1/2 point CDT documented scientific credit. See Page 31.

by Charles B. Fager V, BS, CDT,

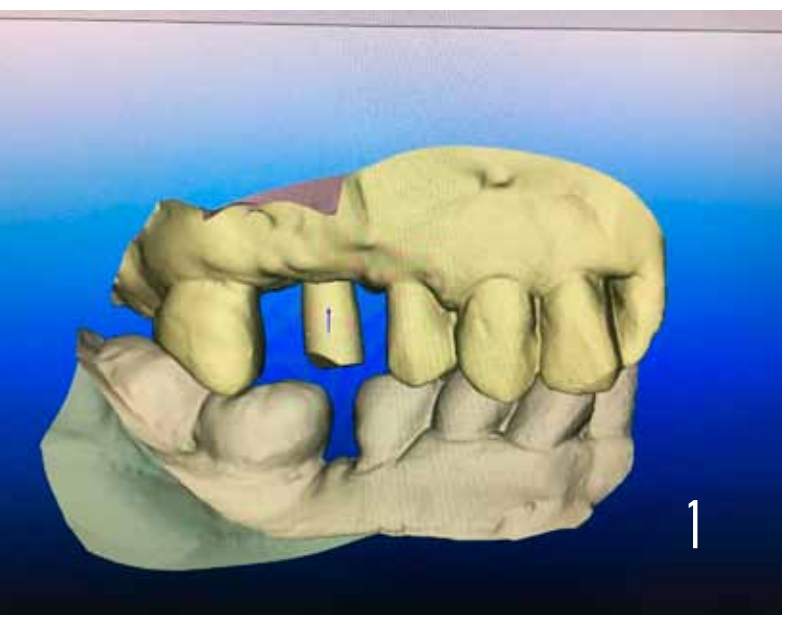
Digital Implant Restoration Workflow

Verification, Validation and Implementation of Techniques for Immediate Provisional and Final Implant Restorations

Figure 1
Example of iTero IOS digital scanner and seated clinical scan body. The scan body is a Nobel Biocare Elos Accurate Intra Oral Position indicator.

Figure 2
Model printed from example scan with removable tissue and digital analog in place.

This article examines the details of digital workflow for immediate provisional (temporary) and final dental implant restorations. Most dental laboratories have already embraced some form of digital dental desktop implant workflow. This can include outsourcing scanning and designing, in lab scanning of poured models and desktop implant scan bodies, or receiving digital implant impressions (with clinical scan bodies) from intra-oral scanners (IOS) (**Figs. 1-2**).



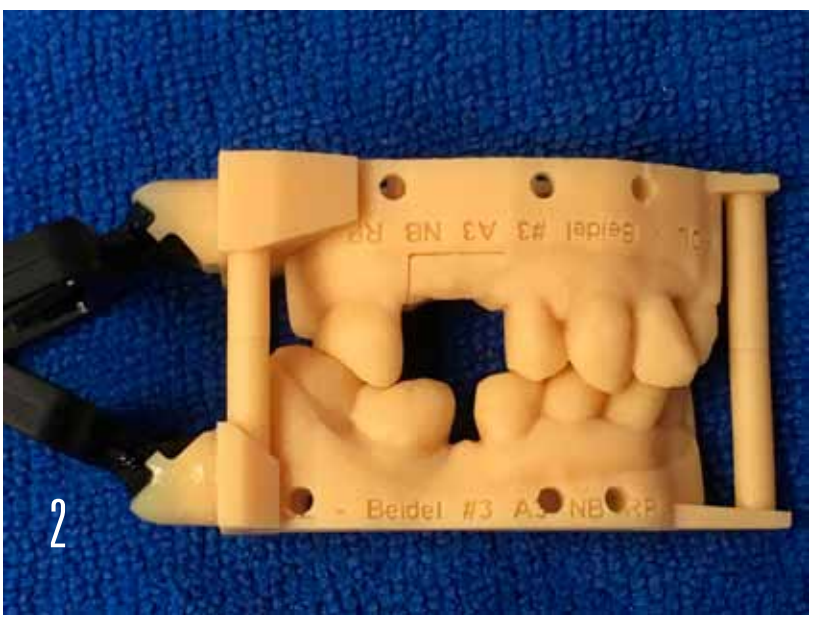
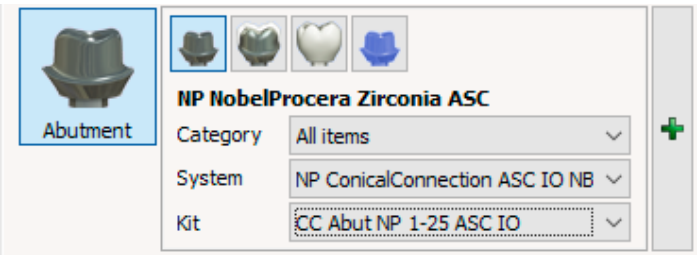


Figure 3
Entering information into 3Shape order entry correctly is critical to success.



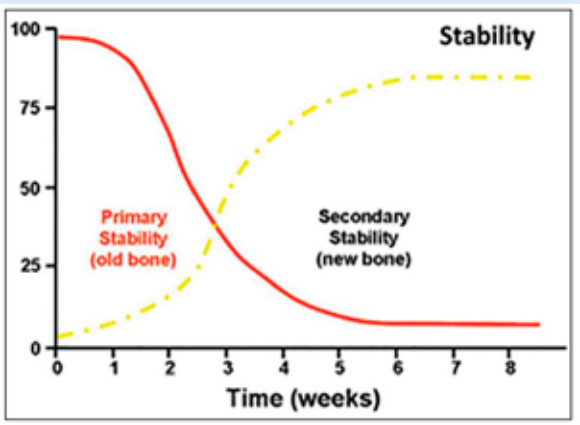


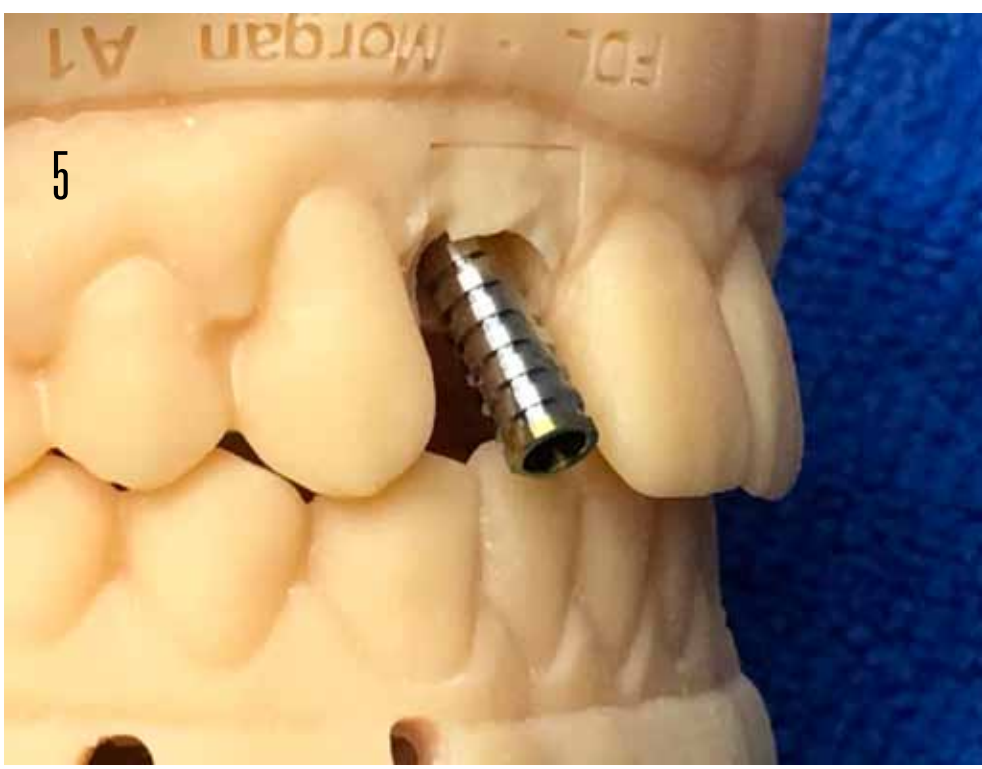
Figure 4
Immediate implant provisionals need to be fabricated within a few days after surgery.

Take note that desktop scan bodies are not usually interchangeable with clinical scan bodies as determined by the manufacturers. Some companies, like Nobel Biocare, are recognizing the need for a standardized scan body workflow. They have a dual purpose scan body that can be used for either application for their universal base. Each unique scan body is specifically linked to brand, size and interface as determined by their associated data media exchange (DME) files and selected when setting up a case in 3Shape order entry (**Fig. 3**). DME files define the parameters of the abutments or restorations which are required for FDA compliance.

One of our goals was to develop an efficient method for producing an immediate implant provisional from an IOS impression. The benefits of an immediate implant provisional are that they can help create ideal tissue contours, maintain adjacent tooth position and provide an alternative to a removable Essix or flipper provisionals.[1,2,3] In reality, not all surgical cases are suitable for IOS procedures because of time or technical limitations of IOS scanners. The basics of any good impression technique; tissue management, fluid control, capturing proper anatomical landmarks, capturing enough dentition so that a meaningful occlusion can be repeated is not solved by simply employing IOS technology. Swelling of tissue, sutures and fluids all make IOS impressions challenging for implants. For this reason, a conventional impression sometimes has to be used in place of or in conjunction with an IOS impression. This can drastically change the restorative workflow and components needed, so coordinating treatment with the specialist office placing the implant is paramount.

Often some of the workflows (poured vs. printed) have to be combined because implant companies have not yet developed complete IOS solutions. Some abutments available from a desktop scan body may not be available from an IOS scan body workflow. This can lead to not being able to complete a restoration that has to be made quickly during a limited time of primary stability when immediate temporary implants must be placed (**Fig. 4**)[4,5] Usually temporary implant abutments must be customized before use and therefore DMEs do not exist. Temporary abutments that are modified must be scanned as a tooth preparation. To do this a model must be used that is either poured or printed (**Fig. 5**). This could be a challenge for a lab that receives a digital impression, but does not have access to an in-house model printer or expedited model printing service. In the validation

Figure 5
Model printed with AsigaPRO2 75 and Whip Mix VERIMODEL OS Generative Resin, for a provisional crown with Nobel Biocare Snap Temporary Engaging abutment in place.



Having a quality in-house printer provides numerous advantages.

section of the article, printer selection for implant models will be discussed. The other option is to use a "final" titanium base abutment for temporaries that can selected in the original order entry. A modeless workflow could be used, but nuances of emergence and the precision of contacts (and lack of occlusion and lateral interference) is much more difficult to achieve.

The major concept to glean from is that planning is required. You must understand the mechanics of each implant system, and be creative to solve workflow paths that are still evolving. Sometimes a seemingly simple workflow of one component to the next is impossible due to software limitations or the unavailability of DMEs. Therefore, it is imperative to have a verified and validated workflow to ensure that you can complete the desired implant restoration.

Verification

For our purposes, verification is an internal check of workflow that establishes that it is possible "on paper" to produce the desired restoration to specification. It defines and provides a road map to the end product. Nothing is more frustrating than accepting a new case and then realizing at some stage of order entry or design that it is not even possible to create the desired product. Charting out all of the components necessary to produce an implant restoration including software, scan bodies and corresponding DMEs, poured model analogs, digital implant model analogs (DIMs) and abutment components is initially required to avoid problems. Desktop digital implant workflow is well developed and numerous original manufacturer and third-party solutions exist. In my opinion, it is paramount to use all "original brand specific" components for quality assurance, efficacy, legal and even marketing considerations. The determining factor is what brand or type of implant system is chosen in the design order form and the implant scan body. If the improper scan body is used, it will not pair properly within the design software. Typically when a scan body is purchased, the corresponding DMEs are loaded into the design software. This defines that each specific scan body can only be used for a specific system, size and implant interface. The same is also true for a digital impression, but sometimes products that are available in the desktop workflow are not available in the IOS workflow. There can be numerous causes of this issue. The manufacturer may not want the component to be used in certain applications, or the application may not be certified by the FDA.

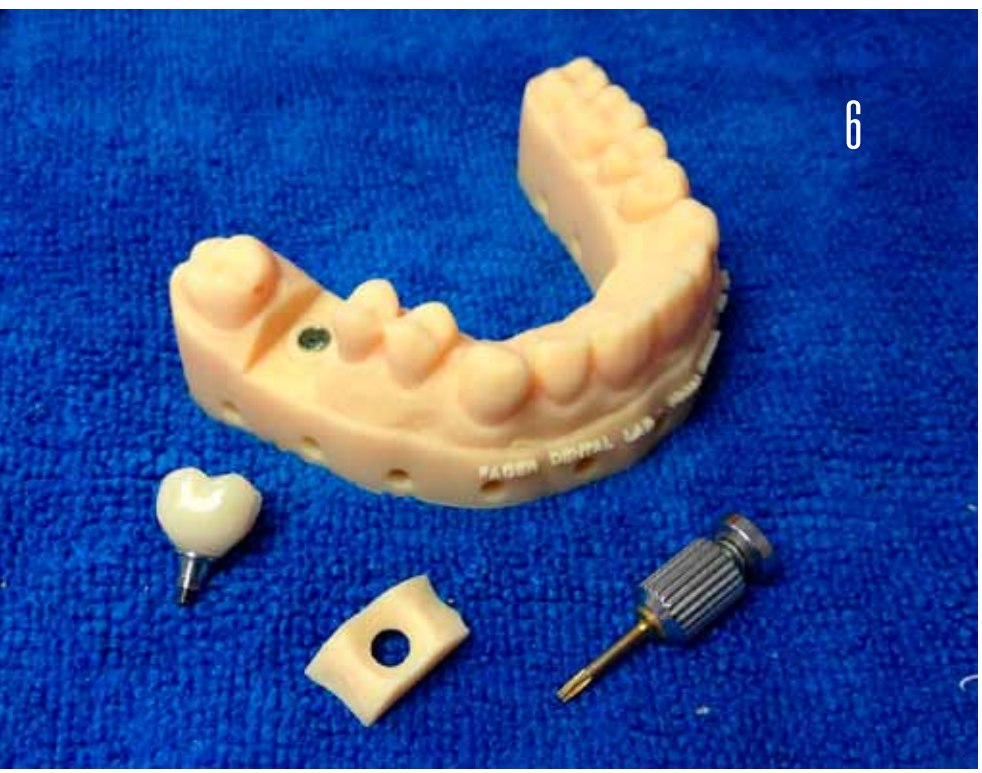


Figure 6
Example of a validation test print (Asiga PRO2 75) with all the files and designs processed properly.

Validation

For our purposes, validation is defined as the ability to produce the temporary or final restoration and judge its suitability as compared to the specifications set during verification. This process is very familiar from the desktop scanning workflow but diverges quickly with IOS impressions. The ability to accept IOS scans from a variety of brands of scanners can be challenging and expensive.

Each company has their own protocol to send, repair/convert and pass on digital files that have to be imported into design software. 3Shape has a very convenient Trios Inbox and automatic data conversion to import scans. Most of the major scanner companies have relatively good systems in place, but vary slightly in processing time or sequence. The best idea is to progress slowly (or as opportunity exists) and to learn one system at a time. The dental laboratory has to have the proper version of model builder software (if a model is required) and enter into an agreement (paid or otherwise) to have access to IOS files. Acknowledging this is part of the verification process and validating it is using the files to produce a model or design. Before accepting any type of "real" work, it is recommended to do a sample case to make sure everything goes smoothly (**Fig. 6**). Nothing could be

worse than accepting an IOS impression from a new or existing client (who has high expectations), and informing them that their case cannot be completed because you do not have the proper software version, file exchange capability or do not have access to a quality model printer service or printer.

For implant models, the fit of DIMs (digital model analogs), surface texture and quality, strength, model color, cost and availability all have to be considered. It can be very difficult to evaluate printers and print quality by manufacturer's specifications. Also speed and volume have to be considered depending upon your need and application. Volume can be achieved by a large build plate area or higher Z axis (vertical dimension) capability. For example, with the Asiga PRO2 75 it is usually better to run multiple single level prints (4-6 models) a few times during the day, but at night run stacked levels taking advantage of the 200 mm Z axis. The best way is to get samples and evaluate the models (**Fig. 7**).

Each implant manufacturer has their own idea how a DIM should be designed. Some index and snap in place or have a friction fit, others screw in place. The fit is adjustable in the control panel under digital models (**Fig. 8**). All are easily retrievable. On larger implant cases we have used verification jigs (similar to poured models) to ensure a good fit. This requires having a variety of DIM analogs in stock (remember the benefit of planning). Once you have tested and evaluated all of the components, systems and models you are ready to get to work. The bottom line is that you must validate your process to confidently produce quality work.

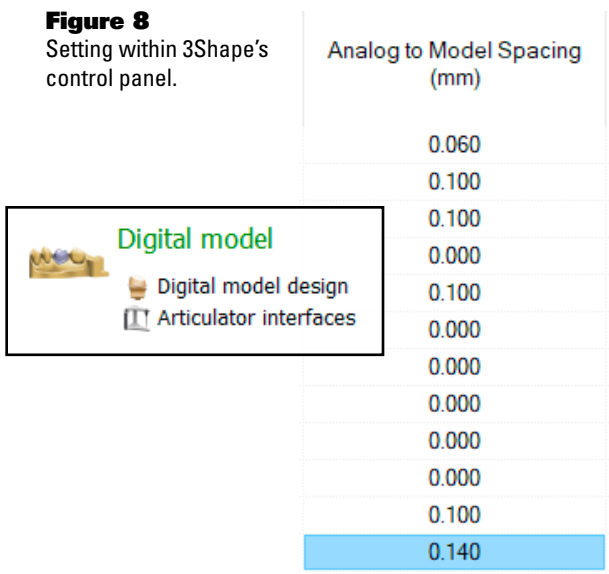


Figure 8
Setting within 3Shape's control panel.

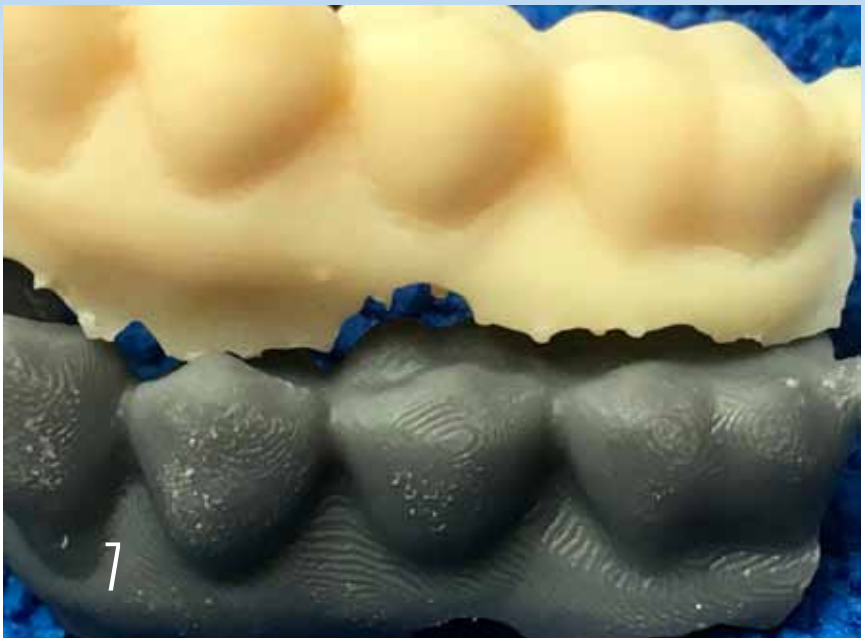


Figure 7
Comparison of Asiga PRO2 75 print with Form 2 print.

Implementation

Final thoughts. Digital workflow is obviously in a state of transition. Clinical scanners are not used by a majority of dentists yet, but the numbers are growing. Understanding and using printing technology now paves the way for the future. One of the definitions of success is when preparation meets opportunity. Having a quality in-house printer provides numerous advantages. It helps retain existing clients and attracts new clients. Verifying, validating and testing helps ensure that you can provide a good service. The final part of this article will highlight a few examples of digital implant provisional and final restorations and examine their workflow for actual cases.

The first example is the most traditional means of accomplishing a laboratory produced semi-digital temporary restoration. The workflow has a conventional impression, the model is produced, a temporary cylinder is adjusted and scanned. The temporary is milled out of PMMA, finished, polished and cemented to the base (**Fig 9**).

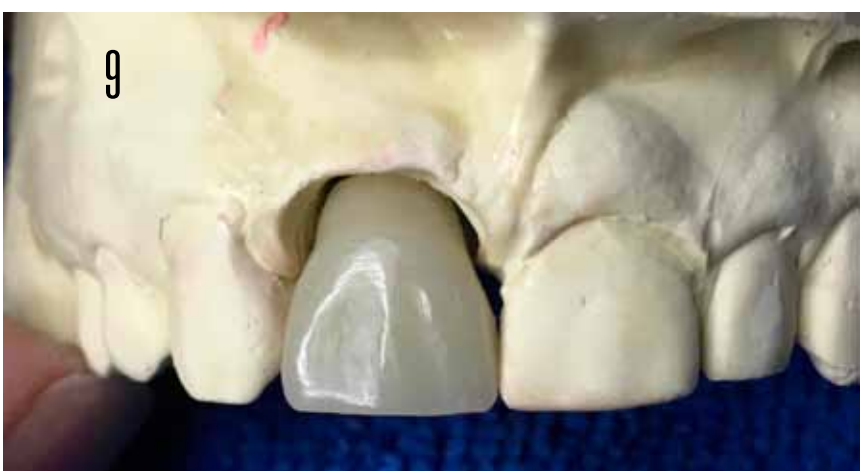


Figure 9
Immediate implant provisional from conventional impression, prepared temporary abutment, scanned and designed, milled out of PMMA and cemented for delivery.

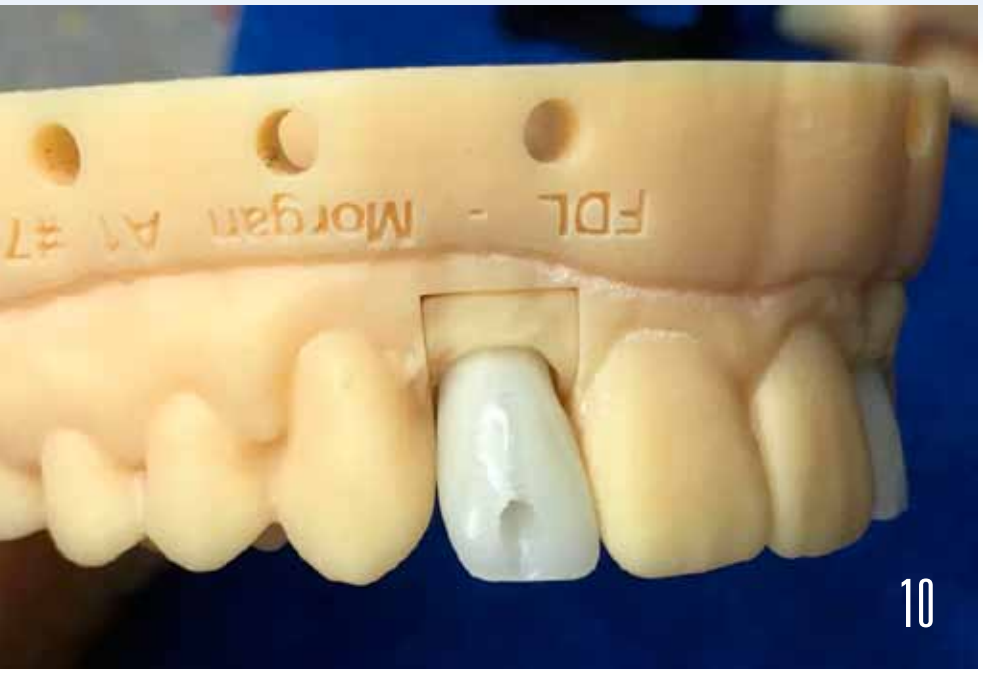
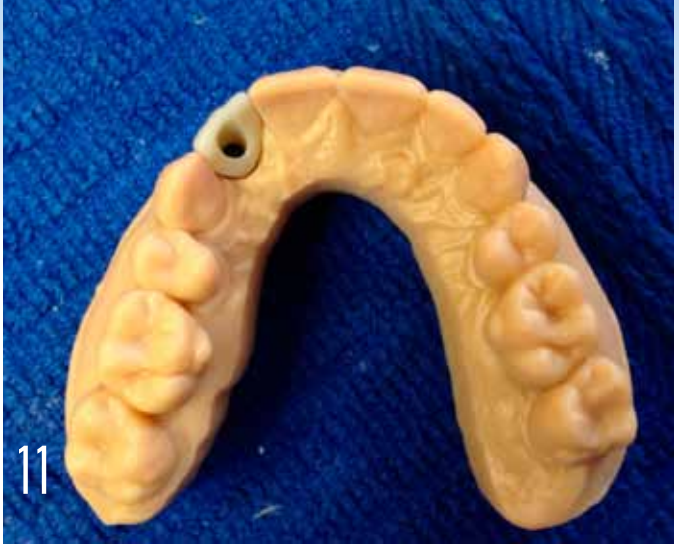
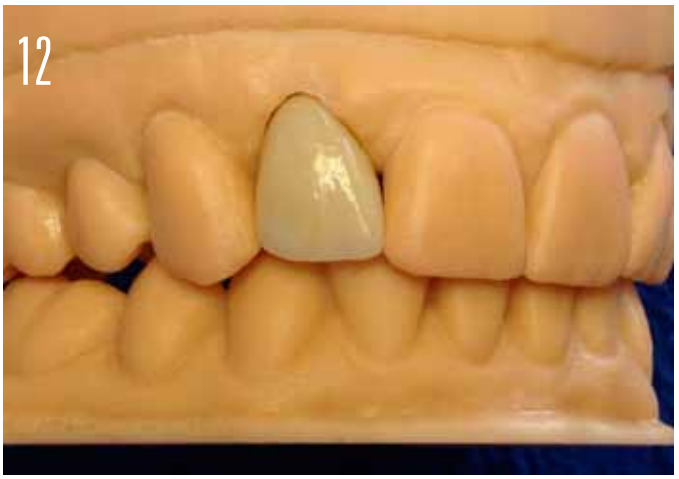


Figure 10
Immediate provisional Nobel Biocare conical connection Snap Temporary abutment with milled PMMA temp. Asiga PRO2 75 printer.

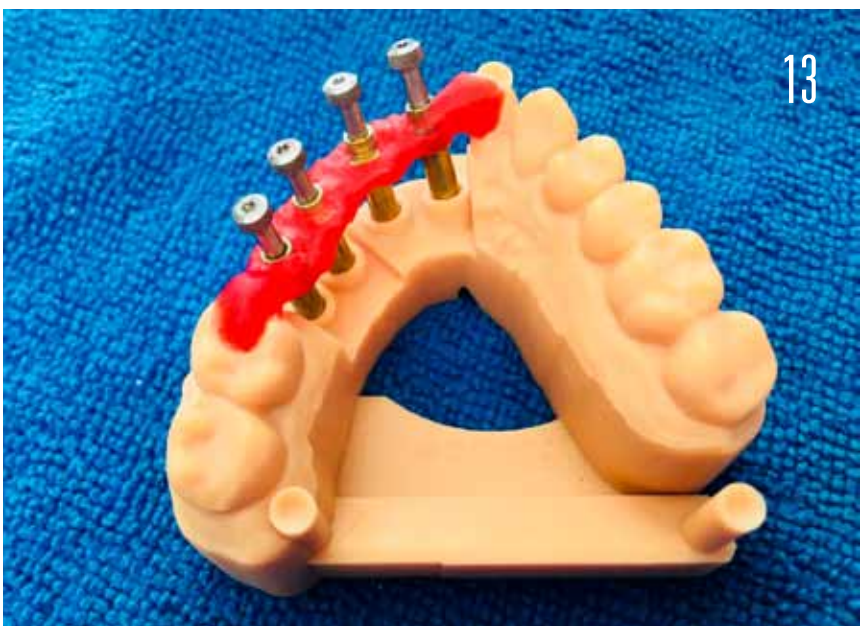




Figures 11-12
Nobel Biocare ASC FCZ with porcelain layering.

Figure 13
Verification guide to check accuracy of analogs.

The second immediate implant example is using an IOS impression. The iTero scan was received and processed and the files were imported into 3Shape. In this case we had to mock up a design with the proper interface and print a model. We could not use a complete digital workflow because a digital temp abutment does not exist. You could use a universal titanium base but that would drive the cost of the restoration higher. The model is printed and DIM placed in the model. The temporary abutment is prepared and scanned. The provisional is designed and milled out of PMMA, finished and cemented for delivery (**Fig 10**).



The third example is a final case with complete digital implant workflow. The Trios impression was imported. The implant interface in this case was a Nobel Biocare conical connection. ASC was chosen to provide a screw retained crown that otherwise would not be possible. The case was designed and the model was designed. The case was sent to Nobel Procera for production and the model was printed. We had the model ready when the unit arrived. This is a very efficient workflow and an example of convergent manufacturing. The case was micro layered and completed for delivery (**Figs. 11-12**).

The final example is a more complex digital implant case that required a modified digital workflow.

The Trios scan was imported into 3Shape and the Nobel Biocare connection interface was chosen in the order entry. The case was to be screw retained so we had to use a Nobel Biocare Multi-unit abutment. The model was printed and checked with a verification jig (**Fig. 13**). The Multi-unit abutments were placed and

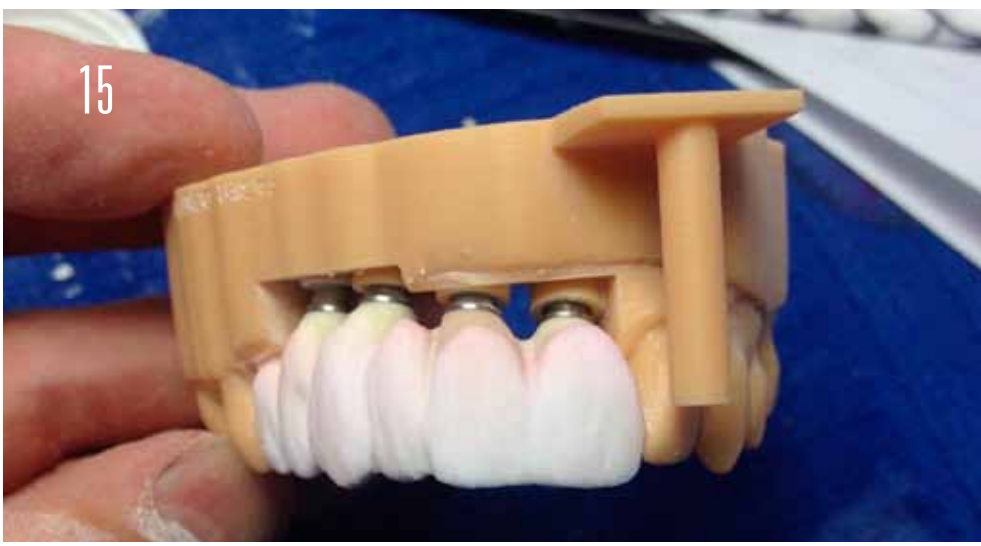
scanned, and the bridge framework was designed. The case was sent to Nobel Procera for production. The case was layered and finished for delivery (**Figs. 14-17**). **JDT**

References available upon request.

About the Author

Charles B. Fager V, BS, CDT, has 37 years of bench experience and 33 years as a business owner of Fager Dental Lab in Camp Hill, Pa. He looks forward to evaluating and applying emerging technology and quality business practices as ways to enhance the careers and professional status of existing and future dental technicians.

Figures 14-17
Final porcelain layering.



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