International Journal of Research and Review
Volume 11; Issue: 10; October 2024
Website: www.ijrrjournal.com
Review Article *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Beyond Traditional Fillings: Why Bulk-Fill Composites Are Changing the Game

Dr. Faiza Javed[1], Dr. Fatima Siddiqui[1], Dr. Adeela Majid[1], Dr. Huma Iftekhar[2]

[1] Post Graduate Student, Department of Conservative Dentistry and Endodontics
[2] MDS, Assistant Professor, Department of Conservative Dentistry and Endodontics
Dr. Ziauddin Ahmad Dental College and Hospital, Aligarh Muslim University, Aligarh, India.

Corresponding Author: Dr. Faiza Javed

DOI: https://doi.org/10.52403/ijrr.20241018

ABSTRACT

This review examines the impact of bulk-fill composites in restorative dentistry, highlighting their advantages over traditional resin-based materials. Conventional composites often require multiple incremental placements, increasing technique sensitivity and the risk of restoration failure. Bulk-fill composites allow for placement in single layers of 4-6mm, reducing chairside time and procedural complexity. The review discusses innovations in formulation, including enhanced translucency and modifications in photoinitiators that support effective polymerization. Key properties such as microhardness, degree of conversion, depth of cure, and polymerization shrinkage are evaluated, showing that high-viscosity bulk fills can achieve hardness comparable to conventional composites. Various commercially available products are assessed for their clinical performance. The review ultimately emphasizes the growing acceptance of bulk-fill composites as reliable alternatives, advocating for continued research to enhance clinician confidence in their application and effectiveness in deep cavity restorations.

Keywords: Bulk fill composites, posterior composites, incremental composite placement, tooth colored restoratives, polymerisation shrinkage, degree of conversion, depth of cure

INTRODUCTION

Resin-based composites (RBC) were developed to address the limitations of traditional restorative materials like amalgam and glass ionomers. However, composite restorations can be technique-sensitive and time-consuming, particularly in deep posterior cavities where the material must be placed in 2mm increments to ensure proper light penetration.[1] This incremental curing process can lead to voids and contamination between layers leading to early restoration failure.[2]

To overcome these challenges, bulk-fill composite (BFC) was introduced. Unlike the incremental technique, BFCs can be placed in a single increment of 4-6 mm. [1] This reduces chairside timing and technique sensitivity. Their clinical performance and mechanical properties depend on effective polymerization, which can be assessed directly by measuring the degree of conversion or indirectly by analyzing the correlation between microhardness and degree of conversion.[3]

Despite the manufacturers' claims of superior performance, clinicians remain hesitant to switch to these composites. This narrative review aims to discuss and highlight the important features and properties of BFCs based on relevant studies.

Features:
Manufacturers have made certain modifications in the composition of these materials:

1) Addition of alternative photoinitiators like Ivocerin and TPO (diphenyl[2,4,6-Trimethylbenzoyl] phosphine oxide).[4]
2) Reduction in filler content while increasing its size which enhances the material's translucency.[4]
3) Incorporating high molecular weight monomers to reduce polymerization shrinkage.[4]
4) Incorporation of short glass fibers as fillers to limit crack propagation.[5]

Types of bulk fill:[6]

Base BFCs /Flowable/low viscosity bulk fills	Full body BFCs /Sculptable composites
Used as a liner/base in deep cavities. Due to lower filler loading, a conventional composite must be placed above as a capping material.	Used to fill the cavity in a single increment without an additional capping layer. Can be placed in stress-bearing areas due to higher filler content.

Properties:

1)Hardness:
It is defined as resistance to indentation or penetration.[2] In vitro microhardness testing using Vickers or Knoop hardness methods reveals that the microhardness of high-viscosity BFCs is comparable to some nanohybrid conventional composites.[7]
Low viscosity(flowable) BFCs exhibit lower microhardness values, which might be attributed to their decreased filler content.[7]

2)Degree of conversion (DC):
This refers to the number of C=C getting converted to C-C bonds. Several factors can influence the DC, such as the light source used, power density, wavelength, irradiation time, light tip size, photo-activation method, organic matrix formulation, distribution and quantity of inorganic fillers, type and quantity of the photo-initiators and color of the composite resins.[2] A minimum acceptable degree of conversion of >55% has been suggested by some authors for ensuring clinical success for most bulk-fill materials[8], except a few (e.g., Beautifil Bulk Restorative).[9,10,11,12,13]

3)Depth of cure (DOC):
The DOC is acknowledged as the thickness of the composite that is adequately polymerized under a given set of curing conditions.[14] Manufacturers claim that these materials claim can be cured up to a depth of 4-6 mm adequately without compromising the physical, mechanical, or biological properties.

4)Wear resistance:
Flowable bulk fills usually exhibit low wear resistance. Hence, a layer of conventional composite is recommended as a capping material over flowable bulk fills to protect them from occlusal wear.

5)Polymerisation shrinkage:
High viscosity RBCs shows smaller polymerization shrinkage than flowable BFCs. This is attributed to the increased filler content in high-viscosity BFCs. As the filler content increases, the monomer content decreases, leading to reduced polymerization shrinkage and shrinkage stress.[15]

6)Translucency:
BFCs are generally more translucent than traditional composites, which allows light to penetrate deeper into the restoration and promotes effective polymerization. Low-viscosity BFCs are notably more translucent than high-viscosity ones due to their lower inorganic filler content and a higher proportion of organic resin matrix. Pigments can influence translucency, as darker shades tend to be less translucent. Because of their high translucency, BFCs are typically not recommended for use in the anterior region, where masking underlying discoloration is necessary.[16]

Properties of some commercially available bulk fill composites:

1)Smart Dentin Replacement (SDR, Dentsply Sirona, USA)

SDR is a flowable bulk-fill composite that cures with visible light and can be applied in 4 mm increments while significantly mitigating polymerization stress. Its innovative design employs a patented urethane dimethacrylate framework, which substantially curtails polymerization shrinkage and stress, achieving an impressive shrinkage rate of just 3.5%, surpassing conventional flowable composites. The reduced stress is attributed to the larger molecular size of SDR resin, compared to conventional resins. Central to its design is a "Polymerization Modulator," a unique chemical component that, combined with the resin's high molecular weight and structural flexibility, enhances both elasticity and network optimization. Additionally, its self-leveling characteristics ensure it conforms precisely to cavity walls. In Class I and II restorations, SDR is intended to be used as a base or liner, requiring a final layer of methacrylate-based universal or posterior composite for ideal performance.

2) Ever X Posterior, GC, Tokyo, Japan

EverX Posterior is a fiber-reinforced composite engineered specifically for dentin replacement. Its short glass fibers form an optimal substructure, reinforcing composite restorations in larger cavities. These fibers are designed to inhibit crack propagation within the restoration, thereby significantly enhancing its fracture toughness. With an extended curing depth of 4 to 5 mm, it is particularly well-suited for deep posterior cavity restorations, offering robust durability in challenging cases.

3) Beautifil-Bulk Restorative, Shofu Inc., Kyoto, Japan

It incorporates Shofu's exclusive Giomer technology, featuring a bioactive surface pre-reacted glass (S-PRG) filler that releases six essential ions, including fluoride. This continuous fluoride release, along with its recharge ability, aids in long-term

prevention of caries. With a high filler content of about 87.0 wt%, it offers minimal shrinkage and exceptional flexural strength.

4) Activa BioActive-Restorative (Pulpdent Corp., Watertown, MA, USA)
It contains a bioactive ionic resin, rubberized resin, and ionomer glass. The bioactive ionic resin excels in releasing and recharging calcium (Ca^{2+}), phosphate (PO_4^{3-}), and fluoride (F^-) ions at a high rate. The durable rubberized resin, enriched with reactive glass ionomer fillers, not only releases fluoride effectively but also replicates the physical and chemical characteristics of natural teeth. Known for its bioactivity, particularly its fluoride-releasing capabilities, it also boasts low polymerization shrinkage (1.7%) and a substantial light curing depth of 4 mm.[17]

5)Sonic Fill™ 3 (Kerr Corporation)
SonicFill 3, has improved adaptation and is optimized for easier handling, sculptability, and polish. It's a sonic-activated bulk-fill composite system that eliminates the need for a liner or capping layer. Its features include 5 mm depth of cure, improved adaptation to internal walls and restoration margins and low shrinkage stress for lasting marginal integrity.

6) Filtek Bulk Fill (3M Espe)

This composite features an addition fragmentation monomer (AFM), which breaks apart during polymerization to relieve stress and then reassembles in a lower-stress environment. Another key resin component, aromatic urethane dimethacrylate (AUDMA), reduces the number of reactive groups in the resin, minimizing the creation of shrinkage zones. This results in significantly reduced shrinkage and stress during the polymerization process.

CONCLUSION

In conclusion, bulk-fill composites have revolutionized restorative dentistry by offering enhanced efficiency, reduced chair time, and improved depth of cure compared to traditional composites. Their ease of application and the ability to place them in thicker increments make them an attractive option for posterior restorations. However, attention to proper light curing, material properties, and clinical considerations are essential to ensure optimal outcomes. With ongoing advancements in composite technology, bulk-fill materials continue to evolve, offering greater versatility and durability for dental practitioners.

Declaration by Authors

Ethical Approval: Not Applicable
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Reis, A. F., Vestphal, M., Amaral, R. C. D., Rodrigues, J. A., Roulet, J. F., & Roscoe, M. G. (2017). Efficiency of polymerization of bulk-fill composite resins: A systematic review. Brazilian Oral Research, 31(Suppl 1), e59. https://doi.org/10.1590/1807-3107BOR-2017.vol31.0059
2. Abed, Y. A., Sabry, H., & Alrobeigy, N. A. (2015). Degree of conversion and surface hardness of bulk-fill composite versus incremental-fill composite. Tanta Dental Journal, 12(2), 98-106. https://doi.org/10.1016/j.tdj.2015.01.003
3. Par, M., Gamulin, O., Marovic, D., Klaric, E., & Tarle, Z. (2015). Raman spectroscopic assessment of degree of conversion of bulk-fill resin composites: Changes at 24 hours post-cure. Operative Dentistry, 40(3), E92-E101. https://doi.org/10.2341/14-267-L
4. Lima, R. B. W., Troconis, C. C. M., Moreno, M. B. P., Murillo-Gómez, F., & De Goes, M. F. (2018). Depth of cure of bulk-fill resin composites: A systematic review. Journal of Esthetic and Restorative Dentistry, 1–10. https://doi.org/10.1111/jerd.12422
5. Lempel, E., Őri, Z., Kincses, D., Lovász, B. V., Kunsági-Máté, S., & Szalma, J. (2021). Degree of conversion and in vitro temperature rise of pulp chamber during polymerization of flowable and sculptable conventional, bulk-fill and short-fiber reinforced resin composites. Dental Materials, 37(6), 983-997. https://doi.org/10.1016/j.dental.2021.03.010
6. Veloso, S. R. M., Lemos, C. A. A., de Moraes, S. L. D., do Egito Vasconcelos, B. C., Pellizzer, E. P., & de Melo Monteiro, G. Q. (2019). Clinical performance of bulk-fill and conventional resin composite restorations in posterior teeth: A systematic review and meta-analysis. Clinical Oral Investigations, 23(1), 221-233. https://doi.org/10.1007/s00784-018-2429-7
7. Kelić, K., Matić, S., Marović, D., Klarić, E., & Tarle, Z. (2016). Microhardness of bulk-fill composite materials. Acta Clinica Croatica, 55(4), 607-614. https://doi.org/10.20471/acc.2016.55.04.12
8. Par, M., Gamulin, O., Marovic, D., Klaric, E., & Tarle, Z. (2015). Raman spectroscopic assessment of degree of conversion of bulk-fill resin composites: Changes at 24 hours

post-cure. Operative Dentistry, 40(3), E92-E101. https://doi.org/10.2341/14-267-L
9. Yu, P., Yap, A., & Wang, X. Y. (2017). Degree of conversion and polymerization shrinkage of bulk-fill resin-based composites. Operative Dentistry, 42(1), 82-89. https://doi.org/10.2341/15-332-L
10. Yap, A., Pandya, M., & Toh, W. S. (2016). Depth of cure of contemporary bulk-fill resin-based composites. Dental Materials Journal, 35(3), 503-510. https://doi.org/10.4012/dmj.2015-322
11. Al-Ahdal, K., Ilie, N., Silikas, N., & Watts, D. C. (2015). Polymerization kinetics and impact of post polymerization on the degree of conversion of bulk-fill resin-composite at clinically relevant depth. Dental Materials, 31(10), 1207-1213. https://doi.org/10.1016/j.dental.2015.07.003
12. Tsujimoto, A., Barkmeier, W. W., Takamizawa, T., Latta, M. A., & Miyazaki, M. (2017). Depth of cure, flexural properties and volumetric shrinkage of low and high viscosity bulk-fill giomers and resin composites. Dental Materials Journal, 36(2), 205-213. https://doi.org/10.4012/dmj.2016-027
13. Ilie, N., & Fleming, G. J. (2015). In vitro comparison of polymerisation kinetics and the micro-mechanical properties of low and high viscosity giomers and RBC materials. Journal of Dentistry, 43(7), 814-822. https://doi.org/10.1016/j.jdent.2015.04.009
14. Jang, J. H., Park, S. H., & Hwang, I. N. (2015). Polymerization shrinkage and depth of cure of bulk-fill resin composites and highly filled flowable resin. Operative Dentistry, 40(2), 172-180. https://doi.org/10.2341/13-307-L
15. Jung, J. H., & Park, S. H. (2017). Comparison of polymerization shrinkage, physical properties, and marginal adaptation of flowable and restorative bulk-fill resin-based composites. Operative Dentistry, 42(4), 375-386. https://doi.org/10.2341/16-254-L
16. Paolone, G., Baldani, S., Masi, N., Mandurino, M., Collivasone, G., Scotti, N., Gherlone, E., & Cantatore, G. (2024). Translucency of bulk-fill composite materials: A systematic review. Journal of Esthetic and Restorative Dentistry, 36(1). https://doi.org/10.1111/jerd.13241
17. Lardani, L., Derchi, G., Marchio, V., & Carli, E. (2022). One-year clinical performance of Activa Bioactive-Restorative Composite in primary molars. Children, 9(3), 433. https://doi.org/10.3390/children9030433

How to cite this article: Faiza Javed, Fatima Siddiqui, Adeela Majid, Huma Iftekhar. Beyond traditional fillings: why bulk-fill composites are changing the game. *International Journal of Research and Review*. 2024; 11(10): 198-203. DOI: *https://doi.org/10.52403/ijrr.20241018*

******