

## The Microshear Bond Strength of Composite-Composite after Salivary Contamination

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### Abstract

**Objective:** Contamination leads to decreased bond strength causing failure of restorative treatments. The present study evaluated micro-shear bond strength of composite-composite after saliva contamination and searched for the best method to maintain primary bond strength.

**Methods:** In this in-vitro trial, specimens made by Z100 composite resin were divided into 7 groups each containing 15 samples and were prepared as follows: Group 1- Control (no contamination), Group 2: Saliva+ air drying, Group 3- Saliva+ rinsing+ air drying, Group 4- Saliva+ rinsing+ air drying+ etching, Group 5- Saliva+ rinsing+ air drying+ etching+ bonding, Group 6- Saliva+ alcohol, and Group 7- Saliva+ 0.5 mm removal of composite+ rinsing + air drying. Z100 composite was added through tiny tubes (0.7x1 mm) to the prepared surfaces and cured. The microshear bond strength was then determined. Data were analyzed using ANOVA and Tukey's multiple comparison tests.

**Results:** Mean and standard deviation of the microshear bond strength was 23.0±3.60 MPa in group 1, 11.71±2.49 MPa in group 2, 17.60±4.25 MPa in group 3, 21.84±6.34 MPa in group 4, 21.25±7.58 MPa in group 5, 21.65±5.53 MPa in group 6 and 17.34±5.95 MPa in group 7. Differences between groups 1 and 2 (P<0.0001), 2 and 4 (P<0.0001), 2 and 5 (P<0.001) and 2 and 6 (P<0.0001) were statistically significant.

**Conclusion:** The results of this study showed that air drying of the surface after saliva contamination decreased microshear bond strength significantly. All cleansing methods increased bond strength of the specimens up to that of the control group.

**Key words:** Salivary contamination, Bond strength, Composite

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### Introduction:

At present, considering people's fascination and obsession with beauty and esthetics, popularity of tooth colored restorations has greatly increased. In order to supply this growing demand, resin composites were introduced to the market and quickly gained fame and success to the extent that nowadays composite resins are among the most commonly used dental materials. However, presence of difficulties like the need for an isolated and dry environment when working and risk of contamination of prepared surfaces have limited the clinical application of composite resins (1). An

important property of composite resins is their adhesion to tooth structure which is best done in a clean environment free of any contamination. Clinically, various factors such as surface moisture, gingival sulcus fluid, blood or hand piece lubricant can compromise the retention and adhesion of resin to tooth structure. These factors act like a barrier and impair the bond between composite resin and tooth structure and result in development of gap, post-op hypersensitivity, color changes, carries recurrence and eventually failure of the restoration (2-4). On the other hand, in order to improve the quality of composite resin restorations, incremental application of material is strongly recommended

which per se requires a contamination free environment. The effect of salivary contamination on the strength of composite resin bond to the tooth structure has been extensively studied in the literature. Some of these studies have reported that contamination with saliva decreases the bond strength between composite and tooth structure (5-10). Some other studies have in contrast reported no significant decrease in bond strength after saliva contamination (11-14). However, the effect of salivary contamination on the bond between composite increments has rarely been studied.

During dental procedures, if rubberdam is not applied, saliva contamination is a routine problem. Decontamination methods for such cases are always a matter of discussion. Some researchers believe that simple water rinsing cannot efficiently neutralize the effect of saliva contamination and the surface needs to be conditioned again (4,15,16). On the contrary, some others believe that saliva contamination does not significantly decrease bond strength (11-14). Such studies have rarely been performed on the bond strength between composite increments and there is an obvious need for studies to select the best method of cleansing if salivary contamination occurs.

The present study was conducted to evaluate the effect of saliva contamination on the microshear bond strength between composite increments and to determine which method best decontaminates saliva from the resin surface and re-establishes the original resin-resin bond strength.

### Methods:

The present in-vitro experimental study was done through the observation of laboratory results and recording the obtained data. A total of 35 composite resin specimens were made using a two piece 2×2×24 mm metal rectangular

mold. The mold was placed on a glass slab and filled with Z100 composite resin (3M ESPE, Dental Products, Batch Number: 44-0007-4122-OA). In order to achieve a flat surface, another glass slab was placed and pushed on top of the mold. The specimens were then light cured from the top and below for 40 seconds for each surface using AryaLuxe light curing unit (ApadanaTak, Tehran, Iran). For placement into the microtensile tester for determination of the microshear bond strength, each mold was longitudinally divided into 3 segments and specimens underwent following procedures in 7 groups of 15 samples each:

Group 1 (Control group (C)): No salivary contamination

Group 2 (dried saliva (DS)): Salivary contamination+ air drying the saliva on samples for 20s using air syringe from 15 cm distance

Group 3 (wash(W)): Salivary contamination+ rinsing with water + air drying

Group 4 (Acid etching (A)): Salivary contamination+ rinsing+ air drying + conditioning with phosphoric acid 37% (Total Etch, Ivoclar Vivadent)

Group 5 (Bond(B)): Salivary contamination+ rinsing+ air drying + conditioning with phosphoric acid as above and then applying bonding agent (Margin Bond, Coltene, Batch number: MBO 11 according to the manufacturer's instructions)

Group 6: Salivary contamination+ application of alcohol (wiping the surface with an alcohol-soaked cotton swab twice)(Alcohol: Alc)

Group 7 (Bur): Salivary contamination+ removing about 0.5 mm of the composite surface using a hand piece and 008 bur+ rinsing+ air drying

Samples were rinsed with water for 10 seconds

in groups where irrigation was required (17-19). In groups where drying was indicated, specimens were air dried using air syringe for 20 seconds from 15 cm distance. Whenever conditioning with phosphoric acid was needed, phosphoric acid 37% (Total Etch, Ivoclar Vivadent) was used for 20 seconds.

After preparing the samples, composite was added through tiny tubes with 0.7 mm internal diameter and 1 mm height (Tygon, Norton Performance Plastic, Cleveland, OH, USA) to the prepared surface of samples in different groups and cured for 40s. The primarily used composite and the one added later were both Z100 composite resin (3M ESPE, Dental Products, Batch Number:44-0007-4122-OA) of A2 shade. The understudy bonding agent used was Margin Bond (Coltene, Batch Number: MBO 11). Microshear bond strength of specimens was determined using microtensile Tester (Bisco Inc. USA) with 0.5 mm/min speed. Considering the normal distribution, data were analyzed using ANOVA test and since the differences were statistically significant ( $P<0.001$ ), comparisons between each 2 understudy groups were performed using Tukey's test.

### Results:

Mean and standard deviation of the microshear bond strength of the understudy groups were as follows:

Group 1 (Controls, no contamination) equal to  $23.0\pm 3.60$  MPa

Group 2 (DS, Dried saliva) equal to  $11.71\pm 2.49$  MPa

Group 3 (W, saliva+ rinsing+ air drying) equal to  $17.60\pm 4.25$  MPa

Group 4 (A, saliva+ rinsing+ air drying+ acid application) equal to  $21.84\pm 6.34$  MPa

Group 5 (B, saliva+ rinsing+ air drying+ acid conditioning+ bonding) equal to  $21.25\pm 7.58$  MPa

Group 6 (Alc, saliva+ alcohol) equal to  $21.65\pm 5.53$  MPa

Group 7 (B, saliva+ bur+ rinsing+ acid+ bonding) equal to  $17.34\pm 5.95$  MPa

Descriptive indices of understudy groups are presented in Table 1.

Microshear bond strength of samples in different groups was compared using analysis of variance and the results showed a significant difference in this respect ( $P<0.0001$ ). The highest microshear bond strength belonged to the control samples that had no contamination. The lowest microshear bond strength was observed in group 2 samples (salivary contamination+ air drying). Microshear bond strength in groups 4 (salivary contamination + rinsing+ air drying+ phosphoric acid application), 5 (salivary contamination+ rinsing+ air drying+ etching+ bonding) and 6 (salivary contamination+ alcohol) was almost similar. Microshear bond strength of groups 3 (salivary contamination+ rinsing+ air drying) and 7 (salivary contamination+ removing about 0.5 mm of the composite surface with hand piece and 008 bur+ rinsing+ air drying) showed close similarities as well. Tukey's post hoc test was employed to find which groups had significant differences with each other. This test revealed significant differences between samples in groups 1 and 2 ( $P<0.0001$ ), groups 2 and 4 ( $P<0.0001$ ), groups 2 and 5 ( $P<0.001$ ) and groups 2 and 6 ( $P<0.0001$ ). No other significant differences were detected when comparing other groups with each other.

**Table 1- Descriptive indices of microshear bond strength of samples in various study groups**

Group	Number	Mean	Standard deviation	Minimum	Maximum	Minimum range	Maximum range
E	15	23.01	3.60	18.15	28.15	21.01	24.99
DS	15	11.70	2.49	6.76	15.52	10.32	13.08
W	15	17.60	4.25	11.14	25.26	15.25	19.95
A	15	21.84	6.34	11.57	31.57	18.33	25.35
B	15	21.25	7.58	11.05	38.68	17.05	25.45
Alc	15	21.65	5.53	11.57	30.0	18.59	24.72
Bur	15	17.34	5.95	11.05	29.73	14.05	20.64

### Discussion:

The present study aimed at evaluating the effect of salivary contamination on the microshear bond strength of composite-composite and determining which decontamination method best re-establishes the original resin-resin bond strength.

Salivary contamination is the most common form of contamination that occurs when restoring the teeth with dental materials. We used Z100 composite and Margin bond due to their high application in operative dentistry. Also, for evaluation of bond strength in this study we used microshear strength method which has many advantages over conventional shear or tensile strength methods. In spite of numerous studies conducted on the effect of salivary contamination on the enamel and dentin, very limited studies have assessed its impact on composite increments, and methods of decontamination in such cases have not been well evaluated either. However, a few studies have investigated the cleansing methods following salivary contamination of tooth structures. Some microscopical studies on the salivary contaminated tooth structures have shown that salivary pellicles cannot be removed through water rinsing alone. Therefore it has been recommended to etch the affected area for

10 seconds (4, 17). In 2006, Sattabanasuk et al. evaluated the effect of salivary contamination on

dentin bond strength in all-in-one adhesives and showed that salivary contamination decreases the strength of bond between dentin and all-in-one adhesives. They recommended application of extra adhesive after cleansing the saliva from the dentin surface (8).

In our study, group 2 had the lowest microshear bond strength. In this group, after salivary contamination, saliva on the composite surface was air dried for 20 seconds and then another increment of composite was applied. This group was the only one showing statistically significant difference with the control group. Other groups although had a microshear bond strength lower than the control group, the differences were not statistically significant. Based on these results, drying the contaminated surface significantly decreases the microshear bond strength. This finding is in accord with those of Eiriksson (2004) and Hitmi (1999)(18, 4). Eiriksson (2004) evaluated the effect of saliva contamination on the microtensile bond strength between resin interfaces in 4 different composite resins and Hitmi (1999) assessed the influence of the duration of salivary contamination at different stages during the bonding procedures on shear bond strengths of 3 dentin adhesives.

In our study, in group 3, salivary contamination was eliminated only through water rinsing and bond strength was not significantly different from that of the control group which is in agreement with the finding of Eiriksson (2004) where he used Pertac II composite resin.

However, in his study bond strength after rinsing the saliva in Z250, Renew and APx composites was found to be lower than the control group (18). Eiriksson in his study first air dried the saliva on the surface and then rinsed them with water but in our study, we rinsed the surface without first air drying it. This may be the reason for decreased bond strength observed in his study in 3 types of composites. However, no decrease in bond strength of the 4<sup>th</sup> composite was detected. Eiriksson (2004) reported that during salivary contamination of a composite surface even for a very short time salivary pellicles are formed on the composite surface and result in reduced bond strength and rinsing alone for re-establishing the original bond strength is not reliable (18).

In our study, bond strength in group 4 (where acid was applied on the composite surface after rinsing and air drying and then the surface was rinsed again), group 5 (where enamel bond was applied after the abovementioned phases) and group 6 (decontaminating the surface with alcohol) was almost similar and had no significant difference with that of the control group. In Eiriksson (2004) study, use of bonding agent increased the bond strength of Z250 and Renew composites up to that of the control group (18). Liyod (1985) has also recommended the use of bonding in one day repair of composite restorations (19). In our study, in group 7, 0.5 mm of the contaminated composite was removed from the top using hand piece bur and bond strength improved to that of the control group. This finding is in concord with Shahdad (1998) study result (20). In his study, surface abrasion significantly improved the bond strength. He also reported that use of bonding agent after surface abrasion enhanced the bond strength, but not significantly (20). Considering our study results, when doing a composite

restoration, if salivary contamination occurs decontamination by using acid etching, alcohol, and margin bond can increase the microshear bond strength up to that of the control group but since the difference in bond strength between the mentioned groups and other ones (where decontamination was done only by rinsing and then the surface was dried out) was not statistically significant, using the abovementioned techniques would be time consuming and not cost effective (time-wise). Therefore, in case of salivary contamination of the composite surface, we should just rinse and air dry the surface thoroughly and apply the next increment of composite resin. However, since our study results are not in complete agreement with some similar studies (18), further investigations in this respect are required to achieve a definite result. Salivary contamination of composite surface during incremental application is a common occurrence in dental clinics and obtaining maximum bond strength in such cases easily and quickly improves the quality and survival of restorations and enhances public health in a community.

### **Conclusion:**

In our study, air drying the specimens for 20 seconds following salivary contamination decreased the microshear bond strength significantly. All the methods used in our study for decontaminating saliva from resin surfaces improved the microshear bond strength of specimens up to that of the control group.

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**References:**

1. Sturdevant MM, Roberson M, Heymann O, Sturdevant R: The art and science of operative dentistry. 3rd Ed. St. Louis: The CV Mosby Co. 2006; Chap 12: 529.
2. Summit JB, Robbins JW, Schwartz RS: Fundamentals of operative dentistry: a contemporary approach. 2nd Ed. Quintessence Publishing Co. Inc. 2006; Chap8:183.
3. Xie J, Powers JM, McGuckin RS: In - vitro bond strength of two adhesives to enamel and dentin under normal and contaminated conditions. Dent Mater 1993; 9:295-99.
4. Hitmi L, Attal JP, Degrange M. Influence of the time - point of salivary contamination on dentin shear bond strength of 3 dentin adhesive systems. J Adhesive Dent 1999; 1:219-32.
5. Barghi N, Knight GT, Berry TG. Comparing two methods of moisture control in bonding to enamel: A clinical study. Oper Dent 1991; 16:130-135.
6. Hiraishi N, Kitasako Y, Nikaido T, Nomura S, Burrow MF, Tagami J. Effect of artificial saliva contamination on PH value change and dentin bond strength. Dent Mater 2003; 19:429-34.
7. Powers JM, Finger WJ, Xie J. Bonding of composite resin to contaminated human dentin and enamel. J Prosthodont 1995 4:28-32.
8. Sattabanasuk V, Shimada Y, Tagami J: Effects of saliva contamination on dentin bond strength using all-in-one adhesives. J Adhes Dent 2006; 8:311-8.
9. Hansen EK, Munksgaard EC. Saliva contamination VS. Efficiency of dentin bonding agents. Dent Mater 1989; 5:329- 33.
10. Pashley EL, Tao L, Mackert J: Comparison of in - vivo vs in - vitro bonding of composite resin to the dentin of canine teeth. J Dent Res 1988; 67:467-70.
11. Taskonak B, Sertgot A: Shear bond strengths of saliva contaminated "one-bottle" adhesive. J Oral Rehabil 2002; 29:559-564.
12. Abdalla AI, Davidson CL: Bonding efficiency and interfacial morphology of one-bottle adhesive to contaminated dentin surfaces. Am J Dent 1998; 11:281-285.
13. Fritz UB, Finger WJ, Stean H: Salivary contamination during bonding procedures with a one-bottle adhesive system. Quintessence Int 1998; 29:567-572.
14. Johnson ME, Burgess JO, Hermes CB, Buikema DJ. Saliva contamination of dentin bonding agents. Oper Dent 1994; 19:205-10.
15. Kanca J: Effect of resin primer solvent and surface wetness on resin composite bond strength to dentin. Am J Dent 1992; 5:213-5.
16. Pashley DH, Nelson R, Kepler EE: The effects of plasma and salivary constituents on dentin permeability. J Dent Res 1982; 61: 978- 81.
17. Silverstone LM, Hicks MJ, Featherstone MJ. Oral fluid contamination of etched enamel surfaces: An SEM study. J Am Dent Assoc. 1985; 110:329-32.
18. Eiriksson SO, Pereira PNP, Swift Jr EJ, Heymann HO, Sigurdsson A: Effect of saliva contamination on resin-resin bond strength. Dent Mater 2004; 20:37-44.
19. Lioyd CH, Dhuru VB. Effect of commercial bonding agent upon the fracture toughness of repaired, heavily filled composite. Dent Mater 1985; 1:83-5
20. Shahdad SG, Kennedy JG. Bond strength of repaired anterior composite resins: an in vitro study. J Dent 1998; 26:685-94.