An Evaluation of the Shear Bond Strength of Four Universal Cements to Five Prosthodontic Substrates

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Introduction

The objective of this study was to determine the shear bond strength of four self-adhesive resin cements to five different substrates used in making fixed prosthodontic restorations. The cements included three universal cements and one cement that required a provided bonding agent.

The substrates were ceramic blocks used in Cerec CAD/CAM machines (Sirona Dental) a Zirconia substrate (Lava 3M Espe), cast gold (ADA type III) and Rexillium, a base metal alloy.

There were six specimens in each group of one cement and one substrate.

Substrate	Brand	Manufacturer
Ceramic	e.max CAD Cerec	Ivoclar Vivadent
Ceramic	Vitablock Cerec	Vita/Vident
Zirconia	Lava	3M Espe
Noble metal	Gold Type III	Ney Dentsply
Base metal	Rexillium	Jeneric Pentron (Pentron Alloys)

Surface treatments for the ceramic substrates followed the instructions of the ceramic manufacturers.

The cements are listed in the table below.

Cement	Manufacturer	Lot Number
Unicem in “Clicker”	3M Espe	315751
Maxcem	Kerr SDS	2950845
Maxcem Elite	Kerr SDS	NA
Panavia F2.0 ED Primer II (A and B)	Kuraray	00152A 00297A 00249A 00126A

Methods

Surface Preparation

Surface preparation of the metal specimens, both gold and Rexillium, after casting and divesting, consisted of:

- Steam cleaning the alloys
- Embedding the specimens in acrylic
- Polishing the surface with 600-grid sandpaper under water
- Drying the specimens
- Sandblasting the entire surface at a pressure of 60 psi
- Rinsing with deionized water and drying

Surface preparation of the ceramic blocks (e.max CAD and Vitablock) consisted of:

- Sectioning the blocks into 3 mm thick slices with a diamond blade wafering saw
- Embedding the slices in acrylic
- Polishing the surface with 600-grid sandpaper under water
- Rinsing and drying

- Etching for 60 seconds with 9% hydrofluoric acid
- Rinsing with deionized water and drying

Surface preparation of the Zirconia specimens was as follows:
- Embedding the specimens in acrylic
- Polishing the surface with 600-grid sandpaper under water
- Sandblasting the surface at a pressure of 40 psi
- Rinsing and drying

Cementing procedure for self-adhesive resin cements
For self-adhesive resin cements, the ceramic and metal specimens received no further treatment and were placed in the shear bond mounting jig (Ultradent). The cement was placed in the aperture and allowed to dark cure (dry) in an incubator at 37º C and 100% humidity for 1 hour. After that time, specimens were removed from the jig and placed in deionized water for 24 hours before testing in the testing machine (Instron). The dark cure and water storage was applied to all specimens.

Cementation procedure for Panavia F2.0
The ceramic surfaces were etched with phosphoric acid for 60 seconds, rinsed, dried and then the porcelain primers were mixed and applied to the ceramic surfaces. The specimen was air dried, placed in the jig and then cement was applied.

For the metal substrates, the metal primer from Kuraray was used with the Panavia F2.0.

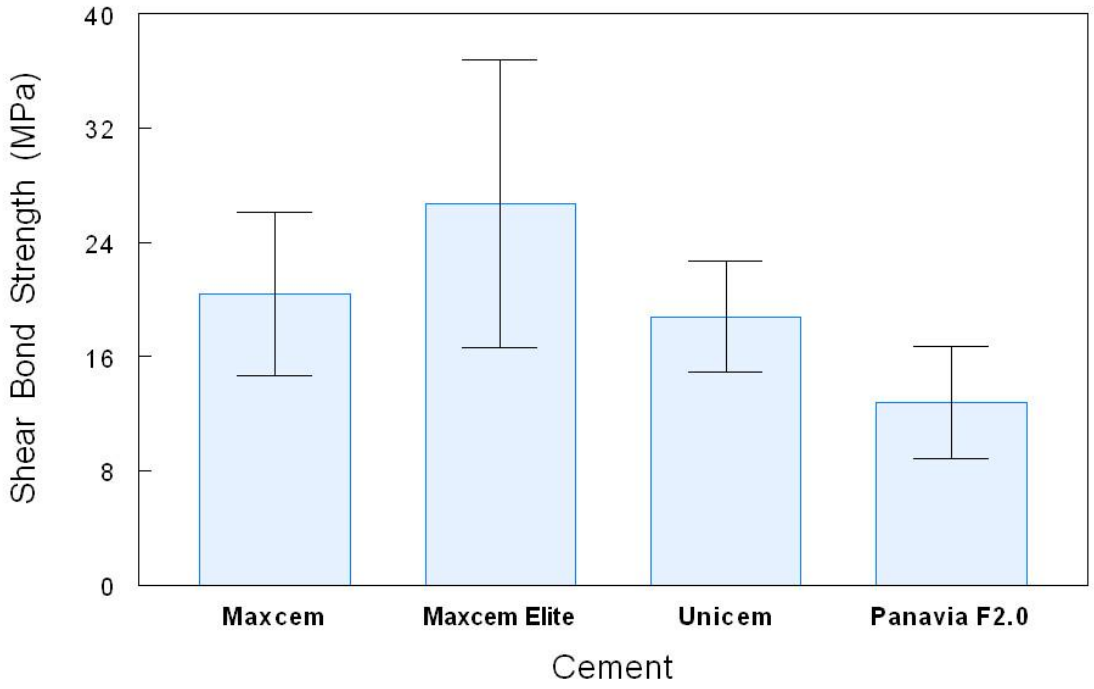
Shear bond testing
The specimens were placed in a holding jig and placed under the hollow notch anvil in the Instron. The shear rate was set at 2 mm/min.

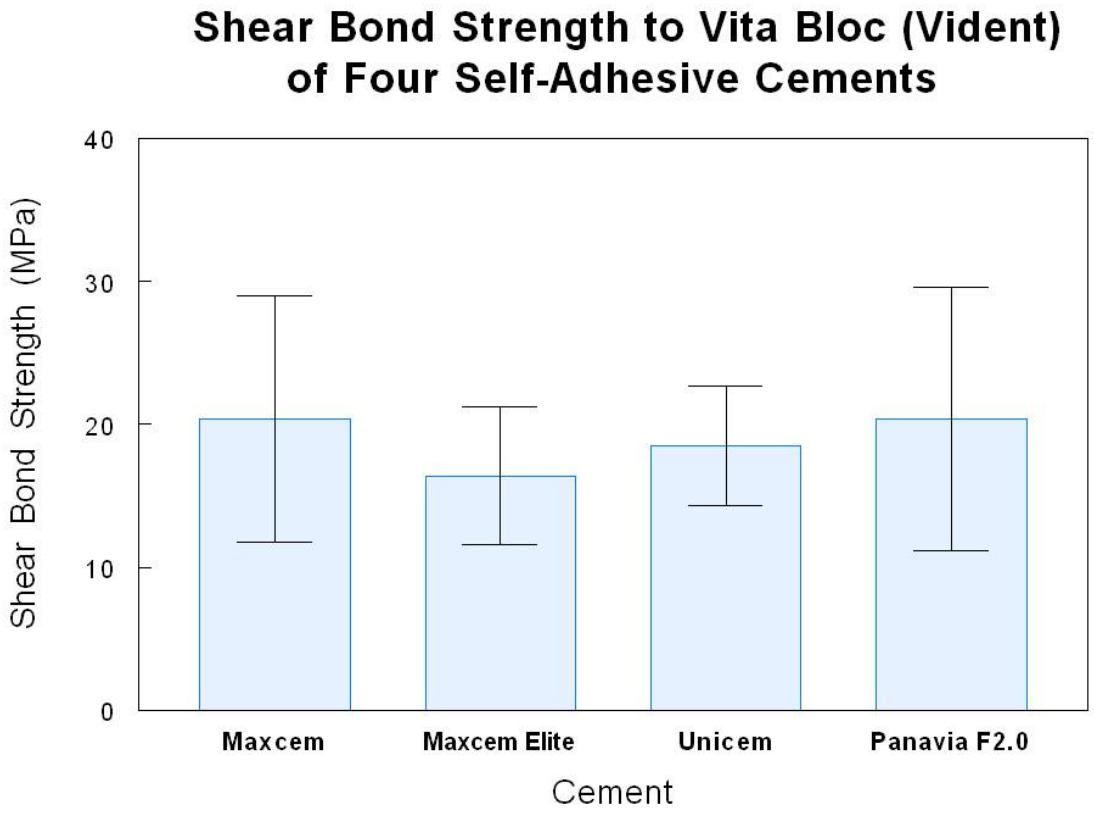
Results
The shear bond strength data in MPa and SD are given in the table below.

Cement	Rexillium	Gold	e.max CAD	VitaBlocks	Lava
Maxcem Elite	25.6 (7.6)	24.7 (5.7)	26.7 (10.1)	16.4 (4.8)	11.6 (1.4)
Maxcem	14.9 (2.8)	25.9 (6.6)	20.4 (8.6)	20.4 (8.6)	13.9 (10.6)
Panavia F2.0	21.9 (10.2)	22.5 (6.1)	12.8 (7.5)	20.4 (9.2)	12.9 (3.1)
Unicem	12.7 (3.6)	9.0 (2.4)	18.8 (3.9)	18.5 (4.2)	14.3 (6.3)

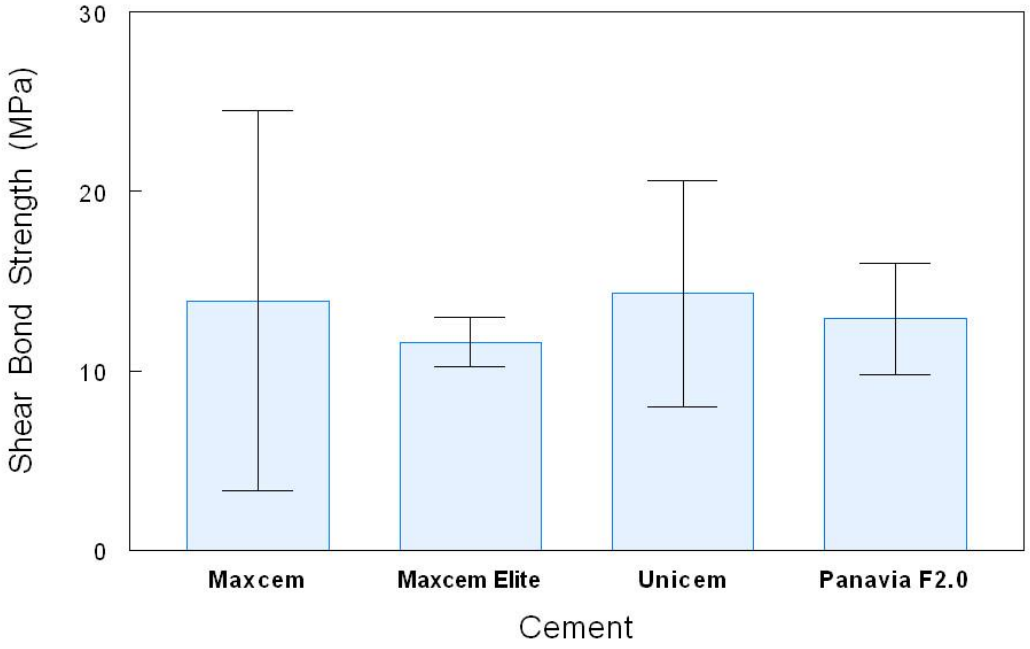
The results are presented in graphs, with each graph representing one substrate.

Shear Bond Strength to e.MaxCAD (Ivoclar Vivadent) of Four Self-Adhesive Cements

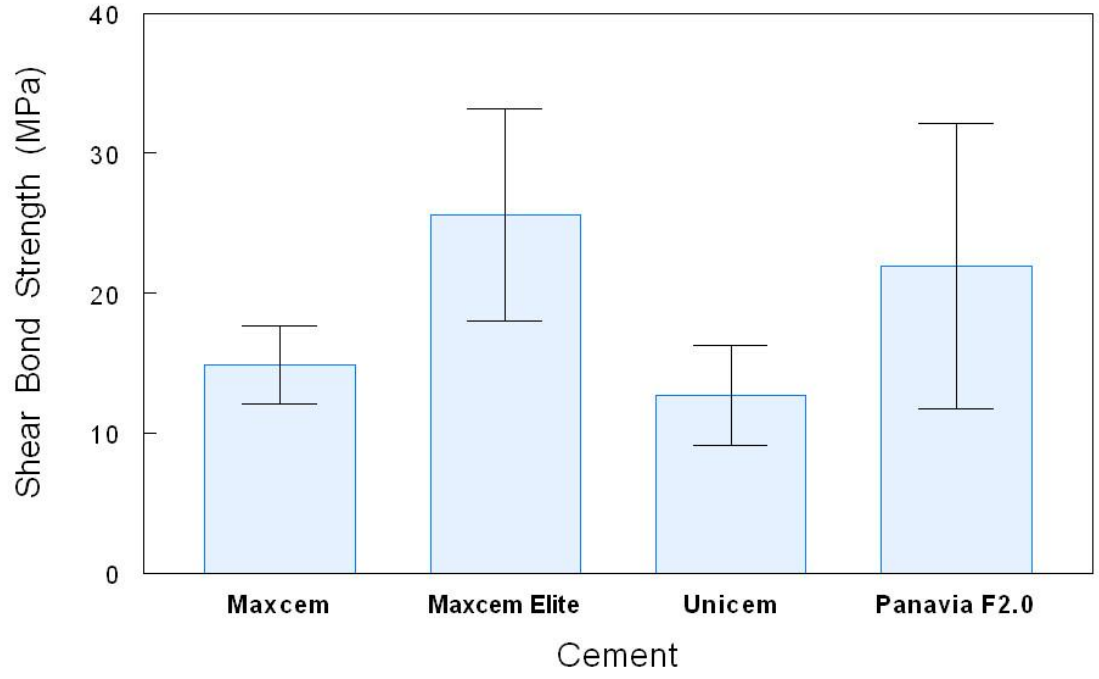


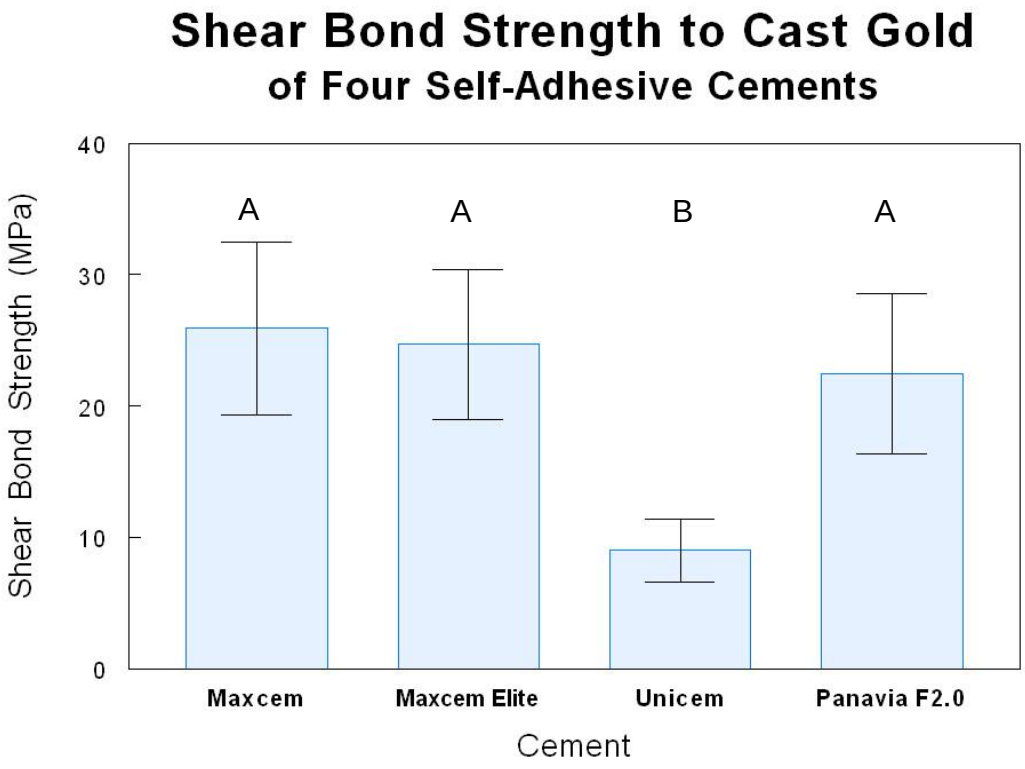

Shear Bond Strength to Vita Bloc (Vident)
of Four Self-Adhesive Cements
Shear Bond Strength (MPa)
40
30
20
10
0
Maxcem
Maxcem Elite
Unicem
Panavia F2.0
Cement

Shear Bond Strength to Zirconia (Lava 3M-ESPE) of Four Self-Adhesive Cements



Shear Bond Strength to Rexillium of Four Self-Adhesive Cements





Statistical Analysis

Statistical analysis was done by comparing the means of all cements on one substrate. The Tukey-Kramer test HSD test was done on all the means, using statistical software (SAS JMP 7.01).

On cast gold the results for Unicem were significantly lower ($p=0.05$) than the rest of the cements.

For all other substrates, no statistically significant differences were observed among the cements.

Discussion

In this study the observed standard deviations are higher than expected. For most of the samples, we found that one or two specimens had a much lower value than the rest of the samples. For this reason, observed trends such as Maxcem Elite on e.max CAD, having a shear bond strength more than double that of Panavia F2.0, cannot be statistically substantiated. Larger samples may verify this difference.