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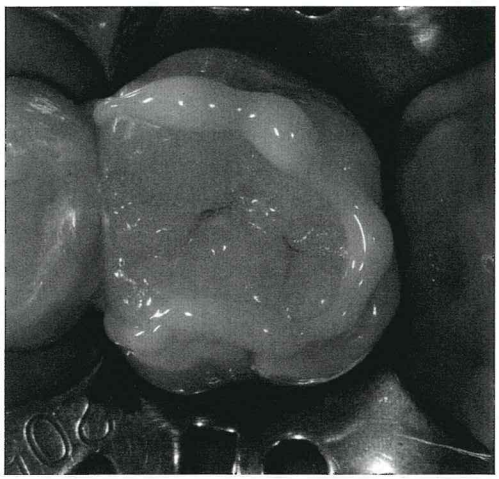

Porcelain inlay being cemented to prepared tooth with resin cement. The ability of the cement to bond the inlay to the tooth structure enhances the strength and durability of the inlay. See *BOND DEGRADATION OF SELF-ADHESIVE RESIN CEMENT AND CONVENTIONAL RESIN CEMENT.*

Dental Cements And Cementation

A cement's ability to retain a restoration to its prepared tooth is critical to the success of any indirect dental restoration. With all-ceramic silica-based restorations, the ability of the cement to bond the ceramic surface to the supporting dentin improves the long-term strength and serviceability of the restoration. A number of advances in recent years have been related to dental cements and cementation techniques. This issue of *Prosthodontics Newsletter* is devoted to studies related to cements and cementation methods.

Bond Degradation of Self-adhesive Resin Cement and Conventional Resin Cement

For strength and durability, all-ceramic restorations depend on the bond between the ceramic surface and the underlying tooth structure. G-CEM cement (GC Corp.; Tokyo, Japan) is a self-adhesive resin cement that is hydrophilic and has properties similar to glass ionomer cement. Prior to bonding, silica-based ceramics are commonly treated with a silane coupling agent, which provides a bond between the ceramic surface and the resin cement.

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Inside this Issue

Bond Degradation of Self-adhesive Resin Cement and Conventional Resin Cement

(continued from front page)

Liu et al from Nanjing University, China, compared G-CEM cement with 3 conventional resin cements: Clearfil Esthetic Cement (Kuraray Medical, Inc.; Tokyo, Japan), Linkmax HV cement (GC Corp.), both of which are dual-polymerizing composite resin cements, and SuperBond cement (Sun Medical Co., Ltd.; Moriyama, Japan), which is unfilled and autopolymerizing. Variables included water sorption, solubility and microshear bond strength against silanized ceramic surfaces after successive thermocycling regimens. Glass ceramic blocks (ProCad; Ivoclar Vivadent, Inc., Amherst, N.Y.) were prepared with a low-speed saw (Isomet; Buehler Ltd.; Lake Bluff, Ill.) to form ceramic plates measuring 13 × 11 × 1.5 mm.

The conventional resin cements were bonded to silanized ProCad plates with the silane coupling agent recommended by their manufacturers. G-CEM was bonded to the ceramic plates with each of the 3 silane coupling agents. Maximal water sorption and solubility of all cements were measured after storage in water for 6 weeks. The microshear bond strengths of the specimens were measured in a universal testing machine (AGS-10kNG; Shimadzu Corp., Kyoto, Japan) after 0, 10,000 and 30,000 thermal cycles (4° C and 60° C).

The G-CEM cement recorded significantly higher water sorption than did the other cements. The conventional resin cements were insoluble, but the G-CEM cement experienced a mean solubility of 4.7 $\mu g/mm^3$. The bond strengths of all cements degraded after 10,000 cycles of thermocycling. While no further significant degradation in mean bond strength occurred after 30,000 cycles with the G-CEM cement, the bond established by conventional cements further deteriorated after 30,000 cycles. After 30,000 cycles, the mean bond strength of G-CEM cement was similar to the strengths recorded for the other cements.

Comment

G-CEM cement showed good compatibility with all 3 silane coupling agents and better long-term bond stability than did the other cements. The advantage of self-adhesive cements, such as G-CEM cement, is ease of use. Because of its bond degradation behavior, this cement could be a practical alternative to conventional resin cements for long-term bonding of silanized ceramic restorations to tooth structure (see cover illustration).

Liu Q, Meng X, Yoshida K, Luo X. Bond degradation behavior of self-adhesive cement and conventional resin cements bonded to silanized ceramic. J Prosthet Dent *2011;105:177-184.*

Metal Primers and Bond Strength of Zirconia and Resin Cements

Because polycrystalline ceramics, such as zirconia ceramics, are acid resistant, conventional acid-etching techniques cannot be used with these materials to bond them to resin cements. To improve the bond of resin cements to zirconia ceramics, metal primers, commonly used to bond resin cements to metal oxides, have been suggested.

Dias de Souza et al from the University of Toronto, Canada, evaluated the influence of metal primers, resin cements and artificial aging on the bonding of resin cement to zirconia ceramic. Zirconia cylinders (Lava Frame; 3M ESPE, St. Paul, Minn.) were prepared, as were composite resin substrates (Z100; 3M ESPE); 100 specimens were assigned to 20 experimental groups ($n = 5$) according to the luting system, primer and storage time (Table 1).

Zirconia was treated with primers designed to bond resin cements to metal alloys; nonprimed specimens acted as controls. Composite resin substrates were cemented to the zirconia with either Panavia F2.0 (Kuraray America, Inc.; New York, N.Y.) or RelyX Unicem (3M ESPE) cement. Microtensile bond strength was evaluated after 48 hours and after 5 months.

Failures were classified as

- **type 1**—occurring between ceramic and cement surfaces
- **type 2**—occurring between composite resin and cement surfaces

Alloy Primer applied to the zirconia prior to cementation with RelyX Unicem produced a relatively high mean bond strength (15.9 ± 6.2 MPa). Other surface treatments did not significantly improve RelyX Unicem's bond strength compared with the con-

Table 1. Resin cements and primers used in microtensile bond strength test

Material	Manufacturer
Panavia F2.0	Kuraray America Inc., New York, N.Y.
RelyX Unicem	3M ESPE, St. Paul, Minn.
Alloy Primer	Kuraray America Inc.
Totalbond	Sun Medical Co., Moriyama, Shiga, Japan
Metaltite	Tokuyama Corp., Taitou-ku, Tokyo, Japan
Metal Primer II	GC Corp., Itabashi-ku, Tokyo, Japan

trol (7.2 ± 3.2 MPa). None of the chemical treatments improved bond strength for the Panavia specimens compared with the control (8.8 ± 5.1 MPa).

After 5 months, both luting systems presented decreased, statistically similar bond strengths. At 48 hours, the RelyX Unicem/Alloy Primer group displayed the lowest incidence of type 1 mode of failure (8%), but after 5 months, type 1 was the predominant mode of failure for all groups.

Comment

This study reported that the initial improvement in bond strength recorded after 48 hours does not withstand the test of time. After 5 months, both resin cements recorded statistically similar reduced mean bond strengths. There appears to be no long-term advantage with the use of the metal primers.

Dias de Souza GM, Thompson VP, Braga RR. Effect of metal primers on microtensile bond strength between zirconia and resin cements. J Prosthet Dent *2011;105:296-303.*

Glass Ionomer Cement Modified with N-vinylcaprolactam

N-vinylcaprolactam (NVC) has been used experimentally as an additive to glass ionomer cement (GIC) to improve the cement's mechanical properties. NVC in modified GIC may improve the surface properties, such as a reduction in the contact angle (enhanced wettability) and higher bond strength to dentin.

Moshaverinia et al from the University of Southern California evaluated the surface properties and bond strength of NVC-modified GIC to dentin. They also assessed NVC as a surface conditioner of dentin.

A terpolymer of acrylic acid (AA), itaconic acid (IA) and NVC with an AA-IA-NVC ratio of 8:1:1 was synthesized. The terpolymer was dissolved in distilled water at a ratio of 1:1 (wt/wt) and was mixed with Fugi IX glass ionomer powder (Fuji IX GP; GC Corp., Alsip, Ill.) with a 3.6:1 powder–liquid ratio. Commercially available Fugi IX GIC powder and liquid (GC Corp.) mixed with a powder–liquid ratio of 3.6:1 served as a control.

To measure contact angles, 10 disc-shaped specimens (12 × 1 mm) were made for each group. The surfaces of the discs were polished with medium-grit (grade P600) silicon carbide paper. Contact angles were measured 20 seconds after a drop of water was placed on the specimen.

Fifty extracted human third molar teeth were used to measure bond strength. One hundred dentin surfaces from these teeth were polished with medium-grit (grade P600) silicon carbide paper. After cements were placed in contact with the dentin surfaces, the specimens were stored at 100% humidity and 37° C for 1 hour and then in distilled water for 24 hours, 1 week and 1 month. Shear bond strength tests were performed in a universal testing machine (Instron Corp.; Norwood, Mass.).

To investigate the effect of dentin pretreatment with NVC-modified terpolymer on the wettability of dentin, human third molars were again used. The dentin surfaces were polished with 500-grit silicon carbide paper. The contact angle of a drop of water was measured on dentin conditioned with a commercially available conditioner (GC Cavity Conditioner; control group) and on dentin conditioned with the NVC-containing terpolymer (experimental group).

The NVC-modified GIC showed a significantly lower contact angle (45°) compared with the control GIC (58°). The wettability of dentin conditioned with the NVC-

containing terpolymer was significantly better (contact angle, 22°) than that of the dentin conditioned with the commercial conditioner (contact angle, 29°). The NVC-modified CIG recorded significantly higher bond strength to dentin (8.7 ± 0.15 MPa after 1 month) compared with the control group (8.4 ± 0.13 MPa after 1 month).

Comment

Introduction of NVC into GIC improved the surface properties of the cement and its adhesion to the tooth. Used as a dentin conditioner, the experimental NVC-containing terpolymer performed better than a commercially available dentin conditioner, as determined by measuring the contact angles.

Moshaverinia A, Chee WW, Brantley WA, Schricker SR. Surface properties and bond strength measurements of N-vinylcaprolactam (NVC)-containing glass-ionomer cements. J Prosthet Dent *2011;105:181-193.*

Dentin Conditioning And Bond Strength Of Self-adhesive Resin Cement

Manufacturers of self-adhesive resin cements claim that pretreatment of the tooth and restoration is not necessary to obtain a durable bond. It is thought that acidic resin monomers contained within the cement can diffuse through the smear layer on dentin and produce a resin bond to dentin, but the ability to form a strong durable bond has been questioned. Pisani-Proença et al from the University of Granada, Spain, evaluated the effects of different surface treatments on the dentin bond strengths of self-adhesive resin cements.

Composite resin blocks measuring 6 × 5 × 5 mm were fabricated (Tetric EvoCeram; Ivoclar Vivadent, Schaan, Liechtenstein). Forty-eight flattened dentinal surfaces on extracted human molars were prepared, and the teeth were divided into 4 groups.

- The control group received no dentin surface treatment.
- Group H_3PO_4 was etched for 15 seconds with 37% phosphoric acid (Total Etch; Ivoclar Vivadent, Amherst, N.Y.).
- Group SEBond received a 2-step self-etching primer adhesive (Clearfil SE Bond; Kuraray Co., Ltd., Osaka, Japan).
- Group EDTA was etched with 0.1 M EDTA (ethylenediaminetetraacetic acid) for 60 seconds.

Three self-adhesive luting agents—RelyX Unicem (3M ESPE, St. Paul, Minn.), Maxcem (Kerr Corp., Orange, Calif.) and Multilink Sprint (Ivoclar Vivadent)—were used to bond the composite resin blocks to the dentin.

After storage in distilled water at 37° C for 7 days, specimens were sectioned and subjected to a microtensile bond strength test. Treatment recommended by the manufacturer (no treatment) produced a statistically significantly reduced bond strength. With an untreated dentinal surface, RelyX Unicem achieved the highest mean bond strength. Overall etching with phosphoric acid achieved the highest mean bond strengths for all cements.

Comment

Self-adhesive resin cements are easy to use and save time. This study suggests that conventional etching of dentin with phosphoric acid will produce a better bond and that the benefit of saving time might come at the expense of compromised bond strength.

Pisani-Proença J, Erhardt MCG, Amaral R, et al. Influence of different surface conditioning protocols on microtensile bond strength of self-adhesive resin cements to dentin. J Prosthet Dent *2011;105:227-235.*

In the Next Issue

- Preparation design for ceramic laminate veneers
- Translucency of zirconia shaded substructure material
- Preparation design and marginal fit of zirconia crown copings

Our next report features a discussion of these issues and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.