Polymerization of a dual cure resin cement is affected by the type of ceramic overlying it, activation method, and post-activation time.

**Objective**: To evaluate the effects of different ceramics and different activation methods on conversion (as indicated by microhardness) of resin cements.

**Methods**: Ceramic specimens of 1.2-mm thickness were fabricated using 7 feldspathic porcelains, a leucite-reinforced ceramic (IPS Empress), a lithium disilicate material (Empress 2), 2 alumina ceramics (Procera and InCeram), and a zirconia ceramic (Cercon). A dual cure resin cement, Rely X ARC, was mixed and inserted into nylon molds. The cement was allowed to chemically cure or was light-activated for dual curing. As a control, no ceramic disk was placed between the cement and the light guide. In the experimental groups, light was delivered to the cement through the various ceramic disks, with an exposure time of 40 seconds. The Knoop hardness of the polymerized resin specimens was measured immediately after curing and 24 hours later. Knoop hardness is an indirect measure of degree of conversion (ie, how well the material polymerized).

**Results**: The light-activated (ie, dual cure) specimens had the highest Knoop hardness numbers (KHN), approaching a value of 50 both immediately and 24 hours later. The self-cure control had the lowest KHN at both measurement times, but it was not significantly different from some other groups. Light-activation through ceramic significantly reduced the KHN of the resin cement, although it generally tended to improve after 24 hours. The lowest KHN values were associated with the alumina and zirconia ceramics.

**Conclusions**: Polymerization of a dual cure resin cement is affected by the type of ceramic overlying it, activation method, and post-activation time.

**Reviewer's Comments**: There is really nothing particularly new or surprising in this study. For example, anyone with experience in this area would expect the cure of a resin cement to be less thorough beneath zirconia ceramic than beneath feldspathic porcelain of the same thickness. However, the study does remind us that curing a resin cement through any type of ceramic, including feldspathic porcelain, can be difficult. The chemical cure component of a self-cure cement helps to improve polymerization. Still, the resin cement cures best when it is not covered by ceramic, which is hardly practical clinically! (Reviewer - Edward J. Swift, Jr, DMD, MS).

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Keywords: Resin Cements

Print Tag: Refer to original journal article
In bench studies for leakage sectioning, the teeth can result in an inaccurate evaluation due to the plane of the cuts. Micro-CT is noninvasive, so this error might be eliminated.

**Background:** Can micro computed tomography (micro-CT) be used to accurately evaluate leakage of Class II resin composite restorations?

**Design:** 7 Class II composites were placed in children using cavity preparation and 7 Class II composites were placed using atraumatic restorative treatment (ART) procedures (hand instruments only). No local anesthetic was used on any of the 14 restorations. The manuscript does not say how long the restorations stayed in the mouth. The teeth were gently extracted when ready to exfoliate. The extracted teeth were then prepared, soaked in a 50% silver nitrate solution for 4 hours, mounted, and scanned with the cone beam.

**Results:** No marginal leakage was found in 5 traditional and 1 ART. The other 8 samples showed evidence of margin leaks.

**Conclusions:** CT is a valuable research tool that does not require destruction of the samples and allows multiple sections in both horizontal and vertical planes.

**Reviewer’s Comments:** The sample size (n=14) was too small and the technique too variable to conclude that ART was clearly inferior to removing the soft dentin with burs in a hand piece. I try to put only a few "pure research" papers in my reviews because I am not that interested in questions remote from the treatment room. Most dentists are convinced that leaking restorations are bad. We understand that if the test dye soak time is long enough and dye particles are very small, every dental material we currently use leaks. For years we have relied on serial sections in extracted teeth to make the leakage evaluations. It is well known that the blade thickness and the sectioning technique could distort the results. It appears that this micro-CT evaluation might be a valuable tool since the tooth and restoration are not cut into pieces. It was a little unusual that the research team had not worked out the time for soaking the teeth in silver nitrate with 100 cow teeth rather than soaking 1 of the precious 14 teeth in the study for 2 hours, 4 hours, and 16 hours. (Reviewer-J.D. Overton, DDS).

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Keywords: Restoration Leakage

Print Tag: Refer to original journal article
It is advisable to cool putty matrices prior to use when fabricating large provisional restorations.

**Background:** Indirect restorative procedures may cause adverse pulpal response due to preparation and reduction in remaining dentin thickness. This adverse response may be exacerbated during fabrication of provisional restorations due to the exothermic reaction during polymerization of acrylic or bisacryl resins. The material used for the provisional matrix has the potential to act as a heat sink and reduce the impact of this exotherm.

**Design/Objective:** This in-vitro study aimed to evaluate the difference in pulpal temperature between a putty matrix and a thin matrix. Additionally, the effect of cooling the putty matrix prior to polymerization was examined.

**Methods:** An extracted human tooth was mounted in a jig to allow an impression to be made as well as thin polyethylene clear matrices and silicone putty matrices. The pulpal tissue was removed and a silicone heat conduction material was placed in the pulp canal along with a thermocouple connected to a digital thermometer with a precision of 0.1°C. The tooth was prepared to receive an all-ceramic crown with 1.2-mm reduction on all surfaces. Three provisional materials were tested: 1 acrylic, *Trim* (Bosworth), and 2 bisacryl resins, *Cooltemp* (Coltene) and *Integrity* (Dentsply). The putty matrices were randomly distributed into 3 groups: room temperature (22°C); domestic refrigerator (4°C); and freezer (-12°C). The clear matrices were held at room temperature. Each combination of resin and matrix was tested by being positioned over the tooth with temperature reading recorded every 15 seconds for 10 minutes.

**Results:** The resins cured in the clear matrix showed pulpal temperature rise ranging from 4.0°C to 8.2°C, with a range of 3.4°C to 5.5°C when a room temperature putty matrix was used. When the putty matrix was cooled in a refrigerator, the temperature rise was reduced to zero. The pulpal temperature was reduced when using a putty matrix cooled in a freezer. The Bis-acryl *Integrity* demonstrated the greatest temperature rise. The *Trim* acrylic did not set in the putty matrix from the freezer.

**Conclusions:** Pulpal damage has been observed with a 5.5°C temperature rise. This study suggests that any of the 3 resins tested can create this in a thin matrix. The use of a putty matrix reduces this, while cooling the putty matrix in a refrigerator eliminates the pulpal temperature increase. It is advisable to cool a putty matrix for 30 minutes in the refrigerator prior to use, particularly with large provisionals.

**Reviewer's Comments:** This study demonstrates that with commonly used provisional materials, including bis-acryls, it is possible to generate pulpal temperature increases high enough to potentially cause damage. The use of putty matrices, particularly cooled, can mitigate this potential. This may be a particularly apt suggestion when fabricating very large provisionals.  (Reviewer-Daniel E. Wilson, DDS).

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Keywords: Provisional Resins

Print Tag: Refer to original journal article
Dentin Desensitizing Agents May Affect Dentin Bonding

Effects of the Desensitizing Agents Gluma and Hyposen on the Tensile Bond Strength of Dentin Adhesives.

Kobler A, Schaller HG, Gernhardt CR:

Am J Dent 2008; 21 (December): 388-392

HEMA-containing desensitizing agents do not appear to affect bond strengths.

**Background:** Dentin hypersensitivity causes brief, sharp pain resulting from hydrodynamic stimuli, such as thermal, evaporative, tactile, osmotic, or chemical. Available desensitizers are classified as neural stimulus blockers, anti-inflammatory drugs, protein precipitants, tubule-occluding agents, and tubule sealants and lasers. Agents should close tubules to block fluid shifts and prevent ingress of noxious substances. Topically applied desensitizers can effectively treat dentin hypersensitivity. Gluma Densensitizer contains 2-hydroxyethyl-methacrylate (HEMA) and 5% glutaraldehyde in water, and causes coagulation of plasma proteins in dentin fluid thereby occluding tubules. Hyposen is based on insoluble strontium salt-complexes that produce exchange of calcium ions with strontium ions and then recrystallization of strontium within the tubules.

**Objective:** To determine whether Gluma Desensitizer and Hyposen affected tensile bond strengths of Clearfil New Bond, Xeno III, and AdheSE adhesive systems. No previous studies involving Hyposen's effect have been reported.

**Methods:** Clinical crowns of freshly extracted third molars were sectioned and pulpal tissue removed. Occlusal surfaces were reduced leaving flat dentin surfaces 2-mm thick over the pulp chambers. Intrapulpal pressure was applied during the testing procedures. Three study groups were created: (1) control; (2) Gluma desensitizing agent application group; and (3) Hyposen desensitizing agent application group. Gluma was applied once to dentin and air-dried 30 seconds. Hyposen was applied, allowed to dry, and then reapplied. Specimens were subdivided into 3 sub-groups according to bonding agents and composite used: (1) Clearfil New Bond/Clearfil Core; (2) Xeno III/Tetric Flow; and (3) AdheSE/Tetric Flow. All materials were applied as directed by the manufacturer to the dentin previously covered with 1 of the desensitizing agents. Tensile bond strength tests were performed 15 minutes after light-curing Xeno III and AdheSE systems and 60 minutes after placement of self-curing Clearfil New Bond system.

**Results:** Bond strength means without desensitizers varied from 11.05 MPa for Clearfil New Bond to a low of 6.01 MPa for Xeno III. Values for groups with densensitizing agent ranged from 10.35 MPa for AdheSE group to 7.17 MPa for Xeno III group. Gluma application had no significant influence on Clearfil New Bond, but Hyposen significantly lowered bond strengths. Neither desensitizing agent significantly affected the AdheSE system bonds. The Xeno group achieved lower values with both desensitizing agents.

**Conclusions:** Gluma Densensitizer did not negatively affect bond strengths of the 3 adhesive systems tested. Using strontium containing Hyposen Densensitizer lowered values for total-etch system, but demonstrated less effect on self-etch systems.

**Reviewer's Comments:** We have many materials and agents from which to choose for placement of composite restorations, but we must be aware of the interactions of these agents and materials as demonstrated by results of this study. Both desensitizing agents work, but 1 appears contraindicated with total-etch adhesives. (Reviewer-Thomas G. Berry, DDS).

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Keywords: Bond Strengths

Print Tag: Refer to original journal article
Objective: To evaluate the dentin and enamel bond durability of 3 all-in-1 adhesives.

Methods: The 3 adhesives tested in this study were Adper Prompt L-Pop, iBond, and One-Up Bond F (OBF-2). Extracted human molars were prepared to obtain either flattened proximal enamel surfaces or superficial coronal dentin. Both were polished to 600 grit. The adhesives were applied according to manufacturer’s directions and composite was applied and cured. Following 24 hours storage in water, the specimens were sectioned into 0.7-mm thick slabs using a diamond saw. Either immediately or after 1 year of water storage, 2 dentin and 3 enamel slabs were sectioned further into small specimens for microtensile bond strength (MTBS) testing. Following the MTBS testing, failure odds were evaluated using optical and scanning electron microscopy (SEM). In additional specimens, bonded interfaces were examined using laser scanning confocal microscopy.

Results: The mean 1-day dentin MTBS values were 36.7 MPa for Prompt, 38.8 MPa for iBond, and 43.7 MPa for OBF-2. The corresponding values for enamel were 23.5, 17.9, and 25.4 MPa, respectively. With 1 exception, the enamel and dentin bond strengths after 1 year were significantly less than at 1 day. Most bond failures were mixed, partially adhesive, and cohesive in the resin material.

Conclusions: Bonds of all-in-one adhesives to enamel and dentin are not hydrolytically stable.

Reviewer’s Comments: Most laboratory studies of adhesives report only initial bond strengths. However, the durability of the bond is actually more important; therefore, studies such as the present one are always interesting. The 3 adhesives tested all performed well when tested shortly after bonding, particularly on dentin. However, after 1 year of water storage (which is considered to represent “accelerated aging,”) bonds to both dentin and enamel declined. These finding suggest that the adhesives form bonds that are not stable in water, a problem with obvious clinical implications. The study could have been improved by inclusion of a control material, preferably a proven 2-step etch-and-rinse adhesive such as OptiBond FL. Regardless, the study stands on its own merits and provides some good information about the all-in-one category of resin-based adhesives. (Reviewer-Edward J. Swift, Jr, DMD, MS).

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Keywords: Dentin Bonding

Print Tag: Refer to original journal article
Rotary instruments are still the best tools for invasive pit and fissure preparations.

**Background:** A number of new air abrasion units are offered to prepare fissures prior to sealant placement, but are these superior to using a bur?

**Objective:** To determine if air abrasion units are better than a bur for invasive pit and fissure preparations.

**Methods:** This extracted tooth study had 2 parts. In part 1, the 6 air abrasion devices were used on a flat enamel surface to determine how much volume loss of enamel happened during preparation of flat enamel surfaces. In part 2, fissures were removed from third molars with 6 air abrasion devices, a diamond bur, a fissurotomy bur, and a sonic tip. The prepared fissures were sealed and the leakage of the sealant determined.

**Results:** Rotary burs and PrepStart had less loss of enamel in part 1 of the study than did Rondoflex 27, Rondoflex 50, Airsonic Mini Sandblaster, and Primeus CPE. The only statistical separation was that the Rondoflex 50 prepared teeth had sealants that leaked more (6.7%) than any of the other choices (1.7% to 4.4%). The other 8 devices were statistically equal for leakage.

**Conclusions:** Because the air units were in no measure superior to a bur, the authors recommend rotary burs for invasive pit and fissure preparations.

**Reviewer's Comments:** Every carpenter knows that you need 2 clean surfaces to glue wood together well. We need the fissures to be clean for the best bond. We have 1/16 burs in the clinic for cleaning fissures prior to sealant application. We teach that the old technique of rubber cup-pumice on the teeth is a bad plan. Burgess found that a wet toothbrush was far superior to pumice on a prophy cup for cleaning teeth prior to sealant application because the pumice got stuck in the fissures and impeded the seal. Air abrasion did not litter the fissures in this study. Air abrasion was just not better than a rotary bur. The authors conclude that the expense and dust mess of an air abrasion unit are not justified by the results. Burs were the most conservative and gave an equal or superior seal. (Reviewer-J.D. Overton, DDS).

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Keywords: Invasive Pit & Fissure Preparations

Print Tag: Refer to original journal article
Which Cement Should Be Used With Fiber Posts?

*Evaluation of the Adhesion of Fiber Posts Cemented Using Different Adhesive Approaches.*
Radovic I, Mazzitelli C, et al:


Most resin cements, when used in self- or dual- cure mode, seem to similarly perform on the luting of fiber posts to root canal dentin.

**Objective:** To investigate the adhesion of fiber posts delivered with etch-and-rinse, self-etch, and self-adhesive resin cements.

**Materials/Methods:** 42 intact extracted human premolars with a single root canal were used. Crowns were removed 1 mm above the CEJ and the root canals prepared and obturated. Nine-mm post spaces were prepared and the teeth allocated into the following groups: (1) Calibra (Dentsply) - XP Bond (Dentsply) - RadiX Fiber Post (Dentsply); (2) FluoroCore 2 (Dentsply) - XP Bond - RadiX Fiber Post; (3) MultiCore Flow (Ivoclar Vivadent) - Excite DSC (Ivoclar Vivadent) - FRC Postec Plus (Ivoclar Vivadent); (4) Panavia F 2.0 (Kuraray) - RadiX Fiber Post; (5) Experimental self-adhesive cement - RadiX Fiber Post; (6) RelyX Unicem (3M ESPE) - RelyX Fiber Post (3M ESPE). Posts on groups 1 and 3 were treated with Calibra Silane Coupling Agent (Dentsply) and Monobond-S (Ivoclar Vivadent), respectively. XP Bond was used as a self cure activator, therefore in dual cure mode. (Panavia F 2.0 was used with ED Primer II. After 24 hours of water storage at 37°C, the roots were serially sectioned, and the push-out test was done on each section.

**Results:** Push-out strengths for Calibra and RelyX Unicem were comparable and significantly higher than FluoroCore 2 and Panavia F 2.0, which were not different between each other. MultiCore Flow and the experimental cement showed intermediate numbers that were not different from any system tested.

**Conclusions:** Push-out strengths of fiber posts bonded to root canals are influenced by different luting agents.

**Reviewer's Comments:** The success of restorations of endodontically treated teeth with fiber posts is directly related to the bonding achieved between fiber post and root dentin. An optimal bonding is difficult to achieve because of the high C-factor of root canals and inappropriate activation of the adhesive/cement. The present study could not determine which adhesive approach works the best for bonding of fiber posts to root canals. Important to point out is that a self cure activator was used when available and different posts were used for different groups. The effect of different post systems on the results is unknown. (Reviewer-Ricardo Walter, DDS).

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Keywords: Adhesion of Fiber Posts

Print Tag: Refer to original journal article
Bulimia damaged dentition can be restored with direct resin composite restorations.

**Case Report:** This is a case report involving 1 patient. The 50-year-old patient had bulimia damaged teeth with dentin exposed on every maxillary occlusal tooth surface and most mandibular teeth. The occlusal vertical dimension was being maintained by amalgams that were still present in 4 maxillary molars and 3 mandibular molars. The rehabilitation was done at the current vertical dimension of occlusion. An anterior jig was used to hold the occlusion while the maxillary posterior resins were placed to repair the molars and premolars. The occlusal surfaces were done with a flat occlusal anatomy. On the next visit, the mandibular posterior teeth were restored using the same flat occlusal anatomy. The porcelain fused to metal (PFM) crowns on #8 and #9 were removed and restored with resin composite. Dr. Belvedere shows a technique in which he stabilizes a mylar matrix at the root surface using unfilled resin or cotton soaked in unfilled resin that is light cured. He then bulk fills the matrix with composite. Other features of his technique are: (1) cutting retention grooves in the teeth; (2) using a flame-shaped red-banded diamond to prepare the dentin rather than pumice; (3) use of ethylenediaminetetraacetic acid (EDTA) prior to acid etching; and (4) a fourth generation etch wash bonding system. After the case is near completion, he uses burs and polishers to cut anatomic detail into the posterior teeth.

**Reviewer's Comments:** I enjoyed this manuscript. By my measure some of his techniques are not well justified and some are very innovative. His justification for retention grooves from a 1970s lecture by Dr. Phillips is quite out of date since in 1970 we had no commercial dentin bonding systems. There is a good chance that the undercuts will collect thick layers of bonding agent or will have air voids when the bulk of resin composite is placed. Research does not support that 1,200 mW/cm2 curing lights can cure resin composite in increments >2 mm, so his report of success with "bulk" fills may not apply to the rest of us. Scrubbing the dentin surface with EDTA is not necessary for these low C factor restorations. The reason that endodontists use EDTA is somewhat of a mystery to me, but I see no reason to do it for conventionally bonded resin composites. I very much like his matrix adaptation with unfilled resin that is not bonded to the tooth but will stay under the passive forces needed to push-pat resin composite to place. (Reviewer-J.D. Overton, DDS).

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Keywords: Bulimia

Print Tag: Refer to original journal article
Improving the Bond of Resin Cement to Zirconia

Effect of Surface Treatments and Aging in Water on Bond Strength to Zirconia.

Lindgren J, Smeds J, Sjögren G:

Oper Dent 2008; 33 (November-December): 675-681

Air abrasion and treatment with a metal primer can be used to improve the bond strength of RelyX Unicem to zirconia.

Objective: To evaluate the bonding of self-adhesive resin cement to zirconia, including the effects of various pre-treatments and aging in water.

Materials/Methods: 60 specimens of a hot pressed yttrium-oxide partially stabilized zirconia (Y-TZP) were obtained from its manufacturer and flattened using a CAD/CAM device. One group of 10 pairs was bonded using a dual-cure, self-adhesive resin cement (RelyX Unicem). A second group of 10 pairs was bonded using the same cement after application of a metal primer, and a third was bonded after application of a ceramic primer. Application of the ceramic primer was preceded by etching with 9.5% hydrofluoric acid (following manufacturer’s directions, although I am not sure why, because zirconia does not etch). Bond strengths were determined by loading to failure in a universal testing machine. After testing, the ceramic specimens were re-used. However, before primers or cement were applied, the surfaces were sandblasted using aluminum oxide particles. Bond strengths were determined shortly after bonding or after 180 days storage in water.

Results: Sandblasting and treatment with either a ceramic or metal primer significantly improved the bond strength compared to untreated specimens. Aging in water reduced bond strengths, except for specimens that were sandblasted and treated with metal primer.

Conclusions: Air abrasion and treatment with a metal primer seem to be an appropriate method for improving the bond strength of RelyX Unicem to zirconia ceramic.

Reviewer’s Comments: For resin bonding, zirconia cannot be treated using the same methods as feldspathic porcelain. It cannot be etched with hydrofluoric acid and traditional silane coupling agents do not work. The present study reports that a metal primer can improve resin bonding. At first, this seems surprising, but the composition of the primer is such that it could interact nicely with zirconia. The authors also recommend sandblasting, and in their study used fairly large particles (110 μm aluminum oxide). However, there is some evidence that sandblasting, especially with large particles, is not a good idea. This has the potential to create microscopic flaws in the zirconia that could lead to eventual failure. (Reviewer-Erward J. Swift, Jr, DMD, MS).

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Keywords: Resin Cement

Print Tag: Refer to original journal article
Radiofrequency surgery can be used to change melanin pigmented gingiva pink.

This paper has several case reports with before and after photographs in which dark brown-black melanin pigmentation of the gingiva is changed to coral pink gingiva after the surgery. Patients with a pacemaker or other similar device should not be treated with radiosurgery. The authors credit a new electrode labelled the Advanced Composition (Alloy) Electrode or ACE Electrode (from Ellman International) with better control and less collateral damage than previous electrodes. Tissue does not tend to adhere to the ACE electrode, which speeds the procedure. The before and after surgery 6-month photographs are significantly different. By report, the procedure can accomplished with a 10% lidocaine spray. I infer from the wording that most of the photographed cases used infiltration local anesthesia. Some of the heavy pigmentation cases had a second surgery at 2 weeks. Radiofrequency surgery with the ACE electrode was successful at reducing melanin pigmentation in gingiva at the 6-month observation period.

**Reviewer's Comments:** For my practice, this will be a seldom prescribed but potentially useful procedure. I have very, very few patients that show mandibular gingiva, so it is unlikely I would prescribe anything for mandibular gingiva. There are case reports of procedures using devices other than radiosurgery. Shimada (*J Periodontol* 2009; 8 [2]: 317 to 323) reported good results with an ascorbic acid gel. Rosa (*J Periodontol* 2007; 78 [10]: 2018 to 2025) reported several successes, but relapse of 1 case at 3 months when treated with an Er:YAG laser. Arikan (*Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007; 103 [4]: 452 to 457) reported good results using 1,1,1,2 tetrafluoroethane as a cryotherapy technique. I could not find any long-term case reports that would give you a way to predict for your patients the expected longevity of gingival melanin depigmentation. The surgeon's informed consent document would have to state that the duration of the effect is not documented in the literature. (Reviewer-J.D. Overton, DDS).

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Keywords: Melanin Pigmentation

Print Tag: Refer to original journal article
Glass ionomer liners improve the marginal quality and reduce leakage of Class I restorations.

Objective: To evaluate marginal quality and leakage in standardized Class I restorations placed using different bonding procedures.

Methods: Standardized Class I preparations (depth of 2.5 mm or 0.5 mm deeper when a liner was to be applied) were made in extracted human molars using diamond rotary instruments. In the "total bonding" specimens, a three-step etch and rinse adhesive (Syntac) was used. These specimens were restored using either Tetric composite resin or a CAD/CAM inlay, the latter serving as a control. For "selective bonding" specimens, the same adhesive and composite were used, but following application of a self-cure or light-activated glass ionomer liner. For "cavity sealing" specimens, the adhesive was applied, but the enamel margins were then prepared with a finishing diamond, etched, and bonded. Impressions of all restorations were made so that baseline margin quality could be assessed. They were then subjected to thermomechanical loading. Impressions were made after loading, and all were cast in epoxy. The epoxy replicas were examined using scanning electron microscopy (SEM) to evaluate marginal quality (presence of gaps, etc). The specimens were immersed in fuchsin dye, sectioned, and examined for microleakage. This was done using digital images made through an optical microscope and an ordinal 0 to 3 scale.

Results: Restorations with glass ionomer liners were found to have "excellent" marginal quality after thermomechanical loading. Margins of restorations placed using the adhesive alone, either in the total or selective bonding approach, had significantly fewer "perfect" margins. Specimens with glass ionomer liners also had significantly less microleakage than those without.

Conclusions: Glass ionomer liners improve the marginal quality and reduce leakage of Class I restorations.

Reviewer's Comments: The ability of glass ionomer liners to improve the margin quality of composite restorations is not completely understood. Numerous laboratory studies have indicated that the liners actually do improve margin quality, but there is little clinical evidence for this effect. It is possible that glass ionomers help to relieve polymerization contraction stress of the composite or simply provide a more favorable configuration factor by reducing the number of walls to which the adhesive is bonded. (Reviewer-Edward J. Swift, Jr, DMD, MS).

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Cement Choice Critical in Luting Zirconia-Based Restorations

Effect of Water Aging on Microtensile Bond Strength of Dual-Cured Resin Cements to Pre-Treated Sintered Zirconium-Oxide Ceramics.

Oyagüe RC, Monticelli F, et al:

Dent Mater 2009; 25 (March): 392-399

Traditional Bis-GMA based resin cements cannot be recommended with zirconia restorations.

**Background:** Zirconia-based ceramic restorations created with a CAD/CAM process have become increasingly common in dental practice today. Cementing these restorations remains problematic since the material is resistant to hydrofluoric acid etching and/or silanization. Some studies have suggested that air abrasion and silica coating may improve luting. Some MDP-containing cements (e.g., Panavia F) have shown satisfactory adhesion to zirconia. Newer MDP-containing cements and self-adhesive cements have been suggested for use with zirconia but with little literature support. Concern with the durability of these cements in the oral environment exists.

**Design/Objective:** This in vitro study examined the bond strength and durability after water storage of several cements and several pre-cementation surface treatments.

**Methods:** 18 zirconia CAD/CAM blocks (Cercon Zirconia, Dentsply) were randomized into 3 groups according to surface treatments: a control group with no pretreatment; a sandblasted group; and a tribochemical silica-coated group. Each group was divided into 3 subgroups according to different resin cements: Clearfil Esthetic Cement (Kuraray), Rely X Unicem (3M ESPE), and Calibra (Dentsply Caulk). Each combination of pretreatment and cement was luted to composite disks under a standardized pressure to analyze the cement/ceramic interface. After 24 hours, the specimens were sectioned in order to allow microtensile bond strength testing for half of the samples. The other half of the specimens were stored in distilled water in a body temperature oven for 6 months and then subjected to microtensile bond strength testing. Fractured specimens were evaluated microscopically to establish the mode of failure.

**Results:** At 24 hours, the Clearfil Esthetic Resin had higher bond strengths than the other 2 cements independent from pretreatment. All Calibra samples with the exception of those luted to sandblasted specimens failed prematurely. After 6 months of water storage, the Clearfil samples showed significant decreases in bond strength, while Rely X Unicem samples did not change. Calibra demonstrated 100% failure over time. In general, the number of adhesive failures increased with water aging.

**Conclusions:** The phosphate-based monomer (MDP) cement Clearfil Esthetic Cement and the self-adhesive cement Rely X Unicem proved satisfactory after water storage. The traditional Bis-GMA-based Calibra demonstrated unacceptable performance with zirconia. Durability was dependent on cement choice rather than surface treatment.

**Reviewer's Comments:** This limited study addresses only the ceramic/adhesive interface, but is important since it simulates the oral environment over time and addresses not only early bond strengths but longer-term durability. Multiple studies show the MDP-containing Panavia to be a good performer with zirconia. This study would have been stronger if it was included in the testing as a benchmark. Clinical studies are needed. (Reviewer-Daniel E. Wilson, DDS).

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Keywords: Zirconia Cementation

Print Tag: Refer to original journal article
Do Desensitizers Affect Bond of Resin Cement?

The Effect of Several Dentin Desensitizers on Shear Bond Strength of Adhesive Resin Luting Cement Using Self-Etching Primer.


J Dent 2008; 36 (December): 1025-1032

Some desensitizing agents could interfere with the bonding of adhesive resin cements that use a self-etch primer.

Objective: To examine the adhesion of a resin cement to dentin following application of various desensitizing agents.

Methods: 125 extracted human molars were ground flat to expose dentin, which was polished to 320 grit. These were divided into a control and 4 experimental groups. Desensitizers were applied in the experimental groups: either SuperSeal (oxalic acid and potassium salt); MS-Coat (a 2-component system using a copolymer and oxalic acid); Gluma (aqueous solution of HEMA and glutaraldehyde); or Copalite Varnish. ED Primer (a mild self-etch primer) was applied to all dentin surfaces. Panavia F was applied in an Ultradent mold (this is a standard specimen fabrication device) to create bonded cylinders of the material. After 24 hours of storage in 100% humidity, shear bond strengths were determined using an Instron universal testing machine. Fracture patterns were examined using scanning electron microscopy.

Results: The mean shear bond strength of the control group was about 15 MPa. Bonding to dentin treated with SuperSeal produced a mean bond strength of about 12 MPa, which was not significantly different from the control. Bond strengths in the other groups were significantly less, at 3 to 5 MPa. Specimens treated with Gluma had "semi-closed" dentinal tubules.

Conclusions: Some desensitizing agents can interfere with bonding of an adhesive resin cement that uses a self-etch primer.

Reviewer's Comments: Some parts of this study do not make sense. For example, only someone who had no idea what they were doing would apply Copalite and try to bond a restoration to it. Also, I question the general idea of using a desensitizer with a self-etch adhesive—why bother? Nevertheless, I am sure this is done occasionally, so clinicians should be aware that some desensitizing agents could adversely affect the performance of their resin cements. The most surprising result of the study is related to Gluma. This material has actually been shown to improve the bond of some etch-and-rinse adhesives but has not been tested extensively with self-etch materials. (Reviewer-Edward J. Swift, Jr, DMD, MS).

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Keywords: Resin Cement

Print Tag: Refer to original journal article
With adequate control of the operating field, glass ionomer can offer a long-lasting repair of root caries damage.

**Case Report:** An 82-year-old man had a failing repair on a crown margin. The previous repair had been done several years ago with resin composite. The author suggested that marginal leakage was likely if he made another repair with composite. The author does not offer amalgam restorations in his practice, so the material of choice was glass ionomer. He lists 8 properties of glass ionomers: fluoride release, bond to tooth, good marginal integrity, shrinkage 9 times less than resin composite, fluoride recharge, no free monomer, bulk fill, and biocompatibility. The restoration was performed with Fuji IX GP Fast. The instructions say to cure for 3 minutes, but the author credits Dr. Geoff Knight with using a curing light to accelerate the cure to 50 seconds. The restoration is finished with a coat of unfilled resin, which is light cured.

**Reviewer’s Comments:** Glass ionomer is an OK choice for margin repairs. I have concerns about a few of the facts reported in this paper. Most glass ionomer restorative materials shrink 3%. Most filled resin composites in use today shrink about 2.5% to 3%. It is thought that the adhesive bonds between the tooth and glass ionomer are constantly reforming as the material shrinks, which, theoretically, could decrease leakage. I looked at 8 different leakage studies, and the glass ionomers leaked just as much as the resin composites. The acid-base reaction that makes a paste into a solid takes time. The manufacturers have done a great deal of tweaking with the poly-acid mixes to speed the early setting reaction. I am reluctant to conclude that exposing a glass ionomer to the heat of my curing light would allow me to finish the restoration at 50 seconds. Water in perfect proportions is required for the glass ionomer setting reaction. Early in the setting phase, too much water or too little water will stop the setting reaction. The author correctly reports that fluoride recharge is a positive for using glass ionomer restorations. The coat of unfilled resin inhibits fluoride release and recharge. I highly recommend the unfilled resin coat because there are secondary reactions in glass ionomers that take up to 24 hours for final set, which could be inhibited by excess early moisture. (Reviewer-J.D. Overton, DDS).

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Keywords: Root Caries

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Marginal gaps of Cerec and IPS Empress inlays are <100 μm.

**Objective:** To compare the marginal accuracy of 2 all-ceramic systems: IPS Empress Esthetic and Cerec 3D CAD/CAM.

**Methods:** 16 upper and lower epoxy resins of fully dentate patients were mounted on articulators. MOD preparations including the distal and distobuccal cusps were made in the lower left first molars. The preparations were randomly divided into 2 groups. For those to be restored using IPS Empress, impressions were made and cast in dental stone. IPS Empress inlays were made using the standard laboratory techniques. The CAD/CAM restorations were manufactured from feldspathic porcelain blocks using the Cerec 3D system. The fit of all inlays was checked using a low-viscosity silicone material. The same material was used to create impressions of the seated restorations. Epoxy replicas were made from these impressions, sputter-coated with gold, and examined using scanning electron microscopy. Marginal gaps were measured using 50x magnification at 11 defined landmarks. The measurements were done by 2 independent examiners.

**Results:** The overall mean gap widths were 56 μm for the IPS Empress inlays and 70 μm for the Cerec inlays. The difference was statistically significant. Of the 11 landmarks, the highest mean gap was 94 μm for the Cerec system. More marginal chipping was observed with the CAD/CAM inlays.

**Conclusions:** This study verified that marginal gaps in proximal boxes were <100 μm for both IPS Empress and Cerec 3D inlays.

**Reviewer's Comments:** With current ceramic technology, the cement space between a ceramic inlay and tooth structure is the potential Achilles heel of the restoration. The literature suggests that a gap width of <100 μm is desirable. A narrow gap allows removal of the unpolymerized resin cement without pulling it out from under the restoration. A narrow gap also is more resistant to wear and minimizes leakage that could result from polymerization shrinkage stress. The Cerec 1 system typically produced inlays with much larger marginal gaps. Research on the Cerec 2 system was mixed, with some trials reporting gaps >100 μm and some reporting smaller. The present study suggests that the Cerec 3D produces inlays well within the acceptable range.

(Reviewer—Edward J. Swift, Jr, DMD, MS).

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Keywords: Ceramic Inlays

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Background: The aesthetic advantage to direct resin composite restorations compared to amalgam is clear. There is debate on the longevity of these 2 materials in posterior teeth, and this is a common question from our patients. Although there have been many studies related to the longevity of composite resin restorations, few directly compared dental amalgam with resin composite restorations.

Objective: To evaluate the need for replacement of amalgam and composite restorations during the subjects’ first years in military service.

Methods: The records of 2780 military personnel were analyzed relative to the number and type of direct posterior restorations present. The numbers of each type of restoration requiring replacement at the initial examination were recorded. The remaining restorations that were deemed satisfactory were followed regarding the need for replacement. Subjects were followed up for a minimum of 2 years and received at least 2 periodic examinations; mean observation time was 3 years.

Results: Upon initial examination, 15.2% of the amalgam restorations and 17.4% of the resin restorations required replacement. Multi-surface restorations required replacement at a higher rate than single-surface restorations. Adjusted hazard ratios were calculated (a comparison of the risk of replacement of composite vs that of amalgam). The hazard ratios were adjusted for material, caries risk status, tooth type, and restoration surfaces. The adjusted ratios demonstrated a significantly higher rate of replacement for resin restorations than for amalgam restorations. For both restoration materials, the higher the caries risk, the greater the risk of restoration replacement. Likewise, replacement rates were higher for multi-surface restorations than for 1-surface restorations. A large proportion of the restorations replaced were done as a result of primary caries on a separate surface. When restorations that were replaced only on the same surfaces (suggestive of material failure or secondary caries) were considered, there was a higher replacement risk for composite than for amalgam.

Conclusions: Within the study period, the proportion of posterior teeth restored with amalgam has steadily dropped. Multi-surface restorations, restorations in higher caries-risk individuals, and resin-based restorations required replacement at a higher rate. The authors suggest that posterior composite resin restorations be limited to patients with low to moderate caries risk and smaller restorations.

Reviewer’s Comments: This study attempts to compare longevity of composite versus amalgam. The large sample size is a strength, but the large number of variables makes drawing a clear conclusion regarding the longevity of amalgam versus composite difficult. This study does not clearly define a superior material choice, but it was clear that regardless of the material, multi-surface restorations and those in higher caries-risk individuals required replacement more frequently. (Reviewer-Daniel E. Wilson, DDS).

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Keywords: Composite Amalgam

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How Does Dentin Etching Affect Self-Etch Adhesives?

Bonding Durability of Single-Step Adhesives to Previously Acid-Etched Dentin.

Ikeda M, Tsubota K, et al:

Oper Dent 2008; 33 (November-December): 702-709

Acid-etching reduces the bond strengths of all-in-one self-etch adhesives to dentin.

Objective: To determine the effect of prior acid-etching on the shear bond strengths of all-in-1 self-etch adhesives to dentin.

Methods: The adhesives tested in this study were Absolute, Clearfil tri-S Bond, Fluoro Bond Shake One, G-Bond, and One-Up Bond F Plus. Each adhesive was used with a composite from its respective manufacturer. The labial surfaces of 200 bovine incisors were ground to expose flat dentin, which was polished to 600 grit. A piece of adhesive with a 4-mm diameter hole was applied to define the bonding area. Half of the specimens were etched with 35% phosphoric acid for 15 seconds. The adhesives were applied according to their manufacturers' directions. Composite was placed and light-activated in a Teflon mold. Bonded specimens from each group were either stored in water for 24 hours or thermocycled 10,000x. Shear bond strengths were determined using an Instron universal testing machine. Treated dentin surfaces and resin-dentin interfaces were examined using field emission scanning electron microscopy (FE-SEM).

Results: Without acid-etching, mean bond strengths for the specimens stored in water ranged from 12.8 to 17.1 MPa. With prior etching, mean bond strengths were 6.7 to 13.3 MPa. Bond strengths were generally lower for the thermocycled specimens but the same pattern held true (ie, pre-etching tended to reduce bond strengths). FE-SEM showed that pre-etched specimens had thicker hybrid layers.

Conclusions: Acid-etching of dentin prior to application of all-in-1 adhesives should be avoided.

Reviewer's Comments: Self-etch adhesive systems, whether the 2-step products that include a separate primer or the all-in-1 systems, are mildly acidic compared to phosphoric acid. Therefore, the ability of these materials to etch enamel is somewhat limited. Because of that, some authors and clinicians have recommended that enamel be pre-etched prior to use of a self-etch adhesive system. However, as this study shows, etching can have an undesirable side effect. While it improves the enamel bond, it also reduces the dentin bond. Therefore, if enamel is etched prior to application of a self-etch adhesive, contact of the acid etchant with the dentin should be minimized as much as possible. (Reviewer-Edward J. Swift, Jr, DMD, MS).

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Keywords: Bonding

Print Tag: Refer to original journal article
The quality of the surface of a sealant, which is likely to improve over time, may affect the long-term success of the material.

**Objective:** To investigate the adhesion of *Streptococcus mutans* to different sealants.

**Methods:** Cylindrical specimens measuring 10 mm in diameter and 2 mm in thickness were made of 10 different pit and fissure sealants: Clinpro Sealant (3M ESPE), Delton FS+ (Dentsply DeTrey), Embrace WetBond Pit and Fissure Sealant (Pulpdent), Grandio Seal (Voco), Guardian Seal (Kerr), Helioseal F (Ivoclar Vivadent), UltraSeal XT plus (Ultradent), Ketac Bond Glass Ionomer (3M ESPE), Fuji II LC (GC), and Dyract Seal (Dentsply DeTrey). Twenty specimens of each material were made, fully polymerized, polished, and stored in distilled water for 5 days before testing. Surface roughness, surface-free energy, and adhesion of *S. mutans* were measured at different time points (baseline, 1 month, 6 months, and after thermocycling).

**Results:** Surface roughness of all materials increased over time. That was especially significant for Guardian and Ketac Bond. Fuji II LC displayed steady high roughness since baseline. The surface-free energy of the materials declined over time. After aging, no difference in *S. mutans* adhesion was found between the glass control and Embrace, Helioseal, and Dyract. Guardian presented a high amount of adhering *S. mutans*, and Clinpro and Delton presented moderate amount of adhering *S. mutans*. UltraSeal XT and Ketac Bond performed the best, showing low numbers of adhering *S. mutans* after aging.

**Conclusions:** Aging reduced the adhesion of *S. mutans* to the materials tested. In part, that may have been because of declining surface-free energy values over time as *S. mutans* have affinity for high surface-free energy substrates. No correlation between surface roughness and adhesion of *S. mutans* was noticed (except for Guardian).

**Reviewer's Comments:** Pit and fissure sealants have proved efficient as a preventive method in clinical studies. However, that has been related primarily to the good sealing ability of the materials. This study presented interesting information that may influence the success of those materials and should be further clinically investigated. This trial did not evaluate the effect of the fluoride contained in some of the materials on *S. mutans* adhesion. (Reviewer-Ricardo Walter, DDS).
Resin-based infiltrants with high penetration coefficients are able to penetrate caries lesions better than resin-based adhesives.

**Objective:** To compare penetration of a resin-based adhesive and an experimental "infiltrant" into natural caries lesions.

**Methods:** Extracted human molars and premolars with proximal white spot lesions were used. Standardized radiographs of each tooth were made, and lesion extension was scored by a single examiner. The crowns of the teeth were sectioned, providing 2 halves of each lesion. These were examined using stereomicroscopy and scored with respect to histologic lesion extension. Next, the cut surfaces were coated with nail varnish, and the lesion surfaces were etched using an experimental 15% hydrochloric acid gel. Either a dentin/enamel adhesive (Excite) or an experimental infiltrant (a dimethacrylate resin in ethanol) was applied to the lesion surfaces. Each resin was labeled with a red fluorescent dye and was allowed to penetrate the surface for 5 minutes before light-curing. The specimens were sectioned and examined microscopically and microradiographically, with lesion depth and resin penetration depth measured at 10 defined points.

**Results:** Penetration depths of the commercial adhesive were significantly less than those of the experimental infiltrant.

**Conclusions:** Resin materials with higher penetration coefficients are able to penetrate natural caries lesions better than resin-based adhesives.

**Reviewer's Comments:** This paper covers a subject that we would not normally review for this Cosmetic Dentistry program. However, I decided to include it because the topic is very novel. As we all know, sealants are commonly used to prevent caries in pits and fissures. There has been some research on the use of sealants and other resin-based materials to seal smooth surfaces. Sealants and adhesives have been shown in some studies to at least partially penetrate artificial caries lesions in vitro, and thus might have some therapeutic value. The present study used an experimental material with a very high "penetration coefficient" (PC). The PC describes the penetration of liquids into porous solids (in this case, a fluid resin into enamel lesions) by capillary action. These findings are probably far removed from clinical application at present. However, this concept of using resins to penetrate and seal enamel lesions could become a routine procedure at some time in the future. (Reviewer—Edward J. Swift, Jr, DMD, MS).

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Keywords: Enamel Caries

Print Tag: Refer to original journal article
Fissures are still at the mercy of the clinical judgment of the dentist. The fissures that show caries progression into the dentin when the tooth is dry are an indication for treatment.

This paper is a product report about the Spectra caries detection aid. A camera wand is hard wired to a computer. The wand is placed over the tooth in question using a 10-mm distance spacer. The wand contains LEDs that generate a violet-blue light. The light stimulates porphyrins from cariogenic bacteria to fluoresce red while the enamel fluoresces green. A computer program interpolates the information and paints different colors in the fissures imaged depending on the degree of fluorescence. The doctor and the patient can look at the colors on the screen and discuss the diagnosis.

Reviewer’s Comments: The first question a doctor must ask would be, "Is the fluorescent plaque in the fissure system diagnostic for the bacteria that cause decay or the decay process?" Coulthwaite et al (Caries Res 2006; 40 [2]: 112-116) found that Prevotella melaninogenica, Actinomyces israelii, and Candida albicans from denture teeth fluoresce red. None of these bacteria are known to cause dentin caries. The conclusion from the study was that the more mature the colony, the redder the color, but it was not a measure of caries activity. Lennon et al (Caries Res 2006; 40 [1]: 2-5) evaluated 11 species of bacteria for the ability to emit red fluorescence. All 11 species would emit red or green fluorescence, but the authors concluded it was not a suitable indicator of the activity of streptococci involved in initial caries. Fissures are still at the mercy of the clinical judgment of the dentist. The fissures that show caries progression into the dentin when the tooth is dry are an indication for treatment. My recommendation is this: if the fissure is suspicious but not frankly cavitated, then a pit and fissure sealant is indicated. By my evaluation, to date all of the fissure caries detection devices encourage over-treatment. (Reviewer-J.D. Overton, DDS).

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Keywords: LED

Print Tag: Refer to original journal article
Stronger concentrations of hydrogen peroxide in tooth-bleaching agents may encourage later repigmentation.

**Background:** Hydrogen peroxide can decrease the superficial microhardness of enamel to the degree that low-concentrate fluoride application is needed to restore the hardness. Alterations and loss of mineral content in the enamel surface result in structural and morphological changes, including a slight increase in surface porosity, which could promote greater susceptibility to repigmentation.

**Objective:** To determine if in vitro changes in surface characteristics of teeth affect susceptibility to pigmentation after treatment with 2 bleaching agents.

**Methods:** Premolars extracted from 16- to 22-year-old patients undergoing orthodontic treatment were sealed apically and then covered with transparent varnish. The mesial half of the buccal surfaces were flattened in enamel and polished to a very smooth finish. A Vita shade guide was used to assign shade value for each tooth. Specimens were stored in distilled water for 15 days. Group 1 specimens (n=12) were bleached using 35% hydrogen peroxide for 15 minutes 3 times a day every other day for 4 days. Group 2 specimens (n=12) were bleached using 16% carbamide peroxide 90 minutes a day for 15 days. At the end of 15 days, Vita shade values were recorded for group 1 and 2 specimens. Specimens were stored in distilled water for 2 days before being immersed in silver nitrate for 4 hours, and then placed in radiographic fixing solution for 24 hours. Specimens were thoroughly rinsed and then dried with cloth impregnated with an alumina suspension to remove loose silver nitrate particles. All specimens were again compared to the Vita shade guide to determine the shade value. Enamel-dentin samples were examined microscopically to determine the effects of bleaching.

**Results:** After bleaching, group 1 and group 2 specimens were lighter in shade but became darker after exposure to silver nitrate solution. This change in value was greater for hydrogen peroxide specimens. Bleaching increased the surface roughness of the enamel. This roughness was greater for the 35% hydrogen peroxide group, but the difference was not considered significant. The 2 bleaching groups demonstrated essentially the same degree of bleaching.

**Conclusions:** Susceptibility of enamel to pigmentation or staining can be increased after bleaching. This pigmentation is greater with hydrogen peroxide bleaching than with carbamide peroxide bleaching, but this effect may be less significant in vivo.

**Reviewer's Comments:** Although tooth whitening is considered very safe if not grossly overdone, research suggests that the agent does affect the enamel, but this does not appear to be clinically significant with routine bleaching regimens. Exposure to the saliva replenishes minerals in the teeth to counteract the effect of the hydrogen peroxide. Until research demonstrates significant damage in vivo, bleaching should still be considered safe for patients. (Reviewer-Thomas G. Berry, DDS).

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Keywords: Bleaching Agents

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**Objective:** To study the thickness of the smear layer formed after preparation of enamel and dentin with different methods and the use of different 1-step self-etching adhesives.

**Methods:** 32 intact extracted human molars were used. Enamel/dentin slices were cut perpendicular to the long axis of the teeth and assigned to 4 groups to be prepared with different rotary instruments (tungsten carbide bur or diamond) and on different surface conditions (wet or dry preparation). The tungsten carbide bur used was 6-fluted, and the diamond had a 25 μm grain size. Wet preparations were done with air water spray and dry preparations with air spray only. The groups were further divided into 4 subgroups to be treated with 2 experimental all-in-1 adhesives (pH 2.5 and pH 1.8) and Adper Prompt L-Pop (pH 0.8). Control specimens received no adhesive treatment. The resinous components of the adhesives were removed, the specimens were prepared for scanning electron microscopy evaluation, and the smear layer thickness was measured.

**Results:** The thickness of the smear layers tended to decrease as the pH of the adhesives increased. However, no overall difference was found between the 2 experimental adhesives. Prompt L-Pop showed no measurable smear layer. A significant difference was found between the smear layer thickness on enamel and dentin, with the latter being thinner. While the adhesive materials significantly influenced the results, the use of carbide burs versus diamonds and wet versus dry preparations did not affect the results.

**Conclusions:** Dentin and enamel smear layers differ after application of different 1-step self-etching adhesives.

**Reviewer's Comments:** Among the limitations of all-in-1 adhesives is the poor etching pattern on enamel by mild (pH) all-in-1 materials. This study showed that different methods of preparation of the tooth surface are unlikely to influence the performance of these materials. Materials with a high pH do not effectively etch enamel, which ultimately results in faulty enamel margins. Materials with a low pH, on the other hand, are highly hydrophilic and suffer hydrolytic degradation over time. The bottom line is that these materials still need to be improved in order to be used in everyday practice. (Reviewer-Ricardo Walter, DDS).

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Keywords: Adhesive

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