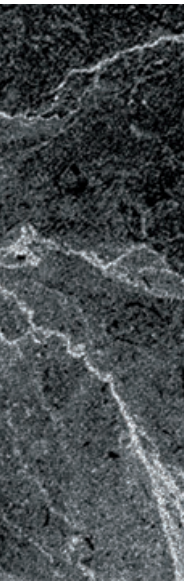

Critical Appraisal

IMMEDIATE DENTIN SEALING FOR INDIRECT BONDED RESTORATIONS

Author and Associate Editor

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For laboratory-fabricated, resin-bonded indirect restorations, clinicians usually prepare the tooth, make an impression, and cement a provisional restoration at an initial appointment. A few weeks later, after the definitive restoration has been tried in and adjusted, it is bonded with some combination of adhesive and resin cement. Another approach—most commonly called "immediate dentin sealing"—has been suggested. This technique involves placement of a resin coating on the dentin immediately after preparation. Several advantages have been cited for immediate dentin sealing. Prominent among those are a reduction in tooth sensitivity during the provisional phase and the potential for better bonding of the restoration to dentin. This Critical Appraisal *reviews several in vitro research studies on the immediate dentin sealing technique.*

IMMEDIATE DENTIN SEALING IMPROVES BOND STRENGTH OF INDIRECT RESTORATIONS

P. Magne, T.H. Kim, D. Cascione, T.E. Donovan
Journal of Prosthetic Dentistry 2005 (94:511–9)

ABSTRACT

Objective: The purpose of this study was to evaluate the effects of immediate versus delayed dentin sealing on the microtensile bond strengths (MTBS) of a three-step etch-and-rinse adhesive.

Materials and Methods: The occlusal half of 15 extracted human molar crowns were removed to expose mid-coronal dentin, which was polished flat to 600 grit. For the control group, composite resin (Z100, 3M ESPE, St. Paul, MN, USA) was bonded to the dentin of five teeth by using the OptiBond FL (Kerr, Orange, CA, USA) three-step etch-and-rinse adhesive system.

In one experimental group, a resin-based provisional material (Tempfil Inlay, Kerr) was applied to the dentin and left in place while the teeth were immersed in saline solution for 2 weeks. After the provisional material was removed, the dentin was cleaned by using airborne-particle abrasion. Composite was bonded by using the same OptiBond FL adhesive system, but the bonding agent (third step of the system) was not light-activated before composite placement. This treatment group represented the delayed dentin sealing technique.

In another experimental group, the OptiBond FL system was applied, and the bonding agent was

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activated once and then light-activated again under glycerin to prevent formation of an air-inhibited layer. The provisional material was applied and left in place during 2 weeks of storage in saline. After removal of the provisional material, the surface was cleaned by using airborne-particle abrasion. A single coat of the bonding agent was applied and was light-cured along with the subsequent layer of composite.

All of the bonded specimens were sectioned into uniform slabs (11 from each tooth) for microtensile bond-strength testing in a tabletop materials testing device. Representative fractures from each group were evaluated by using scanning electron microscopy (SEM).

Results: Mean MTBS were 55.1 MPa for the control, 11.6 MPa for the delayed dentin sealing group, and 58.3 MPa for the immediate dentin sealing group. Differences between the means of the delayed sealing group and the other two groups were statistically significant.

Conclusions: When preparing teeth for indirect bonded restorations, freshly cut dentin can be sealed with an adhesive system before the impression can be made. This improves bonding of resin material applied later and eliminates concerns about thickness of the adhesive layer.

COMMENTARY

The immediate dentin sealing technique has been proposed as a means of sealing the dentin—preventing or reducing problems such as bacterial contamination and tooth sensitivity—during the provisional phase between tooth preparation and placement of the final restoration. One logical question concerning this technique is whether the application of an adhesive at the preparation appointment would adversely affect bonding of the restoration at the delivery appointment. However, this study shows clearly that the opposite is true. The immediate dentin sealing technique provided a bond strength similar to that of the direct composite control group. In contrast, a delayed application of the adhesive system (which mimics the technique used by most clinicians) gave a much lower bond strength. In addition, because the adhesive system is applied and light-activated prior to the impression, concerns about pooling of the adhesive causing problems with restoration fit are greatly reduced.

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IMMEDIATE DENTIN SEALING OF ONLAY PREPARATIONS: THICKNESS OF PRE-CURED DENTIN BONDING AGENT AND EFFECT OF SURFACE CLEANING

M.M. Stavridakis, I. Krejci, P. Magne

Operative Dentistry 2005 (30:747–57)

ABSTRACT

Objective: The purpose of this study was to evaluate the film thickness of pre-cured adhesive in the immediate dentin sealing technique and the effects of cleaning procedures on film thickness.

Materials and Methods: Standardized onlay preparations were made in 12 extracted human molars. The prepared teeth were divided randomly into two groups for treatment using either the OptiBond FL or Syntac Classic (Ivoclar Vivadent, Schaan, Liechtenstein) adhesive system, both of which are

three-step total-etch systems. The adhesives were applied according to manufacturers' directions, while the teeth were perfused with fluid under normal physiologic pressure. The treated specimens were sectioned buccolingually by using a low-speed diamond saw.

The adhesive layer on each tooth was treated with two methods commonly used for removing temporary cement before try-in and cementation of the final restoration. One section of each specimen was airborne-particle abraded with 50-μm aluminum oxide particles, and the other half was cleaned with prophy paste by using a rotary brush. Impressions and replicas were made and examined by using SEM at a magnification of 200×. The thickness of the adhesive layers was measured before and after surface treatment.

Results: The thickness of the adhesive layers varied greatly by specimen and location, with a range of 0–500 μm. Film thickness was greater in more concave than in more convex areas of the preparations. Overall, Syntac had a greater mean thickness (142 μm) than OptiBond FL (88 μm). The amount of adhesive removed by surface treatment also was not uniform. For OptiBond, polishing removed more adhesive than airborne-particle abrasion (16 vs. 8 μm). The two methods removed similar thicknesses of Syntac (11 μm).

Conclusions: The film thickness of pre-cured adhesives varies greatly by the specific product and by location on the tooth. Cleaning methods remove some of the adhesive layer but not all of it.

COMMENTARY

One concern about bonded indirect restorations relates to the film thickness of the adhesive and whether this could affect the fit or marginal adaptation of the restoration. As this study showed, the cured adhesive layer can indeed be fairly thick, and its thickness can vary greatly. However, one advantage of the immediate dentin sealing technique is that the thickness of the adhesive layer considered before the restoration is fabricated because it is captured in the impression. When the definitive restoration is placed, a single layer of the bonding agent can be placed and light-activated at the same time as the resin cement, so thickness of this layer is not a concern.

The authors point out that the use of a glycerin gel to block out oxygen during light-curing is an important step in the procedure at the preparation appointment. This ensures that no air-inhibited layer is formed, and prevents potential interaction with the impression or provisional material.

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EFFECT OF TIME ON TENSILE BOND STRENGTH OF RESIN CEMENT BONDED TO DENTINE AND LOW-VISCOSITY COMPOSITE

R.M. Duarte, M.F. de Goes, M.A.J.R. Montes
Journal of Dentistry 2006 (34:52–61)

ABSTRACT

Objective: The aim of this study was to evaluate the effects of the immediate dentin sealing technique, using a low-viscosity composite (Protect Liner F, Kuraray), on the tensile bond strength of a resin cement to dentin at various times after application.

Materials and Methods: The labial surfaces of 60 bovine incisors were ground to 600 grit to obtain uniform dentin smear layers. The teeth were randomly assigned to six groups of 10. In three groups, the self-etching ED Primer (Kuraray, Osaka, Japan) and the adhesive resin cement Panavia F (Kuraray) were applied, and a composite rod was bonded to each surface by light-activating the resin cement. Tensile bond strengths were measured at 10 minutes, 24 hours, or 12 months after polymerization of the cement. Specimens were stored in water at 37°C.

In the remaining three groups, the self-etch primer adhesive system Clearfil Liner Bond 2V (Kuraray) was applied and used to bond a low-viscosity composite to the dentin surface. The composite was light-activated under a matrix strip and glass slide, so presumably no air-inhibited layer formed. ED Primer, Panavia F, and a composite rod were applied to the treated surfaces. Tensile bond-strength tests were performed by using the same method and intervals as in the other three groups. All bond failures were evaluated by using SEM.

Results: Mean tensile bond strengths of the six groups were in a fairly narrow range—from 8.5 MPa to 11.3 MPa. Higher bond strengths occurred at 24 hours and on specimens that were coated with the low-viscosity composite. SEM analysis showed that failures occurred primarily at the resin–dentin interface for specimens that did not include the low-viscosity composite and within the resin layers (cement or low-viscosity composite) for those specimens with the low-viscosity composite. A more distinct hybrid layer was observed in the latter as well.

Conclusions: Resin–dentin interfaces degraded over time, as evidenced by decreasing bond strengths and changes in failure modes. However, a layer of low-viscosity composite helped to protect the underlying hybrid layer and would be expected to better preserve the dentin seal.

COMMENTARY

The results of this study suggest that immediate dentin sealing, using a self-etch primer adhesive system and low-viscosity composite liner, might provide a better long-term seal of the dentin than that provided by the resin cement alone. Although bond strengths were not dramatically different, the adhesive and low-viscosity sealing composite provided a more defined and more durable hybrid layer. Although it is difficult to extrapolate these results to the clinical situation, it is possible that the immediate dentin sealing technique could provide better long-term adhesion and hence more durable indirect restorations.

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IMMEDIATE DENTIN SEALING SUPPORTS DELAYED RESTORATION PLACEMENT

P. Magne, W.-S. So, D. Cascione

Journal of Prosthetic Dentistry 2007 (98:166–74)

ABSTRACT

Objective: The objective of this study was to determine the microtensile bond strength to human dentin using the immediate dentin sealing method with two different adhesives and delays of up to 12 weeks before restoration placement.

Materials and Methods: The occlusal portions of 50 extracted human molars were removed to expose mid-coronal dentin, which was polished to a flat 600-grit surface. A three-step etch-and-rinse adhesive (OptiBond FL) and a two-step, self-etching primer system (Clearfil SE Bond) were used. Ten specimens constituted the control groups, in which composite (Z100) was bonded to the dentin as direct restorations.

Ten teeth were restored with a provisional material (Tempfil Inlay) for 2 weeks. After the provisional material was removed, the dentin was cleaned by airborne-particle abrasion. The adhesives and composite were applied. The final step of each adhesive system was light-activated along with the composite resin. These specimens represented a delayed dentin sealing method.

In the remaining teeth, the adhesives were applied to freshly cut dentin and light-activated under a lubricant to prevent formation of an oxygen-inhibited layer. The provisional material was applied and left in place, while the teeth were immersed in saline solution for 2, 7, or 12 weeks. After the provisional material was removed, the dentin was cleaned by using airborne-particle abrasion. One coat of bonding agent was applied and cocured with the subsequent composite restorative material. All specimens were sectioned into uniform slabs for MTBS testing in a materials testing device. Four fractured beams from each group were evaluated by using SEM.

Results: For OptiBond FL, mean MTBS values were 55.1 MPa for the control, 11.6 MPa for the delayed dentin sealing group, and 58.3 MPa for the immediate dentin sealing group at 2 weeks. At 7 and 12 weeks, means for immediate dentin sealing were 66.6 MPa and 59.1 MPa, respectively. For Clearfil SE Bond, the mean MTBS was 54.8 MPa for the control and 1.8 MPa for the delayed dentin sealing group. Immediate dentin sealing means were 55.1, 52.0, and 45.8 MPa at 2, 7, and 12 weeks, respectively.

Conclusions: Immediate dentin sealing provides bond strengths similar to those obtained using a freshly placed adhesive, and those bond strengths are not affected by up to a 12-week delay before placement of the definitive restoration.

COMMENTARY

This study is a continuation of the 2005 study reviewed at the beginning of this Critical Appraisal. It indicates that immediate dentin sealing provides excellent bond strengths for the final restoration, not only at the relatively short interval of 2 weeks but also with delays as long as 12 weeks following tooth preparation and resin sealing.

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THE BOTTOM LINE

The immediate dentin sealing technique offers several advantages. First, resin adhesion can be improved by bonding to freshly cut dentin and by polymerization of the resin adhesive without any stresses related to curing of the resin cement that will overlie it. Second, the adhesive provides a seal that reduces bacterial contamination, tooth sensitivity, and the need for anesthesia at the delivery appointment.

Several variations of the technique have been described in the literature—for example, the use of a self-etch adhesive rather than an etch-and-rinse adhesive. However, Magne recommends a three-step, etch-and-rinse adhesive as the type having best clinical track record. In addition, he recommends the use of a filled adhesive because it can provide the most consistent and uniform film thickness.

While the clinical technique is not particularly complicated, two precautions must be taken to avoid potential problems. When the adhesive is placed after preparation, it should be light-activated twice, the second time under a glycerin coating to prevent formation of an oxygen-inhibited layer that could interact with the impression material. Also, before the provisional restoration is fabricated, the preparation should be coated liberally with a separating medium, such as petroleum jelly, to prevent bonding of the provisional to the treated tooth surface.