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How To Predictably Reduce Post-op Tooth Sensitivity and Caries

Gordon's Clinical Observations: Clinicians Report TRAC Research section has been conducting research on the microbiology of dental caries for many years and has developed a technique for accomplishing the desensitization and disinfection of tooth preps. You have heard this information in CR and PCC courses for several years. However, during my many live and virtual courses, questions commonly arise relative to the use of glutaraldehyde/HEMA containing solutions for these purposes. I see considerable and frequent confusion and lack of understanding on how to accomplish this technique. *In this report, the proper method and sequence for achieving the disinfection and desensitization procedure will be clarified, and commonly asked questions will be answered.*

Of high significance, the role of microorganisms in dental caries was proposed over a century ago. Willoughy D. Miller, a dentist from Ohio and later Germany, introduced modern biological principles to dentistry in the late 1800s. He developed a theory that microorganisms breaking down food products caused dental caries. Independent of Miller, GV Black in the same time period had similar writings. In subsequent years, various chemicals were suggested and used to reduce or eliminate the effect of the microorganisms' influence on caries. However, in the mid and late 1900s, in spite of the logic of Miller and Black, tooth prep disinfection vanished. ***Because of current research accomplished by the TRAC Research section of CR on dental caries, it is now time to restart disinfection of tooth preparations!***

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Improving Impressions and Tooth Preps with Intraoral Scanning

Gordon's Clinical Observations: In-office scanning is showing significant growth and acceptance by practitioners despite the clinical success of conventional vinyl, polyether, and alginate impressions. It appears that this concept is the future. Cost, physical characteristics, speed of scanning, and overall performance of these devices varies considerably among brands, but clinical acceptance is very high after a period of accommodation by practitioners. *In this issue, CR clinicians and scientists provide an update on intraoral scanning.*

Example impression *(CEREC Primescan by Dentsply Sirona)* showing such digital tools as occlusal contact strength, margin marking, and labels.

Digital design and fabrication of dental prostheses and devices is increasing. Today, almost all labs scan conventional impressions or casts to digitize them for computerized workflows. For clinicians, an intraoral scanner is the portal to the digital realm and can actually improve the quality of impressions and tooth preparations. Pioneering devices have been available for decades, and the recent proliferation of scanner brands suggests that this concept is gaining acceptance. **The following report provides guidance on changing from conventional to digital impressions; examines the current status of scanning; and reviews features of three current intraoral scanners.**

Continued on Page 3

"Universal" Bonding Adhesives: CR Puts Them to the Test

Gordon's Clinical Observations: Are all bonding agents the same? Should you seek a new one for your practice? In 2003, CR studied every bonding adhesive they could find available on the market—there were 37 in total. Today, there are more than 150 different brands on the market, and the subject is bewildering. When considering the outdated and confusing "generation" labels given to each of these adhesives, how do you know which is the best one for the needs of your patients? Resin-based composite restorations are the bread and butter of most dental practices, and you want the right bonding agent. **Today's formulations do MORE than they did in 2003**. *In this issue, CR scientists and clinicians show you the initial results of our study on representative popular brands of universal bonding agents that will guide you in your choice!*

The following report utilizes the more than 100 years' combined bonding experience CR scientists have put into testing virtually every generation bonding adhesive making it to market—as well as dozens that didn't. **In the following report, CR simplifies bonding adhesives by chemistry—not *generation;* identifies the shortfalls and benefits of each; and looks at the efforts manufacturers are making to combat the biologic-based bond margin degradation believed to be the primary culprit behind many of the failed composite restorations placed today.**

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Products Rated Highly by Evaluators in CR Clinical Trials

The following four products were rated excellent or good by CR Evaluator use and science evaluations.

Visalys CemCore: Conventient core build-up and resin cement in one material with dual cure

StellaLife VEGA Oral Care Gel: Homeopathic oral sore relief gel reduces inflammation and swelling, and promotes healing

OsteoGen Strip: Easy-to-use resorbable grafting strip in two sizes

Premier Universal Primer: For zirconia, glass ceramic, metal, and composite; quick and easy

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How To Predictably Reduce Post-op Tooth Sensitivity and Caries *(Continued from page 1)*

CR Historical Perspective on Tooth Disinfection

Numerous chemicals have been studied relative to their effectiveness for tooth prep disinfection, including benzalkonium chloride, chlorhexidine gluconate, glutaraldehyde/HEMA, sodium hypochlorite, and others. CR's TRAC Research section has conducted both laboratory and sophisticated human research on this subject and has been suggesting 5% glutaraldehyde/35% HEMA for over 10 years. **The commonly used brands containing glutaraldehyde/HEMA are GLUMA Desensitizer *(Kulzer)*, Glu/Sense *(Centrix)*, and MicroPrime G *(Zest Dental Solutions)***, but most of TRAC's work uses GLUMA Desensitizer because of its unique characteristics.

Commonly Asked Questions about use of Glutaraldehyde/HEMA

A. Some companies say NOT to use glutaraldehyde with their products.

Answer: CR has talked with scientists from these companies about this specific recommendation, and their response is that it can irritate soft tissue. That is true, but so do many other chemicals you use daily. Use it in small, controlled amounts applied using magnification and a microbrush, and suction it off. Do NOT blow it on to the soft tissue. If it inadvertently contacts soft tissue, immediately wash and suction.

B. Instructions from some companies say to allow it to be on the prep for a short time and wash it off.

Answer: Washing it off defeats one of the major purposes of the technique. The HEMA, which is a wetting agent, reduces the surface tension of the tooth and the dentinal tubules. This allows the glutaraldehyde to enter and travel down the tubules, thus killing microbes, coagulating the collagen, and eliminating postoperative sensitivity. TRAC tested many different application times, but repeatedly the best results were with the two 1-minute applications. Why does the solution need this contact time? 1) To penetrate the smear layer and enter the tubules, 2) to allow the chemistry of the solution to be refreshed by the second 1-minute application, and 3) to eliminate the microbes.

C. Some say the glutaraldehyde interferes with and reduces the bond of resin bonding agents.

Answer: CR and TRAC Research and others have shown that bonds are either modestly increased or unaffected when preceded by placement of glutaraldehyde *(Glidewell data, Ivoclar data, CR data, and CR overall literature review)*.

D. When using a liner or a base, should the glutaraldehyde be placed before the liner or base or after the liner or base? *(See technique and photos at right.)*

Answer: The answer is easy to remember. The purpose of the solution is to desensitize and disinfect the dentin, so it must be placed on the freshly cut dentin, or it will NOT enter the dentinal tubules.

E. When should the solution be placed on a crown prep: at the prep appointment, at the seat appointment, or at both appointments?

Answer: It is best placed at both appointments—after the prep to desensitize and disinfect during the provisional cementation period. There is obviously saliva leakage and reinfection during the temporary period, so cleaning the prep and re-application of the glutaraldehyde/HEMA before final cementation is indicated.

F. Does the solution injure the pulp?

Answer: Three separate TRAC Research human clinical studies have shown no untoward effects in these studies, including several thousand single and multi-unit restorations monitored yearly up to 10 years after treatment.

G. Should this technique be used on all preps?

Answer: TRAC Research data shows that EVERY tooth preparation and ALL pits and fissures are highly colonized. The microbes cannot be washed away or etched away. They must be killed chemically.

Technique when Using or Not Using a Liner Under a Composite Restoration

1. **Identify caries** as soon as possible and as small as possible.
2. **Anesthetize the patient.**
3. **Make a dry field,** preferably with rubber dam, Isolite 2, Mr. Thirsty, or others.
4. **Make the prep as small as possible** with a carbide or diamond bur with the following size: premolar isthmus width and proximal box with 329 bur, molar with a 330 bur.
5. **Place glutaraldehyde containing desensitizer/disinfectant *for two 1-minute applications*—** MicroPrime G, Glu/Sense, GLUMA Desensitizer, or other *(5% glutaraldehyde/35% HEMA)*. Don't wash. *If a liner is NOT being used, omit steps 6 and the re-application of the glutaraldehyde in step 8.*
6. **Place the liner or base of your choice if the prep is deep.** Current TRAC research with the new generation of conventional glass ionomers *(EQUIA Forte, Ketac Universal, etc.)* shows that their seal of the prep is superior to the resin-modified glass ionomers or other popular liners. The new GIs are significantly easier to use than past versions *(see Clinicians Report July 2020 and soon to be available PCC video on the new glass ionomers, video 3514 (800-223-6569)*.
7. **Acid etch the prep** with your preferred method: total, selective, or self etch. *(Gordon prefers selective enamel etch.)*
8. **Wash and dry the prep.** If a liner or base was placed, using a new microtip, re-wet the enamel surfaces with glutaraldehyde/HEMA. Don't wash and dry, just suction briefly.
9. **Place a bonding/wetting agent of your choice.** Scotchbond Universal or many others; blow thin and cure. **Repeat #9** if there is any question you did not place bond on all the prep.
10. **Place and cure resin** of your choice, preferably in only 2 mm increments.
11. **Finish the restoration.**
12. **Evaluate and adjust occlusion.**

A. Before Treatment

Sensitive premolar teeth with moderate size and depth of proximal caries in a female teenager thought to have bulimia. It was decided as a precautionary procedure that a glass ionomer liner/base would be used.

B. Completed Preps

C. Liner/Base in Place

B. Conservative tooth preparations for resin-based composite *(isthmus width size of 330 bur)*. C. Glass ionomer liner/base placed about 0.5 mm thick using the technique described in this article.

CR CONCLUSIONS: Use of glutaraldehyde/HEMA solutions has been shown to be safe and effective by TRAC Research and many others. Care must be taken to avoid getting the solution on the soft tissues to avoid chemical irritation. It is highly advisable to deactivate the millions of microbes left in tooth preparations and pits and fissures prior to placing direct or indirect tooth restorations and sealants. Leaving active organisms can predispose the tooth to future caries activity. ***Many clinicians continue to report grateful empirical comments to CR on the effectiveness of the glutaraldehyde concept after they have used the proper technique***.

Improving Impressions and Tooth Preps with Intraoral Scanning *(Continued from page 1)*

Guidance on Changing from Conventional to Digital Impressions

The sad reality, as reported by dental laboratories, is that many conventional *(and digital)* impressions are of poor quality and need better soft tissue management. Clinicians and patients are reticent to repeat tedious and uncomfortable elastomeric impressions. **Digital impressions, however, are viewed live and enlarged on a computer screen for instantaneous feedback.** Immediate action can be taken to correct such defects as inadequate reduction, poor margin definition, undercuts, or soft tissue and moisture management issues. Open review by the entire dental team has been shown to improve treatment and refine clinical techniques.

The key requirement for successful digital impressions is clear visualization of all margins.

- Excellent soft-tissue management
- Dry field, with no blood or fluid seepage

Challenging clinical situations *(deeply subgingival margins, moisture problems, etc.)* where the above requirements cannot be met require conventional materials. Clinical cases by CR and others have shown that scanning equals or exceeds conventional impressions.

▶ Example Workflow for Digital Impressions

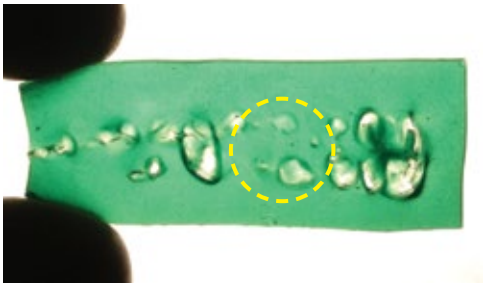
1. **Clinical assistant** welcomes and seats patient, and reviews planned treatment.
2. **Dentist** greets patient, answers questions, evaluates occlusion, and anesthesia is administered by dentist *(or hygienist, where legal)*.
3. **Clinical assistant** makes a quick-set occlusal impression for fabrication of temporary *(if sending case to lab)* and obtains maxillary, mandibular, and buccal bite *(interocclusal)* intraoral scans while anesthesia takes effect.
4. **Dentist** prepares teeth using conventional methods, including adequate soft-tissue management.
5. **Dentist** *(or **clinical assistant**, where legal)* scans the prepared teeth.
6. **Clinical assistant** fabricates temporary restoration, which is seated and adjusted.
7. **Clinical assistant or technician** either includes scans with email case submission to lab, or designs and mills the restoration using an in-office CAD/CAM system, such as CEREC.

Digital impression scan in progress *(Emerald S by Planmeca)*

Intraoral scanning is an exciting opportunity for staff to be more involved in restorative treatment and use high-tech equipment. With a well-trained assistant, it is not unusual for the dentist to spend less than 15 minutes chairside for a single crown procedure.

▶ Clinical Tips

- **Put patient needs first:** Avoid overtreatment or temptation to turn a small restoration into a crown to better suit the scanning or milling process.
- **Patient motivation:** Patients generally prefer digital over elastomeric impressions to avoid the long wait for set, possible gag reflex, objectionable taste, and mess. They also show enthusiasm for new technology and restorative material options.
- **Rapid turnaround time:** Digital impressions eliminate processing steps in the lab. A turnaround time of 2–3 days is possible and may include a discounted lab fee.
- **Restoration fit:** Communicate with lab to refine the settings for contact strength and cement space. ***Currently, many crowns are purposely milled out of occlusion (up to 0.5 mm or 500 µm) to minimize need for chairside occlusal adjustment. This negates the capabilities of the technology, compromises clinical performance, and can cause patient breakage of adjacent teeth due to occlusal forces.***
- **Cost:** Initial cost is high, but most users reported good to excellent return on investment. ***Before purchase, clarify additional costs, including data plan and maintenance plan fees***. Detailed cost analyses indicate that digital impressions range in cost from $14–$204, while elastomeric impressions range from $17–$130 *(depending on numerous variables)*. Increasing the number of crown cases per month was the most significant factor for improving profitability.
- **Technical challenges:** Computerized equipment is expensive and can be frustrating for some to learn. Use motivated staff to learn and operate digital equipment and files.



Occlusal Indicator Wax *(KaVo Kerr)* reveals that a newly seated crown has light occlusion, causing accentuated occlusal stress on both adjacent teeth.

Current Status of Intraoral Scanning: CR Survey

It is estimated that 10–15% of North American dentists currently use intraoral scanners. A recent survey of CR subscribers revealed the following trends (n=1,011).

- **Scanner use among CR subscribers:** Approximately **36%** *(much higher than national average)*
- **Clinical results compared to conventional impressions:** **54%** better; **33%** similar; **11%** mixed results; **3%** worse
- **Cost effectiveness:** **30%** excellent; **42%** good; **23%** fair; **5%** poor
- **Overall satisfaction:** **55%** excellent; **36%** good; **8%** fair; **1%** poor
- **Brands in use:** **44%** CEREC models *Dentsply Sirona*; **19%** iTero models *Align Technology*; **14%** TRIOS models *3Shape*; **8%** CS models *Carestream*; **7%** Planscan models *Planmeca*; **5%** True Definition models *Midmark*; **1%** Medit i500; **1%** Heron IOS *3DISC*
- **Main uses:** **95%** single units; **55%** multiple units; **40%** ortho; **31%** occlusal splints; **26%** implants; **26%** digital record; **26%** study model; **25% or less:** patient education, surgical guides, removable prostheses, interocclusal record, sleep appliances, bleaching trays, dentures, waxups, etc.

Improving Impressions and Tooth Preps with Intraoral Scanning *(Continued from page 3)*

Current Status of Intraoral Scanning: CR Survey *(Continued)*

- **Main advantages:** **83%** preferred by patients; **67%** fast case turnaround time; **63%** accurate fit; **56%** digital record storage; **52%** easier; **50%** improved quality of treatment
- **Main limitations:** **51%** high cost; **37%** soft tissue management; **35%** learning curve; **34%** intraoral access; **29%** moisture management

CR Survey Summary: The majority of clinicians making digital impressions indicated that clinical results are similar to or better than conventional impressions, and their overall satisfaction was good or excellent. Patients prefer digital impressions and clinicians appreciate the fast case turnaround time. Challenges continue to be high cost, soft-tissue management, and technical complexity. It is hoped that increasing competition and innovation will improve these issues.

Features of Three Representative Intraoral Scanners

More than 20 different intraoral scanners are now on the market. The CR science and clinical team recently evaluated three current models, listed below in alphabetical order. *(See Clinicians Report April 2017, August 2016, and March 2014 for previous evaluations.)*

- **Updated CEREC *(Dentsply Sirona)* and Planscan *(Planmeca)* models** offer improved speed, convenience features, and future expansion into in-office CAD/CAM systems, if desired.
- **New WOW *(Denterprise International)* model** offers lower initial cost and no fees for a lower cost entry into scanning.

▶ CEREC Primescan *(Dentsply Sirona)*

$44,995

- **System evaluated:** Stand-alone cart with touch-screen and touch-pad
- **Major improvements over previous Omnicam model:** Wider scan area *(but with a larger handpiece)* and greater depth of field for improved speed of scanning; improved user interface; heated anti-fog handpiece
- **Features:** Color images; high resolution; disposable handpiece sleeves; exports in open STL format
- ***CR Findings:*** Clinical users noted significant improvement in smoothness and speed of scanning over previous Omnicam model despite larger handpiece; intuitive software; and large touchscreen interface.

▶ Emerald S *(Planmeca)*

$32,000

- **System evaluated:** Laptop-based system with mouse
- **Major improvements over previous Emerald model:** Improved speed and ease of scanning; improved color and shade-assist technology; higher resolution detail; updated intuitive software
- **Features:** Color images; autoclavable anti-fog tips; optional smaller SlimLine tip; exports in open STL and PLY formats; no scan, click, or subscription fees
- ***CR Findings:*** Users noted significant improvement over Emerald with faster and smoother scanning, and significantly less loss of tracking. Size and shape of handpiece remain similar.

▶ WOW *(Denterprise International)*

$17,995

- **System evaluated:** Laptop-based system with mouse
- **Technology:** Two video cameras *(stereophotogrammetry)* in a slim, lightweight, USB handpiece with relatively low cost; 3D data created by software processing
- **Features:** Color images; powderless; direct view *(no mirror tips);* snap-on guides in three sizes to help maintain proper distance during scanning; Linux-based software exports in open STL or PLY file formats
- ***CR Findings:*** Video-based 3D scanning was slower and less detailed than other scanning technologies evaluated, but once acclimated to technique, scanning was simple and effective. Distance guides improved ease of use by allowing tip to rest directly on dentition, but made overall size of tip similar to other scanners. Slim, lightweight handpiece had best ergonomics and handling.

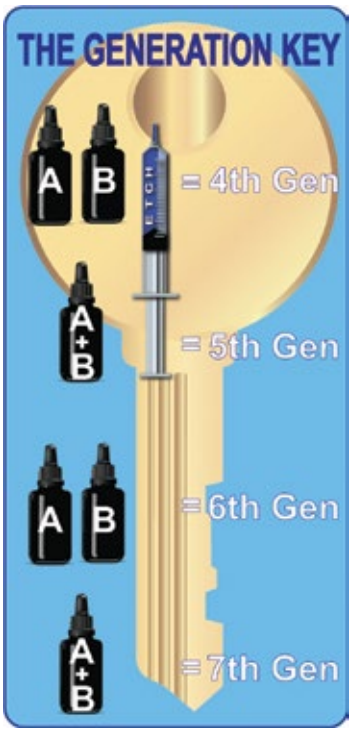
CR CONCLUSIONS:

- The digital workflows of today's advanced materials could logically start in the clinic with intraoral scanning for digital impressions.
- Scanning allows clinician to review tooth preparation and captured details, permitting refinement and improvement of prep and impression.
- Scanning technology is well proven and in a state of rapid evolution with more than 20 models now on the market.
- High cost and complexity remain the main limitations, and conventional impressions are still required for challenging clinical situations.
- Clinicians should ensure good soft-tissue management and moisture control for optimum impressions, whether using elastomeric materials or digital impression scanners.
- WOW *(Denterprise International)* scanner has low initial cost and no fees. Slim, lightweight handpiece utilizes dual video camera technology. Scans were acceptable after initial learning period. Unit offers a relatively low-cost option for initial scanner purchase.
- CEREC Primescan *(Dentsply Sirona)* and Emerald S *(Planmeca)* scanners are improved models with faster, smoother scanning, and enhanced software. Importantly, both can later be upgraded to in-office CAD/CAM systems, if desired.

"Universal" Bonding Adhesives: CR Puts Them to the Test *(Continued from page 1)*

What's in a Generation?

By itself, the term "generation" is arbitrary and confusing. The following is a simplified way of looking at bonding adhesives and a fail-proof method of correctly identifying the "generation" of every adhesive manufactured since the 1990s.



1. Etching required or optional?

- **Total-Etch *(TE)* Systems:** Rely on a pre-treatment of tooled surface with 38% phosphoric acid etchant to dissolve the smear layer and create a zone of demineralization for resin infiltration. *(Total Etch = 4th and 5th generation adhesives)*
- **Self-Etch *(SE)* Systems:** Rely on acidic monomers to break up the smear layer and mildly etch the dentin while leaving smear plugs within tubules. *(Self Etch = 6th and 7th generation adhesives)*

2. Number of bottles in system?

- **Two Bottles: *Total Etch (TE) *Etching Required***
  - ***Bottle 1:*** Resin primer, hydrophilic carrier *(water, acetone, or alcohol)*
  - ***Bottle 2:*** Hydrophobic methacrylate resin and a photo-initiator for light curing
  - ***Examples include:*** OptiBond FL *(KaVo Kerr)*, All-Bond 2 *(Bisco)*, Scotchbond Multi-Purpose *(3M)*
- **One Bottle: *Total Etch (TE) *Etching Required***
  - ***Bottle 1:*** Primer, adhesive, carrier, fillers, and photo-initiator
  - ***Examples include:*** OptiBond Solo *(KaVo Kerr)*, Single Bond *(3M)*, One-Step *(Bisco)*, Peak Universal Total-Etch *(Ultradent)*
- **Two Bottles: *Self Etch (SE) *Etching Optional or Not Required***
  - ***Bottle 1:*** Acidic resin primer, hydrophilic carrier *(water, acetone, or alcohol)*
  - ***Bottle 2:*** Hydrophobic methacrylate resin and a photo-initiator for light curing
  - ***Examples include:*** Clearfil SE *(Kuraray Noritake)*, Peak Universal Self-Etch *(Ultradent)*, Clearfil SE Protect *(Kuraray Noritake)*
- **One Bottle: *Self Etch (SE) *Etching Optional or Not Required***
  - ***Bottle 1:*** Acidic primer, adhesive, carrier, and photo-initiator
  - ***Examples include:*** OptiBond Universal *(KaVo Kerr)*, Scotchbond Universal *(3M)*, Adhese Universal *(Ivoclar Vivadent)*, Clearfil Universal Bond Quick *(Kuraray Noritake)*

What's Different about the "Universal" Bonding Agents?

Functional Group of acidic monomers that etch *and* form chemical bonds with the substrate *(e.g., tooth, metal, ceramic, etc.)*

- ***10-MDP (10-methacryloyldecyldihydrgen phosphate):*** Introduced by Kuraray Noritake in Clearfil SE in the early 2000s
  - – **Clearfil SE** considered to be "gold standard" for self-etching bonding adhesives
  - – Combined hydrophilic primer containing 10-MDP followed by a hydrophobic resin *(adhesive)* coating *(6th generation)*

Since the expiration of Kuraray Noritake's patent, manufacturers use 10-MDP to create new class of single-bottle, self-etching "universal" adhesives

- Single-bottle system requires the chemistry to be both acidic and hydrophilic *(many contain up to 20% water)*
- Protease inhibition *(anti-MMP)* preventing time-dependent bond interface degradation
- Previous single-bottle adhesive systems have been shown to behave as permeable membranes prone to hydrolytic degradation
- 10-MDP containing, single-bottle, universal adhesives only a few years old—***no long-term studies available on bond margin stability***
- ***Peak Universal Total-Etch and Peak Universal Self-Etch*** *(Ultradent):* 0.2% chlorhexidine, a known antibacterial and protease inhibitor
- ***Brush & Bond Universal*** *(Parkell):* additional functional monomer 4-META
- ***Clearfil SE Protect*** *(Kuraray Noritake):* new patented antibacterial functional monomer, MDPB

Which System do You Prefer? *(Data from a CR Survey N=778)*

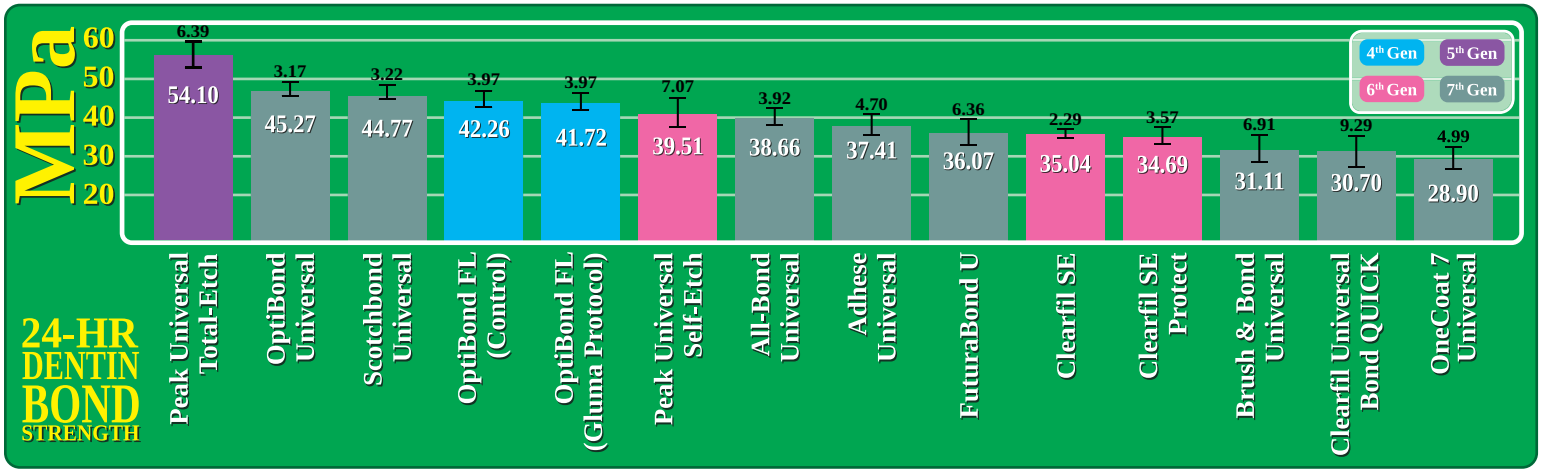
- **2-bottle, TE systems** *(4th Generation)*, such as OptiBond FL *(KaVo Kerr)*, are rated as "the best" by the majority of dentists *(34%)* followed by **single-bottle SE systems** *(7th Generation)* at 27%, **2-bottle SE systems** *(6th Generation)* at 19%, and **single-bottle SE systems** *(5th Generation)* at 19%.
- **Top 5 Most Preferred Adhesives**
  - – Clearfil SE Bond 2 *(Kuraray Noritake)*, 6th Gen
  - – Clearfil Universal Bond QUICK *(Kuraray Noritake)*, 7th Gen
  - – All-Bond Universal *(Bisco)*, 7th Gen
  - – Adhese Universal *(Ivoclar Vivadent)*, 7th Gen
  - – OptiBond Universal *(KaVo Kerr)*, 7th Gen
- **Even though** all of the preferred adhesives fall into the SE category, nearly half *(46%)* of all dentists surveyed still etch both the enamel and dentin and 30% selectively etch the enamel only. CR testing shows etching improves ***initial bond strengths across all generations of adhesives***; however, it also has the same potential to cause post-operative sensitivity independent of whether a TE or a SE system is used. In other words, using a self-etching adhesive does not remedy complications associated with etching with phosphoric acid.
- **Although highly recommended by CR science and staff**, most clinicians *(73%)* do not think a rubber dam is necessary and place them less than 25% of the time for composite restorations.
- **Postoperative sensitivity** is rare for most clinicians with 86% reporting that they experience it less than once in every 20 composite restorations.
- **Desensitizing agents,** such as GLUMA Desensitizer *(Kulzer)*, are popular with 47% of the clinicians surveyed using them to pre-condition the tooth prior to the application of the bonding agent.

	In Practice for More than 10 Years	In Practice for 10 Years or Less
Lifetime expectation of "Successful" Restorations	10.3 YEARS	6.9 YEARS
Lifetime expectation of "Unsuccessful" Restorations	6.0 YEARS	4.4 YEARS

"Universal" Bonding Adhesives: CR Puts Them to the Test (Continued from page 5)

Which System is Best?

Although it is not the only measure when determining the best adhesive on the market, CR laboratory testing has consistently shown total-etch systems to be superior in terms of shear bond strength, especially when bonding to enamel.



CR science picked ten of the top "universal" adhesives on the market along with five time-tested classics. They doubled the standard set sizes they usually do for a bond strength study. For each adhesive, one-half of the specimens were stored in de-ionized *(DI)* water at 37°C for 24 hours prior to debonding. The results are shown in the graph above. The other half are being artificially aged by thermocycling *(5000×)* and storage in DI water and will be tested after six months to see if the new chemistries with functional monomers maintain their bond strengths better over time than their predecessors.

Look for six-month bond stability results in a future Clinicians Report.

(Compare your adhesive and see how it measures up after thermocycling and extended storage.)

Seven Bonding Tips from CR Science

It is well understood that it is rare that in-vitro testing results directly transfer to clinical situations; however, the following are techniques CR scientists have learned are clinically advantageous. **These techniques are universal, *regardless of chemistry, brand, or generation.***

1. **If you are satisfied with your current adhesive, do not change it.** Contrary to popular belief, ***your application technique does matter!*** Switching to something new creates a whole new learning curve.
2. **Use a rubber dam or isolate to control moisture and contamination**, especially when field control is a challenge. ***Contamination interferes with adhesion. Period.***
3. **Always etch the enamel.** The cavosurface margins of most restorations of this type are typically found in enamel, so it is the first line of defense, making a good seal and a strong bond of critical importance. Do this even if it is a self-etching system claiming to etch enamel because ***CR has never tested a self-etching adhesive capable of bonding as well to unetched enamel as it can to etched enamel.***
4. **Use a desensitizer with glutaraldehyde/HEMA.** It will prime the tooth creating a significant barrier to deleterious effects of water present in the dentin. *(See "How To Predictably Reduce Post-op Tooth Sensitivity and Caries" on pages 1–2.)*
5. **Scrub. Scrub. Scrub.** Mechanical agitation keeps the mixture as homogeneous as possible, which helps ensure a completed reaction. Further, it aids bonding by ensuring complete solvent evaporation and physically moves the exposed collagen fibrils back and forth providing a thorough resin coat. Note: Clearfil SE Universal Bond Quick claims "no waiting time" in their directions, but CR testing showed a 17% increase in 24-hour bond strength by scrubbing the adhesive for 15 seconds.
6. **Air thicken for viscosity prior to air thinning for film thickness.** Use a gentle stream of air for 15 to 20 seconds. The goal is to remove as much of the carrier *(solvent)* from the mixture as possible. This is key because even small amounts of residual solvents can have devastating effects on the ability of the resins to polymerize.
7. **Start with a thin layer of composite**, no more than a millimeter thick. Use gentle tapping motions to pat the composite in place. This reduces pullback, which establishes voids along the composite/adhesive bond interface. Cure it in place. Proceed with a standard fill protocol after that.

CR CONCLUSIONS: Although there have been an endless stream of "new and improved" bonding agents appearing on the market over the last 20 years, many of these ***improvements*** have been centralized in simplifying the application procedure—and CR Testing is supported by the literature: ***simplification comes with a cost***. Many of the first 4th and 5th generation adhesives still outperform subsequent versions both in terms of bond strength and bond stability over time. **Clearfil SE *(Kuraray Noritake)*, the first to use 10-MDP and the only one to use it in a 2-bottle system, is time tested and highly recommended by CR scientists**. Concerns about hydrolysis and the lack of time testing makes CR hesitant to embrace "universal" single-bottle adhesives until more time-dependent testing is completed. However, considering the potential utility of a truly universal adhesive and the initial shear bond testing results demonstrated thus far, CR is optimistic about the possibilities of this new technology.

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Earn 1 credit hour for successfully completing each test. Tests are also available at www.CliniciansReport.org. This is a self-instruction program.

At the completion of this test, participants should be able to:

- Discuss the importance of disinfecting tooth preps
- Evaluate intraoral scanners
- Identify bonding adhesive generations and the benefits and limitations of each
- Evaluate new products and their potential clinical usefulness

Self-Instruction Test, October 2020, 1 CE *Check the box next to the most correct answer.*

1. When placing a base or liner in a prep for a Class II resin restoration, the glutaraldehyde/HEMA should be placed:
   - ❑ A. Either before or after the base or liner.
   - ❑ B. After the liner or base is placed.
   - ❑ C. Before the liner or base is placed.
   - ❑ D. Mixed with the liner or base and placed together.
2. Placing glutaraldehyde/HEMA on a tooth preparation:
   - ❑ A. Decreases the bond of bonding agents.
   - ❑ B. Always increases the bond of bonding agents.
   - ❑ C. Modestly increases or does not affect the bond.
   - ❑ D. Should not be used with bonding agents.
3. Which statement regarding current intraoral scanners is ***true***?
   - ❑ A. The new CEREC Primescan handpiece is smaller than the previous Omnicam model.
   - ❑ B. The new Emerald S scanner is slower than the previous Emerald model.
   - ❑ C. The WOW handpiece is lightweight and uses two video cameras to create 3D data.
   - ❑ D. Intraoral scanner technology has stabilized with only a few brands available.
4. Which statement regarding intraoral scanners is ***false***?
   - ❑ A. Digital impressions have been shown to improve treatment quality.
   - ❑ B. Clinical results from scanners cannot equal those from elastomeric impressions.
   - ❑ C. Turnaround time is typically faster for cases submitted electronically with digital impressions.
   - ❑ D. Intraoral scanning provides an opportunity for greater utilization of staff members.
5. You are working with a 2-bottle, self-etching bonding adhesive. What generation is it?
   - ❑ A. 4th Generation
   - ❑ B. 5th Generation
   - ❑ C. 6th Generation
   - ❑ D. 7th Generation
6. Which statement about bonding agents is ***false***?
   - ❑ A. 4th and 5th generation adhesives require an etch step prior to placement.
   - ❑ B. Scrubbing the bonding agent when applying keeps the mixture homogeneous and aids with solvent evaporation.
   - ❑ C. CR has tested many self-etching adhesives that adhere better to enamel without a prior etch step.
   - ❑ D. A "functional monomer" is a monomer that is acidic enough to etch the tooth surface and chemically bond to calcium within hydroxyapatite.
7. Visalys CemCore is:
   - ❑ A. A core build-up material with putty consistency.
   - ❑ B. A kit containing separate core material and compatible cement.
   - ❑ C. An RMGI cement that may also be used for core build-ups.
   - ❑ D. Core build-up and resin cement in one material to reduce components required for these two procedures.
8. StellaLife VEGA Oral Care Gel effectively promotes healing and reduces swelling and inflammation with a combination of homeopathic ingredients.
   - ❑ A. True
   - ❑ B. False
9. OsteoGen Strips are:
   - ❑ A. Syringe dispensed bovine bone particles designed for socket grafting.
   - ❑ B. New bioactive resorbable calcium apatite particles for bone grafting.
   - ❑ C. Bone grafting strip that combines bioactive resorbable calcium apatite within a bovine Achilles tendon collagen matrix.
   - ❑ D. Allograft *(demineralized freeze dried bone)* for socket grafting and ridge preservation.
10. Premier Universal Primer was formulated specifically for increasing resin bond strength to zirconia only.
    - ❑ A. True
    - ❑ B. False

To receive credit, all 2020 tests are due by December 15, 2020.

Submit your test answers online at www.CliniciansReport.org and receive immediate results; mail to Clinicians Report, Attn CE Tests, 3707 N Canyon Rd, Bldg 7, Provo UT 84604; fax 888-353-2121; or scan and email to CR@CliniciansReport.org

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Products Rated Highly by Evaluators in CR Clinical Trials *(Continued from page 1)*

Convenient Core Build-Up and Resin Cement in One Material with Dual Cure

Visalys CemCore
Kettenbach

$170/Starter Kit
($30/ml core refill)

Some dentists have utilized expensive resin cement systems to accomplish both core build-up and cementation procedures with fewer components. Visalys CemCore is a composite resin with dual cure and radiopacity, and was formulated for this simplified core build-up and cementation with one material. It is dispensed from a 1:1 automix syringe. Kit includes an additional initiator system for adhesive bonding. Available in universal *(A2/A3)*, dark *(A4)*, opaque, bleach, and translucent shades.

Advantages:
- One material for multiple purposes simplifies procedures, reduces costs
- Hardness allows easy trimming after cure
- Easy to use, remove excess, and clean up

CR Note:
- Some Evaluators prefer a more putty consistency for the core build-up vs. a flowable

CR CONCLUSIONS: 94% of 16 CR Evaluators stated they would incorporate Visalys CemCore into their practice. **94% rated it excellent or good and worthy of trial by colleagues.**

Homeopathic Oral Sore Relief Gel Reduces Pain and Swelling, and Promotes Healing

StellaLife VEGA Oral Care Gel
StellaLife, Inc.

$35/30-ml bottle
($1.17/ml)

Homeopathic oral relief gel has an analgesic effect that relieves pain of dry socket, canker sores, mouth ulcers, denture sores, mucositis, lichen planus, and surgery, and relieves dry mouth. Non-staining and opioid free. 38% of CR Evaluators reported accelerated healing. Part of the VEGA Oral Care Recovery Kit products that also include an antimicrobial rinse and pain-relief spray. Ideal for perio, chemotherapy, grafting, and implant patients.

Advantages:
- Pleasant flavor; easy to apply and integrate into home care
- Reduces pain from oral lesions and dry sockets; reduces swelling and inflammation; promotes healing
- In-vitro research validates biocompatibility for wound healing and in-vivo study demonstrated lower postoperative pain for patient in an opioid-free regimen started three days preoperatively

Limitations:
- Gel can desiccate in pump tip and prevent dispensing.
- Numerous cases studies are available, but in-depth in-vivo clinical trials could further validate benefits of gel.

CR CONCLUSIONS: 71% of 31 CR Evaluators stated they would incorporate StellaLife VEGA Oral Care Gel into their practice. **90% rated it excellent or good and worthy of trial by colleagues.**

Easy-to-Use Resorbable Grafting Strip in Two Sizes

OsteoGen Strip
Impladent LTD

$99/Box *(2 small strips)*
$199/Box *(2 large strips)*
($49.50/small; $100/large)

The OsteoGen bone grafting strip combines bioactive resorbable calcium apatite with a bovine Achilles tendon collagen matrix. Research on each of these constituents is positive. Combining the calcium apatite with the collagen eliminates particulate wash-out. Suture over top of site to contain *(no membrane is required in most cases)*. Ideal for sinus lift and grafting gap around implants. Available in two sizes: Large *(20mm×40mm×3mm)* and Small *(12mm×20mm×3mm)*. Four year shelf life. Same material as the popular OsteoGen Plug.

Advantages:
- Easy to size and place; single step with no membrane required
- Condensable and easily manipulated
- Low cost

Limitation:
- No major limitations noted

CR CONCLUSIONS: 84% of 19 CR Evaluators stated they would incorporate OsteoGen Strip into their practice. **84% rated it excellent or good and worthy of trial by colleagues.**

Primer for Zirconia, Glass Ceramic, Metal, and Composite is Quick and Easy to Use

Premier Universal Primer
Premier Dental Products

$90/5-ml dropper bottle
($18/ml)

This single-component adhesive primer increases the retention between restorative substrates *(zirconia, glass ceramic, metal, alumina, and composite)* and resin cements. This is accomplished with dual coupling agents, 10-MDP, and silane methacrylate, and becomes desirable for short and/or tapered preparations. Premier Universal Primer is easy to use with no pretreatment of the restoration required, which allows a quick and efficient cementation procedure. No refrigeration required. CR in-vitro testing confirmed initial bond strengths with Premier ZR-Cem and Premier Universal Primer: 29 MPa for Zirconia and 36 MPa for eMax.

Advantages:
- Application of primer is fast and easy
- Increased bond strength with multiple restorative materials
- Long shelf life and no refrigeration

Limitation:
- Long-term clinical bond durability is being established.

CR CONCLUSIONS: 95% of 21 CR Evaluators stated they would incorporate Premier Universal Primer into their practice. **90% rated it excellent or good and worthy of trial by colleagues.**