Esthetic rehabilitation of posterior teeth using bulk-fill composite

Masahi Miyazaki[1]

Introduction

In modern restorative dentistry, a strong emphasis is placed on preserving healthy tooth structure and achieving esthetic results. The use of direct composite restoratives can assist in meeting these demands.

Composite resins have become widely accepted in dentistry as direct placement restorative materials for posterior teeth. The advances made in adhesive technology as well as the improvement of the mechanical properties of composite resins (e.g. wear resistance) have contributed to this development. Nevertheless, the polymerization shrinkage and limited curing depth of composite resins continue to be a concern to the clinician. Polymerization shrinkage of composite restoratives has been associated with micro-leakage, de-bonding of the restoration as well as increased risk of secondary caries or postoperative sensitivity. To reduce the rate of polymerization shrinkage, incremental filling techniques have been recommended for many years. The reduced shrinkage per composite layer is believed to minimize the total volumetric shrinkage.[1]

Even though incremental layering may be necessary to ensure adequate polymerization of the composite resin, there are also some disadvantages to this technique. For example, air entrapment between the different layers may occur. Moreover, the fact that incremental placement requires considerable time may render the restorative procedure excessively long. The controversy among researchers and practitioners with regard to the appropriate placement technique, namely, incremental layering versus bulk placement, continues to persist. In recent years, dental manufacturers have gone to considerable lengths to develop bulk-fill composites that demonstrate lower shrinkage stress during polymerization and offer much greater depth of cure. The goal behind these efforts has been to shorten the duration of the restorative procedure.[2] In the meantime, several posterior composites of this type have been launched on the market. What dentists need now is some sort of guideline for their application in concrete clinical situations.

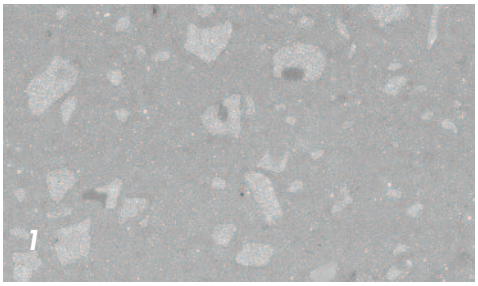
Advantages and limitations of direct composite resin restorations

A major advantage of adhesive composite restorations in posterior teeth is the possibility of preserving healthy tooth structure. Unlike indirect procedures, the direct restorative technique with composite requires only minimal removal of sound tooth structure. Preparation to gain access to the lesion is normally limited to the affected area. Nevertheless, the shape of the cavity should be adjusted to match the restorative material. Elimination of slightly undermined enamel is not always necessary because adhesive composite resin restorations may contribute to the stabilization of the remaining tooth structure.

As a result of the shrinkage stress that occurs during the light-curing of composite resin, there are restrictions with regard to the placement technique employed. Studies have shown that the magnitude of the stress generated is dependent on a combination of the material properties and characteristics of the prepared cavity. Contributing factors include the confinement conditions imposed on the composite, the volume of the restoration, the restorative techniques used and the suitability of the bonding substrate. When restoring cavities with a high C factor, the resultant stress puts the resin-tooth interface under increased tension because there is less free, non-bonded surface. An increase in the C factor is associated with potentially deleterious effects on the marginal integrity and the formation of gaps.[3] Alternatively, high bond strength may cause cusp deflection and cracking of the enamel.

[1] Prof. Dr Masahi Miyazaki, Tokyo/Japan

Contact details:
Prof. Dr Masashi Miyazaki
Nihon University School of Dentistry
Department of Operative Dentistry
1-8-13, Kanda-Surugadai,
Chiyoda-ku Tokyo 101-8310
Japan
miyazaki-m@dent.nihon-u.ac.jp



Figures 1 and 2: SEM of the filler composition and surface structure of Tetric N-Ceram Bulk Fill (magnification: 200x)

Methods of lowering the shrinkage stress

Polymerizing low-volume increments may minimize the resulting shrinkage stress and maximize double bond conversion of the monomers to a polymer. Compared with bulk-filling techniques, incremental filling produces lower shrinkage stress (up to a certain threshold thickness of the composite layer). Incremental placement techniques have the advantage of maximizing the polymerization of each increment because of the reduced attenuation of light through the smaller increments of material and better adaptation of the composite to the cavity walls.[4] Nevertheless, the value of incremental placement in reducing shrinkage stress has been repeatedly questioned.[5] The contradictory conclusions at which studies have arrived might be due to differing testing methods.

Apart from low residual stress and good adaptation, thorough polymerization of the composite resin is an important factor for restorative success. The main concern about the bulk-filling technique is whether the composite cures sufficiently in the deeper portions, as this is a prerequisite for any filling with acceptable physical and biological properties. Recently, several so-called low-shrinkage stress materials have been launched on the market. The majority of them are more translucent than conventional composites. They feature a modified initiator system which allows them to be placed in increments of up to 4 mm thickness (bulk-filling technique), but still ensures a reliable cure with short irradiation times. Bulk-fill materials have been reported to demonstrate significantly less shrinkage stress than conventional posterior composite resins.[6]

Trouble-free restoration

In the restoration of teeth with composite resin, incremental layering is generally preferred because it reduces gap formation at the adhesive interface and the postoperative sensitivities associated with it. However, multiple layers of highviscosity composite may be difficult to place. Recent studies have suggested that fewer increments and even bulk filling can be equally successful. However, the unavailability of suitable bulk-fill materials has discouraged clinicians from employing such techniques.[7] Today, various dental manufacturers have expanded their offering to include lowershrinkage composites, allowing clinicians to achieve reliable and predictable results with the bulk-filling technique.

Bulk-fill composites should offer high depth of cure. This is achieved by means of the photoinitiator Ivocerin® for example, which is employed by Ivoclar Vivadent. Good mechanical properties such as high flexural strength and wear resistance are also important in order to make a composite resin suitable for use in occlusion bearing areas.[8] Tetric® N-Ceram Bulk Fill from Ivoclar Vivadent combines all of these qualities. This light-curing posterior composite has been specifically developed for the bulk-filling technique. Increments of up to 4 mm thickness can be cured in only 10 seconds at a light intensity of > 1,000mW/cm2. Tetric N-Ceram Bulk Fill contains four different types of fillers: a barium aluminium silicate filler, ytterbium trifluoride and mixed oxide. Additionally, a prepolymer filler (a shrinkage stress reliever) has been incorporated which keeps polymerization shrinkage and shrinkage stress to a minimum (Figs 1 and 2). It acts like a spring, dampening the forces generated during polymerization. As a result, gap formation and marginal leakage are minimized, thereby helping to eliminate the risk of secondary caries and postoperative sensitivity.

The photoinitiator system in Tetric N-Ceram Bulk Fill includes conventional initiators as well as the polymerization booster Ivocerin. This polymerization booster ensures a reliable depth of cure in the deeper portions of the cavity after a relatively short irradiation time. A special light sensitivity inhibitor has also been incorporated which makes the composite resin less sensitive to

Figure 3: Preoperative situation: The restoration of the upper posterior tooth shows a marginal fracture.

Figure 4: After the rubber dam has been placed, the restoration as well as carious tissue are removed.

Figure 5: Prior to the application of the adhesive, the cavity is etched with phosphoric acid.

ambient light and thus gives the clinician more time to apply and contour the restoration. Another useful quality of this material is its good polishability, which supports the achievement of a glossy surface, excellent resistance to wear in the contact areas and a high flexural strength of 120 MPa. Moreover, Tetric N-Ceram Bulk Fill is highly radiopaque; therefore, the restorative result is easy to examine on dental radiographs

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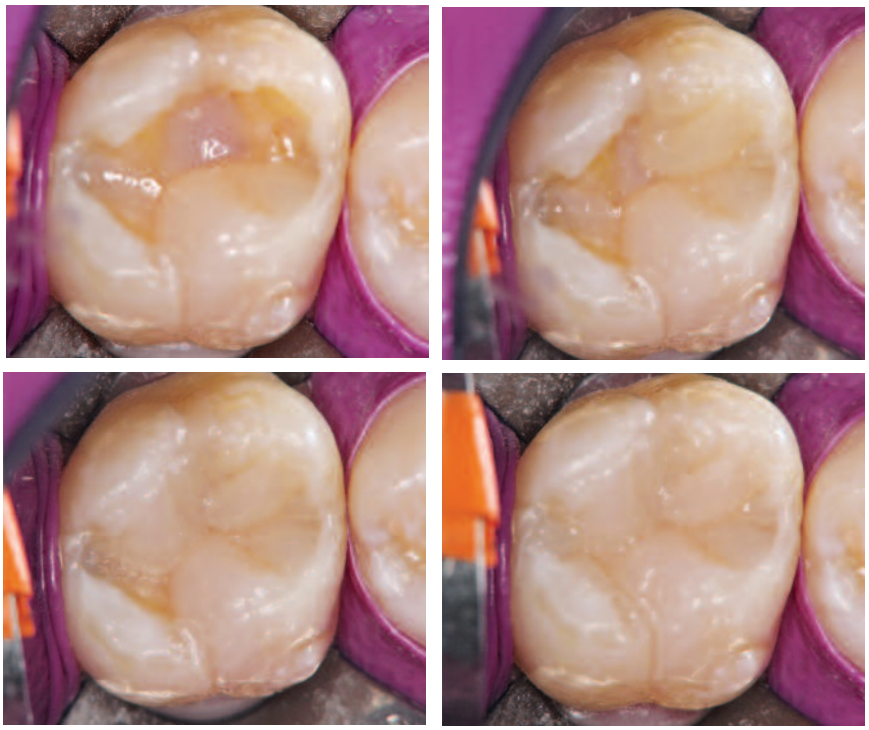
A clinical case

The shade of the composite to be used should always be selected at the start of the appointment, i.e. before the rubber dam is placed. This prevents incorrect colour matching due to dehydration. After the carious tissue has been removed (Figs 3 and 4) and the adhesive has been applied (Fig. 5), the entire restorative procedure can be performed with Tetric N-Ceram Bulk Fill. As a consequence, a uniform restoration featuring homogeneous strength is achieved. Because of the material's natural-looking translucency, the shade of the restored site will blend in with the remaining tooth structure. If stained substrate is visible within the cavity, the clinician may opt to place a layer of Tetric® N-Flow Dentin first. This material has a higher opacity and is thus capable of masking the darker colour of the underlying dentin.

Although the incremental technique has been advocated for the reduction of shrinkage stress, the composite resin described above is an ideal option for the restoration of deeper cavities using the bulk-filling technique. The successive build-up technique makes it possible to ensure correct occlusal morphology through the incremental placement of composite. Thin-bladed placement instruments and special



Figures 6 to 9: The anatomical features of the cusps are successively rebuilt until an ideal occlusal anatomy is achieved.

Figure 10: Carbide burs are recommended for the removal of marginal overhangs.

Figure 11: Final polishing is performed with Astrobrush.

brushes are used to sculpt and contour the restored site. The composite is applied in bulk increments to rebuild each anatomic entity of the affected area. Each cuspal portion is reconstructed with one increment of composite resin, imparting to each of the cusps its adequate anatomical form.

The size and location of the cavity determines the number of increments needed. Relatively small Class I cavities can be filled with a single bulk increment. Medium-sized and large cavities are restored with several increments. Each cusp is rebuilt with an increment of maximum 4 mm thickness. Anatomical features of the occlusal surface should be taken into consideration during the application of the composite resin to mimic the natural tooth structure. Insensitivity to light is a considerable advantage of Tetric N-Ceram Bulk Fill, as it ensures that sufficient time is available to shape and contour the restoration (Figs 6 to 9).

If the composite resin is carefully placed using suitable instruments, only little time is required for the contouring and finishing of the restoration. Hand instruments such as LM Arte-Eccessa (LM Dental) are recommended for the removal of composite excess. Marginal overhangs can be removed with carbide burs (Fig. 10). Composite finishers are then used to refine the anatomical features. Polishing can be accomplished with ease and in one step using Astrobrush® (Fig. 11). The result is an esthetic posterior restoration without postoperative sensitivity (Figs 12 and 13).

Conclusion

Direct composite resin restorations can be performed in a predictable and efficient way if an appropriate technique and advanced materials are used. As the understanding of the characteristics of new filling materials improves among clinicians, the quality of the direct restorations they fabricate will also increase. Tetric N-Ceram Bulk Fill with its many innovative features enables clinicians to restore posterior teeth in a much more efficient way. Proper attention to technological advances in the field of restorative therapy allows esthetic treatment to be provided that will satisfy not only the patient but also the dentist performing the restorative procedure.

A literature list is available from the editors on request.
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Figures 12 and 13: The result is an esthetic posterior restoration without postoperative sensitivity.