Revisiting implant-retained mandibular overdentures: planning according to treatment needs

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Increasingly popular, implant-retained mandibular overdentures have a highly predictable success rate and provide many options in terms of design and attachment systems. General dentists may have some difficulties in choosing the appropriate system. This article provides a general overview of the various options that are available, taking into consideration the specifications and challenges of each.

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Implant-retained mandibular overdentures have proven to be a viable and cost-effective treatment alternative with a success rate between 95%-100%.[1,2] This favorable outcome is the result of proper design, precise execution, and regular maintenance visits to avoid complications. Maintenance sessions should include a periapical X-ray to visualize the bone-implant condition and a clinical examination, including the insertion/removal of the overdenture, checking the opposing denture or teeth, correcting the occlusion/vertical dimension, and verifying that the prosthesis still fits properly. Oral hygiene procedures have to be reinforced at each visit, and a proper cleaning protocol should be implemented for both the implant superstructures and the denture.

A wide choice of mandibular implant overdenture designs and attachment systems exist, and the dentist and patient must decide on the best benefit vs cost choice. This article reviews the various options for an implant-retained mandibular overdenture, and the pros and cons of each corresponding attachment system. Clinical guidelines will help dentists evaluate these options according to their own experience and the patient's needs.

Options for implant-retained mandibular overdentures

The design of an implant-retained mandibular overdenture depends on 2 major factors: the number of implants to be placed, and the type of attachments those implants will support. The number of implants placed in a mandibular overdenture range from 1 to 4; starting from 4 implants, the fixed option becomes possible and recommended as it can help avoid the loss of denture fit on the posterior ridges that is sometimes seen with independent implants.[3-5] The 2 most widely used and documented types of attachment systems are ball abutments with a cap or housing for separate implants, or bar-clip systems for splinted ones.

A complex interplay of factors surrounds the design decision, including the patient's expectations, his/her medical and oral conditions, the dentist's skill set, short- and long-term costs, and readiness of both the patient and the dentist to deal with possible emerging complications in the aftercare phase. Once the design—including the number of implants—is decided, the attachment systems will follow automatically.

Metal reinforcement in mandibular overdentures

The use of chromium or gold alloy frameworks serve to prevent overdenture fractures due to the large space occupied by the abutments and retentive implant components placed in the dentures.[6] They also offer the ability to detect thermal changes, which enhances the perception of ingested food and beverages—a positive attribute related to temperature transmission down to the mucosal tissues underneath.[7] Although the majority of studies recommend this procedure, some authors have witnessed an increased implant loading with metal frameworks, and therefore advocate the use of high impact resins, which are considered safer. These high impact resins present a low fracture rate of approximately 6%.[8]

Implant-retained mandibular overdenture using 1 implant

Rehabilitation with mandibular overdentures anchored to a single implant can be a reliable, therapeutic, and less expensive alternative for elderly patients experiencing masticatory discomfort and functional difficulties. This option is also valid for patients with disabilities or who have reduced dexterity. The implant is usually inserted in the midline of the mandible, and studies have reported 100% success over a 5-year period.[9] Possible complications include poor fit of the prosthesis and inadequate retention, mainly due to the wear on the rubber ring in the O-ring attachments; these need to be replaced on average every 5 to 6 months. The prevalence of wear with a ball attachment system is significantly lower than bar-clips.[10]

A 2008 biomechanical in vitro study by Maeda et al revealed that under molar functional loads, the single implant overdenture had similar biomechanical effects when compared to a 2-implant overdenture in terms of lateral forces to the abutment and denture base movements.[11] The implant in that study was also immediately loaded, with relatively few prosthetic problems compared to other studies.[12] As long as a rough implant surface is used, a beneficial outcome can be expected with a minimal financial outlay.

Implant-retained mandibular overdenture using 2 implants

This type of mandibular overdenture is the most popular for rehabilitating totally edentulous patients. A variety of designs are possible, based first on whether or not to splint the 2 implants, then which

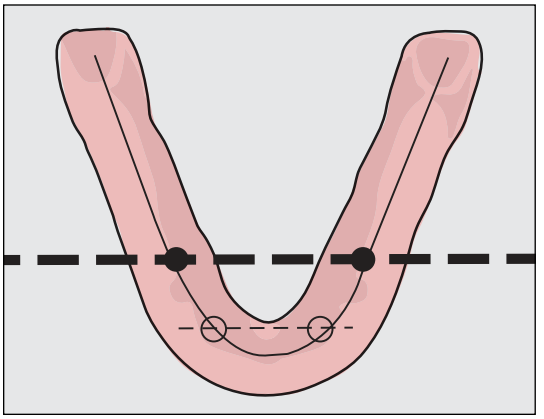

Fig. 1. V-shaped ridge. Distalizing an implant position would result in a bar and denture flange impinging on tongue space.

Fig. 2. Implants placed at lateral-canine sites.

Fig. 3. Optimal distance of approximately 25 mm between implants for a bar design.

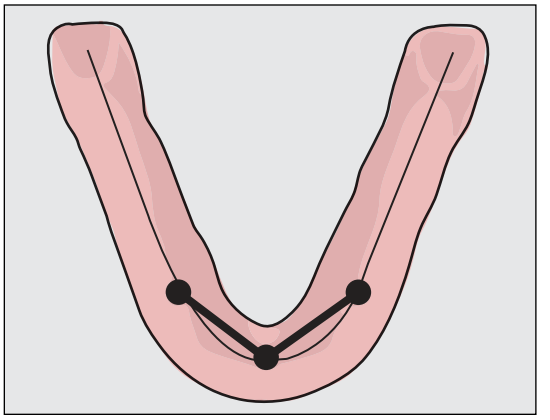

Fig. 4. Schematization of the relation between 3 implants placed in a V-shaped lower ridge.

type of attachment should be used (ball or bar, or a combination of both on the same arch). Both approaches are clinically successful with certain caveats: unsplinted implants with a ball and ring system require more maintenance, and patients with bar-retained implants have greater difficulty with oral hygiene.[13]

For a better biomechanical distribution, the general consensus is to position the implants anteriorly and refrain from inserting them in the premolar area.[14] The anatomical shape of the ridge has a crucial influence on the location of the implants and the selection of the attachment mechanism. Two major ridge types can be described with a multitude of mixed attachment combinations between the left and right sides in the same mandible.

In V-shaped ridges, implants that are placed in the canine area using a straight bar to connect the implants might impinge on the tongue space (Fig. 1). When splinted implants are placed too far anteriorly, the corresponding bar length will be short, thus reducing the prosthesis stability during function, with a resultant increased loosening of the clips. It is therefore advisable to keep implants independent. They are best placed in the area of laterals and canines so as to limit the forward rocking during function (Fig. 2). If placed more posteriorly, greater hinging will be allowed, resulting in greater leverage forces against the implants.[15]

U-shaped ridges are more tolerant than V-shaped ridges in terms of implant positioning. The ideal inter-implant distance differs from one study to the other, probably due to ridge size discrepancies. The optimal distance should be approximately 24 ± 5 mm, as this increases the retention force of the attachment mechanism.[16]

For bar-clip systems, the inter-implant spread should minimally be 14-16 mm to provide adequate length without impinging on tongue space.[17] With a Hader bar and 2 clips, optimal retention can be delivered if the spread is equivalent to the inter-canine distance (approximately 22.5 mm) (Fig. 3).[18]

Implant-retained mandibular overdenture using 3 implants

A 3-implant design resolves some of the problems encountered with bars in V-shaped ridges. Two implants are

placed in the canine position, the third anteriorly in the midsymphyseal region.[19] However, the 2 nonaligned clips prevent the hinging of the distal section of the prosthesis, resulting in an increased load on the implants.[14] In such cases, general requirements are necessary to secure the implant-prosthesis complex: the posterior ridge must be favorable, distal cantilevering must be excluded, and the implants must be widely spread, preferably not in a straight line or frontal plane (Fig. 4).

Implant-stabilized mandibular overdenture using 4 implants

Whatever shape ridge the mandible has, placing 4 implants can provide the prosthesis with different possibilities of support. A full implant support using a bar-clip system can be indicated when a wide implant spread is possible. This design depends on the implant-to-bone anchorage value, a minimal distance of approximately 20 mm between the implants, and the size of the jaw. Preferences of the practitioner and/or patient are also of value. Distal cantilevering is usually contraindicated, as it increases the loads on the most distal implant. However, it might be tolerated under certain strict conditions.

When implants are left independent through the use of 4 separate stud attachments, the prosthesis is implant-assisted and ridge-supported. However, the unavoidable loss of denture fit on the posterior ridges will, with time, overload the distal implants and increase the strains within the matrix-patrix system, leading to the loss of retention and tear of the attachment.

Resilient attachments are desirable when a greater amplitude of movement is needed to accommodate poor ridge anatomy. A stress-breaking effect might be obtained with rotational bars such as Dolder bars. The egg-shaped cross-section, together with the possible use of a spacer placed underneath the clip, allow for an apical movement and a hinge motion. O-ring or extracoronal resilient attachments (ERA, Sterngold) may deliver up to 6 directions of motion since the system is resilient and no bar is limiting the prosthesis movement. A bar-ball design is also possible when the solitary attachments are placed over the bar.[13]

Discussion

Common sense would favor the statement: "The more complicated the design, the more complications one might have!" Having an implant-retained overdenture with a single implant should be easier to maintain and repair than a 4-splinted implants system. However, not all studies have reached this conclusion.[20]

In the single implant solution, the improvement over a satisfactory conventional denture is limited. When compared to 2-implant mandibular overdentures, some benefits are noticed. By placing the implant most anteriorly, the off-axis considerations can be minimized. The single implant overdenture option should be indicated when a patient is elderly, has impaired motor skills, or when there is a surgical risk.[21] A single implant system has the advantage of a decreased need for metal reinforcement, especially with attachments of low profiles. This simple system might also allow a trial period and reassessment in order to keep the denture as is or add more implants.

The 2-implant treatment modality has become increasingly more popular over the past 20 years and is now well-established and documented.[22] With this system, the first premolar positions should be avoided, particularly in splinted designs regardless of the ridge shape. If the bar is curved or angled, the span will be too long relative to occlusal loading and flexibility—the latter is approximately 5 times greater when implants are in the canine position.[23] If the bar is straight, it impinges on tongue space due to the lingual flange accommodating for the attachment volume.

Regardless of the type of attachment, if the prosthetic teeth are set too far anteriorly, rotation and tipping are more prevalent. The resultant transfer of the mastication area tends to occur more posteriorly, thus increasing the load on implants and the posterior ridge.[24]

In 3- and 4-implant systems, it is more common to use bars, since abutment parallelism is usually more critical with independent implant systems.[25] However, a 3- to 4-implant design is a valid transition from a removable design to a fixed one. For that purpose, a judicious initial planning of the case is of utmost importance. Another issue with a 3- to 4-implant design is the anteroposterior (A-P) spread. Since more than 2 implants are placed, the A-P spread can affect the stability of the prospective denture. The distance between the most anterior and the most posterior implant should be evaluated, taking into account the arch form. Tapering arch forms are the most favorable, while square arches are the least.[14]

Regardless of the implant number, the space available for the prosthetic components needs to be considered. With bar systems, a minimal vertical space of 10-12 mm is needed from the gum to the occlusal plane—13 to 14 mm from the implant platform—allowing 4 mm for the bar, 1 mm between the bar and gingiva for hygiene, as well as space for the clip and the acrylic/tooth housing. Individual attachments require only 10-11 mm of vertical space above the implant platform, thus offering more flexibility. When using attachments such as Locator (Zest Anchors), the amount can be reduced to 8.5 mm of vertical space and 9 mm of horizontal space.[26]

Anticipating the type of complications expected post-treatment is another aspect to consider when choosing an implant-retained mandibular overdenture. Since every repair/replacement can be time-consuming and frustrating, the design that requires the least maintenance is preferred.[27]

In general, the most frequent technical and mechanical complications expected post-treatment are the loss of retention, damage to the retention mechanism, fractures of the restorative material, and the need for rebasing or relining.[28] Problems usually appear during the first year post-treatment and may continue in the long term. There is a potential for far more serious complications, making it essential that a dentist thoroughly consider the proper design for each patient in order to achieve a cost-effective outcome.

Finally, both the patient and the dentist carry the expenses of frequent maintenance recalls and needed replacements/repairs. Replacement of delicate attachments on a regular basis is relatively frequent and thus potentially costly. Compared to fixed implant restorations, maintenance requirements in terms of rate and adjustment of implant-retained overdentures is 3 times more than implant-fixed prostheses. The long-term repair costs could run approximately 60% higher than fixed implants,

because the attachments and denture teeth wear faster. This could explain why clinicians are more comfortable with fixed restorations.[29] Another explanation for the increased cost is that extra clinical time is required to manage the complications of implant-retained overdentures. Depending on the system selected, an average of 72-98 minutes of professional time per patient might be necessary in the first year of service, creating additional costs that need to be considered when determining the patient's total financial commitment for this type of treatment.[30]

Conclusion

The 2002 McGill consensus statement addressed mandibular rehabilitations.[31] It stated that, regardless of the attachment mechanism, mandibular 2-implant overdentures will drastically improve patient satisfaction, comfort and oral function compared to conventional dentures.[31,32] Although this treatment is the most commonly used, it is sometimes useful and necessary to have other options ranging from 1 to 4 implants.

The follow-up required post-treatment is necessary for quality service and patient satisfaction, and carries with it a professional, personal, and financial responsibility for both the patient and the practitioner.[33] Despite the apparent simplicity of an implant-retained mandibular overdenture, each treatment option has an ongoing need for aftercare maintenance and the potential for post-treatment prosthodontic complications. The long-term expenses of the treatment, the most favorable design of the prosthesis, and the control of bone loss need to be understood in order to overcome these progressive prosthodontic complications.

The role of the general dentist, in collaboration with a prosthodontist in designing and monitoring the prosthesis, and the oral surgeon in placing the implants, is of paramount importance in reducing aftercare time and improving the cost-effectiveness of the treatment.

Author information

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