

**Confidential report To**

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**Evaluation of Pushout Resistance of Hybrid and Microhybrid  
Composite Resins**

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## **Evaluation of Pushout Resistance of Hybrid and Microhybrid Composite Resins**

### **Purpose:**

The purpose of this study was to evaluate the pushout force of two hybrid and four microhybrid composite resins made in cylindrical cavities prepared with diamond burs to simulate a more clinical approach.

### **Materials and Methods:**

The composite materials used for this study and their respective bonding systems are shown in Table 1.

One hundred and twenty recently extracted sound maxillary and mandibular molars were carefully cleaned of any debris and stored in distilled water at 10 °C until used. Two parallel cuts perpendicular to the long axis of the tooth were made on each tooth. The first cut was made just below the dentino-enamel junction and the second cut was made  $2.5 \pm 0.5$  mm below the first cut. The cuts were made with a thin sectioning machine (Guillis-Hamco, Rochester NY). One wafer was obtained from each tooth and the 120 specimens were randomly divided into 12 groups of 10 specimens each.

Each specimen was centered and mounted in self polymerized acrylic resin to form acrylic cylinders 15 mm in diameter and 2.5 mm in length. The embedded tooth (with the occlusal surface towards the top) was mounted on a centering device and cylindrical holes were made using a high speed hand and copious amount of water. A pilot hole was made with a 2.2 mm round carbide bur (SSW Inc., Lakewood, NJ, USA) followed by a 3.47 mm medium coarse barrel form diamond bur (Indenco Plus 42, Int'l Dental Co, Cuernavaca Morelos, México). A new bur was used for every 5 drilled holes and the prepared specimens will be maintained at 37°C until used.

The specimens were placed on top of a glass slide with the occlusal towards the top and the teeth restored with the corresponding adhesive and bonding agent, following the manufacturer's recommendations. The corresponding composite was packed and polymerized for 20 to 40 seconds (depending on the manufacturers instructions) using a curing light with a guide tip of 11 mm with a light output above  $450 \text{ mw/cm}^2$ . Six groups were fabricated using this method. The other six groups had composite applied and polymerized but no dentin bonding agent was used.

The restored specimens were polished on both sides with a 600 grit carbide paper until there was no excess composite material outside the cavities and the thickness of the wafer was  $2.2 \pm 0.2$  mm. The specimens were stored for 7 days at 37°C and then tested.

The specimens were placed on a testing platform and a piston placed on the center of the specimen and a load applied (F) to the composite resin using a Universal Testing Machine

(Instron Model 1137, Canton, MA) at a linear displacement rate of 1 mm / min. A piston 3.18 mm in diameter designed to match the diameter of the bonded specimen was attached to the upper portion of the testing machine. The specimens were placed in a test base clamp, which was free to move to facilitate positioning under the load. The test base was then positioned so that the piston was placed perpendicular to the bonded specimen.

The force needed to displace the composite resin from the dentin preparation was calculated. The internal surface of the lateral walls of the preparation (A), diameter of the cavity (D) and the length (h) was calculated by using the following formula:  $A=\pi Dh$ . The stress required to dislodge the specimen was then be calculated by using the following formula:  $\sigma=F/A$ .

### **Statistical Analysis**

The mean values for each group were calculated and analyzed using a One Way Analysis of Variance ANOVA. When differences were found, Tukey's test was used to identify the differences at a p value of  $P < 0.05$ .

### **Results and Discussion:**

Summary of the results can be found on Table 1 and Figure 1.

There was no statistical difference in the push resistance for Premise with and without a dental adhesive (28.8 and 24.9 respectively).

There was a statistical difference in the push resistance for all the other composites with and without a dental adhesive ( $P < 0.001$ ).

The difference in bond strength between the other composites and Premise could be explained by the fact that Premise has very low polymerization shrinkage and offered more resistance to the pushout test, even though there was no adhesive on the dentin specimen.

This higher resistance to dislodgement could aid in the reduction of the gap formation at the interface between the composite/adhesive and the tooth.

Results of this novel push test suggest that Premise may reduce the formation of polymerization gaps at the interface between composite and dentin.

## References

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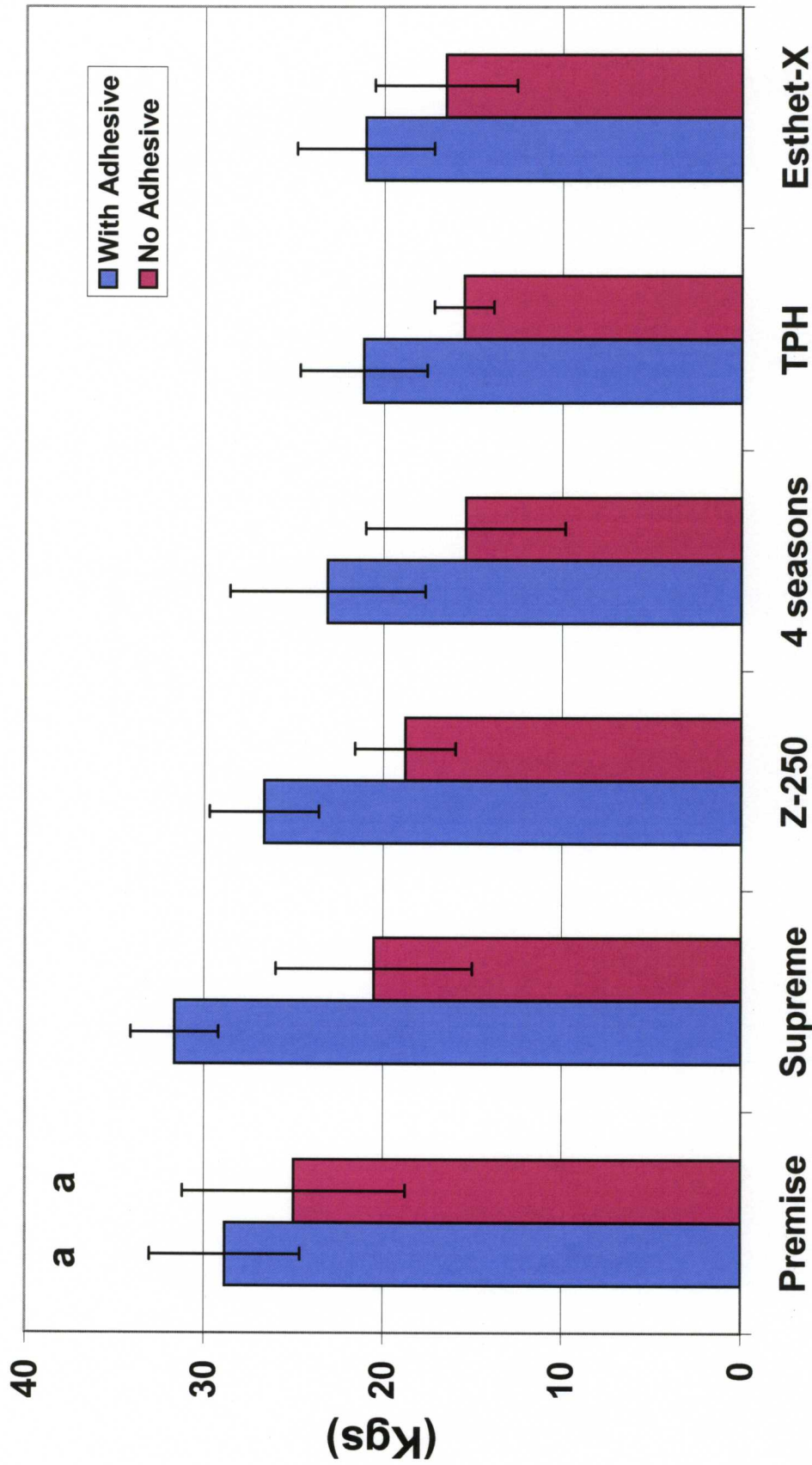
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**Figure 1.- Push-out Resistance of Several Composite Resins with and without Adhesive**



Groups connected by same letter are not statistically different. P>0.05)

**Loma Linda University School of Dentistry**  
**Center for Dental Research / Biomaterials Research Laboratory**

**Date:** July 19 /2004  
**Purpose:** Push Test Resistance  
**Material Category:** Dentin

**Investigators:** Carlos A. Muñoz, Kirk Dahlke

**Standard:** Developed by Universidad Autonoma de Mexico  
 All specimens light cured for 20 to 40 seconds.

**Table 1.- Comparison of Composites with and without Adhesive**

Composite	With Adhesive		Without Adhesive		Significance	P Value
	Mean	SD	Mean	SD		
Premise	28.82	4.21	24.964	6.23	no	0.122
Supreme	31.64	2.45	20.494	5.48	yes	<0.001
Z-250	26.64	3.05	18.764	2.81	yes	<0.001
TPH	21.13	3.55	15.518	1.67	yes	<0.001
Esthet-X	21.03	3.83	16.54	3.98	yes	0.019
4 seasons	23.12	5.46	15.408	5.57	yes	0.006