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The art and science of composite restorations

3M Direct Restorative Solutions

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What's in your composite? Get filled in on fillers.

Microfill, hybrid or nanocomposite? Find out how your composite composition – and filler particle size – could be impacting the success of your restoration.

Mark Agre, 3M Application Engineer

Choosing a dental composite can be complex and flat out confusing. Every commercially available composite has a different set of features, benefits and shortcomings, which can be hard to keep straight – particularly when each manufacturer names their technologies differently. The reality is that dental composites are more than the sum of their parts, but each part is selected for a reason. Knowing exactly what's in your composite and what each ingredient brings to the table can help you make the right choice for every case.

One of the most critical parts of a composite has a deceptively unimpressive name of "filler." But it's worth sweating the small stuff, because these fillers do far more than simply take up space.

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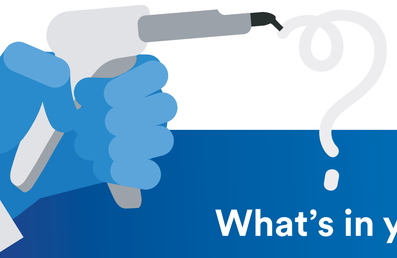
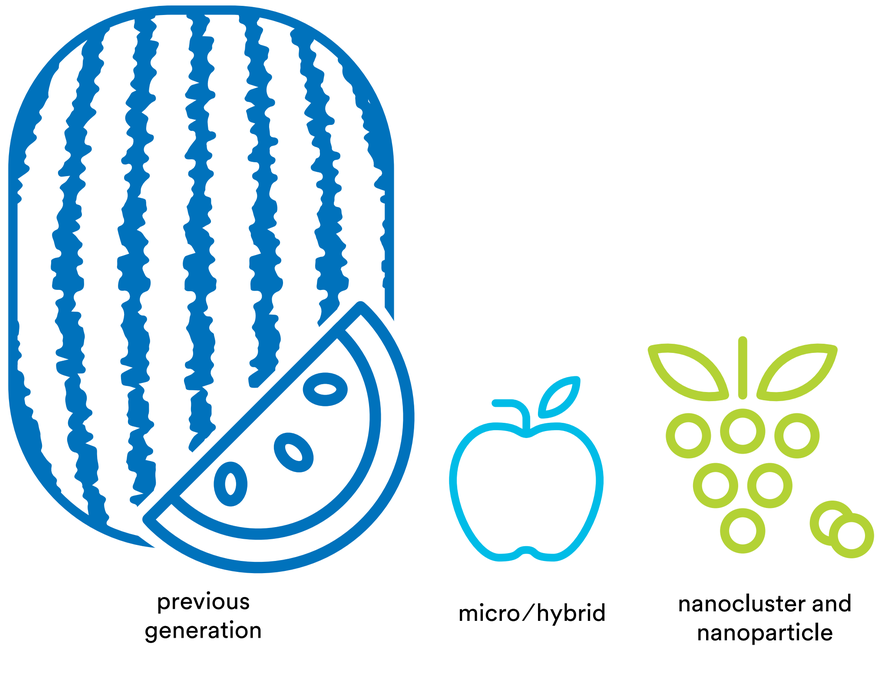


What's in your composite? Get filled in on fillers.

A recipe for robust restorations

Dental composites are made of multiple critical components: a resin matrix, fillers, coupling agents, polymerisation initiators, stabilizers and pigments mixed in different combinations to achieve a specific, desired outcome.[1] Fillers are generally made of fine glass, quartz or silica and are added to enhance the elastic modulus, increase tensile strength, hardness and wear resistance, as well as decrease polymerisation shrinkage of the restoration.[1-3] But composite material properties also depend on the size, shape, concentration and composition of the filler particles, and even their bond with the matrix – so your choice can make a difference.[2]



The tech on the table

While there are many ways to classify composites, they tend to be categorised by the size and distribution of the filler particles. Generally, the smaller the particle, the smoother the surface of the composite over time. The higher the filler content, the stronger the final restoration – but that's much easier said than done.

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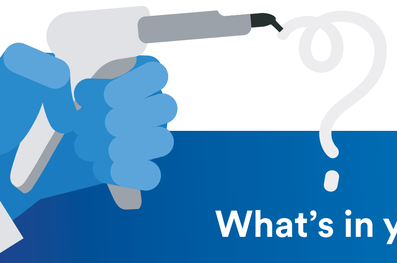

What's in your composite? Get filled in on fillers.

Hybrids or microhybrids

While the term originally referred to the mix of organic and inorganic content in the first composites (the resin matrix and filler, respectively), it's now more commonly used to refer to composites that contain a blend of large and small particles. This mix of fillers is intended to provide the "best of both worlds," with smaller particles improving polish and handling, while larger particles improve strength. In practice, however, it ends up being more of a compromise.

While the differently sized particles provide strength, the composite wears inconsistently over time. As the resin wears down, the larger particles can pop out and fall away, leaving craters that lead to a rough, unpolished surface – which ultimately limits the material's aesthetic potential.[4,6]

Microfills

Microfilled composites were first introduced in the early 1980s to combat the aesthetic deficiencies of earlier hybrid composite compositions. In response, filler particles were drastically downsized. Microfills contain 0.02–0.04 µm particles, hundreds of times smaller than in the previous generation of composites.[4]

These small particles provide excellent natural-looking aesthetics with a high and easily maintained polish. However, the tradeoff comes in the mechanical properties. In order to achieve these results, microfills contain less filler, which results in less strength, less wear resistance and greater polymerisation shrinkage.[4,5]

Some clinicians still utilise microfills for anterior restorations due to their reputation for aesthetics, but as dentistry moves toward simplified, universal composites, their long-term usability is limited. In other words, picking a composite for appearance alone isn't a recipe for success.

Nanohybrids

Probably the most prevalent composite composition used today, nanohybrids are made up of a mix of nanoparticles and larger, conventionally sized particles. As with

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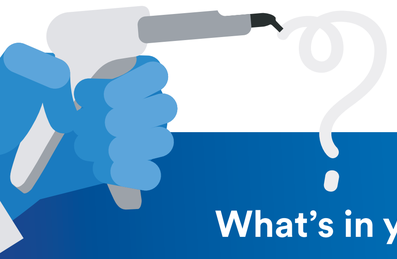
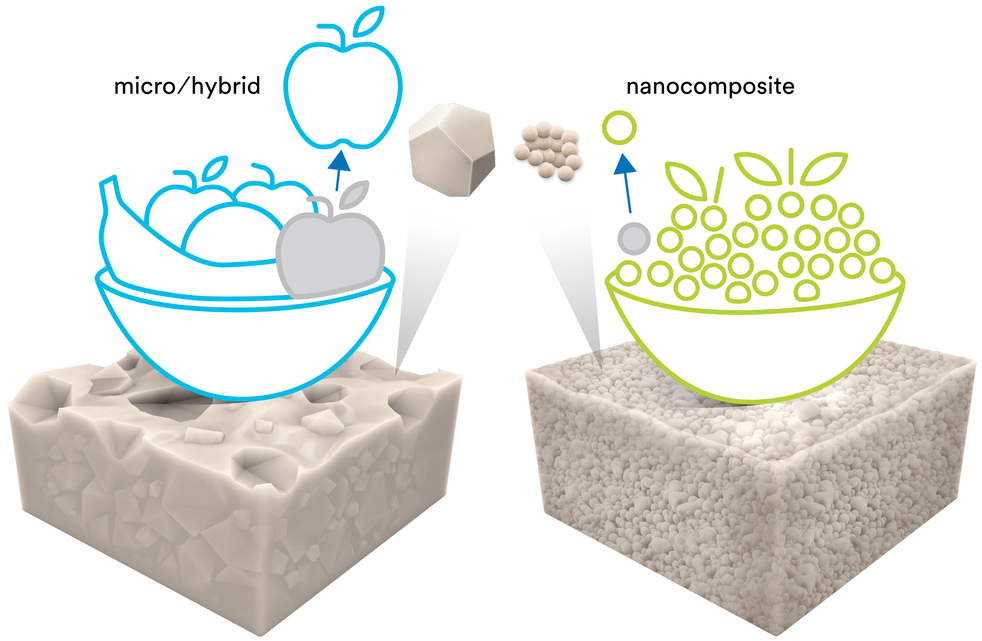


What's in your composite? Get filled in on fillers.

(Nanohybrids continued)
microhybrids, the goal is to achieve a combination of optimal aesthetics and strength with nanoparticles providing the next level of polish and life-like translucency. However, many nanohybrids on the market are primarily made of large particles, with nanoparticles taking up only a small percentage of the formulation. This can result in similar polish retention issues to standard microhybrids and keeps the nanoparticles from reaching full aesthetic potential.[9]

Nanocomposites

Nanocomposite is the most recent development in dental composites, which utilises nanoparticles *exclusively*. But what makes them special? The ultimate goal of dental composite restorations in general is to match the tooth as closely as possible. Teeth themselves are nanostructured – they're made up of nanocrystals called hydroxyapatite – so it's only logical to use particles of the same size to produce the most natural-looking result.



Microfills may have small particles, but it's difficult to get enough filler into the composite to make it strong mechanically and wear like natural enamel, particularly without unwanted interactions with the resin. In many hybrids, on the other hand, the small filler particles are physically downsized from larger particles in a top-down process – which results in a wide range of particle shapes and sizes with the exact same physical properties. While the diversity of particle size enables higher filler loading and strength, the particles are all much harder than the surrounding resin. This means that the resin will wear away more quickly and allow the large particles to reach the surface and pop away. Think of it as filling a bowl with a variety of fruit: pulling any one piece could greatly impact the rest of the bowl.

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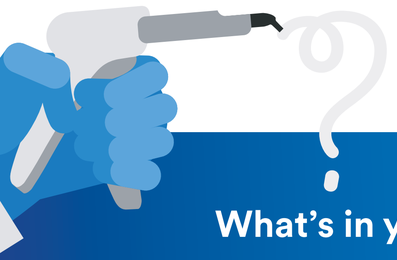

What's in your composite? Get filled in on fillers.

(Nanocomposites continued)
Nanoparticles, on the other hand, are manufactured from the bottom-up. This enables them to be an equal size and shape, so they wear evenly and consistently with surrounding tooth structure.[7] Plus, nanocomposites can be manipulated at the nanoscale: the particles can be fused into nanoclusters that act like larger particles to improve filler loading, which in turn improves strength and wear resistance – without detracting from overall aesthetics.[2,8] You can think of it as filling a bowl with clusters of grapes: you can easily pluck individual grapes from the bunch without leaving a huge space behind.

In addition, working at such a small scale gives manufacturers more control over the optical properties of the composite. This enables them to fine-tune translucency and opalescence in a way that wouldn't be possible in a microfill or hybrid.

Why it matters

When it comes to choosing composites, it can be easy to overlook tiny details like filler particle size – particularly when you can't actually see them without a high-powered microscope. But each composite is much more than meets the eye.

As dental composite technology evolves, it's important to not only keep an eye on ingredient developments, but also to be open to the benefits that new composite technology could bring to your practice. When choosing your next composite, take technology names with a grain of salt, and take a closer look at particle sizes instead. Because the smallest details can ultimately have a big impact on the quality of your restorations.

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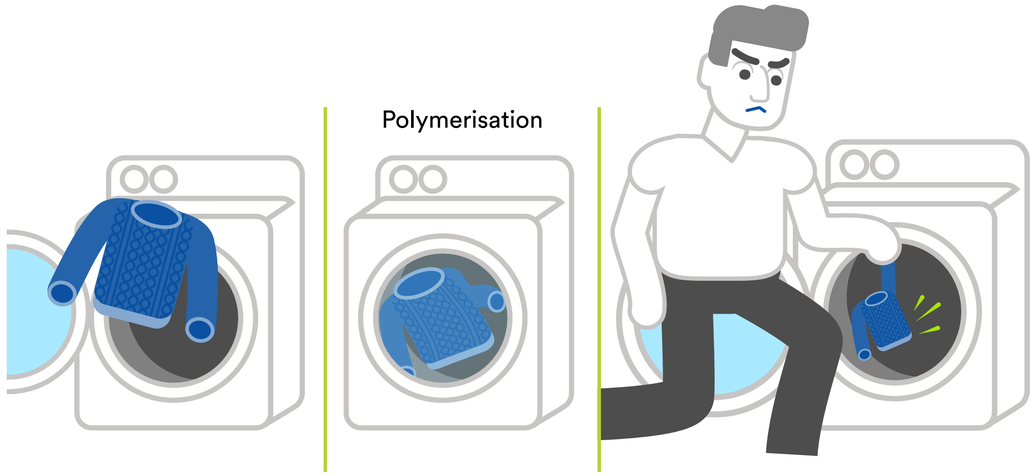
Shrinkage vs. shrinkage stress: What does it mean for your composite?

Do you know the difference between *shrinkage* and *shrinkage stress* and why it matters? While the two terms are often used interchangeably, they're actually two very different outcomes of composite polymerisation – and can drastically impact the success of your restoration.

Timothy Dunbar, PhD - 3M Senior Product Development Specialist



Shrinkage

Just like a wool sweater shrinking in a hot dryer, composites will shrink during polymerisation. This is the process whereby simple molecules called monomers combine to form larger, more complex molecules, or polymers. Depending on the monomers combined, the resulting product can have any number of unique physical properties, including strength or elasticity. However, polymerisation can also have some unavoidable adverse outcomes.

For restorative composites, when the resin converts from a semi-liquid or paste to a solid, its density changes along with its overall volume – literally decreasing in size. Conventional materials shrink by about 1.5-5% during curing.[1]

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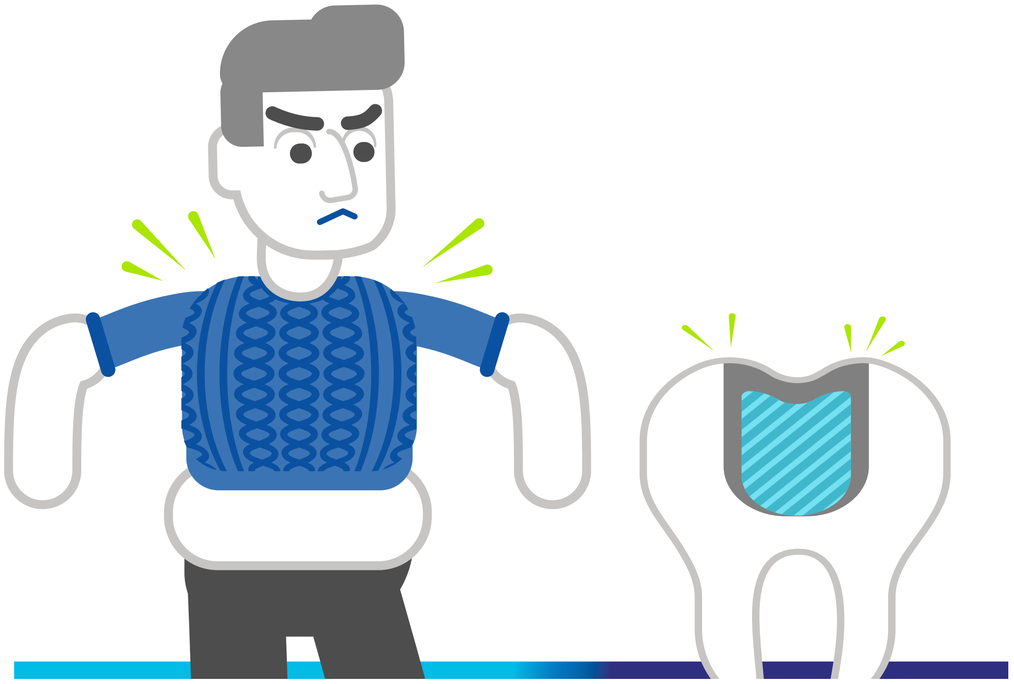
Shrinkage vs. shrinkage stress: What does it mean for your composite?

Shrinkage stress

Imagine you've accidentally shrunk your favourite wool sweater. What would happen if you decided to keep wearing it? Beyond being uncomfortable and tight, the tiny sweater would take up less space physically – leaving gaps at your wrists, waist and in your closet.

That's the fundamental difference between shrinkage and shrinkage stress. On its own, the shrunken sweater or polymerised composite is smaller and takes up less space – but on your body and in a cavity, it can cause a lot of discomfort. Shrinkage causes shrinkage stress, but they aren't the same thing.



Shrinkage stress is the pressure put on the adhesive and surrounding tooth structure during the polymerisation process. If this pressure exceeds the adhesive bond, or the strength of either the composite or tooth, it can cause a variety of problems, such as:

- Debonding resulting in internal or marginal gaps
- Fractures in the material and/or tooth structure
- Marginal staining
- Microleakage
- Secondary caries
- Postoperative sensitivity[1-4]

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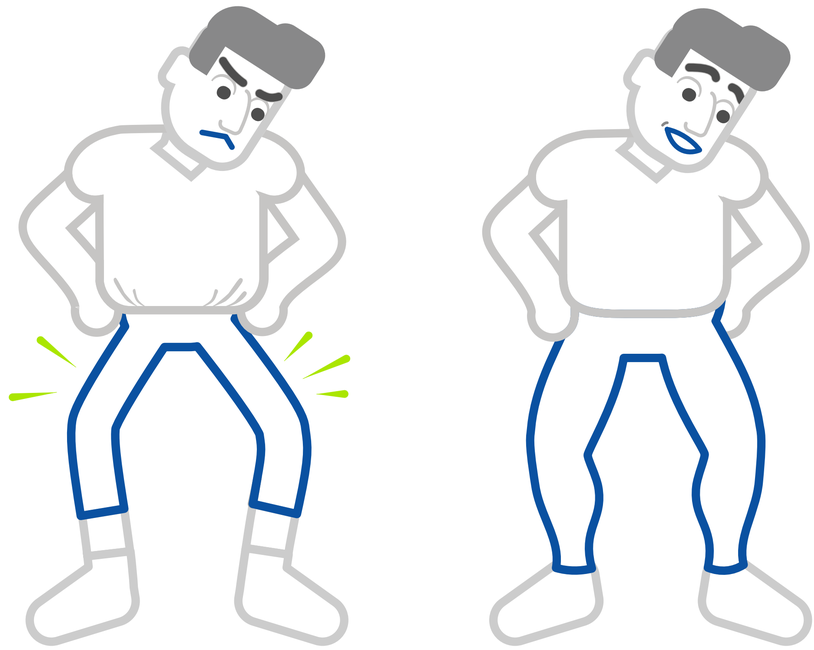
Shrinkage vs. shrinkage stress: What does it mean for your composite?

Why knowing the difference matters

Composite resins will undergo some degree of volumetric shrinkage no matter what you do – but that doesn't necessarily mean it has to impact the success of the restoration. Just as different clothing materials will react differently to a hot dryer, different composites experience shrinkage and stress differently.

Imagine you threw a pair of wool pants and a pair of spandex tights into a hot dryer and both items shrank the same amount. Which do you think would be more uncomfortable to try on? Because of the properties of the material, the spandex would stretch and put less stress on the body, while the stiffness of the wool pants would make them less forgiving and likely to burst at the seams. Similarly, flowable composites may shrink the same amount as a universal (or even more), but their low elastic modulus relieves polymerisation stress.



That's why it's so important to not only know the difference between shrinkage and shrinkage stress, but also to pay attention to the properties of your composite. Selecting a low-shrinkage composite doesn't necessarily guarantee less stress, just as buying pre-shrunk wool won't guarantee a comfortable fit.

How to cope

While polymerisation shrinkage can't be eliminated completely, there are a number of ways to reduce stress. However, many of these strategies, from layering to soft-start curing, are dependent on the properties of the composite.[1-3] Traditional universal composites, for instance, require incremental placement to reduce shrinkage and stress – but this technique can also increase the potential for voids, poor adaptation and contamination from blood

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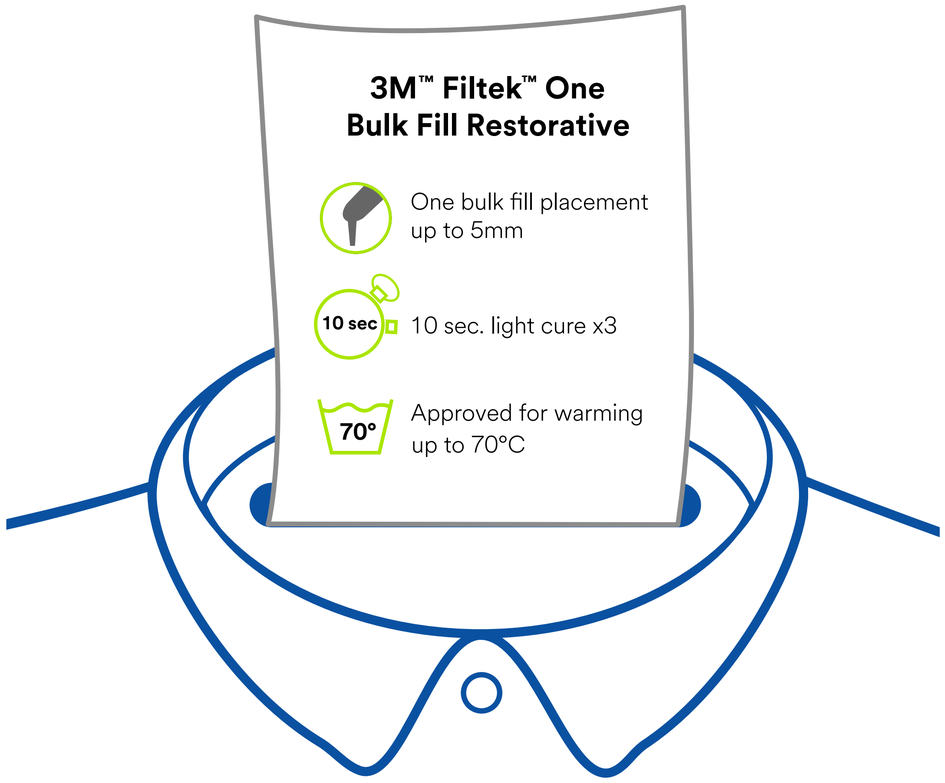
Shrinkage vs. shrinkage stress: What does it mean for your composite?

(How to cope... continued)
or saliva. Ultimately, reducing shrinkage stress comes down to choosing the right material, which should in turn simplify placement and cavity prep. For example, a modern bulk fill, such as **3M™ Filtek™ One Bulk Fill Restorative**, virtually eliminates the need for layering techniques and enables one-step placement because of its low-stress monomers and high depth of cure.

Conclusion

When performing composite restorations, polymerisation shrinkage and shrinkage stress are inevitable – but they aren't insurmountable obstacles. The more you know about how each impacts the tooth and success of the restoration, the better prepared you'll be to find the best fit for each case.



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6 Reasons not to be afraid of composite warming

Unsure about composite warming? Here's why you should reconsider – and how you could benefit from heating things up.

Timothy Dunbar, PhD - 3M Senior Product Development Specialist

Many dental professionals still have questions about composite warming. However, if your composite is manufacturer-approved for warming, and backed by testing for safety and efficacy, then there's no reason not to warm your composite. Let's take a look at how a little bit of heat could change the way you approach restorations – and break down the myths of composite warming.

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6 Reasons not to be afraid of composite warming

MYTH #1:

Warming will damage my composite and compromise the stability and opacity of the restoration.

FALSE.

When heated to the correct temperature, warming-approved composites will maintain the *equivalent* aesthetic, physical and mechanical properties as room temperature composite. Studies have shown that pre-warming composites to 60-70°C for a limited time will not only have no effect on mechanical properties such as fracture toughness, flexural strength or diametral tensile strength, but also won't impact depth of cure.[1-3]

One other mechanical property can't be overlooked, as it can greatly impact the success of your restoration: polymerisation shrinkage and shrinkage stress. It may seem intuitive that warming your composite could increase stress, due to a potential for a higher degree of cross-linking.[4, 5] But far from being negatively affected, pre-heated composite actually generates the same or lower shrinkage forces than room-temperature composite.[1, 2, 6]

With the increasing demand for natural-looking restorative dentistry, one also needs to know how warming could affect the aesthetic properties of the composite. Thankfully, studies show that pre-heated composites *also* maintain the same colour, opacity and polish retention properties as room temperature composite.[1, 2] But if warming doesn't alter the properties of the composite, why should you care? Because this means that dental professionals can take advantage of the other clinical advantages of warmed composite – such as improved adaptation due to a lower viscosity – without worry.

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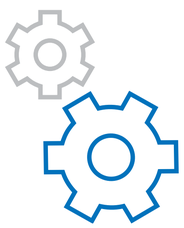
6 Reasons not to be afraid of composite warming

Room temperature	Property	Warmed
✓		✓
✓		✓
✓		✓

MYTH #2:

Warming will make the composite polymerise too soon and jeopardise the success of the restoration.

FALSE.

Studies have shown that pre-heating composite will not compromise polymerisation in the cavity, as long as it's heated correctly.[7, 8] For example, select 3M™ Filtek™ Restorative composite capsules can be heated to 70°C for up to one hour, while select 3M™ Filtek™ Restorative flowable syringes can be warmed to 70°C repeatedly – up to 25 one hour cycles. This manufacturer approved warming procedure has been proven effective with no impact on the material or spontaneous polymerisation (unless heated over 140°C, far above recommended temperatures).[1, 5, 7, 8] Just be sure to contact the manufacturer of your composite to ensure it can be safely warmed.

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6 Reasons not to be afraid of composite warming

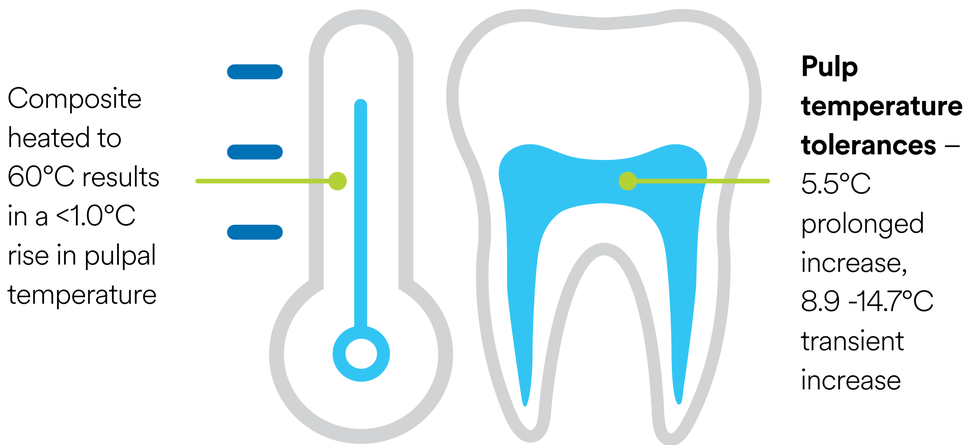
MYTH #3:

Warmed composite will damage my patients' teeth and gums or will cause sensitivity.

FALSE.

Patient safety is a concern for any dental procedure and heated composite is no exception. However, multiple studies have shown that as long as the composite is warmed to the appropriate temperature, there will be minimal heat transfer to the tooth and pulp.

How much heat is transferred to the pulp during composite placement depends on a number of variables including remaining dentine thickness, thermal properties of the tooth and composite, speed and duration of heating, and cavity prep. While it's generally accepted that the pulp can be compromised by a prolonged temperature increase of 5.5°C, recent studies show that the pulp can tolerate transient temperature increases of 8.9 -14.7°C without damage.[9]



Composites are generally heated to a temperature between 50 and 70°C (a range that healthy teeth and gums withstand daily from hot foods and liquids) but begin to cool the moment they come off heater and continue to cool throughout placement.[5, 10] In fact, when using heated composites, the remaining tooth structure acts as a heat sink, quickly lowering the composite temperature, while room temperature composites may actually warm up during placement.[11] Studies have shown that using composite heated to 60°C results in a less than 1.0°C rise in pulpal temperature – lower than temperature increases from light curing, and far below the threshold for critical pulpal temperature increase.[10]

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6 Reasons not to be afraid of composite warming

MYTH #4:

Toxic chemicals will leak out of the warmed capsule.

FALSE.

You may have heard concerns that warming composites could cause hazardous substances to leach into the mouth and cause irritation or sensitivity, or diffuse into the room and create a toxic environment. And any change in procedure – such as composite warming – capable of affecting material properties should always be thoroughly evaluated for potential impact on the health of patients or staff. That's why it's so important to follow manufacturer specifications, and to read up on your composite.

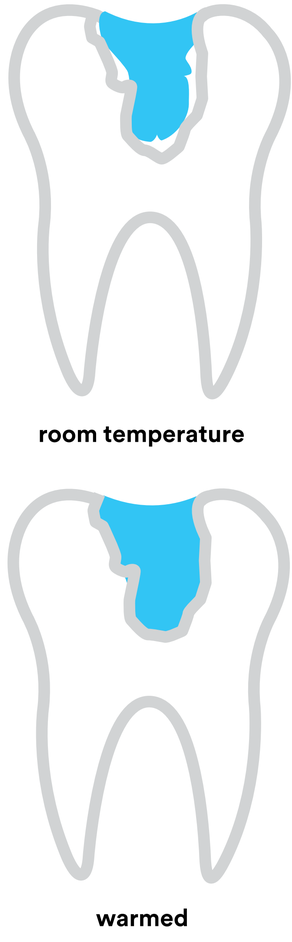
For example, before approving select 3M™ Filtek™ Dental Restoratives for warming, 3M conducted rigorous tests to ensure the safety of pre-warmed composite for both clinicians and patients.[12] Two universal, two flowable and one bulk fill restorative were warmed and rigorously tested by a board-certified toxicologist, who found them to be biocompatible according to ISO 10993-1:2018.[1] Regardless of which product you use, always follow the manufacturer's instructions for how – or whether – to warm your composite.

MYTH #5:

Warmed composite is sticky and more difficult to work with.

FALSE.

Heating composite reduces its viscosity and improves flow, which in turn lowers the force necessary to extrude from the compule. This not only decreases hand fatigue, but also allows for faster, easier, more precise control when placing the material into areas with limited access. And because the composite is more flowable, it's able to fill all the nooks and crannies of the cavity prep – enabling less invasive cavity prep with more unique geometries and improved adaption.[1, 4-11]



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6 Reasons not to be afraid of composite warming

MYTH #6:

Manufacturers don't actually support composite warming.

FALSE.

It's true that until fairly recently, manufacturers did not support warming – and unless you were willing to dig into the literature, it was easy to overlook. However, evidence of its benefits have existed since the 1980s and the trend is only growing.[4]

Before writing off composite warming, make sure to check the manufacturers' instructions. However, when you're evaluating your composite for warming potential, make sure that it's backed by the appropriate testing to ensure you're getting all the benefits without sacrificing efficacy or safety.

Summary

While many dental professionals have concerns about composite warming, the facts speak for themselves. If your composite is manufacturer-approved for warming, backed by testing for safety and efficacy and used correctly, warming:

Will not damage your composite or impact the aesthetic, physical or mechanical properties of the restoration – and will generate the same or lower shrinkage forces than room-temperature composite.

- Will not impact the material or cause spontaneous polymerisation
- Will not harm the pulp
- Will not leach chemicals or hazardous substances
- Can improve flow for easier handling, lower extrusion force and the potential for improved adaption

In addition, manufacturers have begun to take note of these benefits and have started to test, develop and approve composites for warming. In the end, a little heat can go a long way.

One last reminder: *Be sure to contact the manufacturer of your composite to ensure it can be safely warmed.*

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Placing posterior composite: Paving the way to restorative success

Posterior restorations call for strength but can also be optimised for both efficiency and aesthetics. Learn how you can enhance your results by perfecting your composite placement technique – whether in increments or in bulk.

Dr. John Weston, DDS, FAACD

There is no single blueprint for posterior composite restorations. Efficiency, predictability, durability, aesthetics – many factors come into play with each choice of material and technique. Many clinicians rely on standard incremental placement, which is well-practiced and well-known. But mastering one-step placement with bulk fill composites can also pave the way to new opportunities for your practice by improving efficiency without compromising the quality of dentistry your patients deserve.

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Placing posterior composite: Paving the way to restorative success

Bulk fill vs. incremental placement

Incremental composite placement is typically performed to reduce the effects of polymerisation shrinkage stress or to improve aesthetics. Sometimes, this means simply executing a “ramp fill,” where either the buccal or lingual prep wall is filled and light cured in increments. Alternatively, Class II restorations can be placed by restoring the proximal boxes and marginal ridges first, followed by ramp filling the occlusal areas.

Generally speaking, I prefer bulk filling and only place composite in increments when:

- I have a very deep proximal box – in which case, I use flowable on the base of the box up to the pulpal floor, cure and then bulk fill the remaining cavity preparation (following the manufacturer’s instructions for depth of cure).
- When I’m close to the pulp, I prefer to place a protective layer of bio-active material or glass ionomer liner or base, then etch and place my composite in a bulk fill technique.
- When I need to block out discolouration with an opaque composite. As seen in the next set of images.

Class 1 amalgam restoration in need of replacement

Dark dentine exposed after amalgam removal

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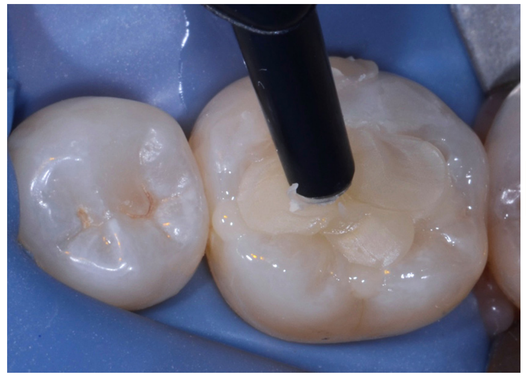
Placing posterior composite: Paving the way to restorative success

(Bulk fill vs. incremental placement > continued)

Dark dentine masked using a flowable composite (3M™ Filtek™ Supreme Flowable Restorative, shade A03)



Placement of bulk fill composite (3M™ Filtek™ One Bulk Fill Restorative, shade A1), which is used in 90% of posterior restorations

Final aesthetic result with no dark dentine “shining through”

Bulk filling has multiple advantages, including the potential for fewer voids and the reduction of time and complexity as compared to incremental composite placement. Older generations of bulk fill composites were not as aesthetic because they required translucency to achieve a high depth of cure. And, they exhibited high polymerisation shrinkage and associated stress. Modern bulk fills, however, allow placement of posterior composites in up to 5mm increments and offer a high degree of confidence in the materials’ depth of cure (using three-point curing) without an increased risk of post-operative sensitivity.

When to use a flowable

Flowables are particularly useful for deep class 1 or class 2 posterior restorations. A deep prep – often in the proximal box – can be lined with flowable and cured to enable you to meet the depth of cure requirements for your bulk fill composite, which in my case is 5mm. But that’s not the only time you can benefit from using a flowable composite.

In my practice, I utilise flowables on every posterior restoration. In part because it’s very difficult to get access to the proximal box with a capsule tip. And, injecting viscous restorative material directly from a capsule may limit composite adaption when irregular cavity shapes are present – particularly if the prep includes 90° angles.

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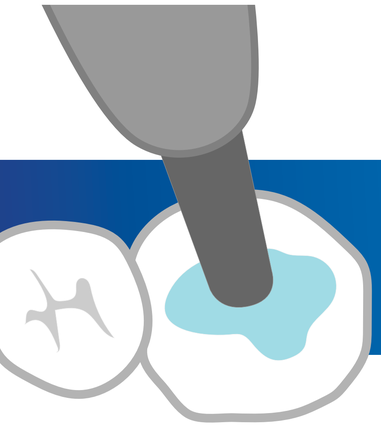
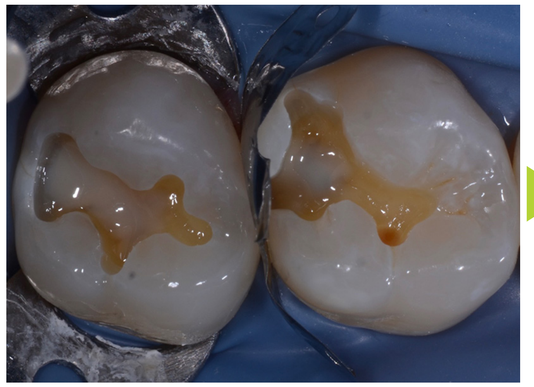


Placing posterior composite: Paving the way to restorative success

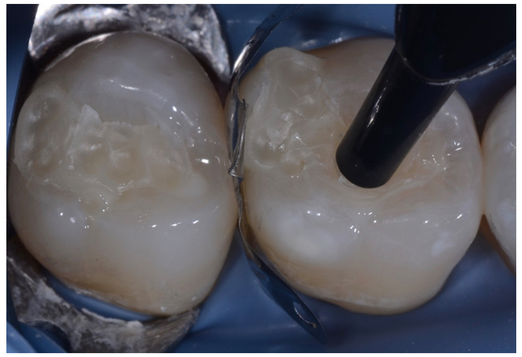
(When to use a flowable > continued)

Irregularities and sharp angles have the potential to leave gaps and voids at the tooth restorative interface. A flowable enables you to fill micro-irregularities before incrementally layering to occlusion.

Most commonly, I use the “snowplow” technique, by placing a thin layer of flowable on the pulpal floor first – without curing – followed by placing bulk fill or universal composite over the top with pressure. This allows the flowable to fill in all the nooks, crannies and irregularities within the cavity preparation. While the two different restorative materials are placed one after another, it’s not actually considered layering or incremental placement, as both are cured simultaneously.



Dark dentine masked using a flowable composite (3M™ Filtek™ Supreme Flowable Restorative, shade A30)



Placement of bulk fill restorative (3M™ Filtek™ One Bulk Fill Restorative, shade A1) is placed directly on top of uncured flowable using the “Snowplow Technique”

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Placing posterior composite: Paving the way to restorative success

When to use an opaquer

Patients today want healthy, natural-looking teeth – even beyond the anterior aesthetic zone. As we strive to maximise aesthetics in the posterior, it's important to pay attention to detail. To this end, I use an opaquer every single time there is an amalgam tattoo or stained dentine present. First, because the grey colour of an amalgam tattoo may look like secondary decay to you or another dentist and may result in the unnecessary replacement of the composite. Plus, patients are investing both time and money into their oral health, so it's understandable that they don't want to see discolouration under a newly placed composite.

Building occlusal anatomy

Some clinicians have a hard time adjusting to bulk fills because they're used to building in occlusal anatomy during incremental placement. They assume that bulk filling will require them to cut back cured composite to sculpt proper anatomy. However, with modern materials, this isn't the case.

In my practice, we always try to sculpt the occlusal anatomy into our restorative material prior to light curing rather than cutting it back to occlusion with burs. 3M™ Filtek™ One Bulk Fill Restorative makes this possible – it's a little softer than some universal restorative materials, but it's not sticky, making it easy to carve and adapt. Most clinicians are well trained in carving anatomy using amalgam, and these skills can easily be transferred to bulk fills – enabling you to take advantage of the fact that there's very little finishing required after placement, sculpting, and curing.

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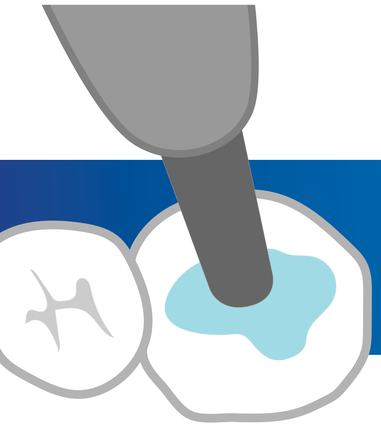


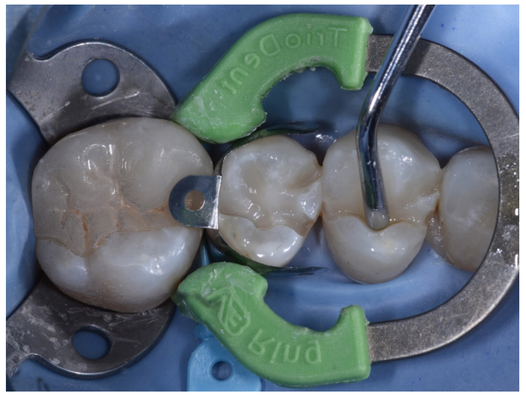
Placing posterior composite: Paving the way to restorative success

Optimising incremental placement

If you're more comfortable with an incremental filling technique, I recommend placing a layer of flowable and teasing it around to fill any corners or irregularities in the preparation, making sure to cover the entire pulpal floor. After curing the flowable, place one increment of composite as a ramp on the buccal side and cure, then add and cure another ramp on the lingual side. Basically, you're filling one side of the restoration first and then the other, avoiding placing increments that connect the cusps, and curing each increment as you go. Start from pulpal floor and work your way up, curing each side separately – never all at once. This helps mitigate polymerisation shrinkage and "C Factor" stress, reduce post-operative sensitivity, and improve the adaptation of the restorative material to the tooth.

Dark dentine is seen during adhesive placement (3M™ Scotchbond™ Universal Adhesive)

Flowable composite (3M™ Filtek™ Supreme Flowable Restorative, shade A03) is placed on the first and second bicuspid to mask dark dentine, smooth irregularities, and improve adaptation of the composite on the pulpar floor



A "ramp" of composite (3M™ Filtek™ Supreme Ultra Universal Restorative, shade A1) is placed on the buccal wall of the first bicuspid and adapted using a Woodson plastic instrument

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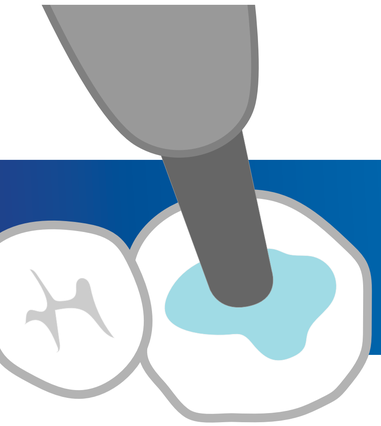

Placing posterior composite: Paving the way to restorative success

(Optimising incremental placement > continued)

Restorations prior to finishing and polishing

The final restorations which are both aesthetic and functional

Worried about curing efficiency and depth of cure?

In order to achieve successful depth of cure, not only do you need to know and trust your materials, but you need confidence in your equipment and your technique. Many clinicians distrust bulk fills because they're not sure that they will cure completely, so choose a material that you can trust. Filtek One Bulk Fill Restorative, for example, has a proven 5mm depth of cure when using a 3-position curing technique. However, the ability to achieve a complete cure often has less to do with the properties of the composite and everything to do with your curing light or technique.

Frankly, some clinicians have lights that simply aren't of sufficient quality or intensity. If a composite isn't completely cured it may discolour, wear prematurely and in some cases the patient may experience post-operative sensitivity. Many dental professionals either aren't aware of their light's inefficiencies or end up over-curing for peace of mind. That's why it's so important to regularly maintain and test your curing lights. It's simple enough to check your equipment using systems like BlueLight CheckUp and CheckMARC – professional resources and testing equipment designed to help you keep your equipment working at its best.

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Placing posterior composite: Paving the way to restorative success

(Worried about curing efficiency > continued)

Most of all, regular testing can help you build trust in your light and confidence in your abilities, so you can become more comfortable with bulk filling.

Maximise restoration quality – while minimising placement time

If you haven't implemented bulk fill materials yet, it's a good place to start to improve your efficiency and reduce chair time. Utilising universal adhesives is also a great addition to your posterior procedure because there aren't any extra steps needed to control sensitivity – they're great at penetrating and creating an excellent hybrid layer, thus sealing dentine, and resulting in very low post-operative sensitivity.

Get an extra boost: Total etch technique with a universal adhesive

Etching has been shown to improve adhesive bond strengths, especially on enamel – and therefore, I always total etch unless we are close to the pulp. Plus, it's often difficult not to etch the dentine when etching enamel margins. Start by placing etch on the enamel surfaces, then cover the dentine and wash after 5 seconds.

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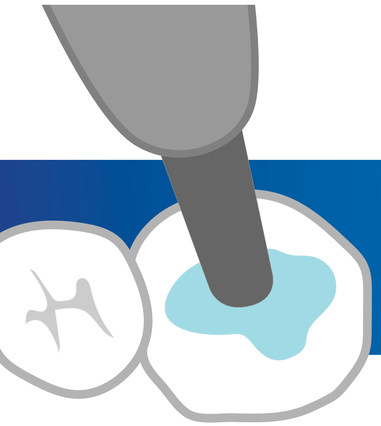

Placing posterior composite:
Paving the way to restorative success

Tips for a strong, long-lasting polish

In the past, patients weren't very concerned about the aesthetics in the posterior teeth but attitudes have changed. Most of my patients want their entire smile, from front to back, to look and feel great. And while often overlooked, the final finishing and polishing steps of a posterior restoration are key to ensuring aesthetic, long lasting results. In addition to improving luster and polish, finishing and polishing can actually help prevent staining and improve colour stability.

Polishing requires a series of progressively finer grits. One way to think about polishing is that you are essentially scratching the surface, and you want to continue to remove the scratches sequentially until all scratches are gone – which will result in a silky-smooth surface luster that is resistant to stain and plaque retention.

I always recommend using diamond impregnated rubber tips, cups, discs or brushes, Medium and Fine. The 3M™ Sof-Lex™ Diamond Polishing System is great, as it's a two-step process. For anterior restorations, we go one step further on anterior teeth and use a paste polisher with felt disc or small brush or rag wheel to get the luster needed. And of course, you need to make sure to use a material that compliments your procedure. In my experience, nanocomposites provide excellent handling, high strength, low wear, with great polish and polish retention. Because of their nano-sized filler particles, nanocomposites wear similarly to enamel and can help you achieve a natural, aesthetic result.

Initial polish (3M™ Sof-Lex™ Pre-Polishing Spiral)

Final polish (3M™ Sof-Lex™ Diamond Polishing Spiral)

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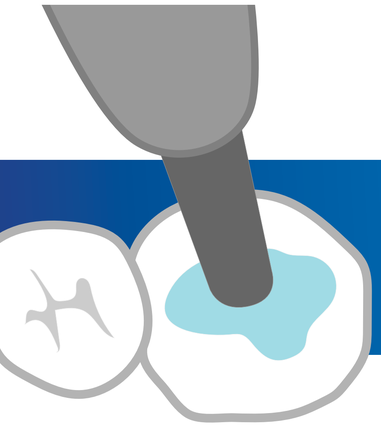

Placing posterior composite:
Paving the way to restorative success

Conclusion

The restorative techniques we've discussed come with both advantages and challenges. Incremental placement is a well-known and well-utilised technique but requires additional time to place and light cure the composite in stages. If you're comfortable with one-step placement using bulk fills, you can take advantage of their time savings. And clinical studies have shown that bulk fill composites can reduce placement times without increasing post-operative sensitivity. Having said that, there will always be ways to optimise your procedure. Either technique, when combined with world-class dental materials and proven systems, can help you achieve long-lasting, aesthetic results.

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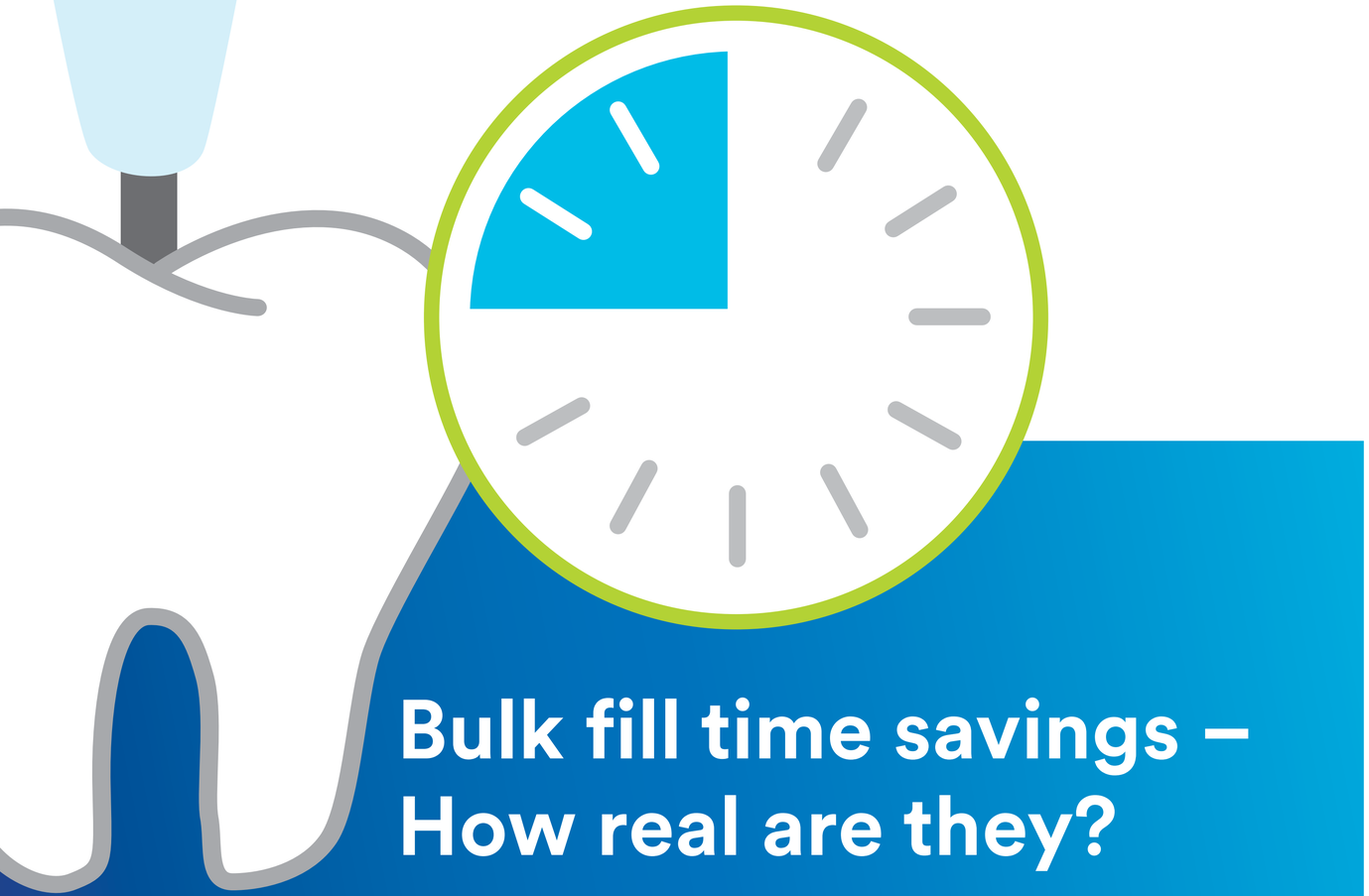

Bulk fill time savings – How real are they?

The idea that bulk fill composites save time has been around for years—and now there are the stats to prove it. See how these time savings are the real deal.

Jean Madden, 3M Global Scientific Affairs Manager

Increased efficiency = boosted profitability

We all know that efficiency is key. Shortening the amount of time it takes to complete a task leads to increased productivity, which is always one of the main outcomes that we are striving for. In dentistry, our days are spent treating patients as efficiently as possible while at the same maintaining quality. But how do we shorten procedure times while maintaining quality?

Whether implementing new techniques, equipment, products, or a combination of all three, updating the methods, products and tools we use to increase productivity is a vital part of our job. Not only does reducing procedure times increase production, it also saves time for your patients, which may improve their overall satisfaction. This is rarely taught in dental school.

The next step is to determine how best to go about increasing efficiency. There are a variety of products specifically designed to simplify procedures, one example being bulk fill composites.

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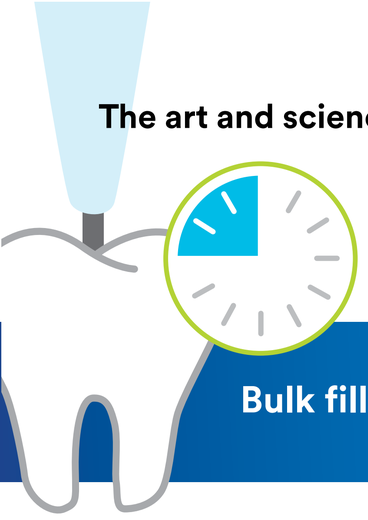

Bulk fill time savings – How real are they?

Bulk fills at a glance

As product developers set out to design materials that will reduce the number of increments a dentist is required to place and light cure in order to complete a composite restoration, the goal is to provide a product that shortens procedure times while still delivering a durable, and well-cured, restoration. The solution was to create an entirely new category of direct restorative materials now known as bulk fill composites that can be light cured in 4 or 5 mm increments.

While bulk fill composites have been on the market for several years, the question has lingered: do bulk fill composites really save you time? The good news is that we now have proof, and the resounding answer is yes.

Backing up the claims

So, first things first, which studies are available to confirm the theory surrounding time savings associated with bulk fill composites? There have been a variety of studies conducted on this topic; however, we shall focus on two in particular:

- Clinical time and postoperative sensitivity after use of bulk fill (syringe and capsule) vs. incremental filling composites: a randomised clinical trial[1]
- Comparison of adaptation and placement times for Class II composites techniques using room temperature and warmed composites[2]

Both studies examined the amount of time that can be saved when using bulk fill composites. Although the studies were performed separately and in different manners, both concluded that using bulk filling followed by bulk curing the composite materials resulted in overall time savings.

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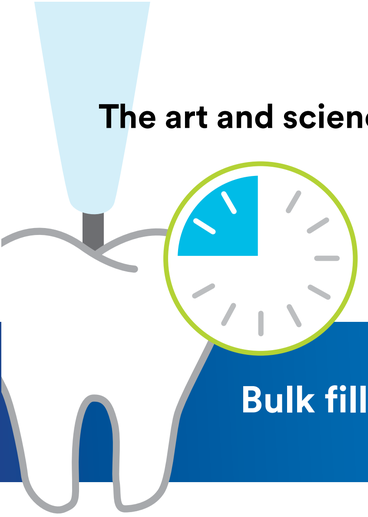

Bulk fill time savings – How real are they?

STUDY #1:

Clinical time and postoperative sensitivity after use of bulk-fill (syringe and capsule) vs. incremental filling composites: a randomised clinical trial*

To start, let's break down the first study listed, *Clinical time and postoperative sensitivity after use of bulk fill (syringe and capsule) vs. incremental filling composites: a randomised clinical trial.* One thing that sets this study apart is that it was the first to evaluate the entire clinical procedure and not just the placement of the restoration. The corresponding author, Dr. Marcos Barceleiro, explains:

"There are some studies that have evaluated the clinical time that you need to make a restoration with bulk fill composites and comparing it with traditional composites. But in those studies, all of the cavities were similar in height and standardised. ... Those studies also didn't include the time to finish, polish or make occlusal adjustments. Our study was the first clinical study that evaluated entire clinical time, all using bulk fill composites."

A unique factor of this study is that this was an *in vivo* study, meaning the restorations were placed clinically. The methodology for investigating the bulk fill time savings was to perform a randomised, double-blind (patient and evaluator) clinical trial on a total of 53 cavities per group.

The restorations were performed using the bulk-filling technique with both syringes and capsules, as well as both with and without selective enamel-etching. The results from each of these groups were compared to the method using traditional composites with the incremental technique (control group).

After comparing the two restoration methods, the study confirms the theory that using bulk fill composites saves time. "From a clinical point of view, our study shows that you spend 50-60% less time to perform the restoration when using bulk fills," said Dr. Barceleiro.

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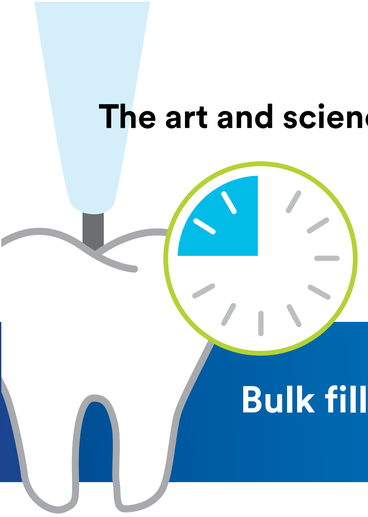

Bulk fill time savings – How real are they?

Along with comparing the procedure time for incremental placement vs. bulk fill placement, this study also evaluated the postoperative sensitivity for each restoration. The results confirmed that the risk of postoperative sensitivity was the same regardless of which type of composite material was used and which type of procedure was performed.

"The study results show that you can safely use bulk fill composites. Your patient will not have a higher risk of postoperative sensitivity because you are making a faster restoration," explained Dr. Barceleiro.

So not only can the procedure be performed more efficiently, but the risk of sensitivity does not increase. This means the chance of patients returning with pain and requiring additional work is no higher than if traditional composite was placed incrementally.

In conclusion, this study found that the average time needed to place incrementally filled posterior Class I or Class II composites (using selective enamel etching) was 28 minutes compared to 11 minutes when using a bulk fill material, in this case, **3M™ Filtek™ One Bulk Fill Restorative**, **which translates into to a 17-minute per restoration time savings**. Importantly, the use of bulk fill composites did not increase the risk or intensity of postoperative sensitivity compared to incrementally layered posterior composites.

STUDY #2:

Comparison of adaptation and placement times for Class II composites techniques using room temperature and warmed composites

The second study was conducted by Dr. Price from Dalhousie University in Canada and had similar findings to Dr. Barceleiro's study. The objective of Dr. Price's study was to compare composite adaptation and placement times using four different techniques.

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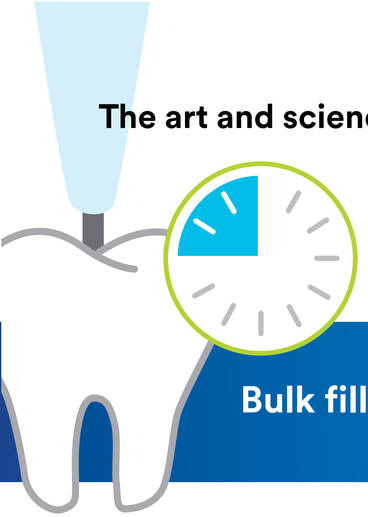

Bulk fill time savings – How real are they?

(STUDY #2 > continued)

One key difference in Dr. Price's study is that it was performed *in vitro*. To conduct the study, 11 dentists filled four Class II MOD molars (5 mm deep proximal boxes) in heated typodont teeth using the following methods and materials:

- Room temperature layered composite
- Room temperature bulk fill composite
- Warmed bulk fill composite
- Warmed flowable and bulk fill composite

The *in vitro* study concluded that the posterior bulk filling technique resulted in a significant time savings. On average, using an incremental filling and light-curing each increment took **15 minutes while bulk filling and then light-curing was completed in just 6 minutes** (2.5 times faster).

After completion of the study, it was concluded that bulk filling with warmed composite followed by bulk curing provided the best adaptation of composite to the cavity walls and the fewest 'knit' lines between increments. However, bulk filling does not mean filling the cavity without care and attention.

When the composite is more than 4 to 5 mm thick (or greater than the manufacturer's maximum recommended depth of cure), each 4 to 5 mm thick increment should be light cured separately while ensuring that the tip of the guide completely covers the occlusal surface area of the composite.

What do these results mean in the real world?

In essence, spending less time on each procedure means that productivity is increased, overall profitability is boosted, and patients benefit from spending less time in the chair.

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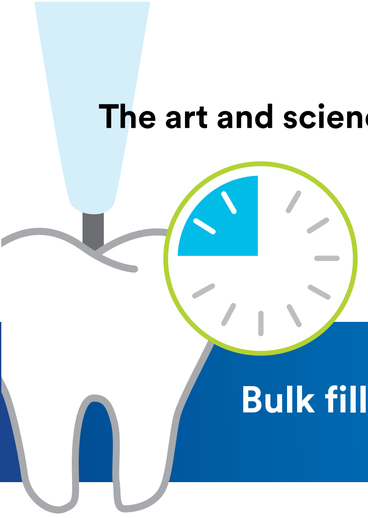

Bulk fill time savings – How real are they?

(What do these results mean... continued)

To conclude, recent studies by Dr. Barceleiro and Dr. Price not only confirm the assumption that bulk fill composites save time, but also that they can provide excellent adaptation to the cavity and low rates of post-operative sensitivity. From a clinician's perspective, bulk fill composites have the potential to improve productivity and, correspondingly, the lives of their patients.

Sources

[1] Barceleiro, M. (2019). Clinical time and postoperative sensitivity after use of bulk-fill (syringe and capsule) vs. incremental filling composites: a randomised clinical trial. Braz. Oral Res. 2019;33:e089.

[2] Price, R P. (2018). Comparison of Adaptation and Placement Times for Class II Composites Techniques Using Room Temperature and Warmed Composites. Dalhousie University. Unpublished data.

Disclaimer

* The study, Clinical time and postoperative sensitivity after use of bulk-fill (syringe and capsule) vs. incremental filling composites: a randomised clinical trial, was not funded by 3M. It was supported by the National Council for Scientific and Technological Development (CNPg 177759) and Coordination for the Improvement of Higher Level Personnel (CAPES) in Brazil.

Acknowledgement

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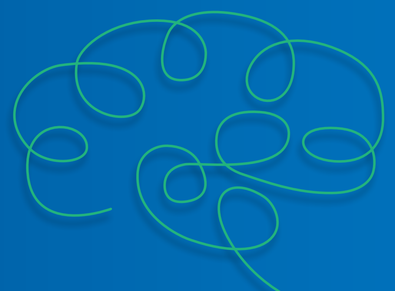

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