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ORIGINAL ARTICLE

A Comparative Evaluation of Three Commercially Available Dentin Desensitizers on the Shear Bond Strength of Composite Resins: An *in vitro* Study

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ABSTRACT

Background: The dentin desensitizers available for in-office application for prevention and/or treatment of post restorative dentinal hypersensitivity, act by blocking the open dentinal tubules. In doing so, they may influence the bond strength of the restorative resins. Thus, the aim of the study was to evaluate the effect of desensitizers on the shear bond strength of dentin adhesives and to check the extent of dentinal tubule occlusion caused by these desensitizers.

Materials and methods: Sixty-four premolars were randomly divided into four groups of sixteen each. The middle depth dentin was exposed by on the buccal surface and was etched using 37% phosphoric acid and rinsed. They were assigned to, Group 1: Gluma desensitizer, Group 2: VivaSens desensitizer, Group 3: Gluma Comfort Bond and desensitizer, and Group 4:Adper Single Bond 2. Composite resin post of 2 mm in height and width were built on these specimens. The samples were then mounted in acrylic resin blocks. Universal testing machine was used to test the shear bond strength. The data were analyzed using one-way analysis of variance (ANOVA) and post hoc Tukey's test.

Results: The mean values of the shear bond strength were for: Group 1—18.61 ± 1.03 MPa, Group 2—17.53 ± 1.36 MPa, Group 3—22.63 ± 1.61 MPa and Group 4—23.12 ± 1.02 MPa. There was a statistically significant difference ($p < 0.05$) among the groups.

Conclusion: The use of dentin desensitizers' influences bond strength between the tooth and the adhesive. Among the various agents, the single bottle system containing Gluma comfort bond and desensitizer had the best adhesion among the desensitizer groups.

Keywords: Adper Single Bond 2, Dentin desensitizers, Gluma comfort bond, Gluma comfort bond and desensitizer, Adhesive resins, Shear bond strength, Vivasens.

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INTRODUCTION

Postrestorative dentinal hypersensitivity is a common occurrence and happens due to the exposure of the dentinal tubules.[1-5] The movement of the dentinal fluid in these exposed tubules, excite the pulpal nerves resulting the perceived sensation.[1,2]

The use of dentin desensitizers has been one of the most common approaches for management of post-restorative dentin hypersensitivity. Dentin desensitizers are applied to the tooth surface after etching and prior to the application of the bonding agent. The dentin desensitizers block the dentinal tubules and bring about a reduction in hypersensitivity.[6-9]

The most commonly used desensitizers are resin based. These agents block the tubules, either by precipitation of water insoluble substances, such as fluorides or by precipitation of plasma proteins in the substance of the tubules respectively.[3,8-11]

The blocking of the dentinal tubules by the desensitizer or the presence of certain components of the desensitizers may impede the permeability of the tubule[9-13] and interfere with interaction between the dentin and adhesive restorative resin or the adhesive bonding agent which is paramount to ensure the long-term success of the resin restoration.[7,9-14] This study was conducted to evaluate the effect of application of commercially available dentin desensitizers on the shear bond strength of the adhesives and compare the differences between them.

MATERIALS AND METHODS

A total of 64 freshly extracted human premolar teeth were taken and were randomly divided into four groups of 16 samples each. The labial surface of each tooth was ground under running water to expose middle depth dentin and the specimens were treated with 35% phosphoric acid for 15 seconds and thoroughly rinsed with water for the same amount of time with water spray.

The sample teeth were assigned to the following product (Table 1) groups:

- *Groups:* Per group (n = 16)
- *Group 1:* Gluma desensitizer, Heraeus Kulzer, GmBH, Hanau, Germany

Table 1: List of products used in the study

Groups	Products	Manufacturers	Composition	Application
1	Gluma desensitizer (GD)	Heraeus Kulzer, GmBH, Dormagen, Germany	5% glutaraldehyde, 35% HEMA	GD application followed by bonding with Adper Single Bond 2
2	VivaSens desensitizer	Ivoclar Vivadent, Schaan, Liechtenstein	Ethanol, water and hydroxypropyl cellulose. Containing potassium fluoride, polyethylene glycol dimethacrylate and other methacrylate	VivaSense application followed by Adper Single Bond 2
3	Gluma comfort bond+ desensitizer (GCBD)	Heraeus Kulzer, GmBH, Dormagen, Germany	5% glutaraldehyde, 35% hydroxyl ethyl methacrylate, urethane dimethacrylate, 4-methoxyethyl tetraacetate, methacrylate, polyacrylic acid)	GCBD only
4	Adper Single Bond 2	3M ESPE, St Paul, MN, USA	Water, ethanol, HEMA, Bis-GMA, dimethacrylates, initiators, methacrylate functional copolymer of polyacrylic and polyitaconic acids and silica nanofillers	Adper Single Bond 2 only

- *Group 2:* VivaSens desensitizer, Ivoclar Vivadent, Schaan, Liechtenstein
- *Group 3:* Gluma Comfort Bond and Desensitizer Heraeus Kulzer GmBH, Hanau, Germany
- *Group 4:* Adper Single Bond 2, 3M ESPE, St Paul, MN, USA

Application of the respective agents:

- *Group 1:* Gluma desensitizer was applied with applicator tip over the dentin surface following which bonding agent (Adper S2) was applied and cured as per manufacturers' instructions.
- *Group 2:* VivaSens desensitizer was applied with applicator tip over the dentin surface following which bonding agent was applied similar to group 1.
- *Group 3:* Gluma comfort bond and desensitizer was applied and cured.
- *Group 4:* The samples were treated with the application of the dentin-bonding agent, alone which served as controls.

Composite resin posts of dimension 2 mm in height and width were then built on the treated surfaces and the specimens were stored in artificial saliva for 48 hours and prior to testing were mounted on cold cure acrylic resin stubs.

Universal testing machine (Instron) was used to apply the shear load until specimen failure occurred at a cross-head speed of 0.5 mm per minute. Maximum load applied and failure load was recorded for each specimen and the shear bond strength was calculated. The values obtained in Newtons (N) were converted to megapascals (MPa).

The data collected was analyzed statistically using ANOVA and Tukey's post hoc test (SPSS 16).

RESULTS

The mean force needed to debond the attachment between the specimen and the composite was the highest for group 4 (control group) at 23.12 ± 1.02 MPa, followed by group 3 (Gluma and desensitizer) was at 22.64 ± 1.61 and group 1 (Gluma desensitizer) was at 18.61 ± 1.03 and the least was in group 2 (VivaSens) at 17.53 ± 1.36 MPa. There was a statistically significant difference between all the four groups (Table 2).

When the pairwise comparison was done significant difference was found between then groups 1 and 3 and between groups 1 and 4 (Table 3).

Significant difference was also noted between groups 2 and 3 and between groups 2 and 4. No statistically significant difference was noted between groups 3 and 4.

DISCUSSION

Dentinal hypersensitivity has been reported after placement of restorations and more so with composite resin restorations. Application of dentin desensitizers has

Table 2: Intra- and intergroup comparisons with ANOVA

		Source of variation			
Groups	Mean ± standard deviation	Between groups	Within groups	f-value	p-value
1	18.61 ± 1.03	381.51	98.15	77.74	0.00
2	17.53 ± 1.36				
3	22.64 ± 1.61				
4	23.12 ± 1.02				

*$p < 0.01$, highly significant [significant at 1% level of significance ($p < 0.01$)]

Table 3: Pairwise comparison of four groups by Tukey's HSD post hoc test

Groups	*Group 1*	*Group 2*	*Group 3*	*Group 4*
Means	18.61	17.53	22.63	23.12
Group 1	1.00			
Group 2	0.09	1.00		
Group 3	0.00	0.00	1.00	
Group 4	0.00	0.00	0.71	1.00

*p < 0.01, highly significant

been one of the recommended modalities for treatment of the same.[1-6]

Studies have shown that application of dentin desensitizers has an influence on the bond strength between the tooth surface and the restoration.[10-14] The present study evaluated the effect of application of dentin desensitizers on the shear bond strength and not micro-shear bond strength (μSBS) or microtensile bond strength (μTBS) as μTBS and μSBS have shown higher pretest failures during sample preparation and over estimation of adhesion respectively.[15-17]

The highest bond strengths in the samples evaluated in the present study were for the adhesive only (control) group, followed by the single bottle Gluma and desensitizer followed by gluma desensitizer and then VivaSens.

The highest shear bond strength was observed with the samples treated with only the bonding agent; this is because a standard bonding procedure was employed for the specimens without any intervening desensitizer. Adper Single Bond 2 being a total-etch adhesive, contains the moisture-tolerant Vitrebond copolymer in a water/ethanol solvent this aids in adhesion between the bonding agent and the dentin surface, and thus the monomer of the adhesive flows into the dentinal tubules and achieves better adhesion.[16-18]

The application of a desensitizer between the bonding agent and the dentin surface may interfere with the flow of the adhesive and that's the reason for lesser bond strengths observed.

The Gluma containing agents showed better bond strengths[10] as compared to VivaSense. The better bond strength of the Gluma based agents is due to the glutaral dehyde in Gluma which may bond to collagen fibrils of dentin and stabilize the network for resin infiltration, it is also shown to coagulate the proteins of the dentinal fluid and plugs the tubules.[7,19-22] But as it is non-polymerizable it is not capable of forming a bond with the resin, and thus it has shown to reduce the bond strength of resin cements.[7,23,24] However, there are reports which show that Gluma desensitizer did not affect the bond strength of any of the three adhesive systems tested[8,13] and in a study[10] the samples treated with Gluma desensitizer had better bond strength when compared to other desensitizers.

The present study also included a group wherein the desensitizer and the bonding agent were in a single bottle and found that the bond strength was better in samples treated with single bottle system as compared to the two-bottled system. This phenomenon can be attributed to the fact that as both the active agents are in the same bottle, and thus during application, the percentage of bonding agent occupying the etched surface may be higher than in the two bottled solutions, where in the desensitizer is completely layering the etched surface prior to the application of the bonding agent.[16]

The least bond strength was with VivaSense, this has been attributed to the fact that the phosphonic acid methacrylate modified polyacrylic acid in VivaSense forms Ca-salts that precipitates in the dentinal tubules. In addition, the potassium ions of its fluoride component support precipitation of the salts[25,26] and the precipitation of microcrystals and mineral deposits into dentin tubules prevent resin infiltration.[7,25] Hence, the reduced bond strength as shown in the study.[7,26] However, a study conducted by Lehmann N et al[10] showed VivaSens desensitizer did not alter the adherence of any of the bonding agents tested.

It can be stated that use of desensitizers showed decreased shear bond strength values as compared to application of the adhesive alone. The Gluma containing desensitizers have better bond strengths than VivaSens. Among the Gluma containing agents, the single bottle system GCBD has better strength as compared to the two-bottled system of GCB and GD.

CLINICAL SIGNIFICANCE

The use of dentin desensitizers reduces the adhesive bond strength between the restorative resin and the tooth surface. In scenarios necessitating the use of dentin desensitizers, it is better to use a single bottle containing the desensitizer as well as the bonding agent.

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