# FINAL REPORT
# A laboratory evaluation of the shear bond strength of composite resin to enamel and dentin using 3 adhesive systems. Part II- after thermocycling.


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## INTRODUCTION

Materials and techniques facilitating bonding resin composites to dentin have become an important part of modern clinical practice. A variety of dentin and enamel surface preparations have been used in combination with hydrophilic primers to increase adhesion and improve the seal of the resin to the tooth structure. More recently some adhesive systems have been developed which use a "self-etching" mechanism eliminating a rinsing step and simplifying the bonding process.

Numerous protocols have been used to screen formulas and to test and compare commercial products. Bond strength testing is a relatively fast and moderately clinically predictive laboratory method to develop data to rank the performance of dental adhesive. Every method has strengths and weaknesses and it is difficult to compare the absolute value of data collected from different labs even using similar methods. However when materials of know performance clinically are included in the testing protocols, relative performance and the handling behavior of the adhesive systems can be assessed with great value using shear bond testing.

## METHODS AND MATERIALS

### Ultradent Method

Caries free human molar were harvested cleaned and stored in a 0.5% solution of chloramines- T. Teeth were pre-mounted in tray acrylic to form a one-inch by one-inch cylinder with the tooth embedded and enamel or dentin exposed by grinding to a 600 grit surface. Using Ultradent bonding jig the adhesive as placed and polymerized according to manufacturer's instructions. The specimen was placed in the specimen former apparatus. In this method a resin cylinder 2.3 mm in diameter x 2.5 mm in height was formed using a Teflon matrix. The composite was visible light cured with a 40-second curing sequence. The specimens were stored in distilled water at 37° C for 24 hours and then thermocycled between water bath at 5°C and 55°C for 1800 cycles. The specimens were then loaded to failure in an Instron Testing Machine (Model 1123, Instron Corporation, Canton, Mass.) equipped with a custom rod to deliver a shearing force. The specimens were aligned with the shearing rod against and parallel to the bonding sites. Each resin cylinder was placed under continuous loading at 1 mm per minute until fracture occurs. Shear bond strength

was calculated in Megapascals units (MPa). The fracture sites were evaluated under light microscopy to determine the mode of failure at the sealant/enamel interface.

Statistical analysis for the dentin and enamel groups was a one-way ANOVA for dentin and enamel with a post-hoc Tukey or LSD test for pair-wise comparison.
The following table represents the groups tested:

**Enamel Substrate**

| Adhesive | Beautifil II Lot 110614 | Filtek Supreme Lot 6FW |
|---|---|---|
| Optibond All- In -One lot C02FEA | N=10 | N=10 |
| Shofu Adhesive lot 78T2060712 | N=10 | N=10 |
| Clearfil $S^3$ Bond Lot 00003A | N=10 | N=10 |

**Dentin Substrate**

| Adhesive | Beautifil II Lot 110614 | Filtek Supreme Lot 6FW |
|---|---|---|
| Optibond All- In -One lot C02FEA | N=10 | N=10 |
| Shofu Adhesive lot 78T2060712 | N=10 | N=10 |
| Clearfil $S^3$ Bond Lot 00003A | N=10 | N=10 |

**RESULTS**

Mean shear bond strength in Megapascals (MPa) for enamel and dentin is reported in the tables below:

**Enamel Substrate**

| Adhesive | Beautifil II | Filtek Supreme |
|---|---|---|
| Optibond All- In -One | 25.7 ± 5.9 | 35.6 ± 5.8 |
| Shofu Adhesive | 24.1 ± 4.5 | 29.9 ± 6.7 |
| Clearfil $S^3$ Bond | 22.2 ± 3.6 | 28.2 ± 4.1 |

**Dentin Substrate**

| Adhesive | Beautifil II | Filtek Supreme |
|---|---|---|
| Optibond All- In -One | 35.8 ± 8.4 | 44.8± 6.7 |
| Shofu Adhesive | 20.9 ± 6.3 | 29.3 ± 5.7 |
| Clearfil $S^3$ Bond | 23.7 ± 6.2 | 28.1 ± 5.4 |

The adhesion values for the Beautifil II specimens were generally numerically lower than the values generated after 24 hours of static storage. However the ranking and statistical relationship among the adhesives was similar except for the Beautifil enamel groups where the Optibond All in One material was now similar to the other two adhesives. For the other enamel and dentin and using both restorative materials OptiBond All-In-One generated the highest values ($p<0.05$) except for the Filtek enamel groups where Optibond was statistically greater than Clearfil $S^3$ but similar to the Shofu adhesive. The Shofu system and the Clearfil $S^3$ system generated statistically similar values for all groups tested. Groups connected by a line were considered statistically similar ($p<0.01$).

**CONCLUSIONS**

The results of shear bond strength testing after thermocycling was similar to data generated with static storage except that the Beautifil groups were numerically lower for all adhesives and substrates. These data also indicated that to both enamel and dentin the OptiBond All-In-One system generated statistically higher bond values to dentin and enamel. The Shofu self-etching system generated statistically similar shear bond strength values to both enamel and dentin compared to the Clearfil $S^3$ system. The lower values may be due to the extended storage and cycling effects on the beautiful material, as shear bond strength values (numerically) can be affected by changes in the modulus of the restorative material used in

the testing. If water sorption occurred in the Beautifil II material, a slightly lower modulus may have contributed to the lower values for shear bond strength.

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