

Restorative

Treating the Edentulous Patient with Dental Implant Therapy: A Review of Treatment Considerations

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Functionally challenged edentulous patients benefit greatly from treatment options beyond simple tooth replacement. Severe bone resorption renders these patients unable to wear comfortable and serviceable prostheses, limiting function, and adding to a loss of confidence and reduction of social interaction. Their options range from conventional dentures to the complex fixed implant-supported restoration. Successful outcomes depend on proper and adequate treatment planning and a comprehensive team approach.¹

Currently, the percentage of completely edentulous patients is declining 10% each decade; however, this is more than offset by the growth of the aging baby boomer population. In reality, an increase in the numbers of completely edentulous cases is being observed. By 2020, an estimated 37.9 million patients will present with one or both fully edentulous arches. According to the National Institute of Health, most of these patients visit their dentist every 14 years, a schedule not conducive to proper maintenance for ensuring properly fitting and functional prostheses.

The problems of edentulism and tooth loss are far more encompassing than just a limitation in function. These issues present many psychosocial implications in patients, such as the fear of aging, social inhibition, and diminished self image. Dental implants not only replace missing teeth and restore functionality and esthetics but also improve confidence and social interaction.² They also re-establish speech and mastication as well as maintain bone.³ Treatment with dental implants requires not only a comprehensive understanding of dental implant therapy but also a complete mastery of removable prosthodontic principles and techniques. Regardless of the desired restorative outcome, complete capture of the edentulous ridge morphology and anatomy during impression making, assessment of the vertical dimension of occlusion, and proper tooth arrangement with attention to occlusal schemes and biomechanics must be well understood and executed. In addition, it is imperative to achieve optimal esthetics, phonetics, and mastication.¹

This article provides an overview of the various restorative options for both the maxilla and mandible, and describes the various dental materials and their benefits that support these restorative options. Approach and treatment is much different for restoration of the maxilla and mandible. Selection of materials and prosthesis design is contingent on many factors. Clinically, assessment of the edentulous ridge anatomy, intra- and interarch spaces, smile line, and need for lip support will aid in determining the optimal prosthetic choice. The opposing dentition, parafunction, and biomechanical loading of the dental implant prostheses also must be considered.

The clinician must understand and identify each patient's anatomic limitations. An anatomic classification system accounts for the ridge morphology, amount of bone height, muscle attachments, bone shape, and arch form of each edentulous

ridge.⁴ Anatomic relationships between the edentulous ridges will determine the success of the prostheses and establish the need for surgical enhancement and/or preprosthetic surgery. The fabrication of implant prostheses for the edentulous patient must include consideration for the need for adequate space for the implant components, as well as the appropriate restorative material (Figure 1 1A [View Figure](#), 1B [View Figure](#), 1C [View Figure](#), 1D [View Figure](#)). This space is not always adequate, and vertical height of bone may need to be removed to facilitate the space requirements for the given prosthesis. It is necessary to account for a larger amount of interarch space to accommodate for the restorative components and prosthetic materials needed to restore the edentulous arch. Fixed restorations need > 10 mm as measured from the soft tissue to the opposing dentition while 12 mm to 15 mm of space is minimally required for restoration of an overdenture depending on the type of attachments or substructure utilized in the restorative design.⁵

The appropriate desired tooth position must be determined to plan treatment of the implant placement. A diagnostic wax-up should be completed and verified intraorally to determine the area that the implant prosthetics must fit within for proper esthetics and function. A surgical guide will then co-localize the implant placement with the desired tooth position.

The maxilla and mandible present very different surgical and restorative challenges because of bone quality and quantity, ridge morphologic and resorptive patterns, location of anatomic structures, and biomechanical considerations. With that said, there are two primary ways to restore the edentulous case. The selection of a fixed vs removable prosthesis is based on many factors. Influencing this decision is patient preference, cost, and ease of maintenance, as well as the clinical considerations of anatomy, bone quantity, quality, and arch form. The predictability of the long-term success of the prosthesis depends on design fabrication and material selection.

Numerous restorative options, materials, and techniques are used in dental implant therapy for edentulous cases ([Table 1](#)). The biomechanical considerations must be weighed. The lack of periodontal fibers surrounding an implant alters the proprioceptive feedback for the completely edentulous patient who has restorative dental implants. This may result in a greater incidence of material fatigue and fracture. Materials should be selected while keeping in mind that bite force has been found to be as much as three times greater for the edentulous case restored with dental implants when compared with a dentate case.⁶ Complications such as porcelain and acrylic fracture and loss of denture teeth are common in the completely edentulous patient restored with dental implant therapy.⁷

MAXILLA

Removable

Frequently, because of the resorptive pattern observed in the premaxilla, both hard and soft tissue is lost following loss of the teeth. This necessitates replacing this lost tissue on the vertical and horizontal planes to restore proper function and esthetics. One of the key advantages of a removable prosthesis in the maxilla is the ability to use the denture flange for lip support without the compromise that may be seen with a fixed prosthesis that can hamper patient home care. A maxillary prosthesis requires a splinted metal bar substructure to facilitate

removal of the prosthesis palate and provide for retention as well as support. Currently, no literature supports a removable prosthesis in the maxilla with free-standing attachments.⁸

Fixed

Often, the bone in the maxilla has been grafted because of insufficient vertical height and/or horizontal width. A successful maxillary prosthesis provides for a splinted restoration, providing cross-arch stabilization, and accounts for significant esthetic requirements. On occasion, a reduction in vertical height is needed in patients with a higher lip line to conceal the junction of the prosthesis and gingiva underneath the lip line.

MANDIBLE

Removable

Loss of the posterior teeth and the resorption that ensues often creates height issues above the inferior alveolar nerve, making implant placement complex or impossible without extensive grafting or nerve repositioning. The primary area for dental implant placement is in the anterior mandible between the mental foramen. The McGill Consensus Statement on Overdentures solidified the importance of dental implant therapy in the mandible and advocated two dental implants “as a minimal treatment objective.”⁹

Fixed

The success of a fixed restoration in the mandible is often determined by arch form. Maximizing anterior-posterior spread allows for a bilateral distal cantilever and a fixed restoration typically to the first molar.¹⁰ Predictability for success is high in the anterior mandible, irrespective of implant type, surface topography, and prosthesis design with success rates reported as 90%-100%.¹¹

Immediate Placement/Immediate Load Dental Implants

Treatment protocols have been predictably enhanced with immediate placement of dental implants at the time of tooth extraction and immediate load and restoration of the implants during their placement (Figure 2 2A [View Figure](#), 2B [View Figure](#), 2C [View Figure](#)). This enables the preservation of bone and soft-tissue morphology while significantly shortening the treatment completion time. Adherence to these protocols ([Table 2](#)) helps ensure the success of the implant fixtures. Loading of these implants has many benefits ([Table 3](#)) with predictable long-term results. However, understanding the risks ([Table 4](#)) could help prevent failure of the fixture and/or prosthesis.¹¹

CT Imaging and Computer-Generated Planning via Software Imaging Systems

State-of-the-art implant planning uses computer-generated software to “virtually” plan the implant placement via 3-dimensional imaging of the patient’s edentulous ridge, including an image of a denture representing an ideal denture set-up of desired tooth position. Once the dental implant planning has co-localized the desired planning with the planned prosthetic tooth placement, a surgical guide can be fabricated to aid in the actual placement of the dental implants. In some cases, these implants can be immediately loaded at the time of surgical placement. Traditional cast gold frameworks can be used to fabricate these fixed restorations with veneered porcelain or acrylic with denture teeth. More recently, CAD/CAM milled frameworks are being used which overcome all the negatives

found in cast structures such as framework distortion during casting and need to have solder or laser joints and provide stronger solid frameworks. Improvements in dental materials now allow fabrication of these prostheses with zirconia substructures and veneered porcelain (Figure 3 3A [View Figure](#), 3B [View Figure](#), 3C [View Figure](#)) or titanium frameworks with acrylic and denture teeth.

Conclusion

Treating edentulous cases with dental implants can be rewarding, providing possibly the highest levels of patient satisfaction. Restoration of esthetics, function, and self confidence while enhancing the biologic benefits of bone preservation are a few of the reasons that patients pursue dental implant therapy. However, the determination of the success of a given prosthesis is established by many clinical, restorative material, and biomechanical considerations. Comprehensive treatment planning will aid in the execution of functionally predictable prostheses.

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1A



1B



1C



1D

FIGURE 1 (1A, 1B, 1C, 1D) Adequate restorative space is essential for the components of this bar and implant-supported overdenture. During fabrication, the laboratory fabricates the substructure according to the desired tooth position. Attachments are placed allowing for requirements for the male attachment to be incorporated within the denture surrounded by enough acrylic for strength.



2A



2B



2C

Figure 2 (2A, 2B, 2C) Transition of the dentate patient to the edentulous state through immediate extraction of teeth, placement of dental implants, and immediate load with an interim fixed restoration.



3A



3B



3C

Figure 3 (3A, 3B, 3C) Zirconia framework with porcelain veneer can be fabricated as a cement-retained or screw-retained prosthesis. The junction of the prosthesis and the gingiva needs to be hidden well above the smile line for an optimal esthetic result.

TABLE 1 <i>Options for Restoring the Edentulous Case</i>
Complete dentures
Implant-retained overdentures (free-standing)
Bar-retained/supported overdentures
Fixed detachable prosthesis (screw-retained hybrid)
Fixed prosthesis (metal or zirconia substructure veneered with porcelain)

TABLE 2 <i>Immediate Load Protocols</i>
No pathology
Primary stability of implant fixture
Significant grafting not needed
Insertion torque 35 ncm to 45 ncm
Eliminate occlusal overload
Splinted restoration
Patient compliance

TABLE 3 *Advantages of Immediate Placement/Immediate Load*

Support and maintenance of bone and gingival architecture
Minimal postoperative discomfort
Fixed provisional restoration
Prevention of need for hard- or soft-tissue grafting
Reduction of number of surgical procedures
Faster case completion
Reduction of clinician chairtime and overhead

TABLE 4 *Disadvantages of Immediate Placement*

More complex surgery
Correction of placement is more challenging
Need for materials, procedures, and laboratory support at time of extraction
Risk of infection/failure
Risk of incomplete osseointegration

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