PEER-REVIEWED

Implant-Retained, Solid Zirconia Full Arch Reconstruction

What our edentulous patients are asking for

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Implant dentistry has become a routine and effective means for restoring edentulous spaces in patients. As engineering principles have become better understood and surgical and prosthetic components made more reliable, the successes have been incredible. When surgically placed and properly restored, dental implants are a viable alternative to conventional dental techniques. Today's patients understand their dental problems and present to the office with missing teeth or conventional removable appliances. The dentist's job is to educate and instruct them about the benefits and risks of the procedures available to treat their conditions. Dental implant procedures have become very well known to the public because of the internet and advertisements, and it is imperative that dentists understand and provide this therapy. Implants need not be placed in every situation; however, clinicians should still be aware of the newest and most effective techniques. With the proper education, a general dentist is capable of diagnosing and treatment planning individual cases as well as treating those that are within the scope of his or her experience and competence. Many general practitioners do not feel comfortable surgically placing dental implants for several reasons, including a lack of proper training, a lack of knowledge of vital anatomy, and a fear of damaging the mandibular nerve, the maxillary sinuses, or both. Competence and confidence in these surgical procedures come through continuous education and are certainly achievable by the general dentist.

Fixed implant prosthetics are quickly becoming an important option for the restoration of edentulous patients. These esthetic, functional, and stable devices provide increased chewing ability, have exceptional wear resistance, and provide for better speech because of the minimal palatal coverage. Because material availability and computer technology have improved, dental laboratories are able to mill precise and esthetic prostheses. In the recent past, fixed hybrid appliances with milled bars and denture teeth were used to eliminate both full palatal coverage complete dentures and removable horseshoe-shaped implant-retained overdentures.[1] Although these threaded appliances provide a permanent, fixed solution for

FIG. 1

FIG. 2

(1.) Preoperative panoramic radiograph of the patient's edentulous maxilla. **(2.)** Preoperative smile photograph with maxillary complete denture in place.

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many patients, problems can arise that result in excessive wear of the denture teeth and fracture of the acrylic framework of the prosthesis. Fixed hybrid appliances were certainly a step in the right direction in meeting patients' clinical expectations but were not a perfect solution.

The current evolution is the zirconia bridge, which can be screw-retained or cemented onto custom-aligned abutments. Both options resemble conventional bridges,[2] and patient responses have been extremely positive in every aspect.[3]

The following case report presents a procedure to create a fixed maxillary restoration using an implant-retained, cemented zirconia bridge (The decision was made to restore the patient's mandibular arch at a later time). This prosthesis had minimal palatal coverage and proved to be very esthetic and functional. It is important to note that, depending on the amount of bone loss that has occurred, it is sometimes necessary to use gingiva-colored material in order to help support the lip while making the teeth appear normal in size.[4] The bridges were designed to be readily maintained by the patient. For home care, dentists can recommend the use of a water flosser to eliminate any debris underneath the bridge. Bacteria and plaque do not seem to adhere to the zirconia undersurface, so maintenance has become fairly routine.


FIG. 3


FIG. 4

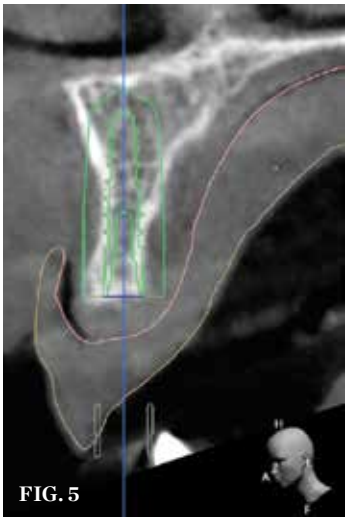
FIG. 5

(3. AND 4.) The edentulous maxilla prior to surgical intervention. **(5.)** Initial CBCT scan demonstrating minimal bone availability for implant placement.

Case Report

A 45-year-old female patient presented to the office with a conventional maxillary denture that had recently been immediately placed at another practice. She stated that the denture had reduced her quality of life and her ability to function at the level she expected. She was losing weight and wanted "permanent teeth." A review of her medical history revealed that she had osteoporosis that was not being treated with medication and that she was allergic to cephalexin and amoxicillin. There were no other reported contraindications to dental implant therapy. The preoperative panoramic radiograph and occlusal view of the edentulous maxilla exhibited what appeared to be sufficient available maxillary bone to accept dental implants (Figure 1 through Figure 4). However, using cone-beam computed tomography (CBCT) as a diagnostic tool, it became apparent that there was only minimal bone available (Figure 5). A guided surgical approach was deemed appropriate so as to angle the most posterior implants in front of the sinuses and to increase the arch form of the anterior and posterior implants.[5] To begin the process of creating a well-fitting surgical guide, her existing maxillary denture was relined with a vinyl polysiloxane-based reline material (Mucopren® Soft, Kettenbach). This material is radiopaque and ensures a complete seating onto the soft tissue of the maxilla. This was a critical step in that a CBCT scan of the denture would be used to help position the implants in their correct intraoral positions. Any deficiency in the contact with the intaglio surface of the denture could result in serious malpositioning of the implants. The radiographic markers were strategically positioned in three planes. A CBCT scan was taken of the denture by itself, and then a second CBCT scan was taken with the denture and markers in the mouth. During this process, it is important to place cotton rolls in the vestibules to push the cheeks away from the edentulous ridges. DICOM files were electronically sent to the practice's surgical guide diagnostic company (3D Diagnostix), and casts of the edentulous ridge, opposing teeth, and bite relation were mailed to them. If a full-arch scanner is available, the model can also be sent electronically.[6] Next, the positions of the implants were planned and they were virtually placed.[7] Following this, a surgical guide was fabricated (Figure 6) that was specific to the type of tapered implant system chosen (Hahn™ Tapered Implant System, Glidewell Laboratories). A guided implant system allows clinicians to make the osteotomy preparations and place the implants through the surgical guide. This simplifies the process immensely and provides added precision.

The surgical guide was firmly positioned on the edentulous maxilla, and retention pins were placed to stabilize it during the entire process (Figure 7). After the guide was stabilized, a tissue punch was used to remove the gingival tissue at each implant site (Figure 8). This minimizes the possibility of the epithelium being pushed into the osteotomy sites, which could affect osseointegration, and it also provides for a clean, circular incision, which minimizes the postoperative discomfort that can be caused by using sharp, tearing osteotomy burs. Figure 9 illustrates the alignment bur that was used to dislodge the

punched tissue from the guide sleeves. Once the punched tissue was removed, a guided surgical bur was used to prepare the osteotomies to the predetermined depth and position by drilling through the guide to the set stop on the bur (Figure 10 through Figure 12). This was possible because the implants had been virtually placed prior to any surgical intervention and the amount of hard tissue and soft tissue, as well as the thickness of the surgical guide, were calculated into the process. After the osteotomies were prepared, the implants were placed right through the surgical guide and hand torqued to 30 Ncm with an insertion tool to their final seated positions (Figure 13 and Figure 14).

Next, the surgical guide was removed, and the positions of the implants were verified. Note the location of the implants through the attached gingiva (Figure 15). A postoperative CBCT scan was used to visualize the final positions of the implants in the hard tissue (Figure 16). Because the patient would continue to wear her conventional maxillary denture during the healing phase and the residual ridge was narrow, requiring smaller diameter implants, cover screws were placed, and the implants were buried. This facilitated a stress-free period of healing. The immediate postoperative panoramic radiograph illustrates the 30° angle of the posterior implants achieved through the virtual planning of the surgical guide (Figure 17). This angulation allowed for an increased arch width to support the final fixed prosthesis and prevented perforation of the maxillary sinuses.

Following a 4-month integration of the implants, a conventional implant impression was made to fabricate the initial maxillary cast. The internal design of the implants was intraorally duplicated by the laboratory analogues, from which the lab created screw-retained impression jigs. After these were passively threaded into place individually and then luted together with a light-cured modeling resin (Primopattern LC Gel, Primotec®) (Figure 18), a final impression was made with medium and heavy body vinyl polysiloxane material (Panasil®, Kettenbach). Next, a very accurate master cast was created by the laboratory from which the prosthesis would be designed.

To begin the restorative process, screw-retained occlusal rims were made to help establish the proper vertical dimension of occlusion. Threading the bite rims into place stabilizes the appliance (Figure 19). The denture teeth were then set in place and a stable try-in was made. This would become the basis for the final prosthesis. After the position, shape, size, and occlusion of the teeth were verified and accepted, the lab fabricated a poly(methyl methacrylate) (PMMA) transitional appliance. The patient was instructed to wear the appliance for a short period of time to verify the fit and esthetics (Figure 20). Once accepted by the patient, the transitional appliance was sent back to the lab for use in milling the final zirconia bridge (BruxZir® Solid Zirconia, Glidewell Lab) (Figure 21 and Figure 22). If no changes are needed on the transitional appliance, the lab can be electronically contacted to complete the process. If any adjustments are made, it is best to send it back for final scanning.

Because the angulation of the implants would require that access holes for a screw-retained prosthesis be positioned on the facial aspect of the prosthesis, the decision was made to fabricate custom titanium abutments and a cement-retained bridge. The margins of these abutments were placed at the tissue crest, allowing for proper maintenance under the bridge (Figure 23). The final zirconia bridge was cemented into place with transitional implant cement (Improv® Temporary Implant Cement, Salvin® Dental Specialties). This creates adequate retention but allows the bridge to be more easily removed by the dentist, if necessary. Photographs showing the retracted facial view, occlusal view, and full smile (Figure 24 through Figure 26) illustrate the final esthetics of the implant-retained maxillary bridge, and the postoperative panoramic radiograph (Figure 27) illustrates its final seating.

FIG. 6


FIG. 7


FIG. 8

(6.) 3D rendering of the surgical guide. **(7.)** The surgical guide is firmly positioned, and retention pins are used to stabilize it. **(8.)** A tissue punch is used to remove the epithelium from the osteotomy site.


FIG. 9


FIG. 10


FIG. 11


FIG. 12

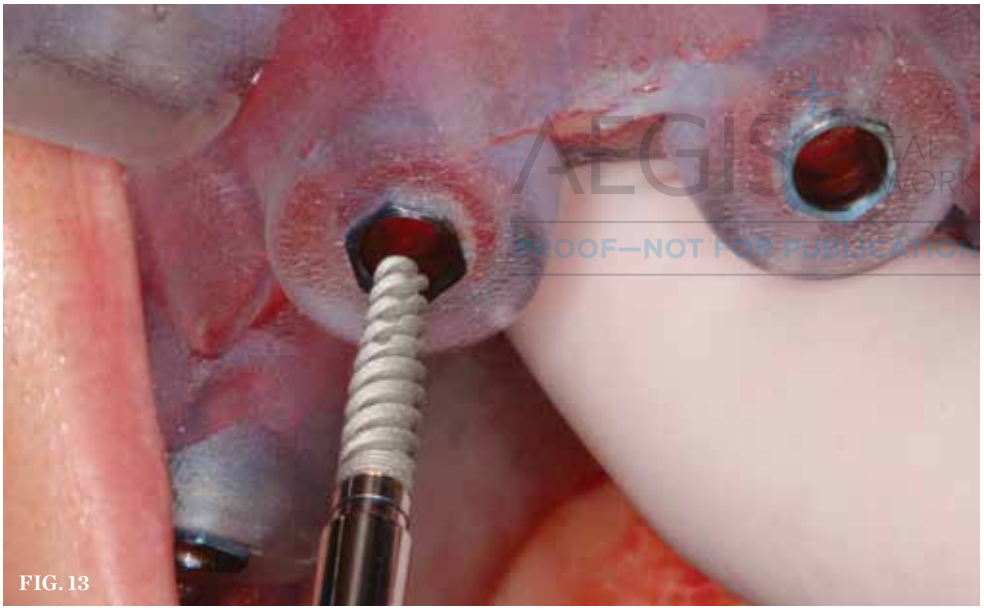
FIG. 13


FIG. 14


FIG. 15

(9.) Alignment bur used to remove the punched tissue from the guide sleeves. **(10. THROUGH 12.)** Tapered osteotomy bur used to prepare the site for implant placement. **(13. AND 14.)** Dental implants hand-torqued into position through the surgical guide. **(15.)** View of final implant locations in the edentulous maxilla.


FIG. 16

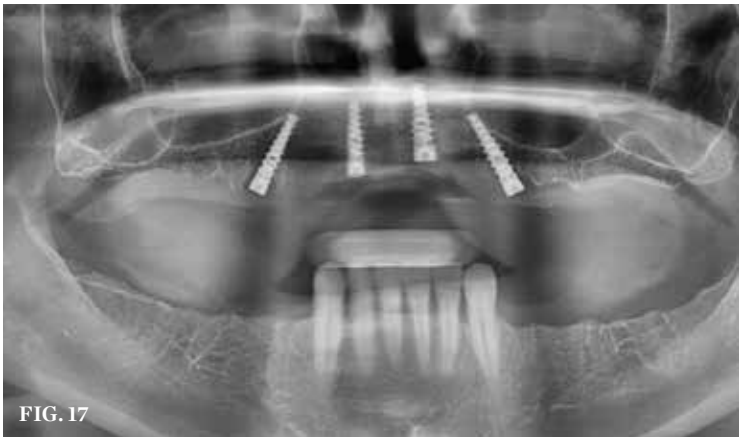
FIG. 17


FIG. 18


FIG. 19


FIG. 20


FIG. 21


FIG. 22


FIG. 23


FIG. 24


FIG. 25

(16.) Postoperative CBCT demonstrating ideal positioning of the four dental implants. **(17.)** The postoperative panoramic radiograph illustrates the 30° angulation of the posterior implants to increase the arch width and prevent perforation of the maxillary sinuses. **(18.)** Screw-retained impression jigs fabricated from the preliminary cast, passively seated onto the implants, and luted together for an impression to fabricate the final working cast. **(19.)** Screw-retained bite rims made to establish vertical dimension of occlusion. **(20.)** Laboratory-fabricated PMMA transitional appliance being worn by the patient to verify esthetics and occlusion. **(21. AND 22.)** The final fabricated cement-retained zirconia bridge. **(23.)** Custom titanium abutments torqued into position. Note that the margins of the abutments are placed at the tissue crest to allow for proper maintenance. **(24.)** Retracted facial view of the fixed prosthesis in position. **(25.)** Occlusal view of the fixed prosthesis in position.


FIG. 26

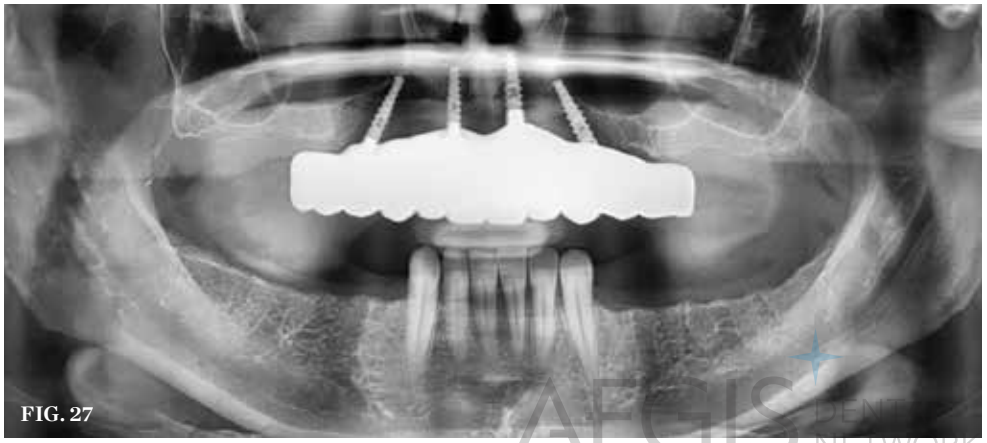
FIG. 27

(26.) Final smile view of the fixed zirconia prosthesis. **(27.)** Postoperative panoramic radiograph of the completed restoration.

Conclusion

Dentists have been creating conventional maxillary complete dentures for patients for many years. Although reestablishing function in this manner can be an acceptable alternative to having no teeth at all, with acrylic resting on the full palate, comfort may be compromised, and taste may be inhibited. Over time, the resorption of bone can result in instability, which requires relining of the existing prosthesis or the creation of a new appliance. Modern osseointegrated dental implants have been around for more than 30 years now, and they can provide dramatically improved function for any prosthesis as well as increased quality of life for the patient. Improvements in engineering principles, materials, and design have made implant therapy a successful and popular alternative to conventional denture techniques.

As the various options for edentulous patients are discussed, it is important to consider the advantages and disadvantages of each type of prosthesis. Conventional dentures may be appropriate for some people but a detriment to others. Removable, implant-retained overdentures improve chewing function, eliminate the palate from a maxillary denture, and can be a godsend to many patients. Patients who request fixed prostheses also have options. If a sufficient number of implants are placed, custom abutments and bridgework can be created. Hybrid appliances offer another solution, which may be more cost-effective for interested patients. Conventional, acrylic-based, denture tooth hybrids work well but will wear over time. The newest CAD/CAM-designed solid zirconia hybrids are the most durable and esthetic appliances a dentist can fabricate. Clinicians must be aware of the anatomic, material, and instrumentation limitations of each prosthetic option. Fully understanding each option is essential in helping patients select the most appropriate style of prosthesis to improve their chewing function, create beautiful esthetics, and psychologically improve the overall quality of their lives.

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