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PR

A NEW DIGITAL SOLUTION FOR IMPLANT-SUPPORTED RESTORATIONS

Designing and milling three components separately but simultaneously offers several advantages

By Thomas J. Balshi, DDS, PhD, FACP; and Stephen F. Balshi, MBE

TODAY'S DENTAL PROFESSIONALS have several prosthetic options for restoring the edentulous arch, from the traditional removable complete denture to implant-assisted prosthetics to the more complex implants such as a bar-supported, screw-retained, non-removable prosthesis or an implant-supported removable overdenture. When presented with the advantages and disadvantages of each of these various prosthetic options, patients often choose the implant-supported solution due to the psychological security and confidence this restorative option provides, as well as the advantages of increased chewing function, improved phonetics, and esthetics. This article focuses on the development of a new technique aided by innovative technological advances that allow the delivery of an efficient, highly esthetic, and better long-term restorative option that is an easily repairable alternative to implant bar-supported overdentures.

The implant bar-supported fixed prosthesis is not a new concept. However, advances in CAD/CAM technology have removed many of the analog processes to increase its predictability and ease of manufacture. Often, these implant-supported prosthetics are composed of two manufactured components—a milled titanium bar substructure with an attachable, traditionally fabricated or milled acrylic denture superstructure set with denture teeth. However, an option that is increasing in popularity due to an enhanced level of esthetics is a milled, screw-retained, full-contour hybrid zirconia bridge. Although both approaches are viable, each has its disadvantages. Acrylic denture teeth demonstrate wear and lessened esthetics, and will need to be replaced over time. In the case of a zirconia superstructure, if a fracture, chip, or any kind of breakage should occur, the entire arch would require replacement. Clinical concerns also exist about the long-term impact that the very stiff milled zirconia will have on the bone-implant interface.

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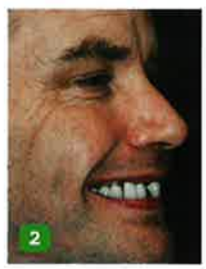
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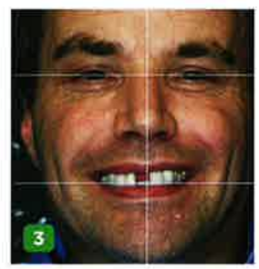
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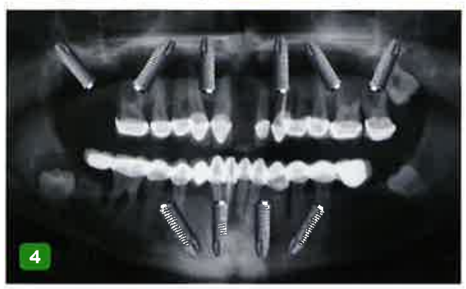
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Fig 1. Preoperative photo of the patient's dentition, with a flipper for tooth No. 8. **Fig 2 through Fig 4.** A comprehensive evaluation is accomplished on the initial visit and a treatment plan is developed.

To overcome these disadvantages as well as improve the esthetics of the final outcome, the authors suggest an approach to their patients that involves a milled titanium bar with preparations that support the cementation of individually fabricated custom crown restorations—whether layered PFM crowns, milled copings with layered ceramics, or full-contour crowns stained and glazed. The bar supports a digitally designed and milled acrylic base to represent the gingival portion of the implant-supported prosthetic. The teeth can be any shape or size because they are custom built and not stock teeth. The esthetics can be optimized with the use of higher-quality materials, and there is little to no wear of the material, because ceramics wear at a slower rate than denture teeth.

Although a more costly option, this approach offers ease of replacement or repair should an individual tooth chip or break. The custom individual tooth setup also allows for a more natural and esthetic appearance of the prosthetic. The primary disadvantages of this approach, until recently, included high analog labor costs for customizing each individual tooth and the length of time required for fabricating a full arch of individual teeth, as well as the fact that the custom restorations could not be completed until after the framework was completed, which required at least a 6-week delivery timeframe. However, these disadvantages have been overcome with new advances in CAD software that allow the simultaneous design and manufacture of the substructure, superstructure, and milled individual, patient-specific custom teeth. This solution not only reduces laboratory production time and cost but also reduces fabrication time from 6 weeks to 3 weeks and offers the dental team a complete digital record for predictable repair or replacement.

Case Report

A patient in his 40s presented with periodontally compromised teeth throughout both arches, with abscesses and decay. He wore a flipper for tooth No. 8 (Figure 1). Furthermore, the patient had osteogenesis imperfecta (type I collagen), a genetic disorder characterized by brittle bones. As a result, even the roots of the teeth were malformed. The patient had

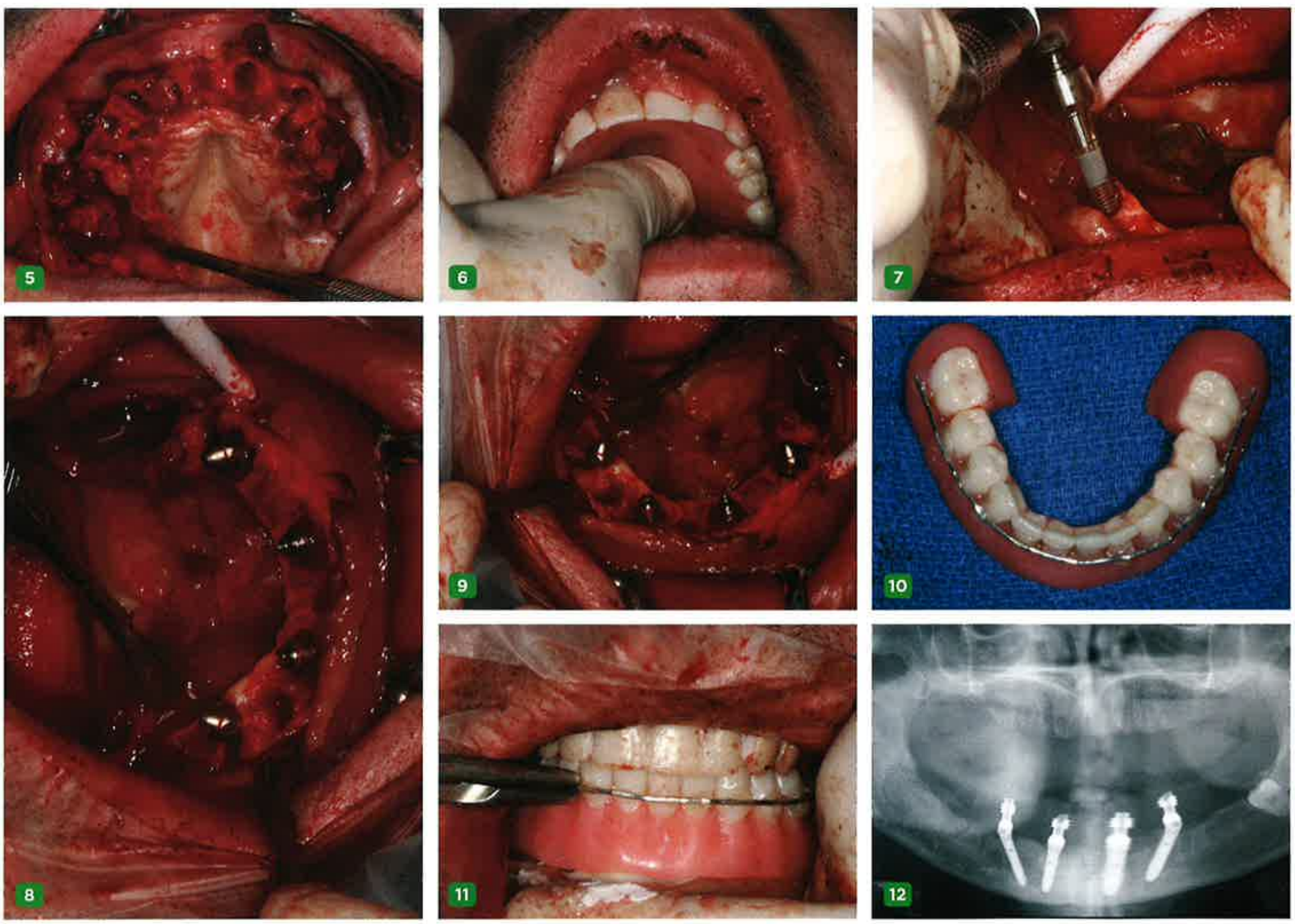

Fig 5. All of the patient's teeth are extracted surgically. **Fig 6 through Fig 12.** An upper immediate denture is delivered at the first surgical appointment and a lower immediate denture is converted to an implant-supported prosthesis.

undergone significant crown and bridge work since he was a teenager.

A comprehensive evaluation was accomplished on the initial visit and a treatment plan was developed (Figure 2 through Figure 4). The decision was made to extract the remaining teeth and fabricate implant-supported upper and lower full-arch prosthetics. Implants can be successful in osteoporotic patients, and osteogenesis imperfecta patients are very similar.

Due in part to the patient's financial concerns, a staged approach was chosen. After surgical extraction of all teeth (Figure 5), the authors would restore the lower arch first, stabilize it against an upper immediate denture, and then use a CBCT scan for precise implant placement in the upper arch.

At the first surgical appointment, an upper immediate denture was delivered and a lower immediate denture was converted to an implant-supported prosthesis (Figure 6 through Figure 12). This set of traditional immediate dentures was fabricated from articulated stone models using the authors' Teeth In A Day® protocol. The lower denture was converted on the day of implant placement to become the patient's first set of fixed implant-supported teeth. The master-verified cast was created using the conversion prosthesis during the impression process. Both the master cast and the conversion prosthesis were scanned in the dental laboratory and the STL file was then transmitted to Global Dental Science (avadent.com) for AvaDent® Digital Dental Solutions design.

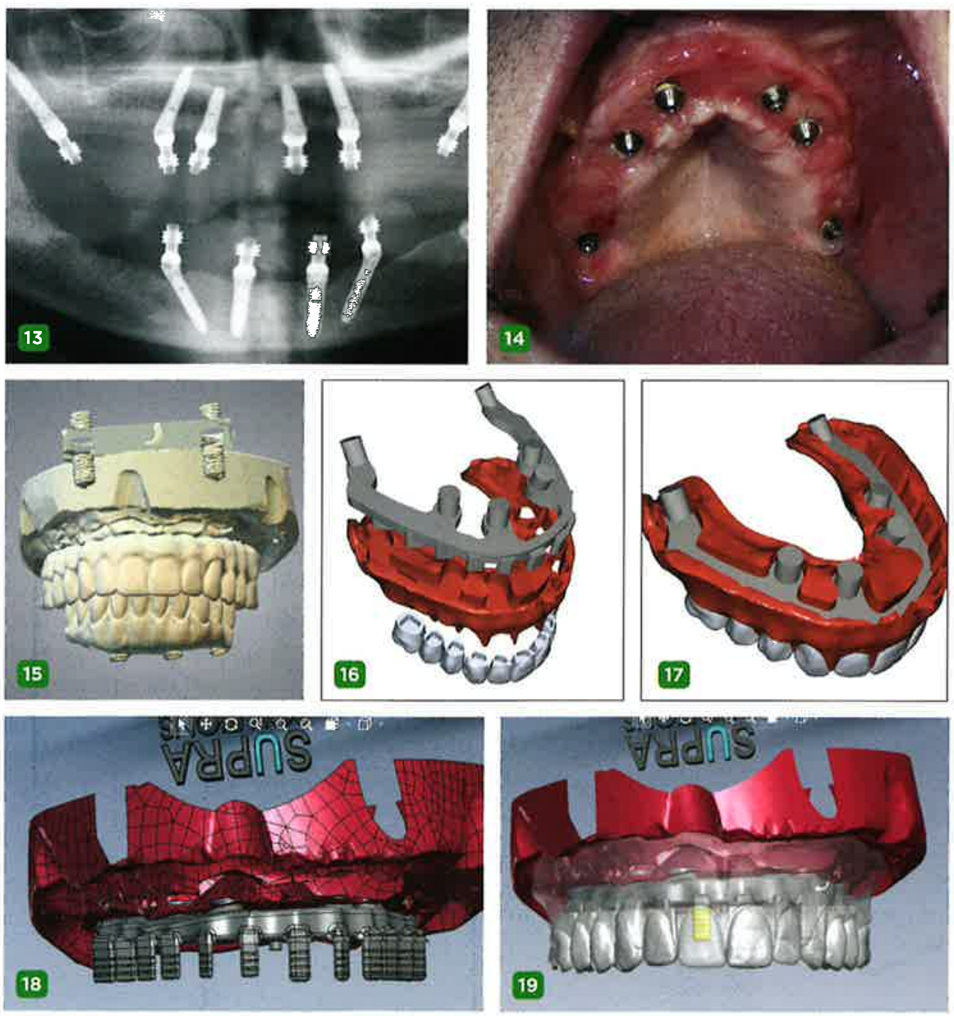

Fig 13 and Fig 14. After several months of healing, the patient commits to the implant treatment in the maxilla. Fig 15. The existing immediate denture is scanned into the design software. Fig 16 through Fig 19. The final upper prosthesis is digitally designed in the laboratory.

After several months of healing, the patient committed to the implant treatment in the maxilla (Figure 13 and Figure 14). The existing immediate denture was scanned (iSeries, Dental Wings, dentalwings.com) (Figure 15) with a wash impression inside the denture to accurately capture the intaglio side of the maxilla. Once that was scanned, the CAD software was able to simply take the scan and generate an output file to copy-mill a fully milled PMMA denture (AvaDent), which would be used to convert to the fixed set of provisional teeth in the maxillary arch.

After a healing period following the initial extraction, a second set of temporaries was fabricated. This was not entirely necessary, but it helped the authors understand the new workflow as the final prosthesis, called Accelerset™ (AvaDent), was developed.

The next step was to begin construction of the final restorations. For the mandibular full arch, the authors designed a fully milled hybrid prosthesis and sent the design to AvaDent, where it was milled with a titanium substructure and a monolithic, fully milled acrylic veneer (without individual denture teeth). The plan was to use the PMMA veneer for the mandibular arch with the intent of having the maxillary arch restored with ceramics. By using these dissimilar materials, 100% of the wear would occur in the mandibular arch on the PMMA veneer. This was done intentionally to create a resilient shock-absorbing system. Although the mandibular arch will wear over time, a "retread" procedure can be accomplished easily.[1]

The authors do not advocate implant-supported ceramics opposing implant-supported ceramics because both prosthetics are supported by bone, so the functioning system has no forgiveness. The analogy provided to the patient was of two glass hammers coming together repeatedly. In the authors' experience, complications arise with the materials in those situations, so they prefer to insert an intentional degree of resiliency in the system to provide controlled maintenance over a long period of time, as opposed to unexpected maintenance of a prosthetic complication. The final upper prosthesis was designed in the laboratory using AvaDent Connect design software (Figure 16 through Figure 19). All components milled by AvaDent separately, but simultaneously, included: a milled titanium substructure, milled acrylic gingiva, and milled

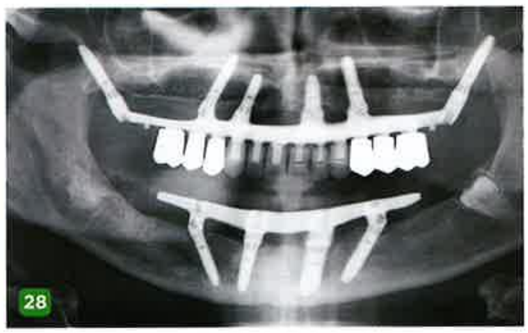

Fig 20 through Fig 23. Zirconia restorations are prescribed for the molars and premolars bilaterally and lithium disilicate for the anterior teeth. **Fig 24.** The mandibular prosthesis is fabricated with a milled titanium substructure that is wrapped with a fully milled PMMA veneer. **Fig 25 through Fig 28.** The successful restorations are shown in the patient's mouth on recall visits.

teeth. For the teeth, zirconia restorations were prescribed for the molars and premolars bilaterally and lithium disilicate for the anterior teeth (Figure 20 through Figure 23). The mandibular prosthesis was fabricated with a milled titanium substructure that was wrapped with a fully milled AvaDent PMMA veneer (Figure 24).

The patient returned for several recall visits in the first 3 months and reported that the prostheses were comfortable, held up well even when chewing tough foods, and esthetically went unnoticed by people who did not know that he had implant-fixed prosthodontics (Figure 25 through Figure 28).

Conclusion

Milling titanium substructures and crowns is not new. The Accelerset process, however, had not been utilized previously due to the gingival component, as well as the fact that software programs previously had not been capable of designing all components simultaneously.

Two concepts remain critically important from the input level. This process will not improve the dentist's impressions or jaw relation records; high-quality, accurate impressions and capturing the jaw positions appropriately remain extremely important. It is also critical for the laboratory to digitize the records properly and accurately in order to replicate what was presented clinically. If the inputs are accomplished appropriately, then the outcome will result in delivery of the final prosthesis with no clinical adjustments—as it was in this case—because everything was scanned, and the dentist could provide a prescription requesting any specific changes from a reference position. The patient in this case was wearing screw-retained provisional restorations during his osseointegration period, and he was satisfied with his temporaries, so the authors made few changes from the temporary to the final stages of the restorations. Using the conversion prosthesis as a reference simplifies the design feature. Articulated master casts and stone casts of the conversion prosthesis are sent to AvaDent for verification of the final Accelerset hybrid prosthesis.

However, if, for example, another patient's temporaries held the correct vertical dimension but the midline was off slightly or the incisal edge length was too short, those temporary restorations could be used as a reference position. When everything is scanned, the dentist and technician can see where the provisionals are in space, and using the prescription and CAD/CAM software they can make virtual adjustments to the teeth in relationship to those reference points. Before anything is ever milled, the clinician can view a digital preview that shows the proposed design in relationship to the references that were provided, whether from a provisional prosthesis or a wax try-in.

The result is a solution with reduced laboratory involvement, cost, and production time, along with digital records that offer more predictable replacement or repair of damaged restorations.

REFERENCE, VIDEO ONLINE
See the reference and watch the authors discuss the case with the patient at insidedentaltech.com/idt934.

This article was double-blind peer reviewed by members of IDT's Editorial Advisory Board