

**A LABORATORY EVALUATION  
OF AN  
ADHESIVE RESIN CEMENT**

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**Creighton**  
**UNIVERSITY**  
**Medical Center**

**PRINCIPAL INVESTIGATOR**

Mark A. Latta, D.M.D., M.S.  
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## INTRODUCTION

Achieving a durable bond between resin materials and non-precious crown and bridge alloys has proved to be a challenge. Current practice for facilitating metal bonding includes grit blasting with 50 micron alumina, and tin plating. These procedures are not convenient for *in-vivo* applications and a chemical adhesion promoter which can generate high bond strengths is desirable. This high bond strength is desirable for both conventional and acid-etched retained prostheses.

Itena has developed an adhesive resin cement for multi-purpose crown and bridge applications. The purpose of this laboratory study is to evaluate this material in a variety of clinically relevant situations.

## METHODS AND MATERIALS

Ni-Cr-Be metal (Rexillum III) specimens were cast to approximate dimensions of 1 cm x 1 cm x 1mm. The cast wafers were potted in one inch phenolic rings with epoxy material. Ni-Cr-Be metal posts (Rexillum III) were cast approximately 3.5 mm in diameter and cut to approximately 5mm in length. The end of the Rexillum III cylinders were sandblasted with 50  $\mu$  aluminium oxide (Micro Etcher, Danville Engineering, Danville, CA) prior to the bonding procedure. The exposed flat metal surfaces mounted in the phenolic rings (n=48) were ground to 600 grit on a water-cooled abrasive wheel. 24 of the non-precious metal specimens were then grit blasted with 50 $\mu$  aluminium oxide. The Rexillum rods were cemented to the polished and grit blasted specimens with the prototype cement and with Panavia 21 (Kuraray America Inc.) cement. Equal amounts of each cement were mixed, placed on the ends of the metal rod and placed with finger pressure to the metal plate specimen. Excess cement was removed with a dental explorer and Oxyguard was placed over the cement margin around each metal post and the cement was allowed to set for 10 minutes. Following rinsing of the Oxyguard, the specimens were placed in deionized water at 37°C and stored for 24 hours. 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 cement or metal cylinder was placed under continuous loading at 5 mm per minute until fracture occurred. Shear bond strengths were calculated in megapascals units (MPa).

## RESULTS

Mean 24 shear bond strengths (SBS) for the groups are reported in the following table:

TEST CONDITIONS	MEAN SBS (MPa)
Panavia 21 - polished	16,5 ± 5,1
TotalCem - polished	27,5 ± 7,6
Panavia 21 - grit blasted	43,8 ± 4,8
TotalCem - grit blasted	43,2 ± 4,9

## DISCUSSION

The prototype cement was equally effective in generating high bond strengths of Rexillum to Rexillum when the substrate was air abraded with 50 micron aluminium oxide. It appears to be equal to or better than Panavia 21 in generating bond strength to polished Rexillum when applied using the Oxyguard product used with Panavia 21.

The results of this study indicate that the Itena cement, TotalCem, has the potential to be an easy to use and effective adhesive resin cement. However, the long term water stability of this cement remains to be determined as well as its clinical performance.

## SHEAR BOND STRENGTH

	% CHART	Kg LOAD	DIAMETER	RADIUS	MPa	FAILURE SITE
1	72	50	3,30	1,65	41,28	Adhesive
2	72,6	50	3,30	1,65	41,62	Adhesive
3	84,8	50	3,30	1,65	48,61	Adhesive
4	95	50	3,30	1,65	54,46	Adhesive
5	70	50	3,30	1,65	40,13	Adhesive
6	74,2	50	3,30	1,65	42,54	Adhesive
7	68,2	50	3,30	1,65	39,10	Adhesive
8	65,8	50	3,30	1,65	37,72	Adhesive
9	79,1	50	3,30	1,65	45,35	Adhesive
10	75,7	50	3,30	1,65	43,40	Adhesive

MEAN 43,42  
STANDARD DEVIATION 4,98

SHEAR BOND STRENGTH: DENTIN  
**24 HOUR SHEAR BOND STRENGTH**

Material: Rexillum to grit blasted Rexillum with Itena prototype cement, TotalCem

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1	83	50	3,30	1,65	47,58	Adhesive
2	73,5	50	3,30	1,65	42,14	Adhesive
3	75,6	50	3,30	1,65	43,34	Adhesive
4	70	50	3,30	1,65	40,13	Adhesive
5	80,8	50	3,30	1,65	46,32	Adhesive
6	61,5	50	3,30	1,65	35,26	Adhesive
7	82	50	3,30	1,65	47,01	Adhesive
8	70,7	50	3,30	1,65	40,53	Adhesive
9	75,5	50	3,30	1,65	43,28	Adhesive
10	91,3	50	3,30	1,65	52,34	Adhesive

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4	18,2	50	3,30	1,65	10,43	Adhesive
5	21,2	50	3,30	1,65	12,15	Adhesive
6	28,2	50	3,30	1,65	16,17	Adhesive
7	48	50	3,30	1,65	27,52	Adhesive
8	21,7	50	3,30	1,65	12,44	Adhesive
9	23,8	50	3,30	1,65	13,64	Adhesive
10	35,3	50	3,30	1,65	20,24	Adhesive

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3	33,4	50	3,30	1,65	19,15	Adhesive
4	24	50	3,30	1,65	13,76	Adhesive
5	56,5	50	3,30	1,65	32,39	Adhesive
6	55	50	3,30	1,65	31,53	Adhesive
7	55,1	50	3,30	1,65	31,59	Adhesive
8	60,5	50	3,30	1,65	34,68	Adhesive
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10	61,2	50	3,30	1,65	35,09	Adhesive

MEAN 27,45  
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SHEAR BOND STRENGTH: DENTIN  
**24 HOUR SHEAR BOND STRENGTH**

Material: Rexillum to Polished Rexillum with Itena prototype  
cement, TotalCem

New Dual Cure, Multipurpose, Adhesive Resin Cement,  
Harry Golfish, H. Dodiuk, A.Valdman and I Eppelbaum  
(Itena laboratories, Rafael Armament Development Authority)

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The objective of the study was aimed at developing a new dental cement which is characterized by superior adhesion to dentine, enamel, precious and non precious cast alloys, porcelain, acrylics and amalgam. Furthermore, the newly developed adhesive composition was designed to be simple to use. When bonding to cast alloys no primers are necessary. Since the cement is dual cured, it can also be used to veneer alloys. When bonding orthodontic brackets, etching of the enamel is not necessary. Thus, upon removal of the bracket, no damage is caused to the enamel surface.

TotalCem is comprised of acrylic multifunctional monomers, coupling agents containing both hydrophilic and hydrophobic groups, which provide high shear bond strength, sufficiently high durability and high bio-compatibility. The system also contains a variety of fillers responsible for the high compressive and hardness properties. The shear bond strength was measured using the Bencor Multi-T system (Danville Engineering Inc.). The force required to fracture the samples was determined using a Lloyd mechanical tester (model LRIOK, Lloyd instruments Ltd.). Each cement or metal cylinder was placed under continuous loading at 5 micron grit blasted Ni-Cr-Be metal (Rexillum III) was  $45.245.7$  (S.D.) MPa, to 600 grit polished Rexillum III  $29.2 \pm 6.9$  MPa, and to unetched enamel  $15.6 \pm 4.7$  MPa. The control group Panavia 21 (Kuraray America Inc.) gave  $45.6 \pm 7.1$  MPa  $12.8 \pm 4.9$  MPa and  $10.9 \pm 2.8$  MPa respectively. The results of this study indicate that the TotalCem adhesive resin cement has the potential to be an easy to use and effective adhesive resin cement. However its clinical performance is still to be determined.

Laboratory: Paris V - Montrouge

Date: April 2006

Tested materials: Self-adhering luting cements

Test: Shear test

Substrates: Sandblasted (50 microns alumina) micro-hybrid composite (TETRIC CERAM-Vivadent) luted on coronal human dentin

Surface treatment: no

Storage: 20 minutes into water: early SBT

Operator: Dr. Wladimir Aranda

Material	Specimen nb	Dentin SBS mean (MPa)	S.D. (MPa)	coef. Var. (%)
TotalCem	10	13,241	1,84	13,90
Maxcem	10	9,548	1,322	13,85
Unicem	10	14,98	2,16	14,42

Statistics: ANOVA 1 and Fischer's PLSD test

comparison	mean Diff.	crit. Diff.	p values	
TotalCem, Maxcem	3,693	1,658	<,0001	S
TotalCem, Unicem	-1,739	1,658	0,0405	S
Maxcem, Unicem	-5,432	1,658	<,0001	S

*Final Report*

**LABORATORY EVALUATION**

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**24 hour Shear Bond Strength of Ceramic to Dentin Using Three  
Cement Systems**

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**SPONSOR / MONITOR**

Mr. Bill McHale  
Premier Dental Products  
Itena Laboratories  
Harry Golfish

September 27, 2006

## **INTRODUCTION**

Adhesive cement systems are preferentially used for luting all-ceramic restorative materials for maximizing longevity of the restoration. The purpose of this laboratory study was to evaluate the 24 hour shear bond strength of Empress rods cemented to dentin using three adhesive cement systems in their light and auto cured modes.

## **METHODS AND MATERIALS**

The bonded assemblies were prepared by wet grinding human teeth on a lapidary wheel with 600 grit silicon carbide paper exposing dentin. The teeth were pre-embedded in acrylic.

The tooth surfaces were conditioned according to manufacturer's instructions. Empress cylinders were cast approximately 2.4 mm in diameter and cut to approximately 5mm in length. The ends of the cylinders were treated with hydrofluoric acid and silanated. The cylinders were placed using finger pressure on the dentin surfaces following tooth conditioning and cement mixing according to manufacturer's instructions. For the light cured groups specimens were light-cured (Astralis® 10 Halogen Light) twice for 20 seconds from opposite sides at a 45 degree angle to the ceramic rod. Ten bonded assemblies with each cement were prepared. For the auto-cured specimens, the bonded assemblies were placed in a 37 degree oven and allowed to cure in air for 10 minutes. They were then stored in water until debonding.

The specimens were placed in an Instron Testing Machine (Model 1123, Instron Corporation, Canton, Mass.) equipped with a custom cross-head member designed to fit the shape of the ceramic cylinder. The specimens were aligned with the shearing member against and parallel to the bonding sites. Each cemented cylinder was placed under continuous loading at 1 mm per minute until failure occurred. Shear bond strength was calculated in Megapascals units (MPa). The fracture sites will be examined to determine where failure occurs during the debonding procedure.

The cements tested were:

<b>Group</b>	<b>Cement</b>	<b>Primer</b>	<b>Manufacturer</b>
I	MaxCem	None	Kerr SDS
II	UniCem	None	3M-Espe
III	TotalCem	None	Itena

## RESULTS

24 hour Mean Shear Bond Strength in MegaPascals (MPa) are reported in the table below:

Cement	Light cured	Auto-cured
Unicem	10.4 ± 4.9	7.6 ± 3.7
Itena	8.4 ± 3.4	5.0 ± 2.2
Maxcem	4.8 ± 2.1	1.9 ± 1.2

## CONCLUSION

Unicem and the Itena prototype generated statically similar values to dentin after 24 hours. (ANOVA, post-hoc Tukey's  $p < 0.05$ ). Maxcem generated the lowest values under both curing conditions.

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6	74,2	50	3,30	1,65	42,54	Adhesive
7	68,2	50	3,30	1,65	39,10	Adhesive
8	65,8	50	3,30	1,65	37,72	Adhesive
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10	75,7	50	3,30	1,65	43,40	Adhesive

MEAN 43,42  
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**24 HOUR SHEAR BOND STRENGTH**

Material: Rexillum to grit blasted Rexillum with Itena prototype cement, TotalCem

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