REVIEW ARTICLE

# Semi-Split Bulk Filling Technique: A Key to Achieve Occlusal Bulk-Fill Resin Composite Restorations Free of Postoperative Sensitivity and Pain

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## ABSTRACT

Internal debonding and shrinkage-induced gap formation are reported to occur at the pulpal floor in large occlusal bulk-fill resin composite restorations placed using the bulk filling technique. Formation of such gaps is linked with persistent postoperative sensitivity and pain. The semi-split bulk filling technique, as a modification of the bulk filling technique, aims to re-direct the shrinkage displacement from axial to lateral within the composite bulk in such occlusal restorations and to prevent the occurrence of pulpal floor gap formation and subsequent postoperative sensitivity and pain.

**Key words:** Bulk filling technique, Bulk-fill resin composite, Debonding; Diagonal gap, Displacement, Polymerization shrinkage, Postoperative sensitivity, Pulpal floor gap, Semi split bulk filling technique, Stress reduction

## INTRODUCTION

Postoperative sensitivity is defined as pain in a tooth associated with mastication, or hot and cold stimuli that occurs one week or more after restoration.[1] This sensitivity is more likely to occur in resin composite restorations of larger and deeper cavity preparations and is related to high polymerization stresses generated in cavities with high C factor and result in resin debonding at cavity walls and/or margins. The internal debonding leads to gap formation at the pulpal floor that fills with fluid, which potentially leads to pulpal stimulation through flow of the accumulated fluid down dentinal tubules during mastication.[2]

Postoperative sensitivity is reported to occur in 4-mm deep occlusal bulk-fill resin composite restorations following placement using the bulk filling technique. In such restorations (Figure 1), the polymerizing resin is restrained by bonding to enamel and/or dentin of prepared cavity walls and floor, or even to itself. As such, it is not allowed to freely shrink and rather generates tensile forces. The restrained shrinkage generated in the top 2-mm composite region is greater than that in the bottom 2-mm composite region. This is due to bonding of the top composite to enamel and dentin of prepared cavity walls, as compared to bonding of bottom composite to dentin only of the pulpal floor and adjacent cavity walls. The greater restrained shrinkage in the top composite generates more axial shrinkage displacement than that in the bottom composite.[3-5] The increased axial displacement in the top composite exerts an upward pull on the bottom composite, debonding it from the pulpal floor and forming a shrinkage-induced gap at the pulpal floor beneath the resin.[6,7]

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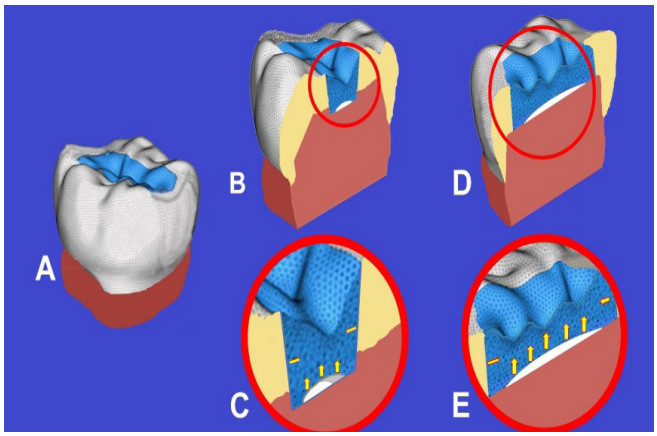


Figure 1. The bulk filling technique. **(A)** A large occlusal cavity restored with a 4 mm single bulk of bulk-fill resin composite and followed by light-curing. **(B)** Buccolingual and **(D)** Mesiodistal sections at the center of the restored tooth. **(C & E)** Close-up views at composite resin restoration showing composite debonding and gap formation at pulpal floor by upward bull of the bottom 2-mm composite region as a result of axial shrinkage displacement exerted by top 2- mm composite region.

The formed gap in the bulk filling technique is associated with persistent postoperative hypersensitivity and pain which occur in higher rates than in similar restorations placed using conventional composite resins and incremental techniques. The fluid filling the shrinkage-induced gap undergoes flow in and out of dentinal tubules upon contraction or expansion by exposure to cold or hot stimuli, or mastication.[8-11] It should be noted that scattered areas of bonding and shrinkage-induced gaps could coexist within the same restoration.[12]

While the shrinkage in light-polymerizing bulk-fill resin composites cannot be avoided, its undesired effect of forming shrinkage-induced gaps at the pulpal floors in large occlusal restorations can be prevented by creating semi-split gaps, prior to light curing.[13]

It is the objective of this paper to draw more attention to the occurrence of shrinkage-induced gaps at pulpal floors of large occlusal bulk-fill resin composite restorations placed using the bulk filling technique, and to also highlight their association with persistent postoperative sensitivity and pain. It additionally aims to present the semi-split bulk filling technique as a key for achieving large occlusal bulk-fill resin composite restorations free of such occurrences and consequences.

**The Semi-Split Bulk Filling Technique**

In the semi-split bulk filling technique (Figure 2), a 4-mm single increment of bulk-fill resin composite is placed into a large occlusal cavity, without light curing. An intentional gap is created in the top 2-mm region of the resin bulk by making a straight-line diagonal gap using Teflon-coated plastic filling hand instrument. This gap is 1.5 mm wide and extends 2 mm in the top composite (i.e.,1/2 of the resin bulk thickness), splitting it diagonally into two equal segments. Following light curing of the split bulk, the gap is filled with bulk-fill resin composite and light cured.

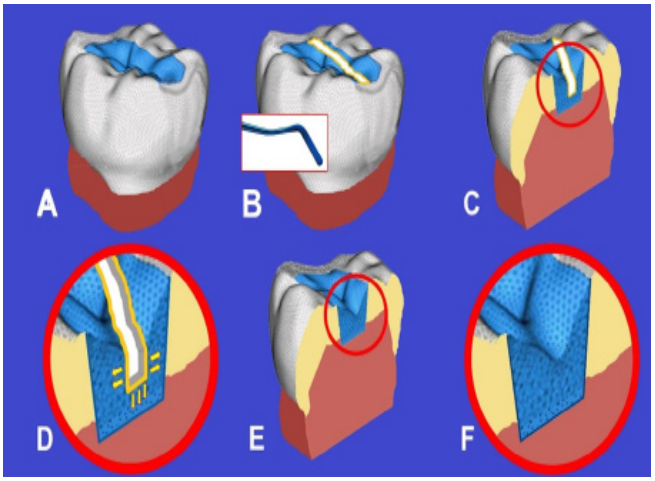


Figure 2. The semi-split bulk filling technique. **(A)** A large occlusal cavity restored with a 4-mm single bulk of bulk-fill resin composite, but not light-polymerized. **(B)** 1.5 mm wide gap created diagonally, prior to polymerization, using a flat bladed plastic filling instrument with rounded tip and extended half-way through the composite thickness and followed by light-polymerization. **(C)**

Buccolingual section at the center of the split, polymerized restoration showing absence of composite debonding from the cavity floor and ***NO*** pulpal gap formation. The magnitude of the axial displacement in the top 2-mm composite region is not high enough to exert upward pull on the bottom 2-mm composite and debond the pulpal floor and create a gap. **(D)** a close-up view of the split, polymerized composite bulk showing more lateral than axial shrinkage displacement in the top 2-mm composite region away from the gap center and towards the bonded cavity walls. **(E)** Buccolingual section view and **(F)** close-up view of the polymerized composite restoration following filling of the diagonal gap with the same bulk-fill resin composite and light polymerization.

In this technique, the diagonal gap created in the top resin prior to light curing acts as a weak joint, permitting itto deform independently of the bottom resin or tooth structure and undergo lateral (horizontal) displacement away from the diagonal gap center and towards the bonded cavity walls. This would prevent axial (vertical) pulling of the less-cured

and less-hardened resin in the bottom region and creating shrinkage-induced gap.

It is worthy to mention that a research study is underway to validate the use semi-split bulk filling technique in achieving a large occlusal bulk-fill resin composite restoration free of postoperative sensitivity and pain.

## CONCLUSION

The use of the semi-split bulk filling technique for restoring large occlusal bulk-fill resin composite restorations can prevent the formation of shrinkage-induced gap at the pulpal floor beneath the restoration. It would eventually prevent the occurrence of persistent postoperative sensitivity and pain.

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