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Research Article

In-Vitro Evaluation of Shear Bond Strength of Glass Ionomer Cement to Primary Teeth Dentin Pretreated with Silver Diamine Fluoride and Sodium Fluoride Varnish

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Abstract

Aim: To evaluate and compare the shear bond strength (SBS) of glass ionomer cement (GIC) to primary teeth dentin pretreated with silver diamine fluoride (SDF) and sodium fluoride (NaF) varnish.

Materials and Methods: A total of 50 non carious human primary molars were used in this study. The teeth were prepared to expose a flat dentin surface, ensuring comparability across samples. The samples were then randomly divided into two groups.

Group I: The dentin surface of the primary teeth was pretreated with 38% SDF.

Group II: The dentin surface of the primary teeth was pretreated with 5% NaF varnish.

Following pretreatment, all samples were restored using GIC. The SBS was evaluated using a universal testing machine, which measures the force required to detach the GIC from the dentin surface.

Results: The study found that the mean SBS of Group I (SDF 38%) was significantly higher at 10.11 ± 2.34 MPa compared to Group II (NaF 5%), which had a mean SBS of 6.34 ± 2.56 MPa. This represented a mean difference of 3.77 MPa in favor of the SDF pretreatment group.

Conclusion: The primary teeth dentin pretreated with 38% SDF demonstrated a significant increase in SBS to GIC compared to the teeth pretreated with 5% NaF varnish. This suggests that SDF not only acts as a caries-preventive agent but also enhances the bond strength of restorative materials adhered to dentin surfaces.

Clinical Significance: The findings hold considerable clinical significance, especially for pediatric dentistry. The use of SDF as a dentin pretreatment can improve the adhesion of GIC to the dentin of primary teeth. This is particularly beneficial given the minimally invasive nature of the procedure, making it an optimal choice for young patients who may find conventional dental procedures distressing. In summary, this study supports the use of SDF over NaF varnish for pretreating primary teeth dentin before GIC restoration, due to the superior bond strength observed. Implementing this can improve the longevity and effectiveness of restorative treatments in primary teeth, offering a viable, simple method that aligns well with pediatric dental care standards.

***Keywords:** Primary Teeth; Dentin; Shear Bond Strength; Glass Ionomer Cement; Pediatric Dental care.*

Introduction

The effective restoration of primary teeth is crucial in pediatric dentistry to ensure proper oral health, function, and aesthetics for children. Among the various restorative materials available, glass ionomer cement is especially favored for children due to its beneficial properties, including chemical adhesion to tooth structure, fluoride release, and biocompatibility. However, achieving optimal bond strength between GIC and dentin surfaces can be challenging, and the pretreatment of dentin has been shown to significantly influence this adhesion.[1]

Glass ionomer cement is a widely used dental restorative material, particularly in pediatric dentistry, because of its fluoride-releasing capability that aids in preventing secondary caries.[2] GIC forms an ionic bond with the dentin, making the initial interaction crucial for the durability and effectiveness of the restoration. Adequate shear bond strength between GIC and the tooth structure is vital to withstand masticatory forces and ensure the longevity of the restoration.[3]

Fluoride is a cornerstone in preventive dentistry, known for its significant role in reducing dental caries and enhancing tooth remineralization. Fluoride can be delivered through various forms, including topical applications like sodium fluoride (NaF) varnishes and silver diamine fluoride. These agents not only prevent decay but also have varying effects on the tooth surface properties, including the potential to enhance the bond strength of restorative materials.[4,5]

Silver diamine fluoride is an emerging caries management agent that has gained significant attention due to its dual action in arresting active caries and preventing new lesions.[6-8] SDF is composed of silver and fluoride ions, which contribute to its unique properties. The application of SDF results in the formation of a protective layer of silver-protein conjugates and calcium fluoride on the tooth surface, which may impact the adhesion of restorative materials.[9,10]

Sodium fluoride varnish is a well-established topical fluoride treatment used extensively for its caries-preventive effects. NaF varnish promotes remineralization by forming a layer of calcium fluoride on the enamel and dentin surfaces, enhancing the tooth's resistance to acidic challenges. However, the impact of NaF varnish on the bond strength of restorative materials, particularly GIC, warrants further investigation.[12,13]

Shear bond strength is a critical parameter in restorative dentistry, representing the force required to debond a material from the tooth surface. High SBS values indicate a strong adhesive bond, which is essential for the clinical success of restorations. Evaluating and comparing the SBS of GIC to dentin treated with different fluoride agents can inform clinical practices and optimize treatment outcomes in pediatric dentistry.[14-16]

The need to improve the bond strength of GIC to dentin in primary teeth has led to the exploration of different pretreatment agents. While both SDF and NaF varnish are beneficial for caries prevention, their effects on the adhesion of GIC to primary dentin have yet to be fully elucidated.[17-19] This study aims to evaluate and compare the SBS of GIC to primary teeth dentin pretreated with 38% SDF and 5% NaF varnish. Understanding these effects can guide clinicians in selecting appropriate pretreatment protocols to enhance the effectiveness and durability of pediatric dental restorations.

The primary objective of this study is to measure and compare the SBS of GIC to primary teeth dentin treated with SDF and NaF varnish. The secondary objective is to determine which pretreatment method provides superior bond strength, thereby informing clinical decisions for optimal restorative outcomes in pediatric dentistry.

Materials and Method

This in vitro study aimed to evaluate and compare the shear bond strength (SBS) of glass ionomer cement (GIC) to primary teeth dentin pretreated with silver diamine fluoride (SDF) and sodium fluoride (NaF) varnish. A total of 50 noncarious human primary molars were collected, following informed consent and ethical approval in line with standard guidelines. The teeth were cleaned and stored in a 0.9% saline solution until use. Their crown portions were sectioned to obtain flat dentin surfaces using a diamond saw under water cooling. These teeth were then mounted in self-cure acrylic resin blocks, ensuring the flat dentin surface was exposed.

The samples were randomly divided into two groups of 25 teeth each. Group I, designated as the SDF Pretreatment group, had their dentin surfaces treated with 38% SDF, applied using a microbrush for 60 seconds and then air-dried. Group II, designated as the NaF Varnish group, had their dentin surfaces treated with 5% NaF varnish, applied similarly using a microbrush for 60 seconds and then air-dried.

Following pretreatment, both groups had their dentin surfaces restored using GIC according to the manufacturer's instructions. Restorations were structured using cylindrical Teflon molds measuring 4 mm in diameter and 2 mm in height, and a light-curing unit was employed to ensure complete setting of the cement.

After a 24-hour storage period in distilled water at 37°C, the SBS was tested using a universal testing machine. A shear force was applied at the tooth-GIC interface at a crosshead speed of 1 mm/min until the restoration detached. The force required for dislodgment was recorded in Newtons, and the SBS values were calculated by dividing this force by the cross-sectional area of the GIC cylinder, expressed in megapascals (MPa). This methodological approach allowed for the systematic evaluation of how pretreatment with either SDF or NaF varnish impacted the bonding efficacy of GIC to the dentin surfaces of primary teeth.

Results

The findings showed that group I's mean SBS was 10.11 ± 2.34, significantly higher than group II's (6.34 ± 2.56), with a mean difference of 3.77 MPa [95% confidence interval (CI), 0.67–6.80]. At p = 0.01, the mean SBS difference between the two groups was found to be statistically significant (Table 1).

Table 1: Comparison of Mean Shear bond strength between two test group

Group	Mean Shear Bond Strength ± Std Dev	Mean Difference	P value
Group I	10.11 ± 2.34	3.77 MPa	<0.05*
Group II	6.34 ± 2.56		

Discussion

The results of this study provide meaningful insights into the bond strength of glass ionomer cement to primary teeth dentin when pretreated with silver diamine fluoride and sodium fluoride varnish. The significant difference in shear bond strength between the two groups highlights the potential of SDF as a superior pretreatment method.

The higher SBS observed in the SDF group (10.64 ± 6.78 MPa) compared to the NaF group (6.90 ± 4.96 MPa) suggests that SDF may promote improved chemical interaction and micromechanical bonding between the GIC and dentin. Several factors may contribute to this enhancement. First, SDF may cause structural modifications to the dentin surface, such as increased roughness or formation of high-affinity bonding sites, facilitating better adhesion for GIC. Additionally, the antibacterial properties of SDF could reduce the microbial load at the interface, thereby creating a cleaner surface for bonding.[20]

In pediatric dentistry, maintaining the integrity of restorative materials is paramount, especially given children's lower ability to comply with extensive dental procedures. The enhanced bond strength with SDF pretreatment supports its use not just for caries prevention but also to ensure the longevity of GIC restorations in primary teeth. This complements the trend toward more conservative and minimally invasive treatments in pediatric patients, as SDF application is a quick and non-invasive process.[21]

The exact mechanisms behind the enhanced SBS with SDF pretreatment warrant further exploration. Possibilities include the deposition of silver and fluoride ions that might facilitate a stronger ionic bond with GIC. Additionally, SDF might alter the dentin collagen in a way that promotes better penetration and adhesion of GIC.[22,23]

While this study provides valuable initial data, it also has its limitations. The in vitro design, while controlled, may not fully replicate intraoral conditions such as moisture and biological variables. Longitudinal clinical studies are necessary to validate these findings in practical settings over extended periods. Moreover, future research should seek to understand the long-term effects of SDF on both the dentin structure and the properties of the adhered restorative material.

Conclusion

In conclusion, pretreating primary teeth dentin with 38% SDF significantly enhances the shear bond strength of GIC compared to 5% NaF varnish. This finding is clinically significant, suggesting that SDF can be effectively integrated into pediatric dental practices to improve restorative outcomes. The non-invasive and cariostatic benefits of SDF combined with its ability to enhance bond strength make it a valuable tool for pediatric dentistry.

Conflict of Interest

The authors confirm there is no conflict of interest to disclose.

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