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RESEARCH ARTICLE

COMPARISON OF SHEAR BOND STRENGTH OF THREE ADHESIVE LINERS TO NANOCOMPOSITE: AN IN VITRO STUDY

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ABSTRACT

Aim: To compare the shear bond strength of three different linersto nanocomposite restorative material. **Material and method:** Twenty sound human posterior teeth extracted for periodontal and orthodontic reasons were selected and sectioned mesiodistally to obtain forty samples. Class V cavities of specified dimensions were prepared on 30 samples using a straight fissure diamond bur with high speed hand piece under air water spray. After cavity preparation specimens were divided into three groups on the basis of liner used to fill the cavities, Group 1- filled with resin-modified glass ionomer, Group 2- filled with SDR liner, Group 3- filled with flowable composite liner.Remaining 10 samples were wet ground with a polishing paper to expose superficial layer of dentin and considered as control group. The prepared samples in each group were then bonded witha cylinder of nanocomposite. Shear bond strength was determined using Instron universal testing machine. The data was analyzed statistically.

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INTRODUCTION

The use of composite resin for dental restorations has increased with the improvement of the bonding systems, curing systems, mechanical and physical properties of the resin systems. However, the main shortcomings – eg, polymerization shrinkage – still remain. Arcangeloa D, Vaninib L. Effect of Three Surface Treatments on the Adhesive Properties of Indirect Composite Restorations.J Adhes Dent 2007; 9: 319-326. In effort to reduce the level of stress due to resin composite polymerization shrinkage, a stress-absorbing layer has been used and tried by placing a cavity liner or base of low-viscosity / low-elastic modulus materials such as resin-modified glass ionomers, filled adhesives & flowable composites. Suprabha BS, Simi B. A comparative study of shear bond strength of two adhesive liners to nanocomposite. Journal of Interdisciplinary Dentistry. 2012;2 (3). While bond strength between dentin and the liner is an important criteria contributing to the clinical success of a composite restoration, thebond between the lining material and resin composite is also critical for the success of a restoration as loss of bond between the liner and composite would amount to failure of restoration. (Suprabha BS, Simi B. A comparative study of shear bond strength of two adhesive liners to nanocomposite. Journal of Interdisciplinary Dentistry. 2012;2(3). Ceram X: Llight curable, radiopaque restorative material for anterior and posterior restorations .Merges hybrid composite filler technology with advanced Nano-Technology resulting in Nano-Ceramic Technolog Comprises organically modified ceramic nano-particles and Nanofillers combined with conventional glass fillers of ~1 μmThe organically modified ceramic nano-particles comprise a polysiloxane backbone Glass ionomer liners have been used under composite restoration, which is referred to as lamination or the sandwich technique. Initially conventional cure glass ionomer cement was used, but failures occurred due to low cohesive strength and minimal bonding of glass ionomer to composites. Hence resin-modified glass ionomers that have better cohesive strength are favored as cavity liners under composite restorations. Suprabha BS, Simi B. A comparative study of shear bond strength of two adhesive liners to nanocomposite. Journal of Interdisciplinary Dentistry. 2012;2 (3) Development in the field of resin-modified glass ionomer cement has led to the introduction of nanoionomer, which combines the benefit of resin-modified glass ionomer cement together with

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nanofiller technology. Nanoionomer: evaluation of microleakage. Upadhyay S' Rao A. J Indian SocPedodPrev Dent. 2011 Jan-Mar;29(1):20-4.

Nanoionomer: The chemistry of Ketac N100 restorative, a resin modified glass ionomer (RMGI), is based on the methacrylate modified polyalkenoic acid. The filler content of the system consists of an acid reactive fluoroaluminosilcate glass (FAS) and a unique combination of nanofillers.Flowable resin-based materials have been used as liners beneath composites due to their low viscosity, high elasticity and wettability. Xie H, Zhang F, Wu Y, Chen C, Liu W. Dentine bond strength and microleakage of flowable composite, compomer and glass ionomercement. Aust Dent J 2008;53:325-31. Currently nano-filled flowable composites that have better physical properties are available. Due to its low viscosity and since it is a bond between two resin layers,flowable composite is expected to bond well with the more viscous resin composite. Castaneda-Espinosa JC, Pereira RA, Cavalcanti AP, Mondelli RF. Transmission of composite polymerization contraction force through a flowable composite and a resin-modified glass ionomer cement. J Appl Oral Sci 2007;15:495-500. Esthet X flow:Liquid micro-hybrid composite material which can be used as a liner under direct and indirect restorative material. The resin matrix consists of urethane modified BisGMA adduct, BisGMA and diluents. The filler matrix consists of barium fluoroalumino-borosillicate glass with a mean particle size of approximately 1 µm and nanofiller silica. However, the higher shrinkage of flowable composites indicates a potential for higher interfacial stresses; (Suprabha BS, Simi B. A comparative study of shear bond strength of two adhesive liners to nanocomposite.Journal of Interdisciplinary Dentistry. 2012;2(3))

In the dental industry's on going search for materials with improved properties, a new generation of flowable composites, known as "bulk-fill flowable composites," has been introduced to the dental market. Ozer S, Tunc ES,Gonulol N. Bond Strengths of Silorane- and Methacrylate-Based Composites to Various Underlying Materials.BioMed Research International. 2014. SDR: Is a posterior bulk fill flowable base is a one-component, fluoride containing, visible light cured, radiopaque resin composite restorative material. Handling characterstics typical of flowable composites but can be placed in 4 mm increments with minimal polymerization stress. Designed to be overlayed with a methacrylate based universal/posterior composite. There is limited knowledge about the bonding properties of combining different materials.

Aim and Objectives: This study aimed to evaluate Shear Bond Strength values of a silorane-based resin composite (Ceram X) to a bulk-flowable composite, a regular flowable composite, a nanofilled - resin glass ionomer liner.

METHODOLOGY

Sample size20 sound human posterior teeth

Inclusion Criteria: 20 freshly extracted human molars were included which were unrestored and caries free.

Exclusion Criteria: Teeth having developmental defects, craze lines & fracture were excluded from the study after observing under operating microscope. The surfaces of the teeth were cleaned with scalers for removal of calculus and remnants of periodontal ligament and stored in normal saline.

Preparation of sample: The teeth were sectioned mesiodistally to obtain two halves.
Each half were then embedded in autopolymerizing acrylic resin to facilitate handling and keeping the buccal and lingual surfaces exposed.

Cavity preparation: Cavities of dimensions 4mm x 4mm x 2mm were prepared on 30 samples to expose dentin surface with a straight fissure diamond bur in high speed hand piece under air water spray Group I (SDR) Total etch dental adhesive applied using a light brushing motion for 10 s, air thinned for 3 s and light cured for 20 s.

Cavity injected with SDR composite (Dentsply) and light cured for 40 s. Cylinder of nanocomposite resin (Ceram X, Dentsply) added over the layer of SDR in increments of 2 mm and light cured for 40 s. Group II (Nano-ionomer) Powder and liquid of resin-modified glass ionomer (Ketac N 100, 3M/ESPE, USA) hand mixed according to manufacturer's instructions.Cavity filled with light cure glass ionomer liner using a plastic filling instrument. Specimens light cured for 20 s as per the manufacturer's recommendations. Total etch dental adhesive applied using a light brushing motion for 10 s, air thinned for 3 s and light cured for 20 s. Cylinder of nanocomposite resin (Ceram X, Dentsply) added over the layer of resin-modified glass ionomer in increments of 2 mm and light cured for 40 s.

Group III (EsthetX Flow) A total etch dental adhesive were applied using a light brushing motion for 10 s, air thinned for 3 s and light cured for 20 sThe cavity were injected with flowable composite (Esthet X Flow, Dentsply) and light cured for 40 s. Cylinder of nanocomposite resin (Ceram X, Dentsply) added over the layer of Flowable compositein increments of 2 mm and light cured for 40 s. Control Group IV (Control) 10 samples were wet ground with a polishing paper to expose superficial layer of dentin.Total etch dental adhesive applied using a light brushing motion for 10 s over a exposed superficial dentin surface , air thinned for 3 s and light cured for 20 s. Cylinder of nanocomposite resin (Ceram X, Dentsply) added and cured as in the previous group. Thermocycling Bonded specimens were stored in distilled water at 37 ± 2°C for 24 h, followed by thermocycling (1500 cycles) in 5°C and 55°C water baths with 1 min dwell times, after which the specimens will undergone shear bonding test.

Shear Bond Testing: Shear testing of the bonded specimens were performed in Instron Universal Testing Machine with a cross head speed of 1 mm/min until failure.

Statistical Analysis: SBS values were expressed as mean ± standard deviation. Statistical analysis was performed using SPSS for Windows, Version 12.0.1. SBS values were analyzed using two way ANOVA. Multiple comparisons were performed using Tukey's post hoc test, with a significance level of $P< 0.05$.

RESULTS

SBS values are given in Table. SBS values of RMGIC were significantly higher than SBS for all underlying test materials

($P < 0.05$). The shear bond strength for various materials: RMGIC > SDR > Flowable composite > Control. Shear Bond Strength values. Statistically significant difference was found between the SBS values of RMGIC & SDR (p= .01).

Fig. 1. 20 sound extracted human molars

Fig. 2. Sectioning of teeth mesiodistally

Fig. 3. Each half embedded in autopolymerizing acrylic resin

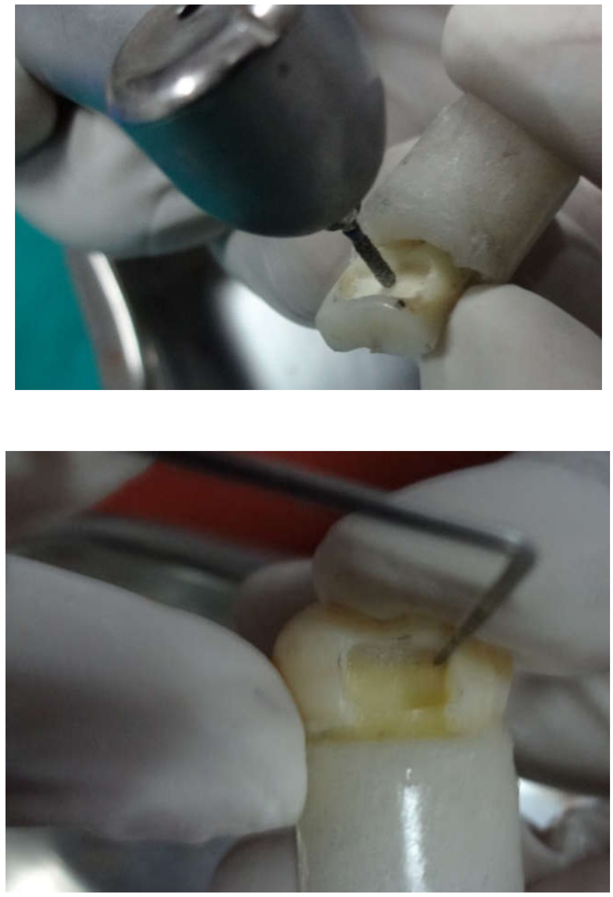

Fig. 4. 1 and 2 (cavity preparation)

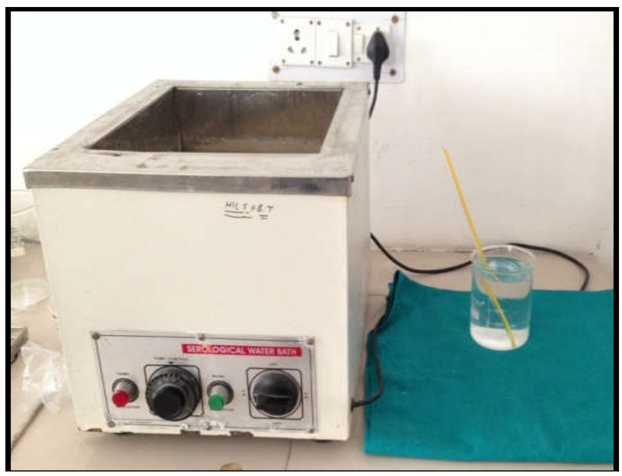

Fig. 5. Thermocycling of samples

DISCUSSION

Thus, by decreasing the bulk amount, of resin used, this technique can also reduce the detrimental effect of polymerization shrinkage, which may result in microleakage and marginal gap. If the quality of interfacial adaptation between two materials could be improved it was assumed that the durability of layered resin restorations may be increased. Some studies have suggested that the presence of HEMA and the formation of resin tags in RMGIC may be responsible for stronger bonding when compared to CGIC, regardless of the adhesive system used. Cross-linking of polyacrylic acid during polymerization increases the strength of cement and ultimately adhesive bond strength to resin composite. Bonding between resin-modified glass ionomer and composite is chemical in nature due to availability of unsaturated double bonds in air inhibited layer of resin-modified glass ionomer cements. Due to low filler loading, flowable composites have greater elasticity and flexibility.

As a result of these properties, flowable composites show better adaptation to the cavity walls and can compensate for polymerization shrinkage of resin composite restorative materials. However, they also undergo more volumetric shrinkage than composites of higher viscosity leading to interfacial stress build up between the two layers of composites. This leads to deflection of the overlying high modulus composite restorative material Babannavar R (2013) reported that mean SBS for Ketac N100 was less compared to Vitrebond attributing to the slowness of set, sensitivity to clinical conditions, and above all a decrease in cohesive strength, which leads to a decrease in bond strength. However, there was no statistically significant difference.

Suprabha BS et al (2012) compared the shear bond strength of resin-modified glass ionomer and nano-filled flowable composite liners to nanocomposite restorative material and concluded that Resin-modified glass ionomer appears to be a more compatible liner under nanocomposite restoration than flowable composite as it exhibited significantly higher shear bond strength. Babannavar R et al (2013)The significant improvement in cohesive strength of resin-modified glass ionomer cements compared with conventional glass ionomer cement might also lead to an increase in bond strength between composite resin and glass ionomer cement In accordance to the previous studies this study serves as a screening test for comparison of efficacy of bonding of resin-modified glass ionomer, SDR and nano-filled flowable composite to nanocomposite. *Placement of a liner such as RMGIC, SDR, flowable composite under the composite restoration is benifitial for the success of the restoration*

Table 1. Showing shear bond strength values

Materials	Sample size(N)	Mean	Std. Deviation	Std. Error	Minimum value	Maximum value
SDR	10	11.371	2.37792	0.75197	8.49	14.6
RM GIC	10	14.768	2.58934	0.81882	11.33	19.8
Flowable composite	10	6.476	1.93145	0.61078	2.8	8.49
Control	10	6.48	2.70442	0.85521	2.8	11.33
Total	40	9.7738	4.24509	0.67121	2.8	19.8

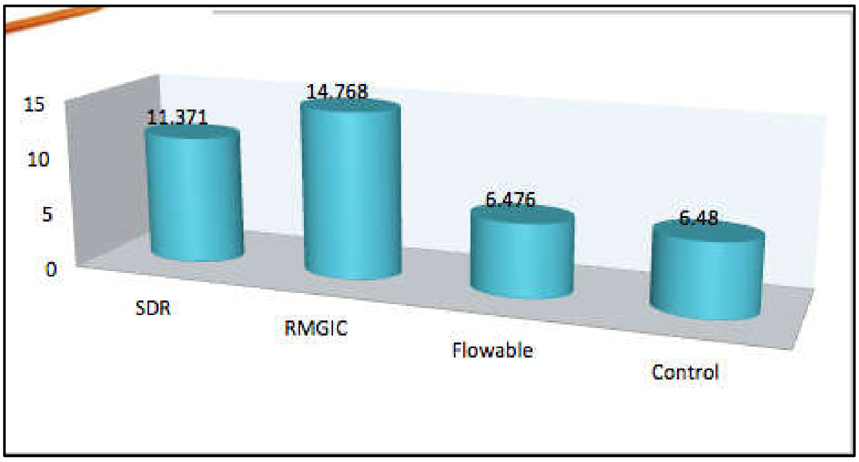

Fig. 6. Comparitive histogram

Ozer S et al (2014) evaluated shear bond strength (SBS) values of a methacrylate (FZ 250) and a silorane-based (FS) resin composite to various underlying materials & reported that SBS value of silorane based composite to RMGIC to be higher than that of silorane based composite to SDR.. The compensation by hygroscopic expansion for polymerization shrinkage is slower in case of resin composites as compared to resin-modified glass ionomers as shown in a study by Versluis et al (2011). Though both resin-modified glass ionomers and flowable composites are known to undergo polymerization shrinkage, water uptake can act as a compensatory mechanism

Conclusion

Under the conditions of this study bonding of resin modified glass ionomer liner to nano-composite restoraative material is better than the other liners used in this study. RMGIC and Bulk-fill appear to be the suitable alternative for use as a base under composite restorative material

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