



## Utilizing CT Scanning Technology in the Placement of Dental Implants

by Timothy Kosinski, DDS, & Raymond Skowronski, DDS

CT scanning software is becoming a viable tool in the diagnosing of dental implant position and placement. Minimally invasive procedures might be requested by patients to reduce their anxiety and increase treatment acceptance rates. In areas where contours and width and height of bone are difficult to determine with conventional radiographic techniques, the CT scanning software allows diagnostic determination if bone quantity and quality exists and can be used to virtually place dental implants using the computer program prior to any surgical intervention. This is an outstanding tool in discussing the risks involved in surgical implant procedures and can help visualize the case finished before ever starting. Used in critical anatomic situations and for placing the implant in an ideal position in bone, CT scanning software eliminates possible manual placement errors and matches planning to prosthetic requirements. This innovative tool makes surgical placement of implants less invasive and more predictable. Prosthetic reconstruction is thus made simpler since the implants are appropriately positioned to allow for fabrication of the final prosthesis.

Dental implants have undergone many positive advances over the years. Successes have dramatically increased to the point where implant dentistry is certainly mainstream and a viable alternative to conventional dental techniques. The procedures have often become routine. When a patient is missing one or more teeth, single implants are both predictable and aesthetic.

There are three major reasons why dentists do not currently place implants in their practices. These reasons are fear, knowledge and confidence. There is a fear that complications can arise, vital anatomy damaged, or simply fear of a procedure they might

not be familiar with. The lack of knowledge as to the benefits, risks and technique associated with implant dentistry also prevents dentists from getting involved. Of course we must understand the intricacies of any new procedure, clearly understand the limitations and our responsibilities, know vital anatomy well and be prepared for unfavorable results. Fear and lack of knowledge leads to a lack of confidence. Confidence is achieved with a better understanding of the procedure and completing more cases. Diagnosis and preparation of any case is the most critical aspect of achieving success. Visualizing the case finished before ever starting and utilizing the modern tools that are available to us today will alleviate fear of the unknown, improve our knowledge about the techniques and improve confidence. Failure of any dental procedure including implant therapy is the result of 1. Lack of preparation 2. Lack of communication 3. Poor or inadequate execution or 4. Inappropriate motives. However, we now have technology that will help in planning and provide a technique that can insure a proper result.

CT scanning software is an incredible tool in the diagnosing of implant position and placement. Minimally invasive procedures might be requested by patients to reduce their anxiety and the pain experienced and thus increases the treatment acceptance rate. With the flapless procedure, patients experienced pain less intensely and for shorter periods of time. Used in critical anatomic situations and for placing the implant in an ideal position in bone, CT scanning software eliminates possible manual placement errors and matches planning to prosthetic requirements. Dental implants can now be virtually placed in ideal position using the computer prior to ever touching the patient. This

innovative tool makes surgical placement of implants less invasive and more predictable. Prosthetic reconstruction is thus made simpler since implants are ideally angled. There are often concerns with any surgical procedures, especially in the sinus area or in bone where nerves are located. These concerns have popularized a newer concept in implant dentistry. We are now able to utilize our CAD/CAM computer software to visualize the patient's entire mouth anatomy in three dimensions, which takes all of 10 minutes. The computer software allows us to simulate the placement of implants accurately before ever touching the patient. A surgical guide, created from the three-dimensional images, helps us place the dental implants in the proper pre-determined positions, often without ever making a flap incision. This technique is proving to be a cost effective solution to assist the implant dentist in planning an aesthetic and functional final result and minimizing any surgical challenges they may face.

The Keystone Easyguide CAD/CAM technology (Keystone Dental) is based on planning algorithms used clinically for more than 11 years. CT scans and 3D planning software can really improve our predictability and safety. The CAD/CAM techniques can be used for single tooth edentulous spaces, single tooth immediate extraction cases, partially edentulous spaces, fully edentulous maxillary and mandibular overdenture cases or fully edentulous maxillary or mandibular full arch permanent restorations. The surgical cases are, therefore, driven by the final aesthetic and functional result. It is important to listen to your patients carefully to determine their goals and desires and design the implant reconstruction accordingly. It is critical today to make sure that the final tooth reconstruction is established before any surgical intervention. Placing the dental implants in the jaw before understanding tooth/implant position and the final result is a big mistake.<sup>1</sup>

The CAD/CAM planning and placement system provides a high level of comfort and safety for the patient by reducing surgical and restorative time. This is done by utilizing an accurate three-dimensional plan prior to implant placement. There are obvious advantages including; easy visual understanding for clear case presentations, reduced surgical chair time, reduced restorative chair time in certain cases because of ideal implant positioning, reduced stress for the clinician and the patient, the avoidance of surprises during surgery, optimal implant placement for long-term implant and prosthetic success and, most importantly, an improved aesthetic result.

Prior to the CT scan a radiographic guide is fabricated by the dentist, which aids in visualization of the optimal prosthetic outcome. The teeth are positioned properly in wax and then a hard model to illustrate what the case will look like finished before ever starting.<sup>2</sup> All appropriate dental anatomy is included. The radi-

ographic guide is placed in the mouth during the CT scan. This allows the clinician to see the ideal position of the teeth on a three dimensional model. The entire 3D image is analyzed and the implant planning and simulation of implant placement completed using the computer. The surgical placement of the implants can be done in a conventional manner using the newly created surgical guide to help direct the implants in the ideal position, but surgery can often be completed without making any incisional flap. The implants are placed in the desired depth using the computer software and the surgical guide.

It is imperative that the implants be placed safely and properly in all three dimensions, as possible, to the long axis of the bone. Vital anatomy is determined before any invasive surgical procedures are done. A clear surgical stent is fabricated using the information created using the CT scanning software. The guide is used to correctly position the implant in the mandibular second molar area to maximize stability of the final implant retained

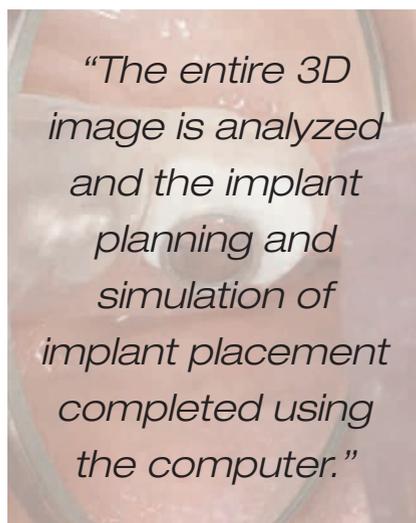
crown. No retraction of the soft tissue was needed, since the CT indicated in three dimensions the length and width and position of the implant to be used.

The use of dental implants has become an important method for restoring missing teeth with function and aesthetics. Various approaches are popular. One stage and two stage applications can be accomplished under different conditions.

We now have another restorative tool for use in cases where adjacent teeth do not require restoration. The success rates for implant cases is proven and the newest techniques have made the process less stressful, simple, and predictable.<sup>3</sup> Emergence profile is the goal of modern

implant prosthetics and the elimination of complications resulting from abutment loosening have all but been eliminated with our modern systems. Once the implant is properly surgically placed and correctly restored, we should assume that the patient will maintain these implant crowns for at least as long as or longer than conventional designs. Previous to implant consideration, an edentulous space with non-restored adjacent teeth would be restored with a three-unit bridge. This means grinding down perfectly healthy teeth to fill a missing area. In this situation the patient may need to resolve himself to never having a tooth in the mandibular second molar area. It is believed that in today's practicing environment, a single tooth implant is considered the standard of care. Tooth by tooth replacement allows the patient the ability to maintain the tooth as if it were naturally, including flossing and brushing. Even our porcelain materials make the aesthetics incredible and the tissue health outstanding. Plaque control is maintained by the glazed porcelain margins.

Patients request this type of therapy today, and the procedures and benefits/risks should be examined. These benefits



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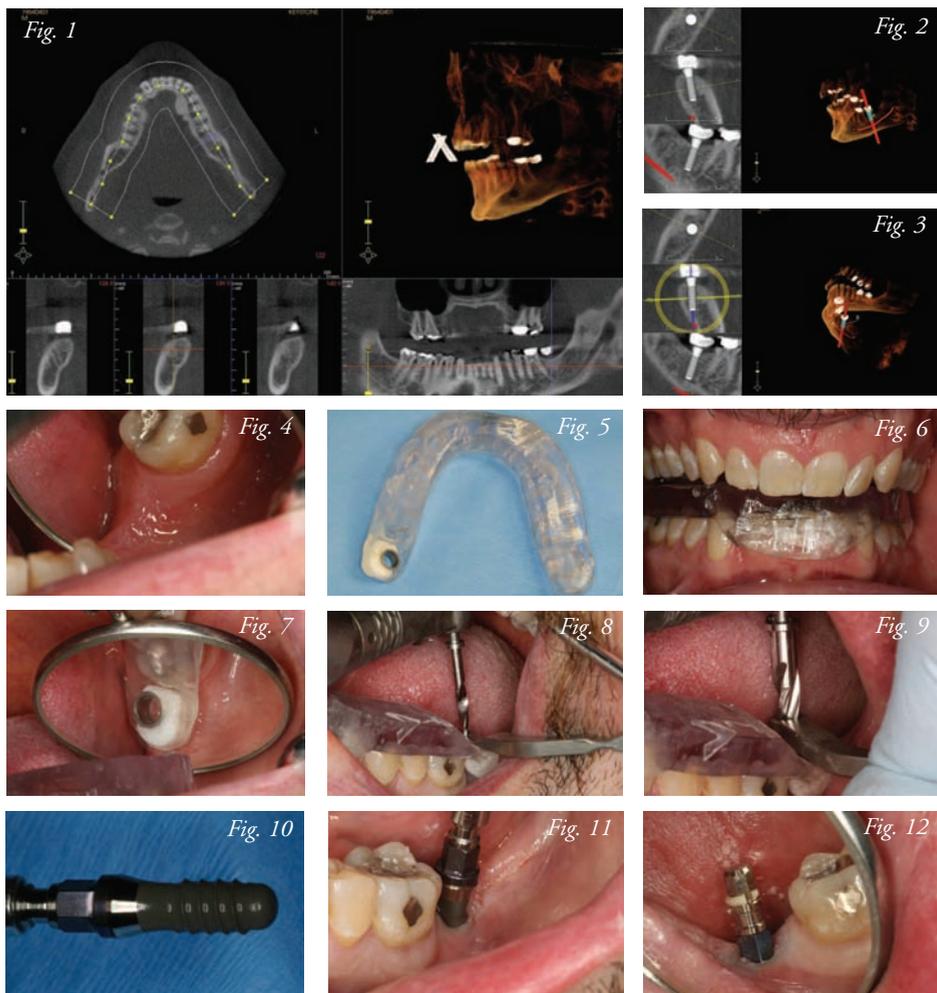
include; adjacent teeth are not compromised to replace missing teeth, minimizing of bone resorption that occurs normally with tooth loss, increased confidence when smiling and speaking, especially when discussing anterior tooth loss, better health due to improved nutrition and proper digestion. The mouth is restored as closely as possible to its natural state. Natural biting and chewing capacity is restored and the integrity of the facial structure is maintained.

Since our patients are more discerning concerning their disposable income and how they want to look and feel younger, implant dentistry may prove to be the single most important treatment modality for replacing missing teeth. As the population becomes more aware of dental implant, their use in our practices will increase dramatically.

The general dentist has an obligation to provide his/her patients with the most innovative, proven techniques available. Since GPs are the professionals the patient consults concerning their dental condition, they must educate themselves with the treatment modalities. Many surgical therapies can be performed by the trained general dentist and certainly all general dentists should be able to restore these cases simply and easily. Implant dentistry has come a long way in providing this service. The predictable results only reinforce the modality.

Our patient is a 44 year old with a chief complaint that he is missing the mandibular left second molar. His health history is unremarkable and there appears to be no medical precautions to an implant surgical procedure. The edentulous area, however, creates some unique complications to implant placement. Due to the potential position of the mandibular canal and the facial bone loss resulting from the extraction of the tooth, placing a dental implant can be complicated and possibly harmful to the patient. Damaging of the mandibular nerve would create paresthesia, which could be permanent. The patient clearly understood the risk involved with surgical placement of a titanium fixture in this particular area. Communication is one of the most critical aspects of our diagnosing and treatment planning. The more the patient understands prior to surgical intervention, the better the end result would be. After discussing the benefits and diagnosing abilities of a CT scan and CT scanning software, the patient was much calmer as to the final result. Figures 1, 2 and 3 show how the CT scanning software is

used to virtually place a single dental implant in the mandibular second molar region. Angulation is determined virtually using the software. The exact type, size and shape of implant are pre-determined as well as proximity to critical anatomic structures, such as the mandibular canal. The ultimate restoration is evaluated also. In properly virtually placing the implant it was noted that the nerve was buccal to the desired implant position and deep enough into the bone to eliminate a concern of damage. Figure 4 illustrates the edentulous ridge area. Prior to the preparation of the osteotomy, the surgical guide was created with a guiding opening in the stent (Figures 5,6 & 7). This allows the pilot drill to penetrate the stent through the soft tissue into the bone to a pre-determined depth (Figure 8). Once the pilot drill makes a mark into the soft tissue and bone, the final depth and width drill creates the final osteotomy. This is done at approximately 800 RPM to the hub of the bur (Figure 9). A 4.1mm X 10mm Straumann dental implant (Straumann Corp.) was chosen (Figure 10). Using CT scanning and diagnosis also allows one to minimize the implant inventory needed in the office. You will know precisely what implant size is needed for each individual case. The implant is threaded into place (Figure 11). The final torque implant is checked for proper angulation and position. The final position is



identical to the pre-determined computer virtualization (Figure 12). Remember that depth into the bone was determined by the CT scanning software. All angles were predetermined with the virtual placement of the implant.

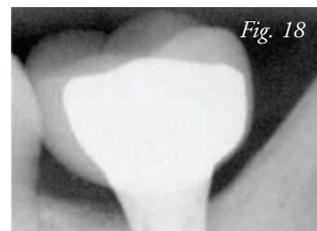
The shoulder of the implant is left slightly coronal to the crestal bone to allow for easy access. Since this is a flapless procedure, sutures are not necessary and post-operative discomfort or complications are nearly eliminated. There is little or no bleeding present at the surgical site (Figure 13). A 1.5mm tall closure screw is placed into the implant (Figure 14). Figure 15 illustrates the radiograph of the implant in position. The panoramic view is only in two dimensions, but we know the implant is ideally placed because of the CT scanning software determination in three dimensions. After integration of approximately three months duration, a closed custom tray impression of the implant is made using the Straumann impression cap and synOcta positioning cylinder. A master impression was sent to the lab to have proper analogs placed into the impression and placed into the impression for a master model pour up. A high-quality porcelain fused to metal crown is cemented onto the Straumann abutment for the final restoration (Figures 16 & 17). The final crown seating is checked with a simple periapical radiograph (Figure 18).

The patient exhibited a positive end result because of precise planning and communication. Using the most innovative techniques, such as CT technology like the Keystone Easyguide system makes for predictable placement and long-term success. Anatomical anomalies are easily differentiated. The three reasons why dentists are not currently placing implants, fear, knowledge and confidence are overcome with CT scans and scanning software. Realizing the limits of a procedure can be determined before a surgical intervention. Failure is diminished because there is tremendous preparation, extensive communication with the patient and execution is made much easier for even the less experienced practitioner. Motives are to benefit the patient and meet

their expectations in a safe and professional manner. CT utilization can make each of us more competent and confident in implant surgical placement. ■

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Authors' Bios

**Dr. Timothy Kosinski** is an adjunct assistant professor at the University of Detroit Mercy School of Dentistry and serves on the editorial review board of *Reality*, the information source for aesthetic dentistry, *Contemporary Esthetics* and *Clinical Advisors*, and became the editor of the *Michigan Academy of General Dentistry*. Kosinski received his DDS from the University of Detroit Mercy Dental School and his Mastership in Biochemistry from Wayne State University School of Medicine. He is a Diplomat of the American Board of Oral Implantology/Implant Dentistry, the International Congress of Oral Implantologists and the American Society of Osseointegration. He is a Fellow of the American Academy of Implant Dentistry and received his Mastership in the Academy of General Dentistry. Kosinski has received many honors including Fellowship in the American and International Colleges of Dentists and the Academy of Dentistry International. He is a member of OKU and the Pierre Fauchard Academy. Dr. Kosinski was the University of Detroit Mercy School of Dentistry Alumni Association's "Alumnus of the Year." Dr. Kosinski has published more than 55 articles on the surgical and prosthetic phases of implant dentistry and was a contributor to the textbook, *Principles and Practices of Implant Dentistry*.

**Dr. Raymond Skowronski** was a clinical instructor at the University of Detroit Mercy School of Dentistry from 1982-1991. He began his private practice in 1983 and is a Diplomat of the Academy of Pain Management, A Fellow of the Academy of Dentistry International and a member of the Academy of General Dentistry, the Academy of Dental Sleep Medicine, and the American Academy of Sleep Medicine.

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