

**The Shear Bond Strength of Dental Resin Cements
to
Dentin and Enamel**

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Introduction

This study aimed to determine the shear bond strength of four resin cements to dentin and enamel. The cements included three self adhesive cements and one resin cement which required a dentin bonding agent.

Materials

Cement	Manufacturer	Lot Number
Unicem in "Clicker"	3M-Espe	315751
Maxcem Clear	Kerr SDS	2950845
Maxcem Elite	Kerr SDS	NA
Panavia F2.0 Primer II (a and b)	Kuraray	00152A 00297A 00249A 00126A

Methods

Extracted teeth were obtained from the UT department of Oral Surgery, and stored in water with 0.02% NaOCl. The teeth were embedded in denture acrylic (Metatone, Memphis Materials Inc) in cylinders of 2.5 cm diameter and 3 cm length.

After embedding, the enamel is exposed by slicing the cylinder with a diamond wafering saw (Buehler Isomet 1204), until enamel is exposed. (This method is similar to the method published by CRA news).

After the tests on enamel bond are completed, the cylinder is sliced again to expose the dentin, and then the specimen can be used for the dentin bonding test.

The method for testing the shear bond test is identical for dentin and enamel, thus the following procedures will apply to both tests.

The cement will be applied according to the manufacturers' instructions, including any bonding agents if they are required.

At first any applicable bonding agents will be placed and cured (if indicated).

Then the specimen is placed in the jig (Ultradent Bonding Assembly) and the cement is applied to the tooth. A thin layer of cement will be placed (< 1mm thick) and agitated with a bristle brush for 0.5 min. The mold is then filled with more cement. The entire assembly was placed in a dark chamber at 100% relative humidity and 37 °C for 1 hour. The specimen was then removed from the mounting jig, and placed in deionized water. All specimens of one experimental group were stored in an incubator at 35° C for 24 hrs.

The specimens were then placed in an Ultradent testing jig to hold the specimen in place, and tested in an Universal Testing Machine (Instron 5567) using Bluehill software for computer based data collection. The hollow notch method of Ultradent was used, with the anvil having a cut out of 2.4 mm diameter. The crosshead speed was 2 mm/min. Shear stress and shear load at fracture were recorded. An elastic modulus calculation from software based curve fitting is also recorded.

Six specimens will be made for each cement, for both dentin and enamel.

Results

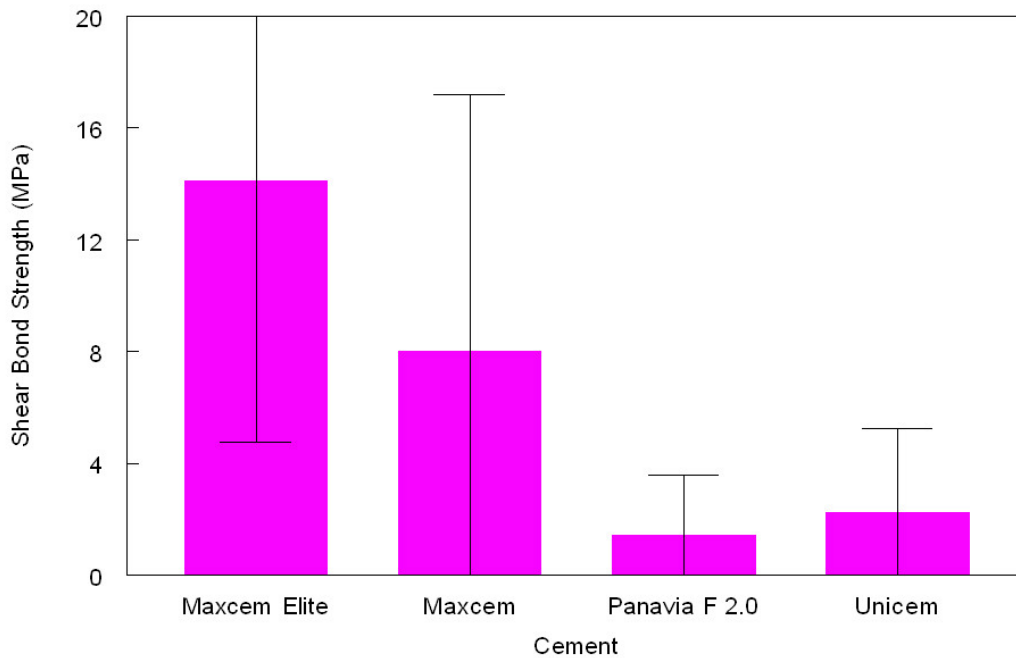
SHEAR BOND TEST DATA
STRENGTH IN Mpa
ENAMEL
FEBRUARY 2008

CEMENT	SP #1	SP #2	SP #3	SP #4	SP #5	SP #6	MEAN	SD	RANGE
MAXCEM ELITE	0.19	28.44	17.17	8.88	14.48	15.53	14.11	9.36	28.25
MAXCEM REG	5.03	13.89	0.30	5.47	23.72	0	8.00	9.20	23.72
PANAVIA F 2.0	3.90	4.56	0	0	0	0	1.41	2.19	4.56
UNICEM	0.35	7.89	5.14	0	0	0	2.23	3.43	7.89

SHEAR BOND TEST DATA
STRENGTH IN Mpa
DENTIN
FEBRUARY 2008

CEMENT	SP #1	SP #2	SP #3	SP #4	SP #5	SP #6	MEAN	SD	RANGE
MAXCEM ELITE	6.78	24.98	8.31	0.04	0.01	13.01	8.86	9.36	24.97
MAXCEM REG	4.00	5.64	26.92	12.69	0	0	8.25	10.31	26.92
PANAVIA F 2.0	2.92	0.16	0.01	15.47	0	0	3.10	6.20	15.46
UNICEM	1.19	1.75	8.35	12.19	0	0	4.30	4.85	12.19

Shear Bond Strength of 4 Cements to Enamel



Statistical analysis

The analysis of all the data will use ANOVA and the Tukey-Kramer HSD test for multiple group comparison.

One-way Analysis of SBS By Cement

Oneway Anova Summary of Fit

Rsquare	0.399979
Adj Rsquare	0.309976
Root Mean Square Error	6.860434
Mean of Response	6.455833
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cement	3	627.4866	209.162	4.4441	0.0151
Error	20	941.3110	47.066		
C. Total	23	1568.7976			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Maxcem	6	8.0683	2.8008	2.226	13.911
Maxcem Elite	6	14.1150	2.8008	8.273	19.957
PanaviaF2.0	6	1.4100	2.8008	-4.432	7.252
Unicem	6	2.2300	2.8008	-3.612	8.072

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Maxcem	6	8.0683	9.16836	3.7430	-1.553	17.690
Maxcem Elite	6	14.1150	9.35933	3.8209	4.293	23.937
PanaviaF2.0	6	1.4100	2.19431	0.8958	-0.893	3.713
Unicem	6	2.2300	3.43385	1.4019	-1.374	5.834

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

	q*	Alpha				
	2.79894	0.05				
Abs(Dif)-LSD			Maxcem Elite	Maxcem	Unicem	PanaviaF2.0
Maxcem Elite			-11.086	-5.040	0.799	1.619
Maxcem			-5.040	-11.086	-5.248	-4.428
Unicem			0.799	-5.248	-11.086	-10.266
PanaviaF2.0			1.619	-4.428	-10.266	-11.086

Positive values show pairs of means that are significantly different.

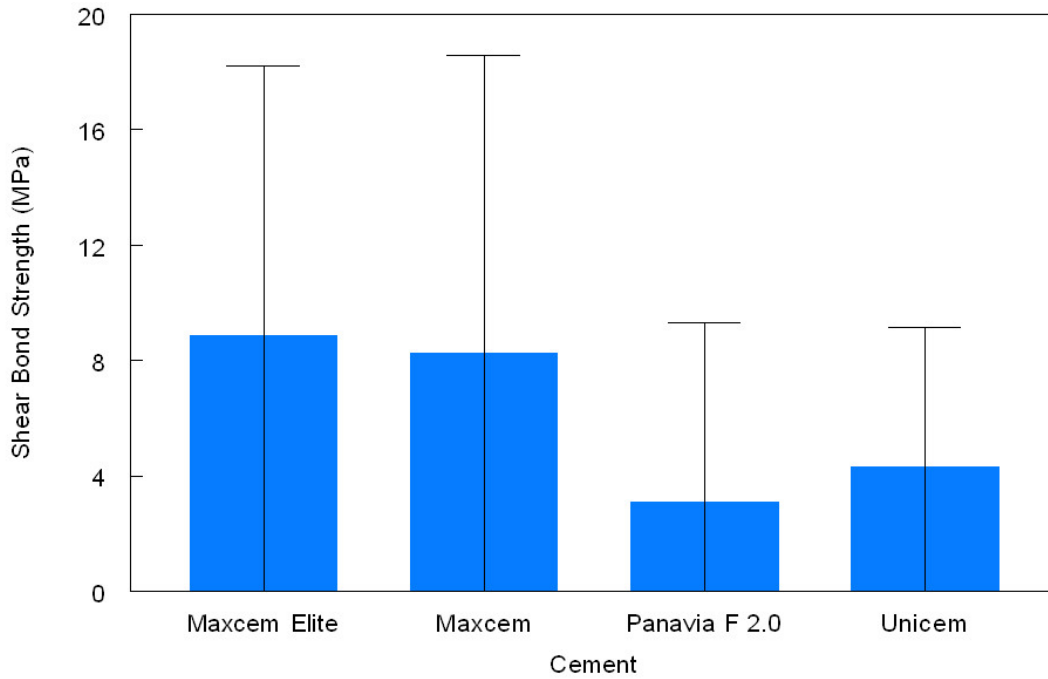
Level		Mean
Maxcem Elite	A	14.115000
Maxcem	A B	8.068333
Unicem	B	2.230000
PanaviaF2.0	B	1.410000

Levels not connected by same letter are significantly different.

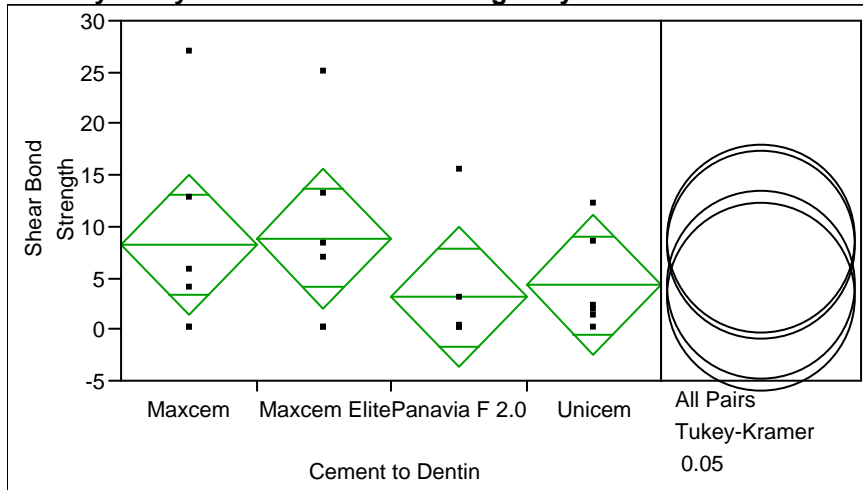
Level	- Level	Difference	Lower CL	Upper CL	Difference
Maxcem Elite	PanaviaF2.0	12.70500	1.6188	23.79124	
Maxcem Elite	Unicem	11.88500	0.7988	22.97124	
Maxcem	PanaviaF2.0	6.65833	-4.4279	17.74457	
Maxcem Elite	Maxcem	6.04667	-5.0396	17.13290	
Maxcem	Unicem	5.83833	-5.2479	16.92457	
Unicem	PanaviaF2.0	0.82000	-10.2662	11.90624	

Maxcem Elite is statistically significant different from all the other cements for bonding to enamel .

Shear Bond Strength of 4 Cements to Dentin



Oneway Analysis of Shear Bond Strength By Cement to Dentin



Oneway Anova Summary of Fit

Rsquare	0.102868
Adj Rsquare	-0.0317
Root Mean Square Error	7.984847
Mean of Response	6.110417
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cement to Dentin	3	146.2136	48.7379	0.7644	0.5273
Error	20	1275.1557	63.7578		
C. Total	23	1421.3693			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Maxcem	6	8.20833	3.2598	1.409	15.008
Maxcem Elite	6	8.85500	3.2598	2.055	15.655
Panavia F 2.0	6	3.09333	3.2598	-3.706	9.893
Unicem	6	4.28500	3.2598	-2.515	11.085

Std Error uses a pooled estimate of error variance

Means Comparisons







Comparisons for all pairs using Tukey-Kramer HSD

	q*	Alpha				
	2.79894	0.05				
Abs(Dif)-LSD	Maxcem Elite	Maxcem	Unicem	Panavia F 2.0		
Maxcem Elite	-12.903	-12.257	-8.333	-7.142		
Maxcem	-12.257	-12.903	-8.980	-7.788		
Unicem	-8.333	-8.980	-12.903	-11.712		
Panavia F 2.0	-7.142	-7.788	-11.712	-12.903		

Positive values show pairs of means that are significantly different.

Level		Mean
Maxcem Elite	A	8.8550000
Maxcem	A	8.2083333
Unicem	A	4.2850000
Panavia F 2.0	A	3.0933333

Levels not connected by same letter are significantly different.

Level	- Level	Difference	Lower CL	Upper CL	Difference
Maxcem Elite	Panavia F 2.0	5.761667	-7.1416	18.66492	
Maxcem	Panavia F 2.0	5.115000	-7.7883	18.01825	
Maxcem Elite	Unicem	4.570000	-8.3333	17.47325	
Maxcem	Unicem	3.923333	-8.9799	16.82659	
Unicem	Panavia F 2.0	1.191667	-11.7116	14.09492	
Maxcem Elite	Maxcem	0.646667	-12.2566	13.54992	

There are no statistically significant differences between the cements for bonding to dentin.