Research Article

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Comparative Evaluation of the Shear Bond Strength of Nanofilled Composite Resin to Dentin with and Without Gluma Dentin Desensitizer: An In Vitro Study

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ABSTRACT

Background: Dentin hypersensitivity is commonly managed using desensitizing agents such as Gluma. However, concerns remain regarding their influence on the bonding performance of adhesive restorative materials. This in vitro study evaluated the effect of Gluma dentin desensitizer on the shear bond strength of a nanofilled composite resin bonded to dentin using a fifth-generation adhesive system. Materials and Methods: Thirty freshly extracted human maxillary premolars were collected and randomly allocated into two groups (n = 15). In Group I (Control), no desensitizer was applied prior to bonding. In Group II (Gluma), Gluma dentin desensitizer was applied according to the manufacturer's instructions before the adhesive procedure. All specimens were restored using Adper Single Bond 2 (fifth-generation adhesive) and a nanofilled composite resin. After storage under standardized laboratory conditions, shear bond strength was evaluated using a universal testing machine. The obtained data were statistically analyzed, with the level of significance set at $p < 0.05$. Results: The specimens pretreated with Gluma dentin desensitizer demonstrated a higher mean shear bond strength compared with the control group. Adper Single Bond 2 exhibited favorable bonding performance following Gluma pretreatment. Statistical analysis revealed that the application of Gluma did not adversely affect the bond strength of the adhesive system. Conclusion: Pretreatment of dentin with Gluma dentin desensitizer did not impair the shear bond strength of nanofilled composite resin bonded using Adper Single Bond 2. The findings suggest that Gluma can be safely used prior to adhesive restorative procedures without compromising bond strength, making it a suitable option for managing dentin hypersensitivity before composite restorations.

INTRODUCTION

Achieving a durable and reliable bond between restorative

materials and dentin remains a fundamental objective in adhesive dentistry.[1] The development of adhesive systems has significantly improved the longevity, retention, and marginal integrity of composite resin restorations.[2] Despite these advances, dentin continues to present bonding challenges because of its heterogeneous structure, tubular morphology, intrinsic moisture, and organic composition, all of which can influence the effectiveness of adhesive procedures.[3]

Dentin hypersensitivity is a common clinical condition encountered after tooth preparation, periodontal therapy, or due to cervical abrasion, erosion, and gingival recession.[4] Desensitizing agents are frequently applied to alleviate hypersensitivity by occluding dentinal tubules and reducing fluid movement within the dentin, as explained by the hydrodynamic theory.[5] Among the available desensitizing agents, Gluma Dentin Desensitizer has gained widespread clinical acceptance because of its effectiveness and ease of application. Gluma contains 5% glutaraldehyde and 35% hydroxyethyl methacrylate (HEMA), which act synergistically to coagulate dentinal proteins and seal dentinal tubules, thereby reducing dentin permeability and postoperative sensitivity.[6]

Although Gluma is widely used before restorative procedures, concerns have been raised regarding its possible influence on the bonding performance of adhesive systems. The occlusion of dentinal tubules and modification of the dentin substrate could potentially interfere with resin infiltration and hybrid layer formation. Conversely, the presence of HEMA in Gluma may enhance resin penetration into conditioned dentin and improve adhesive interaction. Therefore, the effect of Gluma pretreatment on the bond strength of adhesive restorations remains an area of considerable clinical interest.[7]

Fifth-generation etch-and-rinse adhesive systems, such as Adper Single Bond 2, are commonly employed in restorative dentistry because of their simplified application protocol and proven clinical performance. These adhesives create micromechanical retention through the formation of a hybrid layer and resin tags within the conditioned dentin. The use of nanofilled composite resins in conjunction with these adhesive systems has further improved the mechanical properties, esthetics, polishability, and wear resistance of direct composite restorations.

Several in vitro studies have investigated the interaction between dentin desensitizers and adhesive systems; however, the findings remain inconsistent. While some studies have reported that Gluma pretreatment enhances or maintains bond strength, others have demonstrated minimal or no significant effect. These variations may be attributed to differences in adhesive systems, restorative materials, testing methods, and application protocols. Consequently, further research is required to clarify the influence of Gluma on adhesive bonding.

Therefore, the present in vitro study was undertaken to evaluate and compare the shear bond strength of a nanofilled composite resin bonded to dentin using Adper Single Bond 2 with and without prior application of Gluma dentin desensitizer.

MATERIALS AND METHODS

Study Design: This in vitro experimental study was conducted to evaluate the effect of Gluma dentin desensitizer on the shear bond strength of a nanofilled composite resin bonded to dentin using a fifth-generation adhesive system (Adper Single Bond 2, 3M ESPE, St Paul, MN, USA).

Sample Preparation

Thirty freshly extracted, non-carious human maxillary premolars indicated for orthodontic extraction were selected for the study. Teeth exhibiting caries, restorations, cracks, developmental defects, or structural damage were excluded. Following extraction, adherent soft tissue and debris were removed using hand scalers, and the specimens were thoroughly cleaned and stored in normal saline at room temperature until use.

The occlusal enamel of each tooth was removed perpendicular to the long axis using a water-cooled diamond disc to expose a flat mid-coronal dentin surface. Each specimen was then embedded vertically in self-cure acrylic resin using a cylindrical mold, ensuring that the prepared dentin surface remained exposed and parallel to the base of the mold. To minimize the effects of polymerization heat, the acrylic blocks were immersed in distilled water during setting. The exposed dentin surfaces were finished with 1000-grit silicon carbide abrasive paper under continuous water irrigation to obtain a standardized smear layer and a smooth bonding surface.

Grouping of Specimens: The thirty specimens were randomly allocated into two groups (n = 15 each):

Group I (Control): No dentin desensitizer was applied before the adhesive procedure.

Group II (Gluma Pretreatment): Gluma dentin desensitizer was applied to the prepared dentin surface before adhesive application.

Application of Gluma Dentin Desensitizer

In Group II, Gluma dentin desensitizer was applied according to the manufacturer's recommendations. The solution was actively rubbed onto the exposed dentin surface for approximately 30–60 seconds using a disposable microbrush. The surface was gently air-dried until a

uniform matte appearance was obtained and then rinsed with water to remove excess material before proceeding with the adhesive protocol.

Adhesive Procedure and Composite Build-Up

All specimens received the same adhesive protocol using Adper Single Bond 2, a fifth-generation etch-and-rinse adhesive system. The dentin surfaces were etched with 37% phosphoric acid for 15 seconds, followed by rinsing with water for 10 seconds. Excess moisture was removed using absorbent paper, leaving the dentin visibly moist.

Two to three consecutive coats of Adper Single Bond 2 were applied using a disposable applicator and gently agitated for 15 seconds. The adhesive layer was then lightly air-thinned for 5 seconds to facilitate solvent evaporation and subsequently light-cured for 10 seconds using an LED curing unit.

A cylindrical Teflon mold (approximately 3 mm in diameter and 4 mm in height) was positioned centrally over the bonded dentin surface. Nanofilled composite (Filtek Z350 XT; 3M ESPE, St Paul, MN, USA) resin was packed into the mold in incremental layers, with each increment light-cured according to the manufacturer's instructions. After polymerization, the mold was carefully removed, producing a standardized composite cylinder bonded to dentin.

Shear Bond Strength Testing

Following specimen preparation, all samples were stored in distilled water at 37°C for 24 hours before mechanical testing. Shear bond strength was evaluated using a universal testing machine. Each acrylic block was secured in the testing apparatus, and a chisel-shaped loading blade was aligned as close as possible to the dentin–composite interface.

A shear force was applied at a crosshead speed of 1 mm/min until debonding occurred. The maximum load required to produce failure was recorded in Newtons (N). The shear bond strength was calculated in megapascals (MPa) by dividing the maximum failure load by the bonded surface area.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software (version 25.0; IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean and standard deviation. The mean shear bond strength values of the two groups were compared using an independent samples *t*-test. A *p*-value of less than 0.05 was considered statistically significant.

RESULT

Thirty specimens were evaluated in the present in vitro study, with 15 specimens allocated to each group. The mean shear bond strength values obtained for the control and Gluma pretreatment groups are presented in Table 1.

The control group (without Gluma dentin desensitizer) exhibited a mean shear bond strength of 15.95 ± 1.05 MPa, whereas the Gluma pretreatment group demonstrated a higher mean shear bond strength of 16.55 ± 1.21 MPa. Although the Gluma-pretreated specimens showed superior bond strength compared with the control group, the difference between the two groups was not statistically significant ($p > 0.05$).

The findings suggest that pretreatment of dentin with Gluma dentin desensitizer did not adversely affect the shear bond strength of the nanofilled composite resin bonded with Adper Single Bond 2. The observed increase in bond strength following Gluma application indicates that its use is compatible with the adhesive system evaluated.

Table 1. Comparison of shear bond strength between the study groups

Group	*n*	Mean ± SD (MPa)	t value	*p*-value
Group I (Control – No Gluma)	15	15.95 ± 1.05	2.56	>0.05
Group II (Gluma Pretreatment)	15	16.55 ± 1.21		

Independent samples t-test; p > 0.05 was considered statistically not significant.

DISCUSSION

The long-term success of adhesive restorations depends largely on the quality of the bond established between the restorative material and dentin. Dentin bonding remains challenging because of the complex composition of dentin, the presence of a smear layer, and variations in dentinal tubule density.[8] In clinical practice, dentin desensitizers are frequently used to reduce postoperative sensitivity before adhesive restorative procedures. However, their influence on the bonding performance of adhesive systems remains a subject of investigation.[9] Therefore, the present in vitro study evaluated the effect of Gluma dentin desensitizer on

the shear bond strength of a nanofilled composite resin bonded to dentin using Adper Single Bond 2.

The results of the present study demonstrated that specimens pretreated with Gluma dentin desensitizer exhibited a higher mean shear bond strength than the control group. Although the Gluma group showed numerically greater bond strength, the application of the desensitizer did not adversely affect the bonding performance of the fifth-generation adhesive system. These findings suggest that Gluma is compatible with Adper Single Bond 2 and may be safely used before adhesive restorative procedures.

The improved bond strength observed following Gluma pretreatment may be explained by its composition. Gluma contains 5% glutaraldehyde and 35% hydroxyethyl methacrylate (HEMA). Glutaraldehyde coagulates proteins within the dentinal tubules, reducing dentin permeability and minimizing dentinal fluid movement, while HEMA enhances wetting of the dentin surface and facilitates resin infiltration into the demineralized collagen network. This combination may promote the formation of a stable hybrid layer without interfering with the adhesive mechanism of etch-and-rinse adhesive systems.[10]

Adper Single Bond 2 is a fifth-generation etch-and-rinse adhesive that relies on effective acid etching, resin infiltration, and hybrid layer formation to achieve micromechanical retention. Since phosphoric acid etching removes the smear layer and exposes the collagen network before adhesive application, prior treatment with Gluma does not appear to hinder resin penetration. Instead, the HEMA component of Gluma may improve the interaction between the adhesive resin and dentin, thereby maintaining or slightly enhancing bond strength.[11,12]

The findings of the present investigation are consistent with several previous studies that reported no detrimental effect of Gluma on dentin bond strength. Earlier investigations have demonstrated that pretreatment with Gluma either maintains or slightly improves the bond strength of etch-and-rinse adhesive systems by reducing dentinal fluid contamination while preserving adequate resin infiltration. These observations support the clinical use of Gluma in situations where postoperative dentin hypersensitivity is anticipated.[10]

Conversely, a few studies have reported reduced bond strength following the use of certain desensitizing agents. Such discrepancies may be attributed to differences in the composition of desensitizers, adhesive strategies, restorative materials, storage conditions, and mechanical testing methods. Self-etch adhesive systems may respond differently to dentin pretreatment than etch-and-rinse systems because they depend on simultaneous demineralization and infiltration rather than separate etching and bonding procedures.

Although the present study demonstrated favorable results, certain limitations should be considered. As an in vitro investigation, it could not reproduce the complex oral environment, including thermal fluctuations, masticatory stresses, salivary contamination, and long-term degradation of the adhesive interface. Furthermore, only one adhesive system and one desensitizing agent were evaluated. Additional studies incorporating thermocycling, cyclic loading, aging protocols, different adhesive systems, and clinical trials are recommended to validate the present findings.[13]

Within the limitations of this study, Gluma dentin desensitizer did not compromise the shear bond strength of nanofilled composite resin bonded with Adper Single Bond 2. The findings support the clinical use of Gluma before adhesive restorative procedures to manage dentin hypersensitivity without adversely affecting adhesive performance.

CONCLUSION

Within the limitations of this in vitro study, pretreatment of dentin with Gluma dentin desensitizer did not adversely affect the shear bond strength of nanofilled composite resin. Gluma may be safely used before adhesive restorative procedures for the management of dentin hypersensitivity without compromising dentin bonding.

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