DOI: https://doi.org/10.53350/pjmhs211561246

ORIGINAL ARTICLE

Evaluation of Shear Bond Strength of Prepared Samples of Silorane Composite Repaired with Silorane based Composite

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ABSTRACT

Aim: To evaluate shear bond strength of silorane based composite samples repaired with silorane composite with application of silane coupling agent and adhesive bond of silorane before and after thermal cycling.
Study design: Experimental study
Place and duration of study: Science of Dental Materials Department, de'Montmorency College of Dentistry Lahore from 1st January 2014 to 31st October 2014.
Methodology: Sixty composite specimens equally divided into control and experimental groups. Control group was further prepared for repair procedure after polymerization without thermal cycling while experimental group was given with 5000 thermal cycles between temperature range of 5-55ºC, dwell time of 20 seconds) before testing, all samples were surface roughened with 400 grit silicon carbide strip, followed by application of silorane coupling agent and adhesive bond of silorane over the substrate and cured for 20 seconds. Repair silane based composite was applied on all substrate silorane composite samples and polymerized, before testing samples were left in distilled water (24 hour at 37ºC) and tested with universal testing machine (crosshead speed 0.5 mm/min) until fracture.
Results: There is 12 (20%) adhesive, mixed 2 (3.3%) and cohesive is 46 (76.7%). The thermal cycling has no effect on bonding interface in experimental group on strength at bonding interface.
Conclusion: Silorane based composite as repair composite gave better strength with silorane based composite and can be used for repair options.
Keywords: Shear bond strength, Silorane based composite, Silorane adhesive bond

INTRODUCTION

Resin based dental restorative materials having filler loading of approximately 50-60% shows shrinkage of 4.0-5.0% volume and Hybrid dental composites having filler loading of approximately (70–80% showed upto 3% of overall volumetric curing shrinkage. Composites used for posterior restoration having maximum filler loading of approximately above 80% shows at least 2% vol. of curing shrinkage.[1] This Shrinkage associated with the composite curing may cause micro gaps between the restoration and tooth structure resulting into the complications such as post operative sensitivity, stained margins, secondary caries and ultimately breakdown of restoration[2]. To avoid these clinical problems associated with the composite resins change in the chemical composition of resin matrix by developing different type of monomer system having ring opening structural mechanism.[3] This composite resin is developed with ring structured oxirane and siloxane structures[4]. The different type of opening up of ring structure during polymerization is the cause of less curing shrinkage and its highly reactive nature in comparison to conventionally used methacrylate based resin composites[5]. Silorane based resin shows approximately half of shrinkage shown by the methacrylate based composite resins[6].

Received on 03-02-2021
Accepted on 29-05-2021

In comparison with methacrylate based composites, different mechanism of action of silorane composite is also the reason of improved marginal stability of Silorane composite as it may leads to less water sorption, solubility, and decrease diffusion coefficient[7].

Long clinical life of resin based composite due to different types of chemical degradation and mechanical failure causes in the form of less wear resistance of restoration, fracture, secondary caries and associated discoloration require some other treatment alternative protocols.[8,9] By completely removing all of the previous fractured restoration and replacing it with new restorative material may causes the cavity to get enlarged and more healthy tooth structure loss.[10] Hence the advancements in the clinical and adhesive dentistry allows for the repair option for fractured restoration rather than completely removing and replacing the previous restoration[11].

For repair options stability of repaired silorane based composite for long term needs more optimized protocols[12].

For Adhesive bond strength of different types of resin based restorative materials and to the same type of resin based restorative material itself should be of practical importance.[13] Manufacturers of Silorane based composite system recommend that there is chemically an incompatibility for use with composites of different matrix i.e. dimethacrylate base[14]. As the method of activation for silorane composite is different, and the conventionally used

Bis-GMA based adhesives are not compatible to be used with Silorane composite, so some studies suggest that a phosphate methacrylate-based adhesive resin is required.[15]

MATERIALS AND METHODS

Sixty samples having well defined and uniform surfaces of dimensions 10mm depth, 5mm diameter were prepared in custom made Teflon moulds, with the Silorane based composite (Filtek™ P90, 3M ESPE. Germany, shade A2) in increments of 2.5mm and cured separately with the help of LED light (Elipar, 3M ESPE) having light intensity of upto 800 mW/cm^2 for at least 40 seconds keeping a distance of 2mm from the surface of samples. 5mm of the samples were embedded in the acrylic resin and the exposed 5mm as the original filling. After complete polymerization 30 samples from group A which is control group were prepared for repair procedure without the sample being thermo cycled. 30 samples of other group which is experimental group B were thermocycled by placing the samples in deionized water which were placed in thermal cycler (BIO-RAD, T100™) into the PVC tubes for thermocycling by having 5000 cycles (5-55ºC) dwell time 20seconds before repair procedure. This research was approved our institutionsl Ethical Committee.

After thermocycling the surface of samples of both groups A and B was roughened by sliding with 400-grit SiC(silicon carbide) paper in a uniform direction, washed with the water and dried with the help of triplex syringe, after that the surfaces of the samples of both groups were then applied with silane coupling agent (monobond plus, Ivoclar vivadent) allowed to evaporate for 60seconds. After treating the surface with silane coupling agent, samples were applied with the adhesive agent (P90 system adhesive, 3M ESPE. Germany) which is specific to be used with the repair composite, by using a micro brush, and cured it with the help of LED for 20 seconds.

For the repair options different shade was applied to differentiate the substrate and repaired composite interface Filtek™ P90, 3M ESPE Germany, shade A3). For repair procedure the silorane composite was placed in increments of 2.5mm in another teflon moulds having dimensions of (15x5 mm^2) and cured. Before testing process all the samples supported in acrylic resin blocks were kept in distilled water (24h at 37ºC)**.** All the samples were then evaluated for shear bond strength using universal testing machine (Testometric, Model M500-50AT) 0.5mm/min (speed) with the load of 1KN. Mode of failure was evaluated using the 40x light microscope (Zoom microscope, Model SZX7, Olympus, Japan) regarded as cohesive (C), Adhesive (A) and Mixed (M) depending on the occurrence of failure.

The data was analyzed using IBM SPSS version 20. The quantitative variables were calculated by Median (IQR). Frequency and percentages were calculated for qualitative variables. By applying Kolmogorov Smirnov test normality of quantitative variables was checked. The data is non normal distributed, so we have applied Mann Whitney U test to compare the mean difference between the groups. A p-value ≤0.05 was considered as statistically significant.

RESULTS

The overall fracture of samples is showing 76.67% of cohesive failure which indicated the repair interface bond strength is strong enough to show 20% of samples with adhesive failure, while only 3.33% of overall samples showed mixed failure (Table 1). The normality of the data calculated by Kolmogorov Smirnov test and the p-value is less than 0.05 so, the data is non-normally distributed (Table 2). The data is non normal distributed, so Mann Whitney U test is applied and the p-value is greater than 0.05 which is showing that thermal cycling has no effect on bonding interface in experimental group on strength at bonding interface. The mean of both groups showing that silorane composite can be used as repair composite (Table 3).

Table 1: Frequency and percentages were calculated for qualitative variables

Mode of failure	**%**	**%**
Adhesive	12	20.0
Mixed	2	3.3
Cohesive	46	76.7

Table 2: Normality of the data calculated by Kolmogorov Smirnov Test

Variable	**P-Value**
Shear Bond Strength (group A, B)	0.025

Table 3: Non-normal distributed of shear bond strength

Variable	**Group**	**Mean±SD**	**P-Value**
Shear bond strength	Control group	10.28±1.76	0.584
	Experimental group	10.84±3.10	

DISCUSSION

Based on increasing sense of esthetics and the need of dental defects replacement the emerging trend of composite restorative materials has made it challenging for clinicians to overcome the curing shrinkage associated with the use of dental restorative materials, so the use of different matrix system in this study was of high clinical benefit as it is low shrinkage composite.[9]

To simulate the oral conditions in the mouth that take place on routine basis the restorative material in this study have been thermal cycled for 5000 cycles between the temperature ranges of 5-55ºC in thermal cycler providing the temperature variations taking place in restorations during clinical life in mouth, and it has no evident difference in strength testing samples before and after thermal cycling procedure.

To enhance the surface irregularities and to promote the micromechanical interlocking surface roughening with silicon carbide strips (400 grit) was done as many clinicians may not have intra oral micro blasters for silica coating or air abrasions with abrasives, the chemical bonding was enhanced with the use Silorane adhesive and Silane coupling agent.[14]

As the Silorane primer is hydrophilic and surface of tooth was not involved so it was needed. Only adhesive bond of silorane was applied for bonding with composite used as repair which is silorane based composite in both groups, by using Silane coupling agent the shear bond

strength of repaired interface was improved, however more research is needed to prove its performance in clinical practice.[12]

The strength of repaired interface was determined in terms of shear bond strength, which was showing that the Filtek™ P90 Composite showed better repaired strength to be used as repair composite without effecting the strength before and after thermal cycling, in bonding studies and experiments type of failure evaluation is also needed and recommended as well.[8] The fracture that occurred at the repaired area was adhesive, those fractures occurred in filling or repaired composite was regarded as cohesive, and that occurring as either cohesive or adhesive was regarded as mixed type of failure, cohesive failure was most common all samples in terms of mode of failure analysis.

CONCLUSION

Silorane based composite as repair composite showed better strength with silorane based composite and can be used as repair option where needed, use of adhesive bond of silorane based composite with use of silane coupling agent can be made to enhance strength.

Conflict of interest: None

REFERENCES

1. Chen MH. Updates on nano-composites. J Dent Res 2010; 89: 549-60.
2. Monteiro QM. Montes M, Gomes ASL, Mota C, Campello SL, Freitas AZ. Marginal analysis of resin composite restorative system using optical coherence tomography. Dent Mater 2011; 27: 213-23.
3. Marchesi G, Breschi L, Antoniolli F, Lenarda RD, Ferracane J, Cadenaro M. Contraction stress of low shrinkage composite material assessed with different testing system. Dent Mater 2010; 26: 947-53.
4. Gao BT, Lin H, Zheng G, Xu YX, Yang JL. Comparison between a silorane based composite and methacrylate based composite: Shrinkage characteristics, thermal properties, gel and vitrification points. Dent Mater 2012; 31: 76-85.
5. Boaro LC, Gonclaves F, Guimaraes TC, Ferracane JL, Verslius A, Braga RR. Polymerization stress, shrinkage and elastic modulus of current low shrinkage composites. Dent Mater 2012; 12: 1144-50.
6. Sáenz J, Lafuente D. Bond strength of silorane-based adhesive to dentin. IJD 2012; 11:1-6.
7. Al-boni R, Raja OM. Microleakage evaluation of silorane based composite versus methacrylate based composite. J Conserv Dent 2010; 13: 152-5.
8. Fawzy AS, Askary FS, Amer MA. Effect of surface treatment on tensile bond strength of repaired water aged anterior restorative micro-fine hybrid resin composite. *Dent. Mater 2008;* 36: 969-76.
9. Weigand A, Stawarczyk B, Buchalla W, Tauback TT, Ozcan M, Attin T. Repair of silorane composite-using same substrate or a methacrylate based composite. Dent Mater 2012; 28:19-25.
10. Leprince J, Palin WM, Mullier T, Devaur J, Vreven J, Leloup G. Investigating filler morphology and mechanical properties of new low shrinkage resin composite types. J Oral Rehabil 2010; 37: 364-76.
11. Duarte JS, Park JH, Varjao FM, Sadan A. Nanoleakage, ultramorphological characteristics and microtensile bond strength of new low shrinkage composite to dentin after artificial aging. Dent Mater 2009; 25: 589-600.
12. Luhrs AK, Gormann B, Guhr SJ, Guertsen W. epairability of dental siloranes in vitro. Dent Mater 2011; 27: 144-9.
13. Moser S, Hickel R, Ilie N. Strength of aged repairs made by silorane and methacrylate based composite. 2008.
14. Maneenut C, Sakoolnamarka R, Tyas MJ. The repair potential of resin composite materials. Dent Mater 211; 27**:** 20-27.
15. Moser S, Hickel R, Ilie N. Are silorane compatible with methacrylate-base composites? Dent Mater 2009; 25: 14-5.