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Original Research

Comparative Evaluation of Tensile Bond Strength: Resin cement vs. Glass ionomer Luting Cements in Dentistry

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Abstract

Aim: To compare the tensile bond strength of Resin cements and Glass ionomer luting cements. **Materials & methods:** In this study, we collected 50 extracted incisors and prepared them for testing. After extraction, each specimen was thoroughly washed and dried, then stored in containers with normal saline to ensure preservation. Impressions of the specimens were taken following cavity preparation, and castings were subsequently made using dental stones. This casting process involved creating wax patterns, followed by devesting, finishing, and polishing. For the analysis, the specimens were randomly assigned to one of three groups: Group A was treated with Resin cement, while Group B received glass ionomer cement. The tensile strength of each specimen was measured using a Universal Testing Machine. The resulting data was recorded in an Excel spreadsheet and analyzed statistically using SPSS software, with significance levels determined through Student's t-tests. **Results:** Group A (resin cement) showed a mean tensile strength of 3.02 MPa with a standard deviation of 0.49, while Group B (GIC cement) had a mean tensile strength of 2.63 MPa and a standard deviation of 0.43. The p-value of 0.0005 indicates a statistically significant difference between the two groups. **Conclusion:** resin cement demonstrates superior tensile and bond strength compared to GIC and its variants, highlighting its potential as a preferred choice in dental restorations.

Key words: resin, cement, strength

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Introduction

Luting cements are dental materials used to bond restorations such as crowns, bridges, and inlays to the tooth structure, ensuring retention and preventing leakage. The bond strength of these cements, often measured as tensile strength, is crucial for the long-term success of restorations. Tensile strength refers to the ability of the cement to resist forces that may cause it to pull apart or detach from the tooth or restoration. Different luting cements, such as resin cements, glass-ionomer cements (GIC), and zinc-based cements, exhibit varying levels of tensile strength, with resin cements generally providing the highest bond strength due to their chemical bonding properties, followed by GICs, which offer moderate strength along with fluoride release benefits.[1,2,3]

Resin cements, widely employed in luting indirect restorations, offer desirable mechanical and aesthetic properties. Studies exploring the effect of nanofiller incorporation on resin cement performance have shown that adding 1% silanated silica nanoparticles enhances flexural strength. Increasing the nanoparticle concentration to 2.5% improves the flexural modulus without compromising strength. However, higher concentrations (above 2.5%) negatively impact flexural properties, likely due to particle agglomeration, as evidenced by SEM analysis. While higher nanoparticle fractions increase hardness, the concurrent increase in film thickness and reduction in mechanical strength suggest that a modest addition of nanoparticles (up to 2.5%) is optimal for enhancing resin luting materials. The tensile strength of resin cements is an important determinant of their ability to withstand the stresses experienced in the oral environment. Higher tensile strength generally correlates with improved fracture resistance and longevity of the cemented restoration.[4,5,6] Glass ionomer cement (GIC) is a self-adhesive restorative material. Chemically, it combines fluoro-aluminosilicate glass powder and polyacrylic acid liquid. GIC has a broad spectrum of restorative adult and pediatric dentistry uses and exhibits potent anti-cariogenic action.GIC was first described by Wilson and Kent in 1972 and has evolved gradually to improve its properties and broaden its uses. GIC is used for the cementation of fixed dental prosthesis (FDPs), orthodontic bands, and brackets, to restore carious and noncarious lesions, and as liners or bases, core build-up material, pit and fissure sealant, and for atraumatic restorative techniques (ART).[7] Glass ionomer cement (GIC) is typically supplied as a powder-liquid system, where the powder is fluoro-aluminosilicate glass, and the liquid contains polyacrylic acid mixed with other acids to regulate viscosity. Mixing is done manually with an agate spatula, ensuring the powder and liquid are combined in specified proportions. The resulting mixture should have a glossy surface, indicating an adequate number of carboxylic ions for chemical bonding with the tooth. GIC can also come in capsules or syringes for ease of use. The cement is applied after cleaning and conditioning the tooth surface with polyacrylic acid to improve bonding. During setting, GIC undergoes an acid-base reaction, where ions from the glass powder react with the acid to form a cross-linked structure. The final strength is achieved after 24 hours, with maturation continuing as the cement absorbs water. The setting process is moisture-sensitive, requiring protection during the first 24 hours. Finishing involves removal of excess cement, with final polishing done after a day. Glass ionomer cement (GIC) offers moderate tensile bond strength due to its chemical bonding with tooth structures and fluoride release, promoting long-term adhesion. However, its bond strength is generally lower compared to resin cements.[8,9] This study aimed to compare the tensile bond strength of Resin cements and Glass ionomer luting cements.

Materials and Methods

In this study, we collected 50 extracted incisors and prepared them for testing. After extraction, each specimen was thoroughly washed and dried, then stored in containers with normal saline to ensure preservation. Impressions of the specimens were taken following cavity preparation, and castings were subsequently made using dental stones. This casting process involved creating wax patterns, followed by devesting, finishing, and polishing. For the analysis, the specimens were randomly assigned to one of three groups: Group A was treated with Resin cement, while Group B received glass ionomer cement. The tensile strength of each specimen was measured using a Universal Testing Machine. The resulting data was recorded in an Excel spreadsheet and analyzed statistically using SPSS software, with significance levels determined through Student's t-tests.

Results

Table 1: Mean tensile strength (MPa)

Groups	Mean tensile strength	SD	p- value
Group A	3.02	0.49	0.0005*
Group B	2.63	0.43	

*: Significant

Group A (resin cement) showed a mean tensile strength of 3.02 MPa with a standard deviation of 0.49, while Group B (GIC cement) had a mean tensile strength of 2.63 MPa and a standard deviation of 0.43. The p-value of 0.0005 indicates a statistically significant difference between the two groups.

Discussion

The comparative evaluation of tensile bond strength between resin cements and glass ionomer cements (GIC) is crucial in understanding their performance as luting agents in dentistry. Resin cements are known for their superior tensile bond strength, primarily due to their ability to chemically bond with dentin and enamel, forming a strong hybrid layer. This results in enhanced adhesion and long-term stability. On the other hand, GICs, while offering moderate tensile bond strength, have the added benefit of fluoride release, which promotes long-term adhesion and provides anti-cariogenic effects. Despite their advantages, GICs generally exhibit lower bond strength compared to resin cements, making them suitable for specific clinical situations but less ideal for high-stress areas. This comparison is essential in determining the appropriate choice of cement based on the clinical requirements of the restoration.[10,11]

In our study, Group A (resin cement) showed a mean tensile strength of 3.02 MPa with a standard deviation of 0.49, while Group B (GIC cement) had a mean tensile strength of 2.63 MPa and a standard deviation of 0.43. The p-value of 0.0005 indicates a statistically significant difference between the two groups.

Mann et al.[12] evaluated and compared the bonding strength of resin-modified glass ionomer cement (RMGIC), resin cement, and glass ionomer cement (GIC) to four different metal alloys: titanium, cobalt-chromium (Co-Cr), nickel-chromium (Ni-Cr), and noble metal alloys (silver-palladium based). The study found that Co-Cr alloy exhibited the highest shear bond strength (8.06 MPa), while the noble metal alloy had the lowest (5.36 MPa). Resin cement showed the highest shear bond strength overall. Statistical analysis revealed that the interaction between alloy type and cement significantly affected bond strength (p=0.001). The conclusion emphasized that resin cement provided the strongest bond, followed by RMGIC and GIC, with Co-Cr alloy exhibiting the highest shear bond strength.

A study by Sharma S et al.[13] compared the compressive strength (CS) and diametral tensile strength (DTS) of conventional glass ionomer cement (C-GIC) and a silver-reinforced GIC (S-GIC). Ten specimens of each cement type were tested using a universal testing apparatus. The results showed that S-GIC had significantly higher compressive and diametral tensile strengths compared to C-GIC, with a p-value of 0.001. The study concluded that S-GIC could be a viable alternative to conventional GIC due to its superior strength properties.

In our study, Group A (resin cement) exhibited a higher mean tensile strength (3.02 MPa) compared to Group B (GIC cement), which had a mean of 2.63 MPa. This difference was statistically significant (p=0.0005), highlighting the superior bond strength of resin cement over GIC. Similarly, Mann et al. found that resin cement demonstrated the highest shear bond strength when compared to resin-modified GIC (RMGIC) and conventional GIC (C-GIC) across various metal alloys, with a significant effect from the interaction between alloy and cement type (p=0.001). Their study also concluded that resin cement provided the strongest bond, particularly with cobalt-chromium alloy. Sharma S et al.'s study on compressive and diametral tensile strength further supports these findings, as silver-reinforced GIC (S-GIC) outperformed conventional GIC in strength properties, suggesting that modifications to GIC, like the addition of silver, can improve its mechanical performance. Collectively, these studies underline the superior strength of resin cement and the potential for enhanced GIC variants to compete with resin-based materials in certain applications. This study's findings, while insightful, are limited by its small sample size, potentially affecting the generalizability of the results. Future research with larger samples and expanded variables is needed to provide more definitive guidance for clinical practice. A comprehensive understanding of luting cement characteristics is crucial for clinicians to select optimal materials, maximizing restoration durability and success.

Conclusion

Resin cement demonstrates superior tensile and bond strength compared to GIC and its variants, highlighting its potential as a preferred choice in dental restorations.

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