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3M™ RelyX™ Universal
Resin Cement

Scientific Facts

Introducing 3M™ RelyX™ Universal Resin Cement

Offering a single cement for all dual-cure resin cement indications – this is what 3M wanted to achieve when starting to develop 3M™ RelyX™ Universal Resin Cement. Now, after extensive testing, it is clear that this goal has been accomplished: the product is able to fulfill the full range of dual-cure resin cement needs around bond strength and ease of use.

This is possible as the universal resin cement works as a standalone product and as a part of a lean cementation system with only two base components: 3M™ RelyX™ Universal Resin Cement and 3M™ Scotchbond™ Universal Plus Adhesive.

The combination of RelyX Universal Resin Cement with Scotchbond Universal Plus Adhesive (either with or without a separate etching step) allows the user to obtain excellent bond strength values. Hence, the two system components combined can solve demanding cases such as low-strength glass-ceramic restorations on preparations with no mechanical retention.

Whenever the user is in need of a cementation procedure that is as simple and efficient as possible and leads to a reliable bond between the tooth and the restoration, RelyX Universal Resin Cement may be used on its own. This is feasible due to the self-adhesive properties of the universal dual-cure resin cement. Typical indications for the use without a separate adhesive are the cementation of zirconia crowns and bridges, endodontic posts and the placement of metal-ceramic restorations.

In order to evaluate the performance of the resin cement used alone or in combination with the universal adhesive, in different indications and different curing modes, numerous in-vitro studies were conducted prior to product launch. An overview of the wide range of data available at market introduction is provided in this collection of scientific facts.

Enjoy reading!

Content

Shear Bond Strength and Artificial Aging of Self-Adhesive Resin Cements

Published by: R. Afutu, M. Abreu, G. Kugel; Tufts University School of Dental Medicine, Boston, Massachusetts, United States

Published in: J. Dent. Res. Vol 98A, No 3629, 2019, https://iadr.abstractarchives.com/abstract/19iags-3175098/shear-bond-strength-and-artificial-aging-of-self-adhesive-resin-cements

Objectives:

The aim of this study is to determine shear bond strength (SBS) of self-adhesive resin cements (SARCs) to the challenging substrate dentin before and after artificial aging.

Methods:

Bovine teeth were ground flat to expose the dentin layer, polished with grit 320 sandpaper, distilled water-rinsed and gently air dried. Stainless steel rods (diameter = 4mm) were sandpapered, sandblasted, silanized (3M™ ESPE™ Sil, 3M) and cemented to the dentin exposed teeth (n=12 per group) under a pressure of 20g/mm². For self-curing cements, glycerin gel (AIRBLOCK™, Dentsply) was applied to the margins of the cemented area and specimens were stored in a 36° C incubator for 10 minutes. For light-curing cements, the cemented steel was light cured from 4 sides of cemented area (10s each, 3M™ Elipar™ S10 LED Curing Light, 3M). The 20g/mm² pressure was removed and all samples were stored for 24h (36° C, 100% relative contained humidity). Six specimens from each cement underwent artificial aging (thermocycling (TC): 5000 cycles, 5°C – 55°C) before SBS testing (Zwick Z010, n=6, speed 0.75mm/min). Data analysis was performed using One-Way ANOVA (Tukey; $p<0.05$).

Results:

Cement (manufacturer)	Abbreviation	All SBS are bonded to dentin and reported in MPa ± STD			
		SBS to dentin (self-cure) after 24hrs	SBS to dentin (light-cure) after 24hrs	SBS to dentin (self-cure) after TC	SBS to dentin (light-cure) after TC
Breeze® SARC (Pentron)	BZ	5.2 ± 2.0 ^{C,D}	14.0 ± 2.6 ^{B,C}	2.6 ± 1.9 ^{D,E}	7.8 ± 4.5 ^{C,D}
Calibra® Universal (Dentsply)	CU	6.9 ± 3.8 ^{B,C,D}	1.4 ± 1.0 ^{E}	0.4 ± 0.6 ^{E}	0.0 ± 0.0 ^{D}
Experimental Cement (3M)	EXP	26.1 ± 5.1 ^{A}	22.8 ± 3.9 ^{A}	28.1 ± 2.3 ^{A}	27.4 ± 1.5 ^{A}
G-CEM LinkAce™ (GC America)	GCEM	7.8 ± 4.1 ^{B,C}	9.0 ± 3.7 ^{C,D}	10.3 ± 4.8 ^{B,C,D}	12.5 ± 7.0 ^{B,C}
Maxcem Elite™ Chroma (Kerr)	MAX	5.1 ± 2.6 ^{C,D}	9.1 ± 6.7 ^{C,D}	5.8 ± 6.5 ^{C,D,E}	5.2 ± 2.9 ^{C,D}
PANAVIA™ SA Cement Plus (Kuraray Noritake)	PAN	13.4 ± 6.3 ^{B}	10.2 ± 1.8 ^{B,C,D}	16.8 ± 5.9 ^{B}	8.5 ± 1.8 ^{B,C}
PermaCem 2.0 (DMG)	PC2	5.5 ± 4.1 ^{C,D}	5.2 ± 3.7 ^{D,E}	6.2 ± 4.2 ^{C,D,E}	5.6 ± 4.2 ^{C,D}
3M™ RelyX™ Unicem 2 Cement (3M)	RXU2	5.1 ± 2.1 ^{C,D}	16.0 ± 2.1 ^{A,B}	13.9 ± 9.1 ^{B,C}	16.3 ± 4.0 ^{B}
SpeedCEM® Plus (Ivoclar Vivadent)	SCP	10.0 ± 2.3 ^{B,C}	15.8 ± 3.1 ^{B,C}	2.6 ± 1.4 ^{D,E}	8.2 ± 6.2 ^{C}
TheraCem® Ca (Bisco)	TC	0.2 ± 0.4 ^{D}	10.6 ± 4.4 ^{B,C,D}	0.2 ± 0.4 ^{E}	9.6 ± 4.1 ^{B,C}

Table: Shear bond strength (SBS) of self-adhesive resin cements to dentin (means with standard deviation [STD]) before and after thermocycling (TC). Means that do not share the same superscript letter in a column are significantly different.

Conclusions:

EXP showed significantly higher SBS to dentin under all testing conditions. CU and SCP showed a decrease in bond strength after artificial aging. Overall, light-curing delivered higher SBS than self-curing except for EXP where values were the same in both curing methods.

3M summary:

A strong and durable bond to dentin is an important prerequisite for a restoration's long-term clinical success. Based on the results of this shear bond strength test, it may be expected that the use of EXP* as a self-adhesive cement will lead to an excellent bond to the tooth, irrespective of the curing mode. EXP* when used in self-adhesive mode on dentin without the use of a curing light offers reliable bond strength.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

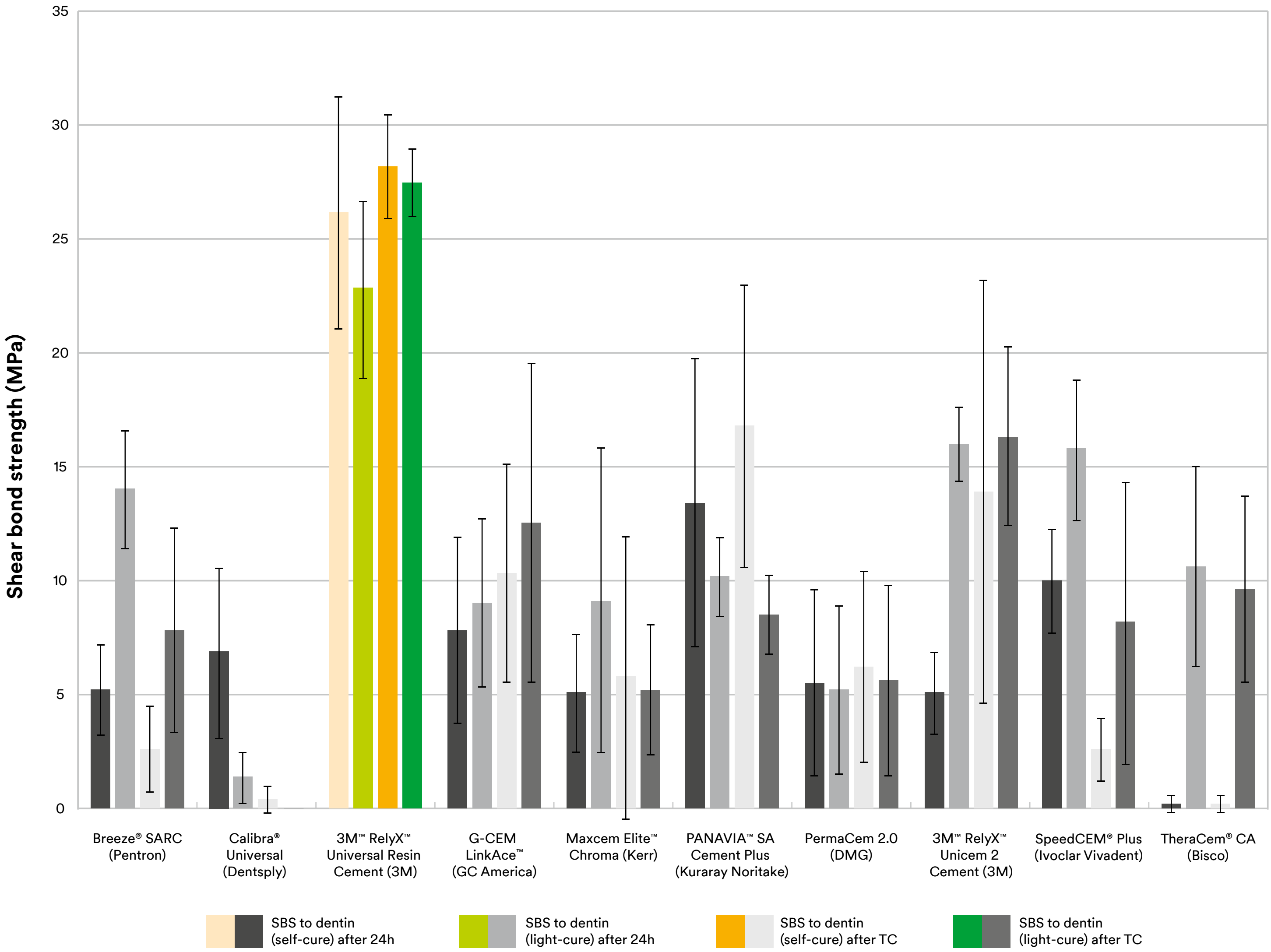

Figure: Shear bond strength values of self-adhesive resin cements to dentin.

Development of Shear Bond Strength to Dentin of Self-Adhesive Resin Cements

Published by: K. Claussen, M. Ludsteck, S. Hader, R. Hecht, A. Lopez, 3M Oral Care, 3M Deutschland GmbH, Seefeld, Germany
Published in: J. Dent. Res. Vol 98B, No 194, 2019, https://iadr.abstractarchives.com/abstract/ced-iadr2019-3218310/development-of-shear-bond-strength-to-dentin-of-self-adhesive-resin-cements

Objectives:

Recently, several manufacturers have launched new self-adhesive resin cements (SARCs), claiming excellent bond strength to the tooth surface. Shear bond strength (SBS) methods usually compare SBS after 24h or artificial aging. However, it is still unclear how quickly the bond strength develops. Therefore, this study compared initial SBS of SARCs with SBS after 24h and artificial aging.

Methods:

Calibra® Universal (CU, Dentsply), Experimental Cement (EXP, 3M), G-CEM LinkAce™ (GCLA, GC), Maxcem Elite™ Chroma (MEC, Kerr), PANAVIA™ SA Cement Plus (PSAC+, Kuraray Noritake), PermaCem 2.0 (PC2, DMG), 3M™ RelyX™ Unicem 2 Automix Cement (RXU2, 3M) and SpeedCEM® Plus (SCP, Ivoclar Vivadent) were tested. All cements were used according to manufacturers' instructions. Bovine teeth were ground flat to expose dentin, polished (grit 320 sandpaper), water-rinsed, and gently air-dried. Stainless steel rods (diameter = 4mm) were sandpapered, sandblasted, silanized (3M™ ESPE™ Sil, 3M) and subsequently cemented (n=6) under standardized pressure (20g/mm^2). The cement was irradiated from 4 sides (10s each; 3M™ Elipar™ S10 LED Curing Light, 3M). Specimens for initial SBS were stored for 5 min at 36°C under pressure. Specimens for 24h were stored for 10 min at 36°C under pressure followed by additional 24h (36°C; 100% relative humidity) without pressure. Part of those specimens was subjected to artificial aging (thermocycling: 5000 cycles, 5°C-55°C). Shear bond strength testing was performed (Zwick Z010; n=6; speed=0.75mm/min). Data analysis was performed using One-Way ANOVA (Tukey; $p<0.05$).

Results:

Cement [MPa] ± STD	CU	EXP	GCLA	MEC	PC2	PSAC+	RXU2	SCP
SBS to dentin lc after 5 min 36°C	1.1 ± 1.5 ^{E}	19.0 ± 3.3 ^{A}	8.8 ± 3.8 ^{C,D}	5.4 ± 1.3 ^{D,E}	8.4 ± 2.2 ^{C,D}	6.1 ± 1.1 ^{D}	10.8 ± 1.0 ^{B,C}	13.5 ± 3.0 ^{B}
SBS to dentin lc after 24h 36°C	7.5 ± 2.9 ^{C,D}	21.0 ± 4.4 ^{A}	10.1 ± 5.4 ^{B,C,D}	3.7 ± 1.5 ^{D}	7.3 ± 3.6 ^{C,D}	16.6 ± 4.4 ^{A,B}	15.2 ± 3.5 ^{A,B,C}	17.4 ± 8.6 ^{A,B}
SBS to dentin lc after 24h 36°C, +TC	3.8 ± 4.6 ^{C,D}	21.4 ± 1.4 ^{A}	8.8 ± 4.6 ^{B,C}	3.6 ± 4.5 ^{C,D}	0.5 ± 0.8 ^{D}	7.5 ± 6.5 ^{B,C,D}	13.8 ± 4.3 ^{B}	8.1 ± 2.2 ^{B,C}

Table: Shear bond strength (SBS) of light-cured (lc) self-adhesive resin cements with standard deviation (STD) after 5 min, 24h at 36°C, and after artificial aging (thermocycling, TC). Means that do not share the same letter in a column are significantly different.

Conclusions:

The Experimental Cement showed significantly higher initial shear bond strength (SBS) than all the other cements tested. In general, SBS increased after 24h with the Experimental Cement showing highest SBS. After artificial aging, bond strength dropped significantly for PermaCem 2.0, PANAVIA™ SA Cement Plus, and SpeedCEM® Plus while the other cements kept their bond strength level. The Experimental Cement showed significantly highest SBS after artificial aging.

3M summary:

The ideal bond between tooth and restoration is strong and stable over time. The results of this study reveal that EXP* – used as a self-adhesive resin cement – offers excellent dentin bond strength already after 5 minutes. The values remain stable, after 24 hours and after artificial aging.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

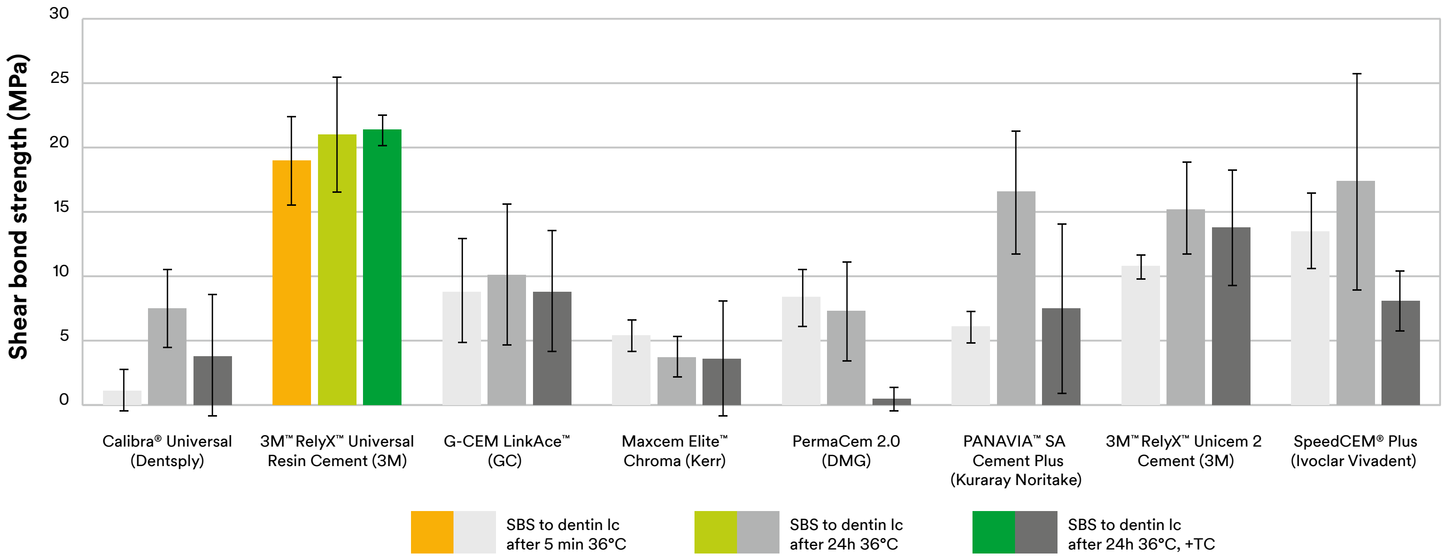

Figure: Development of shear bond strength values of self-adhesive resin cements to dentin.

Tensile Bond Strength of a Novel Self-Adhesive Resin Cement to Dentin

Published by: C.E. Sabrosa (Clínica Odontológica Dr Sabrosa, Rio de Janeiro, Brazil); K. Geber (Clínica Odontológica Dr Sabrosa, Rio de Janeiro, Brazil)

Published in: J. Dent. Res. Vol 98A, No 0381, 2019, https://iadr.abstractarchives.com/abstract/ced-iadr2019-3222956/tensile-bond-strength-of-a-novel-adhesive-resin-cement-to-dentin

Objectives:

Measure tensile bond strength (TBS) of a novel self-adhesive resin cement to dentin in self- and light-cure modes.

Methods:

Seven self-adhesive resin cements 1 (EXP)-Experimental 3M (3M); 2 (RXU)-3M™ RelyX™ Unicem 2 Automix Cement (3M); 3 (CAU)-Calibra® Universal (Dentsply); 4 (GCEM)-G-CEM LinkAce™ (GC); 5 (MEC)-Maxcem Elite™ Chroma (Kerr); 6 (PSA)-PANAVIA™ SA Cement Plus (Kuraray Noritake) and 7 (SCP)-SpeedCEM® Plus (Ivoclar Vivadent) were used. Bovine incisor teeth were allocated into 14 groups (n=12). Dentin was exposed and polished using a 320-grit sandpaper. Stainless-steel 4mm rods were cemented onto moist dentin. Excess cement was removed immediately. For the self-cure mode, AIRBLOCK™ (Dentsply) was applied around the specimens before storage (10min) under pressure at 36°C. For the light-cure mode, an LED unit (3M™ Elipar DeepCure LED Curing Light, 3M) was used to polymerize (40s) specimens. After initial preparation, the pressure was relieved, specimens were washed off with distilled water and stored at 36°C in 100% relative humidity for 24h. TBS was performed in a universal testing machine (Zwick/Roell) with a crosshead speed of 1mm/min. Results were analyzed with ANOVA followed by Tukey HSD test (α=0.05).

Results:

Means and standard deviations of TBS are shown in Figure 1 and Table 1. Failure modes are shown in Table 2 and Table 3. There was a statistically significant difference ($p<0.05$) in TBS between the cements. Subgroups are identified with letters in Figure 1. EXP was the only cement that did not have statistically significant difference ($p>0.05$) between curing modes. All cements presented adhesive failures. EXP presented two in the self-cure and one adhesive failure in the light-cure mode. All other were cohesive or combination of adhesive/cohesive failures.

Group	Cement	Self-cure mode mean ± sd (MPa)	Light-cure mode mean ± sd (MPa)
1	Experimental 3M (3M)	8.35 ± 2.12	8.11 ± 1.90
2	3M™ RelyX™ Unicem 2 Automix Cement (3M)	2.29 ± 2.05	6.91 ± 3.68
3	Calibra® Universal (Dentsply)	1.22 ± 1.69	1.36 ± 0.98
4	G-CEM LinkAce™ (GC)	3.67 ± 0.99	5.83 ± 2.75
5	Maxcem Elite™ Chroma (Kerr)	1.77 ± 1.54	3.25 ± 1.49
6	PANAVIA™ SA Cement Plus (Kuraray Noritake)	4.84 ± 1.89	3.79 ± 2.55
7	SpeedCEM® Plus (Ivoclar Vivadent)	4.72 ± 2.13	7.09 ± 3.81

Table 1: Means and standard deviations of tensile bond strength values (MPa).

Group	Cement	Adhesive (n)	Cohesive (n)	Mixed (n)	0 MPa (n)
1	Experimental 3M (3M)	2	0	10	0
2	3M™ RelyX™ Unicem 2 Automix Cement (3M)	11	0	0	1
3	Calibra® Universal (Dentsply)	6	0	0	6
4	G-CEM LinkAce™ (GC)	12	0	0	0
5	Maxcem Elite™ Chroma (Kerr)	11	0	0	1
6	PANAVIA™ SA Cement Plus (Kuraray Noritake)	12	0	0	0
7	SpeedCEM® Plus (Ivoclar Vivadent)	12	0	0	0

Table 2: Failure mode of tested specimens in the self-cure mode.

Group	Cement	Adhesive (n)	Cohesive (n)	Mixed (n)	0 MPa (n)
1	Experimental 3M (3M)	1	1	10	0
2	3M™ RelyX™ Unicem 2 Automix Cement (3M)	12	0	0	0
3	Calibra® Universal (Dentsply)	10	0	0	2
4	G-CEM LinkAce™ (GC)	12	0	0	0
5	Maxcem Elite™ Chroma (Kerr)	12	0	0	0
6	PANAVIA™ SA Cement Plus (Kuraray Noritake)	12	0	0	0
7	SpeedCEM® Plus (Ivoclar Vivadent)	12	0	0	0

Table 3: Failure mode of tested specimens in the light-cure mode.

Conclusions:

Under the limitations of this study, it can be concluded that the EXP performed statistically significantly better in the self-cure mode. In light-cure mode, EXP, GCEM, RXU and SCP showed significantly highest TBS values. EXP obtained highest adhesion performance in both curing modes and presented combinations of adhesive/cohesive failures, indicating the limitations by the strength of the dentin.

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https://iadr.abstractarchives.com/abstract/ced-iadr2019-3222956/tensile-bond-strength-of-a-novel-adhesive-resin-cement-to-dentin, 2019

3M summary:

Tensile bond strength testing is another relevant method to determine a material´s behavior. The results confirm that, functioning as a self-adhesive resin cement, EXP* may be expected to establish a strong bond to dentin, no matter whether used in the light-cure or self-cure mode.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

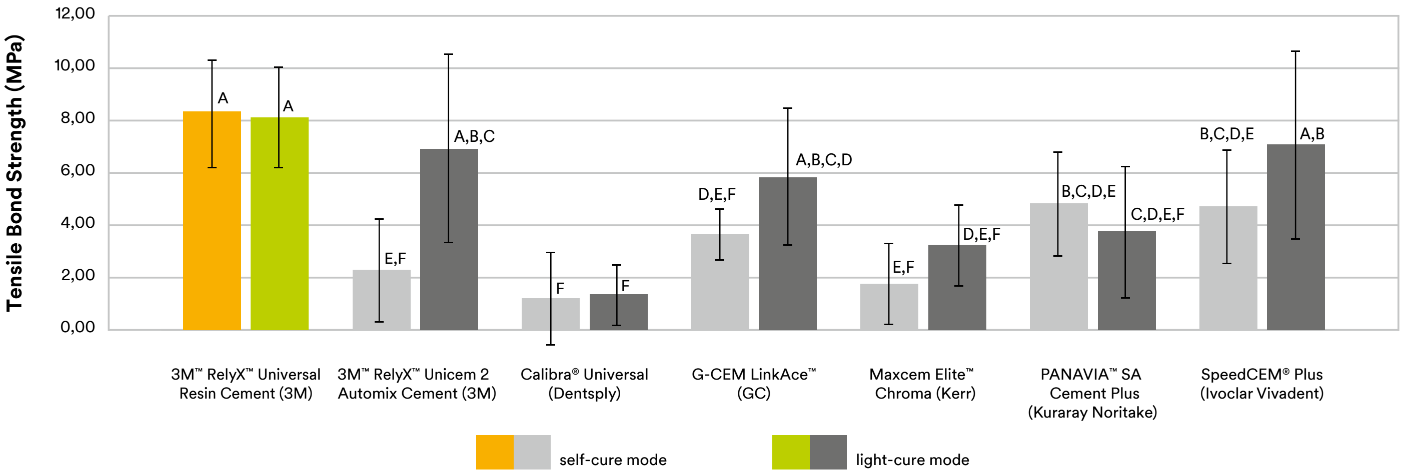

Figure 1: Tensile bond strength values of self-adhesive resin cements to dentin. Different letters indicate different subgroups.

Tensile Bond Strength of a Novel Adhesive Resin Cement to Dentin

Published by: C. E. Sabrosa[1,2], K. Geber[1], P. Monteiro[2]

Published in: J. Dent. Res. Vol 98B, No 328, 2019, https://iadr.abstractarchives.com/abstract/ced-iadr2019-3222956/tensile-bond-strength-of-a-novel-adhesive-resin-cement-to-dentin

[1]Clínica Odontológica Dr Sabrosa, Rio de Janeiro, Brazil

[2]Centro de Investigação Interdisciplinar Egas Moniz, Caparica, Portugal

Objectives:

Measure tensile bond strength (TBS) of a novel adhesive resin cement to bovine dentin compared to other adhesive resin cements in the self-cure mode.

Methods:

Four different adhesive resin cements, 1 (EXP)-Experimental cement (3M); 2 (NX3)- NX3 Nexus™ (Kerr); 3 (PV5)-PANAVIA™ V5 (Kuraray Noritake) and 4 (VES)-Variolink® Esthetic (Ivoclar Vivadent) were used with their correspondent adhesive system, a (EXA)-Experimental adhesive (3M); b (XTR)-OptiBond™ XTR (Kerr); c (PTP)-PANAVIA™ V5 Tooth Primer (Kuraray Noritake) and d (ADU)-Adhese® Universal (Ivoclar Vivadent) that was light cured. Bovine incisor teeth were allocated into 4 groups (n=12). Dentin was exposed and polished using a 320-grit sandpaper. Stainless-steel 4mm rods were cemented onto moist dentin. Excess cement was removed immediately. AIRBLOCK™ (Dentsply) was applied around the specimens before storage (10min) under pressure at 36°C. For the light-cure mode, an LED unit (3M™ Elipar DeepCure LED Curing Light, 3M) was used to polymerize (40s) specimens. After initial preparation, the pressure was relieved, specimens were washed off with distilled water and stored at 36°C in 100% relative humidity for 24h. TBS was performed in a universal testing machine (Zwick/Roell) with a crosshead speed of 1mm/min. Results were analyzed with ANOVA followed by Tukey HSD test (α=0.05).

Results:

Means and standard deviations of TBS values are shown in Table 1. Failure modes are shown in Table 2. There was a statistically significant difference ($p<0.05$) in TBS values between the tested cements. All cements presented with adhesive, cohesive and a mixture of adhesive/cohesive failures. One sample of NX3 failed before testing.

Group	Material	Mean ± SD (MPa)	Tukey HSD (α=0.05)
1	Experimental cement (3M) Experimental adhesive (3M)	9.49 ± 4.60	A, B
2	NX3 Nexus™ (Kerr); OptiBond™ XTR (Kerr)	2.50 ± 2.54	C
3	PANAVIA™ V5 (Kuraray Noritake) PANAVIA™ V5 Tooth Primer (Kuraray Noritake)	13.45 ± 5.05	A
4	Variolink® Esthetic (Ivoclar Vivadent) Adhese® Universal (Ivoclar Vivadent)	5.28 ± 3.25	B, C

Table 1: Tensile bond strength to dentin. Means and standard deviations of tensile bond strength values (MPa).

Group	Material	adhesive (n)	cohesive (n)	mixed (n)	OMPa (n)
1	Experimental cement (3) Experimental adhesive (3M)	5	4	3	0
2	NX3 Nexus™ (Kerr); OptiBond™ XTR (Kerr)	11	0	0	1
3	PANAVIA™ V5 (Kuraray Noritake) PANAVIA™ V5 Tooth Primer (Kuraray Noritake)	0	10	2	0
4	Variolink® Esthetic (Ivoclar Vivadent) Adhese® Universal (Ivoclar Vivadent)	5	5	2	0

Table 2: Failure mode of tested specimens.

Conclusions:

Under the limitations of this study, it can be concluded that there was no statistical, significant difference between PV5 + PTP and the new EXP + EXA in the self-cure mode. NX3 and XTR presented the statistically lowest mean values. Many samples failed due to cohesive dentin failure, indicating the limitations of the study by the strength of the dentin.

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https://iadr.abstractarchives.com/abstract/ced-iadr2019-3222956/tensile-bond-strength-of-a-novel-adhesive-resin-cement-to-dentin, 2019

3M summary:

The results of this study show that the bond strength to dentin of the Experimental Cement* together with the Experimental Adhesive** used in the self-cure mode gives results which are at least comparable to other leading cements – even without the use of a curing light.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

** Now commercially available under the name 3M™ Scotchbond™ Universal Plus Adhesive

Shear Bond Strength and Ease of Use of Adhesive Resin Cements

Published by: K. Claussen, M. Ludsteck, S. Hader, R. Hecht, 3M Oral Care, 3M Deutschland GmbH, Seefeld, Germany
Published in: J. Dent. Res. Vol 99A, No 2785, 2020, https://iadr.abstractarchives.com/abstract/20iags-3318916/shear-bond-strength-and-ease-of-use-of-adhesive-resin-cements

Objectives:

There are many esthetic adhesive cements available, differing in the number of components and steps needed for cementation. In this study, it was determined whether the ease of use provided by less components and steps would come at the expense of shear bond strength to bovine teeth before and after artificial aging.

Methods:

3 adhesive resin cement systems were tested: Experimental Cement (EXP-C, 3M) with Experimental Adhesive (EXP-A, 3M), Multilink® Automix (MLA, Ivoclar Vivadent) with Primer A and Primer B (PAB, Ivoclar Vivadent), and Variolink® Esthetic (VLE, Ivoclar Vivadent) with Adhese® Universal (ADU, Ivoclar Vivadent). All cements and adhesives were used according to manufacturers' instructions. Bovine teeth were ground flat to expose dentin or enamel, polished (grit 320 sandpaper), water-rinsed, and gently air-dried. Stainless steel rods (diameter=4mm) were sandpapered, sandblasted, and silanized (3M™ ESPE™ Sil, 3M). Adhesives were applied as follows: EXP-A and PAB were not light-cured whereas ADU had to be light-cured (3M™ Elipar™ S10 LED Curing Light, 3M) for 10s prior to cementation. Stainless steel rods were cemented (n=6) under standardized pressure (20g/mm²). After excess removal, the cement was irradiated from 4 sides (10s each; Elipar S10 LED Curing Light, 3M). The specimens were stored for 10min under pressure (36°C) followed by additional 24h (36°C; 100% relative humidity) without pressure. Part of the specimens was subjected to artificial aging (thermocycling: 5000 cycles, 5°C-55°C) before shear bond strength testing (Zwick Z010; n=6; speed=0.75mm/min). Data analysis was performed using One-Way ANOVA (Tukey; $p<0.05$).

Results:

Cement	Adhesive	Adhesive(s): No. of mixing or curing steps	No. of components	SBS to dentin lc [MPa] ± STD	SBS to enamel lc [MPa] ± STD	SBS to dentin lc after TC [MPa] ± STD	SBS to enamel lc after TC [MPa] ± STD
EXP-C	EXP-A	0	2	27.9 ± 8.9^{A}	36.8 ± 5.4^{A}	22.7 ± 5.2^{A}	38.8 ± 8.4^{A}
MLA	PAB	1	3	23.9 ± 8.7^{A}	40.1 ± 4.9^{A}	25.4 ± 9.7^{A}	39.6 ± 4.6^{A}
VLE	ADU	1	2	23.2 ± 5.8^{A}	29.0 ± 3.0^{B}	28.2 ± 11.0^{A}	30.2 ± 2.0^{B}

Table: Shear bond strength (SBS) of light-cured (lc) adhesive resin cements with standard deviation (STD) before and after thermocycling (TC). Means that do not share the same superscript letter in a column are significantly different.

Conclusion:

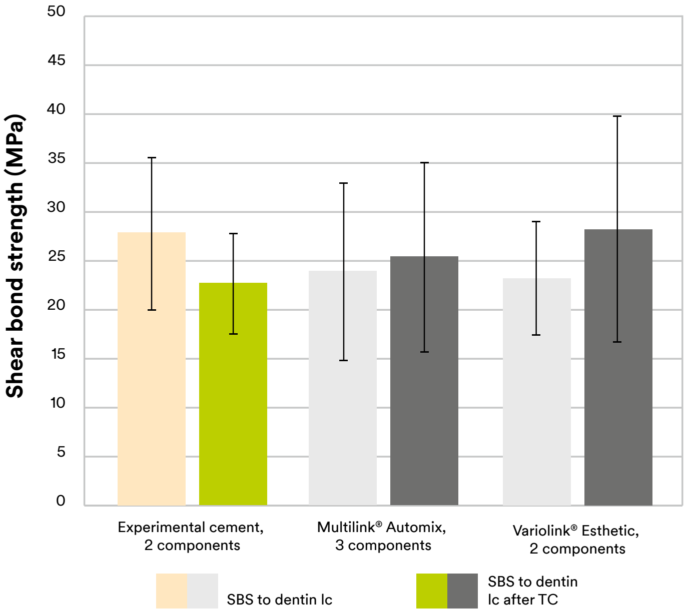
In general, the Experimental Cement & Adhesive deliver at least statistically identical shear bond strength to Multilink® Automix & Primer A+B and Variolink® Esthetic & Adhese® Universal. The Experimental Cement & Adhesive have less steps than Variolink® Esthetic & Adhese® Universal due to the absence of a mandatory light-curing step of the Experimental Adhesive. Furthermore, the Experimental Cement & Adhesive (2 components) consist of less components than Multilink® Automix & Primer A+B (3 components). The data suggests that workflow simplification by less steps/components with the Experimental Cement & Adhesive does not come at the expense of bond strength.

3M summary:

The results of this study show that added procedural simplicity does not automatically lead to compromised bond strength to the tooth structure. In fact, the Experimental Cement* used in combination with the Experimental Adhesive** offers a more simple procedure than the other products tested, but a similar performance before and after artificial aging.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

** Now commercially available under the name 3M™ Scotchbond™ Universal Plus Adhesive



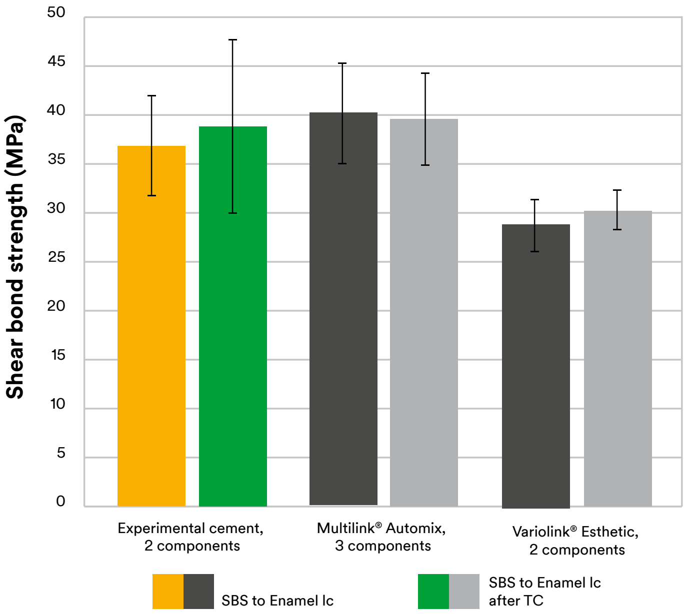


Figure: Shear bond strength values of adhesive resin cements to dentin and enamel.

Resin Cement Bond Strength to Multiple Substrates

Published by: M. Cowen, J.M. Powers
Published in: Dental Advisor Report, January 29, 2020

Objectives:

To determine bond strengths of a new cement and adhesive to multiple substrates in adhesive and self-adhesive modes compared to competitive systems.

Experimental design:

Self-adhesive group:
3M Experimental Cement, 3M™ RelyX™ Unicem 2 Cement and 3M™ RelyX™ Ceramic Primer on lithium disilicate (3M), Maxcem Elite™ Chroma and Kerr Silane Primer (Kerr)

Adhesive cements:
3M Experimental Cement and ADH19, Variolink® Esthetic DC with Adhese® Universal on teeth and Monobond® Plus on ceramics (Ivoclar Vivadent)

Tests: Indirect shear bond strength tests

Substrates:
Self-etched superficial dentin, Self-etched ground enamel, 3M™ Lava™ Esthetic Fluorescent Full-Contour Zirconia (sandblasted), Lithium Disilicate IPS e.max® CAD (hydrofluoric acid etched) curing mode: self-cured
Storage: 24 h in 37°C deionised water
Replications: n=6

<table>
<tr><th>Cement</th><th>Dentin</th><th>Enamel</th><th>IPS e.max® CAD</th><th>3M™ Lava™ Esthetic Zirconia</th></tr>
<tr><td>3M Experimental Cement Self-Adhesive (3M)</td><td colspan="2">self-adhesive</td><td>-</td><td>Self-Adhesive</td></tr>
<tr><td>3M™ RelyX™ Unicem 2 Cement (3M)</td><td colspan="2">self-adhesive</td><td>with 3M™ RelyX™ Ceramic Primer (3M)</td><td>Self-Adhesive</td></tr>
<tr><td>Maxcem Elite™ Chroma (Kerr)</td><td colspan="2">self-adhesive</td><td>with Kerr Silane Primer (Kerr)</td><td>Self-Adhesive</td></tr>
<tr><td>3M Experimental Cement and Adhesive (3M)</td><td colspan="4">with 3M Experimental Adhesive</td></tr>
<tr><td>Variolink® Esthetic DC and Adhese® Universal (Ivoclar Vivadent)</td><td colspan="2">with Adhese® Universal</td><td colspan="2">with Monobond® Plus</td></tr>
</table>

Methods:

Pretreatment of surfaces: Human, adult, extracted third molars, sterilized in 0.5% chloramine T solution were embedded in acrylic resin discs and ground through 600-grit SiC paper to form bonding substrates of superficial dentin and ground enamel. **3M™ Lava™ Esthetic Zirconia** specimens were made to have final dimensions of 10 x 10 mm and mounted in acrylic, ground through 600-grit diamond grit abrasive and sandblasted with 50-µm alumina particles at 50 psi. **IPS e.max® CAD** specimens were ground through 600-grit diamond abrasive and etched with **IPS Ceramic Etching Gel** (5% hydrofluoric acid) for 20 seconds and rinsed thoroughly.

Cement indirect bond testing: Specimens, if applicable, were treated with primers or adhesive before applying single-sided adhesive Teflon tape, 0.13 mm thick, with an approximately 3 mm diameter hole over the bonding site and burnished into place. A dab of cement was placed into the hole. Metal discs, 9 mm diameter by 3 mm thick, roughened with 60-grit SiC paper, and sandblasted at 50 PSI and primed with Monobond® Plus, were then placed on top of the cement concentric with the hole and the loading rod lowered. The excess cement was tack cured and removed according to manufacturer's instructions. The assembly was allowed to cure for 10 minutes under a load of 1000 g before being transferred to a 37°C deionized water bath for 24 hours until testing. Bond strength specimens were tested in shear using an Instron 5866 universal testing machine with a crosshead speed of 1 mm/min. Mean shear bond strength with standard deviations are reported in the results.

Results:

Cement	Dentin	Enamel	IPS e.max® CAD	3M™ Lava™ Esthetic Zirconia
3M Experimental Cement Self-Adhesive (3M)	37.2 (3.1)*	32.5 (7.0)*	-	55.6 (4.2)*
3M™ RelyX™ Unicem 2 Cement (3M)	17.5 (2.8)*	27.6 (6.4)*	49.5 (6.5)	32.6 (6.9)*
Maxcem Elite™ Chroma (Kerr)	7.6 (3.3)*	30.6 (5.7)*	53.5 (8.2)	36.4 (8.4)*
3M Experimental Cement and Adhesive (3M)	46.8 (3.6)	36.2 (2.9)	60.2 (4.7)	61.6 (6.8)
Variolink® Esthetic DC and Adhese® Universal (Ivoclar Vivadent)	42.2 (5.5)	33.3 (4.9)	64.0 (9.3)	40.4 (8.3)

*Cement was used in self-adhesive mode

Conclusion:

Self-adhesive bond strengths of the 3M cements to dentin, enamel and zirconia substrates are the highest of any self-adhesive cements tested with this method by DENTAL ADVISOR. Adhesive bond strength to dentin and enamel was excellent, and in particular, the zirconia bond strengths are the highest among the universal adhesives tested.

3M summary:

High shear bond strength to tooth substance and restoration materials is achieved by 3M™ RelyX™ Universal Resin Cement in the self-adhesive as well as in the adhesive mode when used without a curing light.

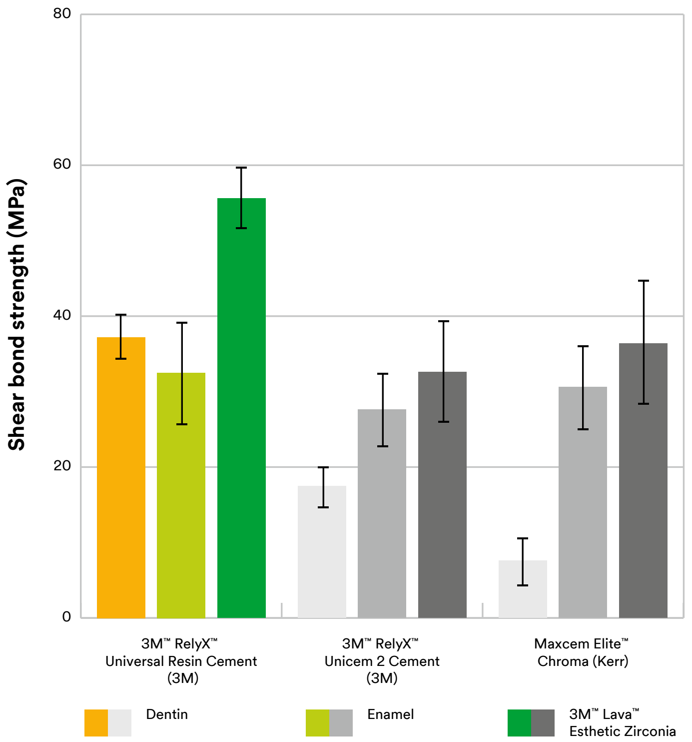


Figure: Shear bond strength of self-adhesive resin cements to different substrates.

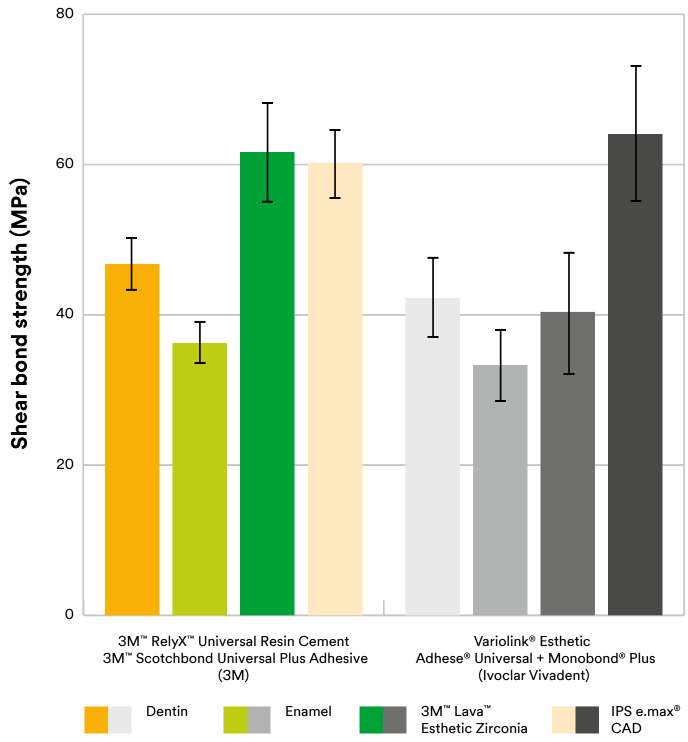


Figure: Shear bond strength of adhesive resin cements to different substrates.

Retention of Zirconia Copings Luted with Self-Adhesive Resin Cements

Published by: N. Lawson[1], C. Huang[1], S. Kwon[2], F. Farheen[1], J. Burgess[1]

Published in: J. Dent. Res. Vol 98A, No 1321, 2019, https://iadr.abstractarchives.com/abstract/19iags-3184931/retention-of-zirconia-copings-luted-with-self-adhesive-resin-cements

[1] University of Alabama, Birmingham, Alabama, United States
[2] NYU School of Dentistry, New York City, New York, United States

Objectives:

To measure the tensile strength of zirconia copings cemented with different cements following thermocycling.

Methods:

60 extracted non-carious mandibular premolar teeth were mounted in acrylic filled cylinders. The teeth were prepared to uniform dimensions (20° total taper) and 3.5mm preparation height using a flat-end tapered diamond bur (846.11.025HP, Brasseler). The surface area of the prepared surface was calculated with digital microscopy. The teeth were scanned with a 3M™ True Definition Scanner (3M). Zirconia crowns (3M™ Lava™ Plus High Translucency Zirconia, 3M) were milled and sintered following manufacturers recommendations. The intaglio surfaces were sandblasted with 30 micron alumina at 2 bar for 10 seconds. The crowns (n=10) were then cemented with either an Experimental Cement (3M), 3M™ RelyX™ Unicem 2 Cement (3M), PANAVIA™ SA Cement Plus (Kuraray Noritake), Maxcem Elite™ Chroma (Kerr), Calibra® Universal (Dentsply), or SpeedCEM® Plus (Ivoclar Vivadent) cement. No primers were used on the crowns or teeth. Crowns were allowed to self-cure under a 2.5 kg weight, stored in a moist bag for 24 hours at 37°C and then thermocycled for 10,000 cycles from 5-50°C with a 30 second dwell time. The specimens were placed in a custom fixture in a universal testing machine and loaded in tension at a crosshead speed of 5mm/min until debonding. The tensile strength (MPa) at debonding was calculated using the maximum recorded tensile force and surface area of the preparation. Data were compared with a 1-way ANOVA and Tukey analysis (alpha=0.05).

Results:

Significant differences between cements were noted with 1-way ANOVA ($p<.01$). Materials can be categorised into significantly different groups with Tukey analysis as represented by the letters in the chart below.

Material	Retention strength (MPa)
Experimental Cement (3M)	6.54 ± 1.30 A
3M™ RelyX™ Unicem 2 Cement (3M)	5.76 ± 1.07 A, B
PANAVIA™ SA Cement Plus (Kuraray Noritake)	6.55 ± 1.79 A
Maxcem Elite™ Chroma (Kerr)	3.16 ± 0.95 C
Calibra® Universal (Dentsply)	3.20 ± 0.79 C
SpeedCEM® Plus (Ivoclar Vivadent)	4.03 ± 1.32 B, C

Table: Retention strength of self-adhesive cements.

Conclusions:

Experimental Cement and PANAVIA™ SA Cement Plus showed significantly higher tensile strength/retention than Maxcem Elite™ Chroma, Calibra® Universal and SpeedCEM® Plus. 3M™ RelyX™ Unicem 2 Cement shared the same statistical group with the Experimental Cement, PANAVIA™ SA Cement Plus and with SpeedCEM® Plus.

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https://iadr.abstractarchives.com/abstract/19iags-3184931/retention-of-zirconia-copings-luted-with-self-adhesive-resin-cements, 2019

3M summary:

Zirconia is a popular restorative material in modern dentistry. The results of this study confirm that the use of the Experimental Cement* in its function as a self-adhesive resin cement leads to a high retention strength to zirconia crowns.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

Shear Bond Strength of Experimental Resin Cement to Zirconia in Comparison to Contemporary Adhesive Resin Cements

Published by: M. Ludsteck, K. Claussen, M. Salex, R. Hecht, 3M Oral Care, 3M Deutschland GmbH, Seefeld, Germany
Accepted for DGPro 2020

Objectives:

Restorations made of zirconia have gained some momentum over the last years. Zirconia can be cemented using self-adhesive (no primer) or adhesive (containing a dedicated primer) resin cements. In this study, we investigated the shear bond strength of a novel experimental resin cement with and without primer to zirconia in comparison to contemporary adhesive resin cements.

Methods:

Calibra® Ceram (CC, Dentsply) + Prime&Bond elect™ (PBE, Dentsply), Experimental Cement (EXP-C, 3M), Experimental Cement (EXP-C, 3M) + Experimental Adhesive (EXP-A), PANAVIA™ V5 (PV5, Kuraray Noritake) + Clearfil™ Ceramic Primer Plus (CFCP+, Kuraray Noritake) and Variolink® Esthetic (VLE, Ivoclar Vivadent) + Monobond® Plus (MBP, Ivoclar Vivadent) were tested. All cements and primers were used according to manufacturers' instructions. 3M™ Lava™ Plus High Translucency Zirconia (3M) was sandblasted (50µm, 2 bar), rinsed off with ethanol and dried with air. Stainless steel rods (diameter=4mm) were sandpapered, sandblasted, silanized (3M™ ESPE™ Sil, 3M).
For adhesive resin cements, PBE, EXP-A, CFCP+ or MBP were applied to the pre-treated zirconia discs prior to cementation. Cementation was performed (n=12) under standardized pressure (20g/mm²). The cements were irradiated from 4 sides (10s each; 3M™ Elipar™ S10 LED Curing Light, 3M). All specimens were stored for 24h (36°C; 100% relative humidity). Then, half of the samples was further subjected to artificial aging (5000 cycles). Shear bond strength testing was performed (Zwick Z010; n=6; speed=0.75mm/min). Data analysis was performed using One-Way ANOVA (Tukey; $p<0.05$).

Results:

Material	SBS to zirconia ± STD, 24h	SBS to zirconia ± STD, 24h + TC
CC + PBE	34.9 ± 4.6 ^{C}	36.9 ± 6.2 ^{B}
EXP-C	36.9 ± 4.0 ^{C}	35.1 ± 2.3 ^{B}
EXP-C + EXP-A	56.6 ± 3.0 ^{A}	51.9 ± 4.0 ^{A}
PV5 + CFCP+	39.0 ± 3.3 ^{B,C}	36.3 ± 7.2 ^{B}
VLE + MBP	44.3 ± 4.5 ^{B}	37.7 ± 4.5 ^{B}

Table: Shear bond strength (SBS) of resin cements with standard deviation (STD) before and after thermocycling (TC). Means that do not share the same superscript letter in a column are significantly different.

Conclusions:

In the self-adhesive mode without any primer, the Experimental Cement delivered statistically identical shear bond strength to zirconia after artificial aging as all the other adhesive resin cements with dedicated zirconia primer. This simplifies the clinical workflow and may reduce the risk of mistakes. If used with the Experimental Adhesive, the Experimental Cement showed the statistically highest adhesion performance to zirconia which may be of benefit to challenging clinical situations.

3M summary:

The results of this study show that the Experimental Cement* used as a self-adhesive resin cement (no primer applied) leads to excellent bond strength values to zirconia comparable to leading adhesive resin cements used with their recommended zirconia primers. In combination with the Experimental adhesive** the bond strength of the experimental cement* is further enhanced.

*Now commercially available under the name 3M™ RelyX™ Universal Resin Cement
**Now commercially available under the name 3M™ Scotchbond™

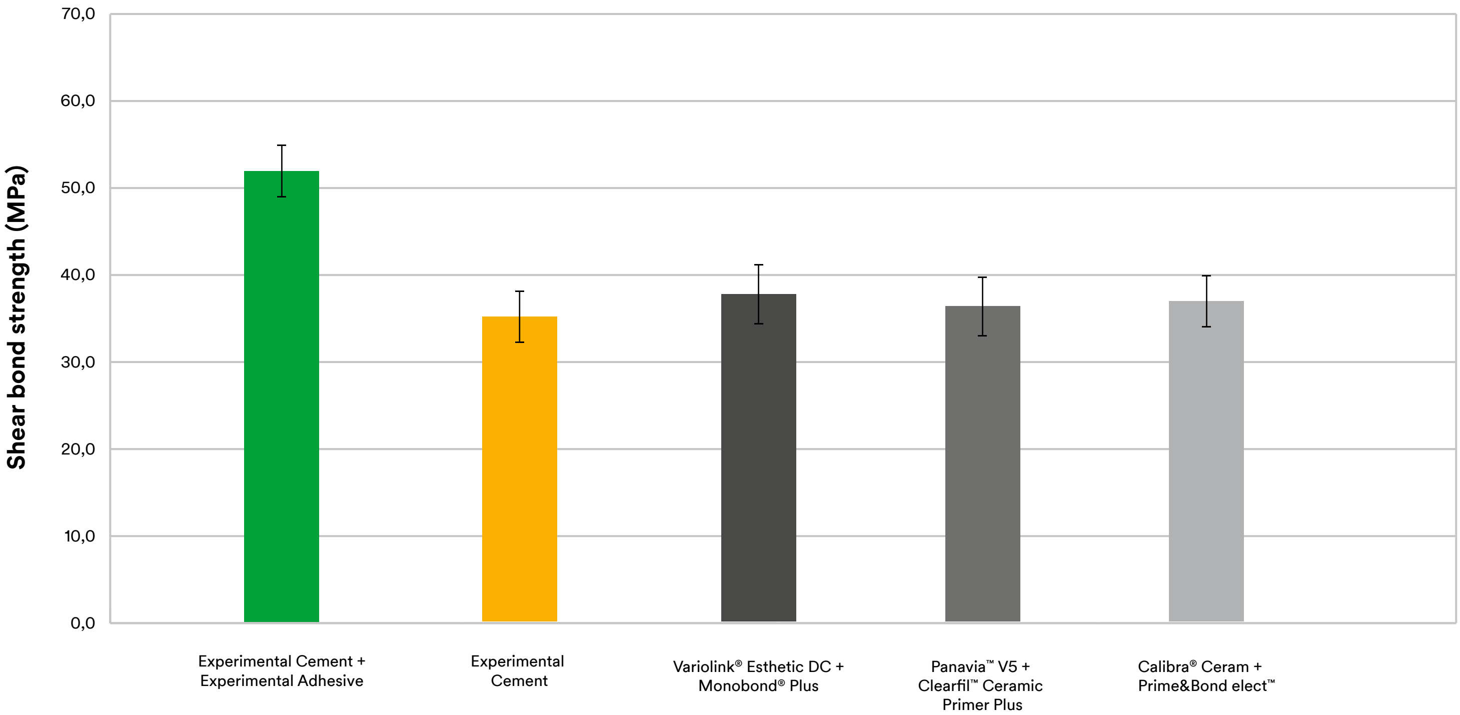

Figure: Shear bond strength values of light-cured resin cements to zirconia after thermocycling.

Shear Bond Strength of a Novel Resin Cement to Zirconia

Published by: C. E. Sabrosa[1], K. Geber[1], S. Vandeweghe[2]

Published in: J. Dent. Res. Vol 99A, No 1838, 2020, https://iadr.abstractarchives.com/abstract/20iags-3318653/shear-bond-strength-of-a-novel-resin-cement-to-zirconia

[1] Clínica Odontológica Dr Sabrosa, Rio de Janeiro, Brazil
[2] Ghent University, Ghent, Belgium

Objectives:

Measure shear bond strength of a novel resin cement to a zirconium oxide restorative material compared to other self-adhesive and adhesive resin cements in the self-cure and light-cure modes.

Methods:

Two different self-adhesive resin cements, 1-Experimental Cement (3M) and 2-Calibra® Universal (Dentsply), and two adhesive resin cements 1-Experimental Cement (3M) and 3-PANAVIA™ V5 (Kuraray Noritake) with their correspondent primer systems, a-Experimental Adhesive (3M) and b-Clearfil™ Ceramic Primer Plus (Kuraray Noritake) respectively, were used according to manufacturers' instructions. Forty-eight disc-like specimens of a commercially available cubic zirconium oxide restorative material (3M™ Lava™ Esthetic Fluorescent Full-Contour Zirconia, 3M) were separated into 8 groups (n=6), prepared by cutting a CAD/CAM disc and firing. The test surface of the specimens was sandblasted with a 50µm Al_2O_3 with 2 bar pressure, rinsed off with ethanol and dried with air before use. When indicated, the correspondent primer was applied before testing. Stainless steel rods measuring 4mm in diameter were sandpapered, sandblasted with 110µm Al_2O_3 modified with SiO_2 (3M™ Rocatec™ Plus, 3M) with 2.5 bar pressure, silanized (3M™ ESPE Sil, 3M) and subsequently cemented under standardized pressure (20g/mm²) onto the sandblasted surface. Excess cement was removed immediately after cementation in 2 different ways: 1-for the self-cure mode, after excess removal, a glycerine gel (AIRBLOCK™, Dentsply) was applied around the specimens before storage for 10min under pressure at 36°C. After 10min the pressure was relieved, the glycerine gel was washed off with distilled water; 2-for the light-cure mode, after excess removal, a LED-curing unit (3M™ Elipar™ DeepCure LED Curing Light, 3M, irradiance of 1470mW/cm²) was used to polymerize all specimens for 10s from 4 different angles. After light curing, the pressure was relieved, specimens were washed off with distilled water. All specimens were then stored at 36°C in 100% relative humidity for 24h before testing. Shear bond strength was performed in a universal testing machine (Zwick Z010, Zwick/Roell) at a crosshead speed of 0.75mm/min. Means and standard deviations were calculated. Results were analyzed with ANOVA followed by Tukey HSD test ($\alpha=0.05$).

Results:

Means and standard deviations of shear bond strength values (SBS) are shown in Figures 1 and 2 and Tables 1 and 2. All tested specimens failed in adhesive mode. There was a statistically significant difference ($p<0.05$) in shear bond strength values between the tested groups. Subgroups are identified with letters in both figures and tables. The group of the Experimental Cement with the Experimental Adhesive in the self-cure mode presented statistically significantly higher ($p<0.05$) shear bond strength values than all other groups. In the light-cure mode although the Experimental Cement with the Experimental Adhesive presented higher shear bond strength values, there was no statistical significant difference ($p>0.05$) to the Experimental Cement in the self-adhesive mode.

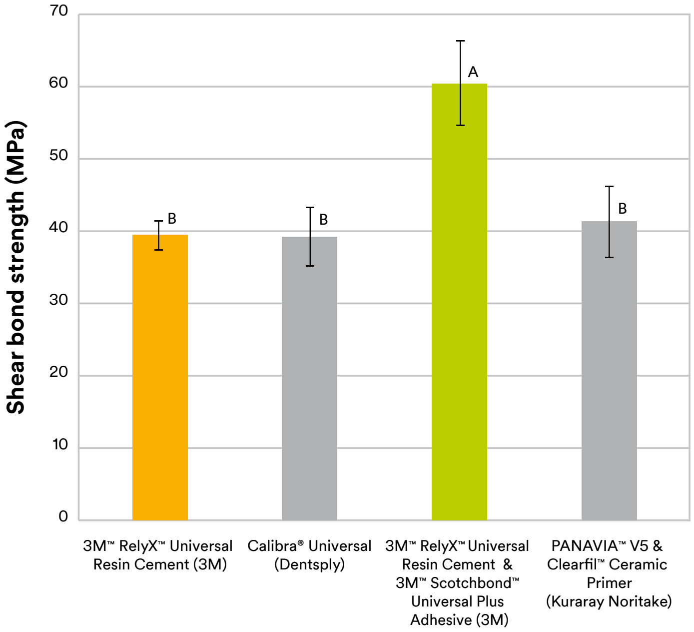

Figure 1: Shear bond strength of self-adhesive and adhesive resin cements to zirconia in the self-cure (SC) mode. Different letters indicate different subgroups.

Group	Material	Mean ± SD (MPa)	Tukey HSD (α=0.05)
1	3M™ RelyX™ Universal Resin Cement (3M)	39.5 ± 1.8	B
2	Calibra® Universal (Dentsply)	39.2 ± 4.4	B
3	3M™ RelyX™ Universal Resin Cement & 3M™ Scotchbond™ Universal Plus Adhesive (3M)	60.4 ± 5.7	A
4	PANAVIA™ V5 & Clearfil™ Ceramic Primer (Kuraray Noritake)	41.4 ± 5.4	B

Table 1: Means and standard deviations of shear bond strength values (MPa) in the self-cure mode.

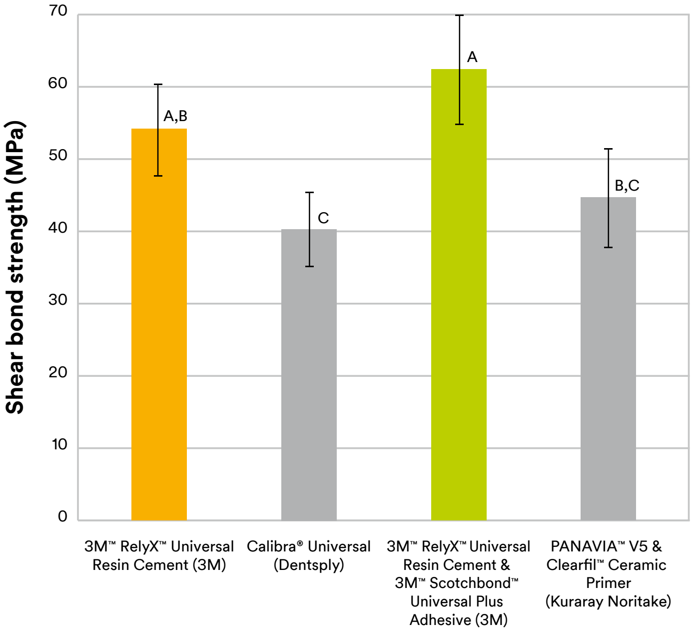

Figure 2: Shear bond strength of self-adhesive and adhesive resin cements to zirconia in light-cure (lc) mode. Different letters indicate different subgroups.

Group	Material	Mean ± SD (MPa)	Tukey HSD (α=0.05)
1	3M™ RelyX™ Universal Resin Cement (3M)	54.2 ± 6.2	A, B
2	Calibra® Universal (Dentsply)	40.3 ± 5.0	C
3	3M™ RelyX™ Universal Resin Cement & 3M™ Scotchbond™ Universal Plus Adhesive (3M)	62.4 ± 7.3	A
4	PANAVIA™ V5 & Clearfil™ Ceramic Primer (Kuraray Noritake)	44.7 ± 7.2	B, C

Table 2: Means and standard deviations of shear bond strength values (MPa) in the light-cure mode.

Conclusions:

Under the limitations of this study, it can be concluded that the Experimental Cement + Experimental Adhesive presented shear bond strength values statistically significantly higher than all other groups in both self-cure and light-cure modes. In the self-cure mode there was no difference between the Experimental Cement in the self-adhesive mode, Calibra® Universal and PANAVIA™ V5 + Clearfil™ Ceramic Primer Plus. In the light-cure mode, the Experimental Cement with the Experimental Adhesive presented the best shear bond strength values although there was no difference to the Experimental Cement in the self-adhesive mode.

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3M summary:

This study shows that the Experimental Cement* used as a self-adhesive resin cement (no primer applied) leads to excellent bond strength values to zirconia comparable to Panavia™ V5 adhesive resin cement used with the recommended zirconia primer. In combination with the Experimental Adhesive** the bond strength of the Experimental Cement* is further enhanced and significantly higher than Calibra® Universal and Panavia™ V5 with primer.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement
** Now commercially available under the name 3M™ Scotchbond™ Universal Plus Adhesive

Shear Bond Strength of a Novel Adhesive Resin Cement to Glass Ceramic

Published by: K. Geber[1], S. Vandeweghe[2], A. Patel[3], C. E. Sabrosa[1,2]

Published in: J. Dent. Res. Vol 98B, No 327, 2019, https://iadr.abstractarchives.com/abstract/ced-iadr2019-3222957/shear-bond-strength-of-a-novel-adhesive-resin-cement-to-glass-ceramic

[1] Clínica Odontológica Dr Sabrosa, Rio de Janeiro, Brazil
[2] Ghent University, Ghent, Belgium
[3] UCL Eastman Dental Institute, London, UK

Objectives:

Measure shear bond strength (SBS) of a novel adhesive resin cement to glass ceramic.

Methods:

Three different adhesive resin cements, 1-Experimental Cement (3M); 2-3M™ RelyX™ Ultimate Adhesive Resin Cement (3M); and 3-Variolink® Esthetic (Ivoclar Vivadent) were used with their correspondent primer system, a-3M™ RelyX™ Ceramic Primer (3M); b-Experimental Adhesive (3M); c-3M™ Scotchbond™ Universal Adhesive (3M) and d-Monobond® Plus (Ivoclar Vivadent). Thirty disc-like specimens of the glass ceramic (IPS e.max® CAD, Ivoclar Vivadent) were separated into 5 groups (n=6), prepared by cutting a CAD/CAM block and firing. The surface of the specimens was etched with HF 5% for 20s and rinsed off with water. The restoration primer was applied subsequently. Stainless steel rods measuring 4mm in diameter were sandpapered, sandblasted (3M™ Rocatec™ Plus, 3M), silanized (3M™ ESPE™ Sil, 3M) and subsequently cemented under standardized pressure (20g/mm^2) onto the etched surface. Excess cement was removed immediately after cementation and an LED curing unit (3M™ Elipar™ DeepCure LED Curing Light, 3M) was used to polymerize specimens for 10s from 4 different angles. After light curing, the pressure was relieved, specimens were washed off with distilled water and stored at 36°C in 100% relative humidity for 24h. SBS was performed in a universal testing machine (Zwick Z010) at a crosshead speed of 0.75mm/min. Results were analyzed with ANOVA followed by Tukey HSD test (α=0.05).

Results:

Means and standard deviations of SBS values are shown in Figure 1 and Table 1. All tested specimens failed in adhesive mode. There was a statistically significant difference ($p<0.05$) in SBS values between the tested groups. Subgroups are identified with letters in Figure 1. The group of the Experimental Cement with a 3M™ RelyX™ Ceramic Primer presented statistically significantly higher ($p<0.05$) SBS values than all other groups.

Group	Material	Mean ± SD (MPa)	Tukey HSD (α=0.05)
1	Experimental Cement (3M) 3M™ RelyX™ Ceramic Primer (3M)	65.68 ± 4.67	A
2	Experimental Cement (3M) Experimental Adhesive (3M)	48.57 ± 6.54	B
3	3M™ RelyX™ Ultimate Cement (3M) 3M™ RelyX™ Ceramic Primer (3M)	52.50 ± 2.44	B
4	3M™ RelyX™ Ultimate Cement (3M) 3M™ Scotchbond™ Universal Adhesive (3M)	39.98 ± 7.99	B
5	Variolink® Esthetic (Ivoclar Vivadent) Monobond® Plus (Ivoclar Vivadent)	50.27 ± 12.24	B

Table 1. Shear bond strength to IPS e.max® CAD (Ivoclar Vivadent). Means and standard deviations of tensile bond strength values (MPa).

Conclusions:

Under the limitations of this study, it can be concluded that the Experimental Cement with 3M™ RelyX™ Ceramic Primer presented SBS values statistically significantly higher than all other groups. The Experimental Cement with the Experimental Adhesive performed as well as 3M™ RelyX™ Ultimate Adhesive Resin Cement and Variolink® Esthetic with their dedicated primer systems.

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https://iadr.abstractarchives.com/abstract/ced-iadr2019-3222957/shear-bond-strength-of-a-novel-adhesive-resin-cement-to-glass-ceramic, 2019

3M summary:

Glass ceramic restorations need to be HF etched and silanized for adhesive bonding protocols. A silane primer is either offered separately or integrated in the universal adhesive. The results of this study show that the combined use of the Experimental Cement* and the Experimental Adhesive** leads to a similarly strong bond to IPS e.max® CAD as Variolink® Esthetic with Monobond® Plus Primer and 3M™ RelyX™ Ultimate Cement with different primers.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

** Now commercially available under the name 3M™ Scotchbond™ Universal Plus Adhesive

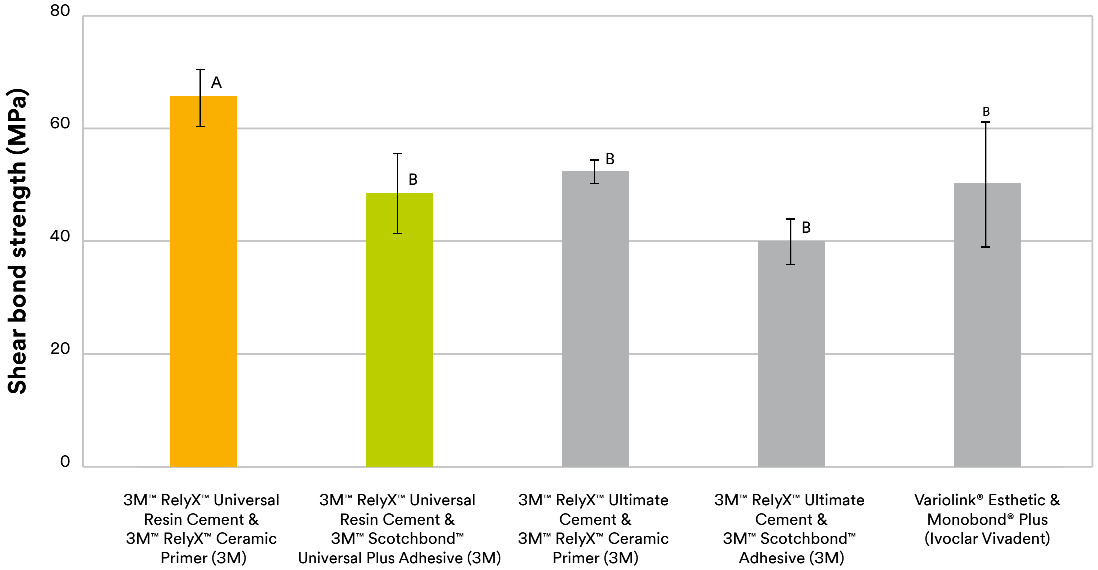

Figure 1: Shear bond strength values of adhesive resin cements to glass ceramic.

Determination of Excess Removability of Self-Adhesive Resin Cements

Published by: R. Afutu, K. Dunn, G. Kugel; Tufts University School of Dental Medicine, Boston, Massachusetts, United States
Published in: J. Dent. Res. Vol 98A, No 3624, 2019, https://iadr.abstractarchives.com/abstract/19iags-3164647/determination-of-excess-removability-of-self-adhesive-resin-cements

Objectives:

While seating a restoration, such as a crown, excess resin cement is formed around the margin. Many manufacturers of self-adhesive resin cements (SARCs) state easy excess removal. We aim to determine the force required to remove a defined amount of SARCs excess from a (pretreated) dentin surface after tack curing.

Methods:

Bovine teeth (n=5) were ground flat to expose dentin, polished (grit 320 sandpaper), distilled water rinsed, and gently air-dried. With the aid of a drilling template fixed with superglue (Sekundenkleber, Renfert GmbH), 1 to 3 cylindrical cavities (4.5±0.1mm diameter x 2.0±0.1mm depth) were drilled. Superglue was mechanically removed after drilling. Resin cement weighing 30mg was placed in the cavity and pushed through with a stainless steel rod (4.0±0.05mm diameter x 2.0±0.1mm height), so that all of the excess cement was pushed out onto one side of the cavity to form a half moon. Excess cement was cured for a defined time of 5 seconds, from a defined distance (2mm spacer) from the tooth surface using a 3M™ Elipar™ S10 LED Curing Light (3M). Excess cement was sheared off using a jig (Zwick Z010, n=5; speed= 0.75mm/min). Maximum force (N) to shear off the excess cement was recorded.

Results:

Cement (manufacturer)	Abbreviation	Irradiation time (s)	Force (N) of cement excess removal
Calibra® Universal (Dentsply)	CU	5	10.0 ± 2.0 [E]
Experimental Cement (3M)	EXP	5	14.4 ± 3.6 [E]
G-CEM LinkAce™ (GC)	GCEM	5	36.8 ± 6.7 [B,C,D]
Maxcem Elite™ Chroma (Kerr)	MAX	5	31.3 ± 6.4 [C,D]
PANAVIA™ SA Cement Plus (Kuraray Noritake)	PAN	5	11.3 ± 2.1 [E]
SpeedCEM® Plus (Ivoclar Vivadent)	SCP	5	21.6 ± 5.6 [D,E]
TheraCem® Ca (Bisco)	TC	5	50.9 ± 8.0 [A,B]
3M™ RelyX™ Unicem 2 Cement (3M)	RXU2	5	56.3 ± 9.2 [A]
3M™ RelyX™ Unicem 2 Cement (3M)	RXU2a	2	42.02 ± 17.5 [D,E]
3M™ RelyX™ Unicem 2 Cement (3M)	RXU2b	1	21.0 ± 2.7 [A,B,C]

Conclusions:

A method was developed to quantify force needed to remove cement excess. Under standardized conditions, different levels of removal force were identified. PAN, CU and EXP require a significantly lower force for excess removal. SCP and MAX require an intermediate force. RXU2 and TC require a significantly higher force to achieve excess removal. Excess removal force can be lowered by reducing irradiation time as shown with RXU2a and RXU2b.

3M summary:

Complete excess removal is a decisive factor influencing the periodontal health around a restoration. A low removal force indicates an easy clean-up. Tack-cure time influence on the removal force was analyzed for 3M™ RelyX™ Unicem 2 Automix Cement. For RelyX Unicem 2 Automix Cement a short tack-cure time of 1 sec is key for easy removal. A long tack-cure time of 5 sec was used to compare all cements. For EXP* a comparatively low force is needed to remove excess.

* Now commercially available under the name 3M™ RelyX™ Universal Resin Cement

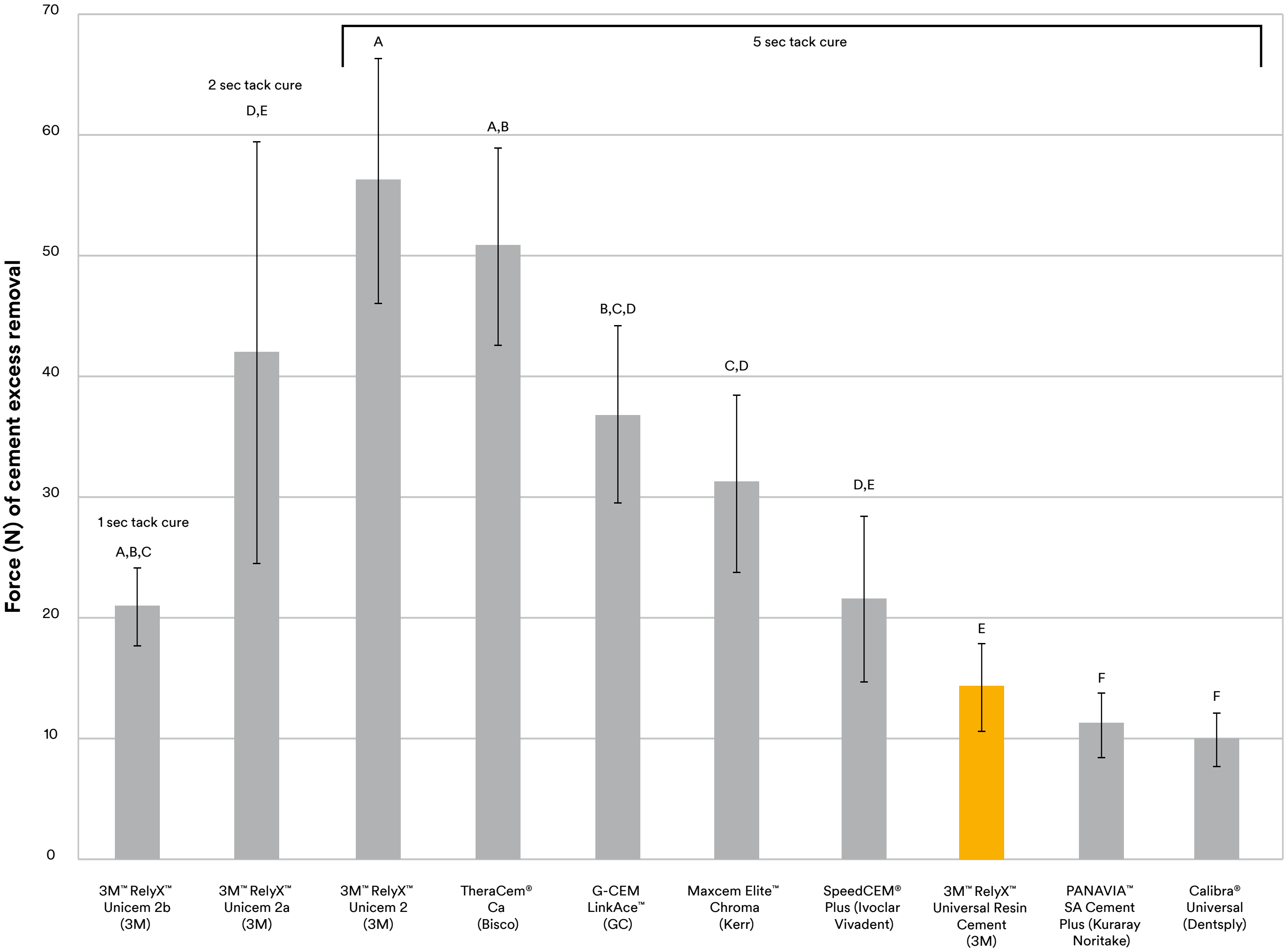

Figure: Maximum force (N) to shear off the excess cement after 5 second tack-cure time at room temperature.

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Always follow the Instructions for Use (IFU) and refer to IFU for full indications, precautions and warnings.