Evaluation of the Bond Strength of Posterior Composites to the Dentin, Treated with Four Different Desensitizing Agents – An *In vitro* Study

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Abstract

Background: Postrestorative sensitivity is frequently associated with composite restorations. Dentin desensitizers are used commonly for the management of postrestorative sensitivity. This study aimed to evaluate the effect of four desensitizing agents on the bond strength of composite restoration. **Materials and Methods:** Sixty-five human premolars are used for the study. The occlusal surface of each tooth is flattened using a diamond disk to expose the dentin. The specimens are then etched with 35% phosphoric acid for 15 s and divided into five groups (n = 13) Group I – VivaSens, Group II – MS Coat F, Group III – Gluma, Group IV – Systemp, and Group V – Control. Single-step adhesive (Single Bond Universal, 3M) will be applied on the specimens and restored with composite material (Filtek Z350XT, 3 M). Shear bond strength is tested using universal testing machine at a crosshead speed of 1 mm/min. Statistically multiple group comparison was done using one-way analysis of variance followed by Tukey's test for group-wise comparison analysis. **Results:** Systemp desensitizer showed improved bond strength values than others desensitizers and control group. **Conclusions:** Systemp desensitizer can be considered as a promising option for preventing postoperative sensitivity associated with resin composite restorations without altering its shear bond strength to dentin.

Keywords: *Desensitizer, Gluma, MS Coat F, postoperative sensitivity, Systemp, VivaSens*

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Introduction

Postrestorative sensitivity is frequently associated with composite restorations. Dentin desensitizers are used commonly for the management of postoperative sensitivity. The dentin desensitizers obliterate the dentinal tubules, thereby reduce hypersensitivity.[1] Postoperative sensitivity is commonly associated with the adhesives that necessitate conditioning of the dentin.[2] Postoperative sensitivity can be caused by multiple factors and does not originate from one isolated aspect. It results from the interaction between the restorative technique, the clinical condition of the tooth to be treated, and the restorative material.[3] Despite the advancements in material science, postoperative sensitivity following composite restoration still remains a drawback.[4]

Various dentin desensitizing methods such as anti-inflammatory agents, adhesives, varnishes, tubular obliterating procedures, and lasers are applied on to the tooth surface after cavity preparation. The current desensitizer includes antibacterial agents such as benzalkonium chloride, triclosan, fluoride ethylenediaminetetraacetic acid, and glutaraldehyde.[5] There are several components in the desensitizer, some

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of which may hamper the interaction between the dentin and composite resin, affecting the bond strength.[6]

Most commonly used dentin desensitizers consist of Gluma, VivaSens, Systemp, and MS Coat F. VivaSens desensitizer consists of organic acids, such as phosphonic acid methacrylate, and solvents, such as ethanol, which induce the precipitation of proteins in the dentin liquid.[7] GLUMA Desensitizer is a glutaraldehyde base substance that contains hydroxyethyl methacrylate (HEMA), which occlude dentinal tubules by coagulation of the plasma proteins in the tubules.[8] Systemp desensitizer contains polyethylene glycol dimethacrylate and glutaraldehyde, which form firm protein plugs. These plugs considerably reduce permeability and incidence of sensitivity.[9] MS Coat F is a fluoride-containing, dentin tubule sealant in a single-bottle system. MS Coat F reacts chemically with the tooth structure and forms a barrier that seals open tubules and blocks thermal, mechanical, and chemical stimulation of odontoblastic processes.[10]

Dentin desensitizers may hamper interaction between dentin and composite. Hence, this study is done to evaluate the effect of different dentin desensitizers on the bond strength of resin composite to dentin.

Materials and Methods

Sixty-five healthy human premolars are selected for the study. Any tissue remnants present are removed using ultrasonic scaler, sterilized, and stored in distilled water until use. The occlusal surface of each tooth is flattened with a diamond disk to expose the dentin. The specimens are then etched with 37% phosphoric acid and divided into five groups of 13 teeth each.

- Group I: Treated with VivaSens (Ivoclar, Vivadent, India) for 10 s and then dried for 10 s
- Group II: Treated with MS Coat F (Sun Medical, Japan) for 30 seconds, dried for 10 seconds, and rinsed
- Group III: Treated with GLUMA Desensitizer (Heraeus Kulzer) using a cotton brush and dried for 30–60 s and then rinsed
- Group IV: Treated with Systemp (Ivoclar, Vivadent) for 10 s and air blowed
- Group V: This group is not treated with any desensitizing agent (control group).

Single Bond Universal (3M ESPE) is applied on the specimens and restored with composite material (Filtek Z350XT, 3M) in 4 mm × 4 mm dimension and then stored in distilled water for 24 h. Shear bond strength is tested using a universal testing machine at a crosshead speed of 1 mm/min.

Statistics

The data collected by experiments were computerized and analyzed using statistical package for social sciences 23.0. The mean and standard deviation of shear bond strength of five study groups as compared using analysis of variance (ANOVA) test followed by Tukey honestly significant difference *post hoc* test. $P < 0.05$ will be considered to be statistically significant.

Results

One-way ANOVA revealed that significant difference was there between the groups regarding the mean bond strength, i.e., $P = 0.0001$ [Table 1]. The *post hoc* analysis is done to find out the significant difference between any of the two given groups. Result showed a significant difference in bond strength reported by all the four groups compared to the control group. Similarly, the significant difference seen between any two experimental groups except between MS Coat F versus VivaSens where $P = 0.9597$ [Table 2].

The mean shear bond strength value is highest for Systemp desensitizer 9.679 ± 1.127 MPa and lowest for dentin surfaces treated with MS Coat F 3.332 ± 0.780 MPa. The bond strength values of VivaSens, Gluma, and control were intermediate between Systemp and MS Coat F [Graph 1].

Table 1: One-way analysis of variance analysis of difference between the groups

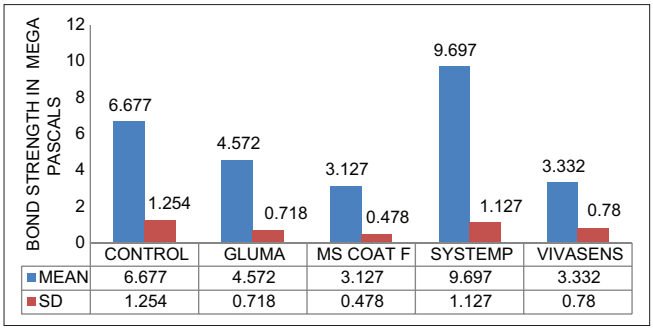
Source of variation	Sum of squares	Degree of freedom	Variance	*F*	*P*
Between groups	392.4813	4	98.1203	166.8116	0.0001*
Within groups	35.2926	60	0.5882		
Total	427.7739	64			

*$P<0.05$ is statistically significant. One-way ANOVA showed significant difference was there between the groups regarding the mean bond strength ($P=0.0001$). ANOVA=Analysis of variance

Table 2: Tukey honestly significant difference *post hoc* test

Groups	Difference	95% CI	*P*
Control versus GLUMA	−2.1050	−2.9511-−1.2589	0.0000*
Control versus MS Coat F	−3.5500	−4.3961-−2.7039	0.0000*
Control versus systemp	3.0200	2.1739-3.8661	0.0000*
Control versus VivaSens	−3.3450	−4.1911-−2.4989	0.0000*
GLUMA versus MS Coat F	−1.4450	−2.2911-−0.5989	0.0000*
GLUMA versus systemp	5.1250	4.2789-5.9711	0.0000*
GLUMA versus VivaSens	−1.2400	−2.0861-−0.3939	0.0011*
MS Coat F versus systemp	6.5700	5.7239-7.4161	0.0029*
MS Coat F versus VivaSens	0.2050	−0.6411-1.0511	0.9597
Systemp versus VivaSens	−6.3650	−7.2111-−5.5189	0.0011*

*$P<0.05$ is statistically significant. Result shows there a significant difference in bond strength reported by all the four groups compared to the control group. Similarly, the significant difference seen between any two experimental groups except between MS Coat F versus VivaSens ($P=0.9597$). CI=Confidence interval



Graph 1: shear bond strength in megapascals

Discussion

Resin composites are increasingly used as an esthetic alternative to dental amalgam. A strong bond between composite and dentin are required to achieve mechanical, biologic, and esthetic properties.[11] Despite advancements in material science, postrestorative sensitivity still remains a problem. Postoperative sensitivity following posterior composite resin restorations is reported in up to 30%–60% of the cases.[9] The use of dentin desensitizers has been one of the most common approaches for the management of postrestorative dentin hypersensitivity.[5]

Systemp desensitizer showed greater mean bond strength than other groups. A study done by Mushtaq *et al*. showed that systemp desensitizer increased the bond strength, and they attributed it to its function as rewetting agent improving resin infiltration.[9] Another study done by Jayashankara *et al.* also showed that systemp increased bond strength values. Increased bond strength values are attributed to the stabilization of the collagen fibril network by glutaraldehyde, facilitating easy resin infiltration. Similar results are shown by a study done by Sevimay *et al*.[12] Systemp desensitizer acts as a rewetting agent before the application of bonding agent. This dual wetting effect may enhance bond strength.[9] Higher bond strength values in our study could be because of its function as rewetting agent improving resin infiltration.

The control group showed higher mean bond strength values compared to other groups except systemp desensitizer. This could be because of standard bonding procedure employed for specimens in this group as per the manufacturer's instructions. Single bond universal is an ethanol/water-based solvent adhesive, which helps decrease its viscosity, thereby facilitating wetting of the surface and penetration of the adhesive into the dentin substrate. It contains vitrebond copolymer, which provides stability against humidity deterioration, and could be associated with the present results. The findings are similar to the study done by Choi *et al*.[13] Another study done by Jayasheel *et al*. also showed that the application of an etching step prior to universal adhesives significantly improves their dentine penetration pattern and improves bond strength.[14]

The mean bond strength values of GLUMA are lower than control and systemp group. GLUMA contains 35% HEMA and 5% glutaraldehyde, which reacts with plasma proteins to form protein precipitates. These precipitates occlude dentinal tubules thus causing the blockage of tubules.[12,15] This could be attributed to decreased bond strength exhibited by Gluma. Furthermore, the high concentrations of hydrophilic components decrease the bond strength values, because it makes it difficult for hydrophobic component of bonding agent to penetrate. Similar results are obtained in the study done by Sevimay *et al*.[12] and Garcia *et al*.[7] Another study done by Huh *et al*. also showed decreased bond strength values with GLUMA desensitizer.[6]

VivaSens showed lower mean bond strength values compared to systemp, control, and GLUMA groups. A study done by N Ravikumar *et al*. showed that VivaSens decreased bond strength values. Decreased bond strength values are attributed to its fluoride content, which plugs tubular orifices and intertubular channels.[13] Similar results are shown by a study done by Akca *et al*. They hypothesized that decreased bond strength values occur due to precipitation of calcium salts in the dentinal tubules and fluoride present in it support precipitation[8] This could be the possible reason for decreased bond strength values in this study.

MS Coat F showed the least mean bond strength values compared to other groups. A study done by Jeetendra *et al*. on the effect of dentin desensitizers on the bond strength using MS Coat F, VivaSens, and Soloeze also showed that MS Coat F decreased bond strength values. They stated that lower bond strength values are possibly due to calcium fluoride precipitates in dentinal tubules which prevents resin infiltration.[10] A study by Külünk *et al*. showed that fluoride-containing desensitizers lowered the bond strength of composites restorations. They stated that increase in precipitated crystals on dentin surface with a higher amount of fluoride results in weaker bond strengths.[16] Tubular occlusion added with a higher concentration of fluoride could possibly have resulted in lower bond strength seen with Ms Coat F in this study.

Conclusions

Systemp desensitizer seems to be promising dentin desensitizer to prevent postoperative sensitivity without affecting bond strength of composite restorations, thus can increase the clinical longevity of the composite restoration. However, the results should be validated

with additional clinical studies as physiological conditions of the oral cavity were not taken into consideration in *in vitro* conditions.

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Conflicts of interest

There are no conflicts of interest.

References

1. Jayashankara CM, Imroze R, Jyothi KN, Venugopal P, Kumar AS, Kumar SP, *et al*. A comparative evaluation of vivasens and system desensitizers on shear bond strength of composite resin to human dentin: An *in vitro* study. IOSR J Dent Med Sci 2018;17:73-7.
2. Awang RA, Masudi SM, Mohd Nor WZ. Effect of desensitizing agent on shear bond strength of an adhesive system. Arch Orofac Sci 2007;2:32-5.
3. Porto IC. Post-operative sensitivity on direct resin composite restorations: Clinical practice guidelines. Ind J Res Dent 2012;1:1-11.
4. Sobral MA, Garone-Netto N, Luz MA, Santos AP. Prevention of postoperative tooth sensitivity: A preliminary clinical trial. J Oral Rehabil 2005;32:661-8.
5. Külünk S, Saraç D, Külünk T, Karakaş O. The effects of different desensitizing agents on the shear bond strength of adhesive resin cement to dentin. J Esthet Restor Dent 2011;23:380-7.
6. Huh JB, Kim JH, Chung MK, Lee HY, Choi YG, Shim JS. The effect of several dentin desensitizers on shear bond strength of adhesive resin luting cement using self-etching primer. J Dent 2008;36:1025-32.
7. Garcia RN, Giannini M, Sato T, Tagami J. Effect of dentin desensitizers on resin cement bond strengths. Rev Sul Bras Odontol 2015;12:14-22.
8. Akca T, Yazici AR, Celik C, Ozgünaltay G, Dayangaç B. The effect of desensitizing treatments on the bond strength of resin composite to dentin mediated by a self-etching primer. Oper Dent 2007;32:451-6.
9. Mushtaq EA, Mathai V, Nair RS, Angelo JMC. The effect of a dentin desensitizer on the shear bond strength of composite to dentin using three different bonding agents: An *in vitro* study. J Conserv Dent 2017;20:37-40.
10. Jeetendra S, Rangappa A, Naganathan M, Lakshminarasimhaiah V. Influence of dentin desensitizers on the bond strength of self-etch adhesive to dentin: An *in vitro* study. J Oper Dent Endod 2018;3:18-21.
11. Ravikumar N, Shankar P, Indira R. Shear bond strengths of two dentin bonding agents with two desensitizers: An *in vitro* study. J Conserv Dent 2011;14:247-51.
12. Sevimay M, Ozyesil AG, Uludamar A. Microtensile bond strengths of composite to dentin treated with different desensitizers. SU Dishek Fak Derg 2009;18:154-60.
13. Choi AN, Lee JH, Son SA, Jung KH, Kwon YH, Park JK. Effect of dentin wetness on the bond strength of universal adhesives. Materials (Basel) 2017;10. pii: E1224.
14. Jayasheel A, Niranjan N, Pamidi H, Suryakanth MB. Comparative evaluation of shear bond strength of universal dental adhesives – An *in vitro* study. J Clin Exp Dent 2017;9:e892-6.
15. Sabatini C, Wu Z. Effect of desensitizing agents on the bond strength of mild and strong self-etching adhesives. Oper Dent 2015;40:548-57.
16. Saraç D, Külünk S, Saraç YS, Karakas O. Effect of fluoride-containing desensitizing agents on the bond strength of resin-based cements to dentin. J Appl Oral Sci 2009;17:495-500.