Chairside

Single-Visit Natural Tooth Pontic Fixed Partial Denture With Fiber Reinforcement Ribbon

Loss of an anterior tooth is a catastrophic event for a patient. The missing anterior tooth has implications on how one presents himself or herself to others and on one's psychology. Sudden tooth loss in the esthetic zone of the anterior region is usually caused by trauma, periodontal disease, or endodontic failure. Replacement of a single missing tooth can be managed with a fixed partial denture, removable partial denture, or a single-tooth implant.

Replacement of missing teeth has been a concern of patients throughout the ages. The first reported prosthesis for tooth replacement was approximately during the period of 2500 BCE in Egypt.[1] The Egyptians recognized the dentist as separate from the physician. From an exhibit of ancient Egyptian origin in Paris, France, an anterior tooth replacement of a mandibular incisor was described. A fixed partial denture was attached to the intact adjacent tooth crowns with gold bands ligated around the abutment teeth.[2] The denture, which was discovered from a tomb at Saida, belonged to an early civilization in ancient Sidon. It was made by cutting the roots from the crowns of the natural teeth before the pontics were placed. In 1856, Divenelle, "the progenitor of modern bridgework," described a method of adapting a coping to the end of a root and attaching an artifical tooth to it.[1] One of the most important advances in fixed prosthodontics was Taggert's development of the lost wax technique of casting gold in 1907. By 1910, this method of casting revolutionized anterior tooth replacement, making it possible to prepare a three-quarter veneer gold crown as a retainer for tooth replacement and to minimize the show of gold when the fixed partial denture was fabricated.[2]

By the 1930s, porcelain veneers were being attached to gold crowns.[3,4] Granger described the firing of porcelain cast retainers of irridioplatinum in 1940.[5] Currently, the use of porcelain-fused-to-metal fixed partial dentures is a routine procedure for replacing a single missing tooth. In the 1970s and 1980s, the concept of an acid-etch bonded fixed partial

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Figure 1—Preoperative view of tetracycline-stained teeth.

Figure 2—Postoperative view of completed Cerinate Porcelain Veneers masking tetracycline staining.

Figure 3—Radiograph revealing resorption lesion at gingival aspect of the root surface of maxillary left central incisor.

Figure 4—Removal of gingival tissue with electrosurgery having the resorptive lesion prepared.

denture was introduced. The earliest bonded fixed partial dentures used either the patient's own tooth, an acrylic resin denture tooth, or a tooth made from composite resin.[6-11] Although these fixed partial dentures were reasonably successful, dentists were concerned about the resistance to fracture of the connector at the pontic–tooth interface. To solve this problem, Rochette described the use of a lingual cast metal framework with retentive perforations and porcelain fired to the pontic area that was retained by acid-etch enamel bonding.[12] However, the metal framework would separate from the resin in the perforations. Thompson and Livaditis created a technique for developing retention of a lingual cast metal framework by electrolytically etching the metal making it microscopically rough and retentive to dental resins.[13] Until an opaque resin cement was developed, the metal framework would "shine through" the facial enamel, discoloring the anterior abutment teeth. Another conservative treatment modality using bonded facial porcelain veneers as retainers to an all-porcelain pontic has been described.[14]

In recent years, a resurgence in the use of a natural tooth pontic, denture tooth, or composite resin tooth pontic combined with enamel bonded composite resin and internal reinforcement materials has been observed. In these cases, the pontics were connected to the adjacent teeth with adhesive composite resins using embedded wires, pins, metal mesh, nylon mesh, or perforated metal strips. However, inherent problems existed with these materials when replacing a missing tooth. If a tooth pontic was fixed to the adjacent tooth, the materials were unable to be chemically incorporated into the dental resin. Clinical failures of these fixed partial dentures were prevalent because these materials could not support the repeated loading stresses placed on the fixed partial denture during normal and parafunctional behavior. Another problem associated with the placement of composite resin splints with submerged wires and mesh grids was that to protect against breakage, more bulk and thickness of composite resin was necessary.[15,16] This overbulking of the restoration led to an increase in food and plaque retention, making it more difficult to clean around the restoration and maintain good oral health.

The challenge of placing a thin but strong bonded composite resin-based single-visit fixed partial denture was met with the introduction of high-strength polyethylene, bondable, biocompatible, esthetic, easily manipulated, fiber ribbons that could be embedded

Figure 5—Restoration of the resorptive lesion with dental silver amalgam.

Figure 6—Five months after repair of the root defect with amalgam, the radiograph reveals the resorptive lesion has continued to progress.

Figure 7—Extraction site after removal of crown and root.

Figure 8—Polysiloxane matrix try-in with natural tooth pontic crown.

into a resin structure. The authors of this article have been using one brand of fiber reinforcement ribbon (Ribbond®*) for more than 10 years successfully. Ribbond is a bondable, polyethylene, lock-stitch, multidirectional reinforcement ribbon for composite resin. Research has demonstrated that the fiber reinforcement with Ribbond provides increased flexural strength and flexural modulus of composite resins,[17,18] and case reports using fiber-reinforced fixed partial dentures have demonstrated success.[15,19-20] In a long-term clinical evaluation of splinting using the original Ribbond including single-visit bridges, it has been reported that throughout a period of 42 to 96 months (the mean being 68.6 months) fiber-reinforced composite resins are highly successful.[21]

When selecting reinforcement fiber ribbon to use in tooth pontic single-visit fixed partial dentures, Ribbond offers not only composite resin reinforcement and esthetics but also ease of use and an assortment of widths of the fibers to manage a wide variety of clinical situations. Moreover, it has been demonstrated that the placement of Ribbond within the fixed partial denture increases the load-carrying capacity of the fixed partial denture.[18] At the same time, Ribbond's unique and patented fiber weave imparts a multidirectional reinforcement to polymeric restorative resins that acts as a crack stopper if microfractures develop in the composite superstructure.[18]

Case Report

In the spring of 1988, a 22-year-old nursing student presented for an evaluation to esthetically treat the anterior spacing and dark discoloration of her maxillary anterior teeth caused by tetracycline staining (Figure 1). During the consultation, a range of treatment options were presented that could change the appearance of her maxillary anterior teeth and fulfill her esthetic goals. The patient selected treatment of the maxillary anterior teeth with bonded porcelain veneers without orthodontic treatment. She wanted her teeth to look similar to what she currently had but with the anterior spaces closed. Although more severe tooth preparations are recommended when masking darkly discolored teeth, in this case the teeth were only slightly modified with tooth preparations because of their flat facial form and tooth position. Also, when cementing the veneers using colorants mixed with the

*Ribbond, Seattle, WA 98101; (800) 624-4554

Figure 9—Immediate postoperative view of completed bonded natural tooth pontic fixed partial denture.

Figure 11—Preparation of the lingual surfaces for the Ribbond reinforcement ribbon.

composite resin cement, a stacked, fired porcelain (Cerinate®[a,b]), combined with a color-neutralization technique, allows the teeth to be masked without significant tooth preparation. Also, using a stacked porcelain to mask dark discolorations offers a benefit compared with more translucent pressed porcelain because the ceramist can control opacity, translucency, and color by building the porcelain from the inside out.[22]

When the porcelain veneers were returned, they were tried in and color matched for masking by using a trial-and-error color-neutralization technique of mixing the composite resin cement (Ultra-Bond®[a,b]) with a white and violet resin colorant paste (Rembrandt® Shade Modification System[b]). Violet and blue are complementary colors to color-neutralize the yellow-orange discoloration of the tetracycline dentin staining. The white colorant paste allows the dentist to control the value for the final shade of the porcelain veneer.[22] When the color try-in was acceptable, Cerinate® Porcelain Veneers[b] were bonded in place (Figure 2).

In July 1990, the patient returned for a routine recall appointment, and a reddish dis-

[a]Den-Mat® Corporation, Santa Maria, CA 93455; (800) 445-0345

Figure 10—Radiograph of completed fixed partial denture with a wire-supported natural tooth pontic.

coloration underlying the enamel of the lingual surface of tooth No. 9 was noted. The area was probed and a defect on the root surface was discovered. The reddish appearance of the enamel was caused by the gingival tissue that had proliferated into the root defect. A radiograph demonstrated a large radiolucency at the cervical of tooth No. 9 (Figure 3). A preliminary diagnosis of root resorption was made. The patient was referred to both a periodontist and endodontist to evaluate the tooth's prognosis. With the information available, it was determined that the tooth's prognosis was hopeless and the tooth needed to be extracted. The patient sought a second opinion from her original referring dentist. In September 1990, that dentist decided to try to salvage the tooth by removing the soft tissue using an electrosurgery device on the lingual surface (Figure 4) and restoring the root defect with dental silver amalgam (Figure 5). The patient understood that the prognosis was still very guarded. Currently, our understanding of these resorptive root lesions would lead today to a different course of action and choice of restorative materials. Dragoo[23] and Kurthy,[24] among others, have successfully treated these lesions with the use of a resin-ionomer (Geristore®[a,b]) to restore the root defect. In these cases, Geristore has demonstrated biocompatibility and healing of the gingival tissues surrounding these restored lesions.

In February 1991, the patient returned to reevaluate the amalgam-restored site. A radiograph revealed the resorptive lesion continuing on the root surface (Figure 6). The tooth prognosis was hopeless, and it needed to be extracted. The patient was presented with several alternatives to restore the site after extrac-

Figure 12A—Facial view of completed fiber-reinforced fixed partial denture with natural tooth pontic; notice the esthetics of the emerging root from the gingival tissues.

Figure 12B—Lingual view of completed fiber-reinforced fixed partial denture with natural tooth pontic.

tion of the central incisor; they included different types of fixed partial dentures, a removable partial denture, and a single-tooth implant. Because of financial and other personal reasons the patient decided to defer a single-tooth implant, and she made the decision to have a natural tooth pontic fixed partial denture. The plan for the fixed partial denture was to fabricate it using the natural tooth crown after extraction as the pontic and joining it to the adjacent teeth with an adhesive composite resin technique. A square orthodontic wire would be used to reinforce and retain the tooth crown. Before removing the maxillary central incisor, a polysiloxane putty imprint was fabricated in the area to be a matrix for the repositioning of the tooth crown pontic.

The left maxillary central incisor was removed in 2 stages. To preserve the porcelain veneer and tooth crown, an atraumatic method was used, separating the tooth crown from the root with a high-speed handpiece holding a very thin diamond (8392-016 diamond[c]). The dentist was certain to cut the crown at the cervical line slightly subgingivally. This would allow for the fabrication of an emerging pontic from the gingival tissues with the natural tooth crown. When the incisor crown was removed, a surgical flap was used to extract the remaining root. A suture was placed to reposition the flap (Figure 7). The tooth crown was reshaped to be an ovate pontic with an adhesive composite resin filling in the root defect on the gingival surface. The tooth crown again was tried in, using the putty matrix as a stent to stabilize and position the natural tooth crown pontic (Figure 8).

Class 3 mesiolingual preparations were made on teeth Nos. 8 and 10. A channel was prepared into the lingual surface of the natural tooth pontic, and 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. The prepared areas were etched, and then a hybrid composite resin (Prisma® TPH®[d]) was placed with a square orthodontic wire embedded into the composite. Then the natural tooth pontic was placed on the lingual surface using an enamel/dentin adhesive (Tenure®[b]). Additional composite resin was placed on the interproximal facial surfaces of the connector area of the fixed partial denture to offer additional stability to the pontic. The completed single-visit natural tooth pontic wire-supported fixed partial denture was esthetically acceptable to the patient (Figure 9). The radiograph shows the completed single-visit fixed partial denture (Figure 10).

Throughout the following 4 years, the fixed partial denture was repaired twice. In March 1995, the patient returned with the tooth pontic loose on the distal surface. It had fractured again. The decision was made to replace the wire with a fiber reinforcement ribbon.

The natural tooth pontic was first stabilized with adhesive composite resin on the facial interproximal surfaces in the connector region. The facial composite resin served to seal the interproximal areas against recurrent caries and provided for a 180° wrap of composite resin to each of the splinted teeth. This would stabilize each tooth and prevent breakage of the final splint-fixed partial denture.[15]

With the pontic stabilized, the wire and the remaining composite resin on the lingual

[c]Brasseler USA®, Savannah, GA 31419; (800) 841-4522

[d]DENTSPLY Caulk, Milford, DE 19963; (800) 532-2855

Figure 13—Radiograph of Ribbond-reinforced fixed partial denture.

Figure 14—Fiber-reinforced fixed partial denture after 7-year recall (14-year recall of Cerinate Porcelain Veneers).

surface were removed. The mesiolingual surfaces of the adjacent teeth (Nos. 8 and 10) and a lingual channel in tooth No. 9 were prepared (Figure 11). The width of the channel was 3 mm, the same width as the reinforcement ribbon. To measure the length of the ribbon needed, a piece of dental floss was placed into the lingual channel of the tooth preparations. Because plasma-treated polyethylene fibers are susceptible to surface contamination, clean, cotton pliers were used when handling the fiber ribbon. Having the floss as a template, a piece of 3 mm-wide ribbon was taken from its package using the cotton pliers and cut to an equal length.

When cut to length, the ribbon was wetted with an adhesive resin (Tenure® S[b]). After the ribbon fibers were wetted, they were blotted using a patient napkin to remove excess unfilled resin. When wetted with resin, Ribbond can be handled like any resin material. The ribbon was put aside and covered to avoid light exposure and premature polymerization until it was ready to be placed. The natural tooth pontic was etched with a phosphoric-acid etchant for 15 seconds, rinsed with water, and dried. Adhesive was painted on the etched tooth surfaces, as well as into the prepared channel on the lingual surface, and light-cured for 20 seconds.

The mesiolingual preparations of teeth Nos. 8 and 10 were etched for 15 seconds with a 32% phosphoric acid gel (UNI-ETCH®[c]). The teeth were then rinsed with an air-water spray for 10 seconds and gently dried. Interproximal matrix strips were placed at the most distal surfaces of teeth Nos. 8 and 10 to maintain separation. A resin adhesive was applied to the etched tooth surfaces and light-cured. A medium-viscosity hybrid composite resin (Prisma TPH) was placed with a syringe into the cavity preparations using preloaded tubes. The Ribbond was embedded into the composite. The restored surfaces were inspected to ensure complete coverage of the fiber ribbon with composite.

Next, the lingual surfaces were light cured for 20 seconds, and then the composite resin was shaped, finished, and polished to remove all excess restorative material and achieve an esthetic result. After that, the lingual surfaces were finished and contoured with an egg-shaped finishing bur (7408 12-bladed finishing bur[f]) and polished with an aluminum oxide abrasive point (Enhance® Composite Finishing & Polishing System[d]).

The final polish was achieved with a composite polishing paste (Prisma®-Gloss™ Composite Polishing[d]). The Ribbond reinforced natural tooth pontic provided the patient with an esthetic result (Figures 12A and 12B). The postoperative radiograph shows the ribbon embedded in the composite resin (Figure 13). In March 2002, the patient returned for a postoperative reevaluation (Figure 14). Regarding the last recall in September 2003, the Ribbond-reinforced natural tooth pontic remains clinically successful at 8.5 years (Cerinate Porcelain Veneers remain so at 15.5 years).

Disclosure

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Conclusion

The results demonstrate an acceptable

[b]Bisco, Inc, Schaumberg, IL 60193; (800) 247-3368
[f]SS White® Burs, Inc, Lakewood, NJ 08701; (732) 905-1100

longevity and durability for the technique described in this article. According to the experience of these authors, with this technique (ie, 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 fixed partial dentures can provide many years of clinical service.

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