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Original Research

Comparative Evaluation of Tensile Bond Strength between Glass Ionomer Cements and Composite Resins in Dental Restorations

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ABSTRACT:

Aim: This study primarily aims to evaluate and compare the tensile bond strength of Glass Ionomer Cements (GIC) and Composite Resins. **Materials and methods**: In this study, 40 extracted canines were collected, thoroughly cleaned, dried, and stored in normal saline to maintain their integrity. Following cavity preparation, impressions were taken and dental stone molds were prepared, including the fabrication of wax patterns, de-waxing, and subsequent finishing and polishing of the castings. The specimens were then randomly divided into two groups: Group A, treated with Glass Ionomer Cement (GIC), and Group B, restored using Composite Resin.Tensile bond strength for each specimen was evaluated using a Universal Testing Machine. The resulting data were organized in an Excel spreadsheet and statistically analyzed using SPSS software, with significance assessed through the Student's t-test. **Results:** The results of the study revealed that Group A (Glass Ionomer Cement) exhibited a mean tensile bond strength of 1.92 ± 0.21 MPa, while Group B (Composite Resins) showed a higher mean tensile bond strength of 2.28 ± 0.29 MPa. Statistical analysis using the Student's t-test indicated a significant difference between the two groups, with a p-value of 0.0005, suggesting that composite resins demonstrated significantly greater tensile bond strength compared to glass ionomer cements. **Conclusion:** Based on the results, it can be concluded that composite resins exhibit significantly higher tensile bond strength than glass ionomer cements, making them a more effective material choice in clinical situations where stronger bonding is required.

Keywords: Composite, Resin, Cements

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INTRODUCTION

Glass ionomer cement (GIC), first introduced by Wilson and Kent in 1972, is a self-adhesive restorative material composed of fluoro-aluminosilicate glass powder and polyacrylic acid liquid. It is widely used in both adult and pediatric dentistry due to its chemical adhesion to tooth structure, fluoride-releasing ability, and biological compatibility. GIC is often referred to as "man-made dentin" because it mimics dentin in its physical properties such as modulus of elasticity, thermal expansion, and conductivity. Its applications span from cementation of fixed dental prostheses, orthodontic bands, and brackets to restoration of carious and noncarious lesions, core build-up, liners and bases, pit and fissure sealants, and atraumatic restorative techniques (ART). Despite its many advantages, limitations such as reduced strength, esthetics, and abrasion resistance restrict its use in some clinical scenarios.[1,2,3]

GIC and its modifications are especially favored for their low polymerization shrinkage, thermal compatibility with tooth structure, and resilience, making them ideal as liners under composite restorations using the sandwich technique. Their ability to bond without smear layer removal and their fluoride release makes them suitable for high-caries-risk patients. Light-cured GICs are particularly useful in pediatric cases due to their ease of placement and quick setting. GICs are effective luting agents for stainless steel crowns, cast metal crowns, fixed dental prostheses, and orthodontic appliances. Resin-modified GICs are used for luting zirconia and alumina-based crowns. Additionally, GICs are employed for stabilizing weakened tooth structures before crown preparation, and they serve as reliable

materials for core build-up, fissure sealants, and cervical restorations.[4]

Resin composites have emerged as the most versatile and preferred restorative materials in contemporary dentistry, particularly for posterior teeth. Unlike dental amalgam, which was once valued for its durability and low technique sensitivity, resin composites support minimally invasive restorative techniques and are compatible with modern adhesive dentistry. The shift from amalgam to resin composites reflects a broader move toward additive, conservative procedures in both direct and indirect restorations. Early generations of resin composites were limited by issues such as high polymerization shrinkage and low wear resistance. However, advancements in formulation—such as the development of high-molecular-weight dimethacrylate monomers, increased inorganic filler content, reduced filler particle size, improved filler-resin matrix bonding, and more effective photoinitiator systems—have significantly enhanced the mechanical performance and longevity of these materials.[5,6]

In parallel with material innovations, advancements in bonding systems, restorative techniques, and supportive devices have contributed to the expanded use of resin composites across various clinical situations. Long-term clinical studies have played a crucial role in validating their performance and reliability in practice. While the selection of high-quality materials and the correct application of restorative techniques are central to clinical success, practitioner skill and patient-related factors—especially individual caries risk and oral hygiene habits—are equally important in determining the long-term survival of resin composite restorations. A holistic approach that includes material science, clinical technique, and patient management is essential to optimize the outcomes of composite-based restorations.[7,8]

In our study we aim to evaluate and compare the tensile bond strength of Glass Ionomer Cements (GIC) and Composite Resins.

MATERIALS AND METHODS

In this study, 40 extracted canines were collected, thoroughly cleaned, dried, and stored in normal saline to maintain their integrity. Following cavity preparation, impressions were taken and dental stone molds were prepared, including the fabrication of wax patterns, de-waxing, and subsequent finishing and polishing of the castings. The specimens were then randomly divided into two groups: Group A, treated with Glass Ionomer Cement (GIC), and Group B, restored using Composite Resin.

Tensile bond strength for each specimen was evaluated using a Universal Testing Machine. The resulting data were organized in an Excel spreadsheet and statistically analyzed using SPSS software, with significance assessed through the Student's t-test.

RESULTS

Table 1: Mean tensile strength (MPa)

Groups	Mean tensile strength	SD	p-value
Group A(Glass ionomer cement)	1.92	0.21	0.0005*
Group B(Composite resins)	2.28	0.29	

*: Significant

The results of the study revealed that Group A (Glass Ionomer Cement) exhibited a mean tensile bond strength of 1.92 ± 0.21 MPa, while Group B (Composite Resins) showed a higher mean tensile bond strength of 2.28 ± 0.29 MPa. Statistical analysis using the Student's t-test indicated a significant difference between the two groups, with a p-value of 0.0005, suggesting that composite resins demonstrated significantly greater tensile bond strength compared to glass ionomer cements.

DISCUSSION

In restorative dentistry, both glass ionomer cements (GICs) and composite resins are widely used materials, each offering distinct advantages. GICs chemically bond to tooth structure and release fluoride, which helps prevent cavities. Composite resins, on the other hand, are known for their superior aesthetics and strength. Combining these materials can potentially leverage their individual benefits.[9]

The tensile bond strength between GICs and composite resins is a critical factor in the success of such combined restorations. Tensile bond strength refers to the maximum tensile stress that a material can withstand before failure when pulled apart. A higher tensile bond strength indicates a stronger connection between the two materials, reducing the risk of bond failure, microleakage, and secondary caries.[10,11]

Evaluating this bond strength is essential to understanding the long-term performance and clinical effectiveness of using GICs as a base or liner under composite resin restorations. Various studies have explored different surface treatments, bonding agents, and material combinations to optimize the bond between GICs and composite resins, aiming to create durable and reliable dental restorations.

In a study conducted by Rix D et al.,[12] the occlusal load strength of Glass Ionomer Cement (GIC) and composite restorations in Class V cavities was evaluated using an in vitro design involving 20 non-carious extracted central incisors. Following Class V cavity preparation, the teeth were divided into two groups of ten and restored with D Tech Restore GIC and Restofill composite, respectively. The occlusal load was applied using a 1 mm diameter stainless steel jig, leading to buccolingual sectioning of the teeth under stress. Statistical analysis using an independent

t-test revealed a significant difference between the groups ($p = 0.034$), with results indicating that composite restorations exhibited higher occlusal load strength compared to GIC.

Bezerra IM et al.[13] conducted a systematic review and meta-analysis to compare the clinical performance and longevity of Glass Ionomer Cements (GIC) and Composite Resins (CR) in the treatment of non-carious cervical lesions (NCCLs). The review included thirteen studies that evaluated key clinical parameters such as retention, marginal discoloration, marginal adaptation, secondary caries, color, anatomic form, and surface texture over 12-, 24-, and 36-month follow-up periods. The findings indicated no significant differences between GIC and CR in most parameters; however, GIC exhibited significantly higher retention rates. Overall, GIC outperformed CR in terms of retention while performing comparably in other evaluated aspects.

In the study by Hussainy SN et al.[14], the clinical performance of capsulated resin-modified glass ionomer cement (RMGIC), flowable composite, and polyacid-modified composite resin (PMCR) was evaluated in the restoration of non-carious cervical lesions (NCCLs). A total of 101 restorations were performed and divided among three groups, with each material assessed using the United States Public Health Services criteria for parameters including retention, marginal adaptation, marginal discoloration, color stability, surface roughness, and sensitivity at baseline, 6 months, and 12 months. Statistical analysis using the Chi-square and Fisher's exact tests revealed no significant differences in retention, color stability, surface roughness, or sensitivity among the groups. However, RMGIC showed statistically significant superiority in marginal adaptation and resistance to marginal discoloration. The study concluded that while all three materials were clinically acceptable, RMGIC demonstrated better performance in terms of esthetics and marginal integrity.

Despite their clinical advantages, both Glass Ionomer Cements (GIC) and Composite Resins have certain drawbacks. GICs, while biologically compatible and capable of fluoride release, tend to have lower mechanical strength, reduced esthetic appeal, and limited wear resistance, which may affect their long-term durability in stress-bearing areas. On the other hand, composite resins, though offering superior tensile bond strength and esthetics, are technique-sensitive and prone to polymerization shrinkage, which can lead to marginal leakage and secondary caries if not handled properly. These limitations must be carefully considered when selecting materials for restorative procedures.

A notable limitation of our study is the relatively small sample size, which may affect the statistical strength and generalizability of the results. With a limited number of specimens, subtle differences between the materials may not have been fully captured, and the outcomes may not accurately represent broader clinical scenarios. Future studies with larger sample sizes are recommended to confirm these findings and enhance the reliability of the conclusions drawn.

CONCLUSION

Based on the results, it can be concluded that composite resins exhibit significantly higher tensile bond strength than glass ionomer cements, making them a more effective material choice in clinical situations where stronger bonding is required.

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