Treatment Planning for Implants in the Maxillary Edentulous Patient

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Recent research has discussed techniques to improve a practitioner’s predictability, proficiency and aesthetic outcomes in removable complete dentures. More than 60 million people in the United States alone have dentures. In a recent survey, a significant number of denture wearers reported household incomes of more than six figures. Patients’ desire to no longer have a removable prosthesis, along with the public’s increased knowledge of implants, means that more patients are electing implant-retained prosthetics over conventional denture counterparts.

For a patient, the psychological effect of missing maxillary teeth is extremely powerful. On several occasions, patients have disclosed to me that their biggest fear was that they may require a lifesaving surgery where intubation was necessary. They mentioned that they would “rather die” than remove their teeth in the presence of other people. It is not uncommon for patients to request after-hours appointments or secluded operators so that they would have limited contact with staff. Many of these patients seek out practitioners who not only have advanced training in implant prosthetics, but can also demonstrate, with prior case documentation, the psychologically beneficial cosmetic appearance they desire.

Where to start

Several options are available for the completely edentulous patient, including a complete removable denture, an implant-supported removable overdenture, a fixed hybrid, or a fixed prosthesis. Once it is determined that the patient has adequate bone to support any of these prostheses, or the ability to undergo augmentation to achieve the necessary bone-level foundation, the determining factor between these options comes down to patient finances. Fees will be discussed later.

“In a 20-year review of the literature compiled by Dr. Charles J. Goodacre and his colleagues, restorations associated with the edentulous maxilla have the highest early loading implant failure rate compared with any other dental prostheses.” In light of this research, it is extremely important to have a clear understanding of implant prosthetics and treatment options available for the edentulous maxillary arch.

Although guidelines exist for the surgical aspect of implantology, few standards exist for the prosthetics.

“A review of the literature indicates that full maxillary fixed-implant-supported prostheses may be fabricated on four to six standard-diameter implants with posterior molar cantilevers. An average of four to six implants also is used to support bar overdentures. Yet the edentulous maxilla has the lowest implant survival for either fixed or removable implant restorations compared with mandibular prostheses with this treatment approach.” These studies indicate that many dentists are choosing to restore a fixed prosthesis in the
maxillary arch with fewer supporting implants than they would choose for that same prosthesis with the natural dentition. The perception is that implants are stronger than natural teeth and can tolerate these forces with fewer abutments than the natural dentition. In actuality, implants are more rigid than teeth—due to the lack of the periodontal apparatus—and when subject to powerful forces, cannot recuperate like the natural dentition can. The rigid abutments transfer force to the implants, which magnifies the inflexibility of the restorative material used and the direction of force applied to the prosthesis and implants.

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The treatment plan

The first step in treatment planning the maxillary edentulous arch is to determine the facial and incisal edge position of the maxillary anterior teeth. This can be accomplished with the use of a papillometer, Alma Gauge, and wax rim. The position of the maxillary interior teeth determines the anterior arch form for the final restoration. This determined arch form often will be different than the existing edentulous ridge. This is a key component to determine the patient’s options due to the differences between the desired arch form and the existing ridge form. When the labial position of the maxillary wax rim is forward of the residual ridge more than 5mm, a bone graft is required before implants to support the lip for a fixed restoration, or an overdenture must be considered as an alternative.

The second step in treatment planning is to determine the key implant positions for the maxillary restoration. As determined by Dr. Carl Misch, the guidelines for key implant position include:

1. No posterior cantilevers. While anterior teeth often can be cantilevered off of implants, there should be little to no posterior cantilevers present in the maxillary edentulous arch.
2. No posterior three adjacent pontics.
The bone density often is less in the posterior maxilla, which increases risk of overload on the implants.
3. Canine site. A traditional prosthodontics axiom indicates that a fixed prosthesis is contraindicated when a canine and two or more adjacent teeth are missing. The canine prosthesis is at greater risk than nearly any other area in the mouth. Once the tooth is missing, it should always be a site for implant placement.
4. The first molar site. This is an important abutment position in an edentulous maxilla. The bite force in this site increases to twice as much as that in the premolar sites.
5. Five-sided arch. Bilateral posterior zones (second molar to first premolar), canines, and incisors (Fig. 1)

The third step in treatment planning is to understand arch forms present for both the premaxilla and the entire dentate arch form. The premaxillary dental arch form is determined by the distance from two horizontal lines. The first line is drawn from one canine incisal edge tip to the other. This line most often bisects the incisive papilla regardless of the dentate arch form. The second line is drawn parallel to the first line along the facial position of the anterior teeth.

If the distance is 8mm or less, the patient has a square arch form and typically the only implants necessary in the premaxillary area are in the canine sites (Fig. 2), with six implants minimally required for bar-retained overdentures, fixed hybrids, or completely fixed cases (Fig. 5). In some cases, four implants may suffice for a removable overdenture without a superstructure bar if the denture is also supported by tissue (removing the palate is typically not an option here).

If the distance is 8-12mm, the patient has an oval dentate arch form, so an additional implant site should be considered. Most commonly this will be in the central incisor area to increase the anterior-posterior spread of the premaxilla (Fig. 3). In a full-arch case, the
minimal requirement for bar-retained overdentures, fixed hybrids, or fully fixed prostheses is at least seven implants (Fig. 6). In instances where a bar superstructure is not being used, five implants may suffice.

If the distance is 12mm or greater, the patient has a tapering arch form, so two additional implants should be placed in the central incisor region to increase the anterior-posterior spread (Fig. 4). The minimum requirement for implant placement in full-arch cases is eight implants, with the potential of 10 implants in the second molar locations for increased force considerations, such as bruxism, or patients who have poor bone quality. This allows for a greater anterior-posterior spread, versus implants placed secondary in the first premolar position (Fig. 7).6,19,23

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A question of space

Deciding between a fixed-implant prosthesis or removable prosthesis depends on the space available for the restoration and restorative material. For a fixed-implant prosthesis, the ideal vertical dimension between the crest of the ridge and incisal edge of anterior teeth should range between 8–12mm. "This measurement accounts for the 'biological width,' abutment height for cement retention or prosthesis screw fixation, occlusal material strength, aesthetics, and hygiene considerations around abutment crowns. It has been called, for lack of a better term, crown height space."26

Crown height space between 12–15mm usually requires the additional replacement of the gingival tissues for aesthetics, otherwise the teeth appear too long. In such situations, materials of choice are either porcelain fused to metal (PFM) or porcelain fused to zirconia. Zirconia has emerged as a potential solution for lab fabrication issues with restorations that have a crown height space in the 12-15mm range. PFM restorations require multiple temperature firings, and labs and dentists have complained that this causes substructure warping and the introduction of error in the fit of the prosthesis. Zirconia can be milled in monolithic form and externally stained, virtually eliminating fabrication errors. Even if porcelain is cracked on zirconia, it is not subject to the same warping potential as a metal substructure.

Crown height space greater than 15mm typically is replaced with either a removable overdenture or a fixed hybrid, due to the amount of gingival tissue replacement required. Fixed hybrids or overdentures are often the treatment of choice in implant prosthodontics because patients receive a securely fitting appliance that also has the desired aesthetic outcome, but at a much cheaper cost than a completely fixed restoration. If the crown height space is less than 12mm, fabrication of an overdenture often isn’t possible due to the lack of space for both a bar and the overdenture. In situations where a fixed hybrid is considered with less than 12mm crown height space, the dentist and patient should understand that the prosthesis is at risk of complications due to the decrease in bulk of acrylic with reduced space, and increased risk of possible fractures.

Fees

Although no set standards exist for fee-setting in bar overdentures, fixed hybrids or completely fixed restorations supported by stock or custom abutments, many dentists use a popular price range. A four-implant bar overdenture should be approximately 4.5 times your practice’s usual, customary and reasonable (UCR) complete-denture fee, not including implant placement. A six- to eight-implant bar or fixed hybrid is approximately 6–7.5 times the UCR complete-denture fee of your practice. In
cases of fixed restorations supported by custom or prepared abutments, fees of 1.5–2 times your UCR traditional crown fee per implant crown (including abutment) are common. Pontics are typically less.

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**Case presentation**

A 49-year-old patient presented with the chief complaints of an ill-fitting, existing implant-supported overdenture, a lack of tooth display during smile, and overall dissatisfaction with the aesthetics of the prosthesis. The denture was palateless, and partially tissue-supported with two ERA locator-type attachments in the maxillary first premolar sites (Fig. 8). This design is contraindicated with so few implants supporting it. It was determined that the patient had enough bone to support a completely fixed prosthesis over abutments, a fixed hybrid, or a bar-retained overdenture. Following a discussion of the fees, the patient chose the fixed hybrid option.

The initial step in the fabrication of the fixed hybrid was determination of the incisor edge position. This was accomplished by using the papillameter reading, lip at rest position, and Alma Gauge from her previous denture with cosmetic mock-up to ideal tooth display. Her arch form was determined and key implant positions chosen. An initial vertical dimension and bite registration was taken with the use of a centric tray at her initial visit (Ivoclar Vivadent). Because she already had implants placed in positions that would contraindicate placement in the adjacent canine positions, secondary sites were chosen (Fig. 8). During the healing process, the patient wore her existing overdenture. She was given the option of having a new overdenture fabricated during this time, but decided against it due to the additional cost.

Following the healing phase, the patient presented for her second visit and the initial implant impression. Open-tray impression copings were placed, hand tightened, and confirmed seated with digital radiography. The impression copings where joined with floss and then flowable composite to prevent rotation of the copings in the impression material during removal of the open tray, and placement of the implant analogs.

A MiraTray Implant from Hager & Werken (Fig. 11) was used to capture the impression. The implant analogs were then placed on the impression copings and sent to the lab for fabrication of a verification jig (Fig. 12). At the patient’s next visit the verification jig was seated and passive fit confirmed with digital radiography (Fig. 13). If the verification jig did not fit properly, it would have been sectioned, placed over the implants, the segments would have been joined with composite (no shrinkage versus acrylic or inlay pattern resin), and the open-tray impression repeated. Vertical dimension and centric relation were recorded with the use of a second set of baseplates. Tooth selection of type, form, size, shade and occlusal design finished the second appointment. Following a visit for wax try-in, the final prosthesis was fabricated (Figs. 14 and 15).

**Conclusion**

Seeing a patient present with a completely edentulous maxilla is common in dentistry today. With more patients seeking implant services, it is important to understand the differences in the prosthodontics for the maxillary arch as compared to the mandibular arch. Typically, more implants are required in the maxillary arch than the mandibular arch, and understanding the key implant positions and rules of prosthetic replacement are paramount to ensure longevity of the patient’s definitive restorations.