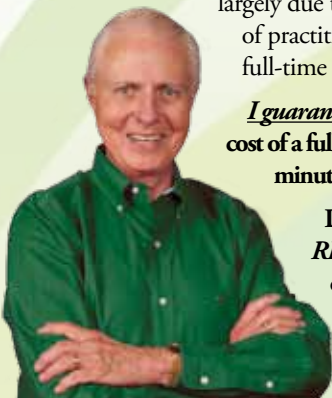


# "I guarantee that you can benefit from our work."

Dear Friends and Colleagues,

Many years ago I recognized the desirability for the development of a non-profit, practitioner oriented dental product evaluation group. I had previously served on numerous national and international committees and councils that evaluated products but I was frustrated about how slowly the groups acted. Subsequently we initiated CRA, now named the CR Foundation (*CLINICIANS REPORT*®).

The group and its influence has grown exponentially around the world largely due to the altruistic volunteer work of hundreds of practitioners and the significant hard working full-time staff.



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Look at the attached *CLINICIANS REPORT*® on the confusing array of new crowns. We spent significant time and effort on this confounded subject to help clinicians know how to use them.

**ZIRCONIA AND LITHIUM DISILICATE RESTORATIONS** have become extremely popular in the last few months. Some of the major labs have informed me that the use of these restorations now exceeds the use of PFM. One of the significant challenges has been how to best cement them.

*CLINICIANS REPORT*® scientists and clinicians have accomplished in-depth research for you and me to identify the best cementation procedures. That information is included in the following *CLINICIANS REPORT*®. We know you will find it to be useful for you and your patients.

This sample Report is representative of the over 30 individual topics and many noteworthy products and techniques included in any one year of the Report. Additionally, after you have read each Report, you may answer a few simple questions and receive CE credits.

We welcome you to participate with us and the CR Foundation!

Gordon J. Christensen DDS MSD PhD  
CEO CR Foundation



**Gordon J. Christensen**  
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## How to Prepare Zirconia and IPS e.max Restorations for Cementation

**Gordon's Clinical Bottom Line:** The rapid acceptance of lithium disilicate (*IPS e.max*), zirconia-based, and full-zirconia restorations has been unprecedented. However, the fast acceptance of these restorations has caused confusion on the best cementation procedures. Restorations may be cemented without any significant **bond** (*luted*), providing primarily mechanical retention only, or the cement may be **bonded** to the restoration and to the tooth creating both mechanical and molecular retention. Manufacturers and clinicians have suggested conflicting protocols, and comparisons of the suggested techniques are minimal. The proven difficult removal of the restorations makes the method of cementation important since luting allows easier removal (*when necessary*) than bonding. *CR scientists and clinicians have accomplished pragmatic research on the topic to help guide practitioners on how to clean the restorations, whether to lute or bond, and how to accomplish each technique.*

Even after several years of placing zirconia and lithium disilicate restorations, many clinicians are still unsure of how to cement these restorations—in part because of the lack of consensus between ceramic and cement manufacturers. Variables regarding pretreatment of the restoration interior and the tooth preparation include: saliva/blood decontamination, surface roughening, and priming (*e.g., primer with or without silane, and/or adhesive.*)

**This report includes multiple cementation options for zirconia-based and lithium disilicate (*IPS e.max*) restorations, and provides clinicians direction on what products and techniques to use when cementing these types of restorations.**

### CR Survey Results

Because of the uncertainty surrounding cementing zirconia and lithium disilicate (*IPS e.max*) restorations, CR conducted a survey to see what is currently being done clinically as well as to assess the general sentiment of clinicians who are placing these types of restorations.

<i>N</i> =1394	Do you place these restorations?	For this type of restoration, do you usually place glutaraldehyde/HEMA desensitizer on dentin tooth preparations?
Full Zirconia/ Zirconia-based	74%	Same response for both: • 61% No • 39% Yes
Lithium disilicate ( <i>IPS e.max</i> )	81%	

What type of cement do you typically use to seat these?		What percentage of these restorations have you had come off during service?
Resin Cement ( <i>self-etch, self-adhesive, total-etch</i> )	Resin-Modified Glass Ionomer ( <i>RMGI</i> )	Same response for both: • 61% report 0% • 32% report 1-5% • 5% report 6-10% • 1% report 11-20%
39%	55%	
63%	32%	

Continued on page 2



## How to Prepare Zirconia and IPS e.max Restorations for Cementation (Continued from page 1)

After trial-fitting, how do you typically prepare the restoration for seating? (*water spray and drying implied*)

Note: Multiple responses possible for multi-step procedure; order varied widely among respondents.

Note: 83% of respondents own and use an in-office sandblasting/air-abrasion unit.

N=1394	Step 1: Roughening and Cleaning						Step 2: Priming	
	Sandblast	Hydrofluoric Acid	Phosphoric Acid	Ivoclean (Ivoclar Vivadent)	Alcohol	Ultrasonic Cleaner	Silane	Adhesive (bonding agent)
Full Zirconia/ Zirconia-based	31%	11%	9%	24%	17%	7%	30%	34%
Lithium disilicate (IPS e.max)	27%	31%	16%	13%	17%	7%	57%	47%

*The lack of consensus denotes a need for research and guidance in this area. (see CR research and suggestions below).*

### Results of CR Testing: Clinical Guidelines for Cement Adhesion to Restoration and Dentin

When bonding zirconia or lithium disilicate (IPS e.max) restorations, there are numerous considerations. The CR Science Team has conducted multiple laboratory experiments to discover variables that affect the bond strength of these restorations. In two parts, we discuss the variables that influence adhesion of the representative cements (*see graph*) to both the restoration and dentin tooth preparation.

#### Part 1: Restoration surface

##### Which surface roughing method works best for each restoration material?

**Zirconia:** When roughening is desired for a low retention prep, sandblast with aluminum oxide, otherwise surface roughening is not needed. *Do not use phosphoric acid on zirconia.*

**IPS e.max:** When cementing restoration with resin cement, surface roughness is needed. 5% hydrofluoric acid roughens restorative material and increases bond strength. Sandblasting alone is not as effective. When luting, such as with RMGI (*not bonding*), surface roughening attaches restoration to cement better than not roughening and may be desirable if additional retention is needed.

##### How do different restoration decontamination materials influence bond of restoration to cement?

**Zirconia:** Phospholipids in saliva reduce bond significantly and must be removed. Either sandblasting restoration with aluminum oxide or cleaning with Ivoclean, a strong basic pH cleaner (*Ivoclar Vivadent*), is effective in decontaminating the surface. Do not use phosphoric acid, which decreases bond strength and does not decontaminate effectively.

**IPS e.max:** Water spray adequately removes contamination.

##### Does priming (examples: Monobond Plus, Z-Prime Plus) of the internal restoration surface improve bond strength? If so, should it contain silane?

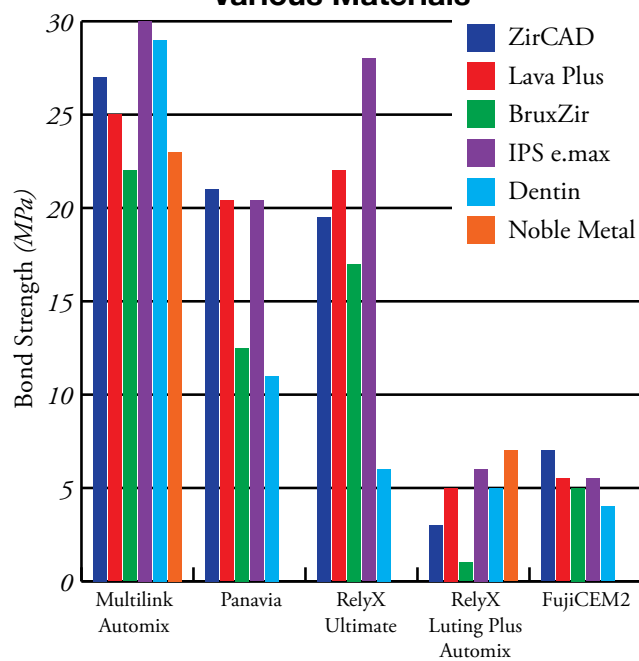
**Zirconia:** Primers with or without silane can improve bond of cement to restoration if desired for low retention preps.

**IPS e.max:** Primers with silane significantly increase bond strength.

##### How do adhesives (examples: Scotchbond Universal, Optibond XTR) placed on the internal of the restoration compare with primers (examples: Monobond Plus, Z-Prime Plus) when using cements that do not contain an adhesive?

**Zirconia:** Although adhesives are not used significantly for this purpose,

### Bond Strengths between Cements and Various Materials



Note: All cements tested were clinically adequate as shown by long-term CR (TRAC) research

they can provide better bond strength than primers for both RMGI and resin cements.

**IPS e.max:** Primers with silane provide highest cement bond to restoration for resin cements. Although not used much for this purpose, adhesives provide highest bond strength for RMGI.

#### Part 2: Tooth surface

##### How should the tooth preparation be cleaned and decontaminated before cementation?

Cleaning the tooth preparation with flour of pumice, not prophyl paste, on a soft rubber cup followed by water spray and a desensitizer if desired (*examples: Gluma, Microprime G*) is a well proven technique.

##### Are glutaraldehyde-HEMA desensitizers, as above, compatible with resin or RMGI cements, and do they influence cement bond to tooth structure?

They are compatible, and they have been shown to have either no influence on bond or in some studies to increase the bond.

##### Does use of dentin primers (separate bottles of solution) provided with self-etching resin cement kits (examples: Multilink Automix, Panavia)

## How to Prepare Zirconia and IPS e.max Restorations for Cementation (Continued from page 2)

### improve bond of resin to tooth structure?

Yes, these materials should be used before cementation with resin. However, self-adhesive cements (*RehyX Unicem 2*, *Maxcem Elite*) have primers contained within the cement itself. When using RMGI cements, most dentists only debride the tooth surface as described on page 2, some use desensitizers, and a few dentists use adhesives on tooth structure before cementing.

### Additional Clinical Tips

**For ease of future restoration removal**, avoid bonding and lute instead. **CR (TRAC) long-term studies have shown RMGI cements to be sufficiently retentive for adequate tooth preparations.** They also offer additional benefits such as fluoride release and easier removal when necessary. More information on the challenges of removing these restorations can be found in *Clinicians Report* July 2012.

**Curing cement:** Most resin cements are dual-cured, which provides clinicians with ability to quickly light-cure the margins of the restoration (*although this fast polymerization does not reach all cement beneath the restoration*). See *Clinicians Report* May 2010 for more on curing light usage. An alternative option provided by some manufacturers for margin protection, especially for those which are only auto-cured, is to use a glycerin gel to prevent adverse oxygen inhibition from occurring along the margin. Both of these options are effective, and one or the other should be considered a necessary procedural step.

### CR Conclusions:

Adequate decontamination of both the restoration and tooth preparation surfaces is critical to ensure an acceptable bond strength. Effective roughening and/or priming of restoration surface also provides improved retention. Although a high bond strength may be favorable in some situations, it can conversely become a disadvantage should the zirconia or lithium disilicate restoration need to be removed. CR survey results and long-term research show RMGI use is sufficient to provide adequate retention unless tooth preparations lack retention.

### Basic techniques for preparing restoration for cementation:

**Zirconia:** After try-in and rinse, 1) sandblast *or* Ivoclean (*Ivoclar Vivadent*), 2) water spray and dry, 3) cement with RMGI (*for retentive tooth prep*) or resin cement system (*for non-retentive tooth prep or veneers*). **Do not use phosphoric acid on zirconia.**

**Lithium disilicate (IPS e.max):** After try-in and rinse, 1) 5% hydrofluoric acid for 20 seconds, 2) water spray and dry, 3) silane primer, 4) cement with RMGI (*for retentive tooth prep*) or resin cement (*for non-retentive tooth prep or veneers*).

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