Implant-supported overdentures

Brenda Baker and **David Reaney** discuss the factors that govern the planning of implant-supported overdenture treatment

An implant-retained overdenture is a removable dental prosthesis supported by the residual oral tissues and employs dental implants for retention.

Implant-retained overdentures are a treatment alternative for many patients for whom conventional dentures are poorly tolerated. They may be indicated in patients with changed anatomy, neuromuscular disorders, significant gag reflexes or considerable ridge resorption (Vere, Bhakta, Patel, 2012).

As life expectancy is increasing globally and people are becoming edentulous at later stages, partial edentulism is becoming more commonplace until old age (Vasant, Vasant, 2013). Implant-retained overdentures may reduce residual ridge resorption and enhance mastication and hence nutritional status, improve speech and patient self-esteem (Doundoulakis et al, 2003).

Factors that govern the planning of the overdenture treatment are:

- The number and length of the implants
- Quality and quantity of the anchoring bone tissue
- Economic constraints.

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Indications for attachment-retained treatment (Dentsply)

- An unfavourable jaw relation that makes treatment with a fixed bridge restoration difficult
- Aesthetic problems, for example, the need for lip support in the upper jaw
- Phonetic problems due to loss of alveolar bone in the upper jaw
- Patient dissatisfaction with removable denture due to oral irritations and/or loss of bone for denture fixation
- A bridge option makes satisfactory oral hygiene impossible or extremely difficult to achieve
- Edentulous patients with a cleft palate.

To ensure an optimised restorative treatment, the following conditions should exist:

- Parallel implants
- If a rigid bar connector is used ensure there are no large distances between implants
- Appropriate length of extension bars, not too long
- Adequate resilience of the mucosa; the mucosa should not be too soft
- Provide an even load on the mucosa when the prosthesis is in function.

Retention of implant-retained overdentures

Overdentures may be retained by a number of different implants, which can be splinted or separate (Dudic, Merickse-Stern, 2002).

Authors have reported high implant survival rates for mandibular overdentures and thus successful treatment outcomes when overdentures are retained by two implants (Meijer et al, 2009), splinted or non-splinted.

In the maxilla, the evidence base supports the use of four to six implants splinted with a bar, although free-standing abutments are increasing in popularity (Galluci, Morton, Weber, 2008).

There are various prosthetic options and attachments that are available to provide a satisfactory overdenture. The success of the implant-supported overdenture will depend on the correct position and distribution of the supporting implants. These considerations have a direct effect on the selection of the attachment for each particular situation.

MANY PATIENTS CAN BITE THEIR OVERDENTURE INTO PLACE AT AN ANGLE AND CAN CAUSE DAMAGE, WHICH MAY REQUIRE REPLACEMENT

Attachment selection

The different attachment assemblies are:

Bar and clip systems

The major bar types come with matching clips. These are incorporated into the prosthesis, either at the time of processing or afterwards as a pick-up procedure. Some systems include a spacer that can be incorporated at processing.

The use of the spacer enables a space between the clip and the bar when the prosthesis is at rest in the patient's mouth. Upon biting, the denture is capable of some vertical movement so that there is some support for occlusal loads instead of purely implant support.

A milled bar is classified as a rigid attachment. Milled bars do not allow movement of the denture base and can provide relief over painful areas, such as superficial mental nerves (Dudic, Merickse-Stern, 2002). A cast bar may be made

Implant-supported overdentures may suit patients with changed anatomy, neuromuscular disorders, significant gag reflexes or considerable ridge resorption

including proprietary components, or a custom design can be fabricated. Subsequently, the denture is made to fit over the custom design.

Resilient bars when appropriately designed allow a single axis of rotation, use greater mucosal support and offer greater protection to the retentive attachments. Both rigid and resilient bars can be used to align non-parallel implants. However, they need at least 10mm of interocclusal clearance and should not be used when vertical space is limited (Chee, Jivraj, 2006). The Hader Bar, which is a semi-precision bar attachment that provides hinge movement provided by only a single Hader Bar, has been used in the attachment assembly design (Shafie, 2007).

The Dolder Bar is a prefabricated precision bar attachment that comes in two forms:

- The rigid form is U-shaped with parallel walls. The resilient form is egg-shaped in cross-section and provides vertical and hinge resiliency
- The resilient Dolder Bar is also called a bar joint. The Dolder Bar is indicated for overdenture patients with adequate or relatively large interridge space.

Studs

There are important considerations regarding stud attachment alignment if stud attachments are used, including:

- All stud attachments should be parallel to each other and the attachments should not interfere with the insertion path of the overdenture
- It is harder to achieve an ideal alignment with taller attachments than shorter ones.

Either synthetic rubber rings or metal lamellae are included in the prosthesis. When the prosthesis is inserted, they flex sufficiently to engage into a circular undercut on a metal post, which is part of an abutment screwed into an implant. The locator overdenture stud attachment was designed for easy insertion and removal, dual retention, a low vertical profile and its pivoting ability, so it was resilient and tolerant for implant divergence.

Many patients can bite their overdenture into place at an angle and can cause damage, which may require replacement. For this reason, the locator attachment was designed to be self-aligning.

As a result of these design features, in 2010 it became available for many different implants from varied manufacturers. A new generation of implants called overdenture implants has been introduced into implant dentistry (Mericske-Stern et al, 2000). The main design difference between overdenture implants and traditional implants is that part of the stud attachment, either male or female, has been combined in the implant body.

Magnets

Magnets provide the least retention and have two main disadvantages:

- The retentive force produced reduces sharply as the distance between the elements increases beyond very close contact (100 microns)
- Over a period of time, there is a loss of magnetic attraction, sometimes accompanied by corrosion (Preiskel, Preiskel, 2009).

Telescopic copings (rigid and non-rigid)

Note that patients with advanced resorption of the ridge are suitable for bar or telescopic attachment assemblies that offer horizontal stability. Patients with minimal alveolar resorption of the ridge are suitable for studs or magnetic attachment assemblies.

Maxillary implant overdentures have different treatment considerations than mandibular implant overdentures; when maxillary bone resorbs and atrophies, this may restrict implant placement. The resorption of the residual ridge area in the mandible, however, may often allow the use of implants anteriorly due to substantial basal bone in terms of width and depth in that area.

Mandibular implant overdentures

The following treatment concepts have been summarised by Sadowsky (2001).

The mandibular overdenture retained by implants in the area between the foramina maintains bone in the anterior mandible. The average annual bony ridge height physiological shrinkage is about 0.4mm in the edentulous anterior mandible. Studies have revealed better patient-based results when two implant supported mandibular overdentures have been used compared with conventional lower dentures.

In 2002, the McGill consensus published that the treatment modality of choice for the edentulous mandible should be a two-implant retained overdenture (Feine et al, 2002). Vere, Bhakta and Patel stated: 'Two free-standing implants in the canine regions, as the simplest option, would appear to be the treatment of choice to retain an

Figure 1: Simulated implant-supported dentures

Figure 2: Implant-supported bar and clip mandibular overdenture

overdenture in the edentulous mandible' (2012).

The anterior mandibular bone under an implant overdenture may resorb at the rate of 0.5mm over five years and long-term resorption may remain at 0.1mm per annum (Jemt et al, 1996; Quirynen et al, 1992; Naert et al, 1998). Bone undergoes remodelling in the anterior mandible as a result of more functional loading with implants.

In younger patients or those edentulous for less than 10 years, a fixed implant denture may preserve posterior bone better than an implant overdenture in the lower jaw. Many patients with mandibular implant overdentures can experience a loss of fit of their maxillary complete dentures and need upper full denture relines. There can be a transfer of significant occlusal forces onto the anterior maxilla with maxillary bone resorption and soft tissue inflammation. The deleterious forces could generate more midline fractures in the maxillary denture, and there should be no anterior contact in the centric relation position and minimal anterior contact in lower excursive movements. Frequent recalls to assess stability and retention should be scheduled.

Retention, stability, and chewing function improve only slightly with an implant-supported mandibular overdenture as compared with an implant-mucosa-supported overdenture.

Multiple implants can be recommended for the mandibular overdenture when there is a:

- Dentate maxilla
- High retention needs
- Implant length less than 8.0mm
- Implant width less than 3.5mm.

When two implants are used in the anterior mandible to retain an overdenture, solitary ball attachments are more economical, easier to clean than bars that are more retentive, less technique sensitive, and more suitable for tapered arches. Mucosal hyperplasia is less likely to develop with solitary ball attachments.

Overdentures retained by two implants in the anterior mandible need more maintenance during the first year than in later years. Whether the ball or bar design requires more maintenance is controversial.

There appears to be no statistical difference when comparing long-term maintenance of mandibular implant overdentures retained by two implants in contrast to those retained by three or more implants. Patients are happier with mandibular implant overdentures than with complete dentures, even when patients had preprosthetic surgery.

Magnet-retaining mandibular implant overdentures are associated with less happy patients than those who wear bars or ball attachments as there are more post-insertion visits due to corrosion or wear. Patients appear to be equally happy with a fixed implant complete denture or a removable implant overdenture on the mandible, and patients who value stability more than hygiene select a fixed prosthesis.

Maxillary implant overdentures

A systematic literature review by Sadowsky (2007) sought evidence to establish criteria to treat the edentulous maxilla with implant overdentures. The following findings were reported.

Maxillary implant overdentures have a higher rate of implant loss than other implant procedures. This has been thought to be a result of relatively poor bone quality and quantity, increased implant-to-abutment ratios and non-axial loading. For this reason, more implants are placed in the maxilla. Delayed loading of four to six splinted implants in the maxilla is advised by Galluci, Morton and Weber, who reported implant survival rates of 94.8-97.7% after 10 years (2009). Ideally, implants in the maxilla should be widely distributed symmetrically about the arch, but this may be compromised by various anatomical issues such as pneumatisation of the maxillary sinus, alveolar orientation and the shape of the ridge.

Maxillary implant overdenture treatment is often compromised by reduced bone quantity/quality, and higher biomechanical forces occur. Maxillary implants are often angled buccally due to resorption. The replaced teeth are usually arranged anterior and inferior to the residual ridge. The implants are often opposed by natural teeth in the anterior and premolar regions, and the cantilever forces can be destructive.

As there is limited space in the maxilla, flexible bar designs may increase bending moments. As the masticatory mucosa is thicker on the maxilla, longer implant abutments are often needed, which increases the lever arm. Thin buccal bone of the rigid maxilla may not tolerate the applied forces as well as the mandible. There are no specific recommendations for the number of implants needed to support a maxillary overdenture. If the design of the denture is such that there is no palatal coverage, then a minimum of four implants is considered necessary.

Grafting procedures and modified implant placements have been done to overcome compromised maxillary jaw volume, limiting implant length. There has been low implant failure reported when severely resorbed maxillae are augmented with sinus grafts. The placement of implants in an angulated position has been suggested if implants are splinted.

The use of the zygomatic or pterygomaxillary implants have been well documented in the atrophied maxilla with the use of fixed restorations. Palatal placement of zygomatic implants can cause overcontouring and unusual substructure designs for overdenture patients with the possible need for angled abutments and/or placement of the connecting bar buccally to the abutment. Zygomatic implants can be useful where there is extensive

pneumatisation of the maxillary sinuses (Jivraj, Chee, Corrado, 2006).

A broadly distributed implant-supported design across the anterior premolar region and tuberosities produces better stress transfer to the underlying bone than a dense number of implants in the anterior region supporting a cantilever. Bars with distal cantilevers can increase the forces on the terminal implants by more than three times. Unsplinted anchorage systems may need less space within the prosthesis, facilitate hygiene and be more cost-effective, less technique sensitive and easier to manage than splinted designs. There is no significant difference in mean bone loss between subjects with ball or bar-retained overdentures.

At least 13.0-14.0mm is needed from the implant platform to incisal edge for a bar design. This is comprised of 4.0mm for the bar, 1.00mm below the bar and room for clip and acrylic/tooth assembly. The span length should not exceed 18.0mm, with a 2.0mm vertical stiffener height below the round portion.

The use of attaching mechanisms, such as a bar clip, requires a minimum distance of 10.0-12.0mm between implants or a milled bar with a frictional fit superstructure. A single anchor will need 10.0-11.0mm space above the implant platform to the incisal tip and permit more flexibility with location. Bars provide more retention than solitary anchors when loaded with both vertical and oblique forces. Implant angulation may compromise the retention of solitary anchors.

Magnets have poor retention but may be suitable for bruxers or patients with difficulty manipulating the prosthesis. Patients appear to be equally satisfied with bars or solitary anchors retaining a maxillary implant overdenture. There is a high incidence of hyperplasia with bars.

Maxillary implant overdentures have a high rate of complications and may need more post-insertion maintenance than implant-supported bridges. Most complications occur in the first year. Mucosal inflammation and mechanical problems (especially in cases without palatal coverage) occur more often in the maxilla than the mandible. This may be due to bigger stresses in the maxilla from the opposing dentition or fixed restorations. The most common complication occurs as there is a change in the retention system due to loosening or fracture. Many retention system fractures occur in bruxers. There may be limitations in the design and material failure due to insufficient vertical space for prosthetic parts as well as morphological and speech factors. Bars are recommended when restoring divergent implants of greater than 10°.

Patients prefer a palateless long-bar overdenture design to a fixed implant denture. Most patients prefer a removable prosthetic design as they are familiar with the shape and it is easier phonetically. A tissue-borne overdenture needs fewer implants than a fixed complete denture and may be more attractive economically.

Patients who have a moderate to severe resorption in the maxilla who want a rigid prosthesis, that is aesthetic and cleansable, may find a milled bar-retained implant-supported prosthesis suitable.

Studies have shown that the individual length of implants is more critical than the complete length of supporting implants for implant survival.

Implant-retained overdentures are an important and useful treatment modality for many patients. A variety of retention systems are available. Some systems link implants while others do not. When a system is selected, the dentist and support teams have to consider the medical history and general wellness of the patient, biofunctional, maintenance and financial requirements. D

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