A LABORATORY EVALUATION OF THE SHEAR BOND STRENGTH OF RESIBOND AND PRIME AND BOND 2.1 TO DENTIN

PRINCIPAL INVESTIGATOR

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INTRODUCTION

Materials and techniques facilitating bonding resin composites to dentin have become an important part of modern clinical practice. A new hydrophilic adhesive system for bonding composite resin to tooth structure has been developed by B.J.M. Laboratories. The purpose of this laboratory study was to evaluate the shear bond strength of this new adhesive system and dentin.

METHODS AND MATERIALS

The shear bond strength of light cured composite resin to dentin was determined as follows: Flat bonding sites were prepared on the buccal surfaces of 20 freshly extracted teeth by grinding the teeth on a water-cooled abrasive wheel exposing dentin (Ecomet III Grinder, Ltd., Lake Bluff, Ill 60044) to 400 grit. The teeth were divided into 2 groups of ten each and bonding specimens were made with Prime and Bond 2.1 (lot 961023) and B.J.M. Laboratories prototype primer/adhesive (lot 79017MP2) A "moist" dentin technique was used where excess moisture is blotted from the surface without the use of an air stream. 38 % phosphoric acid was used to condition the dentin surface (Pulpdent lot C90395). Detailed instructions for each system were as follows:

Prime and Bond 2.1

1. Dentin surfaces were acid treated for 20 seconds and water rinsed.
2. Excess moisture was blotted from the surface. The surface appeared visibly moist.
3. A microbush was used to place ample amounts of the adhesive to the surface. After 20 seconds the surface was air dried for 5 seconds. If the surface

appeared incompletely coated additional material was applied. The surface was light cured for 10 seconds.

4. A second application of the adhesive was applied followed by air drying and light curing for 10 seconds.
5. The composite resin was applied and light polymerized.

B.J.M. Experimental Primer/Adhesive

1. Dentin surfaces were acid treated for 10 seconds and water rinsed.
2. Excess moisture was blotted from the surface. The surface had no visible moisture on the surface.
3. A microbush was used to place ample amounts of the adhesive to the surface. After 20 seconds the surface was vigorously air dried for a least 15 seconds or until no visible movement of the resin was noted on the surface. If the surface appeared incompletely coated additional material was applied. The adhesive was light cured for 20 seconds.
4. A second application of the adhesive was applied followed by air drying and light curing for 20 seconds.
5. The composite resin was applied and visible light polymerized.

Cylinders of composite resin (TPH lot 9607022) were bonded to each dentin bonding site. A gelatin capsule technique was used in which a resin cylinder 4.5 mm in diameter was used. Composite was loaded in the capsules approximately 2/3 full and then cured in a Triad 200 curing unit (Trubyte Division, Dentsply International, York PA 17405) for one minute. Additional composite was added to slightly overfill the capsules. The capsules were firmly seated against the bonding sites and excess resin removed with a dental explorer. The resin was visible light cured with three 20 second curing sequences each from opposite

sides of the capsule at an angle of 45 degree to the tooth surface. The specimens were additionally cured for 20 seconds from the ends of the cylinders.

The 20 specimens were stored in distilled water at 37 °C for 24 hours. Before debonding, the teeth were mounted in one inch phenolic rings with acrylic. The specimens were placed in an Instron Testing Machine(Model 1123, Instron Corporation, Canton, Mass.) equipped with a chisel-shaped rod to deliver a shearing force. The specimens were aligned with the shearing rod against and parallel to the bonding sites. Each cemented cylinder was placed under continuous loading at 5 mm per minute until fracture occurred. Shear bond strengths were calculated in megapascals units (MPa). The fracture sites were also examined to determine where failure occurred during the debonding procedure.

RESULTS

Mean shear bond strengths were:

B.J.M. Primer/Adhesive	Prime and Bond 2.1
20.7 ± 5.0 MPa	23.8 ± 3.6 MPa

A student's t-test revealed no statistical difference at the 5% confidence level ($p>0.05$).

DISCUSSION AND CONCLUSIONS

The reformulated Primer/adhesive from B.J.M. Laboratories is significantly better in terms of bond strength than the material tested in our lab last year. The

values are similar to Syntac single component and Optibond Solo, two other one bottle systems recently tested in our lab. While not statistically different in this study, Prime and Bond' 2.1's values were numerically higher and we have seen these values to be remarkably consistent between 22.5 and 24.5 MPa in the last year across several lots of the material. It is possible that testing a large numbers of specimens could confirm a true statistical equality, but I think this pilot study confirms the viability of B.J.M. material competing, a least with respect to bond strength, with other one-bottle primer/adhesives.

The B.J.M. material at first glance seems very similar to Prime and Bond 2.1, but there are several key differences. First this material's solvent system is markedly less volatile than Prime and Bond's. This is an advantage as there is less chance for degradation of the material in the bottle, but it does require that care be taken to assure adequate air drying to remove all the solvent. This has never been an issue with Prime and Bond. The description of the technique for air drying is the methods section above. I would recommend that the instructions reflect at least a 15 second *vigorous* blast of air after each application. Visually it should be apparent that no more solvent is flashing from the surface and this is associated with the air no moving the resin on the surface. The instructions should be written to include both guidelines for the clinician.

The B.J.M. material has a greater film thickness than Prime and Bond, although I can make no comment as to the actual thickness. Prime and Bond 2.1's film thickness is about 10 microns with 2 coats. The experimental material from B.J.M. subjectively is thinner than Optibond Solo and 3M's new one-bottle adhesive, SingleBond. The clinical effects of this material's film thickness should be determined.

The bond strength testing of the B.J.M. Laboratories primer/adhesive suggests it will be a viable candidate to compete in the very competitive adhesive market.

However, I would suggest that further in-vitro work be done to determine effective film thickness, microleakage and compatibility with cement systems. In addition clinical verification of this material's clinical performance is strongly suggested.

Attached are the data sheets for the specimens of B.J.M.'s material and Prime and Bond 2.1 which I broke. The statistical analysis of the 2 groups is also attached. In addition the raw data for 8 specimens made and broken by Dr. Zalsman in our lab are included. These were not factored into the statistical analysis.

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SHEAR BOND STRENGTH

	% CHART	Kg LOAD	DIAMETER	RADIUS	MPa	FAILURE SITE
1	81.0	50	4.50	2.25	24.97	Adhesive
2	101.5	50	4.50	2.25	31.29	Cohesive
3	69.0	50	4.50	2.25	21.27	Adhesive
4	85.8	50	4.50	2.25	26.45	Cohesive
5	60.8	50	4.50	2.25	18.74	Adhesive
6	71.3	50	4.50	2.25	21.98	Adhesive
7	76.5	50	4.50	2.25	23.59	Adhesive
8	75.0	50	4.50	2.25	23.12	Adhesive
9	67.2	50	4.50	2.25	20.72	Adhesive
10	85.2	50	4.50	2.25	26.27	Adhesive
	MEAN				23.84	
	STANDARD DEVIATION				3.59	

SHEAR BOND STRENGTH: DENTIN
24 hour SHEAR BOND STRENGTH

MATERIAL: Prime and Bond 2.1

1. 15 sec. 38% phosphoric acid treatment
2. rinse and blot dry
3. coat with adhesive, wait 20 sec. dry, recoat if needed
4. cure 10 sec.
5. repeat coat and cure
6. gel-cap with TPH

SHEAR BOND STRENGTH

	% CHART	Kg LOAD	DIAMETER	RADIUS	MPa	FAILURE SITE
1	49.0	50	4.50	2.25	15.11	Adhesive
2	89.2	50	4.50	2.25	27.50	Cohesive
3	95.8	50	4.50	2.25	29.54	Cohesive
4	62.4	50	4.50	2.25	19.24	Adhesive
5	65.2	50	4.50	2.25	20.10	Adhesive
6	57.0	50	4.50	2.25	17.57	Adhesive
7	79.2	50	4.50	2.25	24.42	Cohesive
8	69.8	50	4.50	2.25	21.52	Adhesive
9	50.0	50	4.50	2.25	15.42	Adhesive
10	54.0	50	4.50	2.25	16.65	Adhesive
	MEAN				20.71	
	STANDARD DEVIATION				5.02	

SHEAR BOND STRENGTH: DENTIN
24 hour SHEAR BOND STRENGTH

MATERIAL:B.J.M. Laboratories lot # 79017MP2

1. 10 sec. 38% phosphoric acid treatment
2. rinse and blot dry
3. coat with adhesive, wait 30 sec. dry, recoat if needed
4. cure 40 sec.
5. repeat coat and cure
6. gel-cap with TPH

SHEAR BOND STRENGTH

	% CHART	Kg LOAD	DIAMETER	RADIUS	MPa	FAILURE SITE
1	55.1	50	4.50	2.25	16.99	Adhesive
2	64.2	50	4.50	2.25	19.79	Adhesive
3	73.0	50	4.50	2.25	22.51	Adhesive
4	57.8	50	4.50	2.25	17.82	Adhesive
5	83.7	50	4.50	2.25	25.80	Cohesive
6	96.8	50	4.50	2.25	29.84	Cohesive
7	57.8	50	4.50	2.25	17.82	Adhesive
8	46.1	50	4.50	2.25	14.21	Adhesive
	MEAN				20.60	
	STANDARD DEVIATION				5.16	

SHEAR BOND STRENGTH: DENTIN
24 hour SHEAR BOND STRENGTH

MATERIAL: B.J.M. Laboratories lot #79017MP2-Barry Zalsman

1. 10 sec. 38% phosphoric acid treatment
2. rinse and blot dry
3. coat with adhesive, wait 30 sec. dry, recoat if needed
4. cure 20 sec.
5. repeat coat and cure
6. gel-cap with TPH

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      2.000         10        23.840         3.588

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