Esthetic rehabilitation of posterior teeth using Bulk-Fill Composite

By Prof. Dr Masashi Miyazaki

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 in-marginal micro-leakage, de-bonding of the resin-tooth interface and the formation of gaps. A high bond strength may cause cusp deflection and cracking of the enamel. 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 thickness) and the composite layer. Incremental placement techniques have the advantage of maximizing the polymerization of the composite resin. 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 resins 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 technique 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. Nevertheless, the value of incremental placement in reducing shrinkage stress has been repeatedly questioned. The contradictory conclusions at which studies have arrived might be due to differing testing methods. Composite restoratives suitable for the bulk-filling technique need to fulfill certain requirements. Among other things, they should demonstrate low polymerization shrinkage and ensure a high depth of cure. 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 consistent than conventional composites. They feature a modified initiator system which allows them to be bulk filled 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.

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 thickness) and the composite layer. Incremental placement techniques have the advantage of maximizing the polymerization of the composite resin.

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 excessive 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 depths of cure. The goal behind these efforts has been to shorten the duration of the restorative procedure. 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 resins 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 technique 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. Nevertheless, the value of incremental placement in reducing shrinkage stress has been repeatedly questioned. The contradictory conclusions at which studies have arrived might be due to differing testing methods.

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Problem-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 high-viscosity 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. Today, various dental manufacturers have expanded their offering to include lowshear viscosity 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 Iovicer® for example, which is employed by Ivo- clav Vivadent. Good mechanical properties such as high flexural strength and corrosion 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). The correct colour matching due to dehydorization. After the composite has been removed (Figs 5 and 6) and the adhesive has been applied (Fig. 5), the entire restoration can be rebonded with Tetric N-Ceram Bulk Fill. As a conclusion, a uniform contour can be obtained with the increments used. Because of the material’s natural-looking translucency, the shade of the restored site will blend in with the remaining tooth structure. If stained substrates are 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 tech- nique 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 tech- nique makes it possible to en- sure correct occlusal morphol- ogy through the incremental placement of composite. Thin- layered placement instruments and special brushes are used to sculpt and contour the restored site.

The composite is applied in bulk increments to rebuild each anatomical entity of the affected area. Each cuspal portion is recon- structed with one increment of composite resin, imparting to each of the cusps its adequate anatomical form.

The size and location of the cav- ity determines the amount and advanced materials are used. As the understanding of the charac- teristics of new filling materials improves among clinicians, the quality of the final 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 proce- dure. Full list of references is avail- able from the publisher.

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

Fig. 11. Final polishing is performed with Astrobrush.

Figs 12 and 13. The result is an esthetic posterior restoration without postoperative sensitivity.

**CAD CAM Technology: A Review**

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**CAD CAM technology and materials are currently used in a number of clinical applications, including the fabrication of indirect restora- tions. CAD/CAM gives both the dentist and the laboratory an opportunity to automate fixed restoration fabrication. Both chairside and laboratory automated manufacturing processes are available. The properties of these restorative materials and their indications and approp- riate use must be under- stood in order to enable the achievement of predictable and esthetic results for patients.**

**KEYWORDS:**

CAD/CAM systems

Intraoral scanner

Digital impression

Introduction

In the past decade, the demand for all-ceramic restorations has increased in both anterior and posterior teeth and the search for materials with improved properties has expanded. The need for a uniform material quality, reduction in produc- tion cost, and standardization of manufacturing process has encouraged researchers to seek to automate the manual process via the use of CAD- CAM technology since 1980.

Computer-aided design (CAD) and computer-aided manufactur- ing (CAM) technology sys- tems use computers to collect information and design, and to manufacture a wide range of products. The introduction of this first digital intraoral scan- ner for restorative dentistry was in the 1980s by a Swiss dentist, Dr. Werner Mäormann, and an Italian electrical engi- neer, Marco Brandestini, that developed the concept for what was to be introduced in 1987 as CEREC® by Sirona Dental Systems LLC (Charlottesville, VA), the first commercially CAD- CAM system for dental resto- rations.4 Ever since research and development sectors at a lot of companies have improved the technologies and created in-office intraoral scanners.

All the existing intraoral scan- ners try to face with problems and disadvantages of tradition- al impression fabrication pro- cess and are driven by several non-contact optical technolo- gies and principles.

The purpose of this present publication is to provide an extensive review on the CAD- CAM technology and to em- phasise on the application of this technology in restorative dentistry.

**CAD/CAM techniques**

The major goals of the impres- sion – taking process in restor- ative dentistry are obtaining a copy of one or several prepared teeth, healthy adjacent and an- tagonist teeth, establishing a proper interocclusal relation- ship and then converting this information into accurate rep- licas of the dentition on which indirect restorations can be performed.4

Traditional restorative tech- niques for fixed restorations require the use of impression materials to record the contours, form and dimensions of the preparation. This is followed by the pouring of stone models and dies prior to laboratory fab- rication of the restorations for final restoration. Taking an accurate impression is one of the most difficult procedures in dentis- try, requiring careful retraction or removal of soft tissue around preparation margins, hemosta- sis, and selection of an appro- priate impression material and tray for the technique used.

By using a CAD/CAM restor- ative technique, a number of steps can be simplified or elimi- nated.4 Digital systems now offer the opportunity to avoid tradi- tional, analog impressions, in- cluding the usual impression materials, time, and handling limitations associated with them. Intraoral scanners have the potential to offer excellent accuracy with a more comfort- able experience for the patient and more efficient workflow for the office. But care must be taken to ensure that the whole preparation is scanned, to avoid introducing errors. Two techniques can be used for CAD/CAM restorations: the chairside technique or the in- tegrated chairside-laboratory procedure.