# A Modified Technique for Direct, Fibre-Reinforced, Resin-Bonded Bridges: Clinical Case Reports

## (Technique modifiée pour les ponts directs, renforcés de fibres et liés à la résine : études de cas)

· **Paul van Wijlen,** DDS ·

## Sommaire

*Cet article présente de nouvelles modifications à la technique clinique de fabrication des ponts directs, renforcés de fibres et liés à la résine. La résistance à la torsion et à la flexion est accomplie grâce à une sous-structure prenant la forme d'un ruban de polyéthylène renforcé et entourée de couches laminées de résines hybrides et microfines. Ces modifications permettent d'améliorer, de façon simple, la relation pontique-crête et l'esthétique en général. Une étude de cas à court terme indique que cette technique pourrait offrir aux patients une solution de rechange relativement conservatrice et esthétique au remplacement des dents antérieures, tout en étant non invasive sur le plan parodontal.*

***Mots clés MeSH :*** *case report; composite resins; denture, partial, fixed, resin-bonded; polyethylenes*

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*Cet article a fait l'objet d'une révision par des pairs.*

Traditional options for prosthetic replacement of missing anterior teeth present the clinician with certain challenges. These may include the need to compromise healthy tooth structure to achieve strength or an esthetic result; dependence on the skills of laboratory technicians and clear communications; the need for multiple appointments; the fabrication of adequate provisional devices; the difficulty of effecting durable repairs; the lack of availability and high cost of manufactured prosthetic components; among others. The ability of clinicians to restore these edentulous areas using commonly available materials, combined with a direct method of application, would eliminate or greatly reduce many of these obstacles.

Historically, many materials have been used to fabricate splints for periodontally involved teeth or for temporary stabilization of avulsed teeth. Older methods relied mainly on wire or silk ligatures, but the advent of dental resins and resin adhesive techniques in the late 1950s allowed clinicians to achieve better, more esthetic stabilization techniques. Current reinforcement materials are typically synthetic fibres such as Kevlar, a polyaramid fibre that reportedly has three times the strength of steel by volume.[1]

In 1995, Miller and others[2] reported a case that involved the placement of an immediate and indirect periodontal, prosthetic splint. They described the use of gas-plasma-treated, woven polyethylene fabric to reinforce composite resins used to lute pontics of extracted teeth crowns into place. Gas-plasma treatment of the fibre makes it physically and chemically interactive with the resin in which it is embedded, thus creating an esthetic and resilient matrix. Similar recent case reports have demonstrated the use of reinforcement fibres and directly applied composite resin pontics.[3,4] In 1998, Culy and Tyas[5] suggested that the long-term success of direct, resin- bonded, fibre-reinforced bridges would be enhanced by improvement of the pontic contour and surface quality.

The cases presented here illustrate refinements to previously described techniques. These refinements are designed to increase structural and retentive strength, establish a more intimate relation between the pontic and the ridge, facilitate oral hygiene and improve esthetics.

### Case One

A 50-year-old man requested that a replacement be made for a missing maxillary lateral incisor (Fig. 1). This incisor had been extracted about one year earlier. Proximal caries were noted on the surfaces of the adjacent central and cuspid teeth. After complete examination and radiographic analysis, several treatment options were discussed including removable prosthesis, traditional fixed porcelain fused to metal bridges and implants. Owing to the patient's current financial constraints and difficulties in returning for multiple appointments, it was agreed that a replacement tooth would be fabricated immediately, using fibre-reinforced composite resin. It was hoped that more comprehensive restorative and prosthetic treatments would be carried out in future. Removal of caries and retentive preparation were carried out after placement

***Figure 1**: Preoperative view.*

***Figure 2:** Palatal view.*

***Figure 3:** Tooth preparation.*

***Figure 4:** Kevlar ribbon placement.*

of a rubber dam (Fig. 2). Very thin diamond burs were used to prepare slots in the proximal (abutment) teeth. The general aim in preparation is to preserve as much facial and palatal enamel as possible while securing maximum retention for the polyethylene fibre ribbon (Fig. 3).

A doubled or tripled length of resin-soaked ribbon (Ribbond bondable reinforcement ribbon, Ribbond Inc., Seattle, Wash.) was applied using current dental-enamel adhesive techniques and flowable resins (Tetric Flow, Vivadent). As many and as directionally varied fibre ribbons as can be reasonably fitted should be placed; this creates a strong, resilient and highly retentive substructure (Fig. 4). An appropriately chosen dentinal shade of flowable resin (Flow-It, Jeneric Penetron Inc., Wallingford, Conn.) was used to form the pontic's gingival extension.

Very intimate gingival adaptation of the pontic was achieved by pulling a Mylar strip tightly down across the ridge before applying a mass of flowable resin, which was then photocured. The mass of resin extended between the Mylar strip and the now-rigid ribbon, establishing and fixing a smooth pontic-ridge relationship (Fig. 5).

The bulk of the crown of the pontic was formed using a layer of stronger microhybrid resin (DiamondLite, DMR Laboratories, Inc., Branfort, Conn.). This more colour-saturated "dentinal" layer set the general shade of the tooth. Additional layers of highly polishable microfil resins (Renamel, Cosmodent, Inc., Chicago, Ill.) were then applied to form the surface layer and outer anatomy of the pontic tooth (Fig. 6). Translucent resin material forming the outer "enamel" layer can be used to achieve a natural-looking depth of colour, particularly in the incisal region. In this instance, a small amount of blended, pink resin (Renamel Gingafill, Cosmodent, Chicago, Ill.) was applied to recreate more natural gingival emergence esthetics (Figs. 7 and 8).

During final shaping and polishing, due consideration should be given to the light reflection properties of the convexities and concavities of the external surface (i.e., the visual impact of light reflection on the morphology of teeth). Furthermore, access to and the ability to clean the proximal gingival embrasures must be ensured. This is usually achieved with the careful use of a multi-fluted bur in the shape of a fine flame, followed by application of a coat of light-cured, unfilled resin (Fortify, Bisco, Inc., Schaumburg, Ill.).

This patient was only able to return to the clinic a year later. Examination revealed some minor staining on the palatal surface of the pontic. The abutment teeth remained stable and nonsymptomatic. There were no signs of fracture or fatigue on any part of the resin-fibre prosthesis or supporting abutment teeth. The periodontium appeared healthy in all aspects. The patient expressed his complete satisfaction with the results of treatment.

***Figure 5:*** *Gingival extension.*

***Figure 6:*** *Postoperative, occlusal view.*

***Figure 7:*** *Postoperative view.*

***Figure 8:*** *Gingival detail.*

## Case Two

A 56-year-old man reported for a recall appointment with a missing right mandibular central incisor (Fig. 9). The incisor had been extracted four years earlier and had been replaced by means of a Maryland bridge with an etched metal retainer extending from cuspid to cuspid. The patient reported that this prosthesis had fallen out while he was brushing his teeth and was lost down the drain.

A rubber dam was placed, extending isolation to the first bicuspids on either side. After removal of all remnants of old luting material and stain on the proximal teeth, a thin slot was made in the dentin of the worn incisal surfaces of the remaining three mandibular incisors. This slot was established to a depth of about 2.5 mm using a fine-tapered diamond bur and refined with a fine inverted cone. In addition, a slot was made extending about 4 mm down the proximal surfaces of the teeth on either side of the pontic space.

A length of 3-mm Ribbond mesh was measured and cut to span the pontic space and inserted into the prepared proximal slots. An additional length of 4-mm Ribbond was cut to the length of the prepared incisal groove. Flowable resin was then introduced into the slot preparations and grooves. The Ribbond mesh was coated with unfilled resin according to manufacturer's instructions. Care must be taken to avoid touching the mesh with gloved hands to prevent damage to the plasma-coated surface. (Cotton over-gloves are provided in the Ribbond kit along with special heavy-duty scissors needed to cut the mesh.) The mesh was carefully inserted into the resin-filled slots. The 4-mm-wide mesh was folded longitudinally and tucked into the incisal slot. Care must be taken to ensure that no porosities are left under or around the mesh and that no mesh is left uncovered by resin.

Excess flowable resin was removed and the whole resin-fibre matrix was then photocured. The pontic was established and completed as described in case one, using resin layers to establish form, esthetics and strength (Fig. 10). Surfaces subject to functional wear should be made of microhybrid resin and polished as smoothly as possible. In this case, special care was taken to establish natural-looking root emergence and access for oral hygiene (Fig. 11). This patient has been followed at routine six-month recall visits; the bridge and support structures are periodontally stable and healthy (Fig. 12).

## Discussion

Although this approach was initially intended and offered as an interim method of anterior tooth replacement, its inherent advantages and relatively noninvasive qualities suggest that it should be considered as a permanent alternative in certain cases.

The limitations of the technique require that cases be carefully selected. The general selection criteria closely parallel those for a

***Figure 9:*** *Preoperative view.*

***Figure 10:*** *Gingival extension.*

***Figure 11:*** *Oral hygiene.*

***Figure 12:*** *Six months postoperative.*

Maryland-type bridge. Short spans, not exceeding 8-10 mm are recommended. Functional stresses and occlusal loading of the pontic tooth should be minimal, and the supporting abutment teeth must be structurally sound enough to act as retainers of the resin-fibre matrix. If the prospective abutment teeth exhibit periodontal mobility, extension of the ribbon-retaining splint to include more teeth should be considered.

Over 20 cases of direct, fibre-reinforced, resin-bonded bridges have been placed and followed over a span of two years without a clinical failure of any kind. The rather surprising early success is likely due to conservative case selection and to the inherent flexibility or resilience of the resin-fibre substructure. Traditional porcelain fused to metal bridges or implants are undoubtedly stronger, clinically proven and reliable, and should, therefore, remain the first consideration in discussions with the patient.

The potential advantages of this technique are self-evident. First, the procedure can be completed in one appointment and, apart from the fibre-mesh material, requires no unusual materials or hardware. Second, the periodontal apparatus of the abutment teeth is left entirely uninvaded. Third, interdental spaces may be shaped to facilitate access for oral hygiene. Fourth, because this approach is relatively less invasive, it permits the patient to opt for other, more traditional tooth replacement methods in future. Fifth, repairs can be carried out directly, without the need for any complicated techniques or materials.

A further advantage is the fact that control of the entire procedure remains with the operating dentist. Adjustments to the design, esthetic details and occlusal and soft-tissue relationships may be carried out immediately or with a minimum of time during follow-up appointments. From the patient's perspective, this procedure is attractive mainly because it entails fewer appointments and can offer outstanding immediate results. In several instances, modified versions of the technique have been used to provide immediate replacement of extracted anterior teeth. Formation of ovate pontic depressions during the healing phase is possible.

This prosthetic method is possible because of the success of modern adhesive dentistry. A thorough understanding of new techniques and materials is essential to the success of the procedure, as it is with just about any procedure in conservative, esthetic dentistry. Attempting this type of clinical procedure without the use of vision magnification would be disadvantageous.

## Conclusion

The modifications illustrated in the cases presented here allow for better adaptation of the pontic surface to the ridge and for better overall esthetics. These will presumably result in longer life for the prosthesis as well as better long-term periodontal health and esthetic quality.

Direct fibre-reinforced restorations, intended for more than provisional or shorter term use, should be approached and created with the same care, thoroughness and attention to detail as clinicians typically apply to indirect prosthetics, i.e., appropriate case selection, thorough case analysis, and treatment planning with consideration of biologic and material limitations.

The potential advantages and early clinical success of directly applied, fibre-reinforced, resin-bonded bridges warrant further investigation. In-depth analysis of the combined physical properties of the fibre-reinforced material and the biologic structures, followed by comprehensive clinical trials designed to establish long-term efficacy are necessary for the formulation of objective guidelines for case selection and placement. ◆

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*Le Dr van Wijlen est chargé de cours à la Division de prosthodontie fixe, Faculté de médecine dentaire, Université McGill.*

*Écrire au : Dr Paul van Wijlen, Groupe dentaire de Beaconsfield, 201-444, boul. Beaconsfield, Beaconsfield QC H9W 4C1. Courriel : pvanwi@po-box.mcgill.ca.*

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