

EFFECTIVE AND EFFICIENT USE OF  
LIGHT CURING AND BULK FILL  
DENTAL COMPOSITE PLACEMENT

**IOWA**

Aditi Jain BDS, MS  
Natalia Restrepo-Kennedy DDS, MS

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CONFLICT OF  
INTEREST  
INFORMATION

- No conflict of interest with any material and any content of this presentation

BULK FILL RESIN-BASED COMPOSITE

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OBJECTIVES

- Discuss indications, contraindications, advantages and disadvantages of bulk-fill resin composites



BULK FILL RESIN-BASED COMPOSITE

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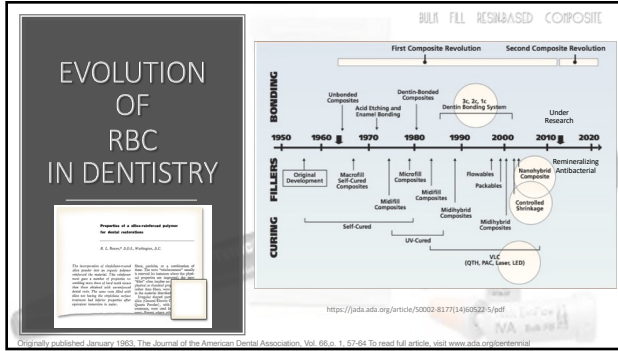
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Why was an increase of RBC material in the world?

- ✦ Treaty by the United Nations Environmental Programme - The Minamata Convention in 2013 - phase-out of dental amalgam. 128 countries signed up to the Minamata Convention
- ✦ Increasing esthetic and mercury free posterior restorations - RBC
- ✦ RBC in USA: Average life span is 5.7 years and cost of approximately five billion dollars annually. (Chesteman, J et al. 2017)

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**Clinical Longevity of Dental Amalgam V/S Resins Based Composites – A Literature Review**  
 1Dr. Varsha Uitarwar, 2Dr. Mohit Gunwal, 3Dr. Snehal Sonarkar, 4Dr. Manjusha Pradhan, 5Dr. Vidya Mokhadde, 6Dr. Vandana Kulkane,  
*Lecturer, 2Asst. Prof, 3 Asst. Prof, 4 Lecturer, 5 Lecturer, 6 Assoc. Prof*

**Conclusion**

Current review on longevity of amalgam and resin based composite restoration presents that amalgam shows superiority when compared to that of composites and there is a definite shift from amalgam towards composite resins as choice of restorative material. Though amalgam restorations are 3 to 8 times more cost effective than composite restorations, but due to concerns of mercury toxicity and esthetics amalgam is nearly on the verge of extinction. Composite represents the future generation of filling materials with ever evolving technology in terms of better adhesion, aesthetics and mechanical properties. **Therefore, more emphasis in dental curriculum and training should be given towards better application of resin-based composites in clinical practice as and when compared to amalgam restorations.**

10.5830/ijdr.v11i05.05  
 P-ISSN: 2279-0853, E-ISSN: 2279-0861, Volume 15, Issue 5, May, 2019, PP 42-44 www.ijdrjournal.org

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**CLINICAL SIGNIFICANCE:**

the most important factor for achieving success is likely careful and proper placement and light-curing technique, independent of the approach.

DISCOVERING COMPARING DIFFERENT COMPOSITE PLACEMENT METHODS FOR CLASS II RESTORATIONS

Journal of Oral Rehabilitation 2020 | August | 2 November 2020  
DOI: 10.1111/jorh.12345

**REVIEW ARTICLE**

**WILEY**

**Probing the hierarchy of evidence to identify the best strategy for placing class II dental composite restorations using current materials**

Jack L. Ferracane PhD<sup>1,2</sup> | Nathaniel C. Lawson DMD, PhD<sup>2,3</sup>

**Abstract**  
 Objective: The objective of this review is to present a concept of the existing clinical data to inform regarding placement of class II restorations with dental composites of varying viscosities, focusing on the marginal integrity of the restoration.  
 Overview: The literature on class II composites placed with various techniques was searched through PubMed, Scopus, and the citation of identified articles, focusing on articles related to placement and clinical performance. Studies comparing curing of conventional composites to leveling with a flowable liner, including the 'base plus technique' use of wettable composites. Flowable bulk fill liners with a conventional composite coping layer, and bulk fill restorations in single increment or hybrid placement with both energy and dual curing.  
 Conclusions: In vivo and clinical evidence does not support any one specific method or material type for achieving optimal performance when restoring class II cavity preparations with current dental composites.  
 Clinical significance: Although there are many available placement methods and types of composite materials on the market for use in class II restorations, the most feasible success presented in the clinical and laboratory literature for the various approaches suggests that the most important factor for achieving success is being careful and proper placement and light-curing techniques, independent of the approach.

Ferracane, Jack L. et al. 2020

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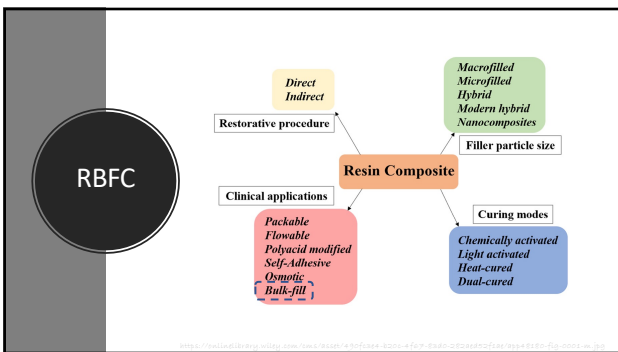
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**What is BULK-FILL RESIN BASED COMPOSITE?**

- Bulk-fill composite is a resin-based composite material that has been introduced to the dental community to simplify the application of the conventional resin-based composite whilst ensuring an adequate depth of cure.

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BULK FILL RESIN-BASED COMPOSITE

ADVANTAGES

- ✓ Single increments of 4-5 mm in posterior teeth.
- ✓ Faster technique than the conventional RBC incremental technique.
- ✓ Greater translucency, allowing greater light dissipation through the material.
- ✓ Incorporation of more reactive photoinitiators, which enable a greater depth of cure.
- ✓ Reduce cusp deformation and polymerization stress and increase fracture resistance (in-vitro).

Rosatto et al. 2015; Van Ende et al. 2017; Emara et al. 2015; Leandrea et al. 2018; Rosatto et al. 2015

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- ✓ Very little clinical (in vivo) research on the long-term outcomes of these materials and so caution is needed as to their efficacy
- ✓ More voids may be present in the mass of the material, since it may be difficult to control the mass placement.
- ✓ Making adequate contact areas may be challenging unless adequate matrices are used.
- ✓ More pronounce shrinkage stress since the entire mass polymerizes at one time rather than in small increments.
- ✓ Polymerization of resin in deep preparation locations may be inadequate.
- ✓ Limited range of shades due to the translucency limitation

DISADVANTAGES

Craig's, 14 ed.; Chesteman, J et al. 2017

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INDICATIONS

- ✓ Capp with conventional RBC to improve the esthetics or physical characteristics of the material specially for low viscosity BF RBC
- ✓ Direct anterior and posterior on Class I, Class II, and Core build-ups
- ✓ Base/liner under direct restorations (Flowable)
- ✓ Restorations on children and anxious patients to reduce the procedural time
- ✓ Extended fissure sealing in molars and premolars
- ✓ Repair of defects in porcelain restorations, enamel and temporaries
- ✓ Rubber dam isolation is indicated

Craig's, 14 ed.; Chesteman, J et al. 2017

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CONTRAINDICATIONS

- ✓ High caries risk patients
- ✓ Poor isolation during the restorative procedure;
- ✓ Failure of the restoration due to parafunctional habits such as bruxism
- ✓ High occlusal loads for low viscosity RBFC
- ✓ Direct anterior due to limited shade options and translucency

Craig's, 14 ed.; Chesteman, J et al. 2017

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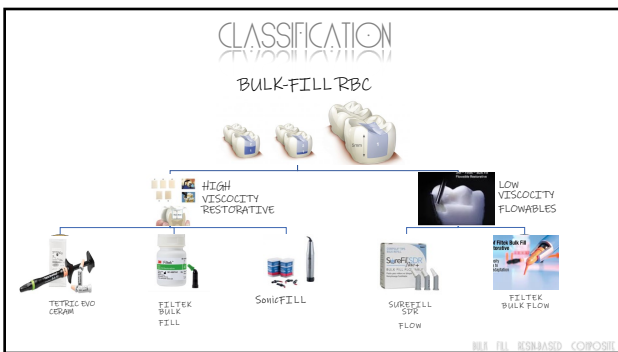
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### CLASSIFICATION

BULK-FILL RESTORATIVE COMPOSITE

Classification of Bulk-Fill RBC Restorative Material

	BULK-FILL RBC	BULK-FILL BASE RBC	SONIC-ACTIVATED BULK-FILL RBC	DUAL CURE BULK-FILL RBC
Commercially available materials	<ul style="list-style-type: none"> <li>↑ 3M ESPE - Filtek Bulk-Fill Posterior Restorative</li> <li>↑ Ivoclar Vivadent - Tetric EvoCeram Bulk-Fill</li> <li>↑ Voco - x-tra fill</li> </ul>	<ul style="list-style-type: none"> <li>↑ Dentsply - SDR</li> <li>↑ 3M ESPE - Filtek Bulk-Fill Flowable</li> <li>↑ Heraeus Kulzer - Venus Bulk-Fill</li> <li>↑ Ivoclar Vivadent - Tetric EvoFlow Bulk-Fill</li> <li>↑ Voco - x-tra base</li> </ul>	<ul style="list-style-type: none"> <li>↑ Kerr - SonicFill 2</li> </ul>	<ul style="list-style-type: none"> <li>↑ Coltene - Fill Up</li> <li>↑ Parkell - HyperFill</li> </ul>
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 coping layer	No	Yes	No	No
3M ESPE - Filtek Bulk-Fill Flowable (Class I cavity = 4 mm) (Class II cavity = 5 mm)				

Chesteman, J et al. 2017

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**CLASSIFICATION**

**BULK-FILL RBC**  
 ↑ The **high-viscosity** restoratives need two layers of composite since they do not adapt to the cavity walls as well. Therefore, needs a low-viscosity composite to achieve adaptation to the gingival floor or axial-pulpal walls.

**BULK-FILL BASE RBC**  
 ↑ The **low-viscosity flowable** needs two layers of composite. One is placed in the axial wall or gingival floor as a dentin replacement base and a second increment is placed as enamel on the occlusal surface.

**SONIC-ACTIVATED BULK-FILL RBC**  
 ↑ It is the only sonic-activated, single-step, bulk-fill composite. It starts out as a low-viscosity composite and transformed to a high-viscosity composite. The handpiece is activated, liquefaction occurs, the viscosity drops, and optimal cavity adaptation occurs. The composite goes through a phase change.

**DUAL CURE BULK-FILL RBC**  
 ↑ 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.

Chesterman, J et al. 2017

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**BULK-FILL RBC IN THE MARKET**

**versal shade color**  
 • no the need to spend time on registration  
 • no create a chromatic effect  
 • VITA A2 and A3  
 • very popular

**ESTELITE BULK-FILL /low**

• BULK-FILL RESIN-BASED COMPOSITE

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**MECHANICAL PROPERTIES**

- ✗ Depth of cure
- ✗ Polymerization shrinkage
- ✗ Marginal gap formation
- ✗ Physical and aesthetic properties

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**DEPTH OF CURE**

- Depending on the depth of cure it can vary with the shade and translucency; darker shades with greater opacity have a shallower depth of cure compared to lighter more translucent resins
- Consider Bulk-fill light-cured and dual-cure.
- Methods to increase the depth of cure:
  - Reducing the filler content
  - Increasing filler particle size
  - Additional photo-initiators
    - Such as Bulk-fill increases the depth of cure by using several different photo-initiators such as IVOCLON that allow it to be polymerized in larger increments, when compared to standard photo-initiators such as camphorquinone or Lucirin.

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**DEPTH OF CURE**

High depth of cure rates by BF RBCs, depends on factors such as:  
\*Material irradiance & \*Exposure time.

Polywave LCUs are useful but not essential on polymerizing alternative photoinitiator-containing BF RBC

When the distance from the light tip is increased, the intensity of the curing light will drop

The dual-cured BF RBC materials, are a possible solution for the depth of cure while they retain the properties of BF RBC restorations.

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**INCREMENTS**

4 TO 5 mm  
SAFE TIME  
5 mm

BULK-FILL RESIN-BASED COMPOSITE

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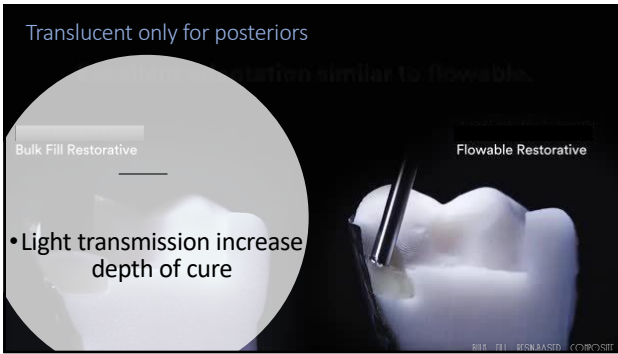
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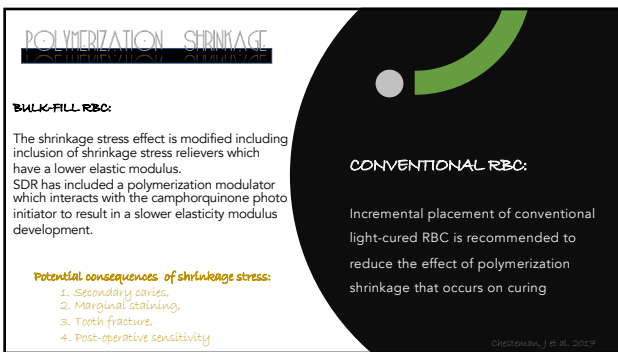
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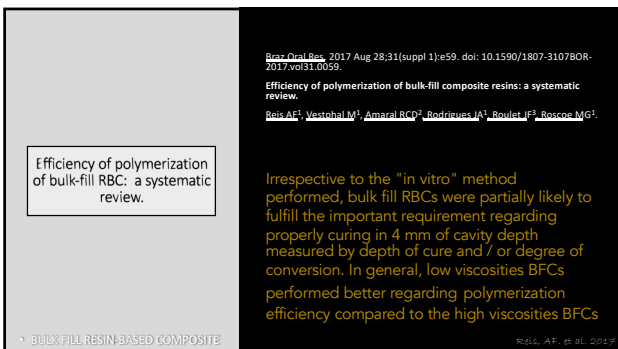
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**CONCLUSIONS**

- The surface microhardness is widely variable between the tested resin composites. No bulk fill resin composite achieved the same surface microhardness as Filtek Z350XT.
- All tested Bulk fill resin composites showed proper depth of cure up to at least 4.5 mm being indicated for bulk placement and presenting higher depth of cure than conventional resin-based composites.
- All tested bulk fill resin composites showed similar or lower volumetric shrinkage when compared with conventional resin-based composites.

Dental Materials Journal 2019; 38(2): 402-410

**Polymerization shrinkage, microhardness and depth of cure of bulk fill resin composites**

Fabio Antonio Piza RIZZANTE<sup>1</sup>, Juliana Alves DUQUE<sup>1</sup>, Marco Antônio Hungaro DUARTE<sup>2</sup>, Rafael Fransoso La MONZELLI<sup>3</sup>, Gustavo MENDONÇA<sup>4</sup> and Sergio Kiyoshi IGHORRAMA<sup>5</sup>

<sup>1</sup>Department of Conservative Care, School of Dental Medicine, Case Western Reserve University, 2124 General Rd, 44106, Cleveland, OH, USA  
<sup>2</sup>Department of Operative, Preventive and General Dentistry, Ribeirão Preto School of Dentistry, University of São Paulo, R. D. César Pinheiro, 110, 13074-901, Ribeirão Preto, SP, Brazil  
<sup>3</sup>Department of Biologic and Material Sciences, Division of Prosthodontics, University of Michigan School of Dentistry, 1017 N University Ave, Ann Arbor, MI 48106, Ann Arbor, MI, USA  
<sup>4</sup>Corresponding author: Fabio Antonio Piza RIZZANTE. E-mail: Apr17@case.edu

The present *in vitro* study assessed the polymerization shrinkage (PS), flexural moduli (EM) and depth of cure (DC) of 49 different resin composites: Filtek Bulk Fill Flowable (FBF), Surefil SDR Base (SDR), Xeno Bond SDR, Filtek Z350XT Flowable (Z3F), Filtek Bulk Fill Fluorinate (FBF), Xeno FB, Tetric Evo Crown Bulk Fill (TET), Alpha Prime Xeno (APX), and Filtek Z350XT (Z3T). PS was assessed with a  $\mu$ -CT scanner, measuring 64 mm<sup>3</sup> samples (n=8) before and after 30 s curing. SDR and DC were performed with a microhardness tester (n=4) for each group right after 30 s light curing, with 2 readings per depth at every 0.5 mm. Low viscosity resin composite showed lower SDR values when compared with high viscosity resins. Z3T showed the highest microhardness among the tested resin composites. Z3T and Z3F showed lower DC when compared with bulk fill resin composites. All bulk fill resin composite presented depth of cure higher than 4.5 mm and similar or lower PS than conventional resin composites.

Keywords: Bulk fill resin composite, Depth of cure, Low viscosity resin composite, Composite materials, Micro-computed tomography

RIZZANTE, F.A.P. et al. 2019

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**Shrinkage vectors in flowable bulk-fill and conventional composites: bulk versus incremental application**

Dalia Katsirly<sup>1</sup>\*, Marcell G. Gatzert<sup>2</sup>, Andreas Keller<sup>3</sup>, Peter Rübner<sup>4</sup>, Karl-Helmut Kurzbauer<sup>5</sup>

Received: 16 June 2020; Accepted: 11 June 2020; Published online: 11 July 2020  
 © The Author(s) 2020

**Abstract**  
 Objective: Sufficient depth of cure allows bulk fill composites to be placed with a 4-mm thickness. This study investigated bulk versus incremental application methods by measuring shrinkage vectors in flowable bulk fill and conventional composites.  
 Materials and methods: Cylindrical cavities (diameter = 6 mm, depth = 4 mm) were prepared in 20 teeth and then etched and bonded with Optibond FL (3M, Ind). The composites were stored with 2 wt% methacrylate plastic beads.  
 In one group, conventional increment (SDR, Densply) was applied as bulk “SDR bulk” (n = 6). In two groups, SDR and Tetric EvoFlow (Evoflow) (Vivadent) were applied as 2-mm-thick increments: “SDR increment” and “Evoflow increment (n)”. Each material application was scanned with a micro-CT before and after light curing (80 s, 1100 mW/cm<sup>2</sup>), and the shrinkage vectors were compared to image superposition. Statistical linear polymerization shrinkage, shrinkage stress and gelation time were measured (n = 10).  
 Results: The greatest shrinkage vector was found in “SDR bulk” and “SDR increment”, and the smallest were found in “SDR increment (conical)” and “Evoflow increment (conical)”. Shrinkage away from and toward the cavity floor was greatest in “SDR bulk” and “Evoflow increment (conical)”, respectively. The mean values of the shrinkage vectors were significantly different between groups (one-way ANOVA, Tukey’s), T2 test, p < 0.05). The linear polymerization shrinkage and shrinkage stress were greatest in Tetric EvoFlow, and the gelation time was greatest in “SDR bulk”.  
 Conclusion: The bulk application method had greater values of shrinkage vectors and a higher debonding tendency at the cavity floor.  
 Clinical relevance: Incremental application remains the gold standard of composite insertion.

**Conclusion**

- The method of application influences the polymerization shrinkage behavior of composites. Bulk application of the bulk-fill composite **SDR yielded greater shrinkage vector values than incremental application**. SDR shows random shrinkage patterns regardless of the insertion technique.
- **Tetric EvoFlow produces a more regular shrinkage pattern than SDR**. Debonding of composites in the incremental application is less likely to take place than in the bulk application.

Katsirly, D. et al. 2020

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**MARGINAL GAP FORMATION**

**Not conclusive results**

- Some studies concluded that the higher viscosity bulk-fill RBCs result in greater marginal gap formation.

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 shown acceptable marginal adaption post curing

Christen-Dorn, J. et al. 2017.

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**The Use of Bulk Fill Resin-Based Composite in the Sealing of Cavity with Margins in Radicular Cavitaries**

Abstract: The aim of this systematic review was to evaluate the marginal sealability of bulk fill resin-based composites (BFRBC) compared with conventional resin-based composites (RBC) in radicular cavitaries. The search was conducted in PubMed, Cochrane, Embase, Scopus, and Web of Science. The inclusion criteria were: (1) RCTs comparing BFRBC and RBC in radicular cavitaries; (2) studies reporting marginal sealability; (3) studies published in English; (4) studies published between 2010 and 2021. The exclusion criteria were: (1) non-RCTs; (2) studies not reporting marginal sealability; (3) studies not in English; (4) studies published before 2010. The results showed that BFRBC had a significantly better marginal sealability than RBC in radicular cavitaries. The time savings and operational simplification make it possible to make the direct restoration technique less dependent on the operator's expertise.

Francesco, P. et al. 2021

MARGINAL SEAL IN CEMENT STRUCTURE ?

There are no clear differences that indicate a better or worse marginal seal with bulk fill composites, while the time savings and operational simplification make it possible to make the direct restoration technique less dependent on the operator's expertise.

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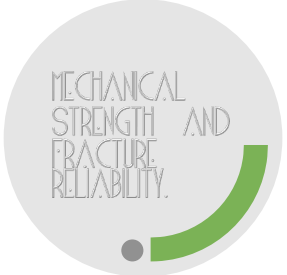
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**CONCLUSION:**

The novel bulk-fill resin-based composites of low and high viscosities show promising application in the restoration of **Class I** cavities in premolars, demonstrating similar mechanical performance and reliability as compared with restorations prepared using conventional RBC. From the bulk-fill materials, the version with **high viscosity** presented the greatest compliant behavior of the study.

Meca de Lencastre, J. et al. 2019



MECHANICAL STRENGTH AND FRACTURE RELIABILITY.

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- ✓ BF RBC have lower filler content to increase depth of cure
- ✓ BF RBC need good isolation since they have poor long-term stability when exposed to the oral cavity
- ✓ Low viscosity BF RBC (flowable) requires a capping layer of conventional RBC due to low fracture toughness and abrasion resistance
- ✓ Dual cure BF RBC also have low filler content (65 % wt.); however, the manufacture have advised this material can be used without a final conventional RBC capping layer
- ✓ Caution using BF RBC due to lack of clinical trials, give low filler content which may render it prone to increased wear rates

PHYSICAL AND ESTHETIC PROPERTIES

PHYSICAL AND ESTHETIC PROPERTIES

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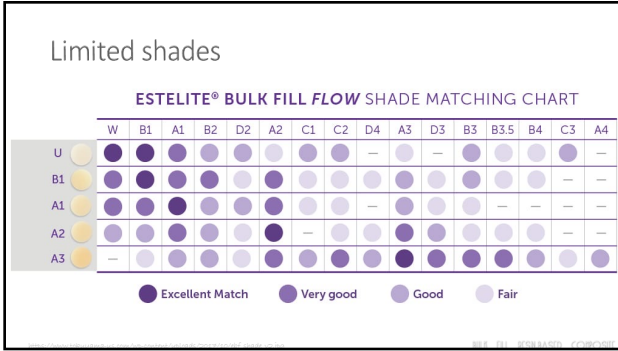
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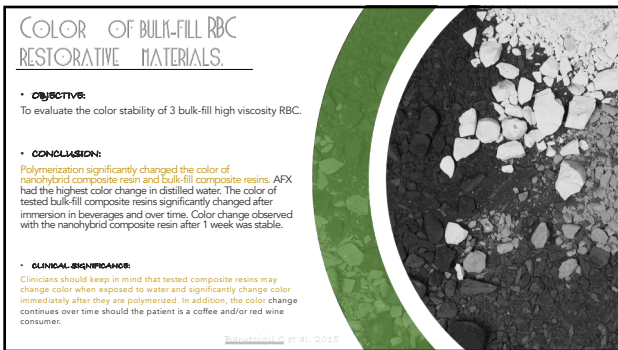
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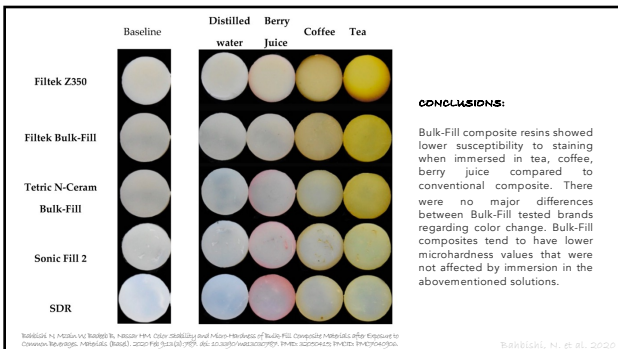
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**RADIOPACITY OF BULK FILL FLOWABLE MATERIALS.** RBC

**\* CONCLUSIONS:**  
As all materials had a radiopacity greater than dentin and enamel; their adequate radiopacity will help the clinicians during radiographic examination of restorations.

**CLINICAL SIGNIFICANCE:**  
Bulk fill composite materials have greater radiopacity, enabling clinicians to distinguish the bulk fill composites from dentin and enamel.

Vidalino, T. et al. 2017

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**BFRC CLINICAL PERFORMANCE ?**

**"Laboratory studies show similar or better performance of bulk-fill materials compared to the traditional composite resins in terms of polymerization stress, cuspal deflection, marginal gap, degree of conversion, flexural strength and fracture strength.**

Furthermore, clinical trials, despite the reduced number, **did not detect differences in the performance of bulk-fill and conventional materials after one to 10 years of follow up."**

Cabrera Borrero, L.C. et al 2019

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**BFRC CLINICAL EFFECTIVENESS ?**

**Conclusions**

"Considering the current evidence, the clinical performance of conventional resins and bulk resins for carious lesion restorations is similar. However, properly designed clinical studies are required to avoid the biases observed in this study in order to reach a better conclusion."

**polymers**  
**Clinical Effectiveness of Bulk-Fill and Conventional Resin Composite Restorations: Systematic Review and Meta-Analysis**  
Molina-For Astivia-Topp<sup>1,2</sup>, Barrios-España<sup>3,4</sup>, Torres-Pardo<sup>5,6</sup>, Gilca-Latorre-Lara<sup>7</sup>, Gómez-Sánchez-Rivas<sup>8,9</sup> and Martínez-Lacortea-Sánchez<sup>10,11</sup>

Abstract: The objective of this systematic review and meta-analysis was to determine the clinical effectiveness of bulk fill and conventional resin composite restorations. A bibliographic search was carried out until May 2020 in the biomedical databases PubMed/MEDLINE, EMBASE, Scopus, Web of Science and Cochrane. The study selection process was: randomized controlled trials in English, with an intervention with a follow-up greater than or equal to 6 months and that reported for clinical effectiveness of fracture, absence of breakdown or marginal staining, adequate adaptation, marginal absence of post-operative sensitivity, absence of secondary caries, adequate color stability and translucency, proper retention forces, proper aesthetic forces, adequate tooth integrity, good marginal adaptation, proper retention, absence of inflammation and adequate post-operative patient comfort with conventional and bulk resins. The risk of bias of the study was analyzed using the Cochrane tool. The results showed that there is no difference between restorations with conventional and bulk resins for the type of restorations, type of tooth restored and restorations technique used. However, further properly designed clinical studies are required in order to reach a better conclusion.

Arévalo-Vega, H. et al 2020

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**CLINICAL PERFORMANCE**

- Good research on in-vitro studies
- Few clinical research on trials and case reports
- Selection of the correct BF RBC material for each individual case is essential
- Limited shade and translucency of the BF RBC compared to the conventional RBC
- Patients with esthetic concerns will need a capping layer of conventional hybrid RBC

SEE BY RESEARCH COMPANY

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**BEST PRACTICES**

- LED curing devices (polywave or monowave) displaying an irradiance  $\geq 1000 \text{ mW/cm}^2$  and 20 seconds of exposure time are imperative to accomplish successful polymerization of most BFRCS.
- Clinicians should keep in mind that tested composite resins may change color when exposed to water and significantly change color immediately after they are polymerized. In addition, the color change continues over time should the patient is a coffee and/or red wine consumer.
- Bulk fill composite materials have greater radiopacity, enabling clinicians to distinguish the bulk fill composites from dentin and enamel.
- One method to overcome marginal adaptation with high-viscosity materials is feating them prior to placement and/or using a low viscosity RBC material to seal the base of the cavity.

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**BEST PRACTICES**

- BF RBC need good isolation since they have poor long-term stability when exposed to the oral cavity
- Low viscosity BF RBC (flowable) requires a capping layer of conventional RBC due to low fracture toughness and abrasion resistance.
- Dual cured BF RBC also have low filler content (65% wt.); however, the manufacturers have advised this material can be used without a final conventional RBC capping layer
- Recent clinical studies indicate that flowable and regular-consistency bulk-fill materials present similar clinical performance compared with conventional materials.
- Clinical trials, despite the reduced number, did not detect differences in the performance of bulk-fill and conventional materials after one to 10 years of follow up.

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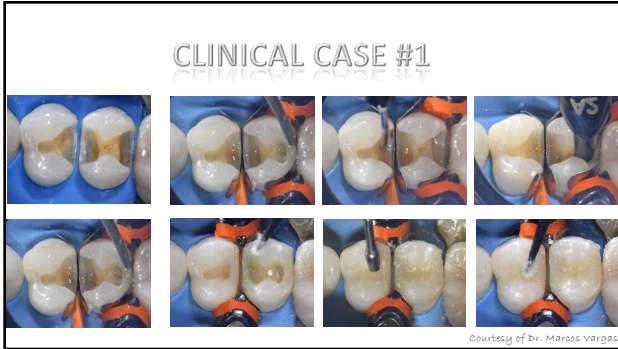
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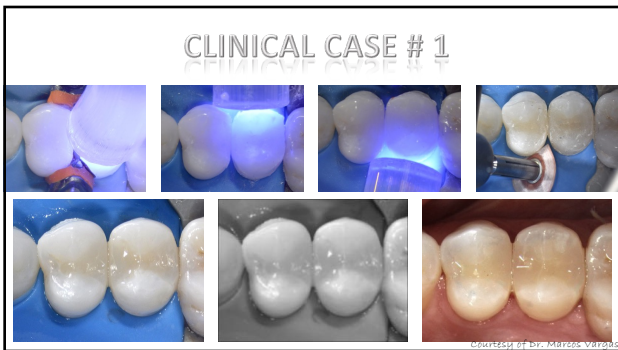
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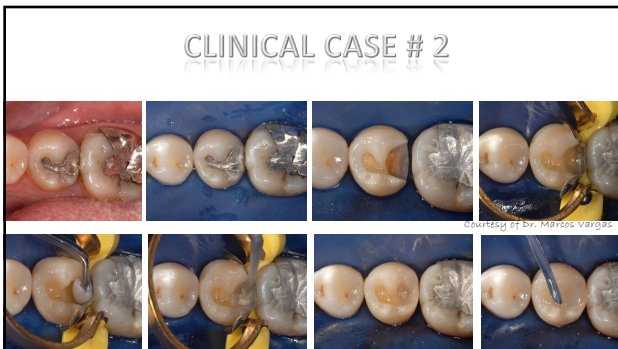
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CONCLUSIONS

1. BFRCs reach acceptable depth of cure (at 4 mm) depending on material and light curing conditions.
2. LED devices displaying irradiance  $\geq 1000 \text{ mW/cm}^2$  (monowave/polywave) and exposure times around 20 seconds are mainly recommended to achieve acceptable depth of cure in most of BFRCs (at 4 mm).
3. The use of polywave light curing units was useful but not strictly necessary for BFRC containing an alternative photoinitiator.

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