

THE DENTAL ADVISOR™

Improving Patient Care Through Research & Education

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Simplifying cementation and bonding

MAIN TOPIC

Simplifying Cementation and Bonding 2

RESEARCH REPORT

Bond Strength Comparison of CLEARFIL Universal Bond Quick 9

CLINICAL EVALUATIONS

Ketac Universal Aplicap
(Self-curing, radiopaque glass ionomer restorative material) 11

SISU NextGen Sports Mouth Guards
(Custom remoldable mouth guards) 14

UNO Gel
(Desensitizer) 15

Nano Freedom Light
(Wireless headlight for loupe) 19

Defend Diamond Burs 20

Defend Carbide Burs 21

DEFENDLOC Sterilization Pouches 22

MTA Repair HP
(Bioceramic, radiopaque endodontic repair cement) 23

Pinkband Contoured matrix bands
(Rubberized silicone-coated matrix bands) 24

PRIMA Quick
(6th Generation bonding agent) 25

Q-Core Syringable
(Dual-cured, fluoride-releasing, core build-up material) 26

Q-Crown
(Resin-based, biocompatible, self-cured temporization material) 27

Q-Seal
(Resin-based, light-cured, fluoride-releasing pit and fissure sealant) 28

LONG TERM CLINICAL EVALUATIONS

Obsidian: 3-year Clinical Performance 16

EDITOR'S CHOICE

ClinPro 5000
(Low abrasive prescription -strength fluoride toothpaste) 12

Antivet
(One-visit stain remover) 13

Plus Series Forceps
(Lightweight extraction forceps) 17

SecureTip
(Locking saliva ejector system) 18



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RATINGS :

Excellent + + + + +

Very Good + + + +

Good + + +

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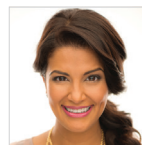
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As new ceramics are introduced, the cementation process continues to adapt and evolve. There are a number of new resin cements on the market, some of which combine existing materials for convenience and simplified procedures, and some that have entirely new chemistry; however, we have yet to see a true universal cement for all indications.

Do we really need a universal cement? This is a frequent question asked at my lectures. My answer is always the same - do you have one type of glue in your home? Personally, I don't. I have a variety of glues that are chosen depending on the materials I am adhering to. When working with paper, I use white craft glue. Although it takes longer to set, it is easy to use and clean up. When I need a strong bond for projects involving metal, ceramics or wood, I opt for super glue. While it is technique sensitive, it forms a very strong bond quickly and dries clear. You can see where I am going with this. There are a number of new materials on the market, and each type of cement has different physical and mechanical properties, making no one cement alone sufficient for every application. To achieve success, clinicians need to be aware of the characteristics of each type of cement and use them appropriately.

The focus of this issue is to provide you with a brief overview of the properties, classifications, and advantages of various resin and conventional cements as well as describe what makes universal bonding agents "unique." As always, I welcome your comments and suggestions; you can reach me at drbunek@dentaladvisor.com.

Cement Choices

All permanent cements can be classified into one of two broad categories:

Traditional cements: (zinc phosphate, zinc polycarboxylate, glass ionomer, and resin-modified glass ionomer) are essentially "gap fillers" relying on micromechanical retention provided by the luting agent. Resin-modified glass ionomers (RMGI) are most commonly used in this category because they offer slightly better strength and adhesion, easy cleanup, and lower solubility.

Resin cements: (self adhesive, adhesive resin and esthetic resin) have gained popularity mainly because they address the shortcomings of luting cements; they exhibit high bond strength to tooth structure, higher esthetics, and the lowest solubility of the available cements. They rely on both micromechanical retention and chemical bonding.

Selecting the Best Cement

There are many types of cement to choose from and often there is more than one viable option.

An easy place to start in the decision-making process is by looking at the strength of the ceramic, as well as taking into account the retentiveness of the preparation.

Generally, when esthetics is of high concern, low- to medium-strength glass ceramics (feldspathic, leucite-reinforced, lithium disilicate) are selected. A benefit of using high-strength cements (adhesive- or esthetic resin) is that they will add strength to the entire restoration. When using a high-strength ceramic (zirconia) with a retentive preparation, a low-strength cement such as a self-adhesive resin cement or RMGI can be used because it is not necessary to rely on the cement for additional strength. Guidelines for cement selection based upon the strength of the ceramic and the retentiveness of preparation are highlighted in the table below.

Ceramic Strength	Preparation	Resin-Modified Glass Ionomer	Self-Adhesive Resin	Adhesive Resin	Esthetic Resin (DC & LC)
LOW (feldspathic, leucite-reinforced)	Retentive			✓	✓
	Non-retentive			✓	✓
MEDIUM (lithium disilicate)	Retentive		✓	✓	✓
	Non-retentive			✓	✓
HIGH (zirconia)	Retentive	✓	✓	✓	✓
	Non-retentive			✓	✓

Simplifying Cementation: Self-adhesive Resin Cements

Resin Cements

Resin cements exhibit high bond strength to tooth structure, excellent esthetics, and the lowest solubility of the available cements. Currently, resin cements can be classified into three categories:

- 1. Self-adhesive Resin Cements:** No separate etching or priming of teeth or restorations
- 2. Adhesive Resin Cements:** Bonding to teeth based on self-etch primer, primer not required for restorative substrate
- 3. Esthetic Resin Cements:** Bonding to teeth based on total-etch adhesive, restorative substrate requires primer

1 Self-adhesive Resin Cements

Self-adhesive resin cements are easy to use and provide low to medium bond strengths (4-16 MPa) to tooth structure. They do not require the use of a bonding agent on the tooth; however, some bonding agents recommended by manufacturers can be compatible with self-adhesive resin cements. Self-adhesive resin cements have a lower incidence of sensitivity than adhesive or traditional crown and bridge cements.

Advantages

- Easy to use (*no etch or primer required*)
- Less technique sensitivity
- Low postoperative sensitivity
- Easy cleanup
- Dual-cured

Disadvantages

- Can have a shade shift over-time
- Clean up can be difficult
- Isolation from moisture/contaminants required

G-CEM Link ACE™ GC America



Chosen as a preferred product for 2 consecutive years, **G-CEM LinkAce™** is a dual-cure, self-adhesive resin cement. It is indicated for cementation of all-ceramic, resin and metal-based crowns and bridges, inlays, onlays and posts. Offering the highest polymerization in self-cure mode, **G-CEM LinkAce** provides reliable results, regardless of the type of prosthetic material that is being cemented. The cement contains proprietary phosphate monomers which ensures bonding to zirconia, as well as CAD-CAM and metal-free restorations. Working time is 3:30. Tack curing of margins is recommended, followed by removal of excess cement. Final self-curing occurs in 4 minutes, or the product may be light cured for 20 seconds per surface. **G-CEM LinkAce** was reported by consultants to be easiest to remove after a short tack cure.

Panavia SA Cement Plus Kuraray Noritake Dental



Awarded the Top Self Adhesive Resin Cement in 2017, **PANAVIA SA Cement Plus** is a dual-cured, fluoride-releasing, self-adhesive resin cement which tolerates both moist and dry surfaces during bonding. With a working time of 1 minute; a tack-cure of 2 to 5 seconds; and a 10-second final cure, cementation is efficient with easy clean-up. It is indicated for placement of crowns, bridges, inlays, onlays, posts and cores, implant restorations, and adhesive bridges and splints. In testing in THE DENTAL ADVISOR'S materials lab, it demonstrated excellent bond strength of >50 MPa to zirconia and lithium disilicate, and 26 MPa to unetched dentin. When evaluated, 100% of clinicians stated they would use this cement. **PANAVIA SA Cement Plus** received a 98% rating and 'Editor's Choice' from THE DENTAL ADVISOR.

- "Very easy to use, a go-to material."
- "After spot curing, the excess peels right away from the margins."

Self-adhesive

Product	Rating
RelyX Unicem 2 Automix Self Adhesive Resin Cement (3M)	96%
G-CEM LinkAce (GC America)	93%
Panavia SA Cement Plus (Kuraray)	98%
Bifix SE (VOCO)	94%

NEW DEVELOPMENTS: Look for these evaluations in a future issue of THE DENTAL ADVISOR

TheraCem™ Bisco Dental Products

BISCO's next generation resin cement combines the benefits of bonding with the simplicity of a traditional cementing protocol. **TheraCem**



is a dual-cured, calcium and fluoride-releasing, self-adhesive resin cement indicated for luting crowns, bridges, inlays, onlays, and all types of posts. **TheraCem** offers a high degree of conversion and transitions from acidic to alkaline pH in minutes. Delivering a strong bond to zirconia and most substrates without the need to prime or etch, along with easy clean up and high radiopacity, **TheraCem** offers clinicians reliable and durable cementation of indirect restorations.

Maxcem Elite™ Chroma Kerr Restoratives

Maxcem Elite Chroma is the first Self-Etch/Self-Adhesive resin cement offering a Color Cleanup Indicator, making it the smartest cement available on the market today. The pink color fades at the gel state, telling you the optimal time to cleanup excess cement. Forming a strong and durable bond with a wide variety of dental substrates, it is compatible with all indirect restorations - anterior or posterior ceramics, PFMs, metal restorations, and CAD/CAM materials. **Maxcem Elite Chroma** offers you best in class adhesion when compared to other leading self-adhesive cements. In addition to the color cleanup indicator – **Maxcem Elite Chroma** also offers One-Peel™ cleanup, automix delivery system, and easy no refrigeration storage.



Simplifying Cementation: Adhesive Resin Cement

2 Adhesive Resin Cements

Adhesive resin cements provide medium-high bond strengths and are an excellent choice when retention is of concern with all restorative materials. They differ from self-adhesive resin cements because they require the use of a separate bonding agent on the tooth. One trend we are seeing from manufacturers is the bundling of their adhesive resin cements and universal bonding agents into pre-packaged kits. With universal bonding agents included in kit, the clinician has the option for total-, self-, or selective-etching of the tooth. Indications for adhesive resin cements include all-ceramic crowns/bridges and inlays/onlays, high-strength ceramic (zirconia) crowns/bridges, Maryland bridges, and posts (metal and fiber).

Advantages

- Can use in with all restorative materials
- Can be used when retention is of concern
- Common shades: universal, translucent, and opaque
- Dual-cured

Disadvantages

- Can have a shade shift over time
- Clean up can be difficult
- Isolation from moisture/contaminants required

Adhesive Resin

Product	Rating
RelyX Ultimate Adhesive Resin Cement (3M)	96%
Duo-Link Universal (Bisco Dental Products)	93%
eCEMENT (Bisco Dental Products)	93%
Multilink Automix (Ivoclar Vivadent)	97%
G-CEM LinkForce (GC America)	97%
PANAVIA V5 (Kuraray Noritake Dental)	92%

3M™ RelyX™ Ultimate Adhesive Resin Cement 3M

When you need extra-strength bonding without the hassle of complex adhesive systems, choose **3M™ RelyX™ Ultimate Adhesive Resin Cement** in combination with **3M™ Scotchbond™ Universal Adhesive**. You'll get versatile, reliable adhesive cementation that's fast and easy to use - all with just two components.



- Proven, industry-leading bond strength
- Fast and easy procedure with only two components
- Total-etch, selective etch or self-etch procedures
- First-class esthetics with natural fluorescence

Duo-Link Universal™ Bisco Dental Products

DUO-LINK UNIVERSAL™ is perfect for reliable, high strength cementation with easy clean-up. Its extremely high, consistent degree of conversion in both self-cured and light-cured modes, is required by today's stronger restorations. In addition, **DUO-LINK UNIVERSAL** has low film thickness to assist in effective seating and offers diagnostic radiopacity for that perfect margin. BISCO's **DUO-LINK UNIVERSAL Kit** is an adhesive cementation system designed to effectively address the cementation of all your indirect restorations for optimal performance and esthetics in an easy-to-use kit.



G-CEM LinkForce™ GC America

G-CEM LinkForce is a dual-cured, radiopaque, universal adhesive resin cement system. The three main components in the kit are the **G-Multi PRIMER**, **G-Premio BOND** and the **G-CEM LinkForce** universal cement.



The MDP and MDTP-based **G-Multi PRIMER** improves bond strength and is applied to the intaglio surface after the restoration has been prepared with hydrofluoric acid (for glass and hybrid ceramics) or sandblasted (all restoratives except glass ceramics), then dried. **G-Premio BOND** (also MDTP-based) is applied to the tooth surface after self-etching, selective etching or total etching. Light-curing of the bonding agent takes 10 seconds. If self-curing is required, **G-Premio BOND** is mixed with an equal quantity of **G-Premio BOND DCA**, applied and then air-dried for 5 seconds after waiting 20 seconds. **G-CEM LinkForce** adhesive cement, after mixing, has a working time of 3 minutes at normal room temperature. Tack-curing takes 1 to 2 seconds for easy clean-up prior to final cure. Light-curing the cement takes 20 seconds for each surface or margin. Alternatively, the cement can be left to self-cure for 4 minutes.

PANAVIA V5 Kuraray Noritake Dental

PANAVIA V5, the latest version of PANAVIA series from Kuraray America, is a dual-cured, fluoride-releasing, color-stable, universal adhesive resin cement. It is available as an all-in-one kit. The self-etching Tooth Primer contains the original MDP adhesive monomer; its new chemistry accelerates cement curing and provides for high bond strength to all tooth structure in the self-cure mode. The **CLEARFIL CERAMIC PRIMER PLUS** also contains MDP and a γ-MPS silane monomer that enhances bond strength to restorative materials. In THE DENTAL ADVISOR'S bio-materials lab, **PANAVIA V5** demonstrated excellent bond strength at 44 MPa to dentin. Tack-curing can be achieved in 3 to 5 seconds using a blue LED light and final cure in 10 seconds. **PANAVIA V5** received a 92% overall rating from THE DENTAL ADVISOR.



- "A 'must-have' for any dental office."
- "This cement can be used in multiple situations. In my office, less (products) is more."

Simplifying Cementation: Esthetic Resin

3 Esthetic Resin Cements

Esthetic resin cements generally contain an option for dual-cured or light-cured only polymerization. However, a few esthetic resin cement kits include light-cured only cements suitable for thin, all-ceramic restorations such as veneers and inlays/onlays. Light-cured cements are preferred due to their color stability and increased working time. Light-cured resin cements do not contain an amine catalyst (found in many dual-cured resin cements), so there is less chance of shade shift over time that can result from oxidation of the amine catalyst. These cements typically require etching the tooth with phosphoric acid, followed by priming of the restoration and application of resin cement. Most manufacturers provide a variety of shades and corresponding try-in pastes, which makes them ideal for esthetic restorations.

Advantages

- Highly esthetic
- Light-cured or dual-cured
- Longer working time
- Color stable
- Highest bond strength to enamel and dentin with appropriate bonding agent
- Available in a variety of shades with corresponding try-in pastes

Disadvantages

- Most technique sensitive
- Isolation from moisture/ contaminants required

Product	Rating
RelyX Veneer Cement (3M)	98%
Variolink Esthetic (Ivoclar Vivadent)	98%
NX3 Nexus Third Generation (Kerr Restoratives)	97%
Mojo Veneer Cement (Pentron)	96%

Variolink® Esthetic Ivoclar Vivadent

Variolink® Esthetic is an adhesive luting composite that offers clinicians incredibly easy clean-up, natural fluorescence and radiopacity. **Variolink Esthetic** is the successor to **Variolink® II** & **Variolink® Veneer** and is available in both a light-cure (LC) and dual-cure (DC) versions. Each version is available in five shades; Light+, Light, Neutral, Warm, and Warm+ for simplified shade matching. **Variolink Esthetic** contains the patented light initiator, **Ivocerin®**, which is 100% amine-free for enhanced shade stability. **Variolink Esthetic** is indicated for the adhesive luting of glass-ceramic, lithium-disilicate, and composite restorations. (0.16 mL each).



NX 3 Nexus® Third Generation Kerr Restoratives

Universally indicated for all indirect applications, **NX3 Nexus® Third Generation** is a permanent adhesive dental cement system with an innovative chemistry for unmatched esthetics, adhesion and great versatility. Delivery system choices include an automix syringe for dual-cure indications and a light-cure cement for multiple units where unlimited work time is needed. The automixing dual-cure cement can be used for all indirect applications, including veneers. With Kerr's proprietary amine-free initiator system and optimized resin matrix, **NX3** is the first truly color-stable adhesive resin cement.



Clinical performance of resin cements over time

RelyX™ UniCem 2 (3M)

15-YEAR CLINICAL PERFORMANCE



6,000
Restorations
placed

3,400
Reviewed
at recall

This product received a 96% clinical performance rating at the 15-year recall.

RelyX Unicem Self-Adhesive Resin Cement is dual-cured and does not require separate etching, priming or bonding. **RelyX Unicem 2** is available in a paste/paste formulation delivered via a Clicker or an automix syringe. Both formulations are indicated for the cementation of composite crowns, bridges, inlays and onlays; PFM and metal restorations, implant abutments and endodontic posts.

RelyX Unicem Self-Adhesive Resin Cement has proven to be very reliable over the 15-year recall period. Retention 108 (4.8%) of the recalled restorations debonded over the 15-year evaluation period. In 90% of these debonds, the cement was in the restoration and not on the prepared tooth. It was not unusual to notice grey or black stain on many of the debonded restorations.

A DETAILED REPORT CAN BE FOUND AT:

<https://www.dentaladvisor.com/evaluations/3mrelyx-unicem-self-adhesive-resin-cement-15-yr>

SpeedCEM® Plus (Ivoclar Vivadent)

2-YEAR CLINICAL PERFORMANCE



136
Restorations
placed

122
Reviewed
at recall

This product received a 98% clinical performance rating at the 2-year recall.

SpeedCEM Plus is a self-adhesive resin cement with a light-curing option. This cement offers an ideal combination of performance and ease of use. Its formulation has been optimized for use in conjunction with zirconia and metal-ceramics, and for the cementation of high-strength ceramics on implant abutments. Strong self-curing capabilities offer an additional measure of reliability when seating opaque restorations.

SpeedCEM Plus has proven to be an excellent, self-adhesive resin cement. After two years in service, there was almost no clinical evidence of marginal discoloration, sensitivity or debonds observed. The ultimate success of a restoration is strongly dependent on the retention.

A DETAILED REPORT CAN BE FOUND AT:

www.dentaladvisor.com/evaluations/speedcem-plus-2-yr

Universal Bonding Agents

For the past two decades, total-etch bonding agents were categorized as 4th- and 5th-generation products, and self-etch bonding agents were categorized as 6th- and 7th-generation products. The new universal bonding agents have essentially replaced these total-etch and self-etch generations of bonding agents.



What is a Universal Bonding Agent?

New “universal” adhesives have gained popularity because they are designed to simplify the steps involved with direct and indirect bonding protocols. The idea that one adhesive system can be used with different etching techniques, can bond to the different substrates, and can dual-cure, all without the use of separate activators or primers, is very appealing to clinicians. However, not all universal bonding agents can make that claim.

While the term universal implies the product can be used in all situations, **it is important to understand that manufacturers do not define “universal” the same way**; it does, however, generally relate to two or more of the following:

- 1 **Compatible with** different etching techniques: total-, self-, and selective-etch mode.
- 2 **Compatible with** dual- and self-cured materials without the use of a separate activator.
- 3 **Can be used as a** primer for silica-based and metallic restorations.

WHAT'S NEW: CLEARFIL Universal Bond Quick

CLEARFIL Universal Bond Quick (Kuraray Noritake Dental), is a fluoride-releasing, single-bottle, universal adhesive containing innovative MDP and Amide chemistry that provides RAPID BOND TECHNOLOGY. This ground-breaking amide monomer rapidly permeates dentin and enamel, minimizing the risk of contamination and eliminating waiting time. The new Amide chemistry also results in less fluid absorption.

In THE DENTAL ADVISOR'S materials lab, **CLEARFIL Universal Bond Quick** demonstrated excellent bond strength to both enamel and dentin. When independently tested in THE DENTAL ADVISOR materials laboratory, Enamel Shear Bond Strength was 43 MPa and 28 MPa respectively, using both a total-etch and self-etch technique. Dentin Shear Bond Strength was 40 MPa and 41 MPa, respectively. **CLEARFIL Universal Bond Quick** Standard is available in both bottle and unit dose delivery.



iBond® Universal KULZER

Awarded as a 2016 Clinical Problem Solver, **iBOND Universal** is an 8th-generation universal bonding agent compatible with self-etch, total-etch or selective etch techniques. **iBOND Universal** enables bonding of composite

materials, precious metals, non-precious metals, zirconia and silicate ceramic and is compatible with light-cure, dual-cure and self-cure materials without the need for a dual-cure activator. **iBOND Universal** offers easy and precise application and the ability to intraorally restore fractures and chips as an effective, economical and efficient alternative to replacement. Restorations with zirconia, precious and non-precious alloys and composites can be repaired intraorally. The **iBOND Universal** bottle has a new drop-control dispenser that allows clinicians to apply just as much or as little bonding agent as needed. The notched bottle design prevents unwanted waste and mess, allowing for an efficient and controlled application, with up to 220 drops per bottle. Having one adhesive for use with all restorative materials simplifies the armamentarium and contributes to clinical success.



3M ScotchBond™ Universal Adhesive 3M

3M™ Scotchbond™ Universal Adhesive

is a single-bottle adhesive that provides uncompromising performance and bond strength whether used for direct or indirect restorations. Its simple application process helps the adhesive perform reliably, regardless of user technique. The product is moisture-tolerant, exhibiting high bond performance on moist and dry substrates. With **3M Scotchbond Universal Adhesive**, dentists have an easy-to-use, single-bottle solution that provides uncompromising results for all surfaces in total- or self-etch mode. It assures dentists of virtually no post-operative sensitivity—in both the total- and self-etch technique, and provides exceptional bond strength to dentin and enamel. For more information on **3M Scotchbond Universal Adhesive**, visit 3M.com/Scotchbond.



Simplifying Cementation: Universal Bonding Agents

FuturaBond U VOCO

Chosen as an Editor's Choice, 5-plus-rated product by THE DENTAL ADVISOR, **Futurabond U** is a universal bonding agent that can be used for all etching techniques as well as for all curing techniques with self-, light- and dual-curing direct and indirect resin materials. No additional activators or primers are required. **Futurabond U** is reinforced with silicon dioxide nanoparticles that reinforce the hybrid layer to provide a durable, high bond strength. It is applied and rubbed in a single layer for 20 seconds, followed by 5 seconds of air drying and curing for 10 seconds. **Futurabond U** is delivered in unit-dose packaging for convenient, contamination free application and does not require refrigeration. The single dose delivery system prohibits the evaporation of the solvent as experienced in bottle systems.



G-Premio Bond™ GC America, Inc.

G-Premio BOND™ is a universal, 8th generation bonding agent that is compatible with total-, self-, and selective-etch techniques, providing excellent versatility. **G-Premio BOND** offers good stability with an extended working time of up to five minutes. It provides better strength in a one-bottle system than most other two-bottle bonding systems. A new silicone bottle cover enables more precise drop dispensing; it is available in a 5mL kit or refill, and a 50 unit dose pack (0.16 mL each). **G-Premio BOND** is also offered in syringe and unitip introductory kits with **G-aenial™ Sculpt**, GC's universal compactable composite.



The table below lists **Universal Bonding Agents** clinically evaluated by THE DENTAL ADVISOR. As with any new dental material, be sure to thoroughly read the manufacturer instructions prior to use.

Product	Manufacturer	Indicated for all etching modes (Total-, Self-, and Selective-etch)	Separate dual-cure activator required (with dual-cure materials)	Primes Silica- and Zirconia- based ceramic and metal restorations	Clinical Rating
Adhese Universal	Ivoclar Vivadent	Yes	No	Monobond Plus recommended	93%
ALL-BOND UNIVERSAL	Bisco Dental Products	Yes	No	Yes*	96%
G-Premio BOND	GC America	Yes	Yes	No	96%
iBOND Universal	Kulzer	Yes	No	Yes**	98%
CLEARFIL Universal Bond Quick	Kuraray Noritake Dental	Yes	Yes	Yes	CE****
Scotchbond Universal	3M	Yes	Yes***	Yes	98%
OptiBond Universal	Kerr Restoratives	Yes	Yes***	Yes	CE****
Futurabond U	VOCO	Yes	No	Yes	96%

* Separate primer not required if bonding agent is light-cured

*** Dual-Cured Activator is not required if adhesive is paired with resin cement from same manufacturer

** Use of ceramic primer is recommended for silica-based ceramics

**** Currently being evaluated

Adhese® Universal Ivoclar Vivadent



Adhese® Universal is a light cured adhesive for direct and indirect procedures. It has consistently high bond strength and virtually no post-operative sensitivity with any etching technique: self-etch, selective etch or total-etch. The revolutionary **VivaPen®** delivery form delivers up to 190 single-tooth applications, three times more applications per ml than the traditional bottle delivery form. This drastically decreases cost per application and contributes to more cost-effective treatments.

ALL-BOND UNIVERSAL® Bisco Dental Products

ALL-BOND UNIVERSAL® combines etching, priming and bonding in a single bottle. **ALL-BOND UNIVERSAL** is now available in unit-dose packaging. The convenient, easy to handle, orange colored unit-dose offers efficiency and ease-of-use. Unlike other one bottle adhesives, **ALL-BOND UNIVERSAL** can be used with both direct and indirect restorations, bonds to all indirect substrates, and is compatible to all composite and resin based cements without an additional activator. The versatility of **ALL-BOND UNIVERSAL** makes it an indispensable part of any dental practice.



Simplifying Cementation: Ionomer Cements

Glass Ionomers

Since their introduction in the 1970s, numerous modifications have been made to glass ionomers making them suitable for an array of modern-day clinical applications, including use as a luting agent. Glass ionomers are derived from an acid-base reaction between a basic glass powder (calcium fluoroaluminosilicate) and an acidic water-soluble polymer. During this hardening reaction, significant amounts of fluoride ions are released. Unlike resin cements, glass ionomer cements are hydrophilic and include water in their formulation, resulting in a moisture tolerant material that directly adheres to tooth structure by a chemical bond. Additionally, because glass ionomers set by an acid-base reaction, minimal shrinkage occurs.

They are classified as either conventional glass ionomer or resin-modified glass ionomer, which have resin added to the formula to improve physical properties. Both cements chemically bond to enamel and dentin, release fluoride, have a coefficient of thermal expansion similar to that of tooth structure, exhibit hydrophilic properties, and are available in powder-liquid, paste-paste, and encapsulated formulas.

Resin-modified Glass Ionomer Cement

Resin-modified glass ionomers (RMGI) were developed in the 1980s to overcome the high solubility of conventional glass ionomers. The addition of resin to the glass ionomer formulation provides slightly greater bond strengths, releases a similar amount of fluoride, and allows for the material to harden when light cured. Although they offer lower strength than resin cements, their adhesion is adequate for metal, metal-ceramic and high-strength ceramic restorations (zirconia) as well as for metal and composite fiber posts. RMGI cements are a great option in cases where moisture control is an issue or when you need fluoride release.

GC FujiCEM 2 GC America

A 5-year Top Award winner as Top Resin Modified Glass Ionomer Cement,

GC FujiCEM 2 is indicated for permanent cementation of all types of metal-, resin-, alumina- and zirconia-based inlays, onlays, crowns, bridges, and endodontic posts. Working time is 2 min 15 seconds, and intraoral setting time is 4 min 30 seconds. Laboratory testing by THE DENTAL ADVISOR found a significantly stronger bond of **GC FujiCEM 2** to dentin compared to **GC FujiCEM**. This cement has a creamy consistency and spreads to a low film thickness that allows complete seating of restorations with little pressure. Cleaning excess cement at about a minute and a half is easily accomplished at soft set. After the full setting time, cement at the margins peels off cleanly with an explorer.



3M™ RelyX™ Luting Plus Resin Modified Glass Ionomer Cement 3M

Convenient, versatile and easy-to-use **3M™ RelyX™ Luting Plus Resin Modified Glass Ionomer Cement** eliminates hand-mixing while offering better bond strength than conventional glass ionomer luting cements. Suitable for a wide range of everyday applications, including PFMs, metal and pediatric crowns and restorations on implants.



- 5-second tack light cure feature for “clean-up on demand”
- Sustained fluoride release for pediatric and geriatric patients
- A good choice for pediatric restorations
- Higher bond strength than conventional glass ionomer
- Virtually no post-op sensitivity

Clinical Tips for GI & RMGI Cements

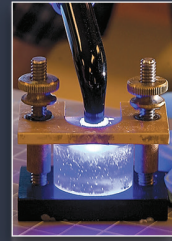
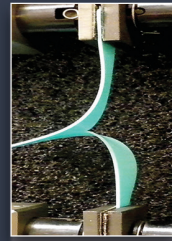
- **The bond to tooth structure is significantly reduced when the tooth is excessively dried**, which also contributes to post-cementation thermal sensitivity. Lightly moisten dentin using a micro-applicator or a damp cotton pellet so it is slightly glossy with no water pooling on the surface.
- **Do not place a bonding agent before placing a glass ionomer** because it decreases fluoride uptake.
- **Light cure resin-modified glass ionomers from the buccal and lingual aspects** to allow cleaning of excess cement in the gel phase.
- **Because both glass ionomer and resin-modified glass ionomer products are water-based**, clinicians should be aware of the expiration dates of the products.
- **Glass ionomer and resin-modified glass ionomer cements tend to be more opaque than resin cements.** Do not use with all-ceramic restorations in the anterior region where esthetics is of concern.



Riva Luting Plus SDI North America

Riva Luting Plus is a resin modified, self curing, glass ionomer luting cement, designed for final cementation of metal, PFM and resin crowns, bridges, inlays and onlays plus ceramic inlays and crowns. **Riva Luting Plus** chemically bonds to dentin, enamel and all types of core material. **Riva Luting Plus** has excellent adhesion to dentine and zirconia. It is great for luting ceramic crowns and inlays. **Riva Luting Plus's** free movement of fluoride allows the formation of fluorapatite, which is more acid resistant than hydroxyapatite creating an optimal environment for tooth remineralization.





Bond Strength Comparison of CLEARFIL Universal Bond Quick

M. Cowen, J.M. Powers

Purpose:

The purpose of this project was to compare the shear bond strength to ground dentin and enamel of a new bonding agent requiring a shorter application time with two other popular bonding agents.



Experimental Design:

Materials and Conditions:

Product	Company	Lot	Etching Time	Application Time	Air Drying Time	Light Curing Time
CLEARFIL™ Universal Bond Quick	Kuraray Noritake Dental	T160128	10 s	3 s	5 s	10 s
K-ETCHANT Syringe, 35% Phosphoric Acid		1M0003				
OptiBond™ Solo Plus	Kerr Restoratives	5738933	15 s	15 s	3 s	10 s
Kerr Gel Etchant, 37.5 % Phosphoric Acid		5702171				
Scotchbond™ Universal	3M	618804	15 s	20 s	5 s	10 s
Scotchbond™ Universal Etchant 32 % Phosphoric Acid		621073				

Composite: *TPH Spectra™ HV* (DENTSPLY Sirona Restoratives)

Light Curing Unit: *Demi* (Kerr Restoratives), >1300 mW/cm²

Substrates: Ground adult human enamel and superficial dentin

Test: Ultradent Shear Bond Strength test (n = 5), 2.38 mm diameter cylinder

Storage Conditions: 24 h in 37 °C followed by 5000 thermal cycles, 5-55 °C in water

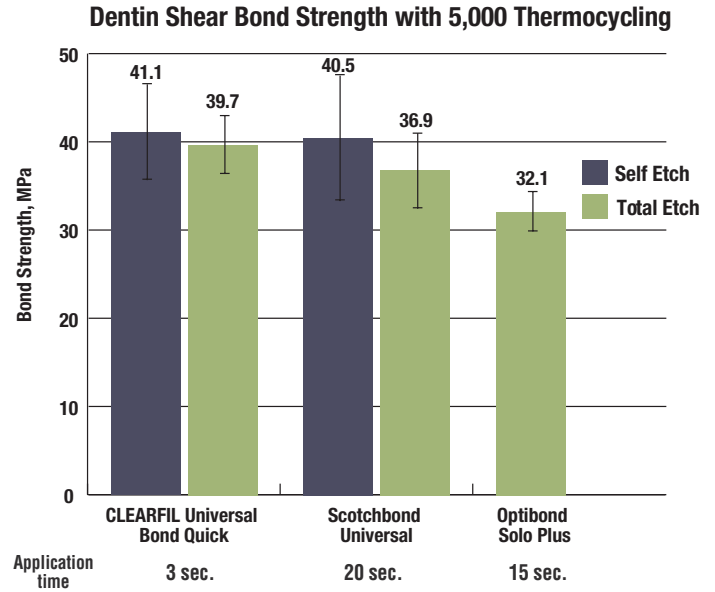
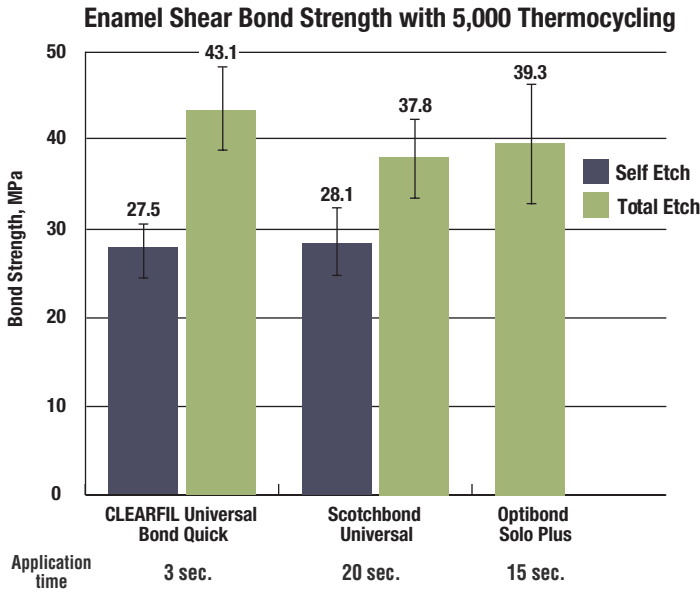
Etching Mode: *CLEARFIL Universal Bond Quick* (Kuraray Noritake Dental): Total-etch and Self-etch

OptiBond Solo Plus (Kerr Restoratives): Total-etch

Scotchbond Universal (3M): Total-etch and Self-etch

Methods:

Human third molars extracted within 3 months of testing, previously stored in sodium azide solution, then in saline and then in water, were embedded in resin and abraded on the facial surface through 600-grit (Carbimet, Buehler, ~15 µm) SiC paper to form a bonding substrate of ground superficial dentin and ground enamel. Each specimen was then ultrasonically cleaned in deionized water for 5 minutes. Each specimen was prepared with the selected etching mode and bonding agent according to manufacturer's instructions, followed by direct placement of the composite material utilizing the Teflon Ultradent shear test mold and set-up jig. The specimens were stored for 24 h in 37 °C water and thermocycled between 5 and 55 °C water with a 20 second dwell time for 5000 cycles. The test specimens were debonded in shear on a universal testing machine (Model 5866 Instron) at a crosshead speed of 1.0 mm/min. Failure mode was determined with a 40x stereomicroscope by classification into categories of adhesive, mixed or cohesive failure. Adhesive failure occurs when greater than 95% of the substrate surface is clear of adhesive, cohesive failure in which there is no debonding and the failure was due to fracturing of the resin or substrate, and mixed failure in which both failure modes are apparent. Shear bond strength means and standard deviations and failure mode are reported.



5000 TC Failure mode

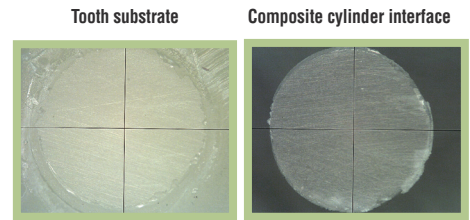
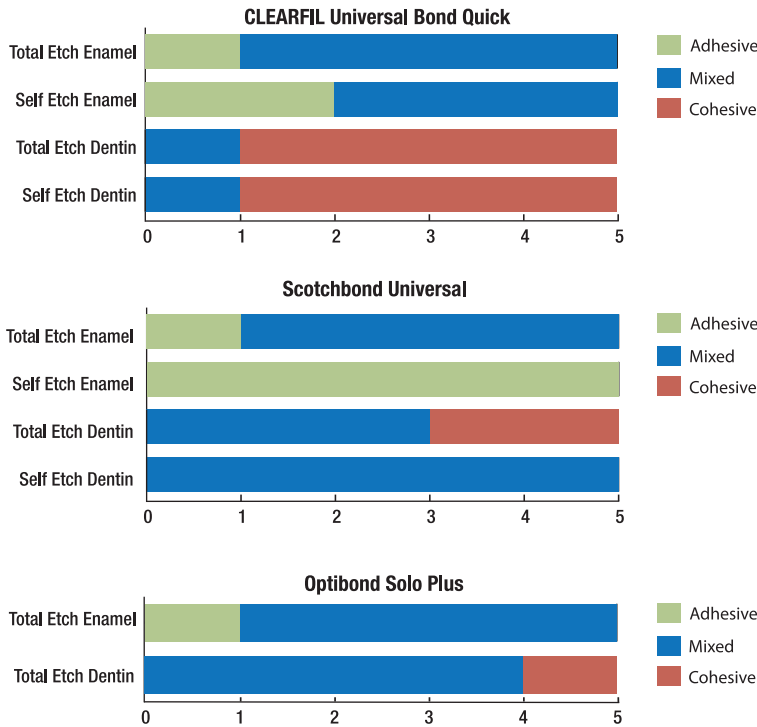


Fig. 1: Adhesive failure

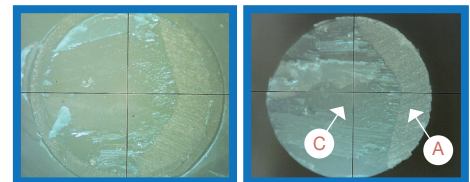


Fig. 2: Mixed failure

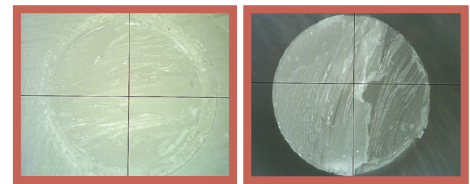


Fig. 3: Cohesive failure

Adhesive failure (green above) indicates the failure occurred due to the bond strength of the bonding agent to the tooth. A cohesive failure (red above) on the other hand, indicates the bond strength was greater than the strength of materials used. A mixed failure (blue above) generally indicates the strength of the bonding agent and supporting materials were close enough to each other to exhibit both failure modes. Cohesive failure generally means the value reported for the bond strength is greater than measured due to early failure of the materials. The large number of cohesive failures in the dentin group for **Clearfil Universal Bond Quick** indicates the bond strength to dentin is even higher than reported.

Conclusion:

CLEARFIL Universal Bond Quick with a reduced application time of 3 seconds showed equivalent, or superior shear bond strengths compared to **Scotchbond Universal** and **OptiBond Solo Plus** after 5000 thermocycles.