A SCREW-FREE FIXED HYBRID PROSTHESIS IN TWO VISITS

Converting an overdenture using digital dentistry

By Michael D. Scherer, DMD, MS

DENTAL TECHNICIANS AND CLINICIANS are often faced with challenging decisions in evaluating and determining the best treatment options for patients who are completely edentulous or whose dentition is failing. Fixed rehabilitation with dental implants typically requires a combination of precise surgical and prosthetic techniques. Fixed restorations are often technically demanding with regard to implant position, angulation, tooth position, biomechanical forces, and the demands of the patient. Additional factors such as the occlusal scheme, implant number, and implant position may further complicate planning and technical fabrication of a fixed prosthesis.[1,2]

While digital techniques are still relatively new to many clinicians, digital dentistry is highly predictable for working with single units and short-span fixed partial dentures (FPDs). The increasing adoption of chairside CAD/CAM systems has helped popularize optical scanning and direct fabrication of restorations for many years.[3] Using digital approaches for full-arch implantology, however, is less embraced by clinicians due to the challenges related to image acquisition and complexity. The term digital dentistry is all-encompassing, including optical scanner systems to help generate images directly of the patient's dentition; cone-beam computed tomography (CBCT) to assist in radiographic planning; and 3D printers and milling machines to help prepare prototypes and definitive prostheses.

Reports and studies have determined that while digital techniques are extremely promising, many clinicians opt for traditional analog techniques for the most challenging cases to ensure reliability and predictability of clinical procedures.[4] Part of the challenge of using optical scanning lies in the method of capturing the images, as accuracy and precision are highly variable based upon the operator and the scanner chosen.[5] Some reports indicate that when parameters are chosen to focus on full-arch rehabilitation in conjunction with an operator who is calibrated and trained properly for that situation, digital methods are just as accurate, if not potentially more accurate, than their analog counterparts.[6] After the optical scans are generated, the decision must be made to produce the prosthetics using 3D printing or milling systems. Some have questioned the impact of the choices between printing and milling, while others have indicated that they are both indispensable in the clinical or laboratory environments.[7]

Education and experience among the dental team is critical in utilizing digital technology. Accuracy of digital optical scanning is significantly affected by operator experience, with emphasis on greater reports of increased accuracy with clinicians who are more experienced.[8] Additionally, long-term success of implant restorations is dependent upon a combination between proper diagnosis, planning, technical fabrication, and patient factors.[9] The challenge remains to be able to plan, design, and fabricate a restoration as simply as possible. This article reviews digital technology and describes clinical approaches to using efficient optical scanning and laboratory fabrication methods for full-arch rehabilitation with dental implants.

Case Report

A patient presented to the author's clinical practice with an existing maxillary complete denture and mandibular implant overdenture (Figure 1). The patient indicated she was happy with her existing dental treatment but was looking for an option of mandibular teeth that are not

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Fig 1. Initial presentation of a patient with an existing maxillary denture and mandibular implant overdenture. Fig 2. The mandibular edentulous ridge has overdenture abutments (LOCATOR R-Tx, Zest Dental Solutions) in place. Fig 3. Housings are removed from the prosthesis and a closed-mouth reline procedure is completed. Fig 4. Existing overdenture abutments are removed. Fig 5. Fixed hybrid abutments (LOCATOR F-Tx, Zest Dental Solutions) are placed. Fig 6. An optical scan (TRIOS, 3Shape) is made of the edentulous ridge, relined prosthesis, and occlusion. Fig 7. An optical scan of the edentulous ridge with denture housings (F-Tx Denture Attachment Housings, Zest Dental Solutions). Fig 8. Optical scans are imported into a laboratory software (exocad, exocad GmbH) and prosthetic teeth and base are designed. Fig 9. The prosthetic base is 3D printed using biocompatible pink colored resin (Denture 3D+, NextDent) and joined together with the prosthetic teeth in the laboratory. Fig 10. The interim prosthesis is seated onto the abutments for the patient to wear for approximately 1 month prior to fabrication of the definitive prosthesis. Fig 11. Retention framework is designed on an optical scan of the edentulous ridge with housings using laboratory software (Dental System, 3Shape). Fig 12. The framework outline and vertical support bars are placed between the housings to enhance the strength of the framework.

removable. Intraoral examination reveals that she has been treated with four dental implants (Legacy 3, Implant Direct) with overdenture abutments (LOCATOR R-Tx, Zest Dental Solutions) in approximately the first molar and lateral incisor region (Figure 2). She was presented with several options, including a screw-retained restoration with denture teeth and a titanium framework; a monolithic zirconia screw-retained full-arch; and a screw-less fixed full-arch hybrid solution. The patient indicated that, because she travels more than 5 hours to the author's practice, she preferred whatever treatment option would minimize the number of visits to the office. Additionally, she indicated that she had been having mobility issues recently and would prefer a treatment option that could be completed within a 1- or 2-day period to minimize travel back and forth to the office. She and the author discussed the advantages and disadvantages of each of the treatment options and decided on a screw-less treatment option that could be started during that same visit. The author also advised her that she would need to wear a prototype prosthesis for at least a month to confirm that the change from an overdenture to fixed is comfortable prior to fabrication of the final restoration.

> Virtual prosthetic teeth were arranged according to the positions within the aligned implant overdenture and a fixed prosthesis base was designed.

First Visit: Same-Day 3D Printed Prosthesis

Denture attachment housings were removed from the existing implant overdenture, and recesses within the intaglio surface of the prosthesis were enlarged. Light-body PVS (Chairside VPS, Zest Dental Solutions) was injected into the intaglio of the prosthesis and placed onto

the edentulous ridge over the abutments. The patient was instructed to close into centric and the prosthesis was border molded to capture the soft tissue borders. After complete polymerization, the prosthesis was removed (Figure 3). The maxillary prosthesis was removed and the existing soft liner removed from the intaglio of the prosthesis. A reline procedure was also completed within the maxillary denture. The patient's mandibular prosthesis was optically scanned 360 degrees around the prosthesis and reline impression using an intraoral scanner (TRIOS, 3Shape). The patient's maxillary dentition was optically scanned, the mandibular prosthesis was replaced onto the edentulous ridge, and an optical scan of the maxillary and mandibular prosthesis in occlusion was captured.

Existing overdenture abutments were removed, implants were irrigated with sterile water, and fixed hybrid implant abutments (LOCATOR F-Tx, Zest Dental Solutions) were placed (Figure 4). A panoramic radiograph was made (Green CT, Vatech) to confirm complete adaptation of the abutments to the implants. The abutments were torqued according to the manufacturer's recommendations and housings were placed (F-Tx Denture Attachment Housing, Zest Dental Solutions) (Figure 5). After the housings were manually angled to parallel with the occlusal plane, an optical scan was made of the edentulous arch (Figure 6 and Figure 7). The patient was asked to return later in the afternoon on the same day for definitive procedures.

The optical scan files were imported into a dental laboratory planning software (exocad, exocad GmbH) and the scan of the prosthesis and edentulous ridge with fixed housings was aligned using an alignment algorithm within the software. Virtual prosthetic teeth were arranged according to the positions within the aligned implant overdenture and a fixed prosthesis base was designed (Figure 8). The prosthesis was designed in a way where the teeth arch can be manufactured separately from the base. The prosthetic base was 3D printed using a pink biocompatible resin (Denture 3D+, NextDent) on a laboratory-grade 3D printer (NextDent 5100, 3D Systems) (Figure 9). Additionally, the prosthetic tooth arch was 3D printed on the same printer using a tooth shade biocompatible resin (C&B MFH, NextDent). The teeth were joined to

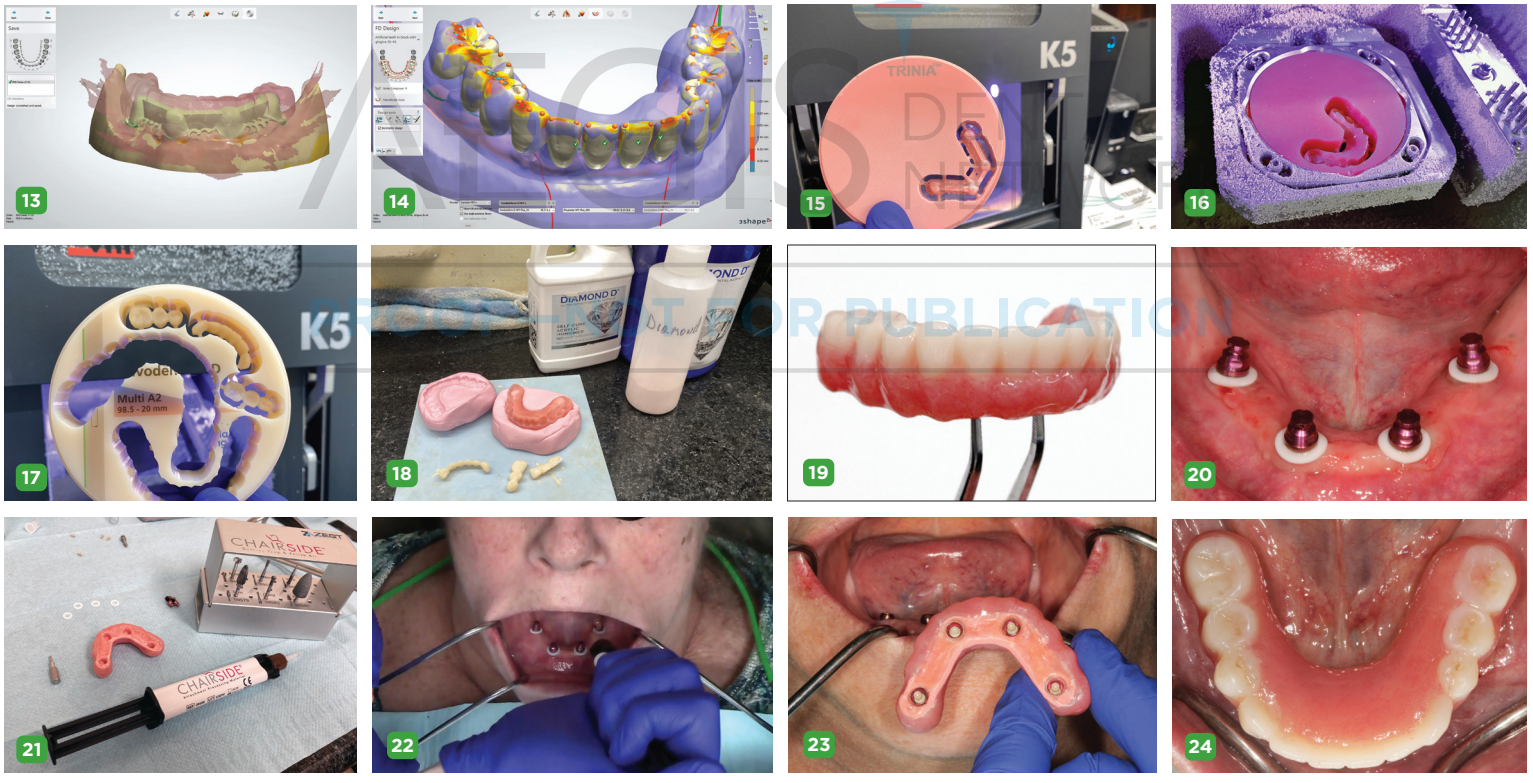

Fig 13. The definitive framework is completed using the interim prosthesis design file as a guide. Fig 14. After a copy of the framework design file is made, the prosthetic teeth and base are designed over the framework. Fig 15. Framework milled using a fiber-reinforced composite resin (Trinia, Bicon) on a laboratory milling machine (K5, VHF). Fig 16. Prosthetic base milled using tissue-colored PMMA material (Ivotion CAD, Ivoclar Vivadent). Fig 17. Prosthetic teeth milled using tooth-colored PMMA material (Ivotion ML, Ivoclar Vivadent). Fig 18. Framework, prosthetic base, and teeth joined together using autopolymerizing acrylic resin (Diamond D, Keystone Industries). Fig 19. Resin flash was adjusted and definitive prosthesis polished using pumice and a ragwheel. Fig 20. The patient returned and the interim prosthesis is removed, and denture housings (F-Tx Denture Attachment Housings, Zest Dental Solutions) are placed. The angulation of the housings is adjusted until the prosthesis fits passively onto the edentulous ridge. Fig 21. Mechanical undercuts are placed into the intaglio of the prosthesis prior to luting. Fig 22. Composite resin (CHAIRSIDE Attachment Processing Material, Zest Dental Solutions) is placed onto each housing and into the intaglio of the prosthesis. Fig 23. The prosthesis is seated and the patient is instructed to close. After complete polymerization the prosthesis is removed and definitive inserts (Retention Balls, Zest Dental Solutions) are placed. Fig 24. The prosthesis is inserted and complete adaptation confirmed.

the denture base using pink biocompatible resin and the prosthesis was stained and glazed using a light-curing resin (OptiGlaze, GC America Inc.). The maxillary prosthesis was relined using a reline jig (Lang Dental) and autopolymerizing acrylic resin (Diamond D, Keystone Industries).

The patient returned for placement of the prostheses later that afternoon. Block-out rings (Block-Out Spacers, Zest Dental Solutions) and denture attachment housings were placed onto each abutment. The prostheses were tried onto the maxillary and mandibular edentulous ridges and passivity of fit around the housings was confirmed. Mechanical retention features were placed within the prepared recesses of the prosthesis and a lingual vent connecting the recesses to the cameo surface of the prosthesis was placed. Composite resin (Chairside Attachment Processing Material, Zest Dental Solutions) was placed onto each housing and into the recesses in the definitive prosthesis, and the prosthesis was seated onto the edentulous ridge, with light finger pressure holding the prosthesis in place. After complete polymerization, the prostheses were removed, verifying attachment of the housings. Polishing procedures were completed and mandibular inserts (F-Tx Retention Balls, Zest Dental Solutions) were inserted. The prosthesis was placed using a spring-loaded driver mechanism to ensure complete adaptation of the retention mechanisms (Figure 10).

The patient was instructed to evaluate the occlusion, esthetics, and phonetics of the prosthesis over the course of an approximately 1-month period. After that month, the author spoke with the patient over the telephone and she indicated that she was comfortable and very pleased with the interim prosthesis. If extensive changes had been requested, a third appointment may have been necessary; however, in this case, because she was comfortable with the interim prosthesis, the author was able to proceed to the final based upon the previous design of the interim prosthesis.

Laboratory Fabrication of Definitive Prosthesis

The optical scans made on the initial patient visit were imported into a dental laboratory software (Dental System, 3Shape) for designing the framework and definitive prosthesis. The optical scan of the edentulous ridge with the housings was virtually blocked-out and retentive mesh was placed (Figure 11). The framework outline was designed using the software and supporting bars

Fig 25. The patient was pleased with the final esthetic and functional result.

were placed between the initial design (Figure 12). The completed mandibular framework was designed around the shape of the interim prosthesis that had been previously designed to ensure sufficient strength and esthetics (Figure 13). The initial framework design was virtually copied and a new design file was created. Virtual denture teeth were positioned according to the original interim prosthesis design and a denture base was designed to match the previously designed framework (Figure 14). Using a laboratory milling machine (K5, VHF), the mandibular framework was milled in a fiber-reinforced polymer material (Trinia, Bicon Dental) (Figure 15). The prosthetic teeth and base were milled on the same machine in a high-strength PMMA denture material (Ivotion, Ivoclar Vivadent) (Figure 16 and Figure 17).

After completion of the milling procedure, the framework, prosthetic base, and teeth were removed, adjusted, and fit confirmed. An additive silicone putty base was fabricated to assist in using auto-polymerizing acrylic resin to adhere the framework, denture base, and prosthetic teeth together (Figure 18). The auto-polymerizing acrylic resin was placed into both the intaglio and cameo surfaces and the fiber-composite framework and teeth were luted to the prosthetic base with the assistance of the putty base and a pressure pot. Any acrylic resin flash was adjusted using acrylic burs and the intaglio recesses in the areas corresponding with the denture housings were slightly enlarged to permit simple placement of the prosthesis. The definitive prosthesis was polished using pumice and a ragwheel.

Second Visit: Definitive Prosthesis Delivery

The patient returned for delivery of the definitive prosthesis. Intraoral examination revealed the 3D printed prosthesis performed very well and the patient indicated she was very satisfied with it. The prosthesis was removed and the fixed abutments were cleaned and torque verified prior to delivery of the definitive prosthesis. Block-out rings and denture housings were placed onto the abutments. Angulation was corrected by placing the definitive prosthesis onto the edentulous ridge over the housings and wiggled gently into place. Centric, vertical dimension, and approximate esthetics/phonetics were confirmed prior to definitive luting procedures.

Mechanical retention features were placed within the intaglio of the housings of the prosthesis prior to luting using specialized burs for the procedure (Figure 21). Composite resin was injected onto the housings and into the prepared recesses of the prosthesis, the prosthesis was seated onto the edentulous ridge, and the patient was instructed to close into centric (Figure 22). After complete polymerization, the prosthesis was removed and definitive retention inserts were placed (Retention Balls, Zest Dental Solutions) (Figure 23). The mandibular prosthesis was placed using a spring-style insert tool to ensure complete adaptation of the prosthesis to the mandibular implants (Figure 24). The patient indicated that she was very comfortable biting and was very pleased with the final esthetic appearance of the restoration (Figure 25).

Closing Comments

Traditional methods of fabricating full-arch fixed implant restorations typically involve four to six clinical visits and multiple laboratory steps in between. Furthermore, clinical and laboratory procedures to fabricate a screw-retained restoration involve a penchant for details that often requires many checks and steps to ensure success. Presented was a simplified and efficient clinical-laboratory workflow to ensure a screw-free full-arch fixed implant hybrid restoration can be completed in an expedited fashion. Additionally, digital workflows were highlighted and novel materials utilized to fabricate a prosthesis that is highly functional yet very practical.

REFERENCES ONLINE
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