

Bulk Fill Composite-A Review¹Dr Dipak Vaghamshi, ²Dr Vineet Agrawal, ³Dr Sonali Kapoor

Corresponding Author: Dr Dipak Vaghamshi, Department of Conservative Dentistry, Endodontics & Aesthetic, Manubhai Patel Dental College & Oral Research Institute, Vadodara.

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Abstract

Resin-based composite (RBC) materials are increasingly being used for the restoration of anterior and posterior teeth. The increasing demand for anterior aesthetic restoration, tooth-coloured restorations coupled with the patient's concerns regarding the use of mercury containing restorations, has driven a surge in the use of RBC materials. The phase-out of dental amalgam and dental schools increasingly teaching techniques for RBC restorations in posterior teeth, it is likely that the dental profession's reliance upon RBC for the restoration of posterior teeth will only increase. In order to simplify and speed-up the placement of large posterior RBCs, manufacturers have produced a range of materials which can be placed in single or deeper increments, known as bulk-fill RBCs. Over a relatively short period of time many bulk-fill RBCs have been marketed quoting increment depths between 4-5 mm. The placement of these larger increments of RBC may reduce the time needed when placing posterior restorations and thereby reduce technique sensitivity. This article aims to review the properties and handling characteristics of the bulk-fill RBC materials currently available, while advising the optimal techniques of placement.

Keywords Bulk fill resin-based composites, Micro-mechanical properties, Depth of cure, bulk-fill resin composite, insertion techniques.

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⁽¹⁾ When restoring cavities, resin composites should be applied only to increments up to 2 mm thick to ensure adequate light transmittance and full polymerization of the material. Sufficient polymerization of resin composites is needed to achieve appropriate physical and mechanical properties and biocompatibility.⁽²⁾ Layering techniques for resin-based composites (RBCs) have been a central point in teaching direct restorations in dental schools in the past decades. The polymerization shrinkage of the matrix, combined with a limited adhesion force of adhesive systems to dental tissue, challenges the stability of a restoration.⁽³⁾ 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.⁽²⁾

In order to overcome the time consuming incremental cavity filling technique with conventional RBCs, bulk-fill RBCs have been developed. This newly developed kind of RBCs claim to allow the use of material increments up to 4 mm in thickness with low volumetric polymerization shrinkage and resulting low polymerization shrinkage stress.⁽⁴⁾

Classification Of Bulkfill (Table 1)⁽⁵⁾

Bulkfill Posterior Restorative

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.⁽⁶⁾



Figure 1: Bulk Fill Posterior Restorative

Table-1 :Classification Of Bulk Fill Composite

	Bulk-fill RBC	Bulk-fill base RBC	Sonic-activated bulk-fill RBC	Dual cure bulk-fill RBC
Materials	Bulk-fill Posterior Restoration Tetric EvoCeram Bulk-fill x-tra fill	Bulk-fill Flowable Venus Bulk-fill Tetric EvoFlow Bulk-fill SDR Bulk-fill x-tra base	SonicFill	Fill up HyperFill
Viscosity	High	Low	2-phase	Medium
Method of cure	Light	Light	Light	Dual
Maximum depth per increment	4mm	4mm	5mm	4mm
Need for conventional RBC capping layer	No	Yes	No	No

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.⁽⁶⁾

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 ESPE, which permanently bonds the restoration to the tooth structure. Filtek Bulk Fill Posterior Restorative is packaged in traditional syringes and single-dose capsules.^(3,6,7)

5mm Depth of Cure : 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.



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

The flexural strength of Filtek Bulk Fill Posterior Restorative is higher than Tetric EvoCeram Bulk Fill Posterior Restorative, and similar to other common bulk fill composites.⁽⁶⁾

Tetric Evoceram Bulkfill



Figure 2: Tetric Evoceram Bulkfill

Tetric EvoCeram Bulk Fill contains in its composition an inhibitor of sensitivity to light and thus provides

prolonged time formodeling of filling, an inhibitor of shrinkage stress in order to achieve optimal marginal seal, and Ivocerin, polymerization photoinitiator allowing curing of 4mm layers of material.(8)

Tetric EvoCeram Bulk Fill takes composite-technology to the next level. Based on the clinically reliable universal composite Tetric EvoCeram, Tetric EvoCeram Bulk Fill is a lightcured, nano-hybrid composite for direct restorations in posterior teeth, and may also be used for class V restorations and extended fissure sealing. Tetric EvoCeram Bulk Fill can be applied in “bulk” increments of up to 4 mm, it can be sculpted and may be polymerised in just 10 seconds (light source: >1000 mWcm²) without compromising the material’s physical properties. It can however also be polymerised with conventional LED curing lights. The possibility to cure 4 mm increments represents a paradigm shift in dentistry.(8,9)

Physical properties

Tetric EvoCeram Bulk Fill can be applied in increments of up to 4 mm. Clearly reducing polymerisation shrinkage is one of the most important issues here. Composite resins shrink during polymerisation which was the original rationale behind applying composites in 2 mm increments with successive polymerisation intervals.(9)

A special patented filler which is partially functionalised by silanes, acts as a unique shrinkage stress reliever.

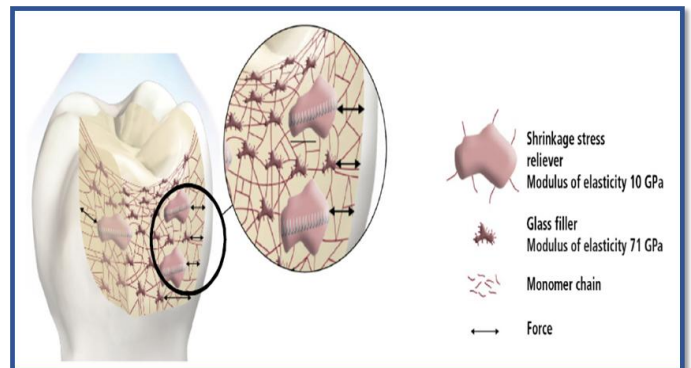


Figure 3: Schematic Representation Of The Shrinkage Stress Reliever In A Tetric Evoceram Bulk Fill

Restoration Acting Like A Spring And Reducing Stress Within The Restoration

Ivocerin And Light Absorption

The standard initiator system plus Ivocerin results in a material featuring an absorption maximum in the blue light range from around 370 to 460 nm.⁸ The initiator absorption spectra are depicted in figures.⁽⁹⁾

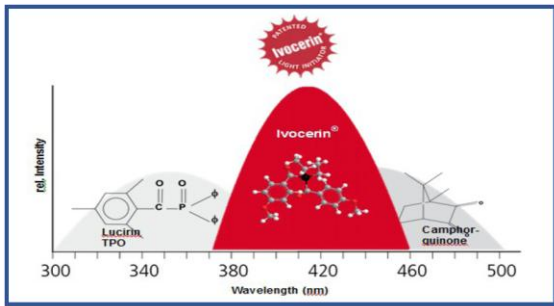


Figure 4 :Schematic Representation of The Absorption Spectra Of Lucirin TPO Camphorquinone And Ivocerin.

Ivocerin features a high absorption coefficient (higher than camphorquinone) allowing for increased quantum efficiency. The initiator is far more light-reactive than camphorquinone or Lucirin TPO, enabling the material to polymerise more rapidly and with a greater depth of cure. In this sense it acts as a polymerisation booster.

The polymerisation booster Ivocerin allows Tetric EvoCeram Bulk Fill to be set to an enamel-like translucency of 15%. This is sufficient, such that when exposed to the light of a high energy curing unit such as Bluephase Style, the restoration cures reliably. Whilst the number of photons that reach the cavity floor is significantly lower than the number that reach the surface, it is sufficient for Ivocerin to trigger polymerisation at a depth of 4 mm.^(8,9)

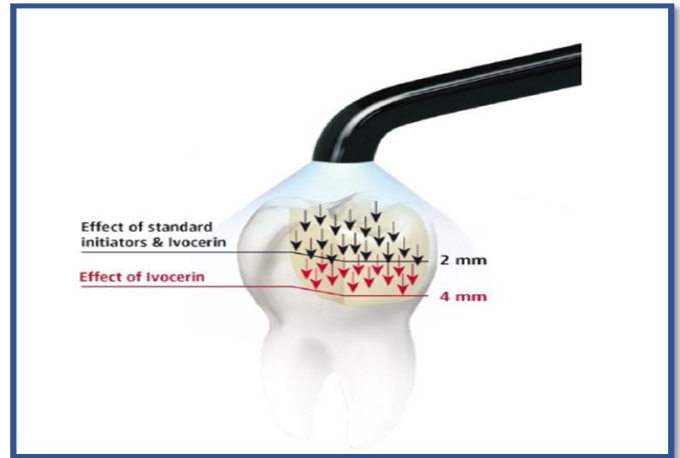


Figure 5 :Effect Of Ivocerin Polymerization Booster On Light Curing (10s > 1000 Mw/Cm2)

X-Tra Fil/X-Tra Base

X-tra fil is Packable bulk fill posterior composite, universal shade composite, that allows the clinician to cure 4mm layers in 10 seconds. It is the perfect match for patients with a limited budget where esthetics are secondary and your office time counts. Use with futurabond dc and you can complete a 4mm posterior restoration in less than 2 minutes. X-tra fil has a smooth and non-sticky consistency that does not slump. A high radiopacity of 330% al makes x-ray identification easy.⁽¹⁰⁾



Figure: 6 X-Tra Fil

X tra fill indicated in restorations class I and II in bulk-filling technique and core build-up.

X-tra base is a flowable, self-leveling base liner composite which allows increments of up to 4mm to be placed in a single step and light cured in only 10 seconds when using the Universal shade, its indicated in Lining (restoration base) for class I and II cavities, Cavity lining (base layer) for class I and II cavities. Low shrinkage stress and outstanding physical properties for long lasting posterior restorations. The X-tra base unit dose caps come with an extra long bendable needle tip. Bend them the way you need for your procedure. The x-tra base tip is 60% longer than the leading bulk fill flowable material, giving you easier access in hard to reach areas. X-tra base not only makes placement easier, it can also cut your procedure time in half. It saves you two increment layers. The x-tra base universal shade cures in only 10 seconds, which is half the setting time of other bulk fill flowable composites.(10,11)



Figure: 7 X-Tra Bases

Venus Bulk Fill

The latest version of flowable composites for simplifying the restorative procedure is the bulk-filling posterior flowable. Surefil SDR Flow and Venus Bulk fill are intended to be placed and bulk-cured in one increment up to 4 mm.(12)

Venus Bulk Fill is an advanced posterior restorative solution that provides dentists with a faster, easier technique than incremental layering. Ideal for use as a

base in class I and II direct restorations (up to 4 mm) or as a cavity lining under direct restorative materials in class I and II. The result – a reduction in chair time, and a more efficient and cost effective restoration.(13)



Figure 8: Venus Bulk Fill

What makes Venus Bulk Fill so efficient?

Easy placement technique in 4 mm increments, no longer a need to fill with several 2 mm layers

Self-adapting handling allows for ideal cavity adaptation eliminating steps prior to final cure., Compatibility with all methacrylate based bonding adhesives and composites, Simple dispensing and placement via a convenient Pre-Loaded Tip (PLT) or a non-dripping syringe.(12,13)

Sonic Fill

SonicFill composite system is the only sonic-activated, single-step bulk fill product that does not require a final capping layer. Now you can go from placement to a polished restoration in less than 3 minutes on cavities up to 5mm(14).

The system consists of a handpiece manufactured by KaVo (Germany), activated sonically and attached to the high-speed multiflex connection. A special composite Unidose manufactured by Kerr Corporation (USA) is screwed on the handpiece. Upon activation with the foot switch, the sonic energy lowers the viscosity and extrudes the composite that has initially a thick consistency. The composite contains about 83.5% of fillers by weight,

mainly silica and barium aluminoborosilicate glass and is available in four shades (A1, A2, A3 and B1). The handpiece can be set on five different dispensing speeds for composite delivery; the most used are the 4 and 5.



Figure 9 :Sonicfill

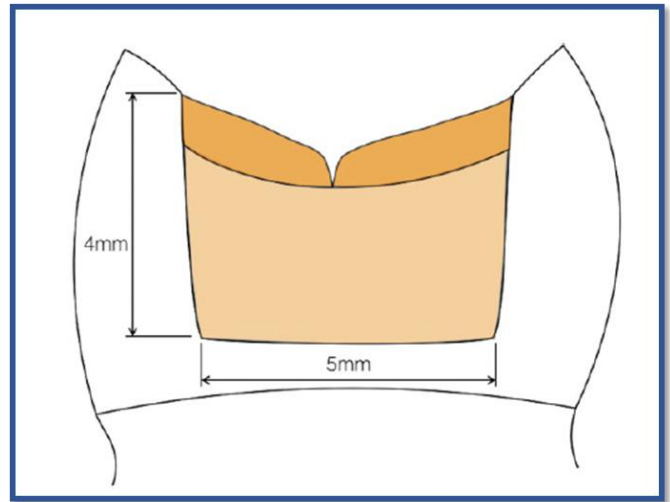
SonicFill system is indicated for posterior restorations in class I and II and as build up material for cusp reconstruction, as well as as a base after a root canal treatment. Its long handpiece allows an easy access in the molar area.(14)

Bulk Fill Restorative Technique

Bulk fill flowable and regular composite: two-step amalgam-like sculpting technique

Low shrinkage bulk fill composites can be used for the filling of posterior cavities, with a correct indication of cavities until 4 to 5 mm thickness.

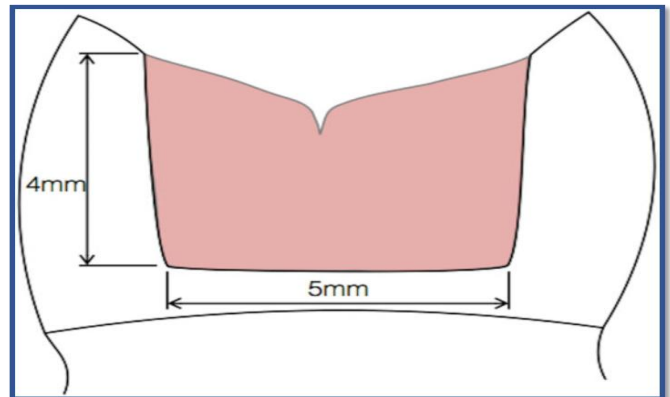
The technique here defined as “two-step amalgam-like sculpting technique” (Figure:10) refers to the use of a flowable bulk fill composite to build the core in one single layer of up to 4 mm thickness, leaving 1.2 mm of space from the margin for the last layer of a regular composite that will allow the final sculpture of the occlusal surface.(15)



Figures 10 :Two-Step Technique

Bulk Fill Regular Composite: One-Step Amalgam-Like Sculpting Technique

This technique refers to the use of a regular consistency bulk fill composite that itself provides enough consistency to allow sculpture and reconstruction of the entire restoration in one shot. This material can be accommodated in a single layer up to 4 mm thickness.(15)



Figures 11 :Single Layer Technique

Conclusion

Bulk-fill RBC materials provide tooth coloured restorations that can be more efficient and less technique sensitive to place than conventional RBCs. The mechanical properties, aesthetic result and placement technique varies significantly across the materials available. These materials may be particularly useful when restoring posterior cavities where procedural time is of

concern. This may include children and anxious patients where the length of treatment time is ideally kept short, but in the wider context of healthcare provision, if procedures can be made more efficient this will have a positive overall benefit providing the treatment is found to be predictable.

However, there is very little clinical (in vivo) research on the long-term outcomes of these materials and so caution is needed as to their efficacy.

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