



Semidirect posterior composite restorations with a flexible die technique

A case series

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Composites have become popular in dentistry because of characteristics that allow them to mimic tooth structures, such as a wide range of color and translucency,¹ and good mechanical properties, such as flexural and tensile strength and fracture toughness.²⁻⁴ Clinical study results show low failure rates for posterior composite restorations,⁵⁻⁷ similar to those for amalgam restorations.^{5,8} In addition, adhesive composite restorations allow preservation of remaining tooth structure because there is no need for additional retention in the final preparation, thus involving minimal intervention.^{6,9}

Although investigators found similar clinical performance for small or medium cavities restored with direct and indirect composite restorations after 5 years,¹⁰ the direct composite technique for large preparations on posterior teeth presents some disadvantages, such as difficulties in achieving proper contours, anatomic form, proximal and occlusal contacts, and marginal adaptation¹¹⁻¹⁶; therefore, indirect techniques are usually preferable. Although ceramic inlays, onlays, overlays, or full crowns are the first choice for restoring posterior teeth with extensive structure loss,¹⁷ semidirect composite restorations may be a viable treatment option for patients who need fast results with lower costs.

The semidirect technique of using a flexible die allows the chairside fabrication of a restoration,¹⁴ thus eliminating the laboratory work. The clinician obtains an

ABSTRACT

Background and Overview. Besides indirect use in the laboratory and direct use for restorations, composites can be used in semidirect procedures. The authors describe the semidirect composite restoration technique by using a flexible die for large lesions in posterior teeth.

Case Description. The authors present illustrations of the clinical steps and the outcomes immediately after the procedures. The authors placed chairside inlay, onlay, and overlay composite restorations. The final esthetic outcome, along with function and anatomic form recovery, demonstrated that this might be a viable cost-effective alternative technique to laboratory-fabricated indirect restorations.

Conclusions and Practical Implications. Clinicians can restore large preparations in posterior teeth successfully with semidirect composite restorations in a single appointment by using the flexible die technique, resulting in satisfactory function and esthetic outcome.

Key Words. Composite resins; semidirect restoration; dental esthetics; shrinkage.

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impression of the prepared and neighboring teeth with alginate and injects silicone inside the cast to obtain the die. After a few minutes, the silicone sets, and the clinician fabricates the composite restoration over the model; this method has the benefit of the restoration being light cured outside the mouth, allowing better cure of the composite, thus improving its conversion degree and increasing its microhardness and wear resistance.¹⁸ Furthermore, in cases of indirect Class II restorations, proximal contact and contour are easy to make. Also, the restoration allows for better finishing and polishing because these steps are performed outside the mouth.¹⁰

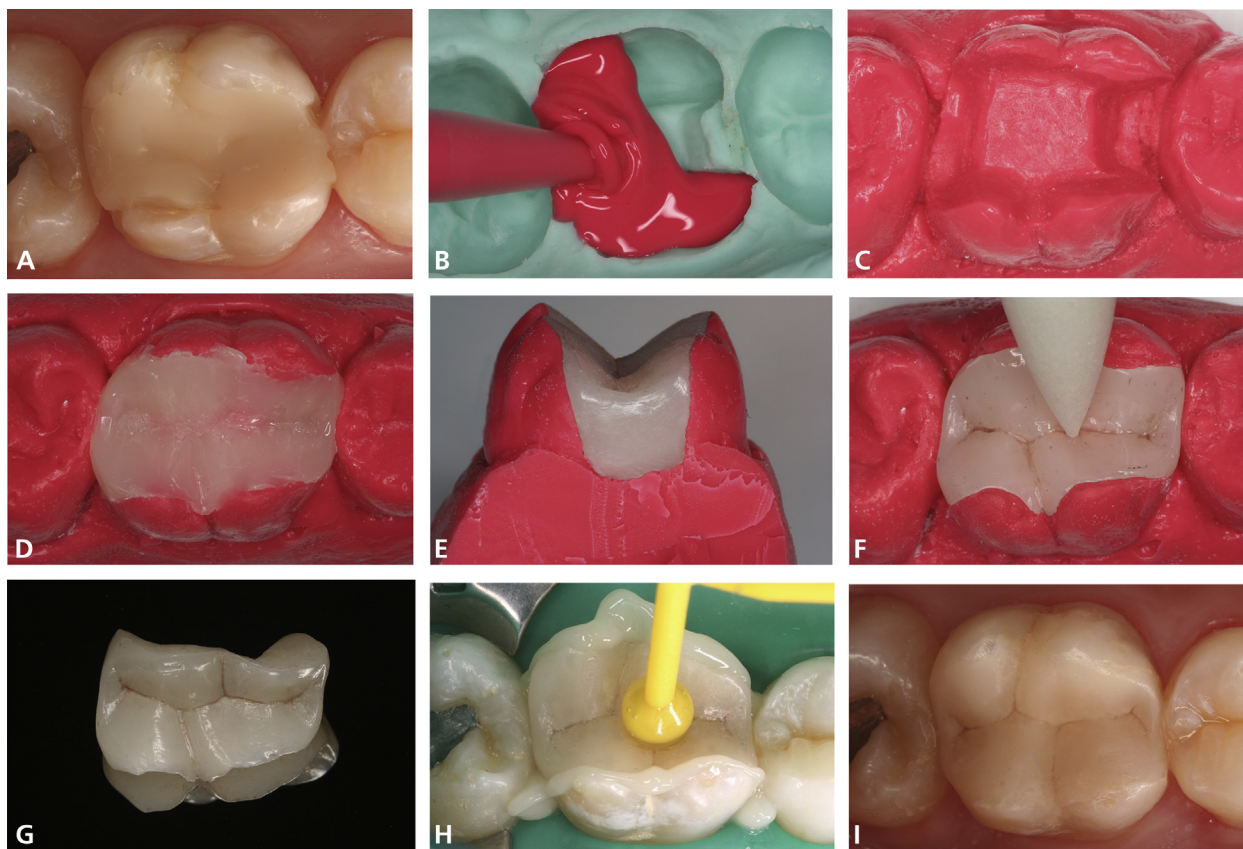


Figure 1. A. Initial condition showing defective Class II (mesio-occlusodistal) restoration on a mandibular molar. B. Model silicon being applied to make the elastic die. C. Flexible die showing tooth preparation. D. Reconstruction of the distal contact. E. Checking gingival cavosurface margin after separation of the mold. F. Finishing and polishing procedures. G. Final restoration. H. Cementation procedure. I. Restoration after adhesive cementation and adjustment.

Finally, the clinician cements the restoration into the preparation and adjusts the occlusion.

Besides the conventional light curing, semidirect restorations can also be exposed to light, heat, and pressure in a light-box oven, which increases their degree of conversion.¹⁸ This method results in improved elastic modulus, higher microhardness, and wear resistance of these restorations, compared with those of direct restorations.^{13,19,20} Also, because the clinician performs polymerization of the composite resin outside the mouth, shrinkage stress over the cavity walls is reduced^{14,20} because it is related only to the curing of the resin cement. This method reduces marginal gaps and microleakage,^{15,21,22} which are the main factors responsible for the occurrence of secondary caries, 1 of the most common reasons for restoration failure over time.^{23,24} Compared with the indirect technique, the semidirect technique allows treatment to be performed in a single appointment, without laboratory cost,¹⁴ thus providing a more cost-effective alternative to laboratory-fabricated restorations. Therefore, the aim of this clinical case series is to describe the technique of semidirect composite

restorations by using the flexible model in large posterior preparations, illustrating the clinical steps and the clinical outcomes immediately after the procedures.

CASE REPORTS

We present a case series of 4 patients, aged 25 to 48 years, who needed large restorations in posterior teeth. We performed diagnosis and clinical assessment, and all patients signed an informed consent form, authorizing treatments and use of images. In case 1 (Figure 1), we replaced a defective Class II (mesio-occlusodistal) composite restoration on a mandibular first molar by using a semidirect inlay. In case 2 (Figure 2), we replaced a defective Class II (mesio-occlusal) amalgam restoration in a maxillary second molar and a Class II (disto-occlusal) glass ionomer restoration in a maxillary first molar by using 2 semidirect composite onlays. In case 3 (Figure 3), we replaced a defective Class II (mesio-occlusodistal) composite restoration in a mandibular first molar by using a semidirect onlay. In case 4 (Figure 4), we diagnosed large tooth structure loss on a maxillary first molar, with satisfactory endodontic treatment and

an unsatisfactory mesio-occlusodistal restoration in a maxillary second molar. We placed 2 semidirect restorations (overlay in the first molar and onlay in the second molar).

For all teeth, we removed old restorative materials with spherical diamond burs and prepared the cavity walls to a slightly divergent shape with a conical diamond bur (FG 3131, KG Sorensen). We then obtained a partial alginate impression (Hydrogum, Zhermack) and filled the mold with silicone die (GrandioSO Inlay System, VOCO). After the silicone cure (3 minutes), the model was ready for building up the restoration. To allow reconstruction of the proximal surface, especially around the gingival area, we made a small cut on the flexible die in the interproximal area by using a scalloped blade in the region of the interdental gingival papillae. We separated the teeth by tearing the model apart to reproduce small irregularities in it. These irregularities made adjustment of both parts possible so we could reconstruct restoration proximal contacts.

We used nanohybrid composite (GrandioSO, VOCO) in all presented cases. We built up restorations by placing 2-millimeter increments over the model and light cured each increment for 20 seconds. We used a layering technique to mimic tooth optical characteristics with different shades and opacities and to simplify the restoration's shape. Because the restoration could be cured

from all directions after removal from the model, we were able to use a bulk placement technique. We performed a complementary cure of 5 minutes by using a light box (Translux CL, Heraeus Kulzer).

We seated the final restorations into the preparations to check the fit. Because the silicone die is elastic, small retentions in preparation would not be enough to prevent mismatch of the restoration in the model but also would not allow fitting into the rigid tooth preparation.

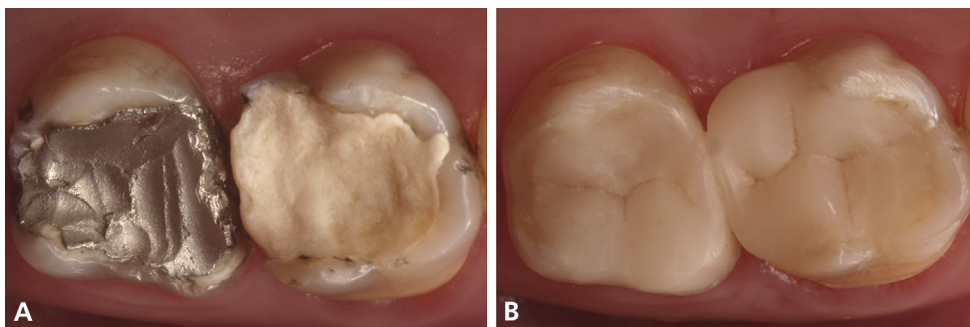


Figure 2. **A.** Initial condition showing a defective Class II (mesio-occlusal) amalgam restoration in a maxillary second molar and a Class II (disto-occlusal) glass ionomer temporary restoration in a maxillary first molar. **B.** Restoration after adhesive cementation and adjustment.

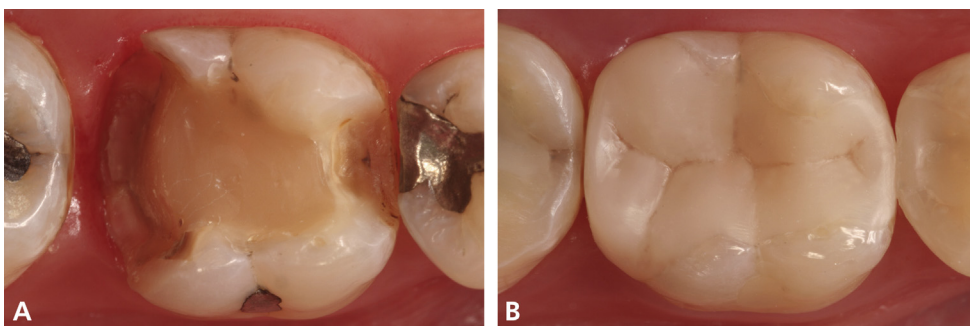


Figure 3. **A.** Class II (mesio-occlusodistal) preparation after filling undercuts with light-cured glass ionomer cement. **B.** Restoration after adhesive cementation and adjustment.

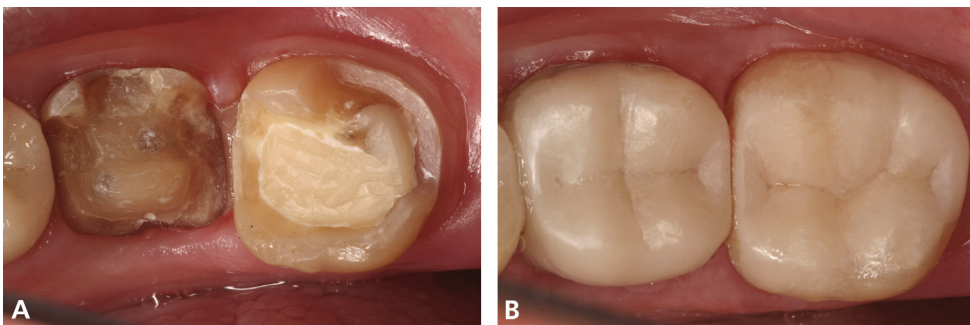


Figure 4. **A.** Tooth preparations after building up the core on the first molar and filling undercuts on the second molar by using dual-cure composite. **B.** Restoration after adhesive cementation and adjustment.

We had to remove these undercuts from the restoration with a diamond bur to obtain adequate fit. We then finished the occlusal and proximal areas with fine-grained diamond burs and abrasive disks and polished them with diamond-impregnated abrasive rubber points (Dimanto, VOCO) and a silicon carbide brush (Astrobrush, Ivoclar Vivadent). After that, we sandblasted the inner surface of the restoration with 50-micrometer aluminum oxide particles for 10 seconds at a distance of 5 centimeters from surface to improve bonding to the resinous cement, taking care to avoid damaging the external margins.^{25,26} We rinsed the restorations with 95% alcohol and dried them with air spray.

We performed adhesion procedures after placing rubber dam isolation. We actively applied the dual-cure self-etching adhesive (Futurabond U, VOCO) with a disposable applicator to the preparation for 20 seconds and to the inner surface of the restoration, followed by an air blast. We did not light cure the adhesive. We also placed dual-cure resinous luting cement (Bifix QM, VOCO) on the inner surface and seated the restoration. We removed cement excess with clean disposable applicators and dental floss. We light cured each restoration surface (buccal, lingual, and occlusal) for 40 seconds. We checked the occlusion with articulating paper and proximal contacts with dental floss.

DISCUSSION

Contemporary dentistry demands simple and effective techniques to restore tooth anatomy, replace lost structure, and reestablish ideal form and function.^{16,27} With the restriction of amalgam use in several countries, clinicians often consider direct composite restorations a viable treatment alternative for severe tooth structure loss in posterior teeth.²⁷ However, depending on the extent of tooth destruction, it is difficult to restore anatomy and function properly while working inside the mouth and using regular matrix systems. Therefore, indirect restorations are indicated. However, the indirect restoration placement technique requires a provisional restoration and laboratory steps, which are time-consuming and increase costs for patients. Ceramics are often the restorative material choice for this kind of restoration, contributing to cost increase.

Indirect composite inlays, onlays, and overlays with the semidirect technique described can be a conservative, cost-effective, and less time-consuming alternative to indirect restorations.²⁶ This technique is indicated for patients who need proper large reconstructions in posterior teeth in a short time and at a lower cost. The technique described eliminates the laboratory phase of indirect restorations, offering patients a single visit to the dental office, with no need for temporary restorations and use of only a single administration of oral anesthetic. Although computer-aided design and computer-aided

manufacturing technology also provides these benefits, the costs associated with this technique are higher than those of the semidirect method, and not all patients can afford paying for it.

Cases of Class II cavities, as described in [Figures 1 through 3](#), with ([Figure 2](#)) or without ([Figures 1 and 3](#)) cuspal involvement, are more likely to have good prognosis and longevity than are total crown recovery cases. Authors of a systematic review show that for cavities with a higher number of remaining cavity walls, there is no difference in clinical performance between direct and indirect composite restorations for up to 5 years.²⁸ However, there is no evidence about which technique is better after 5 years.²⁹ [Figure 4](#) shows a case with great destruction of occlusal and lingual surfaces on the first molar and loss of the distobuccal cusp on the second molar. After endodontic treatment of the first molar, because of the lack of retention, we cemented glass fiber posts and built up the core with a dual-cure flowable composite resin (Rebuilda, VOCO). On the second molar, we filled in the undercuts and irregular pulpal wall with the same material. Despite the indication for full crown cover in teeth with great coronary destruction (less than 2 remaining cavity walls),³⁰ there is some evidence that cusp coverage of endodontically treated posterior teeth provides satisfactory clinical performance in a 5-year period.³¹ Therefore, the semidirect technique used can be a viable and more conservative treatment option for patients who cannot afford ceramic restorations.

One of the major problems regarding direct composite restorations might be shrinkage,²⁰ which produces stress at the tooth-restoration interface and can lead to microleakage, secondary caries, postoperative sensitivity, pulpal irritation, and marginal discoloration.^{12,26,32} Also, physical and mechanical properties of composites are affected by the degree of conversion of their monomers.¹³ A proper degree of conversion is clinically necessary once unreacted monomers and inadequate polymerization compromise the mechanical properties of composites, affecting their performance under masticatory loads, increasing wear, and decreasing restoration longevity.¹⁷ These problems are overcome partially when restorations are fabricated outside the mouth, such as with indirect or semidirect techniques. When the restoration is made over a model, problems regarding shrinkage are reduced because no stress is transferred to the remaining tooth structure, and the clinician can enhance the degree of conversion by means of additional polymerization in all directions, including the inner surface of the restoration.¹⁸ Short-term marginal adaptation in semidirect restorations is comparable with that obtained by using direct composite resin restorations in small and medium cavities. However, semidirect restorations had better long-term clinical outcomes than did direct restorations and, thus, should be

indicated for cavities that are large and have unfavorable configurations.³³

Another difficulty involving posterior direct composite restoration is achieving tight, anatomically correct interproximal contact.¹⁶ Contact areas between teeth are important to avoid displacement and rotation, as well as food impaction, which leads to trauma and an inflammatory response of the periodontium.¹⁶ Semidirect composite restorations exhibit more adequate proximal contact, occlusal morphology, and marginal adaptation than do direct restorations¹³ because they are made outside the mouth, allowing better visualization and control during resin insertion and sculpture. The contouring problems associated with matrix systems can be eliminated with this technique because dental separation promoted by wedges is not always sufficient to compensate for metallic matrix thickness.

The critical point in indirect and semidirect restorations is the bond between the composite resin and the tooth structure.²⁶ Study results show that air abrasion with aluminum oxide particles can improve the bond strength of the resin cement to the restoration^{25,26,34,35} by increasing the surface area and its wettability and by eliminating contaminated areas. However, the clinician should take care with the restoration finishing lines and avoid sandblasting them. In these clinical cases, we protected the margins of all of the restorations with wax during sandblasting.

The cases we presented showed successful examples of teeth restored with inlay, onlay, or overlay by using a semidirect technique. In all cases, we achieved a satisfactory restoration esthetic and adaptation, guaranteeing patient satisfaction. These cases show that semidirect restorations are a viable intermediary option between direct composite resin restorations and indirect reconstructions for patients requiring medium or large restorations in a single tooth. This technique offers effective immediate results and can be used in patients who need fast results and lower treatment costs.

CONCLUSIONS

Restorations performed using the flexible die improved tooth esthetics and function with satisfactory outcomes. The semidirect technique combined the advantages of the direct and indirect approaches and might be a viable low-cost option for large restorations in posterior teeth that require onlays, inlays, or overlays. ■

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