ABSTRACT: While most implant-based treatment has historically focused on fixed prosthetic tooth replacement, the multitude of benefits to the edentulous population from implant overdentures is overwhelming in terms of improved function, emotional stability, physical health, and esthetics. Although there still remains a lack of consistency in terms of techniques, prosthetic design, and attachment systems, these aspects have been proven less important to successful outcomes than once thought. This article presents a simplified approach to patient evaluation, treatment planning decisions, attachment selection, and technique.

While most implant-based treatment has historically focused on fixed prosthetic tooth replacement, the multitude of benefits to the edentulous population from implant overdentures is overwhelming in terms of improved function, emotional stability, physical health, and esthetics. Proper evaluation and treatment planning of the fully edentulous patient has been shown to result in an improved quality of life for patients and predictable results leading to clinical success. The indication for a fixed prosthesis may be limited due to inadequate quantity and structure of the bone. Enhancement of esthetic appearance and facial morphology through replacement of lost hard and soft tissues may be proven easier, if not more effective, with removable overdentures than with conventional fixed prosthesis, with possibly decreased costs and less surgical intervention.

Generally, more implants are required to support a fixed prosthesis than an overdenture. Other factors to consider include the health of the patient, his or her ability to undergo grafting procedures, and cost. There has been an abundance of literature presenting a variety of treatment options, case reports, and clinical techniques over the past 20 years, but more recently there has been general agreement about the treatment protocols and long-term documented benefits of implant overdentures. This treatment option has become the most rewarding care provided in this author’s clinical practice, and with increased life expectancy, its full impact on clinical practice is yet to be realized. Although there still remains a lack of consistency in terms of techniques, prosthetic design, and attachment systems, these aspects have been proven less important to successful outcomes than once thought. This article presents a simplified approach to patient evaluation, treatment planning decisions, attachment selection, and technique. What are agreed upon are the specific indication for this treatment and the benefit derived.

First, there is a need to appreciate the sequelae of tooth loss and associated benefits of implant overdentures, followed by patient evaluation, treatment protocols, and clinical technique. For many years clinicians realized that placement of endosseous osseointegrated implants under a removable prosthesis would provide the definitive advantages of bone preservation, prosthetic retention, stability, and a degree of occlusal support resulting in improved function, facial esthetics, and comfort. More recently, comprehensive and ongoing studies conducted at McGill University have documented the improved nutrition, psychosocial status,
and quality of life that have been gained through the use of overdenture treatment. The use of implants also provides a predictable solution for patients and practitioners to the problems associated with conventional dentures by resolving functional and esthetic compromises.

The sequelae of tooth loss and edentulous arches is residual ridge resorption both in the horizontal and vertical direction. This ongoing loss of hard and soft tissue is most noticeable in the loss of orofacial support: facial esthetics, phonetics, and collapse of vertical dimension. This leads to an aging appearance due to the lack of lip support and decreased facial height (Figures 1 and 2). Concurrent with these changes in facial structures are impaired oral function, pain, insufficient retention, and instability of conventional dentures, as well as nutritional and psychological changes. Many patients seeking resolution to chronic soreness of load-bearing tissues and nonstable or retentive dentures will enjoy increased esthetics, function, comfort, and psychological benefits from implant overdentures, without the need for more extensive fixed restorations.

**PATIENT EVALUATION: MAXILLOFACIAL RELATIONSHIP**

Upon evaluation of the edentulous (or soon to be edentulous) patient, facial esthetics and the amount of extraoral soft tissue support of the lips and associated structures will become an initial guideline to treatment options. If horizontal loss of hard and soft tissue through resorption, disease, or trauma is so advanced that teeth need to be placed far anterior to the residual ridge in order to provide adequate facial support, then an overdenture (ie, acrylic base and flanges) can provide replacement of these structures (Figure 1b). Alternatively, bone grafting procedures can be performed to augment the missing tissues, but limitations must be evaluated. Limiting factors in grafting procedures include adequate blood supply, patient health, and finances. When evaluating vertical loss of hard and soft tissues, the resultant interarch space must be determined in order to see if excessive crown-to-implant ratio and biomechanical forces will preclude a conventional implant-supported fixed restoration (Figure 3). While grafting procedures have radically changed how we treat patients, there are limitations to the amount of vertical augmentation possible.

Any successful overdenture treatment begins with the understanding that we must conform to standard full-denture fabrication principles. These include ideal border adaptation and extension and full-denture occlusion. Through proper articulation and denture tooth set-up, all parameters of final treatment success can be evaluated. An ideal tooth set-up and try-in will quickly allow evaluation of esthetics, phonetics, and support, as well as the critical determination of ridge position relative to the proposed prosthesis prior to surgery. The set-up will then be used to guide ideal implant position, since the most critical factor in overdenture implant placement is that implants emerge well within the confines of the denture.

If an existing denture is available and determined to have adequate tooth position, this can become the surgical guide for implant placement. If a denture with adequate occlusal and esthetic parameters is not available, then a new ideal set-up is necessary to avoid implant placement in a less-than-ideal or even nonusable position. Often the author duplicates the wax set-up in clear acrylic prior to final processing to serve as a surgical guide (Figures 4a and 4b). The risks of proceeding with implant placement prior to tooth set-up and try-in are compromised space for overdenture attachments, inadequate acrylic thickness, and unforeseen laboratory and component costs necessary to correct poor angulation.

**EVALUATION OF RIDGE**

While the majority of patients will realize a wealth of benefits from the two-implant mandibular overdenture, close evaluation of the residual ridge will provide information about the ideal number and position of implants, as well as abutment and attachment...
selection. Single, non-splinted implants can provide ideal retention of the prosthesis to prevent vertical and lateral displacement. However, ideally the majority of occlusal support is provided by the residual ridge and not the implants. The primary goal of any overdenture attachment is to retain the appliance in position with a minimal amount of movement.

Traditional overdentures are classified as implant-retained and tissue-supported prostheses (Figures 5a and 5b). If the patient’s residual ridge is inadequate to provide the majority of vertical occlusal support in function, as in cases of extreme “knife-edge” or chronic mucosal soreness due to the nature of the tissues, then more implants or splinting of the implants may be indicated to provide more implant support and decreased loading of the tissues. The benefit of placing three to four implants (as opposed to only two) is the ability to ease the load on a less-than-ideal ridge, decreasing mucosal bearing areas during occlusal function. Additional implants may also be more desirable when fixtures of reduced length or diameter are necessary due to limited bone volume.

The benefit of splinting implants (ie, bar restorations) is potential distribution of the forces to more osseointegrated surfaces to share the load. The primary reason for splinting is to enable the laboratory to compensate for significant malaligned or poorly positioned implants by fabricating a custom substructure.

Still, the majority of patients will greatly benefit from two to four non-splinted mandibular implants to provide ideal retention and some level of occlusal support. Numerous studies have shown equal outcomes in long-term implant survival in mandibular overdentures regardless of splinting. Many factors prove overwhelmingly in favor of individual non-splinted implants, such as decreased cost, decreased space requirement inside the denture, and improved access for hygiene. The individual non-splinted approach provides the most ideal outcome with the greatest cost effectiveness and greatest efficacy of treatment for the majority of edentulous patients.

There are several attachments available to provide retention of the prosthesis to the implants. Numerous studies over the years have shown that many designs work well. However, in order to provide a guide to attachment selection, numerous factors should be considered. First, all attachments are either rigid or resilient. Rigid attachments restrict rotational movement and provide only a limited path of angle insertion, while resilient attachments allow varying amounts of rotation and angulation correction. In situations where implants are even minimally non-parallel, a resilient attachment will consistently show less friction, wear, and breakage. Considering that patients frequently bite appliances into place, this resiliency will also prevent premature wear and breakage. Clearly the largest overdenture complica-

FIGURES 4 A,B A clear surgical guide fabricated by duplicating the ideal set-up ensures implant placement within the confines of the final denture base.

FIGURES 5 A,B Views of an implant-retained/tissue-supported two-implant overdenture system.

ESSENTIALS
As previously mentioned, the fabrication of a bar allows the laboratory to correct significant implant malalignment, which is often seen in the maxilla due to the resorptive pattern of the basal bone. This suprastructure allows attachments to be cast, soldered, or welded to the bar to provide a common path of insertion, as well as relocate the attachment system within the confines of the denture base because of often buccal-emerging implants. The other potential advantage of splinting through the use of a bar or telescopic copings is distribution of vertical forces to more implants so that rotational torque of the implants is resisted under occlusal loading in cases where there is limited buccal bone volume and encroachment on the residual buccal plate.

Maxillary overdenture implants tend to be angled, placed in less dense bone, and shorter due to the nature of resorptive patterns and sinus expansion. More significant to the decreased stress transfer in maxillary implants is the amount of palatal coverage offered by the appliance to provide greater tissue support. Maintaining palatal coverage to assist in the potential reduction of load to the implants may be recommended in instances of reduced implant support due to the quality of integration, number of implants, or compromised implant positioning and location. This adheres to the primary premise of an “implant-retained and tissue-supported” appliance.

The down side of bars to be considered is the added space required inside the denture, hygiene difficulties, and additional cost involved. Passivity of fit of bar restorations must also be verified to avoid mechanical problems such as screw loosening and fracture.

As a general rule, four implants are the minimal number in the maxilla in order to remove partial palatal coverage. While maxillary overdenture implants tend to show a slightly higher risk of failure than seen in the mandible, this clearly appears to be related not to the prosthetic design but originates as a direct consequence of compromised preoperative bone, thereby necessitating a reduced number, length, diameter, and angulation of implants.

**TECHNIQUE**

Incorporation of the attachment into the denture can be accomplished either chairside or in the laboratory. The advantage of chairside “pick up” is that the attachment can be made in a passive, loaded (ie, bite force) environment to

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*FIGURE 6A* Four regular neck implants were placed anterior to the mental foramen with ideal distribution.

*FIGURE 6B* Abutments were selected based on the depth of the peri-implant sulcus, which was obtained by measuring the distance from the top of the implant to the highest point of soft tissue (eg, transmucosal cuff heights of 1 mm to 6 mm were available).

*FIGURE 6C* Block out rings were placed to prevent material from flowing into undercuts. Special attention must be given to block out any additional undercut areas to prevent “locking into” these areas.

*FIGURE 6D* Housings were placed to verify the full seating of the final prosthesis, without interference from attachments or housings.

*FIGURE 6E* The final prosthesis was prepared for incorporation of the housings.

*FIGURE 6F* “Vent Holes” were placed in the area of the attachments to allow the escape of excess material and prevent complete seating on the tissues.

*FIGURE 6G* View of housings with black processing males, which were tacked in place with acrylic by means of the patient maintaining a medium biting force in centric while the material cured.

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*b* Straumann USA, LLC, Andover, MA
ensure complete seating of the denture on the underlying tissues. This technique is more technically demanding but also enables the incorporation of attachments into an existing denture (Figures 6a through 6i). Laboratory attachment incorporation is less technique sensitive but does not account for the level of mucocoompression necessary to ensure full seating on the tissues. It is recommended with laboratory curing of the attachments that this be accomplished in the base plate prior to processing of the denture at try-in of the wax rim or the set-up appointment\(^2^1\) to evaluate full seating on the tissues and minimize distortion caused by curing of a bulk of acrylic during processing. This will allow evaluation and correction of the attachment position prior to the delivery appointment.

Techniques have been developed to simplify chairside incorporation of attachments.\(^2^2\) The most important concerns are blocking out any undercuts that acrylic may flow into, preventing removal of the denture, and ensuring that the prosthesis can fully seat on the tissues without being held up by interference with the attachments.

**DESIGN CRITERIA**

The only rationale for incorporation of a metal framework or lingual reinforcing bar is to prevent potential fracture of the appliance due to minimal acrylic thickness or excessive occlusal forces.\(^2^1\) The down side of this is the additional cost and laboratory procedures involved. In situations of high potential fracture of the appliance, such as the extreme occlusal forces seen in patients with opposing full-arch implant-supported restorations or areas of minimal acrylic bulk, a metal frame will serve to resist flexure and potential fracture. An important consideration for the laboratory is to allow open space in the framework for incorporation of the attachments.

**SURGICAL CONSIDERATIONS**

While two individual implants provide outstanding, well-documented clinical results, three or four implants will provide greater retention and level of implant support and minimize anterior-posterior rocking from the unsupported long extension of the denture base. Extreme distal implant placement will decrease anterior support by allowing an anterior lever arm in function (Figure 7). A more stable result will be obtained through implant placement with greater anterior-posterior spread in order to decrease rocking, or through the placement of an additional implant in the anterior segment. While the cuspid position has traditionally been the site of choice for the two-implant overdenture, there is much merit in placing the implants closer to the lateral incisor position to minimize rock and allow for potential additional implant placement in the future. In a larger ridge, consideration of two cuspid and one additional incisor implant—for a total of three implants—is more favorable to prevent the anterior-posterior rock and provide a tripod of support. The implants can be placed in a one-stage or non-submerged approach, since esthetic soft tissue contours are not critical in overdenture therapy. This will also allow a more incisal position of the implant/abutment connection and hygiene access. The specific arch position in relation to tooth and embrasure location is also not critical with a removable prosthesis.

**CONCLUSION**

Through proper patient evaluation, adherence to conventional denture techniques, and ideal communication among surgical, laboratory, and restorative colleagues, implant overdentures provide simple, predictable, and cost-effective treatment to edentulous patients. Additionally, they provide the benefits of esthetics, phonetics, bone preservation, increased comfort, better psychosocial state, and enhanced nutrition, all resulting in an improved quality of life (Figure 8).

**FIGURE 6H** Any voids around the housings were filled in extraorally, and black processing males were replaced by final retentive inserts (available in various amounts of retention).

**FIGURE 6I** View of the prosthesis after being polished and having the occlusion checked; it is ready for final delivery and hygiene instruction.

**FIGURE 7** Distal implant placement resulted in a long unsupported span. A more ideal placement could be realized by increasing the interimplant spacing through the placement of the mesial implants closer to the midline.

**FIGURE 8** The patient experienced a return to comfort and confidence that also resulted in an improved quality of life.
REFERENCES


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