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Comparison of Microleakage between Old and New Composite with Two Bonding Agent Systems: An *In-vitro* Study

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ABSTRACT

Composite restorations usually have so many complications and imperfections and it is possible to eliminate impaired region without complete replacement of the composite. Repair ability of the resin composites is a desirable property. In time of need to repair part of the restoration, the composition of preexisting composite is unknown. The aim of this study was to evaluate the microleakage between old and fresh composite with two bonding agents systems. 144 specimens of P90 (3M, Germany) and Z250xt (3M, Germany) resin composite were aged and after surface roughening with diamond bur, they were placed randomly in 8 groups. All of the specimens were covered with nail varnish except on repair surfaces. Specimens were immersed in methylene blue and after that they were sectioned. Microleakage was measured using Adobe Photoshop portable software and stereomicroscope. Data were analyzed with ANOVA test (p=0.05). G8 group (p90+single bond 2+z250XT) revealed maximum of microleakage (1.131mm) and G7 group (p90+etching+p90 bonding+ p90)showed minimum (0.325mm) (P-value=0.0001). Using acid etching and p90 primer had no effect on microleakage. Comparison of groups which were repaired with the same resin composite as preexisting composite revealed no significant difference. Some groups were detected with valuable results (P-value=0.0001). Using acid etching and p90 primer for surface treatment has no effect on microleakage. Bonding materials were used in this study has shown no difference in results. Repairing old composite restoration with composite based on different resin is not recommended.

Key words: Bonding, Composite, Methacrylate, Microleakage, Repair, Silorane

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INTRODUCTION

In recent years resin composites has noticeably improved in physical and mechanical properties, Since the resin composites have fairly low cost for patient and acceptable esthetic, they become popular tooth-like color materials for anterior and posterior restorations. Despite ongoing advancement in adhesive and composite technologies including improvements in mechanical and physical properties of resin systems, polymerization systems most resin restoration service life is limited and still polymerization shrinkage is the most important shortcoming in composites that needs to be improved. This shrinkage can leads to later complications such as microleakage [1, 2]. This is the most important factor in restoration failures. Silorane based composite which were introduced to the market a few years ago and were shown to overcome this problem to certain extent as they are undergoing a photocationic ring opening

polymerization which in result the shrinkage become below than 1%. Replacement of restoration despite having better clinical result and esthetic than repair of the restorations. It is a main procedure for treating failed restorations, in contrast, it also can result in removal of dental hard tissue, pulp traumatization and time and money consuming [1]. In most of the failed restorations, the impaired region can be eliminated without replacing the whole restoration. In cases which restoration has considerable flaw or tooth is in danger of fracture or it has major caries or repair can be dangerous to peripheral tissues restoration replacement is recommended. Due to these facts repair ability of resin composites is considered a desirable property. As the composition of the composite in need of repair is unknown, the objective of this study is to evaluate microleakage between old and fresh composite which one side is silorane based composite.

MATERIALS AND METHODS

The materials used in this study are listed in table 1 and were used strictly according to the manufacturer's recommendations. Current study is a lab trial in which 144 composite blocks (72 p90 and 72Z250XT) were prepared. Each group contains 18 blocks. All composite specimen were made in cylindrical mold was inserted on a glass slide and filled with 2 mm layer of composite then it covered with another glass slide. Each group was light polymerized with LED light cure Demi (Kerr/USA) for 40 seconds with 600 mW/cm^2. The light output was checked regularly during the study and the light curing tube was kept in contact with the glass slide to ensure adequate curing. After curing the top surface, the mold was turned upside down and the lower surface was similarly cured for 40s. The specimens were carefully removed from the mold and were cured at the center of cylinder in each side. All of the samples were stored in distilled water at 37ºC for a month and then thermocycled for10000 cycle between 5ºC(±2)and 55ºC (±2)with 30 second dwell time at each temperature. The surfaces of all of the samples were roughened with diamond bur, each sample with 5 strokes. Later they were rinsed and dried for 20s and were divided between 8 groups:

Group 1: Z25oXT + p90 adhesive system (bonding and primer) + p90
Group 2: Z250XT+ acid etching (phosphoric acid) + p90 adhesive system + p90
Group 3: Z250XT+ acid etching + p90 bonding + p90
Group 4: Z250XT+ acid etching + single bond 2 + Z250XT
Group 5: p90 + p90 adhesive system (bonding and primer) + p90
Group 2: p90 + acid etching (phosphoric acid) + p90 adhesive system + p90
Group 3: p90 + acid etching + p90 bonding + p90
Group 4: p90 + acid etching + single bond 2 + Z250XT

The external surfaces of each sample were coated with two layers of nail varnish with the exception of the side directly exposed to the curing light. Then all of them were stored in distilled water for 1week and then thermocycled for 10000 cycle between 5ºC (±2) and 55ºC (±2) with 30 second dwell time at each temperature. After that they were immersed for 24 hour in 0.5% methylene blue buffered dye solution (PH=7.0).

The samples were transversely sectioned with a double faced diamond disk. Pictures of specimens were taken under stereoscope microscope (40X) and microleakage was measured in the Adobe Photoshop portable software. Data was analyzed using ANOVA, Tukey test and SPSS17 statistical software.

Table1: Materials used for preparing specimens

Material	Manuf-acturer	Material composition
Composite		
Filtek z250XT (mrthacrylate based)	3M,ESEP, Germany	Bis-GMA,UDMA, Bis-EMA, silicon dioxide, zirconium dioxide, barium glass, ytterbium triflouride, mixed oxide perpolymer
Filtek silorane (low shrinkage silorane based)	3M,ESEP, Germany	Silorane(3,4epoxycyclohexyl ethylcyclopolymethylsilane), silicon dioxide, ytterbium triflouride
Adhesive		
Single bond 2	3M,ESEP, Germany	Bis-GMA,HEMA, dimethacrylate, ethanol,water, methacrylate functional copolymer of polyacrylic and polyitaconic acid
Silorane system adhesive	3M,ESEP, Germany	TEGDEMA, phosphoric acid, methacrylaxhexy lester, 1,6hexanediolmethacrylate, Bis-GMA,UDMA Bis-EMA

RESULTS

The mean and standard deviation of microleakage data for each group are illustrated in table 2. The highest microleakage was found in group 8 and the lowest microleakage was revealed by group 7. Tukey test indicated significant differences between group 3, 7 and another group 7, 8 (P-value=0.0001) but there were no other significant differences between others (Table 3).

Table 2: The mean and standard deviation of microleakage

	N	Mean	Std. Deviation	Std. Error	95% confidence interval	
					Lower bond	Upper bond
G1	18	0.788	0.133	0.310	0.721	0.854
G2	18	0.843	0.131	0.031	0.777	0.908
G3	18	0.827	0.164	0.038	0.746	0.909
G4	18	0.664	0.197	0.046	0.566	0.762
G5	18	0.636	0.218	0.051	0.528	0.745
G6	18	0.727	0.228	0.053	0.613	0.840
G7	18	0.549	0.167	0.039	0.466	0.632
G8	18	0.849	0.197	0.046	0.750	0.947
Total	144	0.735	0.206	0.017	0.701	0.769

DISCUSSION

It is possible for the clinician to confront impaired restorations which can be repaired. If the restoration is being replaced it can cause damage to sound dentin and pulp and it is time and money consuming for patients. The basic principle of the repair concept relies on satisfactory bonding between old and fresh composite layers in order to provide the best adaption of repaired composite to the old one. This study is done with the purpose of evaluate microleakage mean between old and fresh composite with or without acid etching or primer application and using p90 and z250XT. Repair of old composite should be capable of forming appropriate bond to the fresh composite. The bond should prevent from microleakage between two surfaces because microleakage could lead to margin discoloration and weakening the bond. [1] This discoloration and microleakage can be an early sign of losing the bond and predict repair failure [1]. Microleakage can lead to dissolving resin bonding and composite, the existing porosity can lead to more water absorption and more material dissolving [1].

For repairing composite restorations surface treatments for old composite is required. For attachment of old and fresh composite micromechanical bond with surface roughening and chemical bond with active molecules and materials is provided. Different surface treatment for repairing old composite is introduced. The most usual ones are roughening with diamond bur , sand blasting, silicon carbide abrasion , air abrasion with aluminum oxide or silicon coated particles [3-5], using bonding on etched surface. In this study roughening with diamond bar, etching with phosphoric acid and using bonding is used. For using acid etch results diagnosed no significant differences in compared groups (comparing 1and 2 or comparing 5 and 6). Shafie [6] used the same method for old composite's surface treatment in her study. Hickel [4] used roughening with sand blast and etching surface for the surface treatment method. These two studies showed there isn't any significant difference between examined groups for using acid etching. Papacchini [7] and loomans [5] showed that acid etching and rinsing is a step for cleansing debris and remained particles from cut and it has no significant effect on retention pattern of composite surface. Ahmadi [8] showed using diamond bur and acid etch is the best method for old composite surface treatment compared to other methods. Using diamond bur is a simple method that can be done with the least in hand materials. This method is used in several studies. [8-10].

This study showed no significant effect after using primer (comparing groups 2 and 3 or comparing 6 and 7).

Table 3: Comparison of groups for mean differences of microleakage

Evaluated subject	Group I and j	Mean difference(i-j)	Std. Error	Sig.(p_{value})	95% confidence interval	
					Lower bond	Upper bond
Usage of acid etching	1,2	-0.055	0.610	0.985	-0.242	0.132
	5,6	-0.090	0.610	0.817	-0.287	-0.975
Usage of p90 primer	2,3	0.015	0.610	1.000	-0.172	0.203
	6,7	0.177	0.610	0.079	-0.010	0.365
Bonding	2,4	0.178	0.610	0.075	-0.009	0.366
	6,8	-0.121	0.610	0.488	-0.309	0.066
Diff fresh composite	3,4	0.163	0.610	0.139	-0.245	0.351
	7,8	-0.299*	0.610	0.0001	-0.487	-0.111
Diffold composite	1,5	0.151	0.610	0.213	-0.126	0.248
	2,6	0.116	0.610	0.552	-0.071	0.303
	3,7	0.278*	0.610	0.0001	0.090	0.466
	4,8	-0.184	0.610	0.058	-0.372	0.034

** Shows significant difference*

After searching through google scholar, PubMed, Medline and science direct from 1990 to 2017 august, found few studies which have evaluated primer usage. Luhrs [10] concluded that using silorane primer weaken the bond between old and fresh composite and it shouldn't be used in cavities without dental tissue. Stoleriu [11] in his study concluded that using primer has no negative effect on repaired surface and it shows similar results to surfaces which used acid etching method. P90 adhesive system contains bonding and primer. Primer contains acid which can do surface treatment by solving mineral material from dental surface and provide micromechanical retention by created porosity. It should be noted that there is no mineral material on old composite surface which is impacted on the repair process and the acid would remain active.

When a restoration is impaired and detected with marginal leakage or is broken It should be considered that In composite resin repair a big challenge is represented by the adhesion between a new composite resin and a pre-existing one, which is unknown most of the time.so it is possible that composite with different resin attached to each other. Generally, when placing two composite layers in contact, the adhesion is obtained through the oxygen inhibited unpolymerized resin layer. Aged composite resins have lesser or no un-reacted monomers, so pour adhesion is expected at the interface with the newer resin. This study showed that only in one comparison (group 3 to7) there was significant difference and G3 showed more microleakage than G7. This result can be explained with different resin based composite that couldn’t form a proper bond. Previous investigations showed that microleakage at the resin interface is not correlated to the type of pre-existing composite resin [2] but Maneenut [9] showed that repairing z250 with p90 can't have a good performance.

This study also showed significant difference between G7 and G8 in which G8 showed more mean microleakage. This incident can be happened because of different resins in old and fresh composites. Previous studies declined that repairing old composite with different composite is successful as long as the bonding system and fresh composite are compatible and similar. In this study using two type of bonding on two types of composite is used an evaluated and no significant effect or difference was detected. Previous studies showed using it is preferred not to use adhesives for preventing microleakage in repairing resin composites [2]. Some studies showed that just roughened surface can't form adequate bond between two composites so bonding systems should be used to improve the bond [11].

Mobarak [12] in his study stated bonding's resin has no effect on repairing p90 composite and this composite showed good results in forming bond with fresh composite despite different bonding systems. Staxrud [13] showed that using dentin bondings can enhance the quality of repairing old composite. Most of dental adhesives contain HEMA, which is a hydrophilic and effective methacrylate monomer, and plays an important role in wetting and enhancement in co -monomer part in hybrid layer structure. High density of HEMA leads to more water absorption and hydraulic disintegration of polymers, swelling, and discoloration and in the end all of it can enhance microleakage. All of the noted disadvantaged for HEMA inspired studies to find more hydrophobic adhesives to solve the disintegration problem. P90 composite and adhesive system are more hydrophobic than methacrylate ones so researchers were looking forward for much better performances from these composite and adhesive. This study showed hydrophobic adhesive has no advantage over hydrophilic ones.

In comparing groups in which each composite repaired with the ones with similar resin, there were no significant difference and p90 showed no advantage over z250XT. In previous studies it was stated p90 low shrinkage property has no advantage over mechanical and physical property of methacrylate composites, in clinical examination [1, 2, 14].

Microleakage tests are advantageous methods for evaluating adhesive system seals. Dye penetration is one of the common methods which is being used. In this study measured plate under microscope lens and adobe Photoshop portable software were used to obtain quantitate data instead of common leveling/ staging methods. This method is on advantage because there is in need for the different examiners. In this study both half after section were examined and the one with more microleakage was chosen. This difference can be because of thickness of cutting blade. The method that is used in this study is similar to which Cigdem Celik [15] used.

Cavalacanti [16] and Shafiei [6] used scale and leveling method but it should be noted in this

method it required more than one examiner and there is higher chance of error.

CONCLUSION

Using acid etching and using p90 primer has no effect on lessen microleakage between composite surfaces. Using bondings with different resin bases showed no difference in microleakage. Repairing both MBC and SBC showed less microleakage with composite with similar resin had less microleakage.

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Conflict of interest
We certify that no actual or potential conflict of interest related to this article exists.

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