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Evaluation of the effect of nitrile and powderless latex gloves contamination on the shear bond strength of orthodontic brackets bonded with composite on dental enamel

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ABSTRACT

Introduction: The composite resin bond strength to the enamel can be affected by contamination with various agents. Protective gloves are one of the factors which can cause contamination and disruption of the composite resin bond strength to the tooth structure. The aim of this study was to investigate the shear bond strength (SBS) of orthodontic brackets bonded with composite resin to enamel after contamination with powderless latex and nitrile gloves.

Materials & Methods: A total of 208 orthodontic brackets were bonded on the mesial and distal of 104 intact extracted premolar teeth. The teeth were randomly divided into latex and nitrile groups. Each group was divided into test and control subgroups. In the test groups, the composite resin was placed with latex or nitrile gloves, and in the control group without contact with the gloves on the bracket base. The SBS of the samples was measured in a compressive test machine at a strain rate of 0.5 mm/min. The data were analyzed by independent t-test. The significance level was set at $p<0.05$.

Results: There was no significant difference in SBS between the latex and nitrile subgroups with or without gloves. There was no significant difference between the latex and nitrile groups and their control groups.

Conclusion: The use of powder-free latex gloves and nitrile gloves does not affect the SBS of composite resins; therefore, they are recommended for dental procedures.

Keywords: Infection Control, Nitrile, Polymers, Protective Gloves

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Introduction

Reliable bond strength of brackets to the tooth structure is essential in orthodontics.[1-4] Composite resins have the highest bond strength to enamel compared to other materials.[5] Although composite resins have many advantages, they are very technique-sensitive.[6] The method of transporting the composite resin to the site of interest can affect its clinical efficiency. However, when used manually, the clinician might inadvertently or intentionally contact composite resin material directly with his/her gloved fingers to homogenize and spread it.[7] The contact of the clinician's gloves with the composite resin might cause contamination which might affect the mechanical properties of composite resin. [6, 7]

Most gloves are made of latex, and due to the adverse effects of powdered latex gloves in dentistry, powderless latex gloves are available.[8] Sanders et al showed that contamination of adhesive resin with powderless latex had the most negligible effect on the bond strength of composite resins. There is a statistically insignificant tendency for the adhesive bond to fail when contaminated with latex.[9] Similar results are seen in the study of Oskoee et al. and Roberts et al.[8, 10] Between 2.8 to 17% of healthcare workers and others who regularly use latex gloves are allergic to latex.[11] Nitrile gloves have a higher chemical resistance than latex gloves and are ideal for individuals allergic to latex.[12, 13]

Nitrile gloves are in widespread use currently. However, there is a paucity of information about their effect on the shear bond strength (SBS) of composite resins. Besides, there is no consensus about the effect of contamination of composite resins with powderless latex on their bond strength. Therefore, the present study aimed to investigate the SBS of orthodontic brackets bonded with composite resin to enamel after contamination with powderless latex and nitrile gloves. The null hypothesis of the study is that the powderless latex gloves and nitrile gloves do not affect the SBS of orthodontic brackets bonded with composite resin to the enamel.

Materials & Methods

The ethical approval was obtained from the Ethics Committee of Zanjan University of Medical Sciences (IR.ZUMS.REC.1398.449). In this in vitro study according to the following formula $n_1 = n_2 = \frac{\left[Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right]^2 (\sigma_1^2 + \sigma_2^2)}{\delta^2} = \frac{10.5*(4.21^2 + 5.68^2)}{(13.55-10.33)^2} = 51$ and for easier division a total of 104 intact premolars extracted for orthodontic purposes were collected from dental clinics in Zanjan (Iran) and after disinfecting with 0.5% chloramine T solution (Merck, Darmstadt, Germany) stored in purified water. To ensure the integrity of the buccal surface, the teeth were examined under a microscope (ST-39, Motic, Barcelona, Spain) at ×4 magnification.

A polypropylene tube measuring 2 cm in height was used as a mold, which was filled with acrylic resin (Acropars Re, Marlic Medical Industries Co., Tehran, Iran) to mount the tooth samples. The tooth roots were placed at the center of the mold and buried up to the cementoenamel junction (CEJ) area in acrylic resin. The tooth long axis was adjusted perpendicular to a horizontal line. The buccal surfaces of all the teeth were brushed at low speed using a handpiece before bonding. Then they were etched with 30% phosphoric acid (Morva gel, Morva Bone, Tehran, Iran) for 30 seconds in both the right and left halves and dried with

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air pressure after washing. An adhesive resin (Sci-pharm, Pomona, CA, USA) was applied to the etched surfaces using a micro-brush, thinned with a gentle air stream, and cured for 10 seconds using a light-curing unit (LED D, Woodpecker, Guangxi, China). The teeth were randomly divided into two latex (A) and nitrile (B) groups (n=52). Then, each group was divided into two subgroups: A-1 and A-2 (n=26), and in each subgroup, the brackets were divided into two groups: a and b.

In the A-1-a group, 26 lower incisor brackets (Shinye Odontology Materials, Hangzhou, China) were bonded in the right half of the teeth as follows. The brackets were held with a bracket holder, and the composite (Sci-pharm, Pomona, CA, USA) was applied directly from the tube onto the base of the bracket using a plastic spatula with five gentle strokes (1 second each, 5 seconds in total). The brackets were placed at the center of the area of interest, and excess composite resin was removed with the tip of a scaler. Then, they were cured for 20 seconds (10 seconds from the right and 10 seconds from the left side).

Twenty-six brackets in the A-1-b group were bonded similarly to the left side of the same teeth, except that the composite resin was applied to the bracket base with five gentle strokes (1 second each) with a finger wearing a latex glove (Op-Perfect, Harir, Ghazvin, Iran). A new glove was used for each bracket. Before curing the composite, a black cardboard piece was placed between these brackets and the brackets of the previous group to minimize the transmission of extra light to the composite resin of the previous group. Then, 26 brackets in the A-2-b group were bonded similarly to the A-1-b group, with the difference that the bonding was performed on the right side of the tooth. The 26 brackets in the A-2-a group were bonded to 26 teeth, similar to the A-1-a group on the left side. The brackets of group B were bonded similarly to those of group A, with the difference that nitrile gloves (Supermax, Selangor, Malaysia) were used instead of latex gloves.

Thus, 208 brackets were bonded on 104 teeth; therefore, the control samples in each latex and nitrile group were on the same tooth. Then, the SBS of the brackets with composite resin to enamel was measured using the universal testing machine (STM-20, Santam, Tehran, Iran) (Figure 1). The chisel-like blade, which was designed and prepared for this purpose, was placed on the right side of the samples along the long axis of the tooth at the bracket base–buccal surface interface. The software was set on a load cell with a capacity of 50 kg (The combined error of 0.03%, or in other words, with an accuracy of 15 grams), and the blade speed was 5.0 mm/min. For the brackets on the left side of the tooth, the blade of the device was placed in the same position as the previous adjustments, and the force was measured and recorded in the same. The bracket base area was considered to be 7.25 mm^2 to calculate the SBS. The SBS of each sample was reported in Mega Pascal (MPa). SPSS 22 was used to analyze the data. Means and standard deviations were used for descriptive statistics. The Kolmogorov-Smirnov test was used to evaluate the distribution of data. Because of the independence of the control group in each study group and the normal distribution of the data, an independent t-test was used to compare the binding strength between groups. The significance level was set at $p<0.05$.

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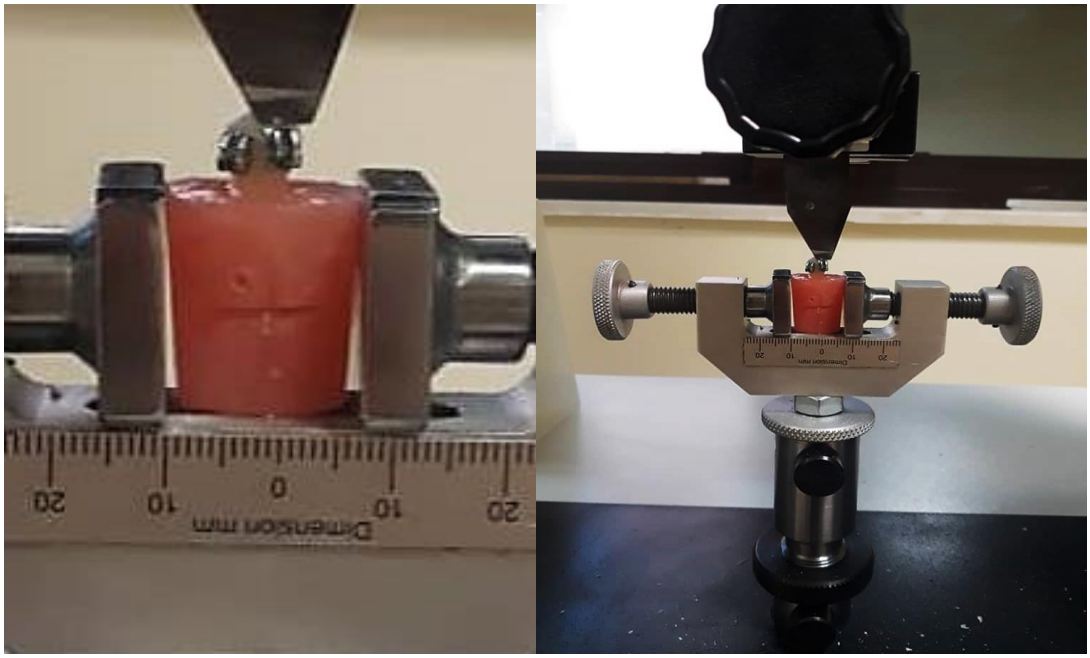

Figure 1. The position of the tooth sample in the machine to measure the shear bond strength of the bracket with composite resin to the tooth enamel

Results

SBS values in the latex group were 25.96 and 25.93 MPa for the test and control groups, respectively, and 24.58 and 24.48 MPa in the test and control groups in the nitrile group, respectively (Table 1). Subgroup comparisons in the latex group showed that the latex gloves did not result in a significant change in SBS (P=0.992). In the nitrile group, there was no significant difference between the respective subgroups (P=0.958). The mean SBS was not significantly different between the latex and the nitrile groups (P=0.571). There were no significant differences between the control subgroups of both groups (P=0.472).

Table 1. Comparison of the shear bond strength values between the latex and nitrile glove groups (MPa)

Group	Subgroup	Mean	SD	P-value
Latex	Test Control[$]	25.96 25.93	13.8 10.04	0.992
Nitrile	Test Control[$]	24.58 24.48	10.54 10.52	0.958

$. No contamination with gloves

Discussion

The results showed that contamination with powderless latex or nitrile gloves did not affect the SBS of composite resin, and the null hypothesis was not rejected. According to previous studies, powdered latex gloves reduce the mechanical properties and SBS of composite resins. However, powderless latex gloves have an insignificant effect on the bond strength of composite resins. However, there is no consensus in this regard.[7, 8, 14]

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A study by Holtan et al showed that contamination with powderless latex gloves did not affect the SBS of porcelain to dentin.[15] Swift et al showed that contamination with powderless latex gloves did not affect the SBS of composite resin to dentin.[14] A study by Oskoee et al showed that the use of powderless latex gloves did not affect the SBS of Single Bond and Clearfil SE Bond composite resins to bovine enamel.[8] Since human teeth were used in the present study, it can be more generalizable than other mentioned articles for orthodontic bracket bonding to enamel. Also in the present study, contamination was performed after curing the adhesive system. whereas In a study by Sanders et al, who used ProBand resins, latex glove contamination was induced through direct contamination of the adhesive system,[9] Since in the orthodontic clinic, the risk of contamination with latex gloves after curing is higher, our results might be helpful in this field; however, in all these studies, powderless latex gloves had no significant effect on the SBS.

The present study showed that nitrile gloves do not affect the SBS of composite resin to the enamel. Nitrile gloves have a higher chemical resistance than latex gloves, and their chemicals - which might interfere with the polymerization process - are not easily released during use in dental procedures.[13]

Latex gloves cause allergies[16] and are associated with some skin diseases.[17] On the other hand, these gloves have relatively low physical resistance.[18] Nitrile gloves have higher physical and chemical resistance than latex gloves. They are more resistant to tearing during the procedure[19] and to the penetration of solvents and chemicals than latex gloves.[20] The present study also showed that the use of nitrile gloves does not affect the SBS of the composite resin. As a result, the use of nitrile gloves is recommended compared to latex gloves in dental procedures.

In this study, the absolute amount of bond strength is not clinically reliable because of the difference in bracket types and teeth because the bracket base does not adequately adapt to the tooth surface. The results of this study might not be generalizable to self-cured composite resins. Besides, in the clinic, a glove might be used several times to adjust the composite resin of several brackets during the procedure, and contamination of the glove with the composite resin might occur, which might affect the bond strength. Further studies are recommended to investigate contamination with different gloves and composite resin types.

Conclusion

The present study showed that contamination with powder-free latex gloves did not affect the SBS of composite resin to the tooth structure. Besides, contamination with nitrile gloves did not affect the SBS. Therefore, it is suggested that powderless latex gloves and nitrile gloves be used in dental procedures.

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Conflicts of Interest

The authors certify that they have no conflict of interest.

Author's Contribution

M. Ghasemi helped with data collection, data analysis, and writing the manuscript. M. Sheikhi contributed to the conception, study design, critical revision of the paper, and manuscript editing. M. Najdalizadeh and A. Yoosefi helped with study design, writing the paper, and data collection. All authors read and approved the final manuscript.

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