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I Have a CBCT Scan — *Now What Do I Do?*

Restoring the Edentulous Maxilla with Dental Implants

by Timothy F. Kosinski, DDS, MAGD

The use of dental implants has become an important method for restoring missing teeth with function and esthetics. Our patients are requesting — some even demanding — this type of treatment. Modern materials and methods have made implant dentistry predictable with long-term positive prognoses.

Proper placement of dental implants involves a comprehensive understanding of both the surgical and prosthetic applications. Today, implant dentistry is prosthetically driven. There must be a clear visualization of the completed restorative case prior to any surgical intervention. This necessitates careful discussion of the patient's desires and expectations. Anatomic considerations must be understood, including the position of the nerves, sinuses and bone undercuts. The thickness and angulation of bone must be studied, and the integrity of the buccal and lingual plates clearly determined. As teeth are lost, bone in the maxilla tends to shrink apically and palatally. This may compromise lip support and phonetics. When placing dental implants, the final functional and esthetic result must be considered. Placing implants too far palatally may result in speech problems and a facial cantilever of the final implant-retained denture, which may result in rocking of the prosthesis or breakdown of the bone around the dental implants — and eventual failure.

Prior to surgical placement of any dental implant, limitations need to be recognized by the dentist, who may be uncomfortable with certain procedures or lack confidence in attaining the appropriate final result. These dentists should

embrace the referral process. Complications may arise in any surgical protocol, so there also needs to be an understanding of potential postoperative complications such as dehiscence or fenestration. Minimizing surgical damage with flapless designs is tissue-friendly; however, flap designs still need to be available for backup should complications arise.[1]

Flapless surgical placement of dental implants has become more popular with the increasing use of digital radiography, which allows us to visualize the underlying anatomy effectively. Regular intraoral and radiographic evaluations are a necessary part of the total implant experience. Maintenance is critical to the long-term positive prognosis of any dental restoration. The prosthesis must be designed in such a way that the patient can maintain it not only today but also into the future.

Modern technology makes it possible to predictably place dental implants using flapless procedures in ideal position, angulation and depth, considering all emergence profile and smile design expectations. This technique proves to be a cost-effective solution to assist the implant dentist in planning an esthetic final result and minimizing surgical challenges. Benefits include patients being positively influenced by the concept of virtual placement because clinicians can discuss the safety and ease of implant surgery for a procedure that the patient may psychologically feel is extremely invasive. Healing time is also reduced, with less postoperative trauma and discomfort.

Success with dental implants is based on achieving primary stability and secondary integration of the titanium fixtures, while also maintaining hard and soft tissue contours for long-term function and esthetics. Any anatomic irregularities or limitations need to be addressed prior to implant placement.[2] Doing the case properly from the start saves the practitioner considerable time and effort. "Measure twice, cut once" is a readily accepted statement in dentistry today.

Becoming educated in any dental technique is essential to achieving positive results. Certainly our dental training allows the dentist to perform implant surgical procedures, yet success with these procedures is largely dependent on the individual practitioner's level of competence and confidence. There are several reasons why dentists are not currently placing dental implants in their practices. Namely, there is a fear that complications may occur, vital anatomy may be damaged, or a procedure may be required that they may not be comfortable performing. There needs to be a clear understanding of the benefits, risks and techniques associated with implant dentistry. Confidence with surgical and prosthetic implant procedures are the result of education and repetition. It must be understood that, in some situations, bone grafting procedures may be needed prior to implant placement. The two-dimensional images provided by bitewings, periapicals, panoramic X-rays or even traditional CT (computed tomography) scans may not be sufficient in diagnosing complicated or challenging situations.

Cone beam computed tomography (CBCT) diagnosis and preparation of any case can help the practitioner guarantee success by alleviating most common fears prior to any surgical intervention. CBCT scanning is a remarkable tool in the diagnosing of implant position and placement. Scanning software allows for the fabrication of precise planning and surgical guides, which help to ensure a positive result. Communication with the patient concerning this innovative therapy reduces anxiety of an unknown procedure and increases treatment acceptance. Reconstruction is made simpler because implants are ideally placed. The latest computer software allows us to simulate the placement of implants accurately without ever touching the patient. CBCT imaging systems provide the dentist with complete information on vital anatomy in the areas to be considered for dental implants by producing a three-dimensional view of all of the oral structures.[3] This allows us to create an accurate treatment plan and increases our chances for a predictable surgical and prosthetic result. The high-resolution volumetric images give us, for the first time, three-dimensional views of bone and tooth structure and orientation.[4] Implant type, size, shape and position are determined prior to any surgical intervention. Any bone irregularities or deformities are determined without elongation or magnification of conventional radiographs. CBCT systems allow us to become better diagnosticians and surgeons because they generate volume images from digitized information, resulting in axial, panoramic and cross-sectional relationships. As there is no distortion of the images, accurate measurements can be made directly from the CBCT information.[3]

Prior to the CBCT scan, a radiographic guide is fabricated from a duplication of the patient's properly fitting and contoured maxillary complete denture. It is wise to get patient acceptance of the prosthesis prior to CBCT scanning, so that information is built from a positive starting point. The final look of the case will be determined before starting implant placement, and the patient's existing prosthesis aids in the visualization of the optimal prosthetic design. The radiographic guide is placed in the mouth during the CBCT scan.[1,5] This allows visualization of the ideal position of the teeth on a 3-D model. The entire three-dimensional image is analyzed and the implant planning and simulation of implant placement completed by computer. The surgical placement of dental implants can be performed in a conventional manner using the newly created surgical guide to help direct the implants into the ideal position. Optimally, the surgery can be completed without making an incisional flap. The implants are placed to the desired depth using the computer software and surgical guide. This software serves

as an ideal aid in evaluating potential implant receptor sites. Using the CBCT scan and interactive NobelGuide™ planning software (Nobel Biocare; Yorba Linda, Calif.) allows for the case to be restoratively driven and makes surgical placement predictable and simple. The virtual three-dimensional model created using the software creates an environment where not only quantity of bone is determined, but also the quality of the bone to be invaded. Buccal and cortical thickness surrounding the trabecular bone is evaluated so that all the implants are properly positioned.[2,6,7] The tool allows us to also determine the position and angulation of the abutments to be used so that the final prosthesis is functioning along the long axis of the dental implants.

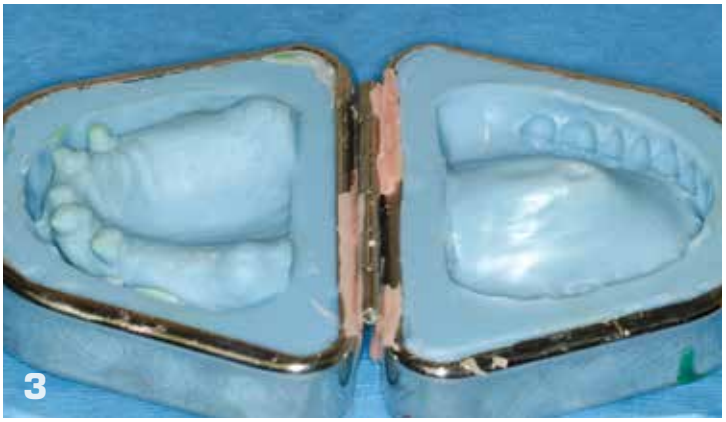
CBCT diagnosis and computer scanning are often done with the assistance of well-trained professionals in our dental laboratories. The final approval of all diagnosing is the responsibility of the treating dentist, but computer experts help us with the idiosyncrasies of the process. Not every dental laboratory can provide dental implant prosthetics, and some laboratories are better prepared and educated to provide highly technological products. Visualizing the finished case prior to any surgical intervention ensures a better result. How long an implant lasts depends on many factors, including biomechanical stresses, patient maintenance and the general health of the patient. Oftentimes, the integrated dental implant remains intact, but the prosthesis needs to be reconstructed after years of use. With modern implant designs, immediate loading has become popular. Of course, the quality and quantity of available bone and initial stability need to be considered. Occlusal forces must be minimized during the initial bone healing phase.

The procedure for placing dental implants today is fairly straightforward and not overly traumatic to the patient in most circumstances. It is generally painless and quick. Following local infiltration of the surgical site, preparation for the dental implant placement begins. First, a small drill is used to create angulation and final depth, and then larger-diameter drills are used to create the osteotomy.

STEP-BY-STEP: Computer-Aided Restoration of the Edentulous Maxilla with an Implant-Retained Overdenture

The patient in this case is a 63-year-old white male with no significant medical findings. He takes no medications and appears to have no medical contraindications or limitations for dental implant therapy. He has been edentulous in the maxilla for more than 15 years. Although his conventional maxillary complete denture has served him well, he desires increased function and chewing ability. Over time, the denture also required relining as bone loss occurred. The increased thickness resulted in a more prevalent gagging reflex.

Figures 1, 2: *Evaluation of the edentulous maxilla intraorally and radiographically appears to demonstrate adequate bone width and height for eventual dental implant placement and fabrication of a palateless maxillary overdenture. The patient desires a stable, palateless prosthesis, which will reduce the gagging reflex and improve taste sensation.*



Figures 3, 4: *The patient's properly fitting and esthetic conventional maxillary complete denture is duplicated to create a stable radiographic guide. Six to eight radiopaque gutta-percha markers are positioned in three distinct planes. These gutta-percha markers are important in determining precise virtual placement of the chosen dental implants using your CBCT scanning software of choice.*

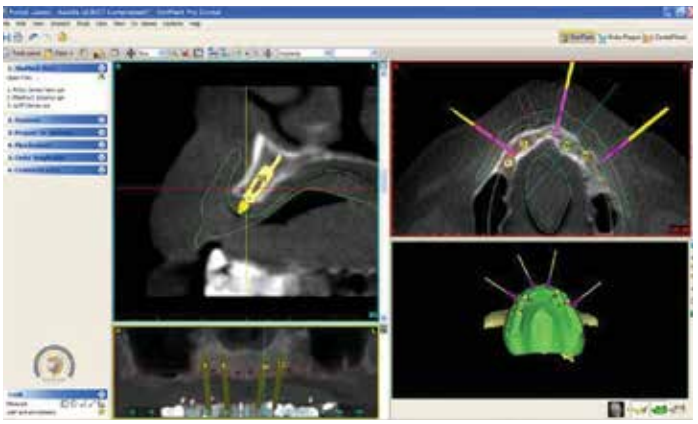


Figure 5: *The CBCT scan allows for virtual placement of the dental implants in ideal bone angulation and depth for proper parallelism. The implant width and length are predetermined prior to any surgical intervention. The dental laboratory can help with the virtual placement, but the practicing dentist gives final approval of the positioning.*

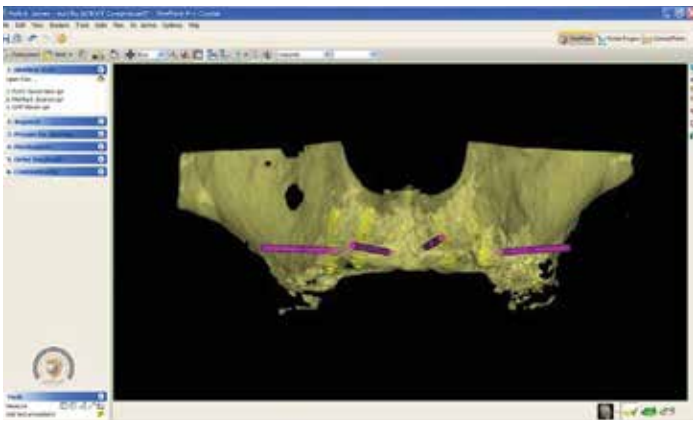


Figure 6: *The CBCT scan allows for visualization of the actual bone morphology.*

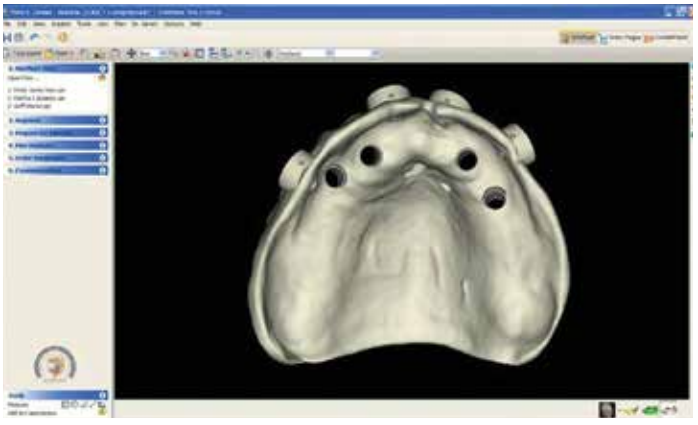


Figure 7: *With computer-aided design (CAD), a surgical guide is fabricated to replicate how the implant was virtually placed prior to the actual surgical intervention.*

Figure 8: *A precise acrylic surgical guide with occlusal sleeve openings will direct the subsequent drill preparation and dental implant placement.*

Figures 9, 10: *The surgical guide needs to seat completely and should be anchored to prevent movement during osteotomy preparation. This is done with the use of stabilizing facial pins that engage the labial aspect of bone approximately 3–5 mm.*

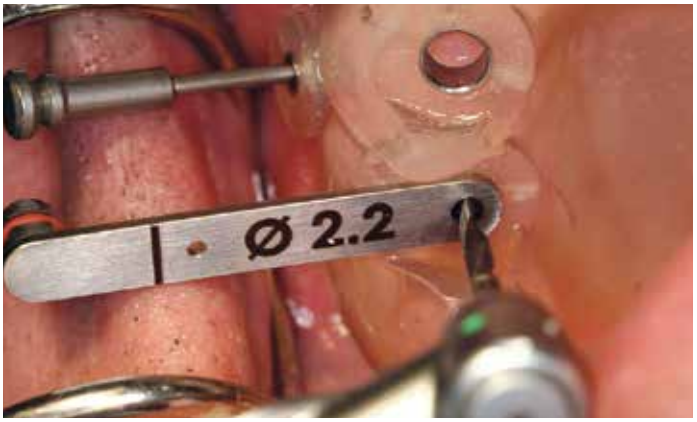


Figure 11: *The depth of the 2.2 mm diameter pilot drill is precisely determined using a 2.2 mm diameter drill key, which allows accurate angulation and depth of this important primary drill.*

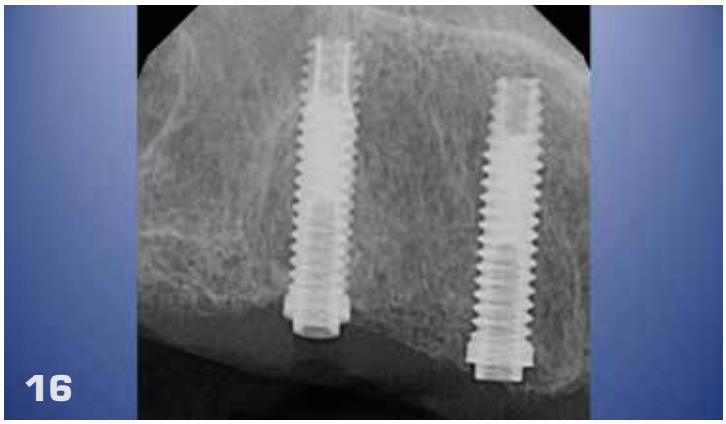
Figure 12: *A 2.8 mm diameter drill key helps guide the subsequent 2.8 mm diameter drill.*

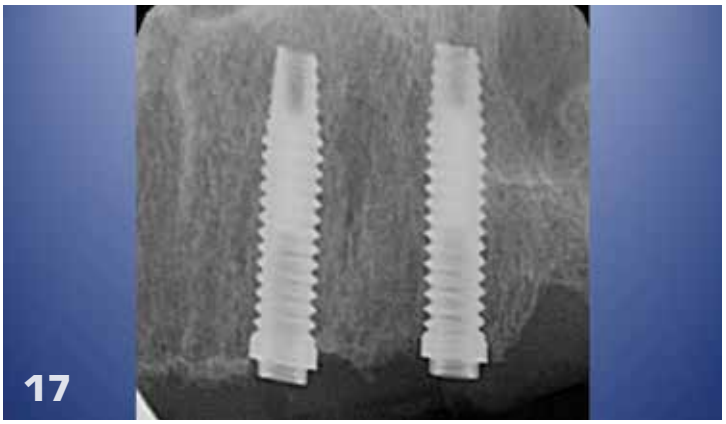
Figure 13: *A tissue punch drill is used to remove soft tissue from the surgical site, preventing possible contamination of the osteotomy. This drill does not require a drill key, as the opening in the surgical guide is the same diameter of the final predetermined implant body.*

Figure 14: *The desired implant is ratcheted to the predetermined depth using the stable surgical guide.*

Figure 15: *All four dental implants are precisely placed based on the computer-aided virtual design.*

Modern technology makes it possible to predictably place dental implants using flapless procedures in ideal position, angulation and depth, considering all emergence profile and smile design expectations.





Figures 16, 17: *Evaluation of the maxillary right and left periapical radiographs demonstrates ideal positioning of the four parallel dental implants.*

Figure 18: *The surgical guide is removed after extracting the stabilizing pins. Note there is little or no bleeding following implant placement and labial pin placement.*

Figure 19: *A conventional panoramic radiograph illustrates proper positioning of the dental implants.*

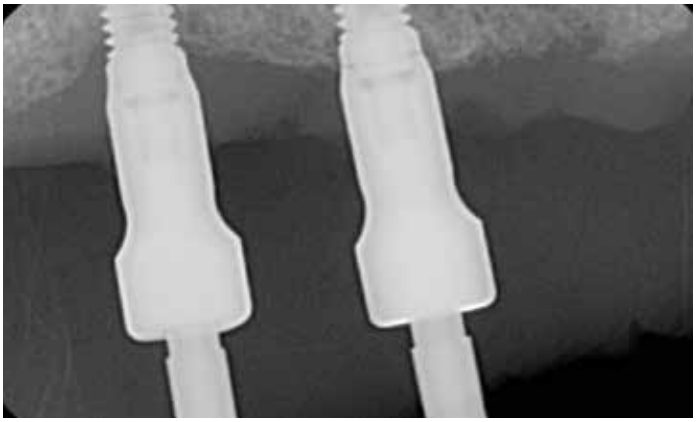


Figure 20: *Following proper integration of the dental implants after approximately four months, a conventional polyvinyl siloxane (PVS) impression is made using impression copings. Radiographs are used to verify complete seating to the top of the implants.*

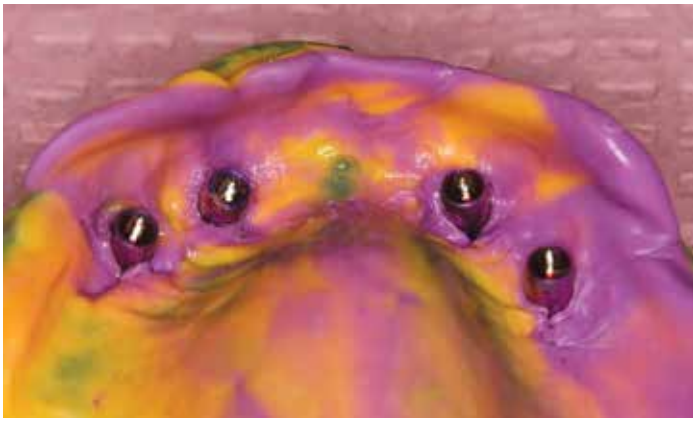
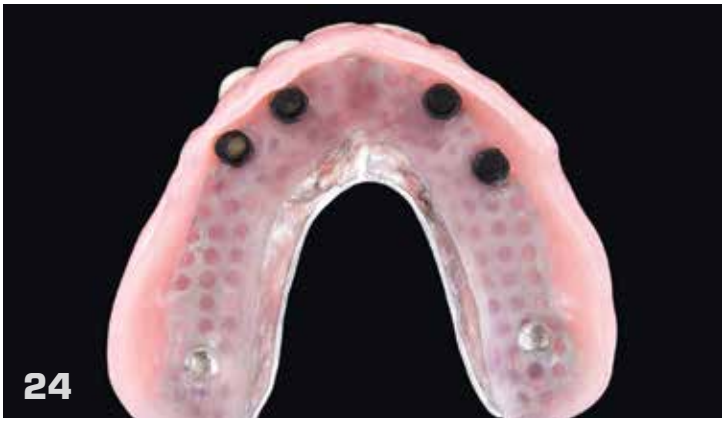


Figure 21: *An accurate impression made using the indirect technique exhibits no voids or distortions. Quality impressions provide for an accurate master cast.*

Figures 22, 23: *The dental lab (Glidewell Laboratories; Irvine, Calif.) fabricates stable record bases and occlusal rims. Conventional denture techniques are used to create an esthetic denture.*

CBCT diagnosis and preparation of any case can help the practitioner guarantee success by alleviating most common fears prior to any surgical intervention….Scanning software allows for the fabrication of precise planning and surgical guides, which help to ensure a positive result.



Figures 24, 25: *The metal framework provides reinforcement and resistance to fracture for the horseshoe-shaped implant-retained overdenture. Locator® attachments (Zest Anchors; Escondido, Calif.) are used to provide retention of the overdenture.*

Figure 26: *Locator attachments of the appropriate height are placed into the master cast. Height is determined by the interocclusal space and soft tissue thickness.*

Figure 27: *The Locator attachments are torqued to approximately 20 Ncm to ensure adequate tightness and resistance to unthreading.*

Figure 28: *The retentive male Locator attachments shown here in the palateless implant-retained maxillary complete denture are available in different colors indicating different levels of retention. They are easily changed as needed over time.*

Becoming educated in any dental technique is essential to achieving positive results…yet success with these procedures is largely dependent on the individual practitioner's level of competence and confidence.

Figures 29, 30: *The palateless implant-retained maxillary complete denture is stable and functional. The patient is pleased with the natural-looking final prosthesis. Quality of life is improved with increased masticatory ability.*

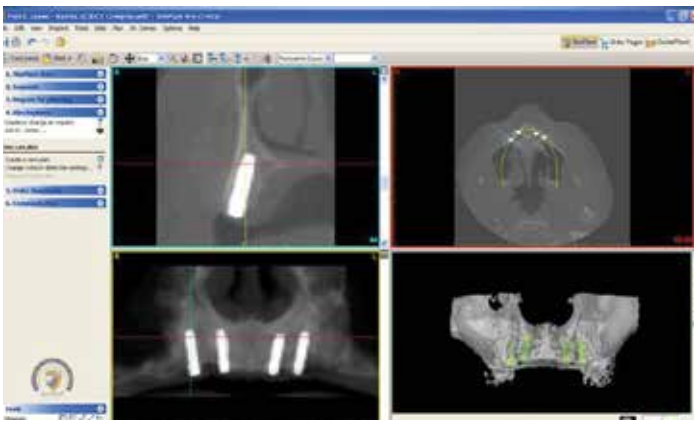


Figure 31: *The postoperative CBCT scan demonstrates that the dental implants are indeed in ideal position and mimic the virtual placement of the implants done prior to any surgical intervention.*

How long an implant lasts depends on many factors including biomechanical stresses, patient maintenance and the general health of the patient.

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