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COMPARISION OF SHEAR BOND STRENGTH OF THREE DIFFERENT BULK FILL COMPOSITE RESINS TO DENTIN: AN INVITRO STUDY

Dental Science

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ABSTRACT

Aim: To compare shear bond strength of three different bulk fill composite materials to dentine. **Materials and methods:** 30 extracted human molars were collected, cleaned and then the mid coronal dentin was exposed by sectioning the teeth parallel to occlusal surface, using a low speed diamond disk. The surface of the dentin was smoothed and randomly divided into 3 groups. A fifth generation bonding system was utilized on the teeth in all groups .Three commercial composite systems ie, coltene everglow, solitaire 2 and beautifil II were used. After adhesive application, a cylinder of composite with 5mm height and 3mm diameter was placed and any excess composite was carefully removed and then cured.. The shear bond strength of resin bond was tested using universal testing machine. The statistical evaluation was performed with ssps software for windows version 20. **Results:** Among the three tested materials coltene brilliant everglow has higher shear bond strength compared to solitaire 2 and beautifil II **Conclusion:** Under the limitations of the study, the results indicate that coltene brilliant everglow has high shear bond strength to dentin compared with solitaire 2 and beautifil II composite.

KEYWORDS

Composite Resin, Shear bond strength, Coltene brilliant everglow, Solitaire 2, Beautifil II

INTRODUCTION:

Among all the dental restorative materials used in today's era, composite resins are being widely used as they have various advantages such as excellent esthetics resembling natural tooth color, high strength and ease of manipulation. The bonding of resin composites to dentin has always been more difficult and less predictable when compared to enamel bonding, mainly because dentin is a vital tissue with high water and organic content and its microstructure is dominated by tubules1. One of the disadvantages of these composite materials is polymerization shrinkage which is a complication of insufficient polymerization2. To overcome this disadvantage, bulk fill composites have become more common. Many materials are being developed with controlled polymerization contraction stresses3 and improvement in curing4. Using this approach, the number of increments required to fill a cavity is reduced in comparison with traditional incremental filling techniques.

In cases of conventional resin composites 2mm increment were recommended. However, for the bulk fill resin composites, the manufacturers recommend 4 or 5 mm increment. The use of the bulk-fill technique simplifies the restorative procedure and saves time in cases of deep, wide cavities 5. The data available for these materials are currently limited, and therefore further laboratory studies are required in order to provide insight into likely clinical outcomes.

The use of thicker increments in bulk-fill resin composites is due to both developments in photo-initiator dynamics and their increased translucency, which allows additional light penetration and a deeper cure. Other than the improved depth of cure, recently developed bulk-fill resin composites exhibit lower polymerization contraction stress and contraction rates than hybrid and flowable resin composites. However, a higher modulus of elasticity and increased plastic deformation suggest that the interfacial stress accumulation generated when using these bulk-fill materials, as well as the resulting consequences such as cuspal deflection and marginal gaps, may be difficult to predict.

BRILLIANT ever glow is a universal composite of latest generation and is a true all round material. It contains submicron barium glass fillers and exhibits care of excellent polishability and gloss retention. The Filler surfaces are treated to ensure optimal compound strength within resin matrix. Prepolymerized fillers lower volume shrinkage and improve sculpting properties.

Solitaire 2 is a light curing, fluoride set of radiopaque polyglass used for fillings of class I, II and V. It can also be used for splinting of teeth that are traumatically loose. It has outstanding packability and does not stick to the instrument. It is extremely resistant to mastication and has excellent abrasion values.

Beautifil II bulk restorative provides exceptional condensability and sculpt ability. It is ideal for posterior restorations. It has high fill ratio that reduces polymerization shrinkage stress and increasing compressive and flexural strength. It has high level of radiopacity and

outstanding Vickers hardness values.

METHODOLOGY

This study was conducted in the department of conservative dentistry and endodontics, Meghna Institute of dental sciences. 30 extracted human molars without cracks and decay were collected. The selected teeth were washed in saline solution and stored in distilled water at room temperature throughout the study. Prior to testing, teeth were cleaned and then mid coronal dentin was exposed by sectioning the teeth parallel to occlusal surface, using a low speed diamond disk (Maximus inc. Michigan USA) under water coolant (Fig 1). The teeth were rinsed again before being mounted in acrylic resin (1cm -1cm dimensions) (Fig2). The surface of the dentin was smoothened with a grit (600, 800, 1200 grit water proof polishing papers) and randomly divided into 3 groups with ten teeth in each group.

- Group 1: Acid etching was done with 37% phosphoric acid (Prime Dental) for 15 seconds to all the samples. A fifth generation bonding agent (Tetric N-Bond, Ivoclar-Vivadent) was applied on the teeth. A single coat application of bonding agent was done over the dentine surface and then light cured. After adhesive application, a cylinder of brilliant everglow (coltene/whaldent AG) with 5mm height and 3mm diameter was manipulated according to the manufacturer's instructions and placed. Any excess composite was carefully removed and then light cured.

- Group 2: Similar to group 1 acid etching was done with 37% phosphoric acid (Prime Dental) for 15 seconds to all the samples and a fifth generation bonding agent (Tetric N-Bond, Ivoclar-Vivadent) was applied on the teeth. A single coat application of bonding agent was done over the dentine surface and then light cured. After adhesive application, a cylinder of solitaire 2 (kulzer) of 5mm height, 3mm diameter was manipulated according to the manufacturer's instructions and placed. The excess composite was carefully removed and then light cured.

- Group 3: Acid etching was done with 37% phosphoric acid (Prime Dental) for 15 seconds to all the samples and a fifth generation bonding agent (Tetric N-Bond, Ivoclar-Vivadent) was applied on the teeth. After that Beautifil II (Shofu dental corporation) composite was manipulated into 5 mm height and 3 mm diameter according to the manufacturer's instructions and placed. The excess composite was carefully removed and then light cured.

Once prepared, the specimens were stored in saline at room temperature at 37 degree, for 24hrs The shear bond strength of resin bond was tested using universal testing machine (MSME, Sanathnagar, Hyderabad) with crosshead speed of 1mm/min. The statistical evaluation was performed with ssps software for windows version 20. The values were subjected to statistical analysis and nonparametric tests were performed for pair wise comparisons among groups.

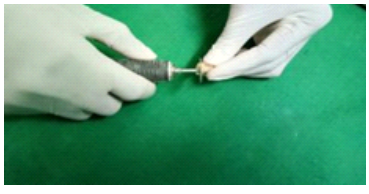

Fig 1

Fig 2

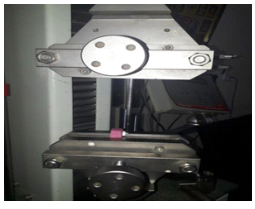

Fig 3: Universal Testing Machine

Results:

Among all the tested samples, Coltene brilliant everglow in conjunction with bonding agent (Tetric N Bond) exhibited significantly higher mean SBS value (8.43+/- 1) than other groups. The frequency table shows mean shear bond strength (SBS) and standard deviation for the three groups tested (Table 1). Kruskal wallis analysis revealed significant difference between coltene everglow and other two groups ($p< 0.005$) (Table 2). However when solitaire 2 and beautifil II were compared, the difference in result was not statistically significant.

Frequencies

Table 1.

Statistics				
		GROUP_1	GROUP_2	GROUP_3
N	Valid	10	10	10
Mean		8.430370	6.460340	6.597630
Std. Error of Mean		.3383308	.3838263	.3471904
Std. Deviation		1.0698959	1.2137654	1.0979126

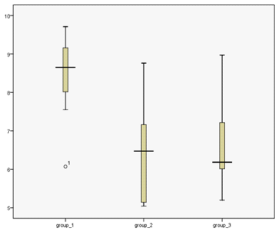

Fig 4: A graph representing the shear bond strength of the three groups tested

Kruskal-Wallis Test

Ranks			
	GROUP	N	Mean Rank
Shear_Bond_Strength	1	10	23.10
	2	10	11.30
	3	10	12.10
	Total	30	

Test Statisticsa,b

Table 2

Test Statistics[a,b]	
	Shear_Bond_Strength
Chi-Square	11.221
Df	2
Asymp. Sig.	.004
Exact Sig.	.
Point Probability	.
a. Kruskal Wallis Test	
b. Grouping Variable: GROUP	

P value is 0.004 (<0.05). Hence there is a statistically significant difference in between the three groups

DISCUSSION

Dentin bonding is challenging when compared to enamel due to difference in the substrates. The hydroxyapatite composition of enamel gives it a homogenous nature. Etchants dissolve these hydroxyapatite crystals in enamel, creating macrotags of resin that envelop the individually exposed hydroxyapatite crystals. Additionally, resin microtags extend within tiny etch pits in the enamel prism cores9. The majority of micromechanical adhesion takes place because of the resin tags in the interprismatic spaces10. In comparison, dentin is heterogeneous, consisting of collagen and hydroxypatite. The degree of mineral content in dentin varies, depending on whether it is near the pulp or the dentino enamel junction11. Another challenge to adhesive bonding of dentin is because of the high water content of dentin when compared to enamel. Studies have shown that insufficient polymerization of composite resins leads to a decrease in their

physical/ mechanical and biological properties. This complication related to shrinkage depth, polymerization shrinkage stress and curing depth still causes significant reluctance to use them. Not only does this polymerization shrinkage stress get trapped within the material itself, but it also exerts forces on adhesive interfaces of the dentin.

The aim of the study was to compare the shear bond strength of recently introduced composite resins i.e, coltene brilliant everglow, with solitaire 2 and beautifil II to dentin using fifth generation bonding agent (Tetric N-Bond, Ivoclar-Vivadent).

According to data collected in the study, coltene brilliant everglow showed higher shear bond strength than solitaire 2 and beautifil II. But there was no significant difference between solitaire 2 and beautifil II in terms of shear bond strength in this study.

Brilliant everglow is a universal submicron hybrid composite. It has sub micron barium glass fillers. These fillers are pre-polymerized fillers. These pre polymerized fillers lower the volume shrinkage, and improve sculpting properties of the paste. The filler surfaces are treated to ensure optimal compound strength within the matrix and support gloss retention.

As it has a sophisticated filler composition, brilliant everglow shows excellent adhesion to the bonded tooth surfaces. Brilliant everglow does not stick to the instruments and causes adhesion to the tooth surface due to its good wettability. The average particle size of the dental glass filler is reduced to below 1 micron(20um) in brilliant everglow to achieve maximum ease of polishability and gloss retention. The formulation has been adjusted without compromising neither the good handling characteristics of composites paste nor the mechanical strength of cured composite. The possible explanation for the highest shear bond strength of coltene brilliant everglow in this study is because of these prepolymerised resins and good wettability property of the material. However further studies have to be conducted inorder to come to a definitive conclusion.

In this study solitaire 2 and beautifil 2 have almost near shear bond strength values. The decrease in bond strength for solitaire 2 composite resin might be the reason that the difference in plasticity of the densely filled posterior resin composite (Solitaire - 2) would have made close adaptation less consistent. The interlocking particle technology inherent in these materials would have decreased the capacity for these composites in helping to compensate for shrinkage stresses.

Greater volume of composite in the bulk filling technique would obviously produce larger stresses when they undergo volumetric shrinkage due to polymerization. While greater enamel bond strengths would have tolerated the shrinkage stresses, the weaker dentin/cementum bond strengths did not. This might be the reason for a lesser shear bond strength of solitaire 2 to dentine than coltene brilliant everglow.

Beautifil II is a universal nano hybrid composite. It is a giomer designed to deliver brilliant aesthetics in long lasting restorations. It has surface pre reacted filler particles within the resin matrix. The giomer particles present in Beautifil II are responsible for high levels of fluoride release/recharge making material excellent choice for patients with a high caries index. The high filler content without bonding of the resin with S-PRG filler might be responsible for decreased shear bond strength, marginal adaptation and surface morphology, increased surface roughness and marginal discoloration in Beautifil II material.

CONCLUSION

Within the limitations of this study, the results indicate that coltene brilliant everglow has high shear bond strength to dentin compared with solitaire 2 and beautifil II composite, because of the sophisticated composition of coltene brilliant everglow.

REFERENCES:

1) Ozer F, Unlü N & Sengun A (2003) Influence of dentinal regions on bond strengths of different adhesive systems Journal of Oral Rehabilitation 30(6) 659-663.
2) Anusavice KJ. Present and future approaches for the control of caries. J Dent Educ. 2005;69:538–54
3) El-Damanhoury H, Platt J. Polymerization shrinkage stress kinetics and related properties of bulk-fill resin composites. Oper Dent. 2014;39:374–82
4) Leprince JG, Palin WM, Hadis MA, Devaux J, Leloup G. Progress in dimethacrylate-based dental composite technology and curing efficiency. Dent Mater. 2013;29:139–56
5) Benetti AR, Havndrup-Pedersen C, Honoré D, Pedersen MK, Pallesen U. Bulk-fill resin composites: Polymerization contraction, depth of cure, and gap formation. Oper Dent. 2015;40:190–200.
6) Thomsen KB & Peutzfeldt A (2007) Resin composites: Strength of the bond to dentin versus mechanical properties Clinical Oral Investigations 11(1) 45-49
7) Van Meerbeek B, De Munck J, Yoshida Y, Inoue S, Vargas M, Vijay P, Van Landuyt K, Lambrechts P & Vanherle G (2003) Buonocore Memorial Lecture. Adhesion to enamel and dentin: Current status and future challenges Operative Dentistry 28(3) 215-235.
8) Shimada Y, Senawongse P, Harnirattisai C, Burrow MF, Nakaoki Y & Tagami J (2002) Bond strength of two adhesive systems to primary and permanent enamel Operative Dentistry 27(4) 403-409.
9) Van Meerbeek B, Yoshida Y, Van Landuyt K, Perdigão J, DeMunck J, Lambrechts P, Inoue S & Peumans M (2006) Bonding to enamel and dentin In: Summitt JB, Robbins JW, Hilton TJ & Schwartz RS (eds) Fundamentals of Operative Dentistry Quintessence, Chicago 183-260.
10) Van Meerbeek B, De Munck J, Yoshida Y, Inoue S, Vargas M, Vijay P, Van Landuyt K, Lambrechts P & Vanherle G (2003) Buonocore Memorial Lecture. Adhesion to enamel and dentin: Current status and future challenges Operative Dentistry 28(3) 215-235.
11) Pashley DH (1989) Dentin: A dynamic substrate—a review Scanning Microscopy 3(1) 161-174.
12) Sano H, Yoshikawa T, Pereira PN, Kanemura N, Morigami M, Tagami J & Pashley DH (1999) Long-term durability of dentin bonds made with a self-etch primer, in vivo Journal of Dental Research 78(4) 906-911.
13) Y Korkmaz , S Gurgan E Firat , D Nathanson Shear Bond Strength of Three Different Nano-Restorative Materials to Dentin Operative Dentistr y, 2010, 35-1, 50-57
14) Jacobsen T & Söderholm KJ (1995) Some effects of water on dentin bonding Dental Materials 11(2) 132-136
15) Triana R, Prado C, Garro J & García-Godoy F (1994) Dentin bond strength of fluoride-releasing materials American Journal of Dentistry 7(5) 252-254
16) UM Abdel-Karim, M El-Eraky, WM Etman Three-year clinical evaluation of two nano-hybrid giomer restorative composites Tanta Dental Journal 11(2014) 213-222
17) Ito S, Tay FR, Hashimoto M, Yoshiyama M, Saito T, Brackett WW, Waller JL & Pashley DH (2005) Effects of multiple coating of two all-in-one adhesives on dentin bonding The Journal of Adhesive Dentistry 7(2) 133-141
18) Hashimoto M, Ohno H, Endo K, Kaga M, Sano H & Oguchi H (2000) The effect of hybrid layer thickness on bond strength: Demineralized dentin zone of the hybrid layer Dental Materials 16(6) 406-411.
19) S Senthil kumar,yohan chacko, L Laxminarayanan, (2005) Microleakage in posterior resin composite restoration using different filling, curing and polishing techniques,journal of conservative dentistry volume 8 issue 1 page 52-59.