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## RESEARCH ARTICLE

### SURVIVAL OF DIRECT POSTERIOR COMPOSITE WITH AND WITHOUT A BULK FILL BASE

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#### ABSTRACT

**Objectives:** Bulk fill base has been generated to help in decreasing the time elapsed in filling posterior teeth with composite resin by conventional layering technique. This review to show the life time of posterior filling teeth by direct composite with and without bulk fill base.

**Data sources:** pubmed, Google Scholar, have been searched for papers that addressed the rule of bulk fill base usage in lifetime of direct posterior composite restoation. It was clear that using bulk fill base under conventional composite in posterior teeth is more prone to failure by increased polymerization shrinkage stresses which lead to tooth fracture and liability for secondary caries neither than conventional layering technique which has more success percentage but showed more liability for composite filling fracture.

#### INTRODUCTION

Since the introduction of light curable composites, dentists have been required to place the material in increments. These composites require light (in the proper wavelength) to excite a photo-initiator, which begins the polymerization process. If the light penetration is insufficient, poor initiation of this reaction can result, which can lead to under-cured or uncured material. The depth of cure of a composite is determined by the monomers, the initiators and the shade/opacity of the material Fan, 2002. Additionally, the effectiveness of the light is influenced by many factors including the wavelength, the light intensity, the distance from the light source, and the exposure time. Dentists use incremental placement techniques for a variety of reasons in addition to the cure depth of the composite. Incremental placement is used to manage the shrinkage and corresponding shrinkage stress Burgess and Cakir, 2010, resulting from the polymerization reaction. Incremental placement allows for more precise manipulation of the restorative to ensure adaptation, particularly at the cavosurface. It reduces the possibility of voids and aids in forming contacts and sculpting the occlusal surface prior to cure. Managing the shrinkage stress and ensuring proper adaptation may reduce the incidence of post-operative sensitivity. Additionally, incremental placement readily lends itself to creating multi-shade restorations. On the other hand, incremental placement is considered time consuming and tedious, especially in posterior teeth.

Increments may increase the potential of voids to form between composite layers, and composites must be placed in a dry field. The risk of contamination leading to a compromised restoration is adversely impacted by the time it takes to place, adapt and cure each increment. In an effort to provide materials that address the challenges of incremental placement, and also provide an alternative material to amalgam, packables were launched in the late 1990s. These materials had a high viscosity and contained a high filler load Tiba et al., 2013. Manufacturers claimed the handling was amalgam-like and the material stiffness aided in forming contacts. In addition, many of the packables were reported to have the capability of being bulk placed, i.e., to be placed and cured in 4-5 mm increments. However, the high viscosity of these composites made adaptation to the cavosurface more challenging. The actual depth of cure of these materials was found to be less than claimed. Even if the adequacy of cure was acceptable, the clinical ramifications of shrinkage stress became more prominent with thicker (4-5 mm) layers. Studies have shown that many of these materials still had high shrinkage and polymerization stress Cheung, 1990. The field of materials science has made remarkable advancements with composite filling materials used for direct procedures, which offer dentists solutions to many of the issues that they see every day. It is pretty widely understood in the scientific and dental communities that bulk filling a restoration increases stresses on the tooth, and can decrease bond strength Park et al., 2008. However, with the capabilities of materials currently available to manufacturers, it is possible to create materials/products that offer lower polymerization shrinkage stress when compared to incrementally placed composites.

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**Table 1. Some available bulk fill materials, the general properties and their indications. adapted from ivoclar vivodent**

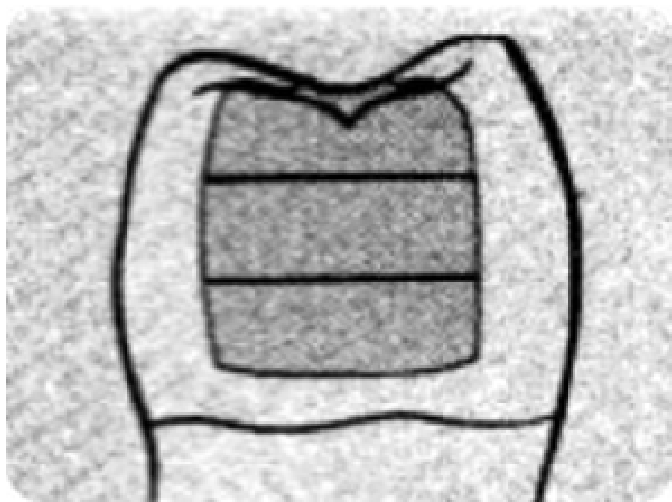
Product	Consistency	Increment thickness	Mode of action:increase depth of cure	Mode of action:reduced shrinkage stress	Indications
SDR(dentsply)	Flowable	4mm	Increased translucency	Flexible resin backbone	Extended flowable base
Venus bulk fill(heraerus kuzler)	Flowable	4mm	Increased translucency	Not described	Extended flowable base
Filtek bulk fill(3m)	Flowable	4mm	Increased translucency	Not described	Extended flowable base
Xtra base(voco)	Flowable	4mm	Increased translucency	Not described	Extended flowable base
Quixifil(dentsply)	Restorative	4mm	Not described	Low shrinkage	Single material build up
Xtra fill(voco)	Restorative	4mm	Not described	Not described	Single material build up
Tetric evoceram bulkfill(ivoclar) evoceram	Restorative	4mm	Modified photo initiator	Low shrinkage	Single material build up
Silorane(3M)	Restorative	2.5mm	N/A	Ring opening polymerization low shrinkage	Single material build up
Sonic fill(kerr)	Restorative sonic activation to make flowable	5mm	Increased photo initiator	High filler load low shrinkage	Single material build up

## Techniques for posterior teeth composite filling

### Incremental layering technique: There are two types for incremental layering techniques

#### Horizontal incremental technique

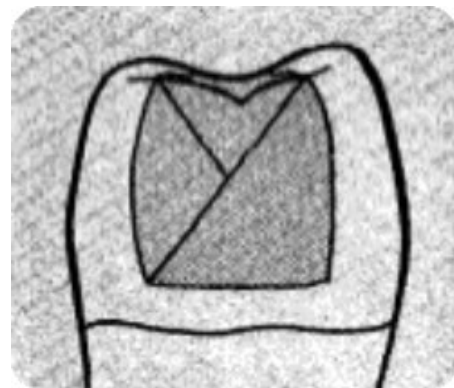
The composite resin is placed inside the cavity in multiple increments. Each increment is light-cured individually. The increments are placed in parallel with each other (Fig. 2). A maximum layer thickness of 2 mm is recommended to provide adequate curing.



**Figure 1. Horizontal incremental filling b.Oblique incremental technique:**

Also known as Z-technique, a method developed to reduce the C-factor. The composite resin is placed inside the cavity in multiple increments so that each increment is in contact only with the bottom and one side wall of the cavity (Fig. 3) Asmussen, 2009.

This results in a relative increase in the free surface of the filling material, and a decrease in the extent of polymerization shrinkage.



**Figure 2. Oblique incremental filling**

One of the objectives of the layering technique is to reproduce the optical properties of the natural tooth by using the correct translucency and opacity for each layer Nash, 2010. An important advantage of working in increments is the possibility of simulating different opacities, shades, and translucency characteristics of enamel and dentin, which can be customized during buildup. The use of incremental layers helps to decrease the stress generated by resin composite polymerization shrinkage because it reduces the configuration factor (the number of bonded walls divided by the number of free surfaces Chi, 2006).

However, precision is needed for each clinical step and specific care must be given to materials that become highly sensitive during handling; the final functional and esthetic result may be compromised if the clinician does not control each layer. Therefore, the filling technique for posterior teeth should guarantee a precise fit for the material, especially to the margins of the cavity; proper anatomic reconstruction; and

reduction of the inherent shrinkage stress generated by polymerization contraction. In the presented layering technique, three different composite layers are used. After the margin of the cavity is finished, a self-etching adhesive can be used due to the consistency of results on dentin, especially those using 10-methacryloyloxydecyl dihydrogen phosphate monomers. On enamel, a selective enamel-etching approach is recommended before using the self-etching adhesive system. The first layer applied has to be a composite resin of the correct dentin, opaque, or body shade. A high saturation A3.5color also is necessary to reproduce the natural look of dentin and to block potential stains from previous amalgam fillings. There is no need for shade matching in posterior teeth because the thickness and levels of opacity and translucency are more important in this region. The key for matching the perfect shade in posterior teeth is to combine dentin layering in its proper thickness, as well as the enamel or translucent layer.

### Bulk fill base technique

The bulk-fill technique is simple when compared with the traditional incremental layering technique just described because specific composites have been developed to simplify the steps, thus avoiding having to place several layers of varied shades Watts et al., 2012. A technique modification has been suggested in an attempt to simplify the steps, based on the premise that incremental layering may not always be necessary. The rationale behind this method is that if the composite is placed in one shot, then a sculpting process similar to that used for amalgam can be used.

The adhesive system application is identical to what has been described previously. After photo curing of the dental adhesive, a layer of flowable composite with a thickness of up to 4 mm is applied on the bottom of the cavity and cured for 20 seconds Jackson, 2014. Low-shrinkage bulk-fill composites can be used safely to fill posterior cavities, as long as the cavities are up to 4 to 5 mm deep; the situation may vary, depending on the manufacturer, and it is important to check instructions. With these materials, a cavity can be filled with fewer layers. Two consistencies are available for the bulk-fill composites: flowable consistency (used as a base or liner) and regular consistency (used to fill and restore in one shot). The bulk-fill technique presented here is called a "two-step amalgam-like sculpting technique," referring to the use of a flowable bulk-fill composite to build the core in a single layer of up to 4-mm thickness, leaving 1.3 mm of space occlusally from the margin for the last layer. Then, a regular composite is used to allow completion of the occlusal surface.

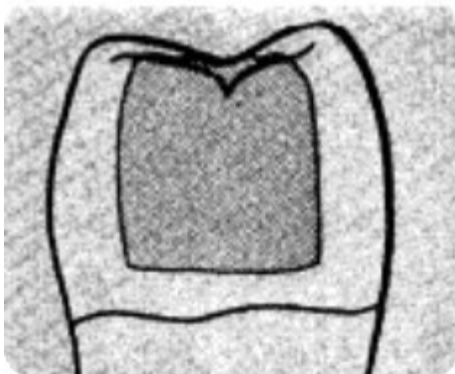


Figure 3. Bulk-fill

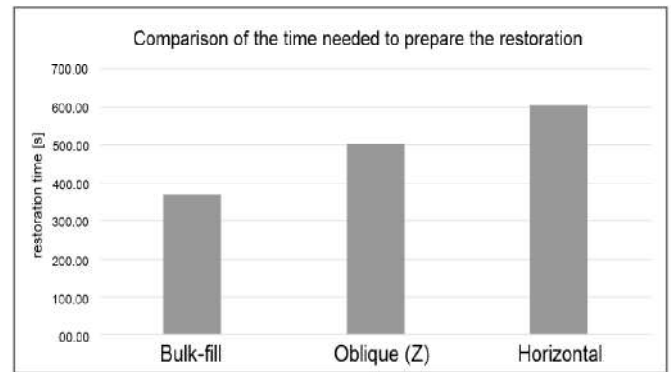


Figure 4. Comparison of the times required to prepare the restoration

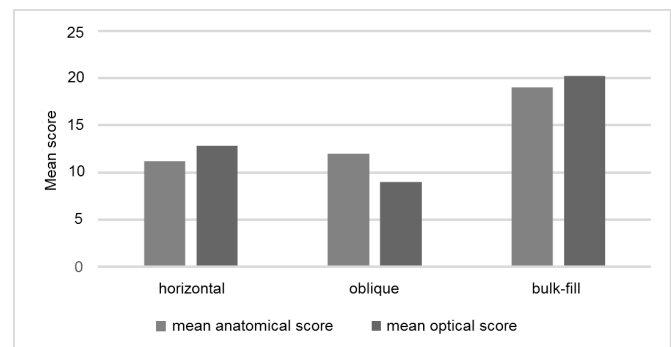


Figure 5. Comparison of optical and anatomical characteristics

### Other aspects that influence longevity and survival of the restoration

#### Number of walls included during composite loading

Retrospective studies have shown that increasing the number of surfaces leads to increased failure rate, this has been illustrated as increasing the number of walls for each composite layer leads to increasing the number of walls undergone to polymerization shrinkage stresses. Multi-surface restorations, extensive cavities, and Class II restorations, are more likely to fail than single-surface and Class I restorations.

The presence of cuspal coverage also produced an increased failure rate when all restorations were considered as a whole. It is well-known from in-vitro studies on extracted teeth that the polymerization of composite can cause cusp deflection Mc Guirk et al., 2017. One such study showed that the bulk-fill flowable base did significantly reduced cuspal deflection following polymerization compared with a conventional composite restored with a conventional technique. While this suggests that the polymerisation contraction stress conveyed to the cusps is reduced due to the more flexible monomer present it may also result in reduced restoration rigidity and support of the cusps in vivo.

#### Cavity size and type

Increasing cavity size make filling is mor prone to failure whatever the technique used. It therefore appears that the size and extent of cavity are related to survival; appropriate case selection is important in minimizing failuresKubo,S.,2011. This may be more important than the choice of restoration technique.

## Operator

It is generally acknowledged that the operator is probably the most important factor in the longevity of a dental restoration. However, evidence from clinical studies does not support this assumption. Clinical studies on posterior restorations and clinical procedures in which more than one operator was involved, do not reveal differences in study outcome among the operators. It is likely that every dentist who is aware that his work is involved in a clinical trial will work as accurately as possible, resulting in fewer operator failures that could influence the study outcome. However, secondary data studies suggest that the operator significantly influences the longevity of a restoration and mention relevant factors such as age, country of qualification and employment status.

## Patients

Although evidence is limited, it is likely that the type of patient and the oral environment play an important role in the survival of dental restorations. The caries risk of patients has been shown to significantly influence the longevity of restorations. Among the selected studies, several investigated the caries risk and found increased risk of failure of restorations placed in patients with caries risk. Restorations in a high-caries risk group had a failure rate more than twice as high compared to low-risk patients. In that study, the caries risk was established by the treating dentist based on the dental history and the expected risk of new lesion. Another study that used a caries risk assessment also showed that high-caries risk patients have increased risk of failure of posterior composite restorations. In a study on direct posterior restorations in children, those with a high DMFT index had an increased risk of restoration failure.

## MATERIALS

In vitro studies on the properties of resin composites for the restoration of posterior teeth have shown considerable differences among commercially available materials. Differences in flexural and compressive strength, elastic modulus, fracture strength and toughness, hardness, and wear resistance Nayif et al., 2008. Among others, have been shown to be significantly different among materials when laboratory techniques were used to compare the restoratives Frauscher, 2012. Despite these considerable differences, which were usually considered to be a result of differences in organic matrix components, filler loading, or particle morphology/size, only minor differences in the clinical behavior of composite restorations placed with different composite materials are often described in clinical studies.

## Advantages and disadvantages of both techniques

	Incremental layering technique	Bulkfill base technique.
Time of procedure	Long	Short
Polymerization shrinkage	Less percentage	Higher percentage
Marginal seal	Better and adequate	More liability for gap formation
Secondary caries formation	Less prone for formation	More prone for formation
Esthetics	Higher esthetics	Less esthetics
Voids formation	Low	High
Liability for tooth fracture	Low	High
Liability for restoration fracture	High	Low
Occurrence of cusp deflection	High	Low

## Summary

The bulk-fill technique appeared to be better in terms of the time required to prepare the restoration; however, the placement of the composite in one bulk could lead to the deterioration of shape and esthetics. The most frequent cause of composite restoration failure is the development of secondary caries and fracture for both the tooth and restoration. In the vast majority of cases, secondary decay develops owing to insufficient marginal sealing. This develops due to the shrinkage of the composite resin during polymerization. Polymerization shrinkage can be reduced by the use of appropriate incremental technique. It was clear that tooth fracture was more related to bulk fill technique, whether composite filling fracture was more related to incremental layering technique. Therefore, the appropriate choice of the incremental technique can positively influence, i.e., reduce the polymerization shrinkage, with less shrinkage resulting in better marginal sealing, and a satisfactory marginal sealing in turn decreasing the risk for the development of secondary caries. Based on these, the use of the appropriate incremental technique reduces the development of secondary caries, thereby increasing the longevity of composite restorations.

## Ethical statement

This review article does not require ethical approval.

## Conflict of Interest

The author of this manuscript has no conflict of interest to declare.

## REFERENCES

- Asmussen, E. 2009. Composite restorative resins: composite versus wall to wall polymerization contraction. *Acta Odontologica Scandinavica*, 33(6). pp: 337-344.
- Bouschlicher, MR., Rueggeberg, FA., Wilson, BM., 2004. Correlation of bottom-to-top surface microhardness and conversion ratios of various resin composite compositions. *Oper Dent.*; 29(6).pp:698-704.
- Bowen, RL., Nemoto, K., Rapson, Je. 1983. Adhesive bonding of various materials to hard tissues: forces developing in composite materials during hardening. *Journal of American Dental Association*, 106(4).pp: 475-477.
- Burgess, J. and Cakir, D. 2010. Comparative properties of low-shrinkage composite resins. *Compendium of Continuing Education in Dentistry*, 31(2).pp:10-15.
- Cheung, GS., 1990. Reducing marginal leakage of posterior composite resin restorations: A review of clinical techniques. *J Prosthet Dent.*; 63(3).pp:286-288.
- Chi, HH. 2006. A Posterior Composite Case Utilizing the Incremental and Stratified Layering Technique. *Operative Dentistry*, 31(4).pp: 512-516.
- Czasch, P. and ilie, N. 2013. In Vitro comparison of mechanical properties and degree of cure of bulk fill composites. *Clinical oral investigation*, 17(1).pp:227-235.
- Demarco, FF., Correa, MB., Cenci, MS., Moraes, RR., Opdam, NJM., 2012. *Longevity of posterior composite restorations: Not only a matter of materials. Dental Materials*, 28(1).pp:87-101.

- Fan, Pl. 2002. Curing-light intensity and depth of cure of resin-based composites tested according to international standard. *JADA.*, 133(4)pp:429-434.
- Frauscher, Ke., and Ilie, N. 2012. Depth of cure and mechanical properties of nano-hybrid resin based composites with novel and conventional matrix formulation. *Clinical Oral Investigations*, 16(5).pp:1425-1434.
- Goldman, M.1983. Polymerization shrinkage of resin based restorative materials. *Austrian Dental Journal*, 28(3).pp:156-161.
- Hansen, EK.1986. Effect of cavity depth and application technique on marginal adaptation of resins in dentin cavities. *Journal of Dentistry Research* ,65(11). pp: 1319-1321.
- Ilie, N. and Hickel, R. 2011. Investigations on methacrylate based flowable composite based on sdr technology. *Dental Materials* ,27(4).pp:348-355.
- Ilie, N., Bucuta, S., Draenert, M. 2013. BulkFill Resin Based Composites; An In Vitro Assessment of Their Mechanical Performance. *Operative Dentistry*;38(6).pp:618--625.
- Jackson, RD. 2014. Posterior composites and the new bulk-fill materials. *Inside Dentistry*,10(8).pp:68-75.
- Kubo, S., 2011. Longevity of resin composite restorations. *Japanese Dental Science Review*, 47(1).pp: 43-55.
- Lenhard, M., 2009. *Large composite restorations in the posterior region. International Dentistry SA*, 11(5).pp:50-60.
- Mc Guirk, C., Hussain, F., Millar , BJ. 2017. Survival of Direct Posterior Composites With and Without a Bulk Fill Base. *Eur J Prosthodont Restor Dent.*, 25(3).pp:136-142.
- Mcculloch, AG. and smith, BG. 1986. In vitro studies of cusp reinforcement with adhesive restorative material. *British dental journal*,161.pp:450-452.
- Nash ,R.,2010. Patient demand is increasing for posterior aesthetics. *Dent Today*.pp: 29:74, 76, 78-79.
- Nayif, M., Nakajima, M., Foxton, R., M., Tagami, J. 2008. Bond strength and ultimate tensile strength of resin composite filled in to dentine cavity;effectofbulk and incremental filling technique. *JDent*, 36.pp:228-234.
- Park, J., Chang, J., Ferracane, J., Bog Lee, I. 2008. How should composite be layered to reduce shrinkage stress: Incremental or bulk filling? *Dental Materials*,24(11) pp: 1501-1505.
- Tantbirojn, D., Pfeifer, CS., Braga, RR., Versluis, A., 2011. Do low-shrink composites reduce polymerizaon shrinkage effects?. *J dent res*, 90.pp:596-601.
- Tiba, A., Zeller, GG., Estrich, CG., Hong, A. 2013. A laboratory evaluation of bulk-fill versus traditional multi-increment fill resin based composites. *J Am Dent Assoc.*, 144(10)pp: 1182-1183.
- Watts, DC., Elsafty, S. Silikas, N. 2012. Creep deformation of restorative resin composites intended for bulk fill placement. *Dental Materials*; 28(8).pp:928-935.

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