The effect of glove contamination on the bond strength of resin to enamel

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Over the past twenty years infection control protocol has evolved and use of gloves is now mandatory. Practitioners have become aware of potential interactions between the latex gloves and many of the dental material used as well as the potential for contamination from the gloves. The purpose of this study was to evaluate the shear bond strength of bonded restorations to enamel of uncontaminated and contaminated resin adhesive with powder free and powdered latex gloves. The results of the study demonstrated that the resin bonding agent that was in contact with either powdered or non- powdered latex gloves did not have a significant effect on the shear bond strength of the bonded restoration.
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INTRODUCTION

Since the introduction of latex gloves, questions have been raised as to the impact that the material has on the resin bonding used in restorative dental procedures. Studies have shown that powdered or powder free latex gloves retards the set of polyvinylsiloxane impression materials.[1-4] Additional studies on etched enamel and porcelain surfaces have demonstrated that contamination of the glove coating resulted in a significantly lower shear bond strength.[5] Because most bonded restorations are placed by direct bonding procedures, the materials may become contaminated during the process. Specifically, contamination of the resin adhesive by powdered or powder free latex gloves may affect the bond strength and ultimately the success of the restoration.

The purpose of this study was to evaluate the effect of glove contamination of resin adhesive on the shear bond strength of the resin restoration.

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METHODS AND MATERIALS

Thirty extracted bovine incisor teeth with intact enamel surfaces were selected for this study. The roots were removed and the facial surfaces were then ground flat with 400-grit carbide paper. The flattened surfaces of each specimen were centered on a cylindrical ring and embedded in cold acrylic (Formatray Acrylic, Kerr Manufacturing). The thirty teeth were randomly separated into six equal groups of five each. The six groups were tested three times each, once under each experimental condition and once in the control condition.

Group I specimens were etched with 37% phosphoric acid (Ultra-Etch, Ultradent Products) for thirty seconds rinsed for thirty seconds and air dried for 20 seconds. Probond (Caulk/Dentsply) resin adhesive was applied to the etched surface following the instructions of the manufacturer and light cured (Visilux Visible light Curing Unit, 3M Dental Products) for 20 seconds. The light curing unit was tested both prior to beginning and during the study to determine adequate output according to the specification of the manufacturer. Equal amounts of resin (Z100, 3M Dental Products) was then applied to the facial surface of each tooth using a Delrin ring mold 4mm in diameter and 2mm in height and light cured for 60 seconds.

Group II specimens were etched as in group I except that the resin adhesive was allowed to be contaminated by placing it in contact with the outer surface of powder free (no cornstarch) latex gloves (Baxter/Allegiance) for two minutes and stored in the dark prior to placing on the facial surface of the specimen. The resin adhesive was cured for 20 seconds and then the remaining steps were followed as in group I.

Group III specimens were etched as in group I. The resin adhesive was placed in contact for two minutes with powdered latex gloves (Baxter/Allegiance) and

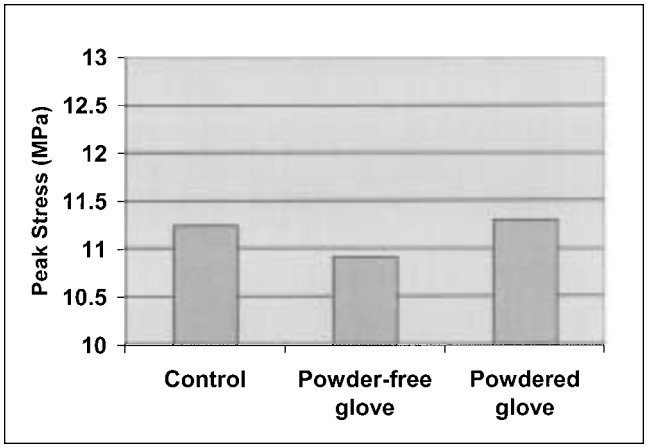

Figure 1.

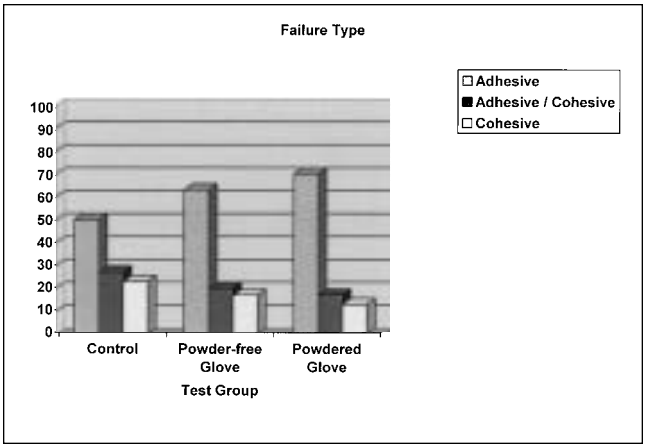

Figure 2.

stored in darkness to prevent the material from curing prior to placing it in contact with the tooth surface. The resin adhesive was then light cured for twenty seconds and the same steps were repeated as in group I.

The finished samples were then stored in water for 48 hours at 37° Celsius followed by thermocycling for 2500 cycles. The specimens were tested for shear bonding strength on the Instron Testing Machine (Instron corporation). Each specimen was attached to the stationary portion of the testing machine and aligned so that the bonding surface was parallel to the line of travel of the machine. A knife-edge steel ring was placed over the specimen to assure that the shear force is directed at the bond surface. The specimens were loaded to failure at a crosshead speed of 1.0mm per minute and shear strength were calculated by dividing load at failure by the specimen area. The failed specimens were stained with disclosing solution and evaluated to determine the mode of failure.

The three groups were compared for differences in shear bond strength using one-way analysis of variance (ANOVA). Pairwise comparisons between the groups were made using Tukey's method to adjust for multiple comparisons.

RESULTS

A total of 90 specimens were tested for shear bond strength, and failure type. The difference in Shear bond strength of the three tests groups were not statistically significant (p=0.90) Table 1, Figure 1. Group III did demonstrate a greater frequency towards an adhesive failure, but again it was not statistically significant (p= 0.62) Table 2, Figure 2).

DISCUSSION

The results of this study indicate that contamination of resin adhesive by either powdered or powder free latex gloves during direct bonding procedures does not decrease the shear bond strength of the composite resin restoration to enamel. Investigations by Holtan and Burke[5,6] are consistent with the results of this study on the effect of latex as a contaminant during bonding procedures.

Previous studies have been concerned with contamination of resins. Garcia *et al.*[7] found that contamination of the resin adhesive with pumice during bracket placement did not significantly affect bracket bond strength. Likewise Bogert and Garcia-Godoy[8,9] found that contamination with pumice during sealant application did not affect sealant bond strength. The results of this study and these other studies suggest that it may be difficult to disturb the polymerization reaction of composite resins enough to greatly affect the measured bond strength of the resulting restorations.

Craig[10] found that latex contamination of polyvinylsiloxane impressions materials result in the retardation of the ionic polymerization necessary for set of polyvinyl a reaction that is not involved in the polymerization of composite resins or resin adhesives. The polymerization reaction of composite resins involves free radical polymerization in which a diketone-amine system and exposure to blue light initiate the reaction of a free radical with the resin itself (Bis-GMA). While both reactions are additional polymerization reactions, the differing mechanism may explain the lack of consistency with regard to sensitivity to contamination.

Although not indicated by our study, one might expect when evaluating the chemical reactions involved, that contamination of any sort should result in a disturbance of those reactions. Perhaps, although there was no significant alteration of shear bond strength, the chemical reaction involved with the polymerization of the resin adhesive was disturbed but not at the level necessary to cause failure of the composite resin restoration. According to Craig[10] even in the most controlled environment the degree of polymerization of resins

Table 1.

Test Group	N	Mean	S.D.	S.E.	Min	Max
Control	30	11.23	3.95	0.72	2.95	18.78
Powder-free glove	30	10.91	3.47	0.63	3.48	16.70
Powdered glove	30	11.30	3.48	0.63	3.34	16.36

Table 2.

	Adhesive		Adhesive/Cohesive		Cohesive	
Test Group	**#**	**%**	**#**	**%**	**#**	**%**
Control	15	50	8	27	7	23
Powder-free glove	19	63	6	20	5	17
Powdered glove	21	70	5	17	4	13

and resin adhesives can fall between 35 and 80% complete so that even an incomplete reaction may result in a clinically successful restoration.

The site of bond failure gives information about the quality of the bond between tooth and adhesive. A cohesive failure occurs between two like materials. An adhesive failure occurs between two unlike materials such as the enamel interface. An adhesive failure may indicate that wetting properties or chemical reaction with the substrate may have limited the joint strength. Although it was not statistically significant there was a greater tendency for an adhesive failure with the powder free (63%) and powdered glove (70%) when compared to the control (50%). It is possible that the contamination of the resin bonding agent does not appreciably affect the bond that occurs with the composite material (cohesive strength), but the tendency towards greater adhesive failure in contaminated samples may reflect a disruption of the flow or the resin across the surface of the enamel.

A study that focuses on the microscopic changes resulting from the contamination of the resin adhesive during bonding would be necessary to determine the extent to which the polymerization reaction was altered. There are many resin bonding systems on the market today, and it is possible that each may react differently to the presence of a contaminant during polymerization. In addition, it would be beneficial to repeat this study using latex free gloves to determine if this would have an impact on the bond strength of the restorative materials.

CONCLUSION

While the use of any dental material based on the instructions of the manufacturer is appropriate and recommended, this study found that contamination of resin adhesive with powdered and powder free latex gloves has minimal impact on the bond strength of the resulting restorations.

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