



# The Use of Dental Implants to Improve Quality of Life for Edentulous Patients

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**ABSTRACT** The number of edentulous patients in the United States requiring prosthodontic care is projected to increase in the next 20 years. Awareness of the restorative options to manage edentulous patients will become increasingly important to all dental practitioners. The authors' purpose is to sensitize the reader to the functional deficit in the completely edentulous patient and how restorative approaches with implants can improve patient reports of function and quality of life.

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One-third of Americans over the age of 65 are edentulous and the number of patients likely to need prosthodontic care in the next 20 years is projected to increase significantly.<sup>1,2</sup> The increasing size of this cohort has implications to social policy, dental education, and patient treatment. As clinicians, it is important to be aware of functional limitations and restorative options for edentulous patients. Missing dentition that is not replaced with a prosthesis has been shown to result in a reduced quality of life comparable with the effect of cancer or renal disease on physical well-being scales.<sup>3</sup> An especially relevant area is the mandibular arch because a lower denture often represents a significant compromise in function compared to natural dentition.

Masticatory performance of people wearing complete dentures is less than 20 percent of those with natural dentition.<sup>4,5</sup> More patients report problems with the lower denture than the upper denture, and the most frequent reasons for dissatisfaction are pain, an unstable denture, and difficulties eating.<sup>6</sup> Functional loss is obviously related to the lack of support and stability afforded by dentition, but it is also influenced by diminished salivary flow, decreased tongue motor control, reduced bite force, and diminished oral sensory function.<sup>7-10</sup> In a study of 30 edentulous elderly patients, Ikebe et al. reported that 67 percent of the variation in masticatory performance could be explained by variation in salivary flow, bite force, and oral sensory function.<sup>8</sup> This is not surprising when one considers

that all sensory abilities (vision, auditory, tactile, chemosensory, etc.) start to diminish after the age of 25, and this has an impact on oral function independent of tooth loss in the dentate individual and synergistically in the edentulous patient.

It is difficult to predict how well an edentulous patient will function based solely on anatomic findings. For example, a patient with sufficient ridge height may not function to the expected level based on anatomic findings. Although studies have shown that masticatory performance of denture patients significantly diminishes, patient-related factors such as ridge height and clinical factors, such as technical quality of dentures, only moderately correlate to patient levels of satisfaction.<sup>4,5,11-15</sup> Of course this does not mean that technical excellence does not play a role in optimizing care for patients wearing complete dentures, just that many biological and psychological factors also affect patient satisfaction. For this reason, a complete history that includes questions about levels of masticatory function and impact of existing dentures on quality of life becomes important when treatment planning the edentulous patient for restorative care.

There are many options for restoring the mandibular arch in the edentulous patient. These include the fabricating a new conventional denture, IOD, an implant overdenture, using two or four implants with either a bar and clip or ball attachments, a completely implant-supported removable prosthesis or a fixed prosthesis.

The authors will be reviewing the relevant dental literature and present related clinical examples of prosthetic approaches when treating the edentulous patient. An emphasis will be that planning the correct treatment for the correct reasons requires sensitivity to the psychosocial implications of edentulism,



**FIGURE 1A.** When an edentulous patient is not a candidate for implants yet has significant concerns with their existing dentures, the authors have found using a gold base for the lower denture improves patient reports of satisfaction.



**FIGURE 1B.** Although this is anecdotal evidence, the weight of the gold base has been found to be helpful in improving perceived retention of the lower denture.

understanding the efficacy of various treatment options, and being skilled in the technical aspects of treatment.

### New Dentures

So what can a patient and clinician expect from a new denture? A new denture has been shown to lead to improvements in patient reports of overall satisfaction; most often measurable improvements in esthetics, comfort, and speech.<sup>16</sup> However, new conventional dentures will often not improve functional outcomes.<sup>16</sup> In reporting what foods patients were able to eat before and after a new conventional dentures, Awad et al. reported no improvement in ease of chewing carrots, apple, cheese, sausage, bread, or lettuce.<sup>16</sup> In some situations, new dentures have actually resulted in an overall decrease in patient satisfaction, usually when patients sought implant treatment but had to settle for conventional dentures.<sup>11</sup>

The functional deficit of denture wearers is more problematic in older patients and in patients who self-select as needing implants<sup>6,17</sup> (FIGURE 1). Smith et al. reported that in elderly denture patients, 25 percent reported pain when chewing, and 41 percent needed more time for chewing.<sup>17</sup> This may be because of age-related physiologic changes such as decreased motor tongue control, decreased biting force, or medication-induced xerostomia. The significance is that the long-term denture patient who currently functions at an acceptable level may, with

age, need to be considered for an IOD because function has decreased. Additionally, patients who present with the request for implants often report more psychosocial and functional problems and are harder to satisfy than patients who request conventional dentures.<sup>6,18</sup>

The ability of edentulous patients to tolerate complete dentures is variable and unpredictable. In some situations, patients adapt well to a conventional denture and such patients may report relatively high levels of function as measured by standardized measures.<sup>16,19</sup> Other patients will not have high levels of masticatory function, but this functional deficit does not adversely impact quality of life reports.<sup>20</sup> Therefore, it should not automatically be assumed all edentulous patients need implants. What is important is a comprehensive dental history that includes questions of function and quality of life measures by asking patients what foods they are capable of eating and if current levels of function adversely impacts daily living.

A simple food scale that has been used by the authors lists food in increasing levels of difficulty from soft chewable foods like macaroni, dry bread and crackers, carrots and celery, meats, and, finally, peanuts, as the most difficult to chew for most individuals.<sup>21</sup> A more sophisticated measure of the impact of edentulism on oral health can be gathered by using the Oral Health Impact Profile, OHIP, a 49-item questionnaire.<sup>22,23</sup> Although the



**FIGURE 2A.** The use of two implants.



**FIGURE 2B.** A connecting bar.



**FIGURE 2C.** A clip. If two clips are desired the implants should be at least 12 mm apart and a metal harder than 220 Knopps hardness for fabrication of the bar because wear of the bar can occur over extended periods. Some authors prefer plastic clips because of ease of replacement while others prefer metal clips, which the authors have found are often more durable.



**FIGURE 3A.** When using four anterior implants with an attachment off the posterior there is increased support and retention compared to the two implant IOD.



**FIGURE 3B.** However, if implants can be placed posterior to the mental foramen there is increased support (e.g., **FIGURE 5**) and comfort, compared to four anterior implants.

OHIP has mostly been used in research, it is applicable to clinical situations to identify the subtle influences edentulism has on patient reports of quality of life.

### Two or Four Implants and a Bar

What can the patient and clinician expect from an IOD using a bar and clip? There are a number of very good studies which compare IOD to conventional dentures with measured outcomes such as patient function, degree of satisfaction, and impact on quality of life.<sup>6,11,16,20,24</sup> The IOD bar/clip prosthesis can be expected to result in higher patient satisfaction in the areas of comfort, stability, and ability to chew.<sup>20,25</sup> Additionally, functional outcomes show significant improvements in the variety of food, particularly hard food, that the patient is able to comfortably masticate.<sup>11,16</sup> In a study of 60 edentulous subjects comparing those wearing conventional dentures to mandibular IOD, Awad et al. showed that the IOD patients were better able to eat carrots, apple, cheese, bread, and sausage.<sup>16</sup>

When planning to place two interforaminal implants, it is important to have sufficient interocclusal space, at least 12 mm between implants and adequate space anterior to the bar for setting denture teeth (**FIGURE 2**). The position of the lower implants can be more confidently communicated to the surgeon by completing a denture set-up prior to implant placement. It is also important to not only inform the patient of the anticipated benefits, but also of the limitations to this option. According to Allen and McMillan, the bar, clip overdenture approach resulted in a significantly improved level of function and improved quality of life measurements compared to conventional dentures, yet 30 percent to 50 percent of the patients wearing an IOD bar and clip still avoided eating foods such as carrots and apples.<sup>11</sup>

The comparison of four mandibular interforaminal implants rather than two has been evaluated by one author and it has not been shown to lead to improvement in patient reports of satisfaction.<sup>26</sup>

However, Geertman et al. compared four transmandibular implants to two endosseous implants and comparing different implant systems may not be equivalent. The authors of this paper suggest that four interforaminal implants offers some advantage over two implants, especially for patients who seek more retention and support of the lower IOD. An example of a patient treated with four implants is seen in **FIGURE 3**.

### Two Implants and Attachments

What can the clinician and patient expect from an IOD with two attachments? Many different types of attachments have been used for anchorage to implants. Some of the older attachments are well studied but not currently available while some of the newer attachments look promising, but have not been rigorously compared to the bar and clip that the authors consider the standard (**FIGURE 4**).

If the outcome measured is initial patient satisfaction then there is probably very little difference between ball attachments, magnets, ERA attachments, or Hader bars.<sup>24,27-29</sup> However, most of the studies that have looked at longer-term outcomes reported that the number of adjustments and repairs with ball attachments was significantly higher than with a bar and clip.<sup>30</sup> In a study of 100 patients studied over a three-year period,

Walton determined ball attachments (Nobel Biocare, Yorba Buena, Calif.) were three times more likely than the bar and clip to need repairs and patients rated the bar and clip far more successful.<sup>30</sup> A strong predictor of favorable patient satisfaction has been shown to be retention of the prosthesis and when an attachment is not working properly patient concern is understandable.<sup>31</sup>

The advantages of ball attachments compared to a bar and clip are that they are less expensive, require less chairtime, less technical expertise, and will probably provide the same initial level of patient satisfaction. However, when implants are malpositioned or excessively divergent, a bar and clip will often facilitate a better functional and esthetic result than attachments. The authors are familiar with some of the newer attachments available (Locator, Zest Corp.) and the reaction is moderately favorable. However, since there are no randomized clinical trials comparing the locator attachment to the bar and clip, the authors' tendency is to recommend a bar and clip when using two implants in the anterior mandible.

### Fully Implant-supported Fixed and Removable Options

Having implants placed posterior to the mental foramen allows for an entirely implant-supported prosthesis that affords a more comfortable and stable prosthesis than possible from two anterior implants (FIGURE 5). It is important to remember that pain is often the chief concern and limiting factor in wearing conventional dentures. Two interforaminal implants offer some support but the prosthesis is implant- and tissue-supported. When additional implants can be placed posterior to the mental foramen significant improvements in support, function, and comfort is possible. Because placement of implants



**FIGURE 4A.** Clinical example of an IOD using Locator (Zest Corp.) attachments.



**FIGURE 4B.** Locator attachments are less expensive than a bar and clip, but few long-term studies have compared bar clip IOD to Locator attachments.



**FIGURE 5A.** This is an example of a CAD/CAM milled bar, an alternative to the traditional metal casting process. In this example, a significant anterior/posterior spread was created so the denture was entirely implant-supported.



**FIGURE 5B.** A metal housing was incorporated into the denture base.



**FIGURE 5C.** This incorporation was done to improve fracture resistance.



**FIGURE 5D.** The final prosthesis is shown.

can help with the preservation of bone, it is often advantageous to the patient to have posterior implants.<sup>32</sup> In young edentulous patients where expected resorption of posterior bone is likely to occur, the authors will often treatment plan implants before the anticipated bone loss makes implant placement more difficult. When implants can be placed posterior to the mental foramen and a completely implant-supported prosthesis can be considered, most of the studies have shown very little differ-

ence when comparing a fixed vs. removable implant-supported prosthesis.<sup>6,33,34</sup>

In a randomized crossover trial, Feine et al. determined most patients reported that a fixed prosthesis provided better stability and chewing ability than an implant-supported removable prosthesis; however, patients who valued aesthetics and cleaning ability were generally more satisfied with an implant-supported removable prosthesis.<sup>33</sup> Feine et al. also showed that a fixed prosthesis enabled the



**FIGURE 6A.** The patient presented with a mandibular implant overdenture but complained about maxillary denture instability. Because of a low sinus, an "All-on-4" approach was planned.



**FIGURE 6B.** Radiograph of the patient with maxillary implants positioned such that the two anterior implants were vertically aligned and the posterior implants inclined to the posterior consistent with the "All-on-4" protocol.

patient to eat harder food such as carrots, apples, and sausage, but that patients over the age of 50 tended to prefer the implant-supported removable prosthesis.

When there is less than 10 mm to 12 mm of interocclusal space, sometimes a fixed prosthesis will be necessary. For an IOD-supported with a long bar, approximately 10 mm to 12 mm of vertical space is required for the space of the bar, clips, acrylic resin, and denture teeth. When considering a long bar implant-supported removable prosthesis, an additional consideration is cost. The additional cost of the longer bar, cast housing in the denture base, more restorative implant components, and increased chairtime can dramatically increase fabrication costs. The authors have found that a metal frame is required for strength in approximately 50 percent of the two-implant IOD prosthesis, but is recommended for all prosthesis that are entirely implant-supported. Further, the cost of a fixed prosthesis is, on average, significantly more expensive than the cost of a long bar removable prosthetic treatment.

### All-on-4 Concept

The use of four implants to support a fixed complete denture has been recently advocated and evaluated.<sup>35</sup> This protocol involves using computer-guided surgery for the placement of four implants: two implants aligned in the edentulous anterior and two implants angled posteriorly so that anatomic barriers such as the maxillary sinus or inferior alveolar nerve can be avoid-

ed. The advantages of angled posterior implants are that longer implants can be used, procedures such a sinus lift can be avoided, and the length of a posterior cantilever can often be decreased. This protocol requires that the patient have an anterior vertical opening of at least 50 mm for placement of angled posterior implants. Additionally, the protocol requires that the implants be splinted and allows for immediate loading and function. The protocol has shown success rates of more than 97 percent but requires additional training and coordination of care.<sup>35</sup> **FIGURE 6** shows an example of implants added at an angle in preparation for a maxillary immediate fixed denture.

### Conclusions

Implants have revolutionized restorative dentistry and have afforded many benefits for patient care. In the management of the edentulous patient, implants offer the potential for significantly improved function, and enhanced quality of life. The contemporary practitioner should be able to carefully assess the patients' current status and desires, appropriately discuss the treatment options with or without dental implants, and be skilled in the technical procedures required for prosthesis fabrication. ■■■■

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