

## Indirect Composite Resin Restorations: *Single Appointment Procedure*

Robert D. Shorey, DDS

### Theory

The increasing popularity of tooth-colored composite resin fillings is making it the dominant choice of most patients for their cavity fillings and replacement fillings. The overall average lifespan of these composite resin materials leaves room for improvement. Polymerization shrinkage is one of the primary limitations affecting the long-term serviceability of direct placement posterior composite resin restorative materials.<sup>3</sup> Managing resin shrinkage has also been cited as a requirement for prevention of biting sensitivity on posterior teeth restored with composite resins. The physical putty nature of un-polymerized resins adds to the challenge of creating good



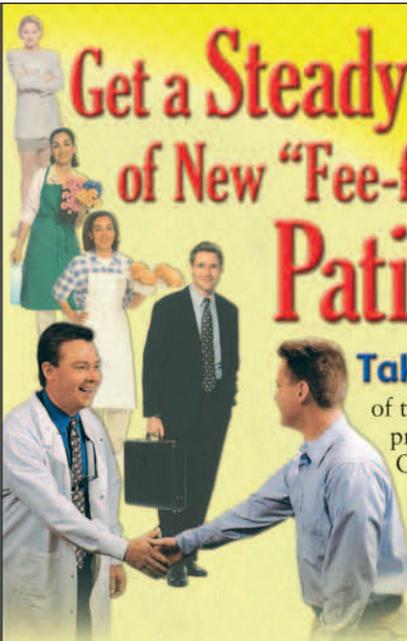
anatomic proximal tooth form and contacts during placement of resin fillings directly in the mouth. These are problems that may be addressed by using an alternative indirect fabrication and placement restorative procedure.

The majority of polymerization shrinkage occurs during the initial polymerization cure and is affected by multiple factors like preparation size, design, type of cure and speed of cure.<sup>9</sup> Studies on the kinetics of resin polymerization show over 98% of the polymerization shrinkage occurs within two minutes after initiation of the resin cure.<sup>2</sup> Although additional polymerization takes place over 24 hours, the largest bulk of shrinkage happens within the first few minutes of polymerization.<sup>10,11</sup> The current generation of composite materials has volumetric shrinkage in the range of 2 to 6%.<sup>9</sup> The *resultant stress from shrinkage* may damage the bonding or cause deflection of the surrounding tooth structure.<sup>1, 5, 6, 12, 13</sup> The gingival marginal bond has been shown to be a typical weakly bonded area for reasons of enamel prism quality, lack of enamel and therefore particularly vulnerable to the stress of resin shrinkage forces.<sup>4,14</sup>

Even well-placed composite restorations often show a tell-tale margin of stain and future marginal leakage<sup>7</sup> after only five years of intraoral service. While we can easily visualize the process of unzipping at the occlusal surfaces imagine the condition of the margins placed in the considerably weaker bonded gingival margin areas, Marginal leakage is speculated to result from gradual unzipping (breakdown of the mechanical bond tags) of the polymerized restoration due to shrinkage forces inherently stored within the composite resins during direct placement and polymerization.<sup>8,15,16</sup> In the meantime many alternative indirect placement restorations regardless of material (porcelain or composite) seem to have less marginal leakage in the early years after placement. This may be ascribed to the much lower volume of curing material as well as the method of cure. When an indirect restoration is placed into a tooth the relatively narrow interface between the cavo-surface area and restoration are concerned with polymerization shrinkage not the entire preparation void. Additionally using a dual chemical cure also lowers the polymerization shrinkage.<sup>11</sup> Placement of a pre-

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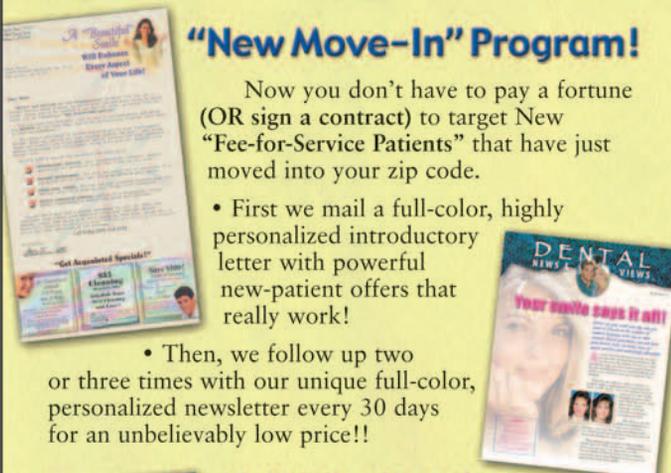
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polymerized restoration and use of a chemically cured luting resin substantially lowers the inherent polymerization stress forces at the resin-bonded cavo-surface.

The issues just mentioned are some of the inherent physical properties of plastic resins. When dealing with our patients, procedurally it is necessary for isolation of treated teeth during the typical *direct resin placement*. Clinically rubber dam placement provides both benefits and shortcomings. Some of the shortcomings revolve around our patients having to keep their mouths wide open during the *entire dental procedure*, drying of the teeth makes shade matching more challenging and preparations often lead below the area of gingival isolation causing additional steps to create a dry field during preparation and placement time. The indirect method of placing composite resin materials in posterior teeth lends itself easily to only utilizing a rubber dam during the final cementation bonding of the restoration.

## Discussion

Most indirect restorative methods require two patient visits and the need for a third-party laboratory. While laboratory-made restorations can ultimately provide a superior restoration to direct resins, the additional time and costs are substantial and can often be considered a barrier to patient acceptance. Indirect methods, like CEREC, can help to eliminate some of the additional time; however, the usual final product can be considered an esthetic concession and the ability to add to the milled restorative material after the creation of the restoration is severely compromised.

This article will present a method of creating highly esthetic indirect resin restorations that will inherently have superior properties to most directly-placed resin restorations in the posterior mouth. This method does not require additional equipment than what is usually present within most general dentists' existing armamentariums. This technique does usually lengthen the delivery time and may therefore necessitate a slightly higher fee than direct placement posterior restorations. Like all procedures, mastery of this technique requires practice. The ultimate result will be restorations with lower frequency of sensitivity, predictable contacts, better physical properties and beautiful esthetics and anatomic form.

This article will outline the procedural process of placing an in-office indirect resin restoration utilizing vinyl polysiloxane and polyether impression material. Indications for this technique are moderate to large restorations needed for posterior teeth, teeth with unusual contact areas (rotated teeth or teeth with greater than average contact distances), or teeth with difficult access and isolation challenges.



Fig. 1: Upper molar with difficult access.



Fig. 2: Restored molar with indirect resin.



Fig. 3: Radiograph.

Fig. 4: One-year post-operative image

A contra-indication as a final restorative option may be individuals known to be moderate to heavy bruxers and individuals with considerable occlusion issues requiring a comprehensive change in occlusion.

Benefits of this procedure are better control of contours and that sculpting is done primarily outside the mouth. The skill-set for creating indirect restorations in this technique is very comparable to the skills necessary to make a temporary crown. Anyone able to create an excellent provisional restoration can create beautiful life-like permanent restorations with this technique. The greatest advantage is delivery of lab-quality restorations chair-side in one visit.

In the procedure about to be described the use of a high-intensity, Triad-style light oven was not used or recommended. The Triad oven is often referred to as a composite tempering process designed to create complete polymerization of composite resins in a shortened period of time. While studies show improved wear of these tempered restorations the physical bond to the restoration is thought to be mechanical because most active bonding sites have been chemically exhausted. It is the author's belief that tying up all external resin bond chemistry may not be desirable when the objective is to chemically bond the restoration to the bonding resins which tie the restoration to the cavo-surface.

The author feels obliged to point out that because it is necessary to prepare teeth for path of draw (try-in and removal of the restoration) when preparing for indirect restorations more tooth structure is removed compared to the equivalent direct resin cavity preparation. This is not necessarily a disadvantage, as it more adequately assures no loose enamel rods are present at the bonding surfaces.

The creation of an indirect restoration using this technique is predicted to extend your chair-side time, depending on your mastery level, anywhere from no additional chair time to 30 minutes longer than the average direct placement posterior composite. Because no lab bill is incurred and no second visit is necessary, the ultimate cost to your patient may be reduced by the amount of a lab bill and second appointment setup time. Procedurally the process begins similarly to a direct placement composite. \*It is suggested, however, that a rubber dam is not placed at the initial preparation to allow for the convenience of impressing the preparation. Ultimately a polyether die will be created and the final restoration layered for color and created on the rubber impression die. A rubber dam is placed and the teeth well isolated. Try-in of the restorations is accomplished and teeth conditioned for resin bonding. The final restorations are seated using a dual cure luting-resin and the rubber dam removed for occlusion review and adjustments.

*\*Preparation of the teeth without isolation facilitates color matching, as well as the ability to take impressions. Placement of a rubber dam for isolation is only needed at the end of the procedure for a short time during seating. Difficult isolation can be augmented using Astringent and products like OpalDam.*

### Armamentarium:

- Pear-shaped carbide or diamond friction grip bur
- Ivoclar Vivadent Astropol polishing cups (gray and green)
- Dentsply Caulk Enhance polishing cups
- Ultradent Jiffy brush
- Multi-fluted composite finishing burs; flame and football shaped
- Flame-shaped fine diamond
- # 2 gold-knife trimming instrument, half Hollenbeck, pig-tail or 3A explorer
- # 12 scalpel blade and handle
- Medium rubber dam material and molar clamps
- Ultradent Astringent
- Ultradent OpalDam
- Kerr OptiBond Solo Plus or Ultradent PQ1
- Ultradent Consepsis
- Phosphoric acid-etch gel
- Ivoclar Vivadent Variolink base and catalyst
- Flowable hybrid composite
- Dentsply Caulk Esthet-X
- Ultradent Amelogen or Vit-I-escence composite
- 3M ESPE Filtek Z250 composite
- Polysiloxane impression material (Kerr Take 1 or Dentsply Caulk Aquasil fast set)
- Polyether impression material (3M ESPE Impregum 3-minute set)
- Retraction cord (if needed)
- Ultradent Sable Seek or other caries detector
- Kerr Kwik-Tray impression tray
- Local Anesthetic
- Air-abrader and cosil or aluminum oxide
- Wedge-shaped microbrush
- Ultradent PermaSeal

*Note: Choice of your composite materials provided they are designed for posterior placement is unlikely to be a determinant factor for this procedure. The author suggests using the materials you currently are using for your direct placement composite on posterior teeth.*

### One visit appointment - Indirect Composite Resin Restorative Procedure

Review your patient's teeth for restorative choices. Small restorations may appropriately be restored directly as polymerization shrinkage is not an over-riding problem due to the small volume of resin material. Teeth with moderate to severe tooth loss may be considered for this procedure. Maintenance of a stable long-term occlusion should be weighed when considering this procedure versus a laboratory-made crown. Studies are still being reviewed to assess the long-term success of composite resin to maintain a stable occlusion. A discussion with your patient regarding the properties of the proposed materials is suggested while

making a final choice. The benefits of an indirect restoration are improved proximal contours, preservation of tooth compared to crowns, excellent shade matching and ability to provide future repair in some instances without complete replacement.

Appropriate anesthetic for the location of restoration is administered. Prepare the teeth similarly to most resin restorations principles, keeping in mind the concept of draw. All surfaces must diverge from the cavo-floor. Rounded line angles are preferred while maintaining enamel at the gingival floor when possible. Any undercuts should be removed in the preparation by preparing at the proper angles or filling any remaining undercuts with the placement of flowable composite resins. Should undercuts need to be removed, placement of resins using a rubber dam will be necessary to control the cavo-environment and avoid moisture and humidity. Review your preparation and make sure all surfaces are divergent and all outside radius-cut surfaces have a 90-degree finish to the outside enamel or dentin surfaces. Compromise exceptions to a 90-degree cut may be the preparation of visible buccal surfaces where transitional blending of resins may be desired for esthetics. Remember that feathered surfaces are more susceptible to bonding failure with time. Hand instruments or disks may be used to assure that proximal cavo-surfaces are free of loose enamel rods and draw appropriately.

Examine the preparation. Use caries detector to assure all decay has been removed. Scrub the cavo-surface with Concephis (chlorhexidine scrub). Control any areas with crevicular fluids utilizing Astringedent scrub, rub and rinse technique. If your preparation extends into deeper areas adjacent to gingival tissues place retraction cord to control fluids and allow space for impression material. Using a Kwik-Tray and Aquasil addition reaction silicone impression material inject medium or heavy body into tray, inject light body material into the preparation and move material through the prep with light air. Inject medium/heavy body onto prep and place tray into mouth. Cotton rolls placed ahead of the tray terminus and against teeth are used to allow your patient to relax their bite and close their mouth while the impression material sets. Set time can vary for silicones from 3 min. to 5 min. depending of regular or fast set. With experience, fast set materials will reduce overall procedure time. After the material is removed from the mouth allow your patient to relax while you work outside the mouth. You will be working outside of their mouth for 15 to 30 min. Impregum impression material (3 min. set preferred) is injected into the silicone impression. Work quickly and make sure to avoid trapping bubbles as the impression material is injected into the vinyl polysilicone impression. Placing your syringe while injecting at the bottom of the impression in the tight intricate areas



Fig. 5: Beginning prep, distal caries.



Fig. 6: Prep after impression, ready for restoration try-in.

will facilitate avoidance of bubbles. Getting this part of the technique down is critical as a poor impression die can either delay the procedure during re-pours or provide an inaccurate model and further delays as you try to fit your final restoration into the actual prepared tooth. Procedurally, the author advises that immediately after removal of the polyether die from the polysiloxane impression you should make another polyether pour for backup and final restoration review. Make sure to pour an appropriate 3-4 mm flat base while creating the polyether die models. You will find that the polyether is appropriately ridged and at the same time flexible to view tooth contacts. Do not ply and bend the model too much as these manipulations are not completely elastic and even small variations in contacts can lengthen try-in times. Bulk filling using a darker base shade is advised leaving room in the proximal and occlusal areas for lighter composite. Keep the resin short of the margins at the occlusal and proximal surfaces but to the margin at the gingival surface. Cure this underlying layer. If you choose to use a flowable resin you will need to test its compatibility with the Impregum die material; some flowable materials will inappropriately stick and fuse with the polyether. Do not use any bonding agents between layers as the alcohol and ketones will facilitate bonding to the polyether die. The author prefers syringe putty composites like Esthet-X, Amelogen or Vit-l-escence as the middle layer of your restoration. Carefully shape it into your preparation using a half Hollenbeck carver. Cure the middle layer to create a simulation of the dentin layer of natural teeth. Lastly place Filtek Z250 or Ultradent Amelogen transparent shades to complete the proximal contact as well as the occlusal surface. Cure and refine your anatomy clearly outlining developmental grooves and supplemental anatomy. Remove the restoration from the die and inspect by peeling and lifting out with a metal instrument like the half Hollenbeck. By this time, your second pour Impregum die should be ready to remove from the polysilicone impression. Remove it and set it aside as a secondary model to confirm fit and contacts. Inspect your restoration and refine the gingival margins and proximal contours. At this stage, lightly plane the internal cavo-surface removing any potential undercuts. Continue to inspect and plane slightly the inner cavo-surface of the restoration to allow for a passive yet accurate fit. Depending on the size and ability to handle your restorations a choice may be made to add a handle to the restorations by cutting into the occlusal surface in an appropriate anatomical area (developmental grooves or pits) and bonding a small stainless-steel wire with ball terminus or Butler floss-threader monofilament loop. These handles can be easily removed with a bur after final bonding. During placement assess your contacts. Contacts and proximal flares having excess resin are the top issues that resist complete seating of your restoration during try-in. Once you successfully fit your restorations and judge the ability to get them completely seated, you are ready to move on.

Tell your patient to wake up, it's time to finish the work. Review the prepared teeth. If any crevicular fluids, like blood, are present use Astringedent to rub, scrub, rinse and control. Place your rubber dam in an individual tooth-by-tooth (punch) fashion or utilize a slip dam technique if oral fluids are well controlled and allow for it. Next begin your intraoral try-in of the restoration(s). If contacts are too tight for complete seating simply remove a small amount. Start your contact assessments beginning with the restora-



Fig. 7



Fig. 8



Fig. 9



Fig. 10



Fig. 11

Fig. 7: First layer of flowable resin.

Fig. 8: Nearly completed layering.

Fig. 9: Restoration before try-in.

Fig. 10: Try-in of restoration.

Fig. 11: Final restoration.

tion neighboring natural teeth, existing filled or crowned areas first. Your contacts against existing teeth, fillings and crowns can easily be re-added during the final seating. Once the seat is definite and proximal contacts confirmed or assessed remove the restoration. Air-abrade the internals and add OptiBond bonding agent and cure. (Do not allow final restoration to be placed back on the Impregum die before the bonding agent has been completely cured or you will bond the restoration to the model die.)

Now once you have tried in and fitted your restoration, air abraded, and added bonding resin, start preparing the cavo-surfaces for composite bonding. Scrub the surface with chlorhexidine, total etch and OptiBond or PQ-1. Move heavy direct operatory light away from the restorative site. Mix your dual cure and begin to seat your restoration with Variolink buttered into the cavo-surface areas. When seating your restorations excess Variolink should be expressed out of the preparation.\*\* If you did not have to modify your contacts utilize the "rapid cementation technique" of tacking and cleaning excess resin from the proximal areas. If contacts need to be added to facilitate try-ins for

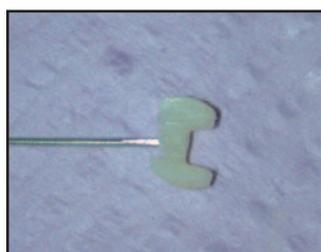


Fig. 12: Stainless-steel wire handling attachment.



Fig. 13: Example of otherwise difficult to reach contact.

restorations resting against natural teeth, crowns or fillings make sure those areas were maintained etch free and bonding agent free. Add a thin (glaze) layer of Filtek Z250 on bonding agent-conditioned surface of the proximal of the restoration. When seating do not floss this area at the curing stage of seating but clean out the proximal gingival area using a wedge-shaped microbrush. Make sure to spend the appropriate time getting contacts correct on the new restoration against new restoration proximal areas before final seating. The technique for creating contacts just previously outlined will not work efficiently in these areas because the restorations will fuse together and extend your cleanup time significantly.

After your initial tack curing and cleanup, begin to cure restorations in all dimensions. Upon final cure, check all areas to make sure no irregularities or voids are present. It is much easier to make any necessary repairs and bonding adjustments while the teeth are dry and isolated. After inspection remove the rubber dam and begin occlusal analysis. Refine the occlusion and anatomy using multi-fluted composite finishing burs. Trim proximal areas with # 2 gold trimmer or # 12 blade and scalpel. Review contacts and floss and reseal the cavo-surface with etch and PermaSeal or composite glaze. A post-operative bite-wing radiograph is appropriate at this time to review your finished work and assure that all resins have been appropriately trimmed away for tissue health. If any flaws are noted at this stage, it is easier to approach your patient and correct the problem immediately chair-side or re-appoint your patient for repair or replacement if needed. Because the frequency of composite resin restoration replacement is higher than many other restorative options, it is important to make certain the final restorative product excels in all criteria so that the longest potential life span is achieved.

### Further Discussion:

Volumetric polymerization shrinkage of composite resins is likely responsible for breakdown of resin bonds and secondary caries in posterior teeth restored with composite resin. Although unproven, a review of the author's clinical photographs over the last six years has shown indirect resin restorations have negligible marginal staining and occlusal wear compared to similarly aged direct resin posterior fillings. Based on previous findings it is likely that research will support the assumption that indirect resin fillings optimize the properties of composite resin fillings by partially eliminating the stresses of polymerization shrinkage. The ability to produce superior esthetics and contacts along with reduced cost compared to other indirect restorative options may support this alternative option while we wait to determine if research can ultimately provide evidence of improved clinical wear to further justify this alternative restorative choice.

Referenceto this article can be found on [www.dentaltown.com](http://www.dentaltown.com).



Dr. Shorey maintains a private practice in Roseville, Calif. He graduated from the University of Southern California School of Dentistry. He is a member of the American Academy of Cosmetic Dentistry.