Single Visit Natural Tooth Pontic Bridge with Fiber Reinforcement Ribbon

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Sudden loss of an anterior tooth is a catastrophic event for a patient. The missing anterior tooth has implications in how one presents themselves to others and the psychological effects of how we feel about ourselves. Sudden tooth loss in the esthetic zone of the anterior region can be due to trauma, periodontal disease, or endodontic failure. If the tooth is intact, it is easiest to use that tooth as a natural tooth pontic and bond it to the adjacent teeth with fiber reinforcement ribbon and adhesive composite resin. When the tooth is not usable a denture tooth or a composite resin pontic can be shaped to fit the space of the missing tooth.

In the past there have been a number of different techniques described in the restorative dentistry literature for splinting teeth and adding a natural tooth pontic, denture tooth, or composite resin tooth pontic. These pontics were connected to the adjacent teeth with adhesive composite resins, wire, metal mesh, nylon, mesh and cast metal frameworks bonded to the adjacent teeth.[1-6] The inherent problems with these materials when placing a tooth pontic fixed to the adjacent teeth when replacing a missing tooth were their inability to be chemically incorporated into the dental resin. Clinical failures of these bridges were prevalent because these materials could not support the repeated loading stresses placed on the bridge during normal and para-function. Another problem associated with the placement of composite resin splints with submerged wires and mesh grids that in order to protect against breakage more bulk and thickness of composite resin was necessary.[7,8] This overbulking of the restoration led to an increase in food and plaque retention resulting in making it more difficult to clean around the restoration and maintain good oral health.

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The challenge to place a thin

but strong, bonded composite resin-based single visit bridge was met with the introduction of a high strength polyethylene, bondable, biocompatible, esthetic, easily manipulated, fiber ribbons that could be embedded into a resin structure. This author has been using one brand of fiber reinforcement ribbon, Ribbond Reinforcement Ribbon, for almost 13 years with good success. Ribbond is a bondable, polyethylene, lock-stitch multidirectional reinforcement ribbon for composite resin. It has been reported that the lock-stitch weave of Ribbond and Ribbond THM are easier for clinician's to manipulate and use when compared to other fiber materials. Also, research has demonstrated that the fiber reinforcement architecture with Ribbond Reinforcement Ribbons provides for an increase in flexural strength and flexural modulus of composite resins that resists cracking.[9-11]

One problem with glass fiber reinforcement materials, is that the glass fibers break and pull out of the composite resin when the composite develops a crack that propagates to the glass fibers.[12] In the case of a lock-stitch weave with a polyethylene fiber, the cracks stops at the node of the leno-lock-stitch weave of the fiber ribbon helping maintain the integrity of the fiber reinforcement.[11] Karbhari and Strassler tested a variety of different fiber reinforcement materials. Their conclusion was that it is crucial that the appropriate selection of fiber architectures be made not just from a perspective of highest strength, but overall damage tolerance and energy absorption. Differences in weaves and architectures can result in substantially different performance and appropriate selection can mitigate premature and catastrophic failure.

The study provides details of materials level response characteristics which are useful in selection of the fiber reinforcement based on specifics of application.[11] In a long term clinical evaluation of splinting using the original Ribbond Reinforcement Ribbon including single visit bridges it has been reported that over a period of 42-96 months (mean = 68.6 mos.) fiber reinforced composite resins are highly successful.[12] Other clinically successful uses for fiber reinforcement ribbon have been described in the dental literature including periodontal splinting,[13,14] restoration of the endodontically treated tooth[15,16] and for cross splinting teeth with large composite restorations.[17]

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When selecting reinforcement fiber ribbon to use in natural tooth pontic single visit bridges the Ribbond offers not only excellent composite resin reinforcement but also ease of use and an assortment of widths of the fibers to manage a wide variety of clinical situations. The Ribbond's unique and patented fiber weave imparts a multidirectional reinforcement to polymeric restorative resins.[11,18]

CASE REPORT

A 48-year-old woman presented to the dental school to participate in a periodontal research study. As part of the study any teeth with a hopeless prognosis would be extracted. The patient had a chief complaint of pain from the mandibular left central incisor. The tooth was very mobile (grade 3 mobility) and was sensitive to percussion and palpation. The distofacial and distolingual surfaces had periodontal probings of 8 mm. Radiographs were taken and revealed severe bone loss (Fig. 1). The diagnosis was severe periodontal disease and a periodontal abscess on the central incisor (Fig. 2). The tooth had a hopeless prognosis and was scheduled to be extracted. The other mandibular incisors had a grade 2 mobility. As part of the

FIGURE 1—Radiograph of severe periodontal bone loss on the mandibular left central incisor.

FIGURES 2A & B—A) Facial view of the periodontally compromised central incisor. **B)** Lingual view of the periodontally compromised incisor.

FIGURE 3—Facial view after extraction of the central incisor.

FIGURES 4A & B—A) Extracted mandibular left central incisor. **B)** Natural tooth pontic after filling in root canal space, shaping the root surface to be the pontic and placing the lingual channel in the tooth crown.

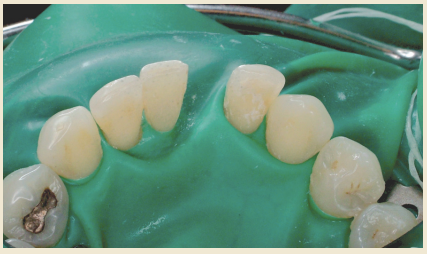


FIGURE 5—Placement of dental dam with no hole punched for extracted tooth.

FIGURE 6—Diamond preparing facial interproximal areas of incisors.

FIGURE 7—Lingual view of Class 3 preparations on the abutment teeth for the bridge.

FIGURE 8—Dental floss placed on the facial surfaces of the anterior teeth for the length needed for the Ribbond THM Reinforcement Ribbon.

therapy, the anterior teeth were scaled and root planed. The patient told us that she had an important family event and asked if there was any way the tooth could be replaced the same day it was removed. The decision was made to extract the tooth and fabricate a single visit, bonded fiber ribbon reinforced bridge using the crown of the extracted tooth as a natural tooth pontic that would also serve as a periodontal splint.

The tooth was removed and the extraction site had pressure applied with gauze for 30 minutes to control the bleeding (Fig. 3). Before placement of the dental dam, the length of the natural tooth pontic was determined by measuring the distance from incisal edge of the central incisor to the extraction site. Some additional length was added so the pontic would be touching the gingival tissue when the extraction site healed. The extracted tooth was measured with a periodontal probe to the length needed. The root was cut from the crown with a 556 bur (SS White Burs) and then shaped with a flame-shaped finishing bur (SS White Burs). The opening in the root where the root canal was present was filled with a bonded composite resin and the gingival aspect of the tooth was smoothed and shaped to be rounded.

To increase the bulk of composite resin at the connector area between the pontic and abutment teeth and to create room for a double thickness of reinforcement fiber ribbon a channel with a width of 3-4mm was cut in the lingual surface (Fig. 4). This was the same width as the 3mm wide Ribbond THM Reinforcement Ribbon that was to be used for bonding and reinforcing the composite resin where the teeth were to be connected. A dental dam was placed. The dental dam did not have a hole punched for the tooth that was removed so that bleeding would not contaminate the area being bridged during the bonding procedure (Fig. 5).

The teeth were cleaned on the facial and lingual surfaces using a prophylaxis cup with a non-fluoridated pumice paste. After the

teeth were thoroughly rinsed and dried, the interproximal surfaces and contact areas of the teeth were cleaned and prepared with a medium grit gapped finishing strip (Soflex Gapped Finishing Strips, 3M-ESPE). To improve stabilization of these periodontally mobile teeth and to minimize the thickness of the splint on the aesthetic interproximal aspect of the facial surfaces of #22-27, a thin diamond (Pirana diamond, SS White Burs) with a high speed handpiece with water spray was used to barrel into the interproximal areas (Fig. 6).

Later, composite resin will be placed on these facial surfaces to improve cross stabilization of the teeth. The mesiolingual surface of the left lateral incisor and mesiolingual surface of the right central incisor had Class 3 preparations made to further reinforce the bridge connectors

The plasma-treated polyethylene fibers are susceptible to surface contamination.

and create room for a double piece of fiber reinforcement ribbon once the pontic was placed (Fig. 7). A double piece of fiber ribbon with composite resin placed in between both ribbons provides additional strength and stability when placing a pontic by creating a laminated composite beam.[32]

Ribbond THM Reinforcement Ribbon was selected for the natural tooth pontic bridge-splint because of the research demonstrating excellent physical properties when embedded into dental composites [27,28] and clinical success with this reported technique.[29] Because all the remaining mandibular incisors were mobile due to periodontal disease, it was decided that all the lower incisors would be splinted with the fiber ribbon to the canines. To measure the length of fiber ribbon needed, a piece of dental floss was placed on the facial surfaces of the teeth, extending from the mesial of the left mandibular canine to the mesial of the right mandibular canine (Fig. 8).

Another technique to determine the length of fiber ribbon to be used, is to take the patient's

diagnostic casts and measure dental floss to the lingual surface of the anterior teeth on the cast. The plasma-treated polyethylene fibers are susceptible to surface contamination. Therefore, when handling Ribbond a clean cotton pliers was used. Using the floss as a template, a piece of 3mm-wide Ribbond THM was taken from its package using the cotton pliers and cut to an equal length with the Ribbond scissors (Fig. 9).

It is important that the scissors supplied with the Ribbond be used, because other scissors and even a sharp scalpel will have difficulty providing for a clean cut of the tough polyethylene fibers of the Ribbond THM. Another piece of Ribbond THM with a length from the mesial of the right mandibular central incisor to the mesial of the left mandibular lateral incisor was also cut. This smaller piece would be placed in the cavity preparations first to help strengthen

The ribbon was put aside and covered to avoid light until it was ready to be placed on the teeth.

and reinforce the pontic connectors with the adjacent teeth. Once cut to length, to make the fiber ribbons more bondable to the restorative composite both fiber ribbons were wetted with an adhesive resin (SingleBond, 3M-ESPE). To evaporate solvent from the adhesive resin, air was blown on the ribbon for 10 seconds. Once the ribbon fibers were wetted, they were blotted using a paper napkin to remove excess adhesive resin.

Once wetted with adhesive resin, Ribbond can be handled like any resin material. The ribbon was put aside and covered to avoid light until it was ready to be placed on the teeth. The natural tooth pontic was etched with a phosphoric acid etchant for 15 seconds, rinsed with water and dried. SingleBond adhesive was painted on the etched surfaces and into the prepared channel on the lingual surface. It was also put aside until it was time to bond it to place.

The teeth adjacent to the pontic in the mouth were etched for 30 seconds with a 32% phosphoric acid gel being certain that etchant was placed on the lingual and facial surfaces (Fig. 10). The

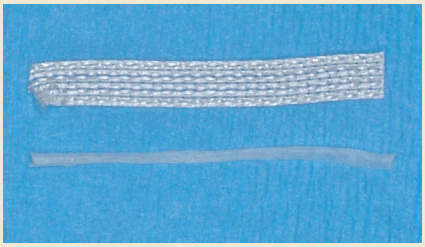


FIGURE 9—Using special Ribbond scissors, the Ribbond THM has been cut to length of dental floss template.

FIGURE 10—The facial interproximal of the abutment teeth were etched with phosphoric acid.

FIGURE 11—After etching, adhesive and composite resin placement on facial surfaces, natural tooth pontic of lateral incisor placed between the right central incisor and left lateral incisor using cotton pliers.

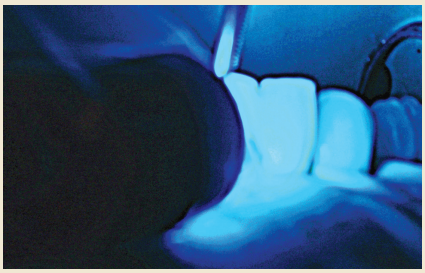


FIGURE 12—Pontic was light cured to stabilize it for the continued procedure.

FIGURE 13—After etching and rinsing all the remaining teeth to be restored, a medium-bodied polysiloxane was placed as blockout into the gingival embrasure spaces.

FIGURE 14—Composite resin placed on the facial interproximal surfaces.

teeth were then rinsed with an air-water spray for 10 seconds and gently dried. A resin adhesive, SingleBond was applied to the etched enamel surfaces, the tooth preparations and facial interproximal areas, using a disposable brush. A medium viscosity micromatrix hybrid composite resin in preloaded tubes (Prisma TPH3, Dentsply/Caulk) was dispensed onto the facial surfaces of the mandibular left lateral incisor and right central incisor. The tooth pontic was picked up with a cotton pliers and placed in the area where it was extracted with the root side pushing into the rubber dam and incisal edge height at the same height as the adjacent central incisor (Fig. 11). The facial surfaces were light cured for 20 seconds (Fig. 12).

The Class 3 preparations and the channel in the natural tooth pontic were prepared again to be certain the channel and Class 3 preparations were in line and the surfaces were ready to be etched again. The remaining teeth on the facial interproximal and lingual surfaces were etched with the phosphoric acid etchant for 30 seconds, rinsed with an air-water spray and dried. Interproximal matrix strips were placed at the most distal surfaces of mandibular canines to maintain separation. In the past, wedges were placed to minimize excess composite in the gingival interproximal embrasure areas. With wedges there is always the potential that highly mobile teeth could be splinted in a different position. An innovative technique for minimizing excessive composite resin in these areas has been described.[36]

> In the past, wedges were placed to minimize excess composite in the gingival interproximal embrasure areas.

The technique is the placement of a medium or heavy viscosity polysiloxane impression material using an impression syringe in these gingival embrasure areas. It is important that the impression material is placed after tooth etching, rinsing and drying to avoid the trapping of moisture that can occur if the technique is done earlier. This use of elastomeric impression material assures a passive placement of the blockout. For this

FIGURE 15—Composite resin placed on the lingual surfaces and into the Class 3 preparations and lingual groove in natural tooth pontic.

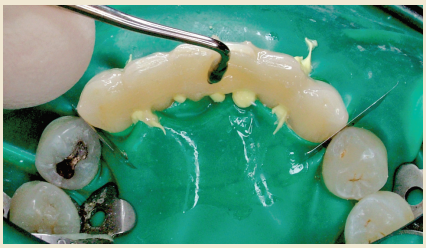


FIGURE 16—The ribbon was placed and further adapted using a burnisher.

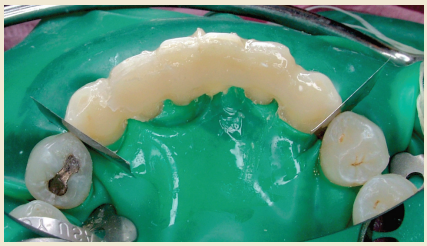
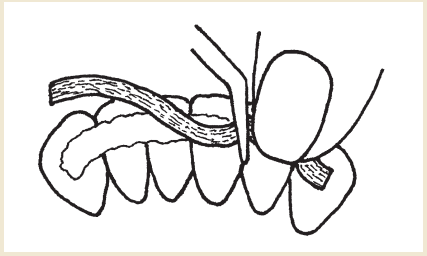


FIGURE 17—After fiber ribbon placement embedding the ribbon into the composite resin so it is well adapted to the lingual tooth surfaces.



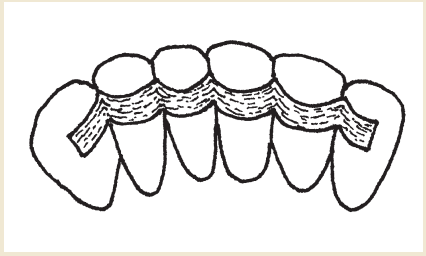


FIGURE 18—Using a thin plastic filling instrument, the fiber reinforcement ribbon is closely adapted to the lingual surfaces pushing the fiber ribbon deep into the interproximal areas.

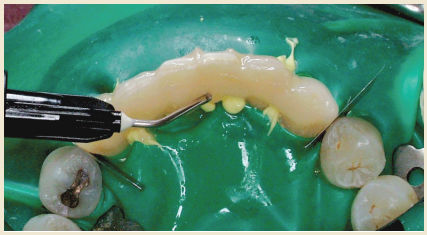
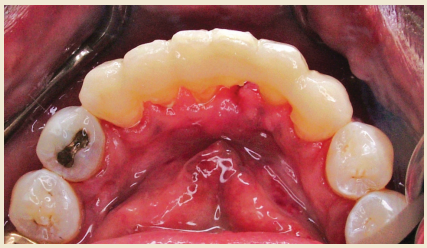


FIGURE 19—Flowable composite resin placed over the top of the ribbon.

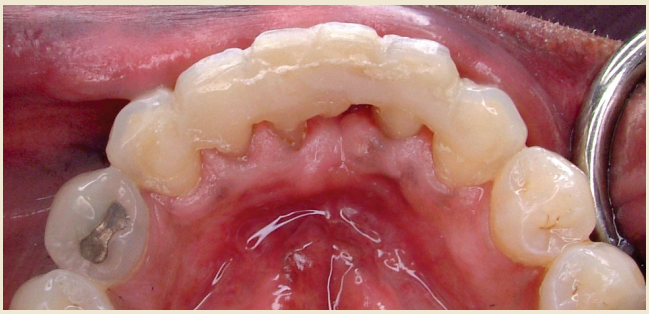


FIGURES 20A & B—A) Lingual view of final esthetic result of the natural tooth pontic bridge reinforced with Ribbond THM and bonded composite resin. **B)** Facial view of the natural tooth pontic bridge reinforced with Ribbond THM and bonded composite resin.

case, a medium bodied fast setting poly vinyl siloxane impression material (ExaMix, GC Dental) was syringed into the gingival embrasure spaces (Fig. 13). The remaining facial interproximal surfaces had composite resin placed, shaped and light cured for 20 seconds (Fig. 14). The facial composite resin serves to seal the interproximal areas against recurrent caries and provides an 180° wrap of composite resin to each of the splinted teeth. This will stabilize each tooth and prevent breakage of the final splint-bridge. This step is important because once splinted, the interproximal surfaces cannot be adequately cleansed.

Composite resin was placed on the facial interproximal surfaces and shaped to minimize excess and light cured. The purpose of this facial composite resin is to seal the interproximal areas against recurrent caries and to provide for a 180° wrap of composite resin to each of the splinted teeth. This will function as a cross-splint of each tooth to prevent tooth movement and breakage of the final splint. This step is important because once splinted, the interproximal surfaces of adjacent teeth can not be cleaned adequately. The composite resin was then placed onto the lingual surface from mid-canine to mid-canine. By placing the preloaded tube tip at a right angle to the lingual surfaces of the teeth, the composite resin was placed in the middle of the teeth and into the lingual groove prepared in the natural tooth pontic (Fig. 15).

The shorter piece of the 3mm-wide Ribbond THM ribbon was picked up and embedded into the composite resin so that it could be placed into the Class 3 preparations and lingual channel in the natural tooth pontic. Additional composite must be covering the fiber ribbon so that when the longer fiber ribbon was



FIGURES 21A & B—A) Lingual view of fiber reinforced splint-bridge at 6 months. **B)** Facial view of fiber reinforced splint-brige at 6 months.

placed on the lingual surface from canine to canine it would be as a double thickness of fiber at the connector between the pontic and adjacent teeth. This double thickness creates a beam effect further reinforcing the composite resin at the connectors. The fiber ribbon is placed on the other lingual surfaces so it would be at mid-tooth.

Using plastic filling instruments and burnishers the Ribbond THM was embedded into the composite resin starting at the left canine and moving around the arch to the right canine (Fig. 16). Using a gloved finger wetted with adhesive resin the ribbon is further pushed into the composite resin so it is covered with composite. The ribbon was further adapted on the lingual and interproximal surfaces using a cotton pliers and plastic filling instrument. It is important that the ribbon be as closely adapted to the lingual surfaces of the teeth as possible (Fig.17).

Figure 18 demonstrates the placement of the Ribbond fiber reinforcement ribbon by holding the wetted Ribbond into position with a finger of instrument against the tooth to avoid pulling out the fiber that has been closely adapted to the teeth and pushed deep into the interproximal areas of the teeth. Excess composite resin was removed before light curing. The lingual surfaces were then light cured for 20 seconds for each tooth to be certain that the ribbon and composite resin were completely cured.

At this time the ribbon may be visible and not completely covered with an adequate thickness of composite resin, as was the case with this patient. For this reason a high strength, wear resistant, flowable composite resin (Gradia Flowable, GC Dental) was applied to smooth the irregular lingual surface and provide an even thickness of composite covering the ribbon (Fig. 19). The flowable composite resin on the lingual surface was light cured for an additional 10 seconds for each tooth. The composite resin was shaped, finished, and polished to remove any excess restorative material and achieve an aesthetic result. This was accomplished with finishing diamonds on a high speed handpiece.

The composite resin was further finished using aluminum oxide impregnated silicone composite

resin polishing points (Enhance, Dentsply/Caulk. The composite resin was then polished using a composite resin polishing paste. The rubber dam was removed and the splint was checked for occlusion and aesthetic appearance. It is important to adjust the occlusion because the natural tooth pontic has been placed in an esthetic position. For this patient, the tooth position before extraction was above the incisal plane. At placement, the incisal edge was placed to be inline with the other incisal edges.

Since the teeth are now joined together, it is important that the patient have demonstrated to them techniques and devices for cleaning the gingival embrasure areas. The patient was shown the use of a proximal brush to clean the embrasure areas. For this patient, the final result is a tooth in the place on the same day as the extraction (Fig. 20). The natural tooth pontic fixed partial denture is functioning well six months after placement. (Fig. 21.)

CONCLUSION

The research has demonstrated good durability for the technique described in this article.

This author's experience is that using this technique — the groove in the pontic on the lingual surface, Class 3 preparations on the adjacent teeth and composite resin on the facial interproximal surfaces, these bridges can provide a patient with many years of service. **OH**

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Oral Health welcomes this original article.

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