

A resin coating technique to achieve minimal intervention in indirect resin composites: A clinical report

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Minimally invasive restorative techniques can be applied with direct resin composites. However, the preparation for an indirect restoration tends to lead to over-treatment of the tooth structures. A resin-coating technique has been proposed in which both a hybrid layer and a tight sealing film are produced on the dentin surface with a dentin adhesive system and a low viscosity micro-filled resin. It covers and protects the prepared dentin immediately after cavity preparation, and minimizes pulp irritation and post-operative sensitivity. In addition, the resin coating technique enables good bonding of the resin cement and adaptation of composite inlays. The following case report describes treatment involving the resin coating technique in order to achieve minimal intervention for an indirect resin composite restoration.

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Key Words: indirect resin composite, minimal intervention, resin coating.

Introduction

Metal-free restorations in tandem with the development of good adhesive materials have become widely accepted.¹ However, the preparation for metal-free restorations tends to lead to over treatment of the tooth structures because of the necessity for enough space for the restorations.² Nowadays, minimally invasive restorative techniques can be performed using direct resin composite restorations even in posterior teeth.^{3,4} However, this is not the case with indirect restorations.

A resin-coating technique has been proposed in which both a hybrid layer and a tight sealing film are produced on the dentin surface with a dentin bonding system (DBS) and a low viscosity micro-filled resin (LVR).^{5,6} It covers and protects the prepared dentin immediately after cavity preparation, and minimizes pulp irritation and post-operative sensitivity.⁷ In addition, the resin coating technique enables good bonding of the resin cement⁸⁻¹⁰ and adaptation of composite inlays.¹¹ If the proper combination of a DBS and a LVR is selected, the bonding performance of resin cements is almost identical to that for a direct resin composite restoration.¹² Therefore, the resin coating technique enables us to achieve minimally

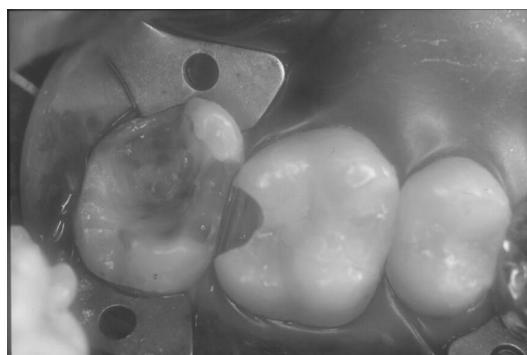
invasive indirect restorations. The following case report describes treatment involving the resin coating technique in order to achieve minimal intervention for an indirect resin composite restoration.

Clinical Report

A 40-year-old patient with failure of a metal onlay in the right upper second molar presented for restoration of the cavity. There was secondary caries in the second molar, and primary caries in the distal aspect of the first molar, which had an occlusal resin composite (Fig. 1).



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Fig. 1. Preoperative condition of right upper molars. Second molar demonstrates failure of a metal onlay with secondary caries. There was primary caries in the distal aspect of the first molar, which had an occlusal resin composite.

Fig. 2. The caries infected dentin was carefully removed with a steel round bur in a low-speed micromoter handpiece leaving the caries affected dentin and intact dentin.

The enamel of the proximal ridges of the first and second molars was cut with a round diamond bur in an air-turbine handpiece with water spray to approach the carious dentin lesions. The caries infected dentin was carefully removed with a steel round bur in a low-speed micromoter handpiece leaving the caries affected dentin and intact dentin. No local anesthesia was given and the patient did not complain of pain while the infected caries was being removed. Neither retention nor resistance form were provided after removal of the caries. Following this, the cavities were isolated with a rubber dam for the subsequent bonding procedures (Fig. 2).

The cavity in the first molar was restored with a direct resin composite because the small cavity was easily accessible. However, the cavity in the second molar was too large to be restored with a direct resin composite and also difficult to be finished and polished in the restricted space. Therefore, it was decided to restore the cavity with an indirect resin composite using the resin coating technique. A steel sectional matrix (KerrHawe, Bioggio, Switzerland) was inserted in the interproximal space and wedged. The first molar was restored using a direct resin composite, Clearfil AP-X (Kuraray Medical, Tokyo, Japan) in combination with a self-etching primer bonding system, Clearfil SE Bond (Kuraray Medical), according to the manufacturer's instructions (Fig. 3). Following this, Clearfil SE Bond was applied to the cavity of the second molar and then a low viscosity micro-filled resin, Protect Liner F (Kuraray Medical), was

additionally applied to the adhesive surface and light-cured for 30 s to seal the cavity margins. The surface was then wiped with a cotton pellet soaked in ethanol to remove the surface air-inhibited unpolymerized layer (Fig. 3).



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Fig. 3. The cavity in the first molar was restored with a direct resin composite. Following this, the resin coating with Clearfil SE Bond and Protect Liner F was applied to the cavity of the second molar.

Fig. 4. An impression was made for the preparation of the second molar with a reversible hydrocolloid-an alginate combination.

After finishing and polishing the composite restoration in the first molar, an impression was made for the preparation of the second molar. A reversible (Aromaloid, GC, Tokyo, Japan) and irreversible (Aroma Fine DF III, GC, Tokyo, Japan) hydrocolloid combination was used as the impression material for the resin-coating (Fig. 4). Following this, a water-setting temporary filling material (Cavit-G, 3M-ESPE, Seefeld, Germany) was placed in the cavity (Fig. 5).



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Fig. 5. A water-setting temporary filling material, Cavit-G, was placed in the cavity.

Fig. 6. A resin composite onlay was fabricated in the laboratory.

A resin composite onlay was fabricated in the laboratory using a highly filled indirect composite (Estenia, Kuraray Medical) according to the manufacturer's instructions (Fig. 6). The cavity surface of the restoration was air-abraded with 50 μm alumina for 5 s to peel the cross-linked resin matrix covering the

surface.

At the second visit, the temporary filling material was ultrasonically removed from the cavity. However, there was no pain because the resin coating protected the pulp. After the preparation was isolated using a rubber dam, the resin-coating surface was cleaned with a cotton pellet soaked in ethanol. After trial seating of the composite onlay in the cavity, the cavity surface of the onlay and the resin-coated cavity were prepared for bonding. Thirty-seven % phosphoric acid (K-etchant, Kuraray Medical) was applied to the cavity surface of the composite onlay for 5 s, rinsed and dried. Following this, a mixture of SE Primer in Clearfil SE Bond and Porcelain Bond Activator (Kuraray Medical) was applied to the surface for 5 s, then gently air-blown for silanization of the surface (Fig. 7). For bonding of the resin-coated surface, 37 % phosphoric acid was also applied for 5 s, rinsed and air-dried. ED Primer II (Kuraray Medical, Tokyo, Japan) was then applied to the surface for 5 s and gently air-blown (Fig. 8).



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Fig. 7. Phosphoric acid was applied to the cavity surface of the composite onlay for 5 s, rinsed and dried. A mixture of SE Primer in Clearfil SE Bond and Porcelain Bond Activator was applied to the surface for 5 s, then gently air-blown for silanization of the surface.

Fig. 8. Phosphoric acid was applied for 5 s, rinsed and air-dried. ED Primer II was then applied to the surface for 5 s and gently air-blown.



Fig. 9. Postoperative view of the second molar restored with an indirect resin composite using the resin-coating technique.

For cementation, the two pastes of a dual-cured resin cement (Panavia F, Kuraray Medical) was mixed and placed in the cavity. After seating of the composite onlay in the cavity, excess cement was removed with an explorer and floss. The cement was then light-cured from the occlusal, buccal and lingual sides for

30 s each. Following this, the interocclusal contacts of the restoration were adjusted, and the restoration was finished and polished again (Fig. 9). The patient was recalled one week after cementation to check for any remaining cement at the cervical and interproximal area. At this point, there were no clinical symptoms including postoperative sensitivity of the restoration.

Discussion

Direct composite restorations are the preferred treatment over indirect resin composites even for posterior restorations because they require minimal intervention and cavity preparation.^{2,4} Indirect resin composites are usually recommended when teeth require large restorations with a limited approach. If an indirect resin composite is selected, a resin coating consisting of a DBS and a LVR should be applied to the dentin surface to improve the bonding⁸⁻¹⁰ and to protect the prepared dentin and pulp.⁷ The combination of Panavia F with Clearfil SE Bond and Protect Liner F was one of the optimal combinations for resin coating.^{9,12} It provided the highest bond strength to dentin, which was almost identical to that for a direct resin composite restoration.¹² Therefore, the resin coating technique enables us to achieve minimally invasive indirect restorations, because of the improvement in bonding of the resin cement.

Adhesion of direct resin composite to dentin occurs as a result of hybrid layer formation,¹³ which is also true for indirect resin composite using a resin coating.^{5,12} The thickness of the hybrid layer with resin coating depends on the adhesive systems used in combination with the resin cements. The thickness of the hybrid layer with the combination of Clearfil SE Bond and Protect Liner F was approximately 0.5 to 1.0 μm .¹²

A single application of a DBS to the prepared cavity before taking an impression has been shown to protect the exposed dentin and prevent post-operative sensitivity.¹⁴⁻¹⁶ However, a previous study has also shown that an additional application of a LVR on the cured adhesive significantly improved the sealing of the dentinal margins.¹⁷ A significantly higher resin cement/dentin bond strength was obtained when the teeth were resin coated with a DBS and a LVR compared to the teeth that were bonded with a dentin bonding system only.⁹ By coating the DBS with a LVR, the oxygen inhibition layer containing uncured resin of the DBS can be reduced.¹⁷ Moreover, any uncured resin of the oxygen inhibition layer may subsequently polymerize by the diffusion of free radicals from the LVR.⁹ In addition, at the time of removal of the temporary cement, a LVR may prevent the DBS from being torn away. Furthermore, as the elastic modulus of the LVR is centered between the bonding resin and resin cement, it can function as a stress breaker.^{9,17}

Selection of the materials for impression making and temporization after application of the resin coating is important for successful cementation of the final restoration. A reversible hydrocolloid-alginate combination impression is more suitable than silicone rubber impression materials. When a reversible hydrocolloid impression material is used, bonding of the resin cement to resin coated dentin is not influenced by the impression material. However, an addition type silicone rubber impression material reduces the bonding of Panavia F. The reduction in bonding performance was found to be more remarkable

when the resin-coated surface was not wiped with a cotton pellet soaked in ethanol to remove the air-inhibited layer.¹⁸ It was considered that oxygen in the inhibition layer or the residual monomer may interfere with the setting of the silicone rubber impression material, resulting in contamination of the resin-coated surface. Therefore, when a silicone rubber impression material is used, the resin-coated surface should be wiped with an ethanol cotton pellet to remove the air-inhibited layer. Better surface characteristics of resin-coating materials were obtained with a condensation type of silicone rubber impression than an addition type.¹⁹

The effect of temporary filling materials on bond strength to resin-coated surface was evaluated after removal of the temporary filling materials.²⁰ The highest bonding was obtained when Cavit G was used as the temporary filling. The air-inhibited layer, which is considered to be effective for bonding with the resin cement, might be protected by this material. A resin-based temporary filling material should not be used, since it may react with the resin coating material. Resin-based temporary filling materials attached to the resin-coated surface are extremely difficult to remove, and any remaining material may affect bonding. Eugenol-based and non-eugenol materials did not show any reduction in bonding, however, the use of eugenol based materials is not recommended since the polymerization inhibition effect of these materials is still unclear.

Currently, a resin coating is being applied in all indirect resin composite restorations in clinic. Long-term clinical evaluation of this new technique should be carried out.

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