Immediate Delivery of CAD/CAM-Milled BioTemps® Full-Arch Implant Restoration


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Advancements in implant design, digital dentistry, restorative protocols, and prosthetic materials continue to improve both the efficacy and efficiency of treatment. The ability to digitally plan and visualize implant restorations prior to surgical intervention allows the clinician to virtually evaluate every aspect of a case before treatment begins, from extraction, to implantation, to the final prosthetic outcome. Intraoral scanning, digital treatment planning, guided surgery, CAD/CAM technology, and the versatility of BioTemps® provisionals allow for the temporization of edentulous cases immediately following tooth extraction. Thus, patients in extremely compromised dental circumstances can be promptly transitioned toward a functional and esthetic fixed implant restoration, with the added benefit of having an opportunity to evaluate the definitive prosthetic design prior to fabrication of the final prosthesis.

The case that follows illustrates how the convergence of digital technologies, restorative-driven treatment planning, and versatile prosthetic materials can facilitate immediate provisionalization for patients with demanding dental conditions. Virtually every concept of modern implant dentistry is utilized in an entirely digital workflow that begins with an intraoral scan and ends with an immediately delivered, digitally fabricated fixed provisional implant prosthesis — all without the use of physical impressions or a conventional stone model.

Case Report

The patient presented with a history of generalized advanced chronic periodontitis *(Figs. 1a–1c)*. Initial evaluation of the patient included extraoral

Figures 1a–1c: *The patient presented for treatment with a history of generalized advanced chronic periodontitis.*

and intraoral examinations, full-mouth radiographs, cone-beam computed tomography (CBCT) scanning, and a digital impression generated from intraoral scans of the patient's maxillary arch, mandibular arch, and interocclusal relationship. It was determined that, due to the patient's advanced periodontal condition, the prognosis of the teeth was hopeless and required extraction *(Figs. 2a, 2b)*. Further, the patient had experienced significant bone loss *(Fig. 3)*. Treatment options were reviewed and included a complete maxillary denture, an implant-retained overdenture, or a fixed implant-supported prosthesis.

The CBCT scan revealed sufficient horizontal and vertical bone for the placement of six implants. The patient's high smile line presented esthetic challenges that could be addressed through prosthetically driven treatment planning *(Figs. 4a–4c)*. The patient opted for a fixed full-arch implant restoration, and a treatment plan was developed that would utilize guided surgery and a BioTemps interim restoration to achieve immediate provisionalization following extraction of the patient's maxillary teeth and placement of implants.

Provisionalization provides many benefits for the patient by creating cross-arch stabilization with the implants, contouring the soft tissue, maintaining esthetics throughout healing, and serving as a prototype for any adjustments needed for the final restoration. Further, the interim prosthesis would give the patient an opportunity to confirm the definitive design, thus helping to ensure patient acceptance of the final restoration.

The intraoral scans enabled a digital workflow where the diagnostic wax-ups, implant positioning, and prosthetic design could be determined with precision in a virtual environment. The STL data produced by the intraoral impression was merged with the DICOM data produced by the CBCT scan to create a digital wax-up of the full-arch implant restoration. The digital treatment plan called for the selective extraction of the patient's maxillary teeth in order to expose the areas where implants would be placed, while leaving the remaining teeth in place to support the surgical guide *(Figs. 5a, 5b)*. A few teeth were retained to help stabilize the surgical guide during implant placement.

Utilizing digital treatment planning software, implants were virtually placed in the digital model of the patient's maxillary arch. The patient's bone volume was evaluated to determine the appropriate implant sizes, with a 4.7 mm x 10 mm implant selected for the areas of tooth #4 and #13, a 4.7 mm x 11.5 mm implant for #5, and a 4.7 mm x 13 mm implant for #7, #10 and #11. Proper depth and angulation were determined, ensuring that the implants were positioned to

Figures 2a, 2b: *Preoperative retracted and occlusal views illustrate advanced gingival recession and tooth decay, requiring extraction of the patient's maxillary teeth.*

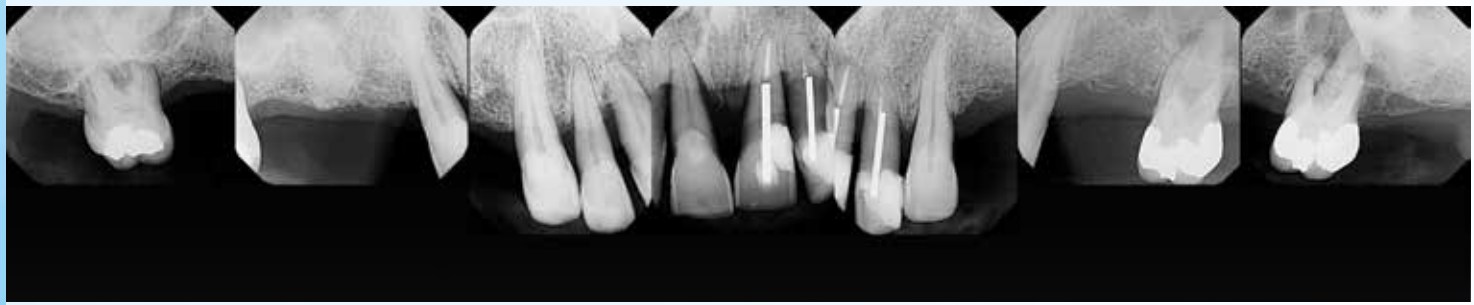
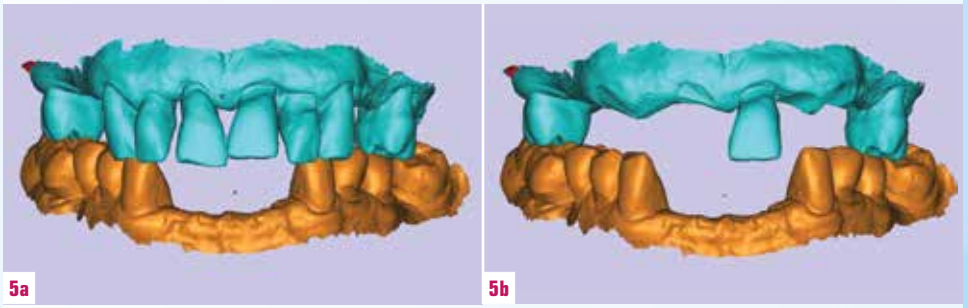


Figure 3: *Preoperative radiographs indicate severe bone loss.*

Figures 4a–4c: *Extraoral photos exhibit the patient's high smile line.*



Figures 5a, 5b: *The teeth in the areas where implants would be placed were digitally extracted.*

Figure 6: *A digital wax-up was created, and the implants were placed virtually in advance of treatment.*

accommodate a maximum amount of bone while establishing optimal support and the platform needed to achieve an esthetic outcome for the proposed restoration *(Fig. 6)*. Multi-unit abutments were selected, with the appropriate height determined based on the depth of each implant, in order to create a tissue-level platform for the temporary and final prostheses. The full-arch prosthesis was designed on the virtual model, including access holes aligned with the implants so the prosthesis could be seated over, and eventually incorporate, temporary cylinders. Following delivery of the interim restoration, any necessary adjustments could be incorporated into the definitive prosthetic design.

Next, the tooth-supported surgical guide was designed utilizing CAD/CAM software *(Fig. 7)*. The surgical guide was designed to contain metal sleeves for use with depth-limiting, guided surgical drills to precisely control the drill position, angulation and depth as defined by the digital treatment plan. The surgical guide was 3-D-printed from a biocompatible material using an Objet Eden500V™ (Stratasys; Eden Prairie, Minn.). A model of the patient's maxilla was also 3-D-printed to aid in the fabrication of the interim BioTemps restoration.

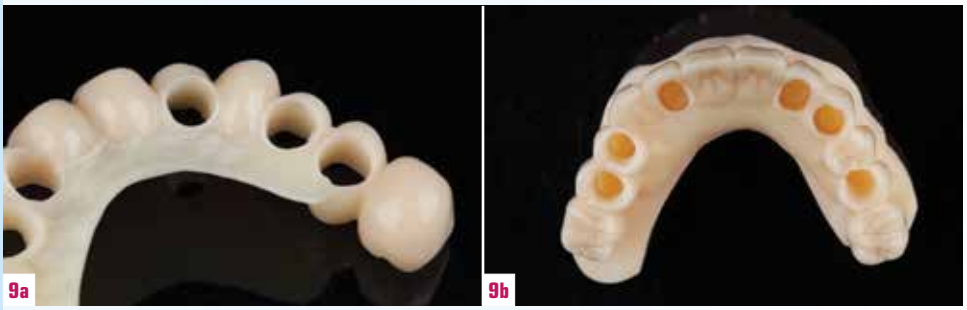
Figure 7: *The tooth-supported surgical guide was designed using CAD/CAM software.*

The full-arch BioTemps provisional prosthesis was fabricated utilizing CAD/CAM and milling technology and seated over the model *(Fig. 8)*. BioTemps material, fabricated from poly(methyl methacrylate) (PMMA), was chosen for its unique combination of durability and adjustability, offering more strength than an interim prosthesis fabricated chairside. After confirming an accurate fit, a stop flange was added to the palatal aspect of the BioTemps restoration to serve as a reference point for the plane of occlusion and vertical dimension of occlusion during patient try-in and relining. The access holes were widened using an acrylic bur so the prosthesis could be fully seated over the temporary cylinders *(Figs. 9a, 9b)*.

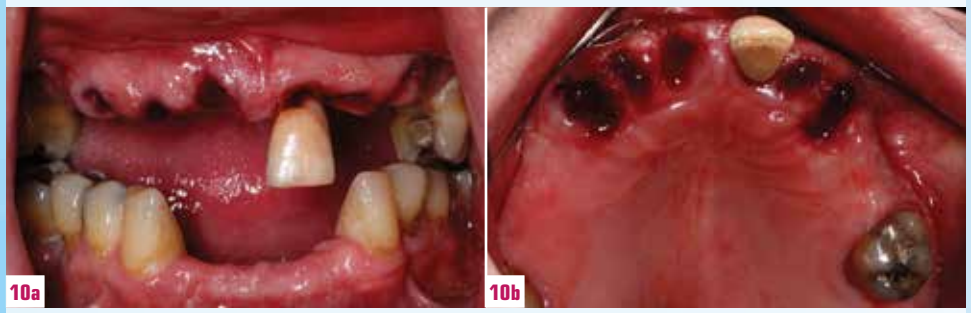
At the second appointment the patient's teeth were selectively extracted, leaving a central incisor and two molars in place to support the surgical guide *(Figs. 10a, 10b)*. Note that a tooth-supported surgical guide was opted for in order to maximize the accuracy of implant placement, as guides that are stabilized by anchor pins and fully tissue-supported at the time of full-mouth extraction can be affected by changes in the soft tissue that may result in misalignment of the appliance during surgery. The surgical guide was seated over the remaining teeth and provided excellent stability *(Fig. 11)*.

The implant osteotomies were created through the surgical guide, and six Inclusive® Tapered Implants

Figure 8: *The BioTemps restoration was fabricated utilizing CAD/CAM technology and seated on the 3-D-printed model, which was generated from the digital wax-up to aid in preparing the temporary appliance for delivery.*



Figures 9a, 9b: *The access holes in the BioTemps restoration were widened to accommodate the temporary cylinders that would eventually be seated in the patient's mouth.*



Figures 10a, 10b: *Selective extraction of teeth.*

Figure 11: *Seating of tooth-supported surgical guide.*

(Glidewell Direct; Irvine, Calif.) were placed in the precise position called for by the digital treatment plan *(Fig. 12)*. The remaining teeth were extracted, and Inclusive® Multi-Unit Abutments (Glidewell Direct) were delivered, establishing a uniform restorative platform at the tissue level *(Figs. 13a, 13b)*.

Temporary cylinders were seated over the multi-unit abutments, and the interim BioTemps restoration was tried in *(Fig. 14)*. The temporary abutments

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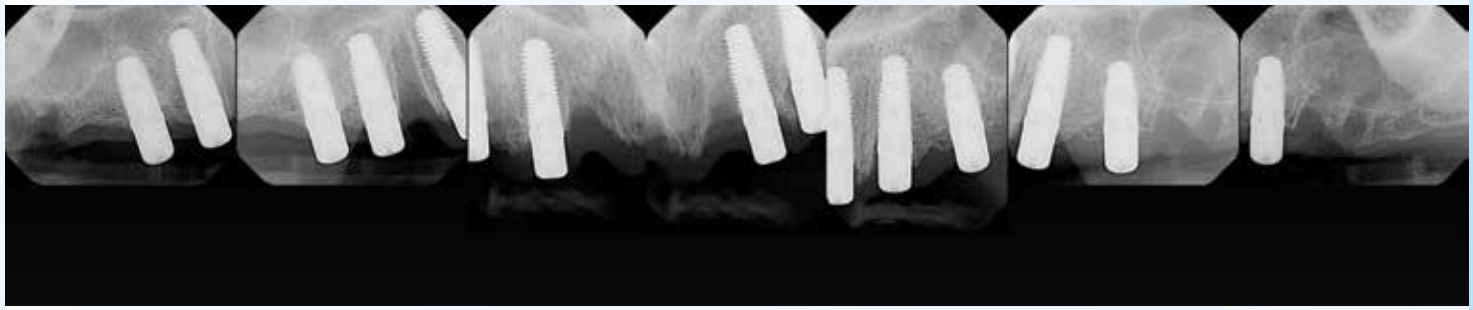
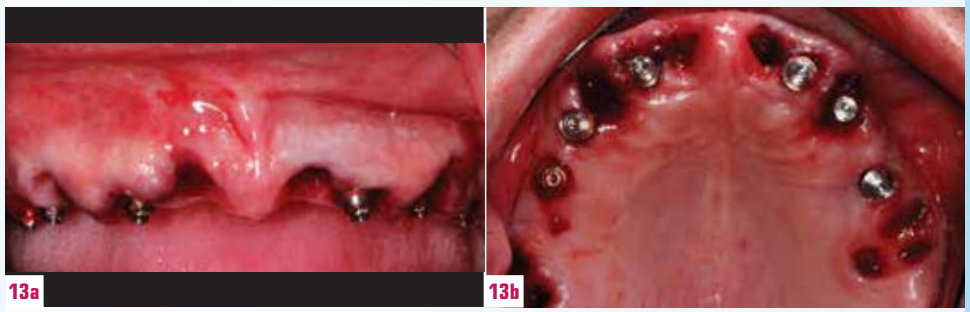


Figure 12: *Radiograph following implant placement and extraction of remaining teeth.*



Figures 13a, 13b: *Delivery of Inclusive Multi-Unit Abutments.*

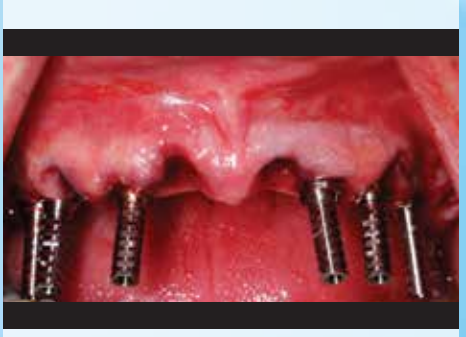


Figure 14: *Seating of temporary cylinders.*

were marked to indicate the correct height to which they needed to be trimmed in order to accommodate the provisional prosthesis. After removing the temporary cylinders and trimming them to the appropriate length, they were placed back into the patient's mouth. Flowable composite was used to attach the temporary abutments to the interim prosthesis.

The BioTemps restoration was then removed with the temporary abutments attached *(Figs. 15a–15c)*. Voids in the full-arch prosthesis were filled in with flowable composite, and pontics were created with an acrylic bur to provide for soft-tissue contouring. The stop flange was removed from the interim prosthesis and Palaseal® sealant (Heraeus Kulzer; South Bend, Ind.) was applied to prevent staining.

The interim BioTemps restoration was seated in the patient's mouth and torqued into place to 15 Ncm *(Figs. 16a, 16b)*. Minor adjustments were made to the prosthesis to establish proper occlusion. Radiographs were taken to verify complete seating of the temporary abutments *(Fig. 17)*. The patient was extremely happy with the fit, function and esthetics of the provisional restoration. At the one-month follow-up appointment, the patient exhibited excellent soft-tissue health and contouring around the interim prosthesis *(Fig. 18)*.

After approximately four months of healing, the patient will be evaluated for the final full-arch restoration, which will, ideally, be fabricated from BruxZir® Solid Zirconia to ensure long-lasting durability and esthetics.

Figures 15a–15c: *The temporary abutments were picked up by the milled BioTemps restoration.*

Figures 16a, 16b: *Delivery of interim full-arch restoration.*

Conclusion

Modern diagnostic and restorative tools allow for the precise, predictable placement of dental implants, providing patients with improved function, comfort and esthetics. Intraoral scanning, digital treatment planning, guided surgery, and CAD/CAM software enable detailed visualization of the prosthetic outcome prior to actual treatment. These technologies help to improve treatment outcomes, offering the benefits of provisionalization to a growing number of patients while helping to ensure an accurate, functional and esthetic final restoration. **IM**

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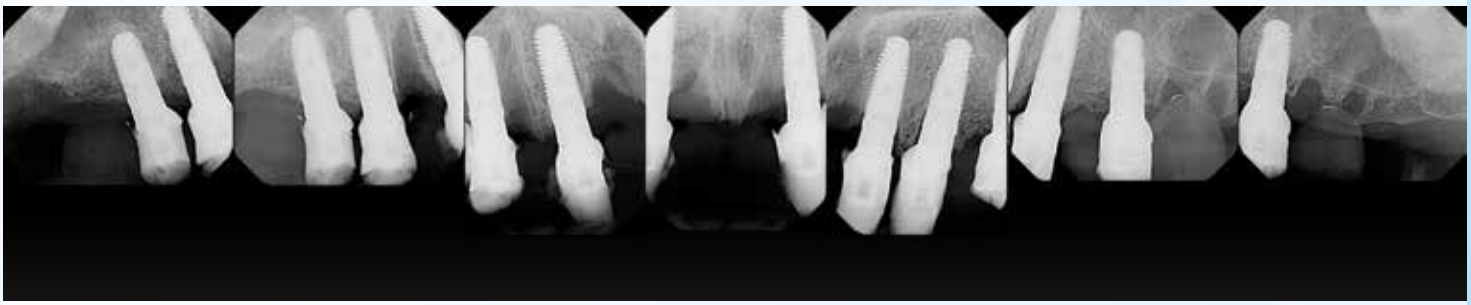

Figure 17: *Postoperative radiographs of interim full-arch restoration.*

Figure 18: *One-month postoperative.*