A Novel Approach for a Single-Tooth Provisional

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There is probably nothing more disheartening for dental patients who have meticulously cared for their teeth their entire life than to learn that a maxillary central incisor is hopeless and must be extracted. As clinicians, we are not only highly empathetic and concerned for the patients' aesthetic and functional concerns, we also realize that the road to restoration can be filled with a series of complex procedures, often entailing a multidisciplinary approach that could easily take several months to complete.

CASE REPORT

Diagnosis and Treatment Planning

A 45-year-old female patient presented to our office as a new patient with no dental concerns other than to become an established patient of record after recently moving to the area. A comprehensive examination including periodontal charting, intraoral photographs, and a full-mouth series of radiographs was performed. The patient was not in pain, and her primary dental concern was to remain current with her biannual prophylactic recare visits.

Upon examination, tooth No. 9 exhibited Class I to Class II mobility with all other visual findings being within normal limits (Figure 1). In her medical/dental history, she indicated that, as a teenager, she had an accident that displaced teeth Nos. 8 and 9, and tooth No. 9 had required root canal therapy after becoming nonvital. Several cracks in both teeth were observed during the visual exam with transillumination, but none were symptomatic. Closer inspection of the periapical radiograph clearly indicated that tooth No. 9 was in a state of active internal resorption and the tooth was diagnosed as hopeless (Figure 2). When the patient was informed that the diagnosis for her maxillary left central incisor was hopeless, she was heartbroken.

Several cracks in both teeth were observed during the visual exam...but none were symptomatic.

Figure 1. Preoperative view.

Figure 2. Preoperative radiograph.

Since her surrounding dentition was caries- and restoration-free, surgical extraction, possible bone and soft-tissue grafting, and implant placement were recommended. Though she had the economic means to treat the condition optimally, her primary concern was, "What will I do without a front tooth until treatment was complete?"

There is no doubt that provisionalizing a single anterior maxillary tooth immediately, following the extraction and throughout the healing phase, for aesthetically and functionally demanding patients is a conundrum. No patient wants to go without a maxillary anterior tooth during any phase of treatment; and for many patients, wearing a temporary removable partial denture for months is unacceptable. Additionally, in order to gain ideal gingival architecture replete with properly supported papilla after implant placement demands that the provisional be static and fixed, and serve as a scaffold that shapes the residual gingival architecture during the healing phase.[1-3] A primary requirement for any form of anterior single-tooth implant provisional is the ease of removal by the surgeon performing the various surgical phases and subsequent re-attachment as treatment progresses.

A Team Approach Was Indicated

For ideal results, cases such as these often require a team approach. Though many general dentists are highly adept in atraumatic surgical extraction and implant placement, the necessary bone and soft-tissue augmentation required often require the expertise of a highly trained and experienced periodontist to achieve optimal results. When this is the case, collaborative treatment goals and consistent communication throughout each phase of the treatment is paramount.

Upon examination by the periodontist, it was decided that extraction and immediate placement of an implant was contraindicated due to the active nature of the internal/external resorption. Treatment entailed microsurgical extraction of tooth No. 9 along with the residual tooth fragments, and the placement of a freeze-dried cadaver bone graft and a connective tissue (CT) graft to preserve bone and tissue height and width. A 2- to 3-month healing phase would begin, followed by the placement of a 3.4-mm Straumann bone level implant (Straumann USA). The recommended time-period for biointegration of the implant was 3 months. Both the initial surgical extraction/graft phase and the implant integration phase required an aesthetic, durable provisional restoration that could be removed and replaced as necessary throughout the restorative process.

Provisional Options for Maxillary Single-Tooth Implants

Though the utilization of a temporary partial denture during the healing and integration phases of implant treatment is an acceptable, affordable, and convenient method of provisionalization, there are many potential negatives associated with this procedure. During the first phase of treatment where the tooth and root fragments are removed and bone and CT grafts

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are placed, it is imperative to not place pressure on the surgical site and to avoid the potential displacement of fragile soft-tissue architecture. Temporary removable partial dentures are typically tissue-borne prosthetics and lack hard-tissue stops to prevent apical forces in the area of the single-tooth site. Additionally, many patients object to the concept of wearing a "denture" in general and prefer to have a fixed provisional prosthetic when at all possible. In cases such as this one where the surrounding dentition is highly polychromatic with variable internal chromagenic tints and areas of hypocalcification (white spots), it is nearly impossible to find a stock denture tooth that replicates these nuances in color and texture.

The role of the provisional restoration during the 6- to 8-month healing phase is tantamount. Not only must the clinician provide a functional and aesthetic replacement that can be easily removed and replaced several times during the various surgical phases of treatment, the ideal provisional must be capable of shaping and supporting the soft-tissue architecture in the form of an ovate pontic after the endosseous fixture is uncovered.

Figure 3a. Surgical site after bone and connective tissue (CT) graft.

Figure 3b. Surgical site after bone and CT graft.

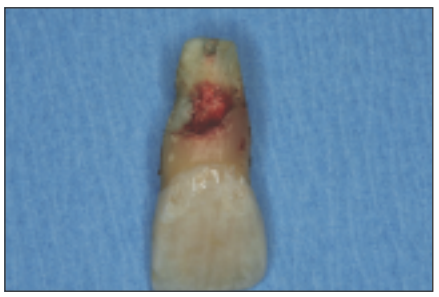

Figure 4. Extracted tooth showing external resorption.

Figure 5. The amount of root to be trimmed was measured.

Figure 6. The root was trimmed to create ovate pontic.

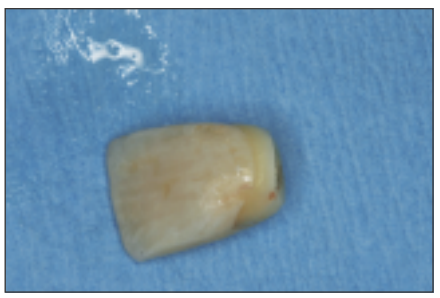

Figure 7. Sectioned natural tooth.

Figure 8. Trimmed natural tooth assessed for proper length to support papilla.

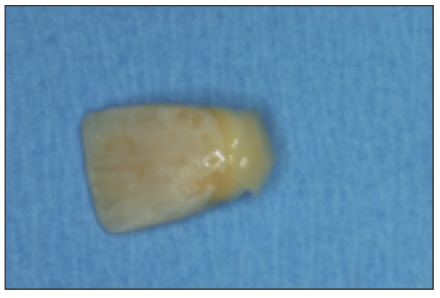

Figure 9. Remaining pulp removed and bonded composite added to create ovate form.

Natural Tooth Pontic as a Provisional Restoration

The concept of using the patient's extracted tooth as a natural tooth pontic has been reported in the literature.[4-6] The benefits of using the patient's natural tooth as an interim pontic, particularly in the anterior aesthetic zone are compelling. Barring traumatic fracture or previous discoloring prior to extraction, the natural tooth is typically the ideal shape, contour, and color of the surrounding dentition and mitigates the necessity of custom staining and contouring of a denture tooth or freehand composite pontic. Aside from the obvious aesthetic benefits of using the patient's extracted tooth as a provisional, the natural tooth is available immediately for bonding at the time of surgery, and no preliminary lab work is necessary.

The use of an ovate pontic adapted to an ovate pontic receptor site is well documented in the literature.[1,2,7-9] In the past, ridge lap or modified ridge lap pontics have been utilized in fixed partial dentures to replace a missing anterior tooth. These pontic forms remain useful when significant buccal-lingual bone loss has already occurred and the patient does not desire surgical augmentation of the defective site prior to fixed bridge placement. However, when an extraction along with bone and CT augmentation are utilized in conjunction with an endosseous implant, the goal is to maintain both hard- and soft-tissue contours such that the definitive restoration retains the radicular root form and dimensions. Therefore, the role of a fixed natural tooth pontic during the healing phase is to extend into the extraction socket, shape the soft tissues, and support the papilla so that the final restoration emerges from the implant platform with the same contour and dimensions as the natural tooth.[1,2,9] Failure to support the mesial and distal papilla during healing can result in vertical tissue loss, creating larger than desirable gingival embrasures or "black triangles" that are unaesthetic and potential zones of plaque and food accumulation.[1,2,9]

Considerations for Utilization of a Natural Tooth Pontic

Several factors must be taken in consideration when choosing a natural tooth pontic as an interim provisional. First and foremost, the extracted tooth should possess an intact, clinical crown that is of ideal shape, contour, and shade, with intrinsic characterization that ideally matches the adjacent dentition. In the case shown, the adjacent natural teeth displayed polychromatic shade variation with multiple areas of hypocalcification and internal tints, which would require custom staining if a traditional denture tooth were utilized. If a prosthetic replacement would be more aesthetically optimal, the extracted tooth should be discarded, and a suitable denture tooth may be utilized in the technique described here.

The concept of using an extracted natural tooth pontic is predicated on the ability to section the clinical crown and desired amount of root structure at the ideal length to maintain support for the interproximal papilla without displacing or disrupting CT or osseous grafts often associated with implant placement. In order to assure that the natural tooth pontic remains stable throughout the course of treatment, it must be securely attached extracoronally (without preparation) to the adjacent teeth. Ideally, the adjacent teeth should be intact, natural teeth that are periodontally sound, with ideal interproximal contact to the extracted natural tooth pontic. Mobile abutments, large diastemata, or prosthetic crowns with metal lingual surfaces are not ideal for this technique. Adjacent teeth with all-ceramic crowns may be utilized, but appropriate resin bonding techniques must be used.

The functional occlusal stress on the pontic site should be minimal and the patient's preoperative centric, working, and nonworking contacts must be assessed to determine whether displacing forces can be reduced or eliminated. When maxillary anterior teeth are to be treated, occlusal contact with the opposing mandibular incisors must be incisal to the cingulum area, permitting clearance of the extrinsic lingual connectors in centric occlusion and function. Mandibular incisors are ideal candidates in Class I and II occlusion where no opposing contact permits ample surface area for connector attachment. Canine teeth, particularly in cases with dominant canine guidance, can be problematic when considering natural tooth pontics. Failure to maintain posterior and anterior disclusion on the canine pontic may result in undesirable forces on the surrounding dentition and the incisal edges of the maxillary lateral incisors may inadvertently be left vulnerable to fracture. Regardless of the tooth to be replaced, complete evaluation of the patient's occlusal scheme must be assessed thoroughly to assure success.

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Perhaps the most important consideration for the patient, restoring dentist, and surgeon is to coordinate surgical and operative appointments on the same day so that when each phase of surgery is completed, the dentist stands ready to reattach the pontic immediately following. Since this may be necessary several times throughout the treatment phases, it is imperative that the patient agree that having a highly aesthetic, fixed, functional interim replacement is worth the extra time and expense commensurate with the service.

Materials for Attaching a Provisional Natural Tooth Pontic

The method and material for attaching a provisional natural tooth pontic extracoronally to the adjacent teeth are critical for success. The technique must be simple, repeatable, and reliable. The material utilized for the attachment must be thin, strong, easily adapted, and highly suitable for resin bonding. When the definitive restoration is an implant, the pontic may have to be removed and replaced several times throughout the course of treatment. Therefore, the material used must be easy to remove from the adjacent teeth without damaging healthy tooth structure.

While several reports in the literature cite using *orthodontic wire* to affix natural tooth pontics to the adjacent teeth when used as a provisional restoration,[3,4] this technique has limitations. The type of wire used can vary from stainless steel ligature wires to round or flat braided wire.[3,10,11] Though these materials are available in dead-soft forms, some clinicians may find that pre-adapting small sections of wire extracoronally in the mouth tedious and difficult. Round wires are less than ideal in that they do not compensate for potential facial/lingual rotational movements. Though metal primers and various extraoral surface treatments have been proposed,[3,4] thorough resin adaptation and bonding remain loosely mechanical. When extracoronal wires fail, the failure mode is typically catastrophic and result in separation of the provisional pontic from the abutment(s).

The use of *ultra-high strength polyethylene* (UHSPE) *ribbons* to attach provisional pontics to adjacent teeth is well documented in the literature.[12-23] First made commercially available by Ribbond in 1992, several companies now offer versions of these materials and there use has expanded to a variety of dental applications. Examples of currently available forms in the United States are Ribbond (Ribbond), Connect (Kerr), Splint-It (Pentron Clinical), and Vectris (Ivoclar Vivadent). These materials are useful for a large number of dental applications including direct periodontal splints, indirect strengthening of lab fabricated indirect crowns, bridges, and provisional restorations.

When an UHSPE fibrous ribbon is placed in a composite resin, the fibers serve as crack stoppers and toughening agents and they provide a set of interfaces that prevent rapid crack growth.Minor cracks that do occur are constrained by interwoven fibers that then restrict their growth. Once the composite crack reaches a directional fiber, the path is blunted and either stops or is diverted to a new direction. This reduces the likelihood of catastrophic failure and increases the longevity of the restoration.[12-14,16,19,20]

UHSPE fibers are unique in that they can be cut and adapted to extracoronal surfaces during the bonding process; they possess high fracture toughness, chemical resistance, and biocompatibility; and through proprietary pretreatment with plasma spraying and silanation, bond strengths to dental resin can be enhanced.[14,19,20] A primary differentiation between currently available UHSPE fiber brands is the architectural pattern or "weave" present in ribbons. Some products, like Splint-It for example, exhibit an open architecture with no horizontal or interlocking pattern with linear strands held together by unpolymerized resin. Others, like Vectris, have a fabric with a combination of linear and woven fibers that are also embedded in an organic resin matrix. Ribbond offers 2 architectural patterns, the patented "leno-weave" that is an open-laced architecture of interlocking threads and a triaxial diagonal weave.[12,13] Ribbond recently introduced Ribbond THM (thinner, high modulus), which offers a higher concentration of thinner (0.18 mm thickness compared to the original 0.35 mm thickness), silanized, plasma-treated polyethylene fibers designed specifically for indications where thinness, adaptability, smoothness, and higher modulus are the primary concerns. This material comes in 2-, 3-, and 4-mm widths, which can be selected based on occlusal clearance, length of span, and the degree of support needed in the dental application.

When considering UHSPE fiber materials for direct use in retaining provisional natural tooth pontics,, there are several features of Ribbond THM that are highly advantageous. This material is unique in that it is composed of ultra high molecular weight polyethylene fibers woven into a patented leno-weave, which is an open-laced architecture of interlocking threads. (Some commercially available products are composed of simple linear strands held together with unpolymerized resin.) This woven pattern makes the material more adaptable and eliminates the possibility of the fibers separating during manipulation. Ribbond THM differs from the original Ribbond material first introduced in that it has a higher concentration of fibers in a thinner weave and is ideal for splinting maxillary natural tooth pontics because it is less likely to interfere with occlusion against the opposing mandibular incisors. Additionally, Ribbond THM tucks into tight interproximal areas without rebounding, and because it is adapted during placement, it does not have to be preconformed to the arch.[12,13]

Technique for Utilization of a Provisional Natural Tooth Pontic

The patient reported to the periodontist for surgical extraction of tooth No.

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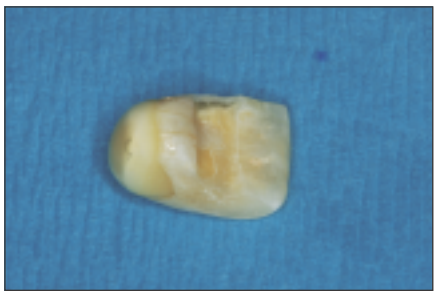

Figure 10. A 2-mm slot cut in natural tooth pontic for placement of the ultra-high strength polyethylene ribbon.

Figure 11. Ribbond THM (Ribbond) set up.

Figure 12. Ribbond Wetting Resin (Ribbond) dispensed.

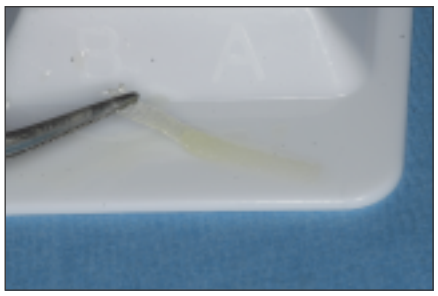

Figure 13. Ribbond THM soaked in wetting agent.

Figure 14. Adjacent teeth etched, bonded, and light-cured.

Figure 15. Ribbond THM soaked in adhesive and flowable composite used to bond fiber to adjacent teeth.

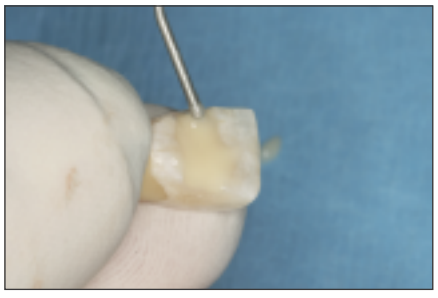

Figure 16. The slot was filled with flowable composite.

Figure 17. Natural tooth pontic seated and additional flowable added.

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9 and freeze-dried bone and CT grafting. Instructions were given to the periodontist to preserve as much of the clinical crown and radicular structure possible and place it in sterile saline. Figures 3a and 3b show the postoperative results of the first surgical phase. A subsequent appointment was scheduled in our office immediately following the surgery for the provisionalization phase. The patient was instructed to bring the extracted tooth in the saline-filled container to the appointment. The extracted tooth is shown in Figure 4. Note that the internal resorption found in the radiograph had reached the external aspects of the facial root surface.

Several factors must be considered when using a natural tooth pontic. The bone and CT grafts should be protected from trauma during chewing and the surgical site should not be disturbed in order to maintain the established soft-tissue height and width. Furthermore, it is imperative to shape the tissue surface of the pontic such that it supports the interproximal papilla preserved in the surgical phase.[1,6] Kois[1] and others[6] have confirmed that unsupported papilla in a post-extraction socket will collapse, resulting in facial and lingual recession, reduced vertical and facial-lingual width, and a flat or concave, unaesthetic ridge profile.[1,6] Therefore, the inciso-apical length as well as the mesiodistal and facial-lingual width of the pontic is critical for a post healing aesthetic result. Utilizing the patient's natural tooth has several advantages. Foremost is that the shape, color, characterization, and contours match the adjacent dentition. But most importantly, once the tooth is sectioned to the appropriate length, the remaining radicular contours must match the socket from which the tooth was extracted. This is superior to attempting to replicate these contours with a synthetic alternative.

In order to assure the proper pontic dimensions, the extracted tooth was measured against the surgical site (Figure 5). Once the inciso-apical length was determined, the tooth was sectioned at the desired length (Figures 6 and 7). The length of the natural tooth pontic was then confirmed by placing it in the extraction site and modifications made to assure proper papilla support and dimensional adaptation (Figure 8).

Figure 18. Immediate view of temporary natural tooth Maryland bridge.

Figure 19. Three-month healing prior to implant placement.

The accessible pulpal remnants were debrided from the canal, irrigated with sodium hypochlorite, and dried. Next, the canal and contoured surface was total-etched for 15 seconds, rinsed, and left moist. A fifth-generation primer-adhesive combination was applied to the etched surfaces in multiple coats, the solvents were volatilized, and the mixture was light-cured for 10 seconds. To create an ovate contour to the tissue surface of the natural tooth pontic, a flowable composite was applied into the canal and over the apical radicular surface, and light-cured. The pontic was checked for adaptation without impingement of the CT graft as well as proper support of the interproximal papilla (Figure 8). The composite surface was shaped with a composite finishing bur and ultimately polished to a high shine with silicone polishing cups and disks. Figure 9 shows the ovate natural tooth pontic.

The accessible pulpal remnants were debrided from the canal, irrigated with sodium hypochlorite, and dried.

The 2-mm Ribbond THM ribbon was chosen for this case due to its minimal thickness, leno weave construction, ease of adaptation to the teeth, and overall superior strength. A rectangular slot was prepared on the lingual aspect of the natural tooth pontic to secure the Ribbond THM and to assure that it remained out of occlusion. The finalized pontic with a rectangular lingual slot is shown in Figure 10.

Ribbond strands cannot be cut with conventional scissors; this most recent product includes a slimmer and more compact industrial-grade scissor, as compared to the more bulky version supplied with earlier kits. The manufacturer recommends the use of Ribbond Wetting Resin (Ribbond), a product sold separately. The strands must be saturated in unfilled resin free of organic solvents and primers. Total-etch bonding resins contain solvents and primers, and self-etching adhesives contain acidic monomers and other solvents such as water; neither should be used as a wetting agent for Ribbond fibers. Ribbond Wetting Resin contains no alcohol, no organic solvents, primers, or acidic monomers and is compatible with both light- and dual-cured resins. It is also useful to be used as an instrument lubricant when adapting the ribbons to the teeth and sculpting the overlying resin. The manufacturer also recommends using Ribbond Securing Composite (Ribbond), a modified flowable composite which is tacky and will hold the Ribbond THM fiber in position during adaptation. The complete armamentarium for a natural tooth pontic is shown in Figure 11.

The span is measured with a flexible ruler, or by cutting a thin strip of foil to ideal length. The Ribbond THM is then cut to equal length. In this case, the patient exhibited a slight Class III, near end-to-end occlusion, but in cases with a Class I or tight Class II, Division II occlusions, the fibers need to be kept cervical to the occlusal contacts. When natural teeth pontics are used as a final long-term restoration, it is recommended to prepare slots in the adjacent abutment teeth and imbed the fibers for strength and greatest wear resistance. Since this case was merely a provisional prior to implant placement, these retaining preparations are contraindicated.

Once the Ribbond THM is cut to length, Ribbond Wetting Resin is dispensed (Figure 12) and the strand is saturated (Figure 13). Phosphoric acid etchant is applied to the lingual and interproximal aspects of the adjacent abutment teeth, and allowed to stand for 15 seconds (Figure 14), then rinsed and dried. A fifth-generation primer/adhesive resin was applied, air-thinned, and then light-cured for 10 seconds. A thin coat of Ribbond Securing Resin (Ribbond) was applied to the lingual and interproximal surfaces of adjacent teeth. The Ribbond THM was then seated at the desired position and adapted first with finger pressure, then with a thin IPC hand instrument. Care must be taken to ensure that the edges of the fiber are flush against the teeth, and that the material wraps slightly into the interproximal areas roughly to the previous contact area. Ribbond THM shapes easily without the fibers fraying or separating. Once the final adaptation objectives are complete, excess resin can be wiped away with a small microbrush, and the Ribbond Securing Resin is then light-cured for 20 seconds. The completed Ribbond THM abutment ribbon is shown in Figure 15.

The rectangular slot preparation in the lingual aspect of the natural tooth pontic is positioned over the cured Ribbond THM to ensure a precise fit. Adjustments to the slot preparation can be performed at this time if necessary. As mentioned before, the ovate pontic form must adapt to the surgical site and support the interproximal papilla, but must not impinge the CT graft or cause blanching of the vasculature of its supporting tissue. Once proper tissue adaptation, interproximal contact, proper inclination, and incisal edge position are confirmed, the lingual slot and interproximal areas are etched, rinsed, and a fifth-generation primer/adhesive is applied and light-cured. Ribbond Securing Resin is then placed in the lingual slot preparation and allowed to flow onto the mesial and distal surfaces (Figure 16). The natural tooth pontic is positioned back onto the Ribbond THM frame. Once proper position has been confirmed, additional Ribbond THM is applied to cover the Ribbond THM fibers, excess resin wiped away with a microbrush, and light-cured for 20 seconds. The occlusion is checked and adjusted with a fine diamond and the entire lingual connector is polished with silicone points and cups. Excess interproximal resin can be removed with fine-tipped composite finishing diamonds or carbides.

Figure 17 shows the lingual view of the completed natural tooth provisional pontic. Note that the Ribbond

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THM is covered with the Ribbond Securing Resin and is smooth to the patient's tongue. The immediate facial view of the completed restoration is shown in Figure 18.

The recommended healing period of 3 months transpired, and Figure 19 shows the highly aesthetic and well-functioning provisional restoration. Note the health and lack of inflammation of the surrounding tissue, and the retention of both mesial and distal papilla at the surgically intended position. On the day of the implant placement surgery, the patient first came to our office for the removal of the natural tooth provisional. A fine diamond composite finishing bur **(Author: Bur number and manufacturer, please.)** was used to remove the Ribbond THM from the adjacent teeth in minutes, without anesthesia. The residual composite was removed with silicone points and cups **(Author: Brand and manufacturer, please.)** and the natural tooth pontic was kept in saline. The patient presented to the periodontist's office for placement of the implant, then returned to our office to have the natural tooth provisional pontic replaced. The fibers were removed from the lingual slot of the natural tooth, and the provisional restoration was placed again using the same technique previously described.

The patient then wore the Ribbond THM retained natural tooth provisional pontic for another 3 months until an implant borne provisional could be placed.

CONCLUSION

There are many options for provisionalizing anterior teeth during the surgical and implant healing phases of treatment. The technique described above, utilizing the patient's natural tooth as provisional abutment, offers many advantages without the negatives of a removable prosthesis. By securing the natural tooth with one of the latest UHSPE ribbons (such as Ribbond THM), the clinician can provide a strong, secure, aesthetic fixed alternative that not only protects and supports the carefully placed surgical tissues, but is also easy to clean and maintain. Additionally, the latest UHSPE material used for this case was easy to place and easy to remove. These factors make this service an attractive option for the dentist, periodontist, and patient.✦

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Disclosure: Dr. Blank reports no disclosures.

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