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Bulk Fill Composite

A project

Submitted to Collage of Dentistry, University of Baghdad. Department of Conservative in fulfillment for the requirement to award the degree B.D.S

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1.1 Introduction

Composite resin is the material with the broadest application in restorative dentistry due to its optic and physic properties being very similar to the natural dental tissue, in order to re-establish dental function, form and aesthetic [1,2]. The material presents as its principal characteristic adhesion to the dental structure, avoiding further damage to the dental tissue, however, it presents as disadvantages a strong polymerization contraction stress, with risk of causing marginal gap and staining, microinfiltration, post-procedure sensibility, secondary caries and cusp fracture, characterising a bad prognostic. With that in mind, the technology industry developed bulk-fill low-polymerization contraction resins, which permit the insertion of larger quantities of resins and a shorter photopolymerization time. There is an expressive growth on the number of studies regarding this issue in the last five years. [3-6]

bulk fill composite

bulk fill composite are a new class of material with scientific evidence for claims of low polymerization shrinkage and 4 mm depths of cure. the appearance ,handling,and mechanical properties of bulk fill composite vary between flowable and high viscosity materials. [3-6]

2.1 Classification of dental composites

2.1.1 According to filler types and particle size

Resin filler can be made of glasses or ceramics. Glass fillers are usually made of crystalline silica, silicone dioxide, lithium/barium-aluminium glass, and borosilicate glass containing zinc/strontium/lithium. Ceramic fillers are made of zirconia-silica, or zirconium oxide. (3)

Fillers can be further subdivided based on their particle size and shapes such as:

2.1.1.1Macrofilled filler

Macrofilled fillers have a particle size ranging from 5 - 10µm. They have good mechanical strength but poor wear resistance. Final restoration is difficult to polish adequately leaving rough surfaces, and therefore this type of resin is plaque retentive. (3)

2.1.1.2 Microfilled filler

Microfilled fillers are made of colloidal silica with a particle size of 0.4 µm. Resin with this type of filler is easier to polish compared to macrofilled. However, its mechanical properties are compromised as filler load is lower than in conventional (only 40-45% by weight). Therefore, it is contraindicated for load-bearing situations, and has poor wear resistance.(3)

2.1.1.3 Hybrid filler

Hybrid filler contains particles of various sizes with filler load of 75-85% by weight. It was designed to get the benefits of both macrofilled and microfilled fillers. Resins with hybrid filler have reduced thermal expansion and higher mechanical strength. However, it has higher polymerisation shrinkage due to a larger volume of dilutent monomer which controls viscosity of resin. (3)

2.1.1.4 Nanofilled filler

Nanofilled composite has a filler particle size of 20-70nm. Nanoparticles form nanocluster units and act as a single unit. They have high mechanical strength similar to hybrid material, high wear resistance, and are easily polished. However, nanofilled resins are difficult to adapt to the cavity margins due to high volume of filler. (3)

2.1.1.5 Bulk filler

Bulk filler is composed of non-agglomerated silica and zirconia particles. It has nanohybrid particles and filler load of 77% by weight. Designed to decrease clinical steps with possibility of light curing through 4-5mm incremental depth, and reduce stress within remaining tooth tissue. Unfortunately, it is not as strong in compression and has decreased wear resistance compared to conventional material (4).

2.1.2 According to Handling Characteristics

This classification divides resin composite into three broad categories based on their handling characteristics:

2.1.2.1 Universal:

advocated for general use, oldest subtype of resin composite

2.1.2.2 Flowable;

fluid consistency used for very small restorations

2.1.2.4 Packable:

stiffer, more viscous material used solely for posterior parts of the mouth

Manufacturers manipulate the handling characteristics by altering the constituents of the material. Generally, the stiffer materials (packable) exhibit a higher filler content whilst fluid materials (flowable) exhibit lower filler loading. (5)

3.1 Classification of bulk-fill RBCs

Bulk-fill RBC restorative materials can be categorized into high-viscosity or low-viscosity, light or dual cured.

Table 1 discusses some of these available materials, their maximum incremental depth and whether or not they require a conventional RBC capping layer.

All of the bulk-fill restorative materials can be capped with conventional RBC to improve their aesthetics or physical characteristics of the restoration; for some of the materials this is advised as essential in providing the restoration.

Table (1) classification of bulkfill resin based composites

Table 1 Classification of bulk-fill RBC restorative materials

	Bulk-fill RBC	Bulk-fill base RBC	Sonic-activated bulk-fill RBC	Dual cure bulk-fill RBC
Commercially available materials	3M ESPE - Filtek Bulk-Fill Posterior Restorative Ivoclar Vivadent- Tetric EvoCeram Bulk-Fill Voco - x-tra fil	Dentsply - SDR 3M ESPE - Filtek Bulk-Fill Flowable Heraeus Kulzer - Venus Bulk-Fill Ivoclar Vivadent - Tetric EvoFlow Bulk-Fill Voco - x-tra base	Kerr - SonicFill 2	Coltene - Fill Up Parkell – HyperFil
Viscosity	High	Low	2-phase	Medium
Method of cure	Light	Light	Light	Dual
Maximum depth per increment	4 mm	4 mm*	5 mm	Any depth
Need for conventional RBC capping layer	No	Yes	No	No

3.1.1 Bulk-fill RBC

Bulk-fill RBCs are designed to be placed in deeper increments (3 mm+) than conventional RBCs (2 mm maximum). Bulk-fill RBC materials can be used more efficiently to restore large cavities with RBC such as that following completion of root canal treatment.

3.1.2 Bulk-fill base RBC

The low viscosity, light-cured flowable materials have been termed bulk-fill bases as they always require a conventional layer of RBC to cap the restoration due to reduced wear resistance and hardness properties (6).

Bulk-fill base RBC can be used along with a conventional RBC to efficiently restore large cavities.

3.1.3 Sonic-activated bulk-fill RBC

Kerr have produced Sonic Fill 2, a high viscosity bulk-fill resin RBC which becomes low viscosity with the use of sonic vibration (allowing the material to flow into the cavity).

Figure (1): handpiece of Sonic-activated bulk-fill RBC

The manufacturers claim that material contains a highly filled composite resin, combined with modifiers that are activated by sonic energy produced by a specially designated handpiece to reduce the viscosity of the material during placement. It can therefore be applied into the cavity as a flowable RBC before returning to a more viscous state that can be carved or moulded.

High viscosity bulk-fill restorative material can be used to efficiently restore large access cavities with RBC following completion of root canal treatment. The flowable properties resulting from sonic vibrations may lead to close adaption of the material to the cavity walls, however, care must be taken to prevent the creation of ledges and overhangs. This can easily be smoothed and polished after occlusal adjustment.**(** 13**)**

3.1.4 Dual cure bulk-fill RBC

Two dual cure bulk-fill RBCs have also come onto the market. These aim to combine both chemical and light-cure technology to enable the surface of restorations to be light-cured for polishing, while the full depth of the restoration will be chemically-cured over time.

The surface of Fill-up (Coltene) can be light-cured, polished and finished. Fill-up can be used with Parabond (Coltene) or One Coat (7) Universal with One Coat Activator (Coltene). Meanwhile the full depth of the restoration will be chemically cured within three minutes and can be suitable for bulk-filling cavities of any depth (10 mm+) in a single increment.(8)

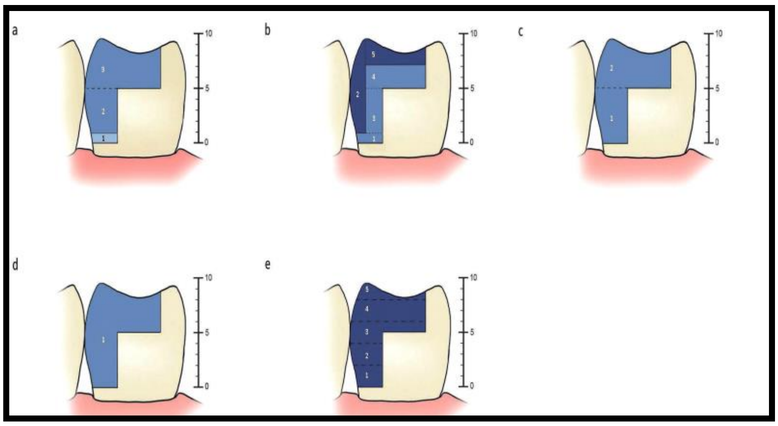

Figure. (2a) Application of a bulk-fill RBC in 4 mm layers with an optional conventional flowable RBC liner that is, 3M ESPE - Filtek Bulk-Fill Posterior Restorative; Ivoclar Vivadent- Tetric EvoCeram Bulk-Fill; Voco - xtra fil. b) Application of a bulk-fill base RBC in 4 mm layers with a marginal ridge and occlusal capping layer of conventional RBC. Note that a 1 mm seal is shown at the base of the cavity with the bulk-fill base RBC that is, Dentsply - SDR; 3M ESPE - Filtek Bulk-Fill Flowable; Heraeus Kulzer - Venus Bulk-Fill; Ivoclar Vivadent - Tetric EvoFlow Bulk-Fill; Voco - xtra base. c) Application of a sonic activated bulk-fill RBC in 5 mm layers that is, Kerr - SonicFill 2. d) Application of a dual cure bulk-fill RBC in a single increment layer that is, Coltene - Fill Up; Parkell – HyperFil. As these RBCs typically have inferior aesthetics a capping layer of conventional RBC can be incorporated to improve these attributes. e) Application of conventional RBC in 2 mm increments that is, Kerr - Herculite XR

3.2 Mechanical properties of bulkfill RBC

3.2.1Depth of cure

It is widely accepted that conventional RBC restorations should be placed and cured in 2 mm increments to allow adequate conversion of the unpolymerized RBC resin.(9) The real depth of cure achieved for a given material can *vary with the shade and translucency*; darker shades with greater opacity actually have a shallower depth of cure compared to lighter more translucent resins.

The majority of bulk-fill materials on the market are purely light-cured, although some are dual-cure. Manufacturers have attempted to increase the depth of cure by a variety of methods including:

- Reducing the filler content (10)
- Increasing filler particle size (10)
- The use of additional photo-initiators. (11,12)

Reducing the filler content and increasing the filler size within RBC reduces the amount of scatter at the resin-filler interface and increases the amount of absorbed light that can activate the photo-initiator.

Tetric EvoCeram Bulk-fill increases the depth of cure by using several different photo-initiators. (11,12) The manufacturers claim that it is the addition of a highly reactive photo-initiator, named **Ivocerin** that allows it to be polymerized in larger increments, when compared to standard photo-initiators such as, camphorquinone or lucririn. (11,12)

Despite these changes, however, the majority of these light-cured bulk-fill materials are still limited to being used in increments of 4–5 mm. It is important to note that some of the manufacturers light-curing claims are based on high intensity LED light-curing units. Some companies recommend a minimum light-curing light intensity which may be higher than many existing units.

Another factor to consider is the drop in intensity when the distance from the light tip is increased.

One study found that increasing the distance from the light-cure tip to the RBC restoration surface, decreased light intensity by ***10%*** for every 1 mm. While it has been found that when curing through 2 mm of RBC the intensity can be reduced to ***6%*** of its initial intensity. (13)

It is for this reason that the authors advise caution when attempting to cure increments of 4 mm or more. An assessment of the direct access, distance of the light tip from the base of the cavity and the intensity of the light-curing unit should be considered when deciding suitable curing times for each individual case (14).

In addition, the effectiveness of light-cure units within general practice has often been found to be inadequate with up to ***50%*** of units not reaching minimum irradiation levels (300 mW/cm2). (15) Therefore, it is recommended that light-curing units are regularly maintained and assessed for their power output.(16)

There is mixed evidence regarding the manufacturers light-cure times. Some studies have suggested that recommended light-cure times for bulk-fill materials cannot be advocated, with longer curing times being required (17).

One *in vitro* study identified that some of the available bulk-fill base RBCs had significantly lower depths of cure than those claimed by the manufacturer (18).

However, most recent studies support the manufacturer's claims, that with optimal curing conditions the RBC can achieve an adequate hardness at the increased depths. (19-21). If the increment depth is too large uncured resin may remain at the base, which may result in post-operative sensitivity, marginal leakage, caries and mechanical failure of the restoration. The advent of dual-cured RBC materials is an exciting innovation, as it negates concerns over depth of cure, whilst retaining the desirable properties of RBC restorations.

3.2.2 Polymerization shrinkage

Incremental placement of purely light-cured RBC is recommended to reduce the effect of polymerisation shrinkage that occurs on curing (22).

When the unpolymerised RBC resin touches more than one wall of the cavity preparation it increases the c-factor (23).

This shrinkage stress can lead to failure of the restoration at the weakest interface which is between the tooth and restorative material (23) .

This in turn can result in a number of potential problems including secondary caries, marginal staining, tooth fracture, and post-operative sensitivity. The manufacturers of bulk-fill materials claim lower polymerization stresses than conventional RBCs when placed in greater increment thickness.

Overall, the bulk-fill materials have been shown to have similar volumetric shrinkage to conventional RBC controls, which may suggest there is no overall benefit to using these materials (18).

However, when looking at the shrinkage stress specifically, in vitro studies have shown bulk-fill materials exhibit less shrinkage stress than conventional RBCs (21).

This suggests that while the bulk-fill materials shrink, this is not necessarily to the detriment of the marginal integrity. Manufacturers have altered the shrinkage stress effect in a number of ways including inclusion of shrinkage stress relievers which have a lower elastic modulus (24).

SDR has included a polymerization modulator which interacts with the camphorquinone photo initiator to result in a slower elasticity modulus development (25).

3.2.3 Marginal gap formation

When looking at marginal gap formation and adaptation, studies are not conclusive. Some have shown no statistical difference between a number of bulk-fill materials compared to conventional RBC, (26) whereas some literature suggests there is an improvement of the marginal seal with bulk-fill materials compared with conventional layering (27).

A further study has found that the higher viscosity bulk-fill RBCs result in greater marginal gap formation (28).

One method to overcome this problem with high-viscosity materials is heating them prior to placement and/or using a low viscosity RBC material to seal the base of the cavity. Dual cure bulk-fill RBCs have also shown acceptable marginal adaption post curing (29) .

Gap-free interfaces have been reported to be lower with increasing depths of preparation as would be expected.35,39 However, when comparing the same preparation depths with conventional RBC against bulk-fill materials no differences were found (26,30).

This suggests that it is the cavity depth which is a more important factor than the type of RBC material with regards to interface gap formation. Overall, the evidence is reassuring for the marginal adaptation of these new materials.

3.2.4 Physical and aesthetic properties

In the development of conventional RBCs, manufacturers have continually sought to increase the filler content of their products in order to improve the materials' mechanical properties. However, this is not the case in many bulk-fill materials, which tend to have lower filler loading in order to increase the depth of cure.

A recent lab-based study comparing many of the materials within this article including a dual cure material (Fill Up – Coltene), highlighted some concerns over the mechanical properties of strength over conventional RBCs (31)

The authors of this study suggested that also some of the bulk-fill base RBCs have poor long-term stability from softening and highlighted the need for ensuring they are not exposed to the oral environment which may negate their advantages (31).

Kerr's Sonicfill 2 system has a relatively high filler content (83.5% Wt.), which has been shown to have the higher flexural and compressive strength values, compared to ***Tetric EvoCeram bulk-fill*** (79-81% Wt.) and ***SDR*** (68% Wt.) which have lower filler contents (32).

The latter requires a capping layer of conventional RBC due to these inferior properties and is therefore a bulk-fill base rather than a material that can be used for an entire restoration (32).

Bulk-fill base RBCs have been found to have comparably low fracture toughness and abrasion resistance to conventional flowable RBCs (33).

Therefore, manufacturers advise that bulk-fill base RBCs are capped with a conventional RBC. This reduces the potential advantage of increased speed of placement compared to materials that do not need a capping layer and may be placed in a single increment depending on the depth of the cavity.

Interestingly ***dual cured bulk-fill RBCs*** (that is, Fill – up) also have low filler content (65% Wt.), (34) however, the manufacturers have advised this material can be used without a final conventional RBC capping layer.

Given the lack of clinical trials the authors give caution to using this material as per manufacture guidelines due to its comparably low filler content which may render it prone to increased wear rates.

Within *in vitro* studies the bulk-fill RBCs show a wide range of physical properties and do not perform equally, therefore, the clinician must carefully select materials based on their experiences

3.2.5 Clinical performance

There is limited good quality in-vitro research regarding bulk-fill RBC materials, while clinical in vivo research is scarce apart from a few trials and case reports. Some clinical evidence is emerging that demonstrates bulk-fill base RBCs are a suitable alternative to amalgam or conventional RBC, (35-37) although more good-quality data is needed.

A recent randomized clinical trial utilizing a bulk-fill base RBC compared with a conventional layered technique found comparable success over five years (35).

Another study has shown bulk-fill base RBCs to be as successful as stainless steel crowns in the restoration of primary teeth having undergone a pulpotomy (38).

However, the reality is that currently bulk-fill RBC restorative materials have little clinical research to support their use. Clinicians must weigh up the potential advantages and disadvantages of a material to the particular clinical scenario.

Aesthetics are greatly improved with all RBC materials compared to amalgam, although bulk-fill materials may be limited in terms of shade and translucency of the materials in comparison to conventional hybrid RBCs. For patients in which ultimate aesthetics are a key factor, a capping layer of conventional hybrid RBC is indicated and is compatible with most bulk-fill materials.

3.3 The potential advantages of bulk-filling are:

- Fewer voids may be present in the mass of material, since all of it is placed at one time.
- The technique would be faster than placing numerous increments if curing times were identical.
- It may be easier than placing numerous increments. (39)

3.4 The potential disadvantages of bulk-filling are:

- it may be difficult to control the mass placement.
- Making adequate contact areas may be challenging unless adequate matrices are used.

• Effects due to shrinkage stress may be more pronounced when bulk-filled than when placed in increments, since the entire mass polymerizes at one time rather than in small increments.

• Polymerization of resin in deep preparation locations may be inadequate. (39)

3.6 Commercially available bulk fill materials

3.6.1 3M™ ESPE™ Filtek™ Bulk Fill Posterior Restorative material

3.6.1.1 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.

3.6.1.2 Composition

The fillers are a combination of non-agglomerated / non-aggregated 20 nm silica filler, non-agglomerated / non-aggregated 4 to 11 nm zirconia filler, 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. (39)

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.(39)

Fig. (3) 3M™ ESPE™ Filtek™ Bulk Fill Posterior Restorative material

3.6.2 Tetric EvoCeram® Bulk Fill composite

Tetric EvoCeram® Bulk Fill composite is a nanohybrid, medium viscosity composite suitable for the bulk filling technique. It allows a new level of efficiency to be achieved in posterior tooth restoration: one filling, one material, one increment (Ivoclar Vivadent, 2013).

This radiopaque composite contains patented polymerization boosters and light sensitivity filters for a deeper depth of cure with extended working time, with high marginal adaptation to the floor and walls of cavitypreparations, without need for a flow able liner (Ivoclar Vivadent, 2013; Olitsky, 2013).

3.6.1.3 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

3.6.2.1 Composition of Tetric EvoCeram ® Bulk Fill composite

Tetric EvoCeram® bulk fill has a total content of inorganic fillers of 79–81% by weight or 60–61% by volume. The particle size with a mean of 550 nm and the monomer matrix mass is composed of dimethacrylates BIS-GMA, BIS-EMA and UDMA which exhibit low polymerization shrinkage by volume (Table 1-2) (Ivoclar Vivadent, 2013).

Table (2): Composition of Tetric EvoCeram® Bulk Fill composite (Ivoclar Vivadent, 2013).

Component	weight%
Dimethacrylate	19.7
Barium glass filler, ytterbium trifluoride, mixed oxide	62.5
Prepolymers	17.0
Additives, catalysts, stabilizer, pigments	1.0

3.6.2.2 Filler technology of Tetric EvoCeram ® Bulk Fill composite

The filler technology is based on the clinically proven glass fillers with low wear, favorable polishing properties, low surface roughness and a high gloss. It incorporates two types of glass fillers with different mean particle sizes: Barium aluminium silicate glass filler with a mean particle size of 0.4 µm and Barium aluminium silicate glass filler with a mean particle size of 0.7µm (Ivoclar Vivadent, 2013).

3.6.3 Sonic Fill ™ composite

Sonic Fill™ composite (Kerr Corp., USA) is a nanohybrid, low-shrink, resin-based, radiopaque, sonic-activated, bulk fill composite material designed for direct placement for all cavity classes in posterior teeth without additional capping layer. It is also used as build up material for cusp reconstruction. It allows a depth of cure of 5 mm. Proprietary sonic activation enables a rapid flow of composite into the cavity for easy placement and good adaptation**)**. The low viscosity varietyoffers superior adaptability, while the medium viscosity type is better for carving and sculptability **.**

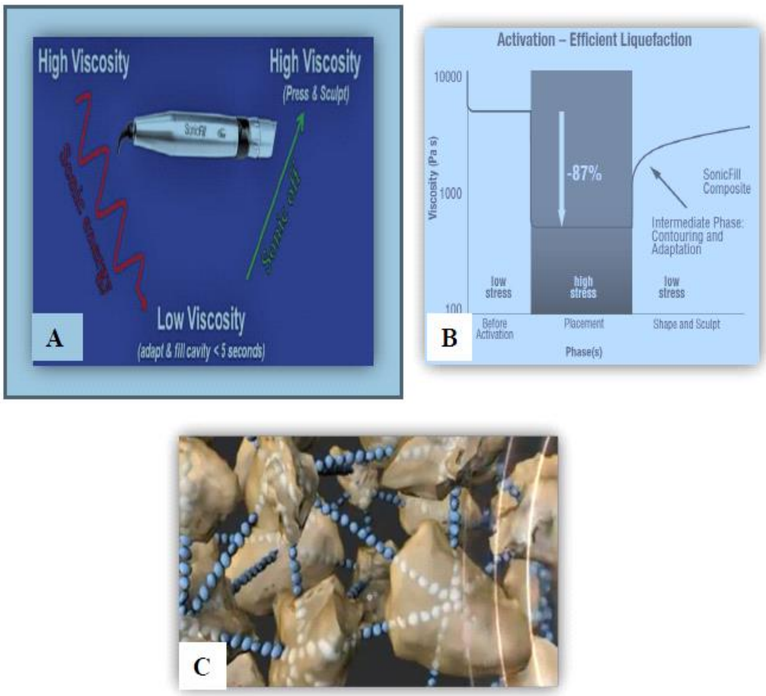

Fig.4. Sonic fill composite

Sonic Fill™ system is a bulk fill system comprised of a specially designed handpiece and new bulk fill composite material in unidose tips. Sonic Fill™ composite incorporates a highly-filled proprietary resin with special rheological modifiers that react to sonic energy. As sonic energy is applied through the hand piece, the modifier causes the viscosity to drop (up to 87%), increasing the flow ability of the composite and enabling quick placement and precise adaptation to the cavity walls. When the sonic energy is stopped, the composite returns to a more viscous, non-slumping state for carving and contouring

3.6.4 x-tra fil

X-tra fil is a posterior, 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.

3.6.4.1 Indications

- Restorations class I and II
- Core build-up

3.6.4.2 Advantages

- x-tra fast
- – 4mm cure in 10 sec.
- x-tra durable
- Low shrinkage of 1.7% through multi hybrid filler technology
- 86% filled by weight for great wear resistance x-tra easy.
- One universal shade fits all. High translucency provides excellent. chameleon effect for good esthetics.
- Perfect for fast core build-ups.

Fig. (5) x-tra fil by voco

3.6.5 SDR®flow+ Bulk Fill Flowable Material

The evolution of composite materials is aimed at meeting esthetic requirements of the filling. Besides permanent and esthetic restoration of the tooth, also fast, comfortable and easy treatment is expected. Most clinicians recommend a 2mm layer of a composite placed in a single layer due to the limitation of hardening depth and polymerization shrinkage of the composite material (53,54).

The size of the layer is also connected with polymerization shrinkage which varies between 2.5% and 3.5% of the volume. The value rises with the increase in the portion of the composite material (54).

Therefore, the technique of layer application, which can be time consuming in case of big cavities of hard tissues, seems to be a must.

According to present studies, the polymerization stress is definitively lower (3-4fold) during SDR polymerization when 4-mm-layer is applied (55-57). SDR technology is based on a unique chemical structure of the organic phase which includes a polymerization modulator. A component- urethane dimetacrylate resin is a kind of a monomer which controls the course of polymerization by being a so called chemical ‘soft start’. A polymerization network is formed in a more straight and slower way. Shrinkage tension can be limited to a great extent (57,58).

Moreover, SDR has similar physical properties to traditional composites, such as susceptibility, surface roughness, shine, and shade. It is a particularly useful feature while restoring hard tissue defects on contact surfaces (54). The base material seems to be a great turning point in the conservative dentistry.

3.6.5.1 Desirable features of SDR

- low polymerization shrinkage and stress

- large increments up to 4 mm thickness
- optimized handling and adaptation
- pre-dose compoul tips for direct intra-oral apliction
- can be capped with any composite materials
- self leveling
- fluoride containing glass fillers
- up to 40% time saving over conventional layering composites (59).

Based on SDR ®Technology , Dentsply Sirona now is introducing the next generation bulk fill flowable with a new formulation. SDR® flow+bulk fill flowable provides Three additional shades, A1, A2 and A3, to simplify esthetic matching in a wider range of applications Enhanced wear resistance with a modified glass filler package that significantly increases durability. Increased radiopacity to provide improved X-ray visibility.

With these enhancements, SDR®flow+ bulk fill flowable is now approved for an expanded range of indications including Class III and V restorations in addition to Class I and II. The new shades also provide dentists with additional esthetic options for creating Class V and Class II restorations as well as primary posterior dentition when the restoration is visible at the smile line.

Fig 6. Show the shades of SDR flow+bulk fill composite

3.6.6 Filtek™ Bulk Fill Flowable composite

- A 4 mm depth of cure – reducing the need for incremental layering and risk of contamination.
- A flowable viscosity for easy adaptation– less instrument manipulation.
- Up to 50 % more strength and nearly twice the wear resistance compared to competitve bulk fill flowables*
- Choice of deliveries: capsules or syringes in orange colour for easy identification
- 4 Shades: A1, A2, A3, Universal (60)

3.6.6.1 Indications

Filtek™ Bulk Fill Flowable Restorative is especially suited for the following indications:

- Base under Class I and Class II direct restorations
- Liner under direct restorative materials
- Pit and fissure sealant (60)

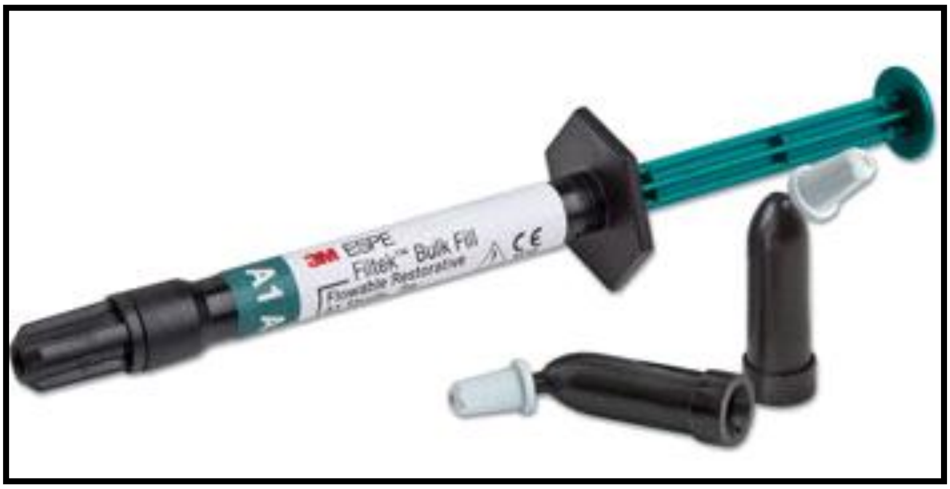

Fig. (7) filtek-bulk-fill-flowable

3.6.7 Venus® Bulk Fill

Venus Bulk Fill is a low stress, flowable posterior composite used as a base in Class I and II restorations. The product can be placed in 4 mm increments and is used in conjunction with a universal restorative material as the surface layer. The composite is a radiopaque nano-hybrid composite. ***Venus Bulk Fill*** has self-adapting characteristics to enable the material to adapt to the cavity walls.

Table (3) physical properties of Venus® Bulk Fill (61)

Physical properties	Venus Bulk Fill / Universal Shade	SDR Smart Dentin Replacement / Universal Shade
Depth of cure [mm] (ISO 4049)	6.2	4.0
Shrinkage stress [MPa] (after 24 h, photoelastic measurement)	3.4	3.6
Compressive strength [MPa]	331	233
Flexural strength [MPa]	120	120
Radiopacity [% Al] (ISO 4049)	300	240
3 Body Wear Resistance [µm] (ACTA method, poppy seed, 300,000 cycles) [mm^3]	32 0.31	41 0.39
Working time [s] (ISO 4049)	80	50
Conversion rate [%] (blue light; 600 mW/cm^2; 20 sec., FTIR spectrometer)	55	49

3.6.8 Tetric EvoFlow ® Bulk Fill

Just like Tetric EvoCeram Bulk Fill, Tetric EvoFlow Bulk Fill is a posterior composite suitable for the bulk-filling technique. Similarly to Tetric EvoCeram Bulk Fill, it can be applied and cured in large increments of up to four millimeter thickness, and requires minimal light exposure time. When a state-of the- art curing light with a light intensity of at least 1,000 mW/cm2 such as Bluephase® Style (1,100 mW/cm2) is used, a four millimeter increment of Tetric EvoFlow Bulk Fill can be cured in just ten seconds. Due to its higher monomer content and the resulting lower surface hardness compared with sculptable composites, Tetric EvoFlow Bulk Fill needs to be covered with a high-viscosity composite just like other flowable composites

Tetric EvoCeram Bulk Fill has been successfully used in clinical applications for almost four years. The highly reactive photo initiator ***Ivocerin*** (62-64) in Tetric EvoCeram Bulk Fill substantiated the confidence in the effectiveness of bulk-fill composites.

The time was ripe to take this technology a step further. The key technologies incorporated into Tetric EvoCeram Bulk Fill formed the cornerstones for the new development.

• Highly reactive initiator system (= Ivocerin and camphorquinone).

• Shrinkage stress control via incorporation of a composite filler (shrinkage stress reliever).

• Long working time (= light sensitivity filter).

3.6.9.1 Indications

- Base for class I and II cavities
- Cavity liner under direct restorative materials in class I and II cavities
- Small, non occlusal stress-bearing class I restorations according to minimally invasive filling therapy
- Class III and V restorations
- Extended fissure sealing
- Undercut blockout
- Repair of small enamel defects
- Repair of small defects in aesthetic indirect restorations
  - Repair of temporary C&B-materials
  - Core build-up

3.6.9.2 Advantages

- 4 mm cure in 10 sec. saves time (Universal shade)
- Low shrinkage stress allows bulk fill speed

- Smart self-leveling properties without slumping out of maxillary restorations
- High Radiopacity (350 %Al) for easy x-ray
- Non-dripping NDT-Syringe technology
- Unit dose caps with extra long bendable needle tip
- Available in Universal and A2 shade

3.6.9 x-tra base

fast bulk fill Flowable Posterior Composite Cure 4mm in 10 sec .

Fig. (8) x-tra base by voco.

3.6.10 Coltène Fill-Up

Fill-Up is a ***dual curing***, medium viscous bulk composite of the newest generation applied in a single step.

It combines the advantages of resin-based composites with a simplified and time-efficient handling. Owing to its dual curing property, fillings with Fill-Up! can be administered in arbitrary filling depth without the need of an additional covering layer.

- Faster than the conventional increment technique
- More economical than the two layer bulk fillings

Conventional light curing bulk filling materials are limited in their curing depth, putting into question whether the restoration fully cures. On the contrary, the dual curing property of Fill-Up guarantees a thorough curing down to the bottom of every cavity. Moreover, chemical curing minimises shrinkage stress dramatically, preventing microfractures and postoperative sensitivities.

The bonding partners ParaBond and ONE COAT 7 UNIVERSAL (together with the activator) caters for a perfect marginal seal comparable to the one of conventional composite - before and after thermo cycling and chewing abrasion – ensuring a secure long-term restorative solution(66).

3.6.10.1 Preventive Effects of Giomer Materials

BEAUTIFIL-Bulk Flowable is particularly suitable for use as a cavity base, thanks to its good self-leveling and handling characteristics.

All Beautifil-Bulk products are multifunctional Giomer composites, characterized by bioactive filler particles. In the manufacturing process, these fillers are coated with a durable glass ionomer phase ("S-PRG") before being embedded in the matrix.

This technology allows the composites to recharge and release fluoride and other ions. In numerous studies conducted at leading universities, this class of materials has been shown to effectively re-mineralize the tooth structure, inhibit plaque formation and neutralize acids.

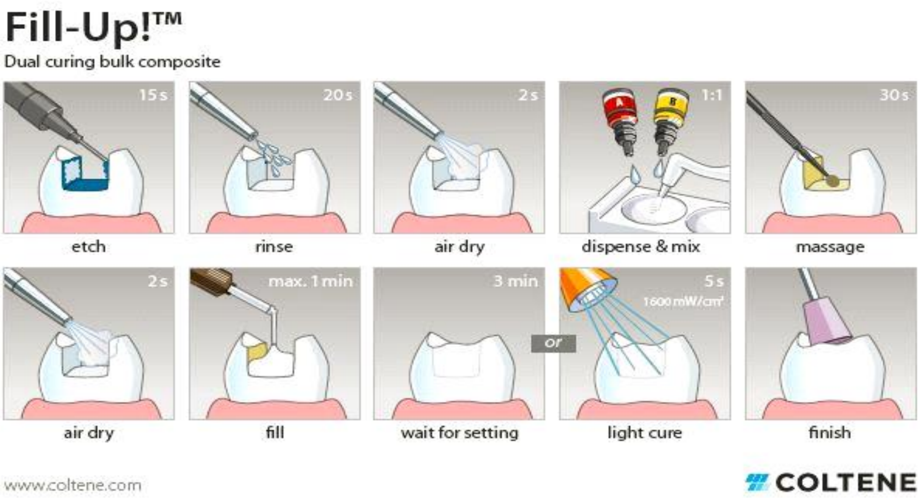

Fig. (9) Step by step coltene fill-up application.

3.6.10.2 Features:

- Arbitrary filling depth
- Minimized shrinkage stress
- Optimized marginal seal
- One layer
- Universal color, fluorescent and radiopaque
- Contains zinc oxide
- Fast and easy procedure

3.6.10.3 Indication:

- Class I and Class II fillings
- Cavity linings
- Core build-ups

3.6.11 Parkell HyperFIL™

HyperFIL™ Dual Cure Restorative Composite is a true bulk-fill material. HyperFIL can be filled to any depth and left on the occlusal surfaces because it can cure to any depth and is strong enough to withstand occlusal forces.

- Nanofilled with 80% inorganic filler for providing greater wear resistance
- Slower rate of self-curing reduces stresses at bonded interface
- Material flows just enough when extruded from mixing tip to adapt to the tooth surface
- Eliminates the need for flowable liners and incremental curing
- Hit material with curing light for 30 seconds (or wait for a total self-cure) and start finishing restoration

Fig 10 parkell hyperfil

1.4 Previous studies on bulk fill materials

Thomposon, in (2011),

Measured the volumetric shrinkage, compressive strength, and flextural strength and flextural modulus of different composite materials including SonicFill™, Quixfil™ and Tetric EvoCeram® composite. He found the volumetric shrinkage of SonicFill™ composite was 1.7% which was the lowest among all tested composite materials, and that of Quixfil™ was 2.2% and Tetric EvoCeram® 1.9%.

He also found that the compressive strength and flexural strength of Sonic Fill™ (253 MPa – 185 MPa) were higher than Quixfil™ (227 MPa -156 MPa) and Tetric EvoCeram® (234 MPa - 132.9 MPa). On other hand, he found that the flextural modulus of Quixfil™ was (19 GPa) which was higher than SonicFill™ (12GPa) and Tetric EvoCeram® (11GPa).

Muñoz-Viveros and Campillo-Funollet, in (2012),

Found in *an vitro study* that Sonic Fill™ composite placed in one bulk increment had the equivalent marginal adaptation to Filtek™ Supreme Ultra filled in 2mm increments and SureFil™

SDR which requires an additional overlay material (Ceram X). Due to the benefit of the sonic activation, no voids are present in the SonicFill™ composite. Thus, bulk fracture is less likely to occur reducing the need for reworks. They concluded that clinical longevity of a SonicFill™ restoration placed in one bulk increment will be thesame or better than a restoration utilizing incremental placement of Filtek™ Supreme Ultra.

Tiba *et al*., in (2013),

Measured the volumetric shrinkage, fracture toughness, fracture work, flextural strength, flextural modulus and performed the polymerization shrinkage stress test for different composite materials including SonicFill™, Quixfil™ and Tetric EvoCeram® Bulk Fill. The results showed that SonicFill™ and Quixfil™ showed the lowest volumetric shrinkage among the tested bulk fill composite materials. Also SonicFill™ composite had the highest value of fracture toughness and fracture work among all tested bulk fill materials (1.65 Mpa m1/2 -100 J/m^2).

Quixfil™ had (1.30 MPa m1/2 -. 50 J/m^2) and Tetric EvoCeram® Bulk Fill had (0.9 MPa m1/2 - 47 J/m^2).

The results also showed the flexture strength of SonicFill™ was statistcally nonsignificant from Quixfil™ but Tetric EvoCeram® Bulk Fill showed lower value than Sonic Fill™ and Quixfil™. The results also showed that the flexure modulus of SonicFill™ was (11 GPa), Quixfil™ (15 GPa) and Tetric EvoCeram® Bulk Fill (15 GPa).

The results of polymerization shrinkage stress test of composite materials

showed that SonicFill™ composite had the lowest value (0.45 MPa) compared to Quixfil™ which had (0.65 MPa) and Tetric EvoCeram® Bulk Fill which had (0.63 MPa).

Furness *et al*., in (2014),

Examined the effects of composite type (bulk fill/conventional) and placement (4-mm bulk/2-mm increments) on internal margina l adaptation of class I preparations, using either a bulk fill (SureFil™ SDR, Quixx, SonicFill™, Tetric EvoCeram® Bulk Fill and conventional composite designed for 2- mm increments (Filtek Supreme Ultra).

Results showed that the marginal integrity was unaffected by placement method. Bulk-placement demonstrated significantly fewer gap-free margins at the pulpal floor than in enamel, for all materials except SDR.

Greater percentages of gap-free margins were found within the mid-dentine than at the pulpal floor for Filtek Supreme Ultra. Quixx had more gap-free margins in enamel compared with the mid-dentine. Proportion of gap-free margins within enamel and mid-dentine was not significantly different for any incrementally placed product.

Excluding Filtek Supreme Ultra, gap-free margins within enamel were significantly greater than at the pulpal floor. Notably, significantly more gap-free margins were found within mid-dentine than at the pulpal floor for SonicFill™

(Benetti et al., 2015).

Median of marginal gap in micrometer ranged from 6.1 to 10.2. The same study assessed the marginal adaptation of paste- like composite, and they found a median gap ranged from Gap 6.6 – 7.1 micrometer. There was no comparison made to the conventional composite.

Andre et al in 2017

Concluded that; bulk fill RBCSwhere partially likely to fulfill the important requirement regarding properly curing in 4 mm of cavity depth measured by depthof cure or degree of conversion. in general low viscosities BFCs performed better regarding polymerization efficincy compared to the high viscositiesBFCs. **Orłowski et al., 2018).**

The depth of cure for flowable and paste-like composite was higher than that for conventional composite. Degree of conversion of flowable in comparison to conventional was contradicting, while paste like bulk fill was higher than condensable conventional composite. Polymerization shrinkage is higher or comparable in flowable bulk fill composite in comparison to that in the conventional composite, while in paste like composite the results was contradicting. The polymerization stress of flowable and paste-like bulk fill composite was lower than that of conventional composite.

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