**Original Article**

# Microshear Bond Strength and Microleakage of a Restorative Composite Resin with Salivary Contamination at Different Time Intervals

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**Abstract**

**Introduction :** Saliva contamination is an inevitable and common challenge in the field of restorative dentistry. Recognizing and considering the key time of isolation is an effective strategy to prevent the deleterious effects of salivary contamination. The purpose of this study was to evaluate the effect of salivary contamination in the course of light curing on microshear bond strength and microleakage of a restorative composite resin. **Methods:** 140 human third molars were divided into seven groups each containing 10 samples for measuring the microleakage and the microshear bond strength. The specimen of each group was contaminated with human saliva at a certain time, while group1 was contaminated in prior to light curing. The samples in groups 2 to 7 were contaminated with saliva at 2, 5, 10, 15, and 20 s after the start of light curing, respectively. The specimens of group7 were light cured and contaminated afterwards with human saliva. **Results:** According to the gathered results, the time of saliva contamination had significant negative effects on the microshear bond strength to the dentin and enamel in the course of light curing throughout the first 2s and 5s, respectively. It was indicated by the microleacage test that the saliva contamination in the first 2s, 5s, and 10s during light curing had a higher microleakage than the other times. **Conclusion:** In conclusion, during light curing of the composite resin, the first 10s was high sensitive to saliva contamination and therefore the isolation is very important in this time.

**Keywords:** Saliva, Contamination, Composite resin, Microshear, Microleakage

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## Introduction

Dental caries remains as a significant and widely prevalent disease problem throughout the world(1). According to the information of Global Oral Health Data Bank, the prevalence of caries was reported to be in the the range of 49% to 83%(2). As a result, dental composites have become the most applied dental material for replacing the tooth structure that had been lost to decay. Aesthetic combined with adequate mechanical and physical properties stand as the main aspects of these materials(3) and achieving these properties is quiet relevant to the polymerization quality of the utilized composite resin(4). The curing reaction in restorative composite resins involves the visible-light-initiated photopolymerization of dimethacrylate monomers and consequently its crosslinking to form the intended polymer(5). Adhesive restorations are required to contain adequate bond strength to prevent the occurrence of microleakage around the restoration margins and protect the tooth structure against mechanical forces that could cause fractures(6).

Saliva contamination is known as an inevitable and common challenge in restorative dentistry, especially when rubber dam isolation is unfeasible(7). There is the possibility of the inducement of deleterious effects such

as a reduction in the longevity of restoration, an increase in the microleakage, sensitivity, tooth discoloration, secondary caries, and finally the loss of restoration(8). Recognizing and considering the key time for isolation is an effective strategy to prevent the negative effects of salivary contamination. The aim of this study was to evaluate the effect of time on salivary contamination during light curing in regards to the microshear bond strength and microleakage of a composite resin. Our null hypothesis was to presume that the time of salivary contamination during light curing has no significant effect on the microshear bond strength and microleakage of the composite resin.

## Materials and Methods

140 caries free freshly extracted human third molars teeth were utilized to perform the microleakage test. For this purpose, the experimental teeth were cleaned and disinfected with the usage of 0.5% thymol solution to be stored in distilled water at room temperature. In each specimen, Class V cavity (3 mm in length, 2 mm in width, and 1.5 mm in depth) were prepared in the buccal and lingual surfaces of teeth by the application of a diamond bur (Tees Kavan Co, Ltd., Tehran, Iran). A 37% Phosphoric acid etching gel (Kimia, Iran) was applied to the prepared tooth structures for 30 s, which were rinsed afterwards with water for 10s and dried. In the following, the bonding agent (3 MESPE, ST Paul, USA) was applied and light cured. Then the cavity was filled with Filtek Z350, shade A2 (3M ESPE, USA). Then, the samples were divided into seven groups to have the surface of each sample contaminated with human saliva and perform light curing by a light-emitting diode (LED) curing unit (500 mW/cm2, Bluephase® C8, Ivoclar Vivadent AG, Schaan, Liechtenstein) as it is mentioned in the following:

**Group1:** Specimens were contaminated with human saliva in prior to being light cured for 40 s (negative control).

**Group2:** Specimens were contaminated with saliva 2 s after the start of light curing.

**Group3:** Specimens were contaminated with saliva 5 s after the start of light curing.

**Group4**: Specimens were contaminated with saliva 10 s after the start of light curing.

**Group5:** Specimens were contaminated with saliva 15 s after the start of light curing.

**Group6:** Specimens were contaminated with saliva 20 s after the start of light curing.

**Group7:** Specimens were light cured for 40 s in prior to being contaminated with human saliva (positive control).

In order to completely seal the tooth surfaces, two coats of nail were applied to the tooth of every sample except the case of restorative composite. All of the specimens were immersed in a solution of 0.5% methylene blue for 24 hrs. Subsequent to being rinsed with distilled water, the specimens were mounted in a transparent clod-cure acrylic resin. Thereafter, they were sectioned in the mesiodistal direction to have the surface of each part sectioned in buccolingual direction into three sections. We determined the dye penetration in specimens by the employment of a stereomicroscope at ×40 magnification.

140 caries-free freshly extracted human third molars teeth were procured to perform the microshear bond strength test. Cylindrical diamond burs were used to remove the cusps and prepare the required flat dentin surfaces. In each sample, a flat surface of dentin and enamel was provided with a thickness of 1mm through cutting and polishing. In the following, the teeth were embedded in chemically cured acrylic resin and 37% phosphoric acid gel (Kimia, Iran) was used to etch the dentin and enamel surfaces for 30 s. The etched surfaces were completely rinsed for 20s afterwards to remove the etching gel. Then, the bonding agent (3 MESPE, ST Paul, USA) was applied and light cured. In this study, Tygon tube (2 mm high and 0. 5 mm in diameter) was used to place the composite on the surfaces of dentin and enamel. The samples were divided into seven groups and the surface of each sample was contaminated with human saliva and light curing in a similar manner to what is mentioned in the section of micro leakage test. The samples were stored in deionized water for 2months and subjected afterwards to microshear bond strength test in a universal testing machine (STM20, SANTAM, Tehran, Iran) at a crosshead speed of 1mm/min.

The statistical analysis was conducted through the exertion of SPSS software version 22 (SPSS Inc., Chicago, IL, USA). All of the gathered data were analyzed through one-way ANOVA at a significance level of 0.05.

## Results

The results of ANOVA test revealed the existence of significant differences between the microleakage of groups(P-value<0.001). Microleakage in group6 and group7 were significantly lower than groups1 to 5 (P<0.05). Group1 and group7 exhibited the highest and lowest microleakage in comparison to the other groups, respectively (TableI).

Table I. Microleakage values of the seven groups.

| Groups | n | Mean | Standard Deviation | P-value |
|---|---|---|---|---|
| 1 | 20 | 0.37 | 0.24 | |
| 2 | 20 | 0.78 | 0.51 | |
| 3 | 20 | 0.76 | 0.31 | |
| 4 | 20 | 0.71 | 0.27 | |
| 5 | 20 | 0.62 | 0.23 | |
| 6 | 20 | 0.51 | 0.19 | |
| 7 | 20 | 0.38 | 0.22 | P<0.001 |

In addition, significant differences were detected between the results of groups microshear bond strength to enamel (TableII) (P-value=0.003). The microshear bond strength in group7 was significantly higher than groups1 to3 (P<0.05). Group1 and group7 displayed the lowest and highest microshear bond strength compared to the other groups, respectively.

Table II. Microshear bond strength to enamel of the seven groups.

| Groups | n | Mean (MPa) | Standard Deviation (MPa) | P-value |
|---|---|---|---|---|
| 1 | 10 | 64.45 | 7.74 | |
| 2 | 10 | 46.95 | 5.09 | |
| 3 | 10 | 49.77 | 6.21 | |
| 4 | 10 | 50.84 | 8.27 | |
| 5 | 10 | 51.84 | 11.80 | |
| 6 | 10 | 54.35 | 10.42 | P=0.003 |
| 7 | 10 | 57.74 | 12.81 | |

The outcomes of microshear bond strength to dentin of each group is represented in Table III. According to the results of ANOVA test, the microshear bond strength was

significantly different between the seven groups (P< 0.001). Microshear bond strength in group 6 and group7 were significantly higher than that of group1 and group2(P<0.05).

Table III. Microshear bond strength to dentin of the seven groups.

| Groups | n | Mean (MPa) | Standard Deviation (MPa) | P-value |
|---|---|---|---|---|
| 1 | 10 | 32.27 | 8.96 | |
| 2 | 10 | 16.84 | 8.71 | |
| 3 | 10 | 19.40 | 8.06 | |
| 4 | 10 | 20.37 | 8.38 | |
| 5 | 10 | 21.99 | 8.18 | |
| 6 | 10 | 20.30 | 12.30 | P<0.001 |
| 7 | 10 | 32.19 | 8.19 | |

## Discussion

Saliva is mostly consisted of water (99.4%) and 0.6% solids that include proteins, glycoprotein sugars, amylase, calcium, sodium, chloride, urea, amino acids, fatty acids, and free glucose(9). In addition, this substance has a high probability to influence an operative field(10) and according to the results of the present study, the time of saliva contamination has a significant negative effect on the bond strength of microshear to dentin and enamel in the course of light curing in the first 2s and 5s, respectively. This difference between dentin and enamel is caused by the heterogeneous nature of dentin since it contains a much higher portion of organic and water content than enamel and therefore, exhibits a lower sensitivity to saliva contamination than enamel(11). The work of Suryakumari et al.(6) stated that the dentin bond strength of a bonding agents are less sensitive to saliva contamination than the previous assumptions.

Microleakage can be defined as the penetration of bacteria and oral fluids through the available gaps (12). The issue of Microleakage around dental restorative materials stands as a crucial obstacle in clinical dentistry(13). It was indicated by our results that saliva contamination caused a higher microleakage in the first 2s, 5s, and 10s during light curing than the other groups. In other words, in the course of light curing, the first 10s contain a higher sensitivity to saliva contamination and therefore, performing a successful isolation at this time is very important. It is stated in the work of Evancusky et al.(14) that salivary contamination had zero significant effect on enamel microleakage, however, a significant increase occurred in both cases of linear and penetrating microleakage versus non-contaminated in regards to both of the compomer/dentin bonding systems(14). According to the results of Farmer et al.(15) Study, composite had less enamel microleakage while the conventional and resin-modified glass ionomer restorations demonstrated less cementum microleakage. Furthermore, it is reported by Shimazu et al.(16) that composite resin showed higher microleakage after artificial saliva contamination, however no significant differences were observed throughout the cases of GIC and RMGIC. It was also discovered by Rosa et al.(17) that contamination whit saliva after acid etching can increase the inducement of microleakage of composite resin restorations. However, performing acid etching subsequent to the saliva contamination can prevent the occurrence of negative effects on restorations margins. Sahebalam et al.(18) studied the effect of saliva contamination on degree of conversion and microhardness of a restorative composite resin. Their result indicated that the time of saliva contamination (before, during, or after light curing of composite resin) had no signifiant negative effects on the degree of conversion and microhardness.

Considering the limitations of this in vitro study, the provided conclusions below can be drawn from the present research:

1. Time of saliva contamination has a significant negative effect on the bond strength of microshear to dentin and enamel during the light curing in the first 2s and 5s, respectively.

2. saliva contamination in the first 2s, 5s, and 10s in the course of light curing results in a higher microleakage than the other times.

3. Overall, the high sensitivity of the first 10s towards saliva contamination and the isolation process during light curing of the composite resin should be considered as essential factors.

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## Conflicts of Interest

The authors declare no conflict of interest.

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