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Original Research

Comparison of Shear Bond Strength of Various Glass Ionomer Cements to Dentin of Primary Teeth

Dr. Rahul Sharma[1], Dr. Harshita Wadhwa[2], Dr. Vijay kumar vijayran[3], Dr. Abhishek kumar[4]

[1]Senior Resident, Conservative Dentistry and Endodontics , All India Institute of Medical Sciences, Jammu
[2]Post Graduate Student, MDS Conservative Dentistry and Endodontics, Post Graduate Institute of Medical Sciences, Rohtak Haryana
[3]Senior resident, Department of dentistry, Indira gandhi hospital dwarka sector 9 delhi 110077
[4]MDS department of conservative dentistry and endodontics

Abstract

Background: The objective of this research was to evaluate and compare the shear bond strengths of various glass ionomer cements when applied to the dentin of primary teeth.

Material and methods: A total of one hundred primary molars exhibiting intact buccal or lingual surfaces constituted the sample for this study. The samples were randomly divided into three groups (A, B, and C), which were restored sequentially with type II conventional glass ionomer cement (GIC), type II light-cured (LC) GIC, and type IX GIC. To replicate oral conditions, thermal cycling was conducted. The shear bond strength was evaluated using an Instron Universal Testing Machine after a 24-hour period, with a crosshead speed set at 0.5 mm/min until failure occurred. The data collected were compiled and analyzed statistically.

Results: The average bond strengths of glass ionomer cement (GIC) for groups A, B, and C were recorded as 3.246, 6.896, and 4.102, respectively.

Conclusion: Type II light cure GIC displayed the greatest bond strength amongst all the variants.

Keywords: shear bond strength, GIC, cements, dentin, primary teeth

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Corresponding author

Dr. Rahul Sharma, Senior Resident, Conservative Dentistry and Endodontics , All India Institute of Medical Sciences, Jammu.

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Introduction

The restoration of primary teeth continues to be a vital component of restorative dentistry. This significance extends beyond the child's overall growth and psychological health, impacting the physiological development of the permanent dentition as well. Effective restoration helps prevent premature tooth loss resulting from extractions or early exfoliation of primary teeth due to extensive decay, which can lead to complications related to space maintenance.[1,2]

Historically, silver amalgam restorations have been the conventional approach for treating posterior primary teeth affected by occlusal and proximal surface cavities, as it was the sole treatment option available. However, the application of amalgam in primary teeth has been constrained by its relatively high failure rate, especially in class II restorations, alongside concerns regarding its mercury content. This limitation is underscored by the fact that contemporary dentistry provides a diverse array of restorative alternatives.[3]

In the management of dental caries in primary teeth, there has been an increased emphasis on minimal intervention dentistry techniques, coupled with a greater consideration for aesthetic outcomes. This shift necessitates a thorough investigation of all modern restorative materials. Furthermore, there has been a demand from parents for alternative materials, driven by community apprehensions regarding the use of dental amalgam. In line with this, the Australian National Health and Medical Research Council recommended in 1999 that healthcare providers consider using alternatives to amalgam "when appropriate.".[4]

The purpose of this study was to compare the shear bond strengths of different glass ionomer cements to the primary tooth dentin.

Material and methods

A total of 60 primary molars exhibiting intact buccal or lingual surfaces constituted the sample for this study. The samples were randomly divided into three groups (A, B, and C), each receiving a different restorative material: type II conventional glass ionomer cement (GIC), type II light-cure GIC, and type IX GIC, respectively. To replicate oral conditions, thermal cycling was conducted. The shear bond strength was evaluated using an Instron Universal Testing Machine after a 24-hour period, with a crosshead speed set at 0.5 mm/min until failure occurred. The data collected were subsequently analyzed statistically.

Results

Table 1: Mean values of shear bond strength of various GIC.

Groups	N	Mean
A	20	3.246
B	20	6.896
C	20	4.102

The average bond strengths of glass ionomer cement (GIC) for groups A, B, and C were recorded as 3.246, 6.896, and 4.102, respectively.

Discussion

The human tooth is a remarkable natural phenomenon; however, its regenerative capacity is limited. This limitation necessitates the application of suitable restorative materials to rehabilitate any lost tooth structure resulting from trauma, caries, or other dental issues. Over the years, various restorative materials have been utilized to restore the form, function, and aesthetics of teeth while conserving the remaining tooth structure. Dental amalgam has long been recognized as a versatile and effective restorative option. Nonetheless, it presents several drawbacks, including aesthetic limitations and the unavoidable incorporation of mercury, which poses potential health risks to patients. Glass ionomer cement (GIC) serves as a self-adhesive restorative material, composed of a combination of liquid polyacrylic acid and powdered fluoro-aluminosilicate glass.[5-8]

The material exhibits a significant anti-cariogenic property, making it beneficial in both pediatric and restorative dentistry. Following the initial description of glass ionomer cement (GIC) by Wilson and Kent in 1972, advancements in technology have led to its enhanced functionality and broader applications. GIC is employed as liners or bases, core build-up substances, pit and fissure sealants, and for securing fixed dental prostheses (FDPs), as well as in orthodontic bands and brackets. Furthermore, it is applied in atraumatic restorative treatment (ART) and for the restoration of both carious and noncarious lesions.[8]

The purpose of this study was to compare the shear bond strengths of different glass ionomer cements to the primary tooth dentin.

In this study, the average bond strengths of glass ionomer cement (GIC) for groups A, B, and C were recorded as 3.246, 6.896, and 4.102, respectively.

The research conducted by Murthy SS et al.[9] sought to evaluate the shear bond strength (SBS) of three commercially available glass ionomer cements: Miracle Mix (MM) from GC America Inc., Ketac Molar (KM) from 3M Corp., and Amalgomer CR (AM) from Advanced Healthcare Ltd. The study focused on primary teeth and aimed to analyze the mode of adhesive failure at the interface. A total of 90 sound primary molars were extracted and prepared by exposing the dentin on the buccal surface of the crowns. The specimens were randomly divided into three groups based on the restorative materials under investigation. Shear bond strength tests were conducted, and the results were statistically evaluated using ANOVA and Tukey tests, with a significance level set at $P < 0.05$. The mean SBS values were recorded in megapascals (MPa), with results showing MM at 5.39 MPa, KM at 4.84 MPa, and AM at 6.38 MPa. The primary mode of failure observed was cohesive. Notably, Amalgomer CR demonstrated a significantly higher SBS of 6.38 MPa in primary teeth, indicating superior adhesion compared to the other materials tested, thus positioning it as a viable restorative option in pediatric dentistry. Nonetheless, further research is necessary to validate these findings and draw definitive conclusions.

Sharma C et al.[10] conducted a comparative evaluation of the shear bond strength among three dental materials: Glass Ionomer Cement (Fuji IX GP), Composite Resin (Filtek Z-250), and Compomer (Compoglass, Ivoclar). This in-vitro experimental study involved 30 freshly extracted over-retained deciduous molars, which were randomly assigned to three groups based on the restorative material utilized. A flat dentinal surface was prepared on each tooth, onto which the respective materials were applied. The specimens underwent shear testing, and the resulting values were analyzed. Descriptive statistical methods were employed to determine the mean shear bond strength for each group. The findings indicated that the composite resin exhibited the highest shear bond strength (17.13 ± 1.54), followed by the compomer (11.32 ± 1.05), while the glass ionomer cement demonstrated the lowest shear bond strength (6.56 ± 0.87). The study concluded that composite restorative

materials possess superior shear bond strength compared to both glass ionomer cement and compomer in primary molars, with the compomer exhibiting a greater shear bond strength than the glass ionomer cement.

Conclusion

In this study, the average bond strengths of glass ionomer cement (GIC) for groups A, B, and C were recorded as 3.246, 6.896, and 4.102, respectively.Type II light cure GIC displayed the greatest bond strength amongst all the variants.

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