Filtek™ Bulk Fill

Posterior Restorative

Technical Product Profile

3M

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Introduction

Since the introduction of light curable composites, dentists have been required to place the material in increments. These composites require light (in the proper wavelength) to excite a photo-initiator, which begins the polymerization process. If the light penetration is insufficient, poor initiation of this reaction can result, which can lead to under-cured or uncured material. The depth of cure of a composite is determined by the monomers, the initiators and the shade/opacity of the material. Additionally, the effectiveness of the light is influenced by many factors including the wavelength, the light intensity, the distance from the light source, and the exposure time. Dentists use incremental placement techniques for a variety of reasons in addition to the cure depth of the composite. Incremental placement is used to manage the shrinkage and corresponding shrinkage stress, resulting from the polymerization reaction. Incremental placement allows for more precise manipulation of the restorative to ensure adaptation, particularly at the cavosurface. It reduces the possibility of voids and aids in forming contacts and sculpting the occlusal surface prior to cure. Managing the shrinkage stress and ensuring proper adaptation may reduce the incidence of post-operative sensitivity. Additionally, incremental placement readily lends itself to creating multi-shade restorations.

On the other hand, incremental placement is considered time consuming and tedious, especially in posterior teeth. Increments may increase the potential of voids to form between composite layers, and composites must be placed in a dry field. The risk of contamination leading to a compromised restoration is adversely impacted by the time it takes to place, adapt and cure each increment.

In an effort to provide materials that address the challenges of incremental placement, and also provide an alternative material to amalgam, packables were launched in the late 1990s. These materials had a high viscosity and contained a high filler load. Manufacturers claimed the handling was amalgam-like and the material stiffness aided in forming contacts. In addition, many of the packables were reported to have the capability of being bulk placed, i.e., to be placed and cured in 4-5 mm increments. However, the high viscosity of these composites made adaptation to the cavosurface more challenging.[1,2] The actual depth of cure of these materials was found to be less than claimed.[3] Even if the adequacy of cure was acceptable, the clinical ramifications of shrinkage stress became more prominent with thicker (4-5 mm) layers. Studies have shown that many of these materials still had high shrinkage and polymerization stress.

The field of materials science has made remarkable advancements with composite filling materials used for direct procedures, which offer dentists solutions to many of the issues that they see every day. It is pretty widely understood in the scientific and dental communities that bulk filling a restoration increases stresses on the tooth, and can decrease bond strength. However, with the capabilities of materials currently available to manufacturers, it is possible to create materials/products that offer lower polymerization shrinkage stress when compared to incrementally placed composites.

Product Description

3M™ ESPE™ Filtek™ Bulk Fill Posterior Restorative material is a visible, light-activated restorative composite optimized to create posterior restorations simpler and faster. This bulk fill material provides excellent strength and low wear for durability. The shades are semi-translucent and low-stress curing, enabling up to a 5 mm depth of cure. With excellent polish retention, Filtek Bulk Fill Posterior Restorative is also suitable for anterior restorations that call for a semi-translucent shade. All shades are radiopaque. Filtek Bulk Fill Posterior Restorative is offered in A1, A2, A3, B1 and C2 shades.

Product Features

- Packaged in 0.2 gram capsules and 4.0 gram syringes
    - Syringes are dark teal green with white labels and shade designations
    - Capsules are black with dark teal green caps
- 5 Shades – A1, A2, A3, B1, C2
- Class II 5 mm depth of cure for all shades

Indications for Use

- Direct anterior and posterior restorations (including occlusal surfaces)
- Base/liner under direct restorations
- Core build-ups
- Splinting
- Indirect restorations including inlays, onlays and veneers
- Restorations of deciduous teeth
- Extended fissure sealing in molars and premolars
- Repair of defects in porcelain restorations, enamel and temporaries

Composition

The fillers are a combination of a non-agglomerated/non-aggregated 20 nm silica filler, a non-agglomerated/non-aggregated 4 to 11 nm zirconia filler, an aggregated zirconia/silica cluster filler (comprised of 20 nm silica and 4 to 11 nm zirconia particles) and a ytterbium trifluoride filler consisting of agglomerate 100 nm particles. The inorganic filler loading is about 76.5% by weight (58.4% by volume). Filtek™ Bulk Fill Posterior Restorative contains AUDMA, UDMA and 1, 12-dodecane-DMA. Filtek Bulk Fill Posterior Restorative is applied to the tooth following use of a methacrylate-based dental adhesive, such as manufactured by 3M, which permanently bonds the restoration to the tooth structure. Filtek Bulk Fill Posterior Restorative is packaged in traditional syringes and single-dose capsules.

Shades

Filtek Bulk Fill Posterior Restorative material is available in 5 shades: A1, A2, A3, B1 and C2. These shades are more translucent than the body or enamel shades of other universal composites.

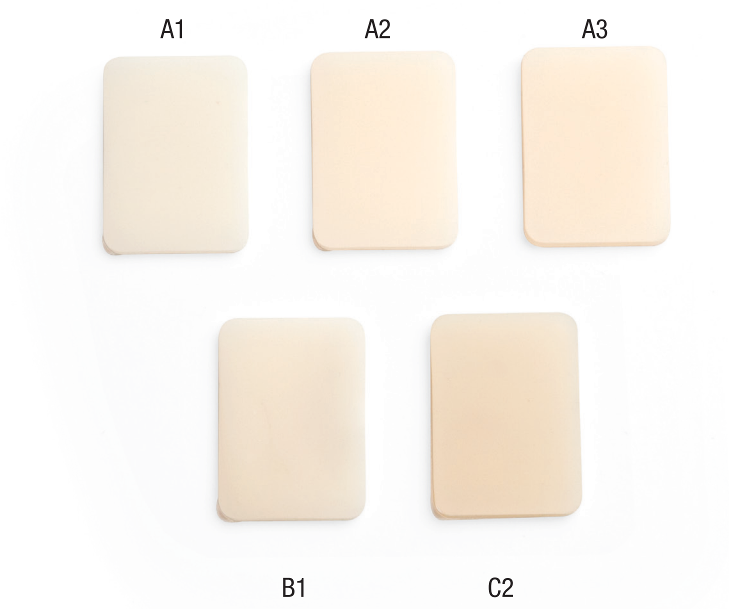


Figure 1:
Source: 3M internal data

Background

Resin System

The primary aim of this development effort was to design a material that would allow a practitioner to place and cure a 5 mm deep restoration up to occlusion. In order to accomplish this task, many aspects of the resin system needed to be considered. One of the primary considerations in designing this resin system was the ability to relieve the amount of shrinkage stress upon light curing. Additionally, because this is a bulk fill material, the depth of cure of the material was a key property considered during development. Unlike many of the flowable composites on the market, this material was designed to be filled up to occlusion, so attaining high wear resistance was a central effort. Another key factor that had to be considered for a material that will be filled in bulk was optimized handling and enhanced adaptation to the cavity preparation.

Methacrylate composites have an inherent tendency to shrink during polymerization and can shrink to varying degrees depending on the monomers being used. Filtek™ Bulk Fill Posterior Restorative contains two novel methacrylate monomers that, in combination, act to lower polymerization stress. One monomer, a high molecular weight aromatic dimethacrylate (AUDMA) (Figure 2), decreases the number of reactive groups in the resin. This helps to moderate the volumetric shrinkage as well as the stiffness of the developing and final polymer matrix—both of which contribute to the development of polymerization stress.

AUDMA

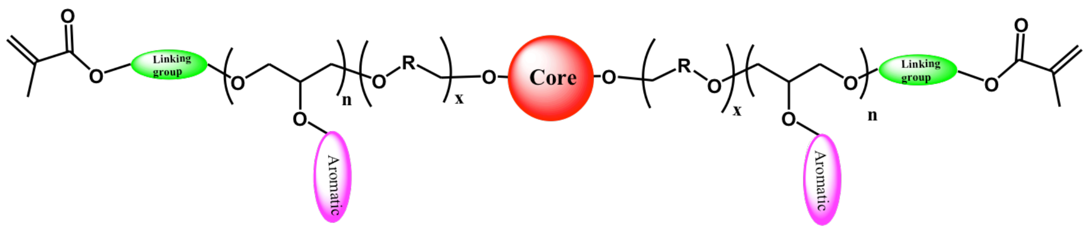


Figure 2: AUDMA Structure

Source: 3M internal data

The second unique methacrylate represents a class of compounds called addition-fragmentation monomers (AFM) (Figure 3). During polymerization, AFM reacts into the developing polymer as with any methacrylate, including the formation of cross-links between adjacent polymer chains. AFM contains a third reactive site that cleaves through a fragmentation process during polymerization. This process provides a mechanism for the relaxation of the developing network and subsequent stress relief. The fragments, however, still retain the capability to react with each other or with other reactive sites of the developing polymer. In this manner, stress relief is possible while maintaining the physical properties of the polymer.

AFM

Figure 3: AFM Structure

Source: 3M internal data

DDDMA (1, 12-Dodecanediol dimethacrylate) (Figure 4) has a hydrophobic backbone that increases its molecular mobility and compatibility with nonpolar resins. DDDMA offers a low viscosity/low volatility resin that is commonly used in biomaterials and dental applications due in part to its fast cure with low exotherm and low shrinkage. This is a high-modulus resin with good flexibility and impact resistance.

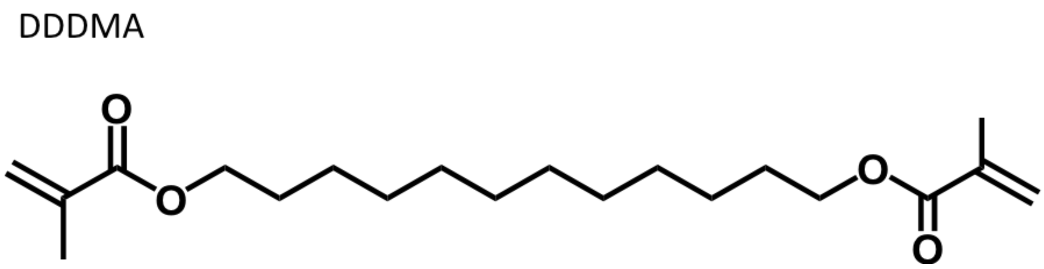


Figure 4: DDDMA Structure
Source: 3M internal data

UDMA (urethane dimethacrylate) (Figure 5) is a relatively low-viscosity, high-molecular weight monomer. This monomer was included in the resin system to reduce the viscosity of the resin.

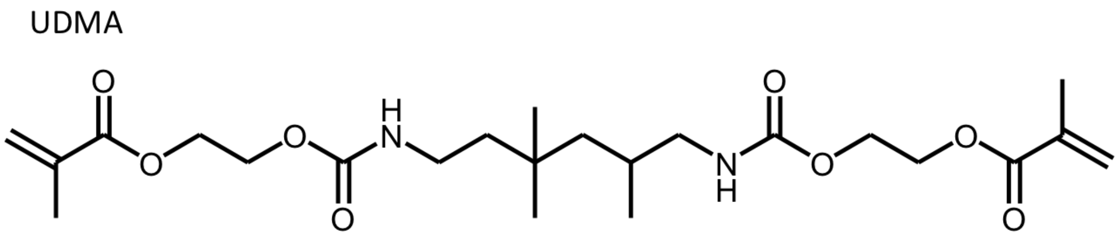


Figure 5: UDMA Structure
Source: 3M internal data

Additionally, the higher molecular weight effectively reduces the shrinkage while still creating a tough, highly cross-linked network.

By modifying the proportions of these high molecular weight monomers, a resin system with the properties of a sculptable bulk fill material was developed. The resin system also produces polymerization shrinkage stress relief and a depth of cure of 5 mm.

Fillers

The fillers included in Filtek™ Bulk Fill Posterior Restorative were designed to maximize strength, wear resistance and radiopacity while minimizing shrinkage and maintaining good handling. The filler system in Filtek Bulk Fill Posterior Restorative is the same system found in Filtek™ Supreme Ultra Universal Restorative, with the important addition of agglomerate 100 nm Ytterbium trifluoride (YbF_3) particles for increased radiopacity. The remaining fillers are a combination of a non-agglomerated/non-aggregated 20 nm silica filler, a non-agglomerated/non-aggregated 4 to 11 nm zirconia filler, an aggregated zirconia/silica cluster filler (comprised of 20 nm silica and 4 to 11 nm zirconia particles), making the total inorganic filler loading approximately 76.5% by weight (58.4% by volume).

Physical Properties

4mm Depth of Cure

Several methods are available for characterizing the extent of polymerization of light-cured dental composite filling materials. One is the "scrape-back" method, which is the basis of the depth-of-cure method described by ISO 4049:2009. In this ISO standard, the uncured composite is placed in a cylindrical-shaped stainless steel mold and light cured from one end of the mold. The composite is immediately extracted from the mold and the unpolymerized or low-polymerized composite is scraped off the end farthest from the light. The length of the remaining "cured" composite is measured and divided by a factor of 2. This length is typically rounded to the closest integer value and claimed as the depth of cure. This follows from the ISO 4049 specification, which allows a claimed depth of cure 0.5 mm greater than half the scrape-back measurement. It has been shown that the extent of polymerization throughout this length decreases from the end closest to the light (where light intensity was greatest) to the end where the uncured material was scraped off [4]. It was also shown in [4] that the extent of polymerization at half the scraped-back length is approximately 90% of the maximum polymerization.

Depth of cure for the indicated shades of Filtek™ Bulk Fill Posterior Restorative measured using the ISO 4049 standard and a 20-second cure with the Elipar™ S10 LED Curing Light using its 10 mm light guide are shown below (Table 1).

Shade	Avg. Depth (mm)	Std. Dev.
A1	4.56	0.09
A2	4.29	0.10
A3	4.40	0.06
B1	4.24	0.04
C2	4.39	0.06

Table 1. ISO 4049 Depth of Cure – Filtek™ Bulk Fill Posterior Restorative. 20s exposure, Elipar™ S10 LED Curing Light

Another common method for assessing extent of polymerization is microhardness testing, which has been shown to correlate with the extent of polymerization [5]. As in the ISO method, it is typical to place the uncured composite in some type of mold and light cure from one end of the mold. This sample is then extracted and the hardness is measured along its length. Rather than reporting the actual hardness value measured, it is more meaningful to represent the hardness at any given point within the sample as a percentage of the maximum hardness attained. It has been shown with a variety of different composites that 80% of the maximum hardness was associated with 90% of the maximum polymerization [6].

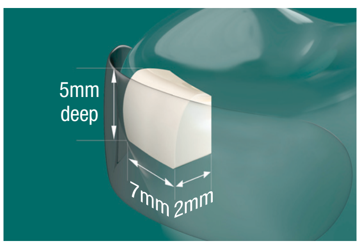
The clinical significance of both tests as described above is not known. In other words, the extent of polymerization that is needed for a durable restoration has not been determined. Some investigators have suggested 80% of maximum microhardness (equivalent to half the scraped-back length as defined by the ISO standard) as a minimum threshold [4,5]. This recommended threshold, however, is not based on clinical studies or laboratory models involving extracted teeth. Recent laboratory studies involving extracted human teeth have suggested a lower limit of polymerization at 73% of maximum microhardness or 80% of maximum polymerization [6].

5mm Depth of Cure
(ex vivo tooth model)

Oregon Health & Science University

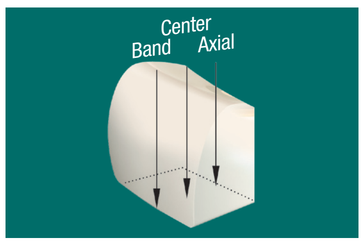
The depth of cure of Filtek™ Bulk Fill Posterior Restorative prototypes was investigated in Class II slot preparations in extracted molars at the Oregon Health & Science University. The experimental tooth was placed in a simulated arch between two adjacent teeth. The depth of the preparation was 5 mm to the gingival floor with a 3 or 7 mm width and 2 mm depth (Figure 6).

1.

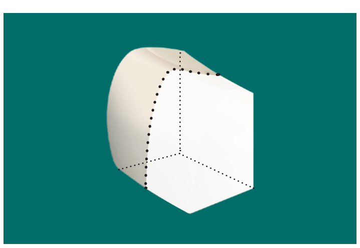


- Class II Slot Preparation in molar tooth not tapered
- Metal matrix

2. Extract restoration



3. Cut restoration through middle in the mesial-distal direction



4. Measure Knoop Microhardness
a) along band side, b) down middle, c) along axial side of tooth in 1 mm increments starting 0.1 mm from top and 0.5 mm within the band and tooth side surfaces.

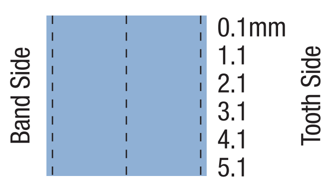


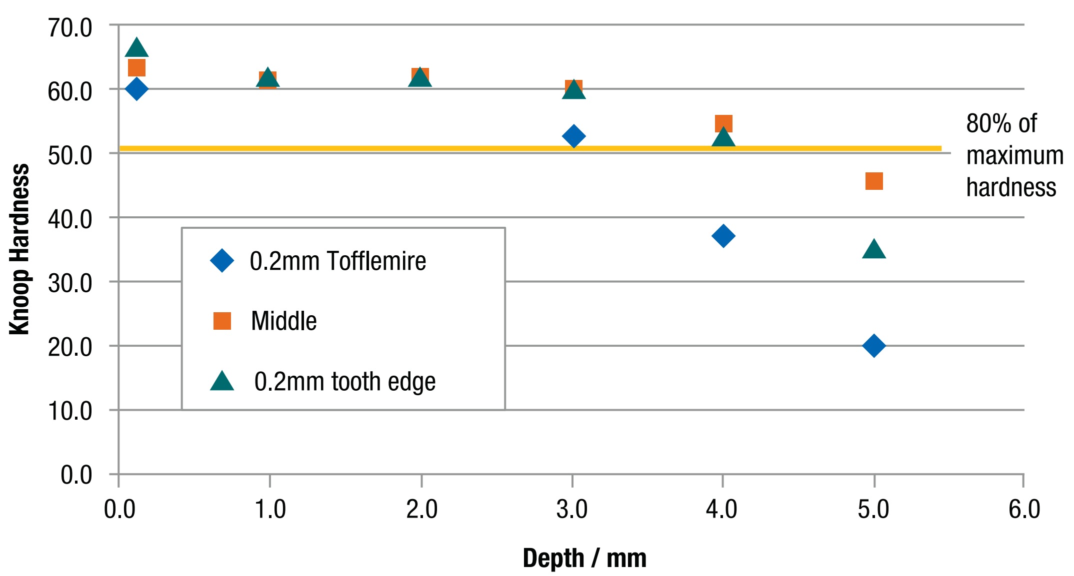
Figure 6:
Source: Oregon Health & Science University

Prior to placement, the preparation was lightly coated with petroleum jelly to facilitate extraction of the restoration. A circumferential metal Tofflemire matrix was applied and the composite was placed in one 5 mm increment and light cured either with a single or a multi-sited exposure with an Elipar™ S10 LED Curing Light. The curing lamp was measured to have an output of 1,000mW/cm^2. After curing, the restorations were recovered and sectioned mesiodistally. Microhardness was then measured at three locations down the length of the restorations—1) 0.2 mm within the composite adjacent to the matrix band, 2) down through the center of the restoration, and 3) 0.2 mm within the composite adjacent to the axial face of the preparation (Figure 7). Three pastes differing in opacity were investigated. The results obtained with the paste with the highest opacity, which most resembles the final prototype, are presented below. Twelve replicates were run for each exposure condition.

Figure 7 reveals a spatial dependence of cure at the deepest (5.1 mm) portion of the restoration with the hardness adjacent to the metal matrix band exhibiting the lowest value. It is also apparent that the hardness does not meet the 80% threshold at any of the locations measured at this depth. At 4.1 mm depth, the interfacial hardness adjacent to the tooth is comparable to that at the middle of the restoration, while the hardness adjacent to the matrix band is suppressed below the 80% threshold. While the curing conditions are not sufficient to meet the threshold cure throughout the Class II restoration at a depth of 4 mm, the results support a sufficient exposure for a 4 mm depth of cure in a Class I restoration where, based on these results, the extent of cure at the tooth-composite interface and down the middle of the restoration are similar.

Figure 7: Hardness versus depth. 20-second occlusal cure, 1000mWcm^{-2}, ***7 mm diameter-*** *wide restoration*

Source: Oregon Health & Science University



An alternative, multi-sited curing protocol has been shown to be effective for bulk light-cured composite materials in Class II restorations made in extracted human teeth [10]. In this investigation, the restoration was first exposed with the light from the occlusal surface followed by subsequent exposures from the buccal and lingual surfaces. This multi-sited approach was shown to be effective in obtaining a 5 mm depth of cure in the Class II restoration using the prototype composite as shown in Figure 8. In this case, the protocol included a 10-second occlusal cure and an additional 10-second cure from both the mesio-buccal and linguo-buccal directions after removing the matrix band. Since the attenuation of light through tooth mineral is likely greater than that through the prototype composite (Figure 8), the multi-sited cure technique was duplicated for a 3 mm diameter-wide restoration, thereby creating a greater curing challenge. The results are depicted in Figure 9. In both cases, the multi-sited curing technique was effective in achieving the threshold of 80% maximum hardness.

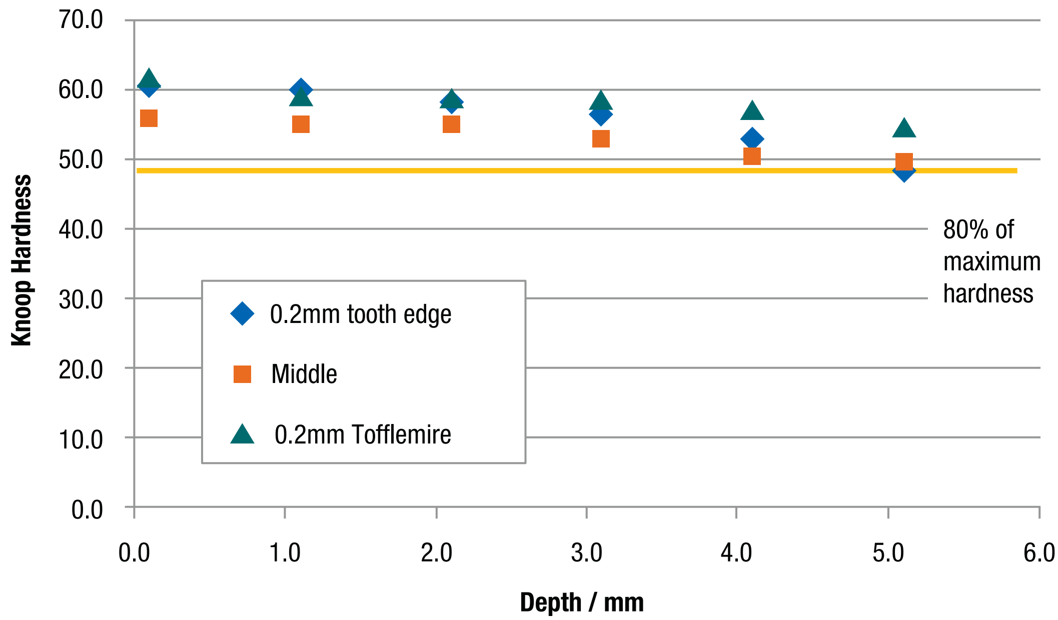


Figure 8: Hardness versus depth. 10s occlusal/ 10s mesio-buccal/ 10s linguo-buccal, ***7 mm diameter*** *restoration, 1000mWcm*$^{-2}$

Source: Oregon Health & Science University

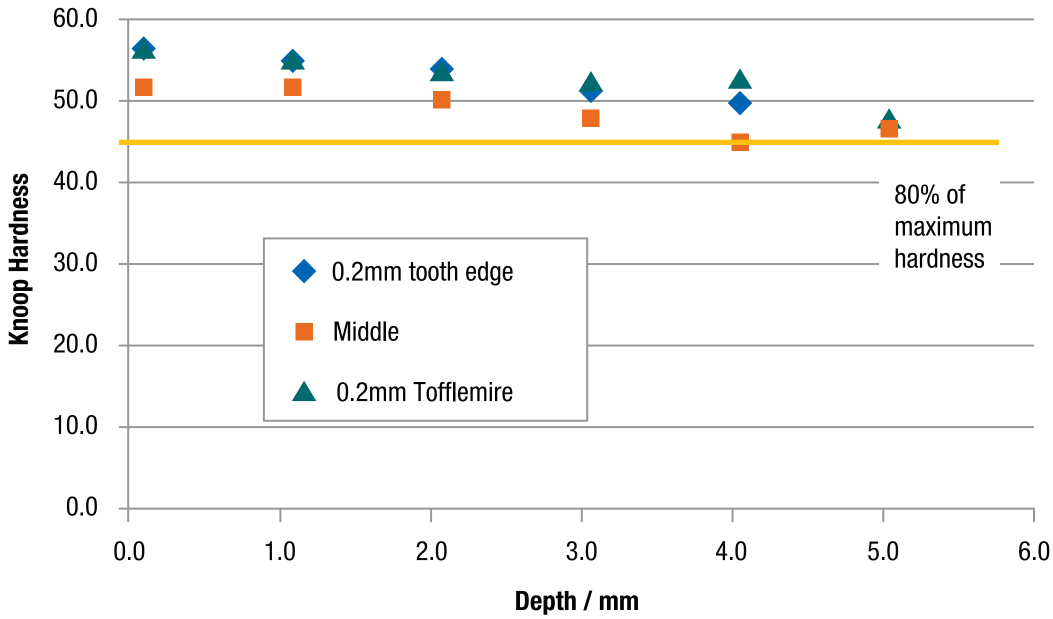


Figure 9: Hardness versus depth. 10s occlusal/ 10s mesio-buccal/ 10s linguo-buccal, ***3 mm diameter*** *restoration, 1000mWcm*$^{-2}$

Source: Oregon Health & Science University

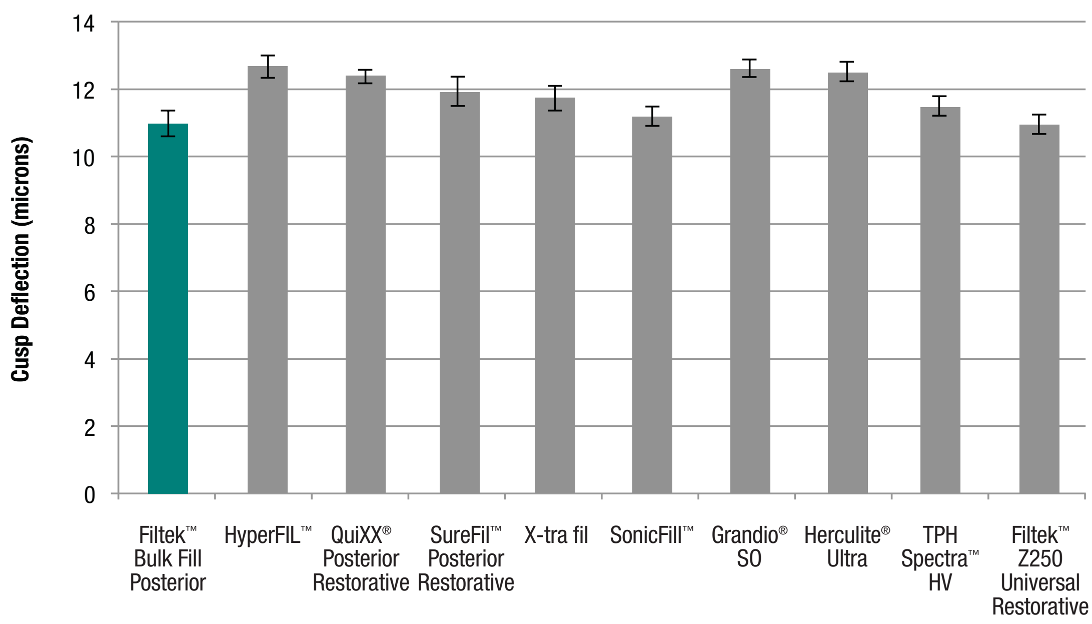
Shrinkage Stress

Cusp Deflection

Shrinkage can cause stress in the tooth, the bonding layer and within the composite. Stress can be a result of the combination of shrinkage and modulus. For materials with similar shrinkage, the material with the higher modulus (or stiffness) will produce greater stress. Conversely, for materials with similar modulii, the material that exhibits the highest shrinkage will produce greater stress. Cusp deflection is a 3M test method that was designed to provide a relative estimate of polymerization shrinkage stress resulting from placing and curing a dental composite in a 4x4 mm open-ended cavity. The cavity dimension roughly simulates a large cavity preparation (e.g., mesial – occlusal – distal (MOD) preparation). The surface of the aluminum cavity is sandblasted, silane treated and a dental adhesive is applied. A composite is then placed in the aluminum cavity to a final depth of 4 mm, either incrementally or bulk filled, and cured with a dental curing light (e.g., one 4 mm deep application of bulk fill composite or two 2 mm deep increments of incremental composite, each placed and light cured). A linear variable displacement transducer is used to measure the displacement of the aluminum cavity wall due to polymerization shrinkage stress. Aluminum was selected as the block material because it has a modulus similar to human enamel. A similar cusp deflection method using an aluminum block has been described in the literature.[4]

Figure 10: Cusp Deflection of common bulk fill and incrementally placed composites

Source: 3M internal data



[4]Park J, Chang J, Ferracane J, Lee IB: How should composite be layered to reduce shrinkage stress: Incremental or bulk filling? Dental Materials 2008; 24:501-1505.

Flexural Modulus

Flexural modulus is a method of defining a material's stiffness. A high modulus indicates a rigid material. The flexural modulus is measured by applying a load to a material specimen that is supported at each end. A low flexural modulus can aid in reducing stress generated during cure.

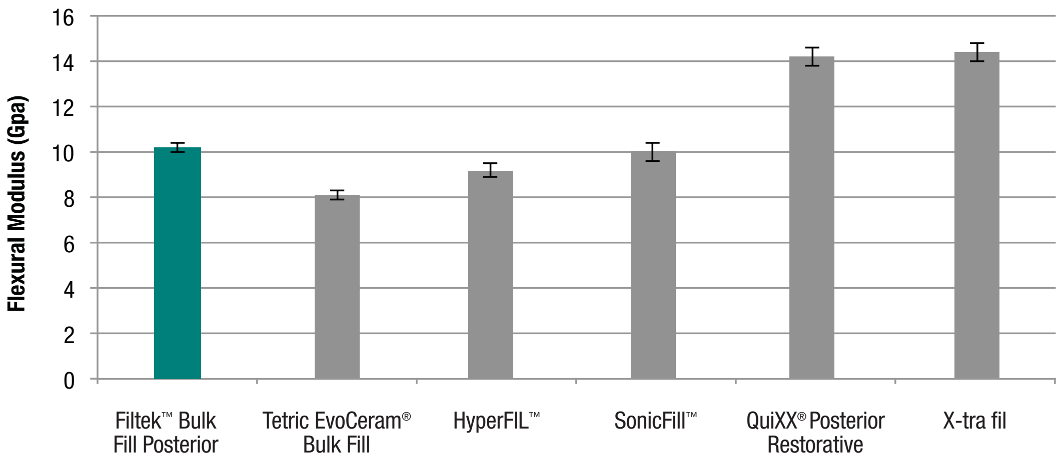


Figure 11: Flexural modulus of ***common bulk fill*** *composites*

Source: 3M internal data

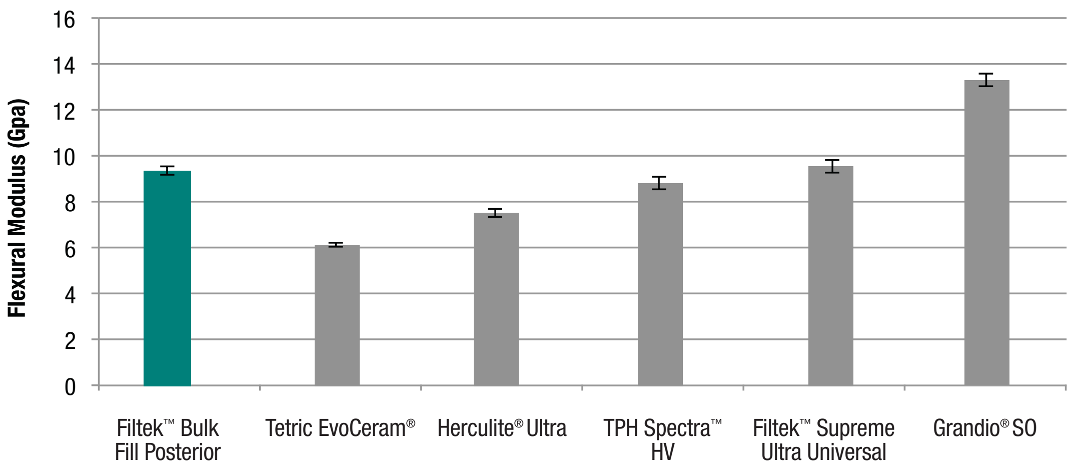


Figure 12: Flexural modulus of ***common incrementally placed*** *composites*

Source: 3M internal data

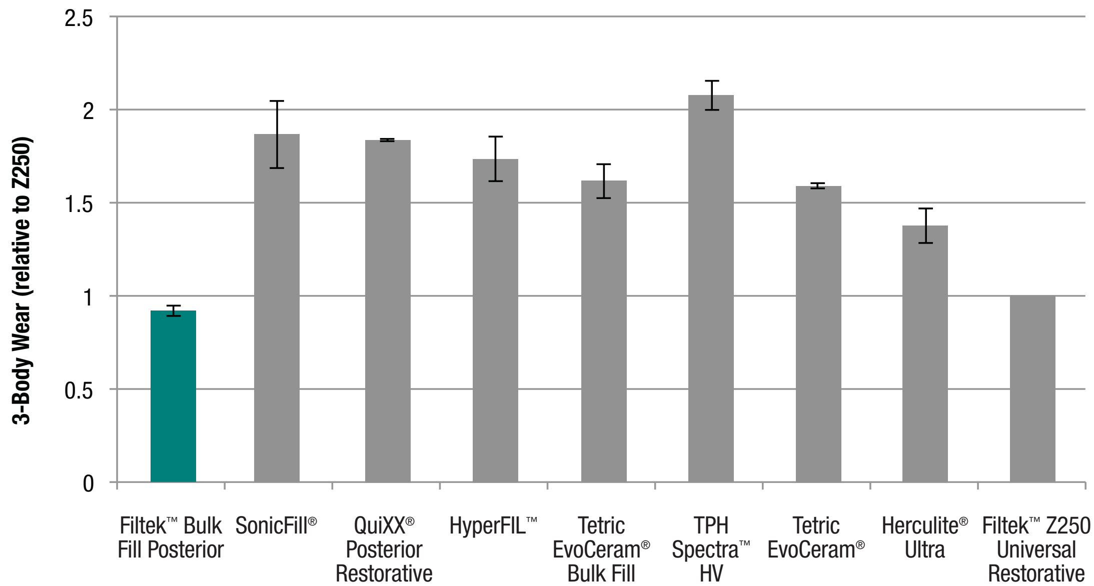
In-vitro, 3-Body Wear

The wear rate was determined using an in-vitro 3-body wear test. In this test, composite (1st body) is loaded onto a wheel, which contacts another wheel, which acts as an "antagonistic cusp" (2nd body). The two wheels counterrotate against one another dragging abrasive slurry (3rd body) between them. Dimensional loss is determined by profilometry at the end of 200,000 cycles. In tests where wear is monitored at regular intervals, it is found to be linear. Consequently, wear rates can be predictive beyond the length of the actual test.

The 3-body wear of Filtek™ Bulk Fill Posterior Restorative is significantly less than a number of bulk fill and incrementally placed composites, including SonicFill and Tetric EvoCeram Bulk Fill (Figure 13).

*Figure 13: 3-body wear of **common bulk fill and incrementally placed** composites*

Source: Oregon Health & Science University



Polish Retention

Toothbrush Abrasion

Composite materials were shaped into tiles and thoroughly cured. The surfaces were polished wet using a Buehler variable-speed grinder-polisher to remove the air-inhibited layer and to ensure a uniform surface. They were stored in water at 37ºC for 24 hours. Gloss was measured. The samples were brushed with toothpaste and a toothbrush that was mounted on an Automatic Toothbrush Machine. Gloss measurements were taken after 500 cycles and then every 1000 cycles. The test was terminated after 6000 toothbrush strokes.

The polish retention of Filtek Bulk Fill Posterior Restorative is significantly higher than a number of bulk fill composites, including SonicFill and Tetric EvoCeram Bulk Fill (Figure 14), and significantly higher than a number of incrementally placed composites, including Herculite Ultra and TPH Spectra HV (Figure 15).

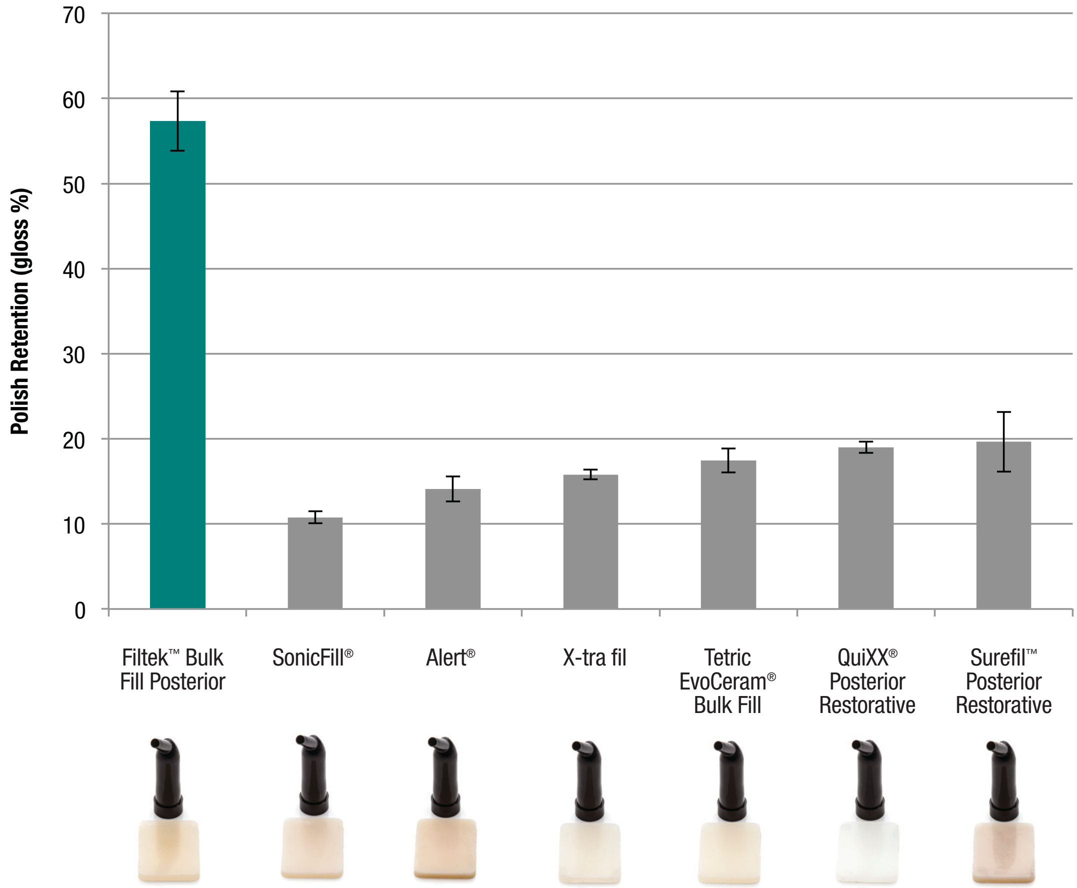


Figure 14: Polish retention of common bulk fill composites

Source: 3M internal data

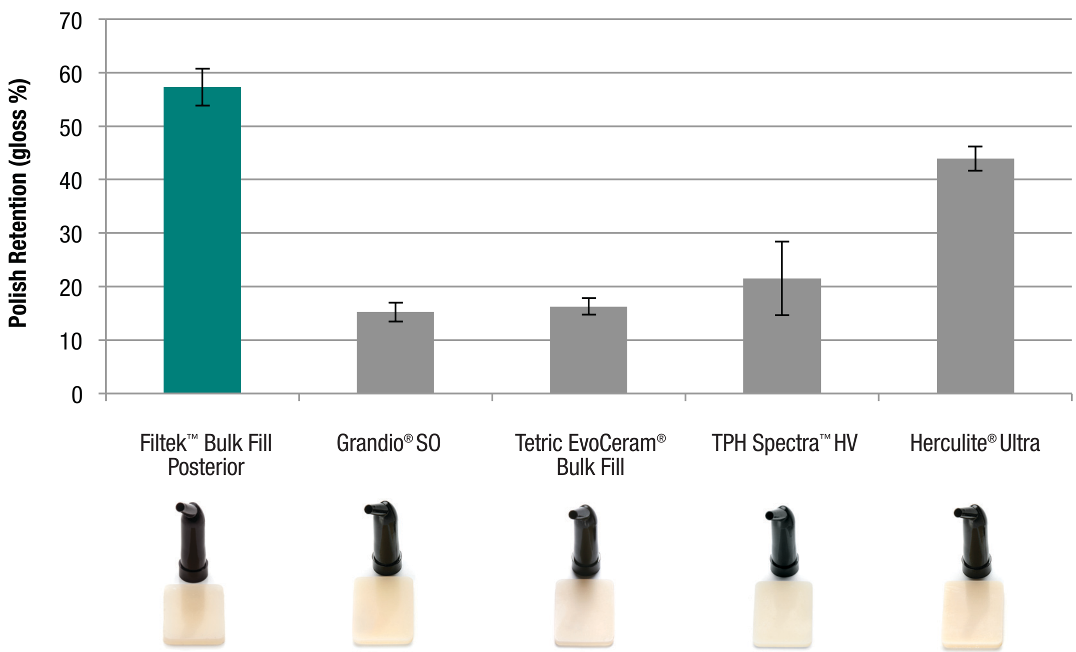


Figure 15: Polish retention of common incrementally placed composites

Source: 3M internal data

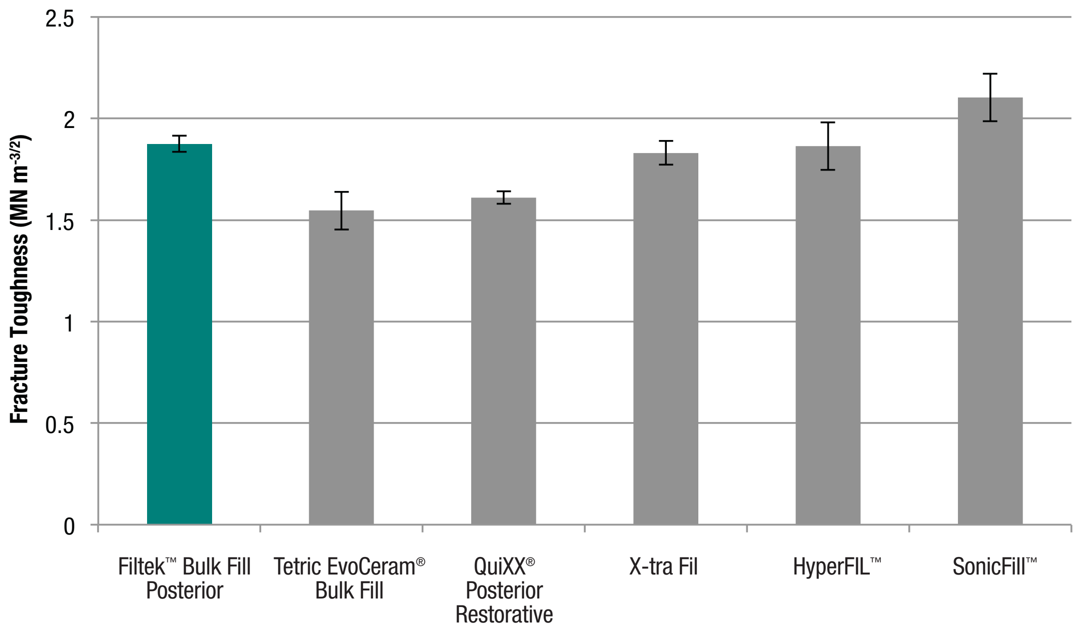
Fracture Toughness

The values reported for fracture toughness (K1c) are related to the energy required to propagate a crack. In this test, a short bar of material is cured. A notch is cut into it. The bar is placed on a fixture that supports either end and an anvil is positioned above the notch. The anvil presses down until the bar breaks.

The fracture toughness of Filtek™ Bulk Fill Posterior Restorative is higher than Tetric EvoCeram Bulk Fill and QuiXX Posterior Restorative (Figure 16).

Figure 16: Fracture toughness of common bulk fill composites

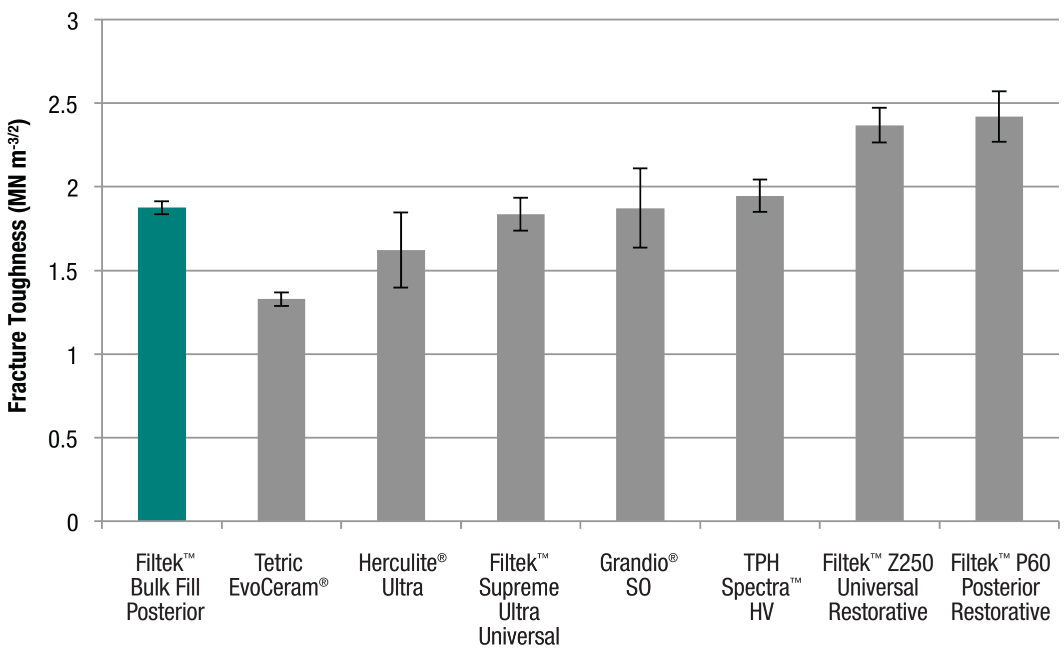
Source: 3M internal data



The fracture toughness of Filtek Bulk Fill Posterior Restorative is higher than Tetric EvoCeram and Herculite Ultra (Figure 17).

Figure 17: Fracture toughness of common incrementally placed composites

Source: 3M internal data



Flexural Strength and Compressive Strength

Flexural strength is determined in the same test as flexural modulus. Flexural strength is the value obtained when the sample breaks. This test combines the forces found in compression and tension. Compressive strength is particularly important because of chewing forces. Rods are made of the material and simultaneous forces are applied to the opposite ends of the sample length. The sample failure is a result of shear and tensile forces.

The flexural strength of Filtek™ Bulk Fill Posterior Restorative is higher than Tetric EvoCeram Bulk Fill and QuiXX Posterior Restorative and similar to other common bulk fill composites (Figure 18).

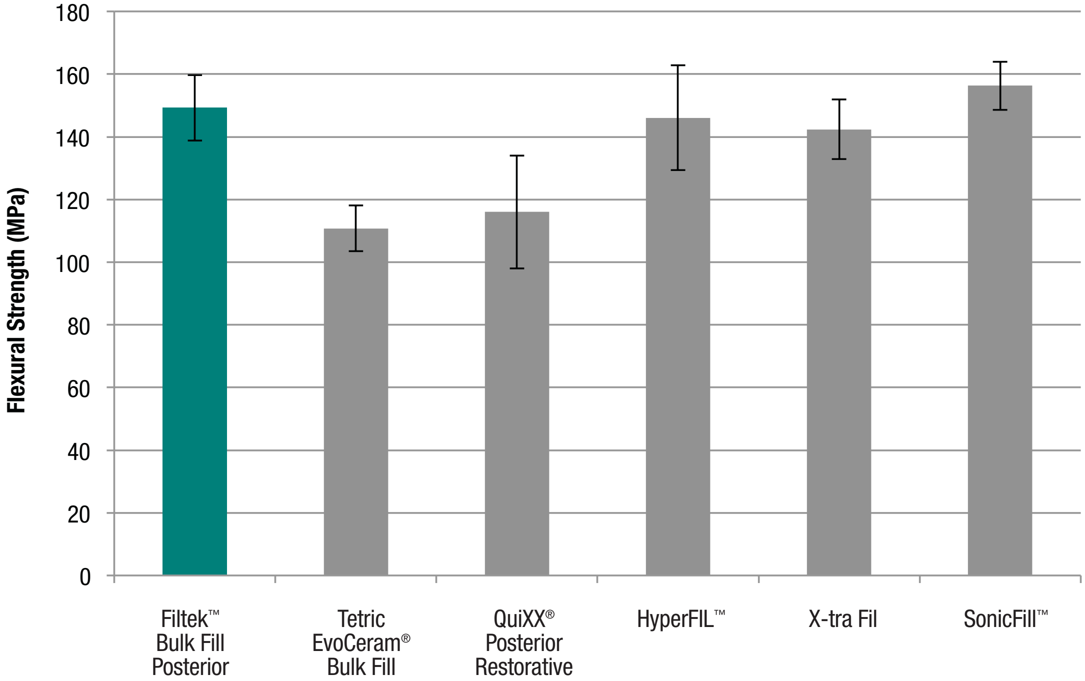


Figure 18: Flexural strength of ***common bulk fill*** *composites*

Source: 3M internal data

The flexural strength of Filtek Bulk Fill Posterior Restorative is higher than Tetric EvoCeram and Herculite Ultra and similar to other common incrementally placed composites (Figure 19).

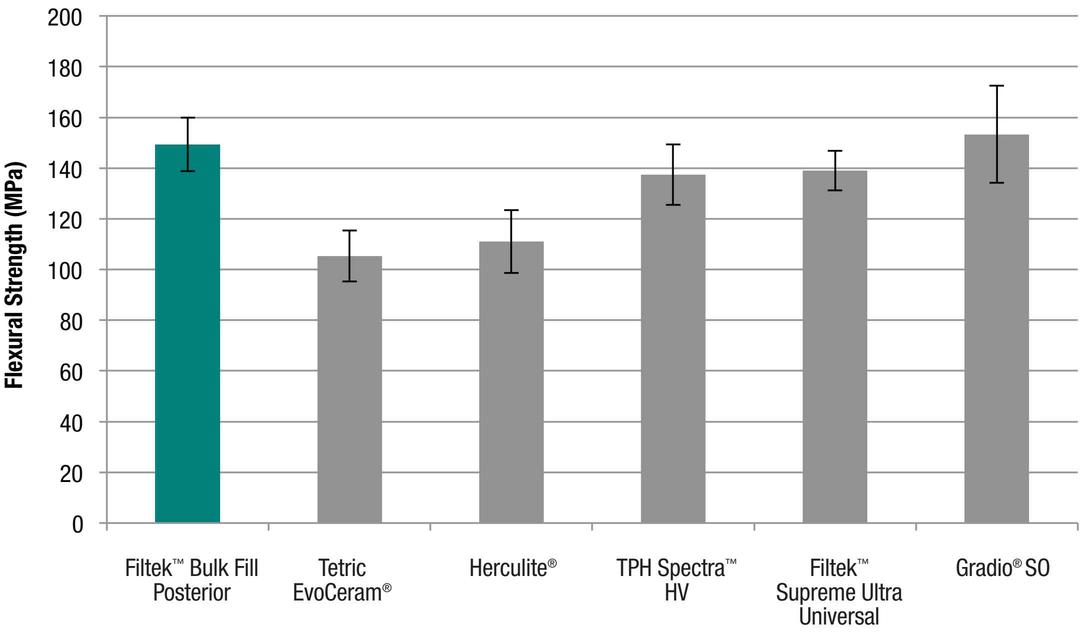
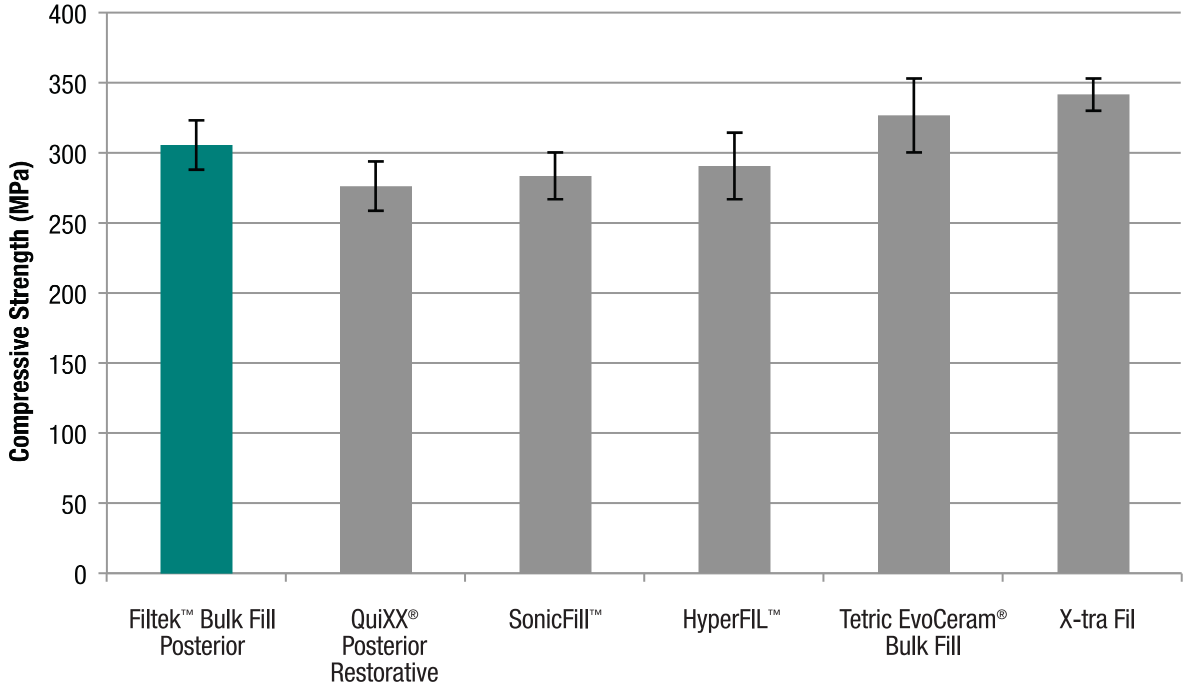


Figure 19: Flexural strength of common ***incrementally placed*** *composites*

Source: 3M internal data

Figure 20: Compressive strength of common bulk fill composites

Source: 3M internal data



Questions and Answers

What makes Filtek™ Bulk Fill Posterior Restorative unique?

The AFM monomer used in Filtek Bulk Fill Posterior Restorative allows dentists to place one-step restorations without compromising wear resistance or stress relief. This, in addition to its excellent handling, makes Filtek Bulk Fill Posterior Restorative a truly a unique restorative material.

What is the benefit of Filtek Bulk Fill Posterior Restorative vs. incrementally placed composites?

The greatest benefit is fast and easy one-step placement. You can restore a 5 mm deep Class II preparation significantly faster than placing and curing in increments.

How is Filtek Bulk Fill Posterior Restorative different than Filtek™ Bulk Fill Flowable Restorative?

The greatest difference is Filtek Bulk Fill Posterior Restorative has been designed as a stress-bearing restoration with strength properties similar to other universal and posterior composite restoratives. It can also be filled to the occlusal surface up to 5 mm. On the other hand, when Filtek Bulk Fill Flowable Restorative is used in a stress-bearing Class I or II restoration, a 2 mm minimum thickness of a traditional composite must be used on the occlusal surface.

What is the volumetric shrinkage of Filtek Bulk Fill Posterior Restorative?

The shrinkage of Filtek Bulk Fill Posterior Restorative is similar to Filtek™ Z250 and Filtek™ Supreme Ultra Universal Restoratives.

What's the difference between polymerization shrinkage and polymerization stress?

Polymerization shrinkage, when expressed as a volume, is simply the decrease in volume of the composite as it shrinks due to the curing process. Polymerization shrinkage stress is the stress created 1) in the bonding interface between the tooth and the shrinking composite, 2) in the tooth provided the adhesive does not fail, and 3) in the composite between the shrinking resin and the filler particles.

Why is polymerization shrinkage stress important?

Polymerization shrinkage stress can contribute to adhesive failure between the tooth and composite, which may result in post-operative sensitivity, marginal leakage and marginal discoloration. If the bond does not fail, polymerization stress may cause fracture of the enamel adjacent to the cavosurface, which may contribute to marginal ditching over time. Polymerization stress may also cause an inward deflection of the cusps in Class II restorations. Over time, composites have been observed to absorb sufficient water to compensate for some or most of this deflection.[10]

How do the new monomers help relieve polymerization stress?

Filtek™ Bulk Fill Posterior Restorative contains two novel methacrylate monomers that, in combination, act to lower polymerization stress. One monomer, a high molecular weight aromatic dimethacrylate (AUDMA) decreases the number of reactive groups in the resin. This helps to moderate the volumetric shrinkage as well as the stiffness of the developing and final polymer matrix—both of which contribute to the development of polymerization stress.

The second unique methacrylate represents a class of compounds called addition-fragmentation monomers (AFM). During polymerization, AFM reacts into the developing polymer as with any methacrylate, including the formation of cross-links between adjacent polymer chains. AFM contains a third reactive site that may cleave through a fragmentation process during polymerization. This process provides a mechanism for the relaxation of the developing network and subsequent stress relief. The fragments, however, still retain the capability to react with each other or with other reactive sites of the developing polymer. In this manner, stress relief is possible while maintaining the physical properties of the polymer.

Is this a nano-filled material? What is the filler?

The filler system uses the same nanofiller technology as Filtek Supreme Ultra restoratives–a combination of silane-treated nanoclusters and individual silane-treated nanosilica and nanozirconia. In addition, it contains nano-scale ytterbium trifluoride to impart improved radiopacity.

How does the radiopacity compare to our other composites?

Filtek Bulk Fill Posterior Restorative is one of our most radiopaque composites. We achieve this high level of radiopacity by incorporating nano ytterbium trifluoride.

Why is Filtek™ Bulk Fill Posterior Restorative described as a BPA-free dental material?

We've replaced the BisGMA monomer that is used in our other composites with a dimethacrylate that does not use Bisphenol A in its synthesis. This was done to maximize the stress relief during polymerization.

What adhesive should I use with Filtek Bulk Fill Posterior restorative?

All methacrylate-based dental adhesives are compatible with Filtek Bulk Fill Posterior Restorative.

How can I be assured of getting good cavity adaptation of Filtek Bulk Fill Posterior Restorative—especially in the proximal box?

Start dispensing in the deepest portion of the preparation, holding the tip close to the preparation surface. For proximal areas, hold the tip against the matrix to aid material flow into the proximal box. Withdraw the capsule tip slowly as the cavity is filled, and avoid lifting the tip out of dispensed material while dispensing to reduce voids. When dispensing has been completed, drag the capsule tip against the cavity wall while withdrawing from the operative field.

What is the curing protocol?

It depends upon the class of restoration and the intensity of your curing lamp. For Class II restorations that are 5 mm deep, we instruct curing for 10 sec from the occlusal surface followed by curing 10 sec each from the mesio- and/or distobuccal and lingual directions after having removed the matrix band. For a Class I restoration, which is not likely to be more than 4 mm deep, we instruct curing from the occlusal surface for 20 sec. These times are applicable for curing lamps with an intensity of 1000mWcm-2 or greater. For curing lamps with intensities less than 1000mWcm-2, we instruct that the cure times are doubled.

Caries Classification	Increment Depth	All halogen lights (with output of 550-1000mW/cm^2)	3M™ ESPE™ LED lights (with output 1000-2000mW/cm^2)
Classes I, III, IV and V	4 mm	40 sec	20 sec
Class II	5 mm	20 sec occlusal, 20 sec buccal, 20 sec lingual	10 sec occlusal, 10 sec buccal, 10 sec lingual

Note: For class II restorations, remove the matrix band prior to the buccal and lingual curing steps.

Yes, but how can I be sure that I'm getting a sufficient cure at 5 mm?

The three-sited curing technique that we recommend was based on in vitro studies carried out at the Oregon Health & Science University. We discovered in a 5 mm-deep Class II preparation that the cure adjacent to the metal matrix band was equivalent to the cure down the center of the restoration as well as the cure at the restoration-tooth interface when a three-sited curing technique was used. When the restoration was cured from the occlusal direction only, the cure adjacent to the metal matrix tended to be lower at deeper depths compared to the rest of the restoration. This tells us that there is less light available for polymerization adjacent to metal matrix bands at deeper depths within the restoration. A three-sited curing technique overcomes that limitation.

Does a 4 mm Class II restoration require the three-sited curing technique or can I cure it for 20 seconds as you described for a Class I?

To ensure sufficient cure throughout the restoration, we recommend the three-sited curing technique be used for 4 mm Class II restorations as well.

What are the indications for use?

Filtek™ Bulk Fill Posterior Restorative was designed to be durable in stress-bearing Class I and II restorations. The bulk fill capability also makes it appealing as a light-cured core build-up. In the Instructions for Use, it is noted that Filtek Bulk Fill Posterior Restorative can be used in Class III through V restorations. As Filtek Bulk Fill Posterior Restorative is semi-translucent, the esthetic outcome in anterior restorations will be affected by variables such as the location of the restoration and underlying tooth color. When esthetics are a primary outcome, we recommend using a Filtek™-branded universal restorative. See Instructions for Use for a complete list of indications.

What shades are offered and how do they compare to our other Filtek products?

There are five shades of Filtek Bulk Fill Posterior Restorative: A1, A2, and A3, B1 and C2. These are based on the Vitapan Classical Shade Guide, and hence are similar to the Filtek Supreme family of composites. Filtek Bulk Fill Posterior Restorative shades, however, are more translucent than all but the translucent shades of Filtek™ Supreme family to enable the bulk curing feature.

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