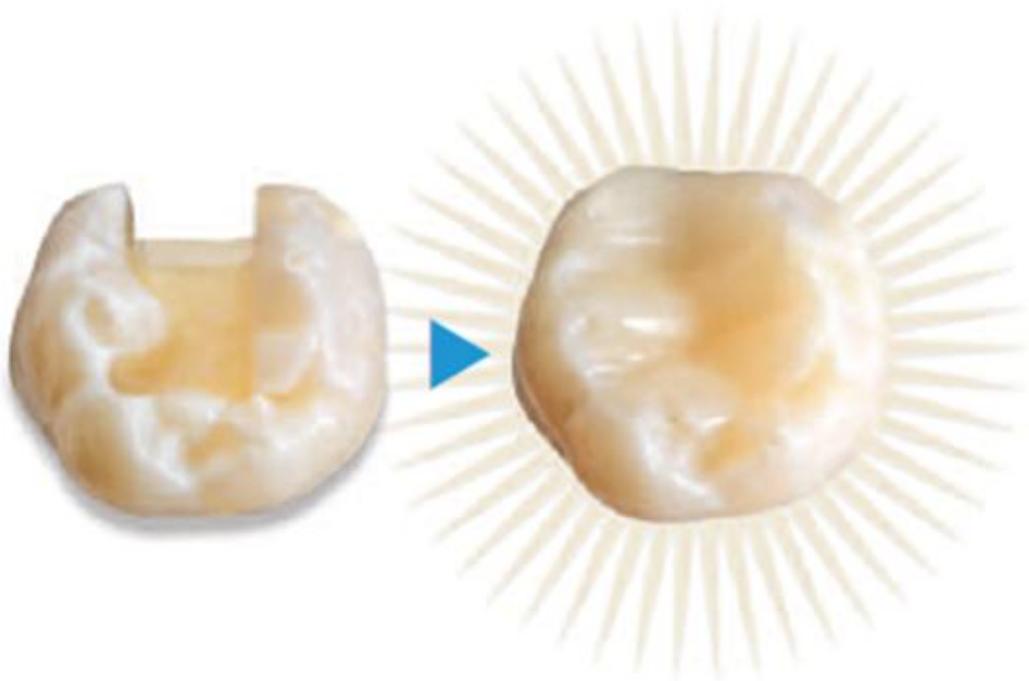


DENTSPLY  
CAULK

## WHITEPAPER: CLASS II RESTORATIONS



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# CLASS II TOTAL PRACTICE SOLUTION

PRODUCTS . EDUCATION . SUPPORT .

DENTSPLY Caulk's Class II Total Practice Solution is a comprehensive approach that is designed to support clinicians in their everyday practice. A combination of a proven **product portfolio**, **total office education**, and a **dedicated support team**; DENTSPLY Caulk's Class II Total Practice Solution helps clinicians identify their unique Class II challenges and provides them tools and training to implement solutions for a better practice all round.

As you read, keep an eye out for the Class II Total Practice Solution tip symbol  at the end of each topic of discussion. This is the DENTSPLY Caulk recommendation for how to bring predictability, efficiency, and optimized performance to that step in the Class II Procedure.

Visit [www.class2restorations.com](http://www.class2restorations.com) to learn more.

## Overview: What the Class II Procedure Means to your Practice

Direct restorations represent approximately 1/3 of annual dentist generated revenue, with an estimated 69% of annual dental patients finding themselves on the receiving end of a direct restorative procedure.<sup>1,2</sup> And believe it or not, nearly half of those are Class IIs.<sup>3</sup> When the Class II procedure accounts for such a substantial piece of your business and contributes to the experience of 1/3 of your patient base - it's time to rethink what it means to your practice. Class II restorations play a big role in patient experience, retention, and referrals – and ultimately the growth and overall health of a practice. Taking steps to make the procedure more efficient and the outcome more predictable can positively influence the practice in big ways.

Due to patient driven demand for improved esthetics and health concerns around the use of mercury, composite placements are gaining popularity over amalgams, and composite replacement procedures are on the rise. The most recent ADA procedure recap report (2006) showed that 70% of direct restorations used resin based restorative materials.<sup>3</sup> But composite restorations last just 5.7 years on average. In fact, a recent report showed that Class II resin restorations were 10 times more likely to be replaced at the clinician's expense than Class II dental amalgams.<sup>4</sup> Given these trends, the importance of ensuring positive composite restoration outcomes is more important than ever. As we look to continually improve along procedural lines, we consider some ways that composite success can be measured. How does it look? How does it feel? How long does it last?

Studies tell us that the #1 reason for composite failure is recurrent caries, and the floor of the proximal box in a Class II is the most vulnerable interface.<sup>5</sup> Poor execution at this interface can lead to premature restoration failure that impacts the bottom line of your business. The average cost to redo a failed Class II restoration is \$292 inclusive of the doctor's time and materials.<sup>6</sup> On top of that, the look, feel, and longevity of the completed restoration impact patient experience. Many of the common failure modes at the floor of a Class II proximal box are also leading causes of sensitivity, and shade match and surface roughness impact look and feel – all key indicators to the patient as to whether the restoration was a success.

Patient perception is important. In an ADA study of reasons people do not go to the dentist, 26% blamed a previous bad experience, making them less likely to refer their friends and family.<sup>7</sup> With 50% of new business coming from referrals, and an average patient being worth \$1000 to a practice annually - patient experience directly influences an office's ability to maintain a strong patient base and revenue stream.<sup>8</sup> Approach the Class II experience as an insurance policy for your patient base. Through a single procedure, you can create a positive experience for 1/3 of your annual patient base.<sup>2,3</sup>

But it's more than achieving clinical results that satisfy the patient and their oral health needs. There are also business based implications to consider that highlight the value in achieving the ideal Class II outcome *efficiently*. To reach the average daily revenue for a general dentist, he or she needs to be making about \$450 per hour. This can be tough to do given today's operating overhead in a general practice, with a Class II procedure typically generating less than \$200 in revenue and taking 30-40 minutes to complete.<sup>6</sup> For this reason, technology advancements that make posterior composite procedures faster, easier, and more profitable, without taking compromising shortcuts warrant strong consideration.

Proper execution during each step of a Class II procedure is essential to success. By addressing the most vulnerable Class II interface, and delivering esthetic results efficiently, you can be more confident that the result will positively impact your patients' experience and the bottom line of your business.

# Protecting the Most Vulnerable Class II Interface

*The #1 reason for composite failure is recurrent caries, and the floor of the proximal box in a Class II is the most vulnerable interface.<sup>5</sup>*

## PROTECT THE FLOOR OF THE PROXIMAL BOX

ISOLATE THE RESTORATIVE FIELD

CREATE A STRONG BOND

MAINTAIN MARGINAL INTEGRITY

CURE TO CLINICALLY RELEVANT DISTANCES

## ISOLATION AND CONTACT CREATION

Class II success can be compromised before you lay a hand on adhesive or composite materials. Just like building a house, you have to start with a solid foundation or what you build on top of it won't last. When prepping a proximal box, avoiding the adjacent tooth with the bur is tedious and time consuming. Achieving and maintaining an isolated restorative field can be difficult, and creating ideal interproximal contact is often hit or miss.

**Preparation:** Iatrogenic damage refers to any adverse condition in a patient resulting from treatment by a physician.<sup>9</sup> Studies have shown that in 70% or more of Class II restorations, the clinician nicks the adjacent tooth with the bur during prep – a prime example of iatrogenic damage. When the bur nicks the adjacent tooth, it roughens the tooth surface and creates an area for bacteria to collect more easily and form caries. In order to avoid nicking the adjacent tooth, clinicians tend to spend more time to slowly and carefully prep the tooth. To avoid the extra time and risk of iatrogenic damage, it is recommended to use an interproximal guard to protect the adjacent tooth (see image to right).<sup>10</sup> This allows you to prep faster without worry, and simultaneously do right by your patients.



**Isolation:** When using resin-based restorative products, isolation is critical for success. If the restorative field is contaminated with moisture, the physical properties and ultimate success of the restoration may be compromised. The ability to achieve and maintain isolation is affected by a number of factors including: oral hygiene of the patient, location of the restoration, irritation of the tissue around the restorative field, and the seal provided by the matrix system.<sup>11</sup> While you cannot control the fact that the patient does not floss, or that isolation is more difficult in the posterior where 74% of direct restorations are performed; you can control to a degree how much you irritate the surrounding tissue during the procedure, and how well you seal the restorative field off from surrounding moisture.<sup>3,11</sup> In dental school, you may have been trained to use a tofflemire matrix system with a wooden wedge for a Class II restoration. Unfortunately, because the tofflemire band engages with the tissue all the way around the tooth, and the wooden wedge is forced into the interproximal space to create separation between the teeth – bleeding is likely to occur around the tooth to be

restored. With sectional matrix systems, the matrix band only engages with a 'section' of the tissue surrounding the tooth. Additionally, the ring separates the teeth (see image to right) to make room for the matrix band so that the wedge doesn't have to (passive wedging), leading to wedge designs that are more tissue friendly and reduce the amount of bleeding that occurs.



**Contact Creation:** Restoring proper interproximal contact and contour is a critical factor in the success of a Class II restoration. Yet according to a recent DentalTown survey, 70% of clinicians find contact creation to be the most challenging part of a class II restoration.<sup>12</sup> Achieving proper contact and contour means that the tooth being treated tightly contacts the adjacent tooth at the middle third, and has a natural, convex contour (see image to right). An open, or improperly placed/shaped interproximal contact can result in a fracture, as well as food impaction in the interproximal space which can result in periodontal inflammation, bone loss and recurrent caries.<sup>13</sup>



**In order to create a solid foundation for your Class II Restoration, it is advisable to use an interproximal guard to speed up prep while protecting the adjacent tooth, and to choose a matrix system that minimizes impingement and bleeding of soft tissue, creates a tight seal, and provides an anatomically accurate form for restorative material placement. While waiting for the anesthesia to take effect, place the Palodent® Plus ring in the interproximal area to be treated. This will create separation between the teeth, making it easier to place the Palodent® Plus WedgeGuard prior to prepping the tooth. With the WedgeGuard in place during tooth preparation, you can prep more quickly while eliminating the chance for iatrogenic damage of the adjacent tooth with the bur. You can then remove the guard, leaving the wedge in place to keep pressure on the tissue and keep bleeding to a minimum. Follow this with placement of the Palodent® Plus matrix and ring. The Palodent® Plus system will seal and shape the restoration, helping to maintain isolation and create tight, accurate contacts and contours.**

## CREATING A STRONG BOND

Tooth preparation is complete, and the restorative field has been successfully isolated with the help of a matrix system. The next challenge is within the adhesive step. The best and most durable bond is well established to be to etched enamel; but at what cost, as etching on deep dentin can increase the probability of post-operative sensitivity.<sup>14, 15</sup> Can we get a durable bond to the enamel at the cavo surface margin without increasing the probability of sensitivity by etching on deep dentin? What's the better choice – self-etch to avoid sensitivity or total-etch for a better bond to enamel? Universal Adhesives provide the flexibility to make chairside decisions about technique to achieve a strong bond and minimize the likelihood of post-op sensitivity.<sup>16</sup>

**Why we etch:** Applying phosphoric acid to the tooth after prepping removes the smear layer (debris left on the surface from tooth preparation), opening the tubules and exposing the collagen fibers, to effectively create an area that the adhesive can penetrate into, lock onto, and form a strong bond with. The challenge with etching though, is that it affects enamel and dentin at different rates. Enamel exposure to etchant is

typically recommended to be at least 15 seconds, whereas dentin exposure to etchant should not exceed 15 seconds.<sup>17</sup> This is where the beauty of universal adhesives comes in – you can treat both the dentin and enamel appropriately by choosing when and where to etch, while only stocking a single adhesive in the office. The amount of available enamel is the primary determining factor in selecting the proper etching mode for the universal adhesive.

**Total-Etching:** It may be beneficial to utilize a total etch technique when a large percentage of the substrate being adhered to is enamel. Bonding to etched enamel is the most durable bond we can form in the mouth.<sup>14</sup> In this technique the phosphoric acid etchant is applied to the entire preparation, then rinsed thoroughly, and dried until there is no pooling of water, leaving a moist, glistening surface.

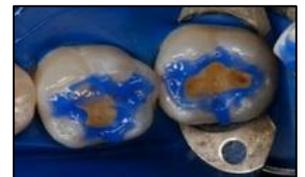
Application of a Universal Adhesive in this technique will often require scrubbing/agitation during placement. This is common for self-etch application but a technique modification for traditional total-etch adhesive users.



**Self-Etching:** Traditionally, the self-etch technique is appropriate when the prep is mostly in dentin, with little or no available enamel margins to etch.<sup>15</sup> The goal is to minimize the probability of post-op sensitivity. Both self-etch and universal adhesives contain acidic monomers that achieve adequate demineralization of the dentin for successful bonding; therefore no separate phosphoric acid etching step is required. Using a Universal Adhesive in this technique can help to avoid post-op sensitivity by eliminating the possibility of over-etching or over-drying the dentin, as the smear layer is not entirely removed. It is instead incorporated into the hybrid layer upon curing of the adhesive.



**Selective etching:** Universal Adhesives were created to give clinicians the opportunity to obtain a strong bond to enamel while reducing the chance of post op sensitivity by not placing phosphoric acid on the dentin. The advantages of selective-etching are most realized when the prep exposes the dentin, but enamel margins are also available.<sup>18</sup> If you are traditionally a 'self-etch user', application of the etchant to the enamel margins (but not to the dentin) provides you the confidence that you will not increase the probability of sensitivity but will strengthen the bond at a vulnerable interface. If you are traditionally a total-etch user, you can be confident that you are not sacrificing your enamel bond but you are reducing the chance of post op sensitivity by avoiding over-etching or over-drying of the dentin.



*Note: When selective etching, the ideal phosphoric acid is one that is higher in viscosity. This will allow you to trace the available enamel margins with the phosphoric acid, while minimizing the chance that it drips or slumps onto undesired areas like the dentin. Recognize that some self-etch products on the market contraindicate exposing the dentin to phosphoric acid.*



**Avoiding Post-Op Sensitivity:** The following adhesive technique mistakes are leading causes of post-op sensitivity. To minimize the occurrences of post-op sensitivity, be sure to review the directions for use of the adhesive to ensure proper adhesive technique.

- **Over-etching dentin** – Dentin exposure to etchant should not exceed 15 seconds. Etching for too long may result in a deeper level of dentin demineralization and more difficulty in obtaining an adequately intact hybrid layer through adhesive resin infiltration, leading to possible sensitivity.<sup>17</sup>
- **Over-drying dentin** – Dessicating (over-drying) the prep removes the moisture needed to properly suspend the delicate collagen fibers and make them available for the adhesive to lock into. Keep the dentin surface slightly moist prior to bonding.<sup>19</sup>

- *Solvents not removed during drying step* – You may be conscious of how solvents work (acetone vs. alcohol) based on table top evaporation, but recognize that each requires a different amount of air thinning to be completely volatilized once placed. This is a critical step in ensuring the material performs to its highest potential.<sup>19</sup>
- *Incomplete material coverage* – It is important to completely and uniformly cover the internal surface of the cavity preparation with the adhesive. You can confirm this by visually inspecting the surface after curing – the surface should appear glossy rather than matte.<sup>19</sup>
- *Under curing* – In a Class II, the adhesive is often 8mm or more away from the tip of the curing light. To ensure proper adhesive curing for a strong bond at the bottom of the proximal box (the most vulnerable interface of a Class II) choose a light that performs well at clinically relevant distances.<sup>20</sup>

**Why adhesive film thickness matters in a Class II:** Thick adhesives have a tendency to pool in the corners of the proximal box of a Class II. These adhesive pools show up as translucent areas on the radiograph, which can easily be misdiagnosed as a void, gap, or secondary decay – causing you to question whether you should redo the restoration.<sup>21</sup>



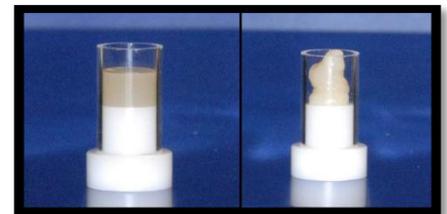
**Choose an adhesive that offers versatility in application technique depending on the clinical situation, allowing you to utilize the application technique that best suits the substrate you're trying to bond to. Prime&Bond Elect® Universal Dental Adhesive not only gives you the ability to decide chairside which etching technique is appropriate, its streamlines inventory by providing technique flexibility in a single bottle, and has low film thickness for increased accuracy. The Introductory Kit comes packaged with Caulk 34% Tooth Conditioner Gel, which has a high viscosity that allows you to trace the available enamel margins, while minimizing the chance that it drips or slumps onto the dentin.**

## ACHIEVING AND MAINTAINING MARGINAL INTEGRITY

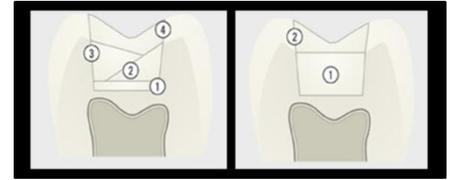
The tooth has been prepped, isolated, and the adhesive placed using an etching technique appropriate for the substrate you are trying to bond to. After light curing the adhesive, it's now time to place the restorative material. Here, you face two key challenges:

1. Cavity Adaptation
2. Incremental Material Placement

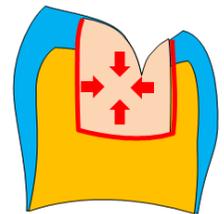
**Cavity adaptation:** If the restorative material is unable to take on the shape of the cavity preparation, unfilled areas or voids can occur, which may result in post-op sensitivity or create a pathway that could potentially lead to recurrent decay.<sup>22</sup> The way a material handles has a big impact on its ability to adapt to the prepared surface. The vast majority of posterior dentistry performed today is amalgam replacement.<sup>23</sup> Because prep anatomy is often irregular after the amalgam removal has been completed, it is important to take special care to ensure the restorative material adapts completely to these surface irregularities, so as to not leave a void or gap for bacteria to collect.<sup>22</sup> Most universal composites are higher in viscosity to allow for sculpting anatomy, which is why it's not surprising that 90% of dentists report using a flowable as a liner in a Class II to increase marginal adaptation.<sup>24</sup> Recognize though, that not all flowable composite resins are truly "flowable" (see image above – both products are considered flowables, but the material on the left is clearly better suited for marginal adaptation on an irregular surface, while the material on the right would be more appropriate for Class V's, undercuts, blockouts, etc.).



**Incremental material placement:** Historically, clinicians spend a considerable amount of time during the composite resin procedure placing material in small increments followed by light curing. This is done to achieve adequate depth of cure of the material and to minimize the chance for issues related to material shrinkage and stress.<sup>22</sup> Given today's operating overhead in a general practice, and the perceived low profitability of a Class II restoration - technology advancements that make posterior composite placement faster, easier, and more profitable, without taking compromising shortcuts warrant strong consideration.<sup>25</sup> With the introduction of low-stress bulk fill composite materials, it is now possible to reduce procedural steps because larger increments of material can be used. By choosing a bulk fill material low in viscosity, successful cavity adaptation can also be achieved.<sup>22</sup>



**Bulk Fill Materials and Shrinkage Stress:** During the light curing process, composite resins undergo dimensional shrinkage. But focusing on this dimensional or volumetric shrinkage may not be a good indicator of what is happening clinically, as the test for this does not measure the effect of composite shrinkage on the tooth when it is bound by an adhesive. When bonded to the internal walls of a cavity preparation, this light initiated shrinkage creates stress on the tooth (known as polymerization stress), as the shrinking material pulls the bonded walls inward toward its mass. Typically, the higher the number of surfaces the material is bonded to, the higher the stress on the tooth structure after curing. High polymerization stress can cause the bond between the material and the cavity wall to break, creating a pathway for microleakage and secondary caries to potentially form. These stresses can also lead to enamel fractures, cracked cusps, marginal staining, white lines around the restoration, and post-operative sensitivity. So while bulk fill materials can greatly improve procedure efficiency, it is important to choose a bulk fill material with not just excellent flowability, but also a low shrinkage stress value.<sup>23, 26</sup>



**Radiopacity of Restorative Materials:** Radiopacity of materials is also important. Some early flowable composite resin products had low radiopacities due to low filler content, and when placed as liners in deep cavity preparations appeared as a void or recurrent decay on radiographs.<sup>27</sup> To be able to distinguish restorative material from tooth structure or decay on a post-op radiograph, the radiopacity of the restorative material should be at a minimum greater than natural dentin (1.0), but preferably greater than enamel (2.0).<sup>27</sup> Ideally, if multiple restorative materials are being used in a single restoration, their radiopacities should match so that the interface between the materials does not lead to misinterpreting the integrity of the restoration. (In the photo on the right, the high radiopacity of the Bulk Fill Flowable matches that of the Universal Composite to provide great visualization of the final restoration.)



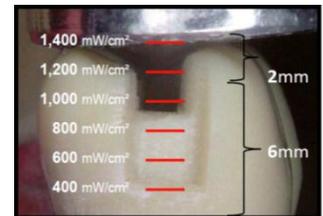
**We recommend SureFil® SDR® flow Bulk Fill Flowable Base Material for the first layer of restorative material placement. Its low viscosity allows the material to flow into small areas without agitation, and the material is self-leveling allowing it to adapt to the cavity dimensions; even against gravity in maxillary teeth without slumping or running. Because SureFil® SDR® flow has a radiopacity greater than enamel and dentin; you will easily be able to visualize the restoration and differentiate it from surrounding structures. Its ability to be placed in 4mm increments while reducing polymerization stress up to 60% makes it a catalyst for both increased procedure efficiency and excellent marginal integrity.**

## LIGHT CURING

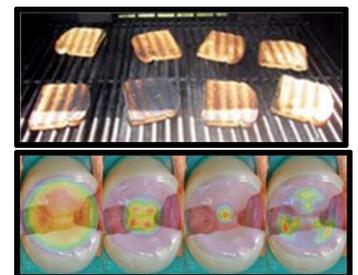
It is common to believe light curing is the uncomplicated part of the Class II procedure. You may have been conditioned to believe that as long as blue light is coming out of the tip, the manufacturer's stated output value is high, and the light is near the restoration for long enough, the restorative material will cure. In truth, the amount of energy delivered by the curing light to the adhesive and composite is a critical factor in the success of a Class II restoration, and there are a number of factors that often keep this from happening.

Polymerization of composites is the process by which the material 'sets' and the physical properties and functionality of the composite are established. The energy from the curing light interacts with photoinitiators in the material to initiate the process of monomers joining together to form polymers. The more energy delivered to the restoration, the more monomers will convert into polymers, and the stronger the material will be.<sup>28</sup> Despite the importance of ensuring a high degree of polymerization, the lack of attention paid to this step in the procedure may help explain studies showing that more than 37% of composite restorations are being insufficiently cured.<sup>29</sup> An insufficient cure can lead to adverse effects on physical properties, reduced bond strengths, breakdown at the margins, increased potential for microleakage, and ultimately secondary caries and failure.<sup>28</sup>

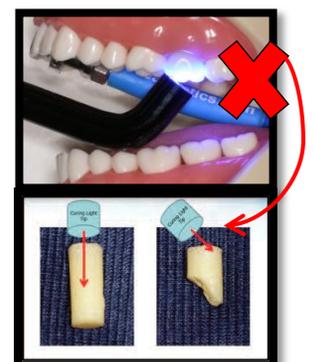
**Performance over distance:** 45% of direct restorations are Class IIs.<sup>3</sup> The #1 reason for Class II failure is recurrent caries, and the floor of the proximal box (often 8mm away from the tip of the light) is the most vulnerable interface.<sup>30</sup> Inadequate light curing can lead to premature failure at this interface.<sup>30</sup> All curing lights experience an energy drop-off that decreases the amount of energy delivered to the restoration over distance (see example to the right), and the amount of energy lost varies among curing lights. In fact, many lights deliver as little as 35% of their stated output to the bottom of the proximal box.<sup>31</sup> For that reason, it's critical to know the performance of your curing light at clinically relevant distances.



**Beam uniformity:** The average adult molar is 10mm in diameter, so one might think that the larger the probe diameter, the more confident they can be that the restoration will fully cure. BUT, there can be hot spots or cold spots within the light beam that lead to a non-uniform cure across the restoration.<sup>32</sup> This is why we want a uniform beam profile. Think of it in terms of a BBQ grill – it doesn't matter how big your grill is if only part of it gets hot enough to cook your food sufficiently. You'd rather have a grill that cooks the same across the whole surface, so that you know all the food on top of it cooks at the same rate. Same with a restoration – you don't want to have to guess which part of the light tip is effective; you want the entire restoration cured evenly.



**Angle:** The angle at which the probe tip is directed affects the amount of energy that is delivered to the restoration. The light guide tip should be as close as possible and parallel to the occlusal surface of a Class II to have the best chance at directing light to all corners of the proximal box. Angled light guides can make it difficult to keep the surface of the light tip flat to the restoration, especially in the posterior, where 74% of direct restorations are performed.<sup>3,28</sup> Directing light at an angle increases the chance that proper light energy does not reach the corners of the proximal box. Pen-style



lights make it easier to maintain the proper curing angle when space is an issue – such as the back of mouth, and in geriatric and pediatric cases.

**Ergonomics and Operation:** In a recent study using new curing lights to test the ability of dental professionals to deliver energy to simulated restorations - there was a 10x difference in energy delivery between the best and worst operator.<sup>33</sup> The variable is technique! It is common for curing light operators to place the tip of the curing light in proximity to the restoration, turn on the unit, and then look away to protect their eyes from the damaging effects of blue light. As a consequence of looking away, the curing light typically moves a little during curing. Additionally, during longer procedures or curing cycles, the operator's hand may fatigue and cause slight mispositioning of the light. Further still, a light with complex controls (multiple settings/modes) presents a higher chance that light could be used at the incorrect setting for a given restoration by some users. Therefore, a lightweight, ergonomic curing light design with simple controls may help reduce the opportunity for technique variability.

**Curing Cycle Length:** Research does not support curing today's resins using fast, high-power curing lights and light exposure times of less than 10 seconds - doing so puts you at risk for not achieving the minimum conversion % (monomer to polymer) required for a successful restoration.<sup>34</sup> AND - if the light tip of a high-power curing light is misaligned for 1 second when using the light for only 2 seconds, the amount of energy delivered to the resin is reduced by as much as 50%. While it may seem responsible to tack on an additional cure to compensate for this, clinicians actually should not arbitrarily increase the curing time beyond the manufacturer's recommendations. While you can't overcure the composite itself, you CAN, in fact, deliver too much radiant energy to the tooth, causing an excessive increase in temperature which can cause sensitivity, and damage the pulp and oral tissues.<sup>34</sup> The safest and most reliable approach is to deliver a lower intensity over a longer exposure time to ensure adequate polymerization and avoid creating excessive shrinkage stress and heat.



**For a reliable cure at distances that matter, choose the SmartLite® Focus Pen-Style LED Curing Light. Its collimated light beam reduces light divergence to ensure reliable curing all the way to the floor of the proximal box, the most vulnerable interface in a Class II restoration. A homogeneous beam profile delivers uniform performance within the curing area, and its pen-style design with low head profile and long rotatable tip provide excellent intraoral access. Easy one touch operation with a 20 second curing mode, low heat generation and a lightweight design bring reliability and simplicity to the light curing step in the procedure.**

## Achieving Efficient Esthetics

*More than 80% of patients are reportedly aware of color differences between restored and adjacent natural teeth.<sup>35</sup> • Studies show that on average, finishing and polishing represent 14% of total chair time for a class II procedure.<sup>36</sup>*

### BE EFFICIENT WITH THE ESTHETICS

SIMPLIFY THE SHADE SELECTION PROCESS

UTILIZE YOUR PREFERRED VISCOSITY

FINISH IN A SINGLE STEP

ACHIEVE PATIENT SATISFACTION

The tooth has been prepped, and isolation maintained through adhesive and flowable base placement. We have a strong bond to the tooth, accurate interproximal contact and contour, as well as excellent cavity adaptation for the first 4mm of the restoration. Now it's time to complete restorative material placement and sculpt primary occlusal anatomy. Clinical challenges associated with the final layer(s) of composite include:

- **Shade Selection:** Practitioners may be overwhelmed with the number of composite shades available to choose from, and there are a number of factors to consider when choosing the correct one.
- **Shade Stability:** Even if the clinician restores the tooth with a shade that matches surrounding tooth structure well, color change of the material over time may make the restoration less esthetically pleasing to the patient.

**Selecting your composite material:** You face many choices when selecting your preferred composite resin material. We know the first “must have” in a composite is handling characteristics that match your preferences (slump resistant, non-sticky, desired level of stiffness). And although physical properties such as fracture resistance, compressive strength, and modulus of elasticity are important; if the composite is coming from a reputable manufacturer it will probably perform adequately in those areas. So assuming your composite material checks the ‘preferred handling’ box and comes from a reputable manufacturer what else should you consider?

**Shade Selection:** Shade selection is challenging and can be affected by many factors. The genetic disposition of the shade selector themselves is a big one. At an American Dental Association Annual Meeting, 13% of 670 participants who were screened for color vision acuity were found to have irregular color vision.<sup>37</sup> Another study found the human eye to be accurate in composite shade selection just 27% of the time.<sup>38</sup> On top of that, color blindness affects more than 10% of US males.<sup>39</sup> Despite these statistics, patients still look to you to provide an undetectable restoration (Proof: 50% of crown remakes are the result of a failure to match shades accurately).<sup>39</sup> And so, here are some helpful tips to keep in mind when attempting to select the appropriate composite shade:

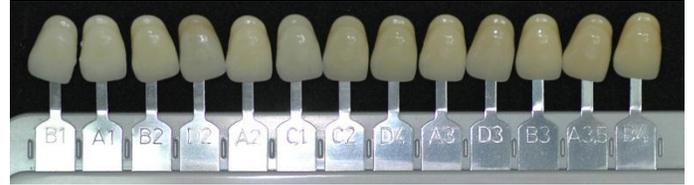


- Remove all extrinsic staining from the tooth enamel first, and if the patient is wearing lipstick, have them remove it.
- Rearrange the manufacturer shade guide by increasing brightness (value) rather than by color range (A, B, C, D). This way, you can miss to the left or right of the appropriate shade and still have an esthetic restoration (See image to right).
- Always determine the shade(s) needed for the restoration prior to tooth preparation, comparing against a wet tooth. A dehydrated tooth can change as much as 6 shades if under rubber dam isolation for 60 minutes.<sup>40</sup>
- Compare tooth color to the shade guide using various types of incident light (natural light, examination light, room light, etc.). Observing the same material/object under different light conditions can alter the perceived color in some materials – this phenomenon, metamerism, results in a shade looking different due to differences in how the type of light is absorbed and reflected from the material.<sup>41</sup>
- Glance at the shade tab and tooth for only a brief moment to avoid eye fatigue that can distort color perception. Rest your eyes between glances by looking at a neutral gray or white background.



- If still uncertain which shade to select, place a small increment of composite on the surrounding tooth to get the best match.

**Chameleon effect:** Some composites have a chameleon blending effect with surrounding tooth structure that can minimize human errors in shade selection to aid in producing ideal esthetics. By choosing a composite with chameleon like blending abilities, you can be confident that as long as you can get the shade close, the shade matching ability of the material should take care of the rest. Evidence of this can be seen in sales data for a composite with market leading chameleon ability, showing 75% of sales to be in just 5 shades.<sup>42</sup> How can such few shades cover most all cases? If the two



shades adjacent to one another (tooth to composite or composite to composite) have a Delta-E difference (color difference) of less than 3, the color difference is difficult to distinguish for the human eye.<sup>43</sup>

Additionally, to enhance color matching ability, a composite's refractive index (describing how light passes through the material) should fall between enamel (1.63) and dentin (1.54).<sup>44</sup> In the image above, a hole has been drilled in the center of each shade tab, and filled with shade C2 of a composite brand with a great chameleon effect. Note its ability to easily blend into the surrounding color environment.

**Stain Resistance:** Staining of composite restorations can be caused by a number of patient, material and even dentist related factors. A patient's dietary habits can affect the shade of the material. Regular exposure of the restoration to substances such as red wine and coffee can lead to increased staining of the composite over time, for example. According to recent studies, the nature of agglomeration and distribution of composite filler in some materials is believed to trap stains intrinsically, meaning they cannot be polished out of the material. If occurring at the margins of the restoration, this staining may be interpreted as secondary caries.<sup>45</sup> Not only is this undesirable from a patient perspective in terms of esthetics, but may also lead to premature restoration replacement. It is advised to use composites with greater stain resistance and to properly finish and polish the restoration to further protect it against staining.



**To simplify decision-making without sacrificing ease of composite placement, esthetics, or longevity, choose TPH Spectra® Composite. Because handling preference is subjective and highly individualized, TPH Spectra® offers both a high and a low viscosity with comparable physical properties in each handling. In order to make shade selection simpler, TPH Spectra® is available in 7 shades that cover the entire 16 shade Vita® range. Because of TPH Spectra®'s excellent optical properties and a refractive index similar to natural tooth structure, it has excellent color blending abilities and creates restorations that are unable to be detected. Research has also shown TPH® composite to have better stain resistance than Filtek Supreme Ultra, as staining on TPH Spectra® can be removed by brushing, differentiating it from Filtek Supreme Ultra's susceptibility to intrinsic discoloration which cannot be brushed out.<sup>45</sup>**

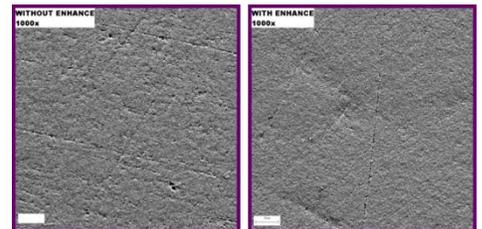
## FINISHING

Finishing and polishing products are often not given much attention when it comes to discussions around improving procedure outcomes and efficiency. After spending more time than you would like to adjusting the occlusion and recontouring the restoration with a bur (tap, tap, grind, recontour, repeat), you may be inclined to just want to get a quick shine on the surface and then call it done. Studies show this approach may not give the restoration the best long term prognosis.

In order to fully realize the benefits of making good material choices, proper attention to finishing and polishing is important.

First, it's important to distinguish between the terms 'finishing' and 'polishing'. You may have settled on a 3-4 product finishing and polishing armamentarium that you pull from after the final composite cure to shape and shine up your work before you send the patient out the door. Although the terms 'finishing' and 'polishing' are often used interchangeably, they are in fact different. To 'finish' is to refine the anatomy and smooth the restorative surface, reducing scratches and surface irregularities. 'Polishing' is the act of creating a luster, or shine, on the surface of the restoration. Are both necessary? Clinicians Report (CR) states that both 'finishing' AND 'polishing' of *anterior* restorations is critical because patients demand excellent esthetics and a smooth shine on the surface of teeth in the smile line. However, for *posterior* composite restorations, strength and durability (enhanced by a proper 'finish') are more important than achieving a highly polished surface.<sup>46</sup>

**Why the 'finishing' step is a big deal:** A recent CR report stated that "Clinicians can potentially increase the longevity of their Class II restorations with proper finishing technique."<sup>46</sup> A smooth surface finish minimizes the presence of surface irregularities that can lead to plaque retention, staining, gingival irritation, recurrent caries, and tactile perception by the patient.<sup>47,48</sup> Diamond finishing burs are highly efficient in rates of material removal, but leave a significantly rough surface, which requires further finishing before polishing to a final luster. If use of a coarse diamond bur is followed by use of a polisher like PoGo® (skipping the 'finishing' step), for example, the surface may have luster or be reflective, but upon high magnification may be rough and prone to plaque retention and staining. Conversely, if the occlusal anatomy is defined with a finishing bur, and then a finer grit 'finishing' product is used to further smooth the surface before picking up the polisher – a smoother, shiny surface that is resistant to plaque retention and staining will be the result (1st image to the right: bur then polished = scratches remain, 2nd image: bur, then finished, then polished = less scratches/smooth surface).<sup>49</sup>



**Choosing products for performance and efficiency:** Research has shown that on average, finishing and polishing represents about 14% of total chair time for a Class II procedure.<sup>36</sup> That's a lot! Here are a few things to consider to shorten the time spent on this step, while improving the clinical results.

- **What matrix system are you using?** We all know the importance of creating a tight, contoured interproximal contact. You may have found a way to achieve contact, but if the matrix system you are using does not tightly seal the margins and create accurate contours, you might end up having to take a finishing strip interproximally to smooth and shape that surface. If you grind it down too far though, the contact might be lost, forcing you to start the whole restoration over. Eliminate the agony of this step and save time by making sure you are using a good matrix system.
- **What composite are you using?** In a study examining composites and polishing systems supplied by the same manufacturer, it was concluded that, "the finishing/polishing system from the same company as the composite resin should be used, as these showed good results in comparison with other systems."<sup>50</sup>
- **What happens when your current finisher contacts adjacent teeth?** You may be utilizing tungsten carbide burs and multi-step disc systems as a part of your finishing and polishing protocol, however studies have shown that while these products may decrease composite surface irregularities, scratching of enamel with these products (another example of iatrogenic damage) is inevitable.<sup>51</sup> The



scratches in the enamel then become sites for bacteria to collect. You may therefore want to consider finishing products that are less likely to harm enamel.

- **How efficient is your current finishing & polishing regimen?** You may be using a multi-step disc system that consists of four (coarse, medium, fine, ultra fine) discs. The recommended sequential use for these products, starting with the coarse grit and gradually progressing to the superfine grit is necessary to smooth and polish the surface adequately, but is also time-consuming.<sup>51</sup> The first 2 discs are there to accomplish the ‘finishing’ step, and the second two are for achieving the ‘polish’. We know that it is common not to use all 4 discs, and that the CR report referenced above suggests that for a Class II, using the first two discs to get a smooth surface takes priority over using the second two to obtain a shiny surface. Wouldn’t it be nice if there were a product that was able to consolidate the work done by the first two ‘finishing’ discs into a single component to save time?



**Recognizing that look, feel, and restoration longevity largely influence patient satisfaction and efficiency is important for Class II profitability, proper execution during the finishing step is of critical importance. A smooth composite surface is more plaque and stain resistant, and is a necessary step to achieving composite longevity and patient satisfaction. Surface roughness testing proves that the composite surface is smoother when Enhance® Finishers are used after gross contouring with a bur. And it achieves both intermediate and final finishing in a single step - the pressure applied controls the aggressiveness: more pressure for an aggressive initial finish; less pressure to smooth the surface. As pressure is applied, abrasive particles disengage from the Enhance® cup, disc, or point to effectively buff the surface of the restoration. The result is a smooth, contoured surface in less steps. And if you’re looking for added shine, try our PoGo® One-Step Diamond Micro Polishers for creating a glass-like luster after smoothing the surface with Enhance® Finishers.**

## References

- 1 2010 Survey of Dental Practice – Income from the Private Practice of Dentistry. <http://www.ada.org/1444.aspx>
- 2 Centers for Disease Control and Prevention <http://www.cdc.gov/chronicdisease/resources/publications/AAG/doh.htm>, Oral and Dental Health, United States: 2011, table 98
- 3 American Dental Association Procedure Recap Report (2006).
- 4 J Dent 2001;29:317-324. and Overton JD, Sullivan DJ. Early failure of Class II resin composite versus Class II amalgam restorations placed by dental students. J Dent Educ 2012;76:338-340
- 5 Durable Bonds at the Adhesive/Dentin Interface. Braz Dent Sci. 2012 ; 15(1): 4–18.
- 6 2013 Levin Group Annual Practice Research Report. Dental Economics November 2013.
- 7 2003 Public Opinion Survey: Oral Health of the US Population. American Dental Association
- 8 DENTSPLY Caulk survey June 5, 2012 n=297
- 9 Torrey, Trisha (2010). What is the definition of Iatrogenic? Health: Patient Empowerment (about.com).
- 10 Christensen, Gordon J (2012). Protecting the Adjacent Tooth. Clinician’s Report – Volume 5 Issue 11.
- 11 Gilbert GH, Litaker MS, Pihlstrom DJ, Amundson CW, Gordan VV. Rubber dam use during routine operative dentistry procedures: findings from The Dental PBRN. Oper Dent 2010;35(5):491-9.
- 12 DentalTown (2012). Restorative Dentistry. Monthly Poll: What is the most challenging part of a Class II Restoration?
- 13 Rosenburg, Jeffrey M (2013). Dentistry Today. Making Contact: A Method for Restoring Adjacent Posterior Direct Resin.
- 14 Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res. 1955;34(6):849-853.
- 15 Perdigão J, Geraldini S, Hodges JS. Total-etch versus self-etch adhesive: effect on postoperative sensitivity. JADA 2003;134(12):1621-9.
- 16 Perdigão J. New developments in dental adhesion. Dent Clin North Am. 2007 Apr;51(2):333-57.
- 17 Am J Dent (2010). Dec; 23 (6): 335-40;
- 18 Heintze SD, Rousson V. Clinical effectiveness of direct class II restorations - a meta-analysis. J Adhes Dent 2012;14(5):407-31.
- 19 Porto IC. Post-operative sensitivity in direct composite restorations: Clinical practice guidelines. Indian Journal of Restorative Dentistry 2012;1(1):1-12.
- 20 J Can Dent Assoc 2011;77:b9
- 21 Reis, Andre F. DDS, MS, PhD (2014). Film Thickness FE-SEM evaluation of resin-dentin interfaces produced by Universal Adhesives
- 22 Posterior Composite Resins – A Current Assessment. Accessed from [http://www.surefildrflow.com/sites/default/files/Posterior\\_Composite\\_Resins\\_A\\_Current\\_Assessment.pdf](http://www.surefildrflow.com/sites/default/files/Posterior_Composite_Resins_A_Current_Assessment.pdf)
- 23 Dentistry iQ. Everyone Wins with Quadrant Dentistry. Accessed from <http://www.dentaleconomics.com/articles/print/volume-96/issue-2/departments/everyone-wins-with-quadrant-dentistry.html>
- 24 Council on Scientific Affairs of the American Dental Association. Spring 2009;4(2).
- 25 Jackson RD. Placing posterior composites: increasing efficiency. Dent Today 2011; 30(4):126,128,130-1.
- 26 Larissa Maria Cavalcante, Luis Felipe J. Schneider, Nick Silikas. Shrinkage Stresses Generated during Resin-Composite Applications: A Review. Accessed from <http://dbm.sagepub.com/content/1/1/131630.full>

28 Price R., Felix C., (2010). Factors Affecting the Energy Delivered to Simulated Class I and Class V Preparations. *JCDA Applied Research.*

29 Boksmann, L., Santos GC., (2012). Principles of Light Curing. *Inside Dentistry, Volume 8, Issue 3.*

30 Strassler H., Price R. (2014). Understanding Light Curing Part 1. *Dentistry Today Continuing Education Course 173.*

31 Irradiance Value Comparison among commercially available curing lights. *BlueLight Analytics. (2012)*

32 Strassler HE., Felix C.(2013). Quantifying the clinical implications of the ISO standards used in light curing. *IADR Poster.*

33 Price and Felix IADR 2010 Barcelona #467 Quantifying Light Energy Delivered to a Class I Restoration

34 Ruggerberg, F., Ferracane J., Price,R (2013). What is the latest thinking on fast-curing composites? *Inside Dentistry, Volume 9, Issue 2.*

35 Joiner A. Tooth colour: a review of the literature. *J Dent.* 2004;32(Suppl. 1):3–12

36 DENTSPLY Caulk Procedure Timing Breakdown Study. Data on file.

37 Moser JB, Wozniak WT, Naleway CA, et al. Color vision in dentistry: a survey, *JADA* 1985;110:509-510.

38 Visual and Spectrophotometric Shade Analysis of Human Teeth *J DENT RES* August 2002 81: 578-582

39 Perry, Ron DMD MS. Increasing Accuracy and Esthetics Through Digital Shade-Matching

40 Haywood, Van (2009). In Office Bleaching: Lights, Applications, and Outcomes.

41 Lowe Robert A. (2010). Composite Restorations: Subtleties in Shade and Technique. Accessed from : [http://www.ineedce.com/courses/1972/PDF/1011cei\\_nuance\\_web2.pdf](http://www.ineedce.com/courses/1972/PDF/1011cei_nuance_web2.pdf)

42 Strategic Data Marketing (2013). Data on File.

43 Jaju RA, Nagai S, Karimbux N, Da Silva JD. Evaluating tooth color matching ability of dental students . *J Dent Educ.* 2010;74(9):1002-1010.

44 8 Meng Z1, Yao XS, Yao H, Liang Y, Liu T, Li Y, Wang G, Lan S. Measurement of the refractive index of human teeth by optical coherence tomography. *J Biomed Opt.* 2009 May-Jun;14(3):034010.

45 Yan-Fang Ren, Lin Feng, Diana Serban, Hans S. Malmstrom (2012). Effects of common beverage colorants on color stability of dental composite resins: The utility of a thermocycling stain challenge model in vitro.

Division of General Dentistry, University of Rochester Eastman Institute for Oral Health, Rochester, NY, USA with Department of Endodontics and Operative Dentistry, Peking University School of Stomatology, Beijing, China

46 Christensen, G J. (2014). Simplifying your Class II Composite Finishing Technique. *Clinicians Report, Colum 7 Issue 4.*

47 Morgan M. Finishing and polishing of direct posterior resin restorations. *Pract Proced Aesthet Dent* 2004;16(3):211-7.

48 Lu H, Roeder LB, Lei L, Powers JM. Effect of surface roughness on stain resistance of dental resin composites. *J Esthet Restor Dent* 2005;17:102–109.

49 DENTSPLY Caulk Surface Roughness Testing and SEM photo analysis. Data on file.

50 Berger SB, Palialol AR, Cavalli V, Giannini M. Surface roughness and staining susceptibility of composite resins after finishing and polishing. *J Esthet Restor Dent* 2011;23(1):34-43.

51 Ulusoy C. Comparison of finishing and polishing systems for residual removal after debonding. *J. Appl. Oral Sci.* vol.17 no.3 Bauru May/June 2009. Accessed from [http://www.scielo.br/scielo.php?pid=S1678-](http://www.scielo.br/scielo.php?pid=S1678-77572009000300015&script=sci_arttext)

77572009000300015&script=sci\_arttext