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DIGITAL INTRAORAL SCANNING: IMPRESSION-FREE IMPLANT PLANNING AND RECONSTRUCTION

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INTRODUCTION

Over the last several decades the world of implant dentistry has seen immense changes. Significant research in the field has centered on improving the implant body design to optimize surface characteristics and thread pitch to allow for earlier final restorations. (See also *Selected Readings in Oral and Maxillofacial Surgery*, Vol. 7, #3) Research into the restorative phase of dentistry has aided bone preservation (platform switching) and improved long-term outcomes for dental implants. Implants have a proven success rate and are the ideal option for replacing missing teeth.

Until recently, little advancement had been made in the process leading from initial treatment planning to the final seating of the restoration; the basic process of fixture-level impressions has persisted in implant dentistry. In some circumstances, these cumbersome steps preclude restorative doctors from offering implants to ideal candidates. Multiple appointments and a large parts inventory were required to maintain a restorative implant practice. With the advancement of digital technology and specifically the application of intraoral digital scanning, treatment planning and restoring implants is dramatically different than just a few years ago.

A surgical implant practice that supports digital implant dentistry utilizes multiple technologies, including cone-beam CT, 3-D computerized treatment planning, and intraoral digital scanning. Whatever systems a surgeon decides to incorporate into a practice, it is crucial that the different technologies work together. With cone-beam technology DICOM files are standard and can be integrated into any software, but some integration is more seamless. That is, some programs (e.g., practice management software) have links that provide a simple click access to open the implant planning software and the specific patient's CT is automatically loaded. In my experience, this does not always function as advertised, and it leads to a situation in which multiple programs are open on the desktop and may tax your computer.

With intraoral digital scanning, the key is a system with open architecture that allows files to be shared with modeling companies, laboratories, and that can be integrated into the cone-beam file for treatment planning. Furthermore, when implementing any technology into a practice all clinical matters should be based in science. With regard to intraoral digital scanning and dental implants, the number of studies in the literature demonstrating the superiority of the technique is quite limited. Despite this, current literature supports the technique and justifies its use in indicated patients.

A REVIEW OF THE HISTORY AND TECHNOLOGY

In 1973, Dr. Francois Duret introduced the application of CAD/CAM technology into dental applications. After research and patenting, a system was presented in 1989 for fabricating a dental crown using intraoral scanning. In 1987, Cerec® by Sirona Dental Systems, LLC (Charlotte, NC) became commercially available. Since then the technology has continually improved, and today systems can capture three-dimensional virtual images of teeth and prepared teeth to create precise-fitting dental restorations. As of 2011, ten brands of intraoral scanning devices were available worldwide, but this number is sure to grow.

Logozzo et al. have published an excellent review article that details the specifics of the top ten scanners used worldwide.[1] The basic technology behind digital scanning involves a camera and a light source, but specific features differ with each system. Even within a single system, technological advances have improved quality over time. For example, Cerec® systems used to use an infrared laser light source but newer versions use intense blue light for greater precision. Stabilization features are also present in the newer Cerec® AC Bluecam system.

The system that many implant companies used for their Beta testing is the iTero scanner by Align Technology* (San Jose, CA). It utilizes 36 beams of red laser light passing through focusing optics and a probing face to shine on the teeth. Each beam creates a spot on the teeth, and the intensity of the reflected light is measured. This data is used to generate the three-dimensional shape of the teeth.

With this system, capturing the scan involves a series of specific steps by the operator that are prompted by the computer. (Fig. 1) The facial and lingual surfaces of each tooth are captured by 45-degree angled views (one facial and one lingual view of each tooth). The area of interest, i.e., the scannable abutment in our case, generally involves occlusal, lingual, facial, and interproximal contact views for a total of five views. The bite is then recorded with bite registration views. At each step, the views are prompted by the computer, but as operator experience increases speed the prompts can be overridden. The total scan time is around ten minutes. No application of reflective coating is needed; thus no powder is used to capture the data.

In my opinion, the ability to eliminate the use of reflective powder is a huge advantage when scanning for implant abutments, but it does require a color wheel in

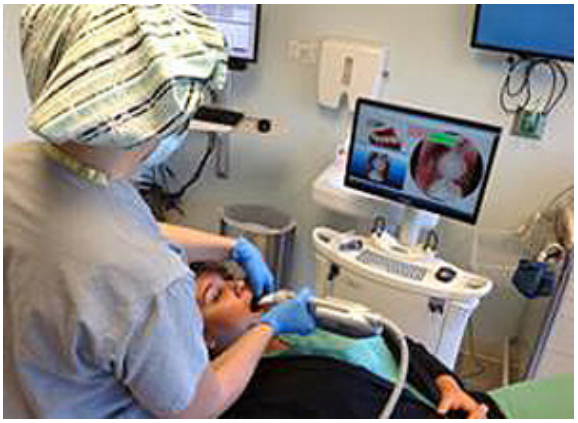

Fig. 1. Intraoral scanning

* Formerly Cadent, inc.

the acquisition unit, which makes the scanner head larger than in other systems. In my experience, this is of little consequence because patients tolerate it very well, and are very thankful to avoid impression material. Additionally, once the patient views the scan, any negative thoughts concerning the process are diminished as the "wow" factor becomes evident. Feedback from patients has been extremely positive, especially from patients that have had implants previously restored with fixture-level impressions.

The Lava™ Chairside Oral Scanner by 3M ESPE is now an option to digitally scan implants. This technology is marketed as "3D-in-Motion technology". The camera is very complex with 22 lenses and 192 blue LED cells. The camera has a rotating aperture so that the single camera functions as if multiple cameras were involved. The data is captured in a video sequence and displayed in real time. The data can also be viewed in 3-D while wearing 3-D glasses. However, the Lava™ requires powder to complete the scan.

Undoubtedly newer scanners with claims of marked improvement in detail and ease of use will become available. As you consider adding this technology to your practice, you will eventually have to decide which scanner is right for you. If you are scanning prepped teeth and packing cord, then real-time fluid scanners may be the best option. If you, as I do, only scan the dentition and scannable abutments, then it is my opinion that the optics in any system will suffice. Therefore, use the system that is the easiest to use and does not have significant per-scan fees. In my opinion, a powder-free system that basically functions as a digital camera is the best option. Of course, you will want to verify that the system you choose will work with your implant system and the labs with which you affiliate.

INTRAORAL DIGITAL SCANNING FOR IMPLANTS

Old Technology in a New Package

Intraoral digital scanning is not a new technology. Many of our referrals have digital scanning systems in their offices for restorative needs. It is the application of this technology to the implant restorative world that is new. Ironically, this is a more straightforward application of the technology than that currently employed by dentists; the digital scans are supragingival and involve non-prepped teeth.

The delay in applying this technology to implants was due to the need for a scannable abutment, ideally a scannable healing abutment that does not require removal until the final abutment is placed. In the case of Biomet 3i, the Bell Tek® system can be used with the iTero scanner, the Lava™ scanner, and recently the Sirona Cerec® scanner. Straumann has introduced a scannable abutment that is specific to the iTero scanner. 5 Axis Dental Design Center, a dental lab in Canada developed a scannable abutment for most systems but that is also specific to the iTero scanner. I have used the iTero scanner to digitally scan Nobel implants using a 5 Axis abutment, but it involves an additional abutment change, a disadvantage that will be discussed later.

In 2012, Glidewell introduced scanning abutments for most implant companies. Initially this was limited to certain scanners, but now the majority of available scanners can be used. Over the next few years, as the technology becomes more widely used, an effort is being made to use any scanner with any scannable abutment. Because this application of the technology is new, I would strongly recommend using FDA-approved systems.

Similar or Improved Accuracy

Intraoral digital scanning is marketed as an easy, user-friendly replacement for conventional impressions. Seelbach et al. demonstrated the accuracy of intraoral scans in restoring fixed restorations and concluded this technique has accuracy similar to conventional impressions.[2] Other studies have demonstrated the accuracy of digital impressions and even suggested superiority of some scanners to impressions.[3-5]

A definite advantage with digital scanning that is not emphasized in the literature is the ease of obtaining full arch scans. While it takes 5 to 10 minutes of additional assistant's time compared to a quadrant scan, it adds no additional costs and provides the lab with a full arch model and more information to establish occlusion in excursive movements. Other studies have demonstrated that digital impressions assure precise restorations,

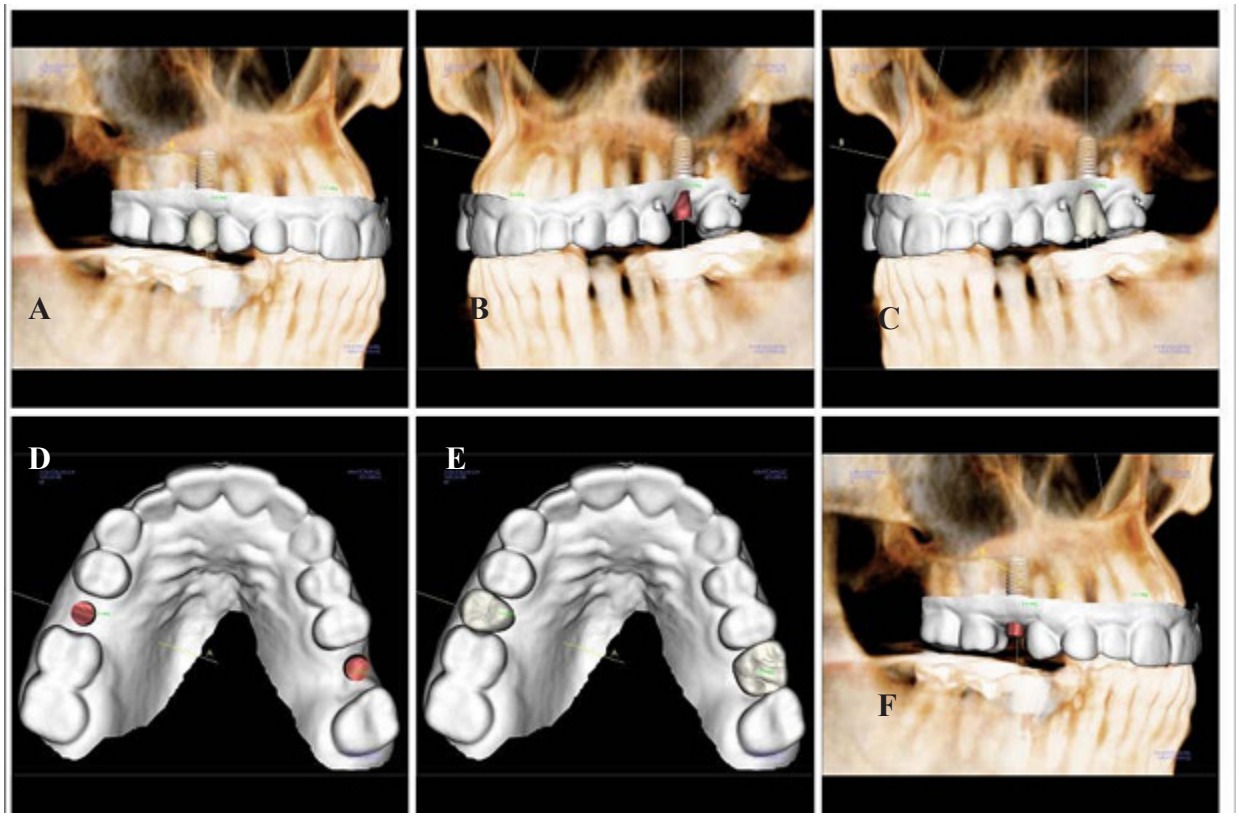

Figure 2. Digital scan morphed to a CBCT image (A. Righ latreral with restoration; B. Left lateral without restoration; C. Left lateral with restoration; F. Right lateral without restoration) to fabricate a CT-based guide (D. Without restoration; E. With restoration) (Anatomage, San Jose, CA).

with a better fit, faster seating, and fewer remakes.[6-7]

In our experience, during the initial implementation of digital scanning, contacts and occlusion needed to be adjusted frequently. The consensus among the restorative doctors was that the lab was placing heavy contacts because they felt the need to accommodate for errors in the process, perhaps based on experience with abraded stone models. As the volume of cases increased and a discussion was had with the various labs, the final restorations are now being seated with fewer adjustments and minimal chair time for the restorative doctor.

Multiple Uses

Intraoral digital scanning can be used anytime taking impressions would be needed. Alcan et al. demonstrated that models made from digital scanning are at least as accurate as alginate impressions and stone models.[8] Intraoral digital scanning is routinely used in conventional prosthetics and with in-office milling of crowns.

An intraoral scan can be taken at the initial implant consultation appointment, and the digital scan can be morphed onto a cone beam CT 3-D reconstruction to visualize soft tissue contours. (Figs. 2A-C) From this, a CT-based guide can be fabricated Figs. 2D,

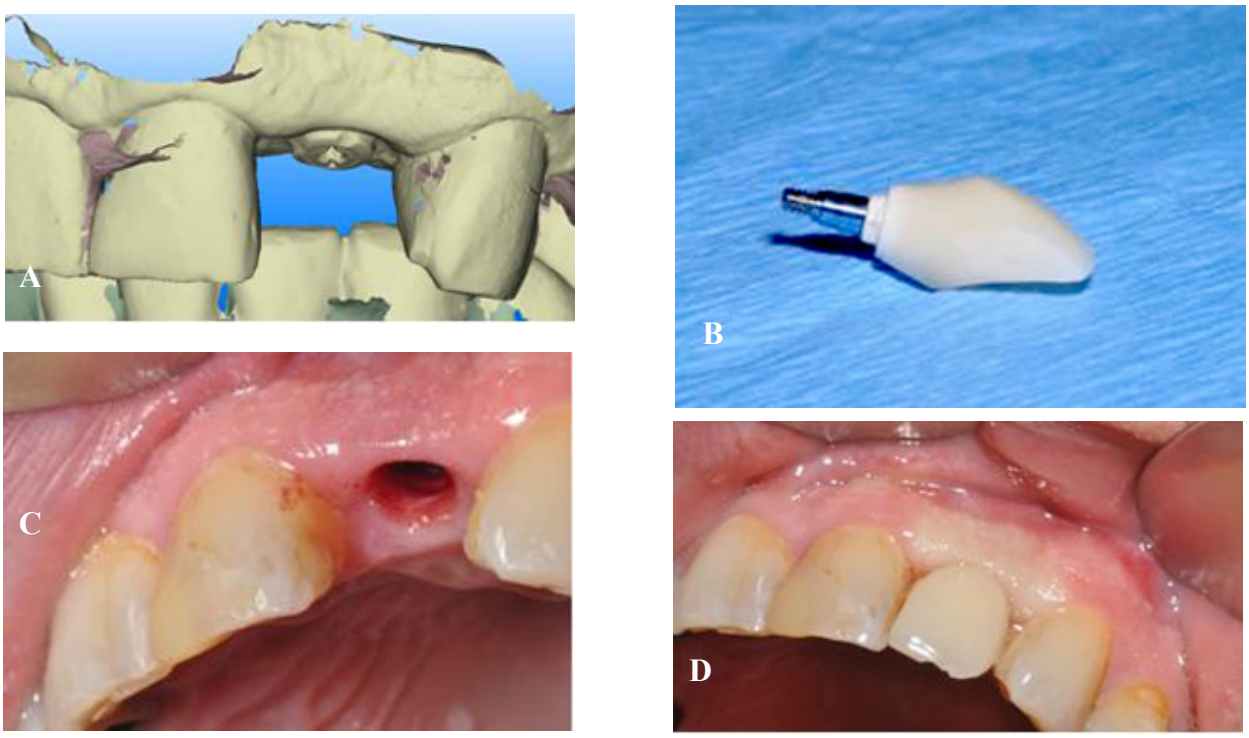

Figure 3. **A.** Healing abutment scanned; **B.** Lab-fabricated provisional; **C.** BellaTek® Encode® removed (appropriate healing abutment selection provides for initial emergence profile); **D.** provisional placed in preparation for soft tissue molding.

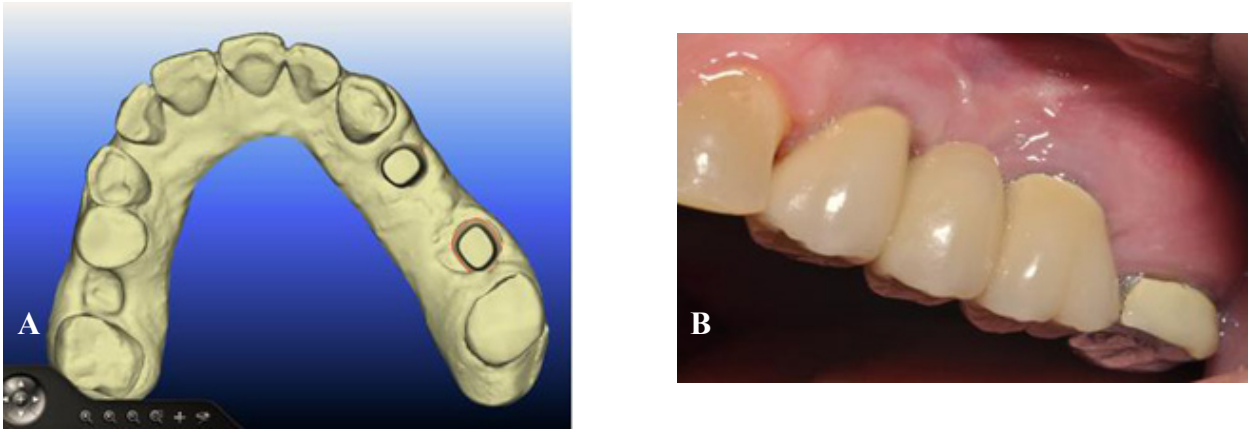

Figure 4 **A.** Digitally scanned 2-implant supported FPD; **B.** Clinical intraoral photograph of the custom abutment design and seated restorations.

E) and, if one chooses, a complete CT-guided surgery, including depth measurements, can be performed. The scan can be used in the production of a milled model for diagnostic purposes. Additionally, a lab-fabricated provisional restoration can be made from the scan. (Fig. 3) Depending on the lab, a model can be fabricated from the digital scan or the provisional restoration can be made virtually and milled. Lastly, intraoral digital scanning can be used in place of fixture level impressions with dental implants. (Fig. 4)

With digital impressions, there is a cost reduction in trays, impression material, stone, doctor/staff time to take impressions, impression copings, staff time to pour up and trim models, and model boxes. As with a stone model, if the patient has issues in the future, a baseline is available from the digital scan and can be reproduced at a later date.

Scanning Implant Abutments

The key to using intraoral digital scanning to restore implants is the scannable abutment. Several companies (e.g., Biomet 3i, Palm Beach Gardens, FL; and Straumann, Basel, Switzerland) have scannable abutments as part of their implant product line. Third market companies also make scannable abutments for any mainstream implant; thus, essentially all implants can be scanned. Many of these are autoclavable scan bodies. In some cases, the lab may provide the scan body.

An important point about intraoral scanning of implant abutments is that scanning of implant abutments is all supragingival, therefore tissue retraction and bleeding are not factors in scanning implant abutments. This in turn makes it very simple and reliable, with a rapid learning curve to master the technique. It only takes 5 to10 scans for an assistant to become competent in scanning. Scan times vary, but the majority of scans, including scanning the abutment, take place in 10 to 15 minutes.

In my experience the technique sensitive areas to scan are the interproximal areas

of adjacent teeth. Clearly these are critical areas because the future contacts are dictated by these scanned areas. In the contact areas adjacent to the implant abutment, our protocol has the assistant taking additional scans as part of the initial scanning and prior to viewing the stitched computer model. This increases accuracy and limits the needed for additional scanning to fill in any voids. Lastly, it is very easy for the doctor to review the scan and add further additional scans if indicated. In our experience, this has happened less and less frequently.

WHY SHOULD AN OMS IMPLEMENT INTRAORAL DIGITAL SCANNING?

While various answers to this question are possible, the goal is to provide the best clinical care based on sound scientific principles, at a reasonable fee, and in a timely fashion, always striving to improve both the process with implant treatment and the success of the implants. In providing customer service to both the patient and the referrer, the surgeon should eliminate difficulties in the process that might prevent an implant referral. In applying a business model to an oral and maxillofacial surgery practice, one must extrapolate the benefits of providing this service to our patients. It is difficult to argue that it can be a wonderful service to a referral base. For dentists that are intimidated by the process of impressing and restoring implants, the entire algorithm is simplified. For our patients, we offer a methodology that provides increased accuracy without impressions ("no goop in the mouth") and, the majority of the time, with one fewer appointment.

From the surgeon's perspective, communication between the surgical office and the restorative office is greatly simplified. The restorative doctor will not have to order any parts, thus implant size for records' sake is the only pertinent information. Prior to scanning implants, much staff time was spent coordinating care among the offices and insuring all parts were ordered and present in the respective offices. Digital scanning utilizes technology to make things simpler and more streamlined.

The cost is certainly a consideration for an individual dentist in implementing the technology into a practice. Not only are the scanners relatively expensive ($12,000 to $30,000), but a yearly maintenance fee or scanning agreement can also be costly ($4,000/year). Expendable items such as scanner sleeves or, with some systems, powder costs should also be factored into the overall cost of the technology. (Table 1) Over the first five-year period, costs may range from $8,000 to $12,000 per year to utilize the technology. Clearly this can be cost prohibi-

TABLE 1: COST ANALYSIS OF IO DIGITAL SCANNING TO RESTORE IMPLANTS		
Slightly more expensive lab fee than fixture-level impressions	Costs offset by not having impressions, copings, trays, impression materials, staff time, shipping costs, and chair time.	Lower costs than conventional impressions of Bell Tek® Encode® impression system.

tive to an individual restorative doctor and even for most group practices. The savings in chair time and materials would only benefit the restorative doctor after a minimum of 50 implants. For most general dental offices, having an intraoral scanner in the office solely for scanning implants is not feasible.

By creating a digital implant center, an oral and maxillofacial surgeon absorbs the aforementioned costs. The advantages to the restorative doctor of decreased chair time, ease of restoring the implant, and the "wow" factor for the patient are all experienced. The restorative dentist now treats the implant patient as a true "crown and bridge" patient. The dentist receives the custom abutment and final crown and the seating appointment becomes simply torquing the abutment in place and cementing the final prosthesis. The restorative doctor needs only the torque wrench: no parts to buy, no impression copings, no trays to fabricate, no expensive impression materials, etc. This is a huge benefit for dental offices that restore a relatively small number of implants because the entire process is streamlined and straightforward; dental offices are very good at crown and bridge. It is also a huge advantage for the restorative practice that restores a large number of implants because impression appointments are no longer needed.

The scientific basis for an oral and maxillofacial surgeon to decide to undertake intraoral digital scanning of implants revolves around the scannable abutment. With any abutment, a surgeon wants to support and protect the supporting hard and soft tissues and to decrease the risk of any deleterious effects. Implant surgeons have a protocol for placing abutments at the time of implant placement based on initial stability. With high initial stability of implants the healing abutment can often be placed at the time of initial surgery.

With fixture-level impressions the healing abutment would be removed, hemostatic measures could be taken, a fixture-level impression would be taken, and then the healing abutment would be replaced. When a scannable healing abutment is used the abutment is only removed by the restorative doctor at the final restoration appointment. The literature supports the notion that the more times an abutment is removed, the more likely it is to see horizontal bone remodeling.[9] Non-removal of this abutment until final custom abutment placement results in statistically significant reduction of crestal bone resorption.[10]

When following the protocol of non-removal of the abutment, the implant surgeon needs to be attentive to which abutment is placed at time of surgery because the creation of the emergence profile from the implant begins at implant surgery. A wide-flare healing abutment is the preferred choice because this better matches the final custom abutment. If the restorative doctor must significantly contour the soft tissue at final abutment placement, then the advantages of digital scanning are muted, and soft tissues might be negatively affected. When a properly flared scannable healing abutment is placed at surgery the removal of the healing abutment and placement of the final abutment requires minimal or no treatment of the soft tissue.

Digital scanning to restore implants has many advantages. Digital scanning has increased accuracy that translates to decreased chair time for seating the restoration by the restorative doctor. The patient generally has a shorter appointment time and reports increased satisfaction both by avoiding impressions but also due to the "wow" factor. Additionally, digital scanning is easily reviewed and scans can be quickly added, allowing competent staff members to become the primary scanners.

Digital impression taking has a major advantage in multiple-unit cases. The time needed to scan one healing abutment or multiple implants is nearly the same. This is in sharp contrast to fixture-level impressions, in which each implant needs an impression coping placed, the tray often needs to be customized, and the process is much more technique-sensitive. Moreover, digital impression-taking alleviates the difficult task of placing impression copings in difficult areas such as the posterior regions. Lastly, by reducing chair time and eliminating the costs of impression and model materials, fees associated with implants are decreased and the savings can be passed on to patients, making the costs of a single implant similar to that for a three-unit bridge.

IMPLEMENTATION OF INTRAORAL DIGITAL SCANNING IN A SURGICAL PRACTICE

Three key factors must be in place to implement digital scanning of implants in your office. First, the general dental referral base must be on board, be involved, and view digital scanning as advantageous. Because the impression is key to having appropriate contacts and occlusion, the dentist's control is relinquished by having the oral and maxillofacial surgeon provide the digital impression. The restorative doctor must fundamentally accept that digital impressions have increased accuracy. The net outcome will be a streamlined "KISS" approach to implant dentistry.

But we dentists love the tried and true approach, and change is often considered a nemesis. Some dentists will embrace the idea of simplifying a process while others will be hold-outs. The best approach would be to demonstrate that the new technology is a viable option, and not force anyone to adapt.

Some surgeons approach the scanning of implants as a solution for dentists who don't feel comfortable with the implant process. In essence, the surgeon takes the impression and the dentist, except for torquing the custom abutment in place, simply performs crown and bridge dentistry. Dentists are comfortable with crown and bridge dentistry, and digital intraoral scanning by the surgeon make implants part of their comfort zone.

This approach has merits, but I would warn that implant restorative treatment is not really crown and bridge. Without a periodontal ligament, improper occlusal adjustment and overloading the occlusion can lead to late failure of the implant. No doubt every implant surgeon has had failures due to restorative problems, and simplifying the process is not the answer to poor quality restorative dentistry.

You will need to change your referral forms to indicate the digital options you offer. The dentist will now send you the prescription for the lab to fabricate the abutment and crown; many referrals will also fax or email the form directly to their lab of preference. The referring office often has a staff member with the title of implant coordinator. This person is in charge of ordering parts and materials for impressions and needs to know all the specifics of the implants we place. In my practice, my referral offices have been able to lessen the implant coordinator's role because there are no parts to order; the only issue is really coordination between the two offices to ensure that the patient is scheduled for the crown as soon as he or she is released from surgery.

This is an important point. If the surgical office is doing the digital impression, the surgical office must make sure the patient has an appointment with the referring office for restoration delivery. The very last thing you want is to have a crown made and delivered to a busy dental office that cannot schedule the patient for several weeks. When the digital scan is done, the patient wants and expects the crown within a few weeks, something they have come to expect with conventional crowns.

Next, you need to have proper lab support in place prior to scanning your first implant. Implant companies with scannable abutments will have preferred labs that you can choose to use. These labs have demonstrated a level of competency with this technology and can often be considered "tried and true".

The other option is for local lab support. For example, with Biomet 3i an implant can be digitally scanned in my office, a custom abutment fabricated by Biomet 3i, and an abutment, die, and mounted cast can be sent to any lab anywhere for fabrication of the crown. In essence, the lab receives a trimmed die with perfect margins and a mounted cast for contacts and occlusion. This allows the dentist to continue a relationship with a lab with whom he or she feels confident. Moreover, (and many of us deal with this issue) the "keep it local" campaign can derail the best policy often without benefiting anyone. It is important for a surgical office not to alienate local labs that have long standing relationships with the dental offices.

The restorative doctor may be more specific with anterior cases. In our experience, patients will still go through a custom shade-match process by a local lab, and the porcelain will be stacked locally. This is an easier process for the lab because they have no models to pour, no dies to trim, and essentially have a perfect margin to stack to.

The fees associated with fabricating the final crown should be similar to those for a conventional crown plus the fee for the custom abutment. This is a very important point and cannot be overemphasized. There is no justification for labs to increase charges for crowns fabricated with digital technology. In reality, fewer materials and less time should lead to decreased costs for the implant crowns. It is imperative that the oral and maxillofacial surgeon inform the dentists about lab costs associated with the digital scanning process.

TABLE 2: PATIENT FLOW IN A DIGITAL IMPLANT CENTER	
CBCT	
Digital Software for Implant Planning	Top-down treatment planning with digital wax-up
Order CT-based Surgical Guide, if indicated	
Surgical Placement of Implant	Placement of scannable abutment if torque > 35NCM (Unless provisional is placed)
Appropriate Integration Time	
Stability Check/Digital Scan of Implant	
Bite Wing Confirms Implant Abutment is Seated	Restorative doctor should verify
Restorative Office Seats Restoration	

The last item needed to implement digital scanning of implants is a competent staff in the surgical office. If you have a busy implant practice, digital scanning will be occurring throughout the course of the day. Two to three staff members will need to be competent in scanning the patient, organizing the prescriptions, and sending the digital files to the respective labs. The surgical staff will also be involved in coordinating care with the dental offices. In my opinion, this is very much simplified with digital scanning technology because the restorative office does not need to order any parts and the inter-office coordination is basically verifying that the patient has a delivery appointment at the restorative doctors office.

PATIENT FLOW IN A DIGITAL IMPLANT PRACTICE: EXPERIENCE AT ROGUE VALLEY OMS (TABLE 2)

At the consultation appointment, patients have a CBCT (ICatR) taken and 3-D implant planning is performed (Anatomage, San Jose, CA). A necessity of a restorative-driven implant practice is that a 3-D wax-up be performed to verify the position of the final restoration and confirm that the implant is appropriately positioned in the bone. Many different software programs enable a surgeon to do this. In my office I use Anatomage imaging software due to the ease of obtaining a CT-based guide.

At this time, the decision is made whether or not a CT-based surgical guide will be ordered. If the answer is yes, then the patient has a full arch digital scan performed by an assistant using the ITero system. This scan is sent along with the CBCT scan to Anatomage and the two are morphed together because the soft tissue and hard tissue are both involved in the treatment planning. The future restorative position is verified, the implant position relative to the restorative position is verified, and the surgical guide is ordered. Additionally, if a lab fabricated provisional is to be made, the digital scan can be sent to a lab where a model will be milled and a provisional made that will be re-lined at implant placement. (Fig. 5, on next page) The

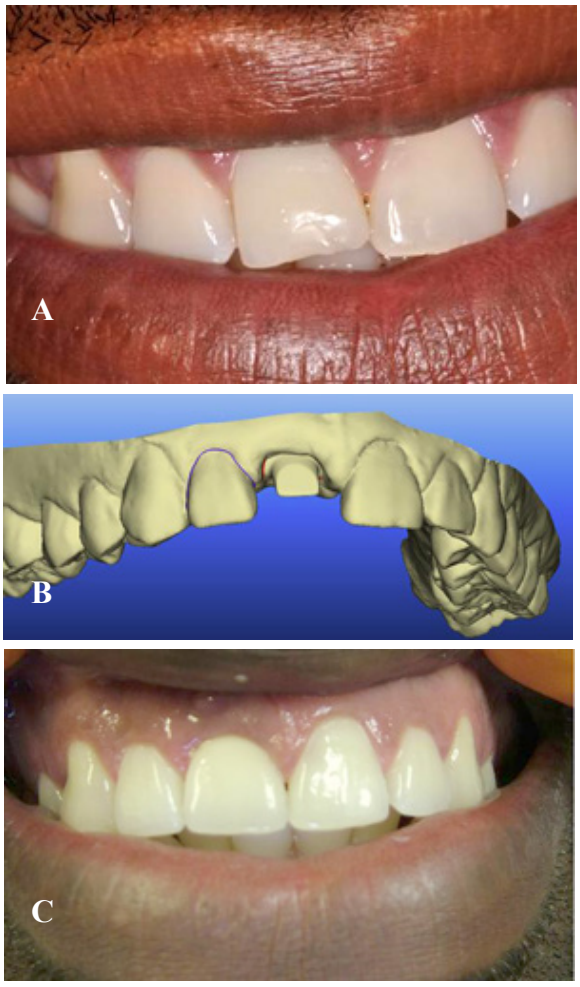

Figure 5. **A.** Provisional in place, fabricated from a digital scan of the healing abutment performed at the initial surgery; **B.** Provisional removed, scannable abutment placed and scanned, custom abutment designed; **C.** Final crown #8 seated.

digital scan can also be used as a baseline for other procedures, and a model can be milled at a later date if needed.

The next option for a digital scan is at the implant surgery. For anterior cases, the goal is to have a provisional prosthesis in the office at the time of implant placement for immediate provisionalization. Unfortunately this is not always possible, and a fixture-level impression is then needed. While a chairside provisional is an option, I often choose to place the implant and the scannable healing abutment and then perform a digital scan. From this, a provisional is ordered and can be placed at the uncovering appointment or at the integration check.

In the posterior region, a surgeon may decide to scan the abutment at the time of surgical placement. When this is done, the custom abutment and crown are available on the day of integration check. This will allow the patient to have the crown 2 to 3 weeks sooner. Of course, if the implant fails the integration check the costs associated with fabricating the abutment and crown are lost.

For the majority of the patients I treat, the digital scan is performed at the stability check appointment. The surgeon does the stability check and an assistant performs the scan. The surgeon reviews the scan prior to discharge and takes any indicated additional views. In my office, I coordinate scheduling with the restorative office so that the patient has an appointment there immediately after the scan.

For Biomet 3i implants, a radiograph is needed to verify that the abutment is seated prior to fabrication of the crown. I have the restorative office take this film; the restorative doctor verifies that the healing abutment is seated. At that time, the dentist will also verify shade selection and complete the final lab prescription.

Much consideration has been given to this step in the digital scanning process. The feedback I have received has been very positive. The restorative doctor wants to see the patient for this appointment for a multitude

of reasons. First, they may have not had any contact with the patient for several months. With my office doing digital impressions, and the ease in which the implant is restored, it gives an impression that the "dentist isn't doing much". This appointment prior to seating the final restoration also allows the restorative office face time with the patient, and opportunity to evaluate the soft tissue and implant position and gives a last chance for verification of the lab prescription.

The actual chair time with the dentist is minimal and often the patients are worked into the schedule as soon as they arrive at the office. The patient is seen just before or immediately after the digital scan in my office, thus the patient is not inconvenienced with an appointment on a different day. The restorative office will also confirm the seating appointment for the implant crown. After the digital scan is completed in my office, my staff will digitally attach the laboratory prescription, choose the lab that will fabricate the final prosthesis, and hit the send button.

CONCLUSION

Intraoral digital scanning and the use of scannable implant abutments are supported in the literature as a viable option for restoring dental implants. The technique lends itself to fewer appointments, decreased materials, shorter chair time, and a more pleasurable experience for patients, compared to conventional fixture-level impressions. While the costs associated with the process may prohibit individual restorative doctors from utilizing the technology, implant dental centers, such as oral and maxillofacial surgery offices, are in a position to absorb the costs in order to improve the process.

Dr. Michael J. Doherty received his D.D.S from the University of North Carolina and his oral and maxillofacial surgery training at the National Capital Consortium (Walter Reed National Medical Center/Bethesda Naval Hospital). He then served as the oral and maxillofacial surgeon for the Naval Health Clinic, Hawaii, and was an attending at the Tripler Army Hospital oral and maxillofacial surgery program. He currently maintains a private practice in Medford, Oregon. Dr. Doherty feels fortunate to have provided care for many seriously injured service members in support of overseas military campaigns. He constantly applies techniques gained from treating such complex cases into his implant practice. He has authored chapters regarding wartime trauma as well as lectured at AAOMS on the subject. He has been involved with the practical application of digital implant dentistry in the private practice setting and Rogue Valley OMS has been a test site for multiple new technologies. He has lectured at AAOMS and numerous local society meetings regarding intraoral digital scanning for implant reconstruction.

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