

# DENTIN SENSITIVITY: Causes and Prevention

*Reduce the risk of post-op discomfort by utilizing effective methods and materials.*

By Laura Dorr

Every practitioner has experienced it: You place a perfect, flawless restoration, but the patient calls back a few days or a week later complaining of postoperative sensitivity. You feel confident you performed good tooth preparation, and the occlusion looked good. So, where did it all go wrong?

As many as 26% of patients report post-op sensitivity after composite resin restorations, lasting from a few days to a few months.<sup>1</sup> Most of these patients will cite pain on biting (or pressure-induced pain) or cold-induced discomfort as their primary concern.<sup>2</sup> But these problems are merely symptoms of an underlying issue. What are the causal complications behind these indications, and how can they be avoided or rectified?

## Problem: Post-Op Sensitivity

Sensitivity occurs when dentin tubules — which are normally protected by enamel — are exposed to external stimuli, explained BISCO Associate Research Scientist Timothy Sedlacek who has researched tooth sensitivity extensively.

Dentinal tubules can be exposed a number of ways.

“While the most dramatic and visible scenarios might result from enamel or gingival decay, the dentinal tubules can also be exposed by tiny cracks and crevices at the microscopic level,” Sedlacek says.

Although every patient is potentially at risk for post-op sensitivity, certain factors can greatly exacerbate the likelihood of issues.

## Materials Used

In addition to patient presentation, the restorative materials used for the procedure can be contributing factors to post-op sensitivity.

“If an adhesive does not provide an adequate seal against the flow of fluids, bacteria or other contaminants, a tooth can be vulnerable to post-op sensitivity even if the restoration looks solid and complete to the naked eye,” says Sedlacek. “That’s why the quality and reliability of the adhesive [are] so crucial even with the most expertly prepared restorations.”

Wynn Okuda, D.M.D, president of Pan Pacific Dental Academy and a private practitioner in Honolulu, Hawaii agrees, adding that even when using the best materials, clinicians still need to be careful to utilize them correctly.

“[In addition to microbiological reasons], post-op sensitivity can be caused by [using the] wrong materials for the dental problem, using materials together that are not compatible or using materials ... the wrong way,” he says. “For example, dental adhesives like [BISCO’s] All-Bond Universal or All-Bond 3 are proven adhesives to properly seal dentinal tubules during the bonding procedure. However, if not done correctly, this can lead to post-op sensitivity.”

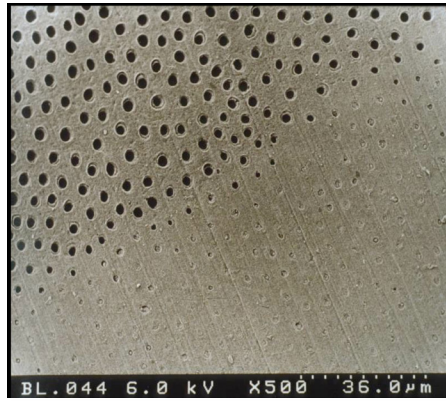
When choosing an adhesive to minimize post-op sensitivity, Sedlacek recommends clinicians keep in mind a few things.

“Consider the properties of adhesives that can create reliable seals,” Sedlacek explains. “Low film thickness allows ready flow into intricate surfaces and prevents leakage, while hydrophobic formulas promote durable, uniform bonds.”

## Clinical Technique

The extent of the underlying issue and the correct material usage are huge factors in post-op sensitivity risks, but clinical technique also plays a role. In fact, several studies have found that the three most common reasons for post-op sensitivity in resin restorations are microleakage around the restoration margins, resin polymerization shrinkage and compounding residual stress to the tooth’s makeup after composite-restoration placement — all of which result from technique problems.<sup>3</sup>

Dr. Okuda cited several other technique-related factors that can increase the frequency of sensitivity issues, including inadequate light curing of the adhesive layer due to weak or deficient light curing, or incorrect placement of dental adhesives. He also noted improper placement of composite resin material as a common cause for post-op complications.



Open dentinal tubules after etching with phosphoric acid.

“Improper placement may lead to marginal leakage and ... result in post-op sensitivity,” he explains. “And in addition to these factors, something as simple as contamination during the bonding procedure can cause significant problems during restorative procedures, leading — once again — to post-op sensitivity.”

Rolando Nuñez, D.D.S., clinical affairs manager at BISCO, adds, “Sensitivity can be generated by multiple causes, such as occlusion or periodontal issues, but I often hear from clinicians that they encounter sensitivity after doing bonding procedures. This is most common with clinicians [who] use total etch as a bonding technique.

“Post-op sensitivity that is related to bonding is not related to patient risk — it is related to technique. There are steps that can be taken during the procedure to reduce the chances that post-op sensitivity will occur.”

## Investigate Material Options

While there’s not much clinicians can do about underlying patient conditions, they can reduce the probability of post-op sensitivity — and achieve predictable results — by selecting the proper materials and implementing the correct techniques.

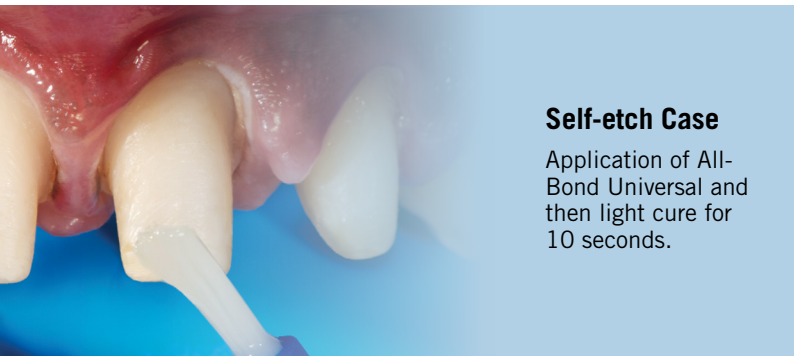
First, you need to explore material options.

“In addition to low-microleakage adhesives, cements and composites, there are prospective products that can directly alleviate dentinal sensitivity,” Sedlacek says. “Fluoride- and/or calcium-releasing varnishes can help relieve such symptoms.”

These fluoride varnishes — as well as resin-modified calcium silicates, resin-modified glass ionomers (RMGIs), glutaraldehyde-based products and dentin-adhesive bonding resins — are all in-office materials that can help seal the dentin and provide a barrier to reduce sensitivity. They work in different ways but can all contribute to lessened post-op sensitivity.

**FLUORIDE VARNISHES:** Fluoride is important for desensitization because it creates fluorapatite, which re-mineralizes enamel. But clinicians should look for varnishes that go beyond just stimulating healthy fluorapatite or hydroxyapatite through ion release.

“A well-designed varnish will occlude the open tubules to prevent the flow of fluids toward the sensitive roots,” explains Sedlacek. “Consequently, [it] promotes both chemical rejuvenation to worn-out surfaces, as well as mechanical protection and relief.”



#### Self-etch Case

Application of All-Bond Universal and then light cure for 10 seconds.

**RMGIs:** RMGIs also employ the power of fluoride for successful desensitizing because they actually release it. They have the added benefits of being biocompatible and having a coefficient of thermal expansion close to that of natural tooth. In addition, Dr. Okuda notes, “When used for crown buildup, there is lower polymerization shrinkage in RMGIs [compared] to composite resin-based buildup materials — and this can lead to lower post-op sensitivity.”

**RESIN-MODIFIED CALCIUM SILICATES:** Working through different pathways, resin-modified calcium silicates are also effective at reducing post-op sensitivity and can be used as direct and indirect pulp-capping materials, as well as liners for deep restorations.

“Resin-modified calcium silicates, such as [BISCO’s] TheraCal LC, reduce tooth sensitivity through multiple avenues,” explains Dr. Okuda. “The calcium release helps to produce hydroxyapatite formation, secondary bridge formation and a protective seal, thereby insulating the pulp.”<sup>4,5,6\*</sup>

**GLUTARALDEHYDE:** Glutaraldehyde materials desensitize the tooth prior to bonding. The material coagulates the collagen in the dentinal tubules to reduce the amount of pain stimuli that is transmitted to the brain. Applying glutaraldehyde to a tooth preparation can greatly desensitize the tooth, while having the added bonus of disinfecting the area.

**UNIVERSAL DENTIN ADHESIVES:** These universal bonding agents desensitize teeth by sealing the dentinal tubules when they bond to dentin. One-bottle systems, such as All-Bond Universal, are self-etching primers that use non-rinsing acidic monomers [to] dissolve the smear layer and prime the dentin.

“The all-in-one etcher, primer and adhesive in [a] single component creates a more uniform penetration of resin into the dentinal tubules to result in a better seal and [an] effective adhesion layer, while reducing technique sensitivity,” Dr. Okuda explains.

“New dental adhesives and related products expand the range of substrates and clinical conditions that can be repeatedly bonded to with reliable seals,” Sedlacek adds. “A truly universal adhesive is not merely sufficient for every substrate or bonding condition, but [also] fully compatible without introducing undesirable trade-offs. ...”

And there’s still more work being done to further increase the efficacy of these universal adhesives.

“On top of producing strong, long-lasting mechanical bonds, we see so much potential for adhesives that promote healthy tooth maintenance and inhibit microbial growth,” Sedlacek says. “Still, the bedrock of every successful restoration is a durable, long-lasting and reproducible bond.”

Once the patient leaves the office, there are at-home products and practices that also can help reduce

sensitivity. While not designed for managing post-op sensitivity due to poor bonding technique, desensitizing toothpastes, fluoridated mouthwashes and soft-bristled toothbrushes can all help prevent and minimize sensitivity from other sources.<sup>10</sup>

“For at-home remedies, using either [a] higher-concentration [fluoride toothpaste], such as [Colgate’s] PreviDent 5000 Plus, or toothpastes such as Sensodyne that contain potassium nitrate can help reduce post-op sensitivity at home,” Dr. Okuda recommends.

Making recommendations for these products should go beyond simply reducing post-op pain; be sure to also take into account any at-home contributing issues.

“It’s important to look for indications to treat not only sensitivity introduced by clinical consideration, but also ... sensitivity exposed by toothbrush abrasion, gingival recession, periodontal disease or acid erosion,” Sedlacek says.

## Perfecting Technique

Materials and technique go hand in hand when it comes to minimizing post-op sensitivity. Perfect technique isn’t enough without the right materials and, conversely, having the right materials means nothing if they aren’t implemented expertly. Consider the following to further enhance your clinical technique:

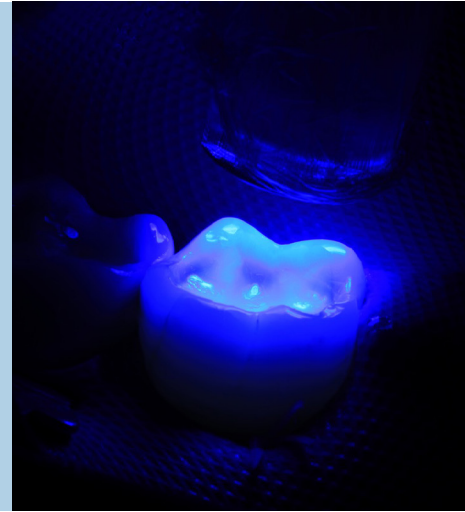
**PREPARATION:** Before you begin, take into consideration depth of preparation because the deeper the prep, the higher the risk of sensitivity issues. In deep preparations, composite resins can be a pulp irritant, and extra protective steps — such as the use of desensitizing agents, liners and RMGIs — might be necessary to prevent post-op sensitivity or, even worse, eventual pulp death caused by damage from total-etch bonding systems.<sup>1</sup>

When dealing with particularly deep preparations, consider addressing the restoration as if it were one of average depth. After this initial prep to address an “average” restoration, take extreme care to very gently remove the deeper caries. Then evaluate whether an indirect pulp capping material, such as TheraCal LC, is

warranted to protect the pulp from exposure. It’s best to use these materials in 0.5 to 1 mm thicknesses on the deepest portions of the restoration.<sup>3</sup> When applied correctly, they can be very effective at shielding the pulp and, as a result, reducing post-op sensitivity.

### Selective-etch Case

Light curing of  
All-Bond Universal.



**DESENSITIZING AGENT APPLICATION:** Desensitizers, such as a 5% glutaraldehyde, can be extremely effective at reducing post-op sensitivity. Placing a desensitizing agent during treatment can reduce the potential for tooth pain post-treatment.

“I use glutaraldehyde desensitizers prior to placing a crown buildup with an RGMI [and] then place desensitizing agents again before placing a temporary crown,” Dr. Okuda says. “I find this reduces tooth pain potential after treatment.”

It’s important to be precise when placing glutaraldehyde because it can potentially irritate soft tissue, negating the post-op sensitivity benefits. It’s recommended to use only a small amount of the liquid and to apply it with a microtip to avoid exposure to the surrounding tissue. Apply these desensitizers twice for a minute at a time in deep cavities.<sup>3</sup>

Oxalate dentin desensitizers are also effective at preventing the intratubular fluid movement that causes sensitivity. They do not contain glutaraldehyde, making them safer for mouth tissue. These desensitizers



are recommended for use prior to direct-restoration placement or prior to the temporization or placement of indirect restorations.

**LAYER, LAYER, LAYER:** Precise layering can be key to restorative success when it comes to limiting post-op sensitivity.

“To reduce post-op sensitivity consistently, it is about using the appropriate levels of detail,” Dr. Okuda says. “Using the right materials in the correct layering sequence has helped me remove post-op sensitivity problems for my patients. Adding layers of detail to the bonding technique is important to attain consistent results.”



#### Total-etch Case

Treatment plan:  
lithium disilicate  
veneers #4-#13 with  
minimal preparations  
on enamel only.

Incremental layer techniques, like those implemented by Dr. Okuda, are proven to reduce post-op sensitivity in deep cavities. Studies have found that many patients experience pain after the composite resin shrinks during polymerization. This shrinkage causes a void, which can fill with fluid and put extra pressure on the sensitive dentinal tubules. Using an incremental layering or “sandwich” technique can prevent the void from occurring and negate the subsequent sensitivity issues.<sup>3</sup>

“During bonding of indirect restorations, I use a disinfection product like benzalkonium chloride in the phosphoric acid etchant [and] then place a glutaraldehyde desensitizer prior to using an all-in-one dentin adhesive, such as All-Bond Universal,” explains Dr. Okuda. “For composite resin restorations, I use similar layers of details [like I do for] the indirect restorative procedure.

Using desensitizers, resin-modified calcium silicates, RMGIs and, finally, an effective dentin adhesion layer will help reduce post-op sensitivity potential.”

**ETCHING:** Etching can be a tricky step and, when done incorrectly, a direct contributor to post-op pain. Dr. Nuñez does not recommend using a total-etch technique when concerned about post-op sensitivity because he sees greater rates of sensitivity in cases where total-etch was used.

“Using the selective-etch bonding technique will help diminish sensitivity,” Dr. Nuñez says. “When using a total-etch bonding technique, phosphoric acid is used to etch the dentin to remove the smear layer, also exposing collagen and open dentinal tubules. Studies have shown that etching the dentin with phosphoric acid will open the dentinal tubules. Unless the collagen is impregnated by resin and the tubules are properly sealed by resin, there is a high risk of post-op sensitivity. ... To reduce the chance of this, etching dentin with phosphoric acid should be avoided.”

Research showing that etching dentin with phosphoric acid will open dentinal tubules was first published in 1986 by the late Martin Brännström, D.D.S. This research established that open dentinal tubules can transmit changes in pressure, pH and temperature directly to the pulp. Even small temperature changes can cause pain due to outward fluid movement in the dentinal tubules. By sealing the tubules, such changes in conditions and stimuli can be avoided.<sup>8</sup>

As a result, Dr. Nuñez recommends a selective-etch technique.

“Selective-etch technique does not require the use of phosphoric acid etch on the dentin [and instead] uses a universal adhesive to achieve bonding,” Dr. Nuñez says. “This will prevent the tubules from opening [so] post-op sensitivity is unlikely. ...”

Dr. Nuñez says, ultimately, it’s up to clinicians to see what works best for them in terms of reducing sensitivity.

“If clinicians are using total-etch as their bonding technique of choice and [their patients] are not

experiencing post-op sensitivity, they should keep ... using the technique they feel most comfortable with,” he says. “But if the clinician is using total-etch bonding and experiencing post-op sensitivity in some cases, he ... should give selective-etch a try.”

**CURING:** It may seem like an innocuous step, but light curing is critical to reducing sensitivity. Inadequate light curing can lead to insufficient polymerization or result in incomplete curing of composite material near the pulpal area. It can also result in microleakage around the margins of the restoration, which is one of the most commonly cited causes of post-op sensitivity.<sup>3</sup>

“During composite resin restorations, it’s important that, as each layer is placed, you make sure it is completely light cured,” Dr. Okuda explains. “This will eliminate post-op sensitivity issues as it relates to marginal leakage.”

It’s also important to remember that enamel and dentin are different structures, so they require different curing techniques. Studies have found that to help reduce polymerization shrinkage, flowable or microhybrid resin composites used in dentin restoration should be cured progressively. This differs from the ideal curing technique for microhybrid resin restorations on enamel, which should be cured with pulse-delay curing.<sup>9</sup>

When light curing, follow the manufacturer’s instructions for the material you are curing, and be sure that your curing light is strong enough. Weak curing lights are a common culprit in curing failures. To avoid complications, curing lights should be delivering 1,000 mW/cm<sup>2</sup> at minimum. Clinicians also should ensure they’re using the lights correctly and at the proper distance from the restoration for maximum success.<sup>7</sup>

## Reduce the Risk of Post-Op Sensitivity

Although post-op sensitivity isn’t always avoidable, executing good technique with the right materials can reduce the risk.

“Post-operative sensitivity is a prevalent symptom, especially at mild levels, and does not imply a failure of treatment,” says Sedlacek. “But it can be minimized

and alleviated with the appropriate products and techniques. At BISCO, we want to equip clinicians so ... their patients can [enjoy healthy] lives unimpeded by post-op sensitivity.”

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\* TheraCal LC calcium release data on file with BISCO