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

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Abstract

Aim: To evaluate of shear bond value of conventional glass ionomer cement and zirconia reinforced glass ionomer cement.

Material and Method: Thirty-two extracted premolars with intact buccal or lingual surfaces were collected. All selected sample were divided randomly in two group i.e. Group A (n=16): Conventional Glass Ionomer Cement and Group B (n=16) = Zirconia Reinforced Glass Ionomer Cement (Zirconomer). Thermocycling was done to simulate oral conditions. After 24 hours, shear bond strength (SBS) was determined using universal testing machine at crosshead speed of 0.5 mm/ minute until fracture. Results were tabulated and statistically analyzed.

Result: Zirconomer (6.49 ± 0.54 MPa) showed higher shear bond strength as compared to conventional glass ionomer (3.05 ± 0.43 MPa) cement which was found to be statistically significant ($p \leq 0.05$).

Conclusion: Within the limitations of this study, it can be concluded that Zirconomer is better than conventional GIC in terms of shear bond strength. However, further clinical trials are required to find out the clinically efficacy of Zirconomer as restorative material.

Keywords: Glass Ionomer Cement, SBS, Zirconomer

Introduction

A wonder of nature is the human tooth. Its ability to regenerate is however constrained. This call for the restoration of missing tooth structure with an appropriate restorative material when it has been lost due to caries, trauma, or other causes.[1] To replace missing tooth structure and preserve form, function, and aesthetics, a variety of restorative materials have been employed for years. Dental amalgam has long been used as a superior and adaptable restorative substance. But it has several disadvantages, including a lack of aesthetics and the obligatory use of mercury, which may be hazardous to the patient's health. This results in the search for more advanced materials.[2]

Glass ionomer cements (GICs), which Wilson and Kent created in 1971, have a few characteristics that make them a good candidate as a restorative material.[3] These characteristics include physicochemical bonds to both enamel and dentin, the sustained release of fluoride, and a thermal expansion coefficient that is identical to that of dentin.[4-7] However, compared to composite resin, these cements often have slightly lower aesthetic and abrasion resistance, which restricts their usage in severe stress-bearing areas.[8]

Zirconomer, a unique biomaterial that combines and maintains the advantages of both amalgam and traditional GI, has recently been created to address the shortcomings of previously utilised tooth-colored restorative materials. It contains deionized water, tartaric acid (1 to 10%), polyacrylic acid (20–50%), glass powder, zirconium oxide, and glass powder. Zirconomer is said to offer prolonged fluoride release and to have exceptional strength and endurance.[9]

Good tooth surface adhesion and resistance to various dislodging forces operating within the oral cavity are essential for restorative materials to be successful in clinical settings. The resistance to forces that slide restoration material past tooth structure is referred to as shear bond strength. Because the majority of dislodging pressures at the tooth-restoration interface have a shearing impact, it is thought to be of greater clinical significance. Therefore, a high SBS indicates stronger restorative material bonding to the tooth.[10] 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.

Material and Method

The materials used in the study were Zirconomer (Shofu inc. Kyoto, Japan) and conventional Fuji II GIC (GC, Tokyo, Japan).

Collection of Sample

Thirty two extracted premolars with intact buccal or lingual surfaces were collected. After extraction, teeth were washed in running water and made free from blood and adherent tissues with an ultrasonic scaler. Teeth that were carious, hypoplastic and cracked were excluded from the study.

Preparation of Sample

The specimens were set in uniform autoclavable Teflon moulds that were filled with acrylic resin. A groove of 1.5 mm depth from the enamel surface was created using a fissure diamond bur to assist in reaching a uniform depth of dentin in all samples. All teeth were then embedded in auto polymerizing acrylic resin with either the buccal or lingual surface positioned for bonding with the restorative material. **(Figure 1)** All selected sample were divided randomly in two group i.e. Group A (n=16): Conventional Glass Ionomer Cement and Group B (n=16) = Zirconomer.

Fig 1: Sample Embedded in Acrylic Resin

Restoration of Samples: In the Group A (conventional GIC), conditioning of exposed dentinal surface was carried out with cotton pellet using GC dentin conditioner (GC Co. Tokyo, Japan) for 20 seconds. The surface was rinsed thoroughly with water and then blotted with a cotton pellet to remove the moisture. Powder and liquid were hand mixed in a ratio of 1:1 conforming to manufacturer's instructions. Cement was then condensed onto the exposed dentinal surface through the hole of the jig. In the Group B (Zirconomer), a powder to liquid ratio of 2:1 was used as per manufacturer's instructions. 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.

Evaluation of Shear Bond Strength: To evaluate shear bond strength, Universal Testing Machine was used. **(Figure 2)** Each sample was put inside the Universal Testing Machine and secured so that the dentin surface would remain parallel to the machine's path. A shearing force was generated at the bond interface between the sample and restorative cement using a steel knife edge moving at a speed of 0.5 mm/minute. A computer was used to record the highest load required to trigger debonding in Newton (N) and convert it to megaPascal. (a ratio of load to the surface area of cement).

Data were collected and statistically evaluated. Student 't' test were used to analyze the data with $p < 0.05$ set as level of significance.

Fig. 2: Universal Testing Machine

Result

Zirconomer (6.49 ± 0.54 MPa) showed higher shear bond strength as compared to conventional glass ionomer (3.05 ± 0.43 MPa) cement which was found to be statistically significant ($p \leq 0.05$).

Table 1: Mean Value of Shear Bond Strength

Group	Mean Value of Shear Bond Strength
Group A Conventional GlC	3.05 ± 0.43 MPa
Group B Zirconomer	6.49 ± 0.54 MPa
P value	$p \leq 0.05$

Discussion

Humans have been afflicted by dental caries, an infectious bacterial illness, for many years. All age groups experience a high prevalence of dental caries. The ultimate treatment objective is to excavate cavities and eventually restore them with an appropriate restorative material. The notion of conservation and rehabilitation of normal occlusion and dental function underlies restorative dentistry. Numerous advancements have been made in dentistry during the past 100 years, and the field's expansion is expanding quickly. Minimal tooth preparation is typically required in the modern era of restorative dentistry.[11]

Glass ionomer cement has been widely employed as luting, base, liners, and restorative materials due to its capacity to release fluoride and possess a number of other desirable properties. The material's main drawbacks, however, are its high dissolving in-water sorption, low wear resistance, and fracture toughness, all of which can cause restorations to fail and cause secondary caries or tooth fracture.[12]

The bygone decade has seen several innovative additions to enhance the properties of GIC whilst simplifying its usage. Unlike the early glass ionomers, these newer systems are easy and more practical to use as a dental restorative and luting material for preschoolers, children and teenagers alike. These newer glass ionomers also claim to address the poor physical properties such as surface crazing and low fracture resistance which had negatively affected its' clinical usage for long. Zirconia (ZrO_2) infused GIC (Zirconomer) is one such recent addition to the GIC family which has been introduced to address all the issues that have plagued the conventional ionomer thus far.[13-15]

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. In present study it was found that Zirconomer (6.49 ± 0.54 MPa) showed higher shear bond strength as compared to conventional glass ionomer (3.05 ± 0.43 MPa) cement which was found to be statistically significant ($p \leq 0.05$).

According to previous studies, the SBS of GIC to dentin is in the range of 1–3 MPa, rarely surpassing 5 MPa. In a recent study Somani et al. (2016) evaluated the SBS values of different types of GIC to primary tooth dentin. The SBS value was highest for light cure GIC, followed by type IX GIC; it was least for conventional GIC which is in accordance to our study.[16]

Zirconomer (White Amalgam) has been developed to exhibit strength similar to silver amalgam, through a rigorous manufacturing technique. The glass component of this high-strength GI undergoes finely controlled micro ionization to achieve optimum particle size and characteristics. The introduction of ZrO_2 as a metal free, "ALL" ceramic option opened a new horizon for restorative dentistry with unlimited possibilities and virtually no limitations.[17] ZrO_2 is alluring due to its good mechanical properties, aesthetics and low plaque accumulation. It was introduced by Martin Heinrich Klaproth in 1789. This material is a noncytotoxic metal oxide, is insoluble in water and has no potential for bacterial adhesion. In addition, it has radiopaque properties and exhibits low corrosion. These elements of ZrO_2 led to the formulation of ZrO_2 infused GIC to enhance the strength and aesthetics of GICs. "Zirconomer," is a GIC infused with esthetic ZrO_2 which has the potential to enhance its mechanical properties as well. The improvement can only be assessed by comparing it with the gold standard "conventional GIC."[18]

Conclusion

Within the limitations of this study, it can be concluded that Ziconomer is better than conventional GIC in terms of shear bond strength. However, further clinical trials are required to find out the clinically efficacy of Zirconomer as restorative material.

References

1. Shubhashini N, Meena N, Shetty A, Kumari A, Naveen DN. Finite element analysis of stress concentration in Class V restorations of four groups of restorative materials in mandibular premolar. J Conserv Dent 2008 Jul-Sep;11(3): 121-126.
2. Hubel S, Mejare I. Conventional versus resin-modified glassionomer cement for Class II restorations in primary molars. A 3-year clinical study. Int J Paediatr Dent 2003 Jan;13(1):2-8
3. Wilson AD, Kent BE. The glass ionomer cement: A new transluscent dental filling material. J Appl Chem Biotechno 1971;21:313.
4. Hotz P, McLean JW, Sneed I, Wilson AD. The bonding of glass ionomer cements to metal and tooth substrates. Br Dent J 1977;142:41-7.
5. Swartz ML, Phillips RW, Clark HE. Long term fluoride release from glass-ionomer cements. J Dent Res 1984;63:158-60.
6. Wilson AD, McLean JW. Glass ionomer cements. Chicago: Quintessence Publishing Co.; 1988.
7. Craig RG. Restorative dental materials. 8 th ed, vol. 53. St. Louis: CV. Mosby Co; 1989. p. 256.
8. Mclean JW, Powis RD, Prosser HJ, Wilson AD. The use of glass ionomer cements in bonding composite resin to dentin. Br Dent J 1985;158:410-4.
9. Chalissery VP, Marwah N, Almuhaiza M, AlZailai AM, Chalisserry EP, Bhandi SH, et al. Study of the mechanical properties of the novel zirconia-reinforced glass ionomer cement. J Contemp Dent Pract 2016;17(5):394-398.
10. Bhattacharya P, Naidu J, Tambakad PB. Comparative Evaluation of Shear Bond Strength and Flexural Strength of New Zirconia Reinforced Glass Ionomer Cement with Commonly used Glass Ionomer Cements Used in Atraumatic Restorative Treatment: An In Vitro Study. J Oper Dent Endod 2018;3(2):83-91.
11. Frencken JE, Peters MC, Manton DJ, et al. Minimal intervention dentistry for managing dental caries–a review: report of a FDI task group. Int Dent J 2012;62(5):223–243. DOI: 10.1111/idj.12007
12. Balagopal S, Nekkanti S, Kaur K. An In Vitro Evaluation of the Mechanical Properties and Fluoride-releasing Ability of a New Self-cure Filling Material. J Contemp Dent Pract 2021;22(2):134–139.
13. Yadav G, Rehani U, Rana V. A comparative evaluation of marginal leakage of different restorative materials in deciduous molars: An in vitro study. Int J Clin Pediatr Dent 2012;5:101-7.
14. Gu YW, Yap AU, Cheang P, Khor KA. Zirconia – Glass ionomer cement – A potential substitute for miracle mix. Scr Mater 2005;52:113-6.
15. Prabhakar A R, Kalimireddy PL, Yavagal C, Sugandhan S. Assessment of the clinical performance of zirconia infused glass ionomer cement: An in vivo study. Int J Oral Health Sci 2015;5:74-9

16. Somani R, Jaidka S, Singh DJ, Sibal GK. Comparative Evaluation of Shear Bond Strength of Various Glass Ionomer Cements to Dentin of Primary Teeth: An in vitro Study. Int J Clin Pediatr Dent. 2016; 9: 192–196.
17. Tung FF, Goldstein GR, Jang S, Hittelman E. The repeatability of an intraoral dental colorimeter. J Prosthet Dent 2002;88:585-90.
18. Haragopal S, Sreeramulu B, Shalini K, Sudha MD, Kiran G. Zirconia: A creditable restorative material – A review. Ann Essences Dent 2012;4:63-5.