Cements

Terminology for Glass-Ionomer Cements and Related Materials
Newly-Marketed Resin Cements
Dispense No Cement Before Its Time
New Developments in Dental Cements
A Luting We Will Go

Terminology for Glass-Ionomer Cements and Related Materials (Originally published in Jan 1996)

Question: I am really confused about the light-activated glass-ionomer restorative products on the market. It seems that everyone calls them by different names. I've heard the terms "hybrid resin/glass ionomers," "light activated glass ionomers," and even "compomers" applied to products such as Fuji II LC, Vitremer, and Dyract. What terms are the correct ones, and aren't the terms really all the same?

Answer: I understand your confusion; glass-ionomer terminology has become quite complicated. For the sake of simplification, I'll only talk about terminology as it applies to currently-available glass-ionomer restorative products. Until recently, the terms "light-activated glass ionomer" and "hybrid resin/glass ionomer" have been used in a rather nonspecific manner to refer to all products that were purported to be combinations of resin and glass ionomer. Unfortunately, the terms did not discriminate between resin-modified glass ionomers that have many of the beneficial features of traditional glass ionomers and products that were primarily resin that had few, if any, glass-ionomer characteristics. This lack of specific terminology to distinguish between products made it easy for manufacturers to market "resin-modified glass ionomers" that were more resin than glass ionomer. In fact, at least one popular product from a major manufacturer was touted to be a glass ionomer but it didn't exhibit the type of acid/base, chemical setting reaction typical of true glass ionomers. In an attempt to distinguish between true glass ionomers, glass ionomers with resin, and resins with little, if any, glass-ionomer component, three well-known educators wrote an editorial that was published in the journal Quintessence International (Quintessence Int 1994;25:587-589). The purpose of the editorial was to propose new terminology to make these differences easier to understand. The authors describe three terms: "glass-ionomer cements," "resin-modified glass-ionomer cements," and "polyacid-modified composite resins." The glass-ionomer cements are materials that consist of an acid-decomposable glass and an acidic polymer that undergo an acid/base reaction when mixed. The reaction does not require light to occur (i.e., the mixed material sets in the dark). Examples of these products are Ketac-Fil (ESPE) and Fuji II (GC America). These are the traditional glass-ionomer restorative products that were first made available to the profession. The next type of product is the resin-modified glass-ionomers. These are glass ionomers to which resin has been added in one form or another. In addition to the glass-ionomer acid/base reaction, they also undergo a resin polymerization reaction that is usually initiated by light exposure or, at least theoretically, can be initiated by chemicals. All of the currently-marketed resin-modified glass ionomers require light exposure to harden. They include such products as Fuji II LC (GC America), Vitremer (3M), and Photac-Fil (ESPE). The third type of glass-ionomer product is known as the polyacid-modified composite resin. As the name implies, these are more resin than glass ionomer. They contain one or both of the basic glass-ionomer components but the components are in such small quantities that they either do not cause an acid/base glass-ionomer setting reaction or contribute little to the overall setting reaction of the material. These products usually do not set without light exposure or set very slowly. They include products such as VariGlass VLC (Caulk), Dyract (Caulk), and Geristore (Den-Mat).

Many clinicians think that just because a hybrid product that is purported to be a glass-ionomer sets without light exposure, it must be a glass ionomer. This is not the case. If a supposed glass ionomer sets without light exposure, it may be hardening because it contains chemicals that cause its resin portion to polymerize. The true glass-ionomer reaction may not actually be occurring. So, just because a purported glass-ionomer material sets in the dark does not mean that the product is necessarily a glass ionomer. What you can say is that if a supposed glass ionomer product does not set in the dark, it can not be a

glass ionomer, because it is not exhibiting the acid/base setting reaction common to all true glass ionomers.

Return to Top

Newly-Marketed Resin Cements (Originally published in Jan 2000)

Question: It seems that dental companies are marketing a lot of new resin cements lately. It is hard to keep track of them and to figure out how they differ. What is DIS's opinion about the new products?

Answer: Manufacturers have devoted a great deal of time and money to developing new brands of resin cements. They realize there is a need for luting agents that can be used for successfully cementing esthetic restorations such as all-ceramic, porcelain, and resin-composite restorations. Resin cements as a group are well suited for these restorations because of their high compressive strength and low solubility. They can also be formulated in different shades to produce an esthetic result for translucent restorations. DIS has published comprehensive synopses of resin cements in previous newsletters (for the most recent, see *DIS* 55-11), however we have continued to evaluate new resin cements as they have been introduced and it can be difficult for readers to keep them all straight because each has its own characteristics. To make it easier to differentiate between the most-recently evaluated products (Variolink II, Calibra, and RelyX ARC), their most relevant characteristics have been listed in the following table. Please note that the information is from the manufacturers.

Product	**Calibra**	**RelyX ARC**	**Variolink II**
Company	Dentsply/Caulk (800) 532-2855	3M ESPE (800) 237-1650	Ivoclar Vivadent (800) 533-6825
Gov't Cost	$202.25	$135	$135
Retail Cost	$367.55	$225	$350
Curing Method	Dual Cure	Dual Cure	Dual Cure
Number of Shades	5	2	5
Number of Viscosities	2	1	3 (only 2 come in kit)
Radiopaque?	Yes	Yes	Yes
Contains Fluoride?	Yes	No	Yes
Try-in Pastes?	Yes, 5 included	No	Yes, 5 available separately
Filler % (Wt) **Filler % (Vol)**	62 to 68 (varies by viscosity) NA	67.5 NA	75 NA
Average Particle Size	1.3 to 1.5 microns	1.5 microns	1 micron
Bonding Agent Provided?	Yes—Prime & Bond NT	Yes—Single Bond	Yes—Excite
Silane Provided?	Yes	Yes	Yes
Film Thickness: **Company Claim** **DIS Measurement**	11 to 19 microns 18 to 20 microns	13 microns 11 microns	22 microns 23 to 26 microns
Rating by DIS	Acceptable	Acceptable	Acceptable
Report in DIS	60-09	59-13	56-25

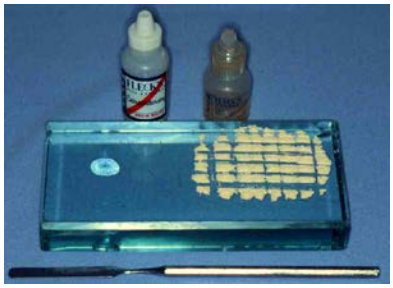
As you can see from the table, the cements have some differences with regard to availability of try-in pastes, number of shades, and fluoride content. In general they all can be used for luting the types of restorations you'd want to cement with a resin cement, including metal, ceramic, porcelain, and resin composite inlays, onlays, crowns, fixed partial dentures, and veneers. Some differences do exist between brands, however. For instance, RelyX ARC can be used for for amalgam bonding as well as for luting "Maryland" bridges and posts but is not recommended for cementing veneers.

All three products appear to have acceptable characteristics for a resin cement and will probably meet your needs. To better determine the "best" product for your clinic, first identify the purpose(s) for which you want a resin cement. Then, review the specific findings included in the DIS evaluations of the products on our Web site. If you need any additional advice or information, please contact DIS.

Return to Top

Dispense No Cement Before Its Time (Originally published in Jan 2001)

Question: Once in a while I use a cement that I have to hand mix because it doesn't come in capsules. Sometimes, my assistant puts the powder and liquid on the glass slab before she is ready to mix it. I remember being told that isn't a good thing to do, but I don't remember why. And, anyway, does it really have any bad effects?



Answer: Although the majority of information provided at lectures or courses is solidly backed by research-based evidence, some instructions or guidance stems simply from tradition. Whenever a recommendation is made to mix or use a dental material a certain way, it is important to know if there indeed is a basis in fact for the recommendation. The specific recommendation you ask about is that cement liquids be dispensed only immediately before mixing and not at the beginning of the appointment just because it might be convenient at that time to do so. What exactly is the rationale for this? Well, the reasoning is that if you dispense the liquid and it is water-based, as many cement liquids are, the water will begin to evaporate. This can change the water/acid ratio and produce adverse effects on the cement's final properties. For the same reason we are cautioned against leaving the bottle of liquid uncapped for extended periods. Now, the important question: what is the evidence that this can actually happen? Although we have seen previous research that indicates that changes in the liquid can affect cement properties[1], a recently published article has evaluated the effects of these changes on newer brands of water-containing cements. Hondrum[2] studied how evaporation of the liquid affected the a number of physical properties of four water-containing cements (Hy-Bond Zinc Phosphate, a zinc phosphate cement; Hy-Bond PCA, a zinc polycarboxylate cement; GlasIonomer, a glass-ionomer cement; and Advance, a resin-modified glass-ionomer cement). He found that the cements' properties changed when the cement liquids were dispensed early and began to evaporate prior to mixing. Specifically, he saw that pH decreased, viscosity (i.e., thickness) increased, and film thickness increased. These could be clinically important changes because they may result in adverse effects on the pulp as well as incomplete seating and decreased retention of the restoration. Interestingly, the zinc polycarboxylate cement (Hy-Bond PCA) and the glass-ionomer cement (GlasIonomer) showed greater changes than the zinc phosphate cement (Hy-Bond Zinc Phosphate) and the resin-modified glass-ionomer cement (Advance). The effects on other properties that Hondrum measured varied depending on the type of cement and the amount of liquid allowed to evaporate before mixing.

So, as you can see by this research, there are important reasons to avoid allowing cement liquid to evaporate. There are a couple of easy ways to do this. First, don't allow your assistant to dispense the cement until just before you are ready to have him/her begin mixing. A second way is to ensure that the assistant recaps the bottle of liquid immediately after dispensing, because evaporation can occur from the bottle even though the orifice is small. Some researchers have suggested that improving the way the liquid is packaged may also reduce evaporation. For example, one way might be to provide the liquid in a syringe rather than a bottle. This, of course, is out of our control, however we can do the simple things already mentioned to minimize the effects that changes in liquid content can have on the cements we use so frequently in dentistry.

Return to Top

New Developments in Dental Cements (Originally published in Sept 1999)

Question: It seems like I see a new cement being advertised almost every time I pick up a dental journal. In dental school I learned about one or two cements and got to know how to use them, but I don't want to miss the boat if there are new and better products being sold. What are the new cements and are they any better than zinc phosphate?

Answer: Although we have had good luting agents for more than 100 years, the development and use of innovative, esthetic restorative materials have lead to the marketing of new types of cements. Some of the recently developed luting agents represent significant advances in physical properties that may result in better clinical performance of the luted restorations.

The case can be made that the recent increased attention to developing and marketing new cements began with the development of zinc polycarboxylate cement in the late 1960s. This cement was a truly innovative development in dentistry because it was the first material to chemically bond to tooth structure. This led researchers to assume that it would provide a strong, durable bond between restorations and tooth structure. However, some clinicians have expressed reservations about zinc polycarboxylate cement's ability to retain restorations and researchers have recently shown that the cement deforms under load, which may contribute to this perceived problem. At any rate, the jury still seems to be out concerning the degree to which the chemical bond contributes to the retention of the cemented restoration. Zinc polycarboxylate cements are also well known for their biocompatibility. Because they are kind to the pulp, they are particularly indicated for situations where the involved tooth has minimal remaining dentin or a history of sensitivity. The most commonly noted disadvantages of polycarboxylate cement is its marked thickness and short working time. Currently marketed brands include Durelon (3M ESPE), Liv Carbo (GC America), Shofu Polycarboxylate (Shofu), and Tylok Plus (Dentsply/Caulk). The most recent innovation in these cements has been the development of Durelon Maxicap, an encapsulated version of Durelon, from ESPE America (see Dental Items of Significance 50-23 for a full review). Because it is mixed and expressed from a capsule, the traditional difficulties of short working time and excessive thickness are overcome. For those who like to use polycarboxylate cement, this is a nice product.

Glass-ionomer cements, which have had a major effect of dentistry, were first marketed as luting products in 1979. These cements have many positive features including fluoride release, chemical bonding, and low solubility. Several well-performing products have been on the market for many years and include Ketac-Cem (3M ESPE), Fuji Ionomer I (GC America), and GlasIonomer (Shofu). Although post-cementation sensitivity has been noted for at least one of these products (Ketac-Cem), proper attention to mixing and handling of the cement can greatly minimize the occurrence.

A tremendous amount of attention has been given to the development of resin cements in the last 10 years, primarily because of the growing interest in esthetic types of restorations. All-ceramic and resin composite veneers, inlays, onlays, and crowns have characteristics that call for the use of low-solubility, high-strength cements and, for the most part, resin cements are well suited in these regards. An entry in an upcoming DIS newsletter will discuss the many changes in resin cements that have been made over the years and will describe some of the new products available. For a recently-published list of resin cements, please see item 55-11 in our September, 1998 newsletter.

The most recently developed cements have been the compomer cements and hybrid resin/glass-ionomer cements. The best know compomer cement, Principle (Dentsply/Caulk), was recently evaluated by DIS (see Dental Items of Significance 58-12 for a full review). Although most of our clinical evaluators found it easy to handle and use, they disliked the fact that it had to be hand mixed and felt it didn't offer any advantages over cements already available.

The hybrid resin/glass-ionomer cements (Fuji Plus, GC America, see Dental Items of Significance 47-20 and RelyX, formerly known as Vitremer Luting Cement, 3M ESPE, see Dental Items of Significance 45-16) have several advantages compared to traditional glass-ionomer cements. For example, they are stronger in tension (which should improve retention), less brittle, less sensitive to moisture, and less

soluble. All of these characteristics are important to a cement. Unfortunately, there have been a number of anecdotal reports of post-cementation fracture of all-ceramic restorations luted with Fuji Plus and RelyX. This problem is believed to be the result of expansion due to water sorption. **It is very important to avoid using these cements for luting all-ceramic restorations.** Fuji Plus and RelyX differ considerably in cost, use, and handling characteristics, so it is a good idea to compare them before choosing one to purchase.

Although the time-tested zinc phosphate cement continues to be an excellent choice for routine daily prosthodontic use, it is important for clinicians to be aware of the many new luting products. Some of these products may be suited for use in your practice, particularly if you frequently place esthetic all-ceramic or all-resin restorations.

Return to Top

A Luting We Will Go (Originally published in Jan 2003)

Question: I was reading a question and answer that was in an old issue of your newsletter and saw that you listed some of the new resin cements DIS had evaluated. Could you do the same thing again for the ones you've evaluated since that earlier issue?

Answer: I'd be happy to. The previous entry you're referring to is located at *DIS* 59-08, which was published in January, 2000. Since that time, DIS has evaluated three more products. More will surely appear in the future as manufacturers take advantage of the tremendous interest patients have shown in esthetic dentistry. Finding a resin cement with which you will be satisfied depends, to a great degree, on your specific needs and on what you consider to be important features. For example, if you use a resin cement to lute the occasional all-ceramic restoration, but mostly use it for resin-bonded bridges (i.e., Maryland bridges) and other all-metal restorations, you probably would be satisfied with a small number of shades but would want the kit to include a good metal primer. On the other hand, if you are primarily cementing porcelain veneers and rarely use the cement for all-metal restorations, you would want a wide range of shades, corresponding try-in pastes, a porcelain etchant, and a good silane solution. Because contents vary so much from product to product, DIS occasionally likes to present short synopses of its most recently evaluated products so that you can easily compare their features. The three resin cements evaluated since *DIS* 59 are Illusion, Nexus 2, and M-Bond. Pertinent information for each is given in the following table.

Product	**Illusion**	**Nexus 2**	**M-Bond**
Company	Bisco, Inc. (800) 247-3368 www.bisco.com	SDS/Kerr (800) 537-7123 www.kerrdental.com	Tokuyama/J. Morita (888) 566-7482 www.jmoritausa.com
Gov't Price	$263.50	$135.14	$144.00
Retail Price	$310.00	$174.00	$240.00
Curing Method	dual cured	dual cured	self cured
Packaging Form	two pastes	two pastes	powder and liquid
Number of Shades	Theoretically unlimited with use of Color Modifier; 3 supplied shades are Clear, Milky, and Opaque	4 in kit (Clear, White, White Opaque, Yellow); a 5th (Brown) is available separately	2 (Clear, Ivory)
Number of Viscosities	One shade that can be altered with Viscosity Modifier	Two (high and low)	One
Radiopaque?	Yes	Yes	No
Fluoride-Containing?	No	Yes	No
Number of Try-in Pastes	3	4	None

Bonding Agent in Kit	One-Step	OptiBond Solo Plus	Two-bottle Primer
Silane Provided?	Yes	Yes	No
Metal Primer(s) Included?	No	No	No
Film Thickness: **Company Claim** **DIS Test Results**	20 microns 36 microns	18 microns 32 microns	None provided 71 microns
Comments	Also comes with porcelain etchant; composite primer, and VLA blockout paste to neutralize dark underlying dentin	Packaged in compact "tackle box"	Good working and setting time; generally handles well but kit is incomplete; not radiopaque
DIS Rating	Recommended	Recommended	Marginal
Location of Review	DIS 64-11	DIS 63-10	DIS 67-07

For additional information about these cements, please refer to their product reviews published by DIS or contact the product's manufacturer.

Return to Top