Direct posterior resin composite restorations: New techniques and clinical possibilities. Case reports

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Direct adhesive resin composite restorations in posterior teeth are now a reality thanks to improvements in these restorative materials and adhesive techniques. However, correct selection and application of materials are vastly important to clinical success. Two restorative techniques are described in detail, in one, a low-viscosity resin composite is placed incrementally, and in the other a condensable resin composite is placed in bulk. The former allows for greater security, because it is more traditional and has already proved to have clinical longevity; the latter has the advantage of being a quicker and simpler procedure. However, both techniques provide restorations that faithfully copy the dental tissues and have all the advantages of adhesive procedures.

Key words: adhesive technique, bulk restoration, condensable resin composite, flowable resin composite, posterior restoration, stratified restoration

Improvements in the physical properties of resin composites, added to the development of effective enamel and dentin adhesive systems, have made their use routine in daily clinical practice. No doubt the most popular and more indicated material for posterior teeth is silver amalgam, the value of which cannot be underestimated. Nevertheless, the growing desire of patients to have almost imperceptible restorations, even in posterior teeth, and the development of techniques and materials that make such restorations easier have contributed to the popularity of esthetic restorations in posterior teeth.

Among metal-free restorative alternatives, resin composites are the first choice because of their relatively simple procedure, low cost, and satisfactory clinical success rate when proper technique is followed. In addition, composites preserve dental structure, in keeping with prevailing concepts of conservative restorative dentistry. The present study reviews some concepts about adhesive restorative procedure and presents the esthetic possibilities of two different techniques: bulk condensation and stratified layering.

SELECTION OF THE RESTORATIVE MATERIAL

Until a few years ago, a high rate of occlusal wear on posterior teeth presented a barrier to the use of resin composites. Some of the initial formulations had general occlusal wear of 100 to 150 µm a year. Some currently available materials show much less wear than those earlier posterior composites, with wear rates of less than 10 µm/year. The state of the art is now such that the wear rates of some composites are not significantly different from those of silver amalgam restorations. Thus, the problem seems to have been solved for small and medium occlusal restorations.

To secure more lasting clinical results, it becomes extremely important to observe a few crucial points:

1. Occlusal contacts. The occlusion should be analyzed when the greater part of occlusal forces should be supported by tooth structure. In addition, intensive contacts on the preparation area may contraindicate the use of composites. Although newer materials have a noticeably reduced general wear on areas free of occlusal contacts, an opposing cusp with occlusion on the restoration surface may increase this wear rate four to five times.

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2. Type of restoration on opposing teeth and the presence of wear facets. Ceramic restorations on opposing teeth and the presence of wear facets, which suggest a parafunctional habit, contraindicate resin composite restorations on posterior teeth.

3. Size of the occlusal opening. Preferably, the isthmus of the cavity preparation should not be greater than one third the intercuspal distance. Larger occlusal areas expose the composite to greater occlusal forces, reducing its wear resistance.11

4. Position of the tooth in the arch. The more distally a tooth is positioned, the greater will be the wear of the restoration, because acting forces are greater. Thus, direct resin composite restorations perform better in premolars than in molars.12

5. Correct adjustment of the restoration. Static and dynamic occlusion must be tested for interference, because a well-adjusted restoration stands a better chance of resisting occlusal challenges.

Based on these considerations, highly filled resin composites (60% to 70%) with smaller particles (1 to 3 μm) have been the choice for posterior teeth.13 Restorations made with these materials offer an acceptable capacity to be finished and polished, have greater resistance to the challenges of the oral cavity, and are less sensitive to discoloration.14,15 A recent clinical study found that resin composite restorations in posterior teeth offered 98% esthetic excellence even after 2 years of clinical function.16

STRATIFIED PLACEMENT TECHNIQUE

Literature review

This technique, also called successive cuspal reconstruction, makes it possible to obtain correct occlusal morphology through the application of multiple layers of resin composite of different shades and opacities. Nonadherent spatulas and special brushes are used to carve the restoration.

The composite is inserted as small spheres, so as to reconstruct each anatomic entity of areas involved in the preparation. First, the proximal surface, if involved, should be restored. The occlusal part is then reestablished, with a small increment of the desired shade under the cusp, in a resin with an opacity similar to that of dentin. Each of the cusps is then restored successively. Next, a transparent resin with optical characteristics similar to those of enamel is inserted, returning each of the cusps to the correct anatomic shape.

Because of their low viscosity, resin composites used for this technique are easy to shape. Nevertheless, care must be taken when they are handled, so that adaptation to the cavity walls is maximized. Excessive manipulation must be avoided, because it could increase porosity.17,18

Excess-free restorations make recontouring, finishing, and polishing procedures easier and almost unnecessary. The restoration will be less susceptible to occlusal wear and marginal leakage. With the conventional bulk technique for restoring posterior teeth with resin composites, the cavity is overfilled and then finished and sculptured with diamond points and burs. With this procedure, more time is required, adequate anatomic contour is not obtained, the easier-to-polymerize surface layer is removed, marginal adaptation is negatively affected,19 and a greater rate of occlusal wear is introduced.20 In addition, occlusal wear that occurs during the first 2 weeks apparently develops a standardized surface roughness, regardless of whether finishing procedures have been performed or not.21

Case report

A 19-year-old healthy man presented with a Class II lesion on the distal surface of the maxillary right second premolar. The patient asked for replacement of the amalgam mesio-occlusal restoration on the maxillary right first molar (Fig 1a). A bitewing radiograph revealed the existence of a caries lesion on the distal surface of the second premolar (Fig 1b). Occlusal contacts had been checked previously.

For convenience, it was suggested to the patient that the amalgam restoration be removed to gain direct access to the distal cavity in the second premolar. After placement of rubber dam isolation (Fig 1c), the amalgam restoration was removed (Fig 1d). This provided better visual access to the cavity in the distal surface of the second premolar (Fig 1e). After the carious tissue was removed, the second premolar was restored with Tetric Flow flowable resin (Vivadent), chosen for its radiopacity,22 which permits radiographic examination of the restoration. In addition, an adhesive restoration, the surrounding tissue becomes more resistant to recurrence of the lesion.23

A Palodent kidney-shaped concave matrix (Darway) and a Bitine ring (Darway) were gingivally secured to the first molar with a wooden wedge (TDV) (Fig 1f). This precontoured matrix makes proximal recontouring easier, because the contact point is adequately established.

The enamel and dentin were etched with 35% phosphoric acid (Fig 1g) and rinsed with water for 15 seconds. A small cotton pellet was placed in the cavity to prevent dentin from being dehydrated during the removal of excess water from the operative field. In a complex cavity, the adequate control of humidity after acid etching is extremely important, because
Reduction of the light energy required to penetrate tooth structure might occur because of the lack of humidity. This would be more important in Class II cavities, where the light-curing technique apparently occurs because less light energy is required to penetrate tooth structure. The resin increment made contact with the resin increment made contact and not because of a polymerization vector toward the light source. Another rationale for the use of the incremental technique is that minimal shrinkage takes place within each increment, because there is a low cavity configuration factor and the surface permits resin to flow during polymerization. If the resin is positioned in contact with a small area, there will be no competition between two different sites. Clinically, bulk placement can result in more gap formation at the resin-dentin interface than the incremental technique. Finite-element analysis has revealed that polymerization shrinkage of resin composites on posterior teeth can be directed toward the cavity walls, where an effective adhesive seal can be found. It is important to consider this detail during the placement of the very first increments, because polymerization contraction stresses would tend to weaken the bond with the lowest strength in the restored cavity, which is bonded at the pulpal floor of deep cavities.

**BULK PLACEMENT TECHNIQUE**

**Literature review**

More recently, condensable resins have been developed with the goal of making restorative techniques easier, because the insertion of such materials is similar to that of amalgam restorations. To attain these handling characteristics, each commercial brand has used different strategies to eliminate stickiness. Some of these commercial strategies include the use of fused particle agglomerates, fibrous filler additions, and better filler particle packing arrangements.

The increased viscosity of these resins apparently simplifies the restorative technique for correct proximal contouring. In addition, manufacturers recommend the use of 5-mm increments for polymerization, to make the process more efficient. Few studies are available, but Kerby et al have reported that Surefil (Dentsply) has a greater polymerization conversion rate than do other direct-use resins at a depth of 4 mm.

In vitro incremental placement can augment deformation of the cavity walls in a mesio-occlusodistal cavity. However, greater gap formation and postoperative sensitivity were reported in Class II and Class II occlusoproximal restorations. Incremental application of resin cements, nevertheless, to facilitate marginal adaptation and wetting. Clinically, an alternative would be the use of flowable resins, because highly filled condensable resin composites do not permit adequate wetting.

Recent laboratory studies have indicated that currently available condensable resin composite materials...
The darkened area on the mesial region, visible on the closeup, is suggestive of caries. Note the pigmentation at the bottom of the fossae of the adjacent teeth and whitish staining of cuspal inclines.

A discrete translucent halo is visible under the amalgam restoration in the first molar and a caries lesion is present on the distal surface of the second premolar.

Rubber dam is placed to improve visibility.

A discrete translucent halo is visible under the amalgam restoration in the first molar and a caries lesion is present on the distal surface of the second premolar.

Rubber dam is placed to improve visibility.

The restoration, carious tissue, and darkened marginal enamel are removed. Note the adequate enamel thickness on cervical margins and cavitation of caries lesion on the distal surface of the second premolar.

A kidney-shaped concave matrix and ring are gingivally secured with a wooden wedge, allowing for a fine proximal contour and contact.

Enamel and dentin are conditioned with 35% phosphoric acid for 15 seconds.

Two coats of an adhesive are applied.

After the marginal crest is reconstructed, the matrix system is removed.
Fig 1j  Cuspal inclines are reconstructed through the application of small, spherical increments of hybrid resin.

Fig 1k  The dentinal portion is completed.

Fig 1l  Brown paint is applied with a soft brush close to the main sulcus.

Fig 1m  Brown paint is applied at the bottom of fossae and white is applied at the inclines to mimic adjacent teeth.

Fig 1n  Small amounts of transparent resin are layered with a fine antecedent spatula.

Fig 1o  The enamel portion is completed.

Fig 1p  After proximal excesses of adhesive and resin are removed, sandpaper strips are used gingivally and flexible extraline sequential disks are used at the marginal crest.

Fig 1q  Closeup preoperative view.

Fig 1r  Closeup postoperative view 48 hours after direct resin composite restoration.
have physical properties capable of ensuring their clinical success in years to come. Nevertheless, it is still early to guarantee that their laboratory qualities will translate to clinical use. Excellent 6- and 12-month clinical results, however, are already a reality.

A disadvantage of condensable resins, compared to the more traditional hybrid composites, is an inferior capacity to be polished to a smoother surface. This may be the result of their high percentage of inorganic filler and the presence of larger filler particles. Figures 2a to 2c present scanning electron microscopic images of cured condensable resin composites (Alert, Jeneric/Pentron; Surefil, Dentsply) and a traditional hybrid composite (ClearFil AP-X, Kuraray). The differences in the particle size distribution are apparent.

In addition, most brands of high-viscosity resin do not offer a great diversity of colors. Clinically, some brands have problems with translucency. Alert, for instance, is too translucent, whereas other brands, such as Solitaire (Kulzer), seem to be excessively opaque.

**Case report**

A 19-year-old healthy man presented with a sensitive mandibular right first molar. A bitewing radiograph revealed a carious distal portion. The existing amalgam restoration on the second premolar was removed, at the patient's request. The amalgam restoration was removed from the
first molar to analyze the feasibility of a tunnel restoration, a conservative preparation that preserves the marginal ridge (Fig 3d). However, following removal of the carious tissue, the ridge was found to be too weak; this fact, associated with difficult access to the lesion, contraindicated use of a tunnel restoration. A mesio-occlusodistal preparation (Fig 3e) decreases tooth resistance by almost 50%. However, laboratory and clinical data suggest that bonded resin composite restorations also provide significant cuspal reinforcement.

The automatrix (Caulk/Dentsply) was placed after an adequate burnishing of those portions turned to the proximal surfaces. This process allows easier recutting of the proximal convexity. The matrix was stabilized with means of wooden wedges placed distally and mesially (Fig 3f). The enamel and dentin were etched with 36% phosphoric acid (Fig 3g), and rinsed with water for 5 seconds. A small cotton pellet was placed in the cavity to prevent desiccation of the dentin during removal of excess water from the operative field.

A nanofilled adhesive (Prime & Bond NT, Caulk/Dentsply) was applied in one coat with a fully saturated brush (Fig 3h). After removal of the excess, a flowable resin (Tetric Flow) was applied in a thin layer to all internal walls (Fig 3i). Cuspal deflection is reduced when these highly flowable resins are applied. This initial layer may also help in another way, ie, the shrinkage stress of the subsequently applied resin composite can be absorbed by a relatively elastic initial layer, thereby reducing the stress at the restoration-tooth interface.

A packable resin (Surefil, shade A) was inserted in bulk on the proximal box and light cured from the occlusal aspect, initially for 20 seconds, with a light unit of 300 mW/cm² light intensity (Figs 3j and 3k). After removal of the matrix, the whole occlusal portion of the cavity was filled with the same composite and packed with antiadherent condensers (Fig 3l).

An amalgam-carving tool was used to sculpt the occlusal surface. The restoration was light cured in bulk from the occlusal direction for 20 seconds. Brown paint was applied and light cured for 40 seconds (Fig 3m). After removal of the rubber dam, small excesses found on the distofacial cusp were adjusted with fine and extrafine diamond burs (Komet, Brasseler). Fortify (Bisco Dental) was used to rebond the occlusal surface. After the finishing step, microcracks are formed on the restoration surface and below it. To minimize these harmful effects, low-viscosity monomers can be used as surface sealants; they penetrate the defects and refortify the surface layer. In this way, the wear rate of some composites is reduced, resulting in a restoration with greater marginal integrity. Additional light curing was performed from the lingual and facial directions. In spite of the opacity of the material, the bulk placement technique provided excellent esthetics (Figs 3n and 3o).

**REDUCING POLYMERIZATION STRESS**

Light curing with high-intensity light units, traditionally recommended, will increase the stresses at the restoration interface. One way to minimize such effect is to initially polymerize the restoration with a low-intensity light and then to apply a high-intensity light, resulting in a better marginal adaptation where the mechanical properties of composites would remain unaffected. The rapid development of the polymerization reaction of light-cured composites impairs the stress relief normally provided by flow; worse results are found for restorations cured with higher light intensities.

Alternatively, low-intensity light-curing units (300 mW/cm²) can be used for longer periods of time. Although high-intensity lights may provide higher values of degree of conversion and mechanical properties, they also introduce higher contraction strain rates during polymerization of the composite. Thus, an equivalent degree of conversion may be achieved by applying a lower intensity light for a longer period of time. The concern about the effects of polymerization shrinkage is so great that some authors suggest that areas most sensitive to contraction, such as the gingival floor of a proximal cavity preparation, might be able to withstand poorer mechanical properties in order to enjoy the lower contraction stress generated by a lower intensity light.

**CONCLUSION**

Placement of direct esthetic resin composite restorations in posterior teeth is not complex; however, it requires an accurate technique and specific tools to guarantee results that fulfill the expectations of increasing well-informed and demanding patients. Condensable resin composites should not be viewed as competitors to traditional composites. Rather, the development of this new restorative technique represents another tool for the difficult task of restoring posterior teeth. Bulk placement may have a few advantages, such as a simpler procedure for extensive cavities and some beneficial mechanical properties of some new condensable composites, like flexural strength and cure depth. However, these properties must be confirmed through clinical studies.
Fig 3a A mesio-occlusal amalgam restoration is present on the mandibular right first molar and a disto-occlusal amalgam restoration is present on the second premolar. Note the pigmentation of the occlusal sulci of the second molar.

Fig 3b Caries lesions are present on the distal surfaces of the first molar and second premolar.

Fig 3c A direct resin composite restoration has been placed on the second premolar.

Fig 3d The amalgam restoration is removed from the first molar. Note the remnants of calcium hydroxide cement, used for pulpal protection.

Fig 3e When the mesio-occlusal distal cavity preparation is completed there is adequate enamel thickness at the cervical margins.

Fig 3f A circumferential matrix is applied with forceful wedging.

Fig 3g The enamel and dentin are etched with 36% phosphoric acid.

Fig 3h An adhesive system is applied.

Fig 3i Flowable resin composite is applied in a thin layer.
Fig 3j Condensable resin is inserted in bulk to reconstruct the distal marginal crest.

Fig 3k After reconstruction of the mesial marginal crest is completed, the matrix system is removed.

Fig 31 The resin composite is inserted and condensed to a "Class I cavity," reconstructing a portion of dentin.

Fig 3m Cusp-to-cusp reconstruction is completed with adequate spatulas. Sulci are painted to mimic the adjacent molar.

Fig 3n One week after direct resin composite restoration, the esthetics of the restoration is excellent, despite the opacity of the material.

Fig 3o View 1 week after direct resin composite restoration. The characterization is similar to that of adjacent teeth.

REFERENCES


