluded teeth that were hypoplastic, carious, or cracked. The specimens were placed in uniform Teflon molds that could be autoclaved and filled with acrylic resin. To help achieve a uniform depth of dentin in all samples, a fissure diamond bur was used to create a groove 1.5 mm deep from the enamel surface. Following that, auto polymerizing acrylic resin was used to embed all of the teeth, positioning the buccal or lingual surfaces to be bonded to the restorative material.

All selected sample were divided randomly in two group i.e. Group A (n=10): Conventional Glass Ionomer Cement (Fuji II GIC, GC, Tokyo, Japan) and Group B (n=10) = Zirconomer (Shofu inc. Kyoto, Japan). The exposed dentinal surface in Group A (conventional GIC) was conditioned for 20 seconds using cotton pellets and GC dentin conditioner (GC Co. Tokyo, Japan). After giving the surface a thorough water rinse, the moisture was blotted away using a cotton pellet. In accordance with the manufacturer's instructions, the liquid and powder were manually combined in a 1:1 ratio. After that, cement was forced through the jig's hole and onto the exposed dentinal surface. As directed by the manufacturer, a 2:1 powder to liquid ratio was used in Group B (Zirconomer). The cement was hand mixed and inserted onto dentin surface through the hole of the template. The surface was coated with petroleum jelly for protection against moisture. The restored specimens of all groups were stored in distilled water at 37°C for 24 hours.

The Universal Testing Machine was utilized to assess the shear bond strength. To ensure that the dentin surface would stay parallel to the machine's path, each sample was placed inside the Universal Testing Machine and fastened. A steel knife edge moving at a speed of 0.5 mm/minute was used to create a shearing force at the bond interface between the restorative cement sample and the material. The maximum load necessary to cause debonding in Newton (N) was recorded using a computer, and it was then converted to megaPascal—a measure of load to cement surface area. Data were gathered and assessed statistically. The data was analyzed using the student "t" test, with a significance level of $p < 0.05$.

3. RESULTS

The shear bond strength of zirconomer (7.11 ± 0.50 MPa) was found to be statistically significant ($p \le 0.05$) when compared to conventional glass ionomer (4.05 ± 0.35 MPa) cement.

Table 1: Mean Value of Shear Bond Strength

Group	Mean Value of Shear Bond Strength
Group A	4.05 ± 0.35 MPa
Group B	7.11 ± 0.50 MPa
P value	$p \le 0.05$*

***Significant**

4. DISCUSSION

Thanks to its ability to release fluoride and many other desirable properties, glass ionomer cement has been used extensively as luting, base, liners, and restorative materials. Nonetheless, the material's primary shortcomings are its high water solubility, poor wear resistance, and fracture toughness, all of which increase the risk of restoration failure and subsequent caries or split teeth.[4]

Several creative additions to improve the features and streamline the use of GIC have been made in the last ten years. As a dental restorative and luting material, these more recent systems are simpler and more useful to use for preschoolers, kids, and teenagers alike than the earlier glass ionomers. These more recent glass ionomers also make the claim to address the material's poor physical qualities, which for a long time had limited its clinical use due to surface crazing and low fracture resistance. One such new member of the GIC family that has been introduced to treat every problem that has beset the conventional ionomer up to this point is Zirconia (ZrO2) infused GIC (Zirconomer).[5,6]

The current investigation revealed that Zirconomer exhibited a statistically significant ($p \le 0.05$) increase in shear bond strength when compared to traditional glass ionomer cement. Past research indicates that the SBS of GIC to dentin typically ranges from 1-3 MPa and rarely exceeds 5 MPa. Somani et al. (2016) assessed the SBS values of various GIC types to primary tooth dentin in a recent study. According to our study, the SBS value was lowest for conventional GIC and highest for light cure GIC and type IX GIC.[1]

By using a strict manufacturing process, Zirconomer (White Amalgam) has been created to have strength comparable to that of silver amalgam. To obtain the ideal particle size and properties, the glass component of this high-strength GI is subjected to meticulously controlled micro ionization. ZrO2's debut as a metal-free, "ALL" ceramic alternative created a whole new world of restorative dentistry opportunities with practically no bounds. ZrO2 has good mechanical qualities, a pleasing appearance, and little plaque buildup. In 1789, Martin Heinrich Klaproth presented it. This substance is an insoluble metal oxide that is noncytotoxic and does not have the ability to cling to bacteria. Because of these ZrO2 components, ZrO2 infused GIC was created to improve the GICs' strength and appearance. "Zirconomer" is a GIC that has been treated with attractive ZrO2, which may also improve its mechanical qualities. Only by contrasting it with the gold standard "conventional GIC" can the improvement be evaluated.[7]

5. CONCLUSION

Given the constraints of this investigation, it can be said that Ziconomer outperforms traditional GIC in terms of shear bond strength. To determine Zirconomer's clinical efficacy as a restorative material, more clinical trials are necessary.

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