Factors to consider in selecting an occlusal concept for patients with implants in the edentulous mandible

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This article discusses the occlusal concepts when making implant-supported and implant-retained mandibular overdentures. The dentate or edentulous condition of the maxilla plays a significant role in this respect. If the maxilla is edentulous, balanced occlusion is indicated. In a maxillary Kennedy class I or II situation, either group function or balanced occlusion is advocated depending on the characteristics of the opposing dentition. When a complete dentition is present in the maxilla or in the case of a Kennedy class III or IV situation, mutually protected occlusion or group function is recommended depending on the length, position, and number of implants. It is stressed that detailed preimplant placement diagnosis and treatment planning are essential to obtain a high standard of treatment with overdentures supported and retained by implants. (J Prosthet Dent 1995;74:380-4.)

In complete dentures an occlusal concept based on "balanced occlusion" is generally recommended, because this concept is believed to contribute to the stability of the dentures during eccentric movements and to minimize alveolar bone loss.1 "Balanced occlusion" is defined as an occlusal scheme in which bilateral, simultaneous, anterior and posterior occlusal contact of teeth occurs in centric and eccentric jaw positions.2

Little has been written about occlusal concepts in situations where oral implants are involved with the edentulous patient population. Concepts normally used for natural teeth and concepts suggested for edentulous situations have been recommended.3-6 This article reviews the occlusal concept choices for the mandibular overdenture supported by oral implants with respect to (1) the condition of the maxilla, (2) the location of the implants, and (3) the design of the overdenture into consideration.

LOCATION OF IMPLANTS

It is important to realize that implants are "ankylogically" anchored in bone, and in contrast to natural teeth, they are relatively immobile.7,8 In principle, implants must be

vertically loaded.9 Horizontal forces or horizontal components of the vertically directed forces should be avoided as much as possible; such horizontal forces lead to bending moment stresses that have been suggested as causative factors in bone resorption around the implant.10-12 When the axis of the implant and the occluding antagonist are in line, horizontal loading of the implant can be reduced (Fig. 1). The artificial teeth should be arranged in this vertical relationship above the implants to minimize horizontal forces. If this arrangement is not possible, horizontal forces should be avoided by choosing an occlusal concept that reduces these forces as much as possible.

Overdenture design

The overdenture design can be mainly mucosally supported, a combined mucosa-implant-supported, or an implant-supported overdenture depending on the number and location of the implants.13

The mainly mucosally supported overdenture is attached to two implants by means of resilient stud attachments or magnets. This type of attachment allows a rotation and translation of the overdenture. The overdenture is almost totally supported by the mucosa. It is indicated for patients who have a retention problem and when new dentures without implants will not adequately solve the problem. It is also useful in geriatric or handicapped patients in whom oral hygiene practice may be compromised, because access permits easy cleaning of the superstructure. The cost can also be a deciding factor.14 The edentulous maxilla and the potential for an unequal force distribution with the risk of an extreme loading of the individual implants are also reasons for this choice.15
With a combined mucosa implant-supported overdenture, two to four implants (four grouped in two pairs) are positioned in the anterior region of the mandible and connected with a bar. Retentive clips or a retentive sleeve are constructed in such a way that permits rotation around the bar. This overdenture approach is indicated when, apart from a retention problem, the patient has a severely resorbed mandible and only relatively short implants can be placed. The implants are connected, and the occlusal forces are spread over a larger implant-bone interface.\textsuperscript{16}

The implant-supported overdenture requires four to six implants placed in the anterior region of the mandible that are rigidly connected by a bar superstructure. The overdenture is attached to the bar by clips and is thus implant-supported (Fig. 2). This type of overdenture is indicated for patients with sensitive mucosa easily irritated by the pressure of a denture, for example, when bone is resorbed and thus exposes the alveolar nerve or when a knife-edge ridge or sharp mylohyoid projection is present. It is also indicated in patients with an extreme gag reflex. The overdenture is held in place during function and thus does not trigger the gag reflex. When the opposing arch has natural teeth, this type of overdenture is also indicated for reasons of stress distribution.

**OCCLUSAL CONCEPT CHOICE**

When an occlusal concept for the mandibular overdenture supported by oral implants is considered, in the authors' opinion it is the opposing arch condition that greatly influences the choice of occlusal concept. Three types of conditions are usually found: (1) edentulous maxilla, (2) fully dentate maxilla, and (3) partially dentate maxilla.

**The edentulous maxilla**

When the maxilla is edentulous, a mucosally supported or a combined mucosa implant-supported overdenture is indicated for the mandible. The authors believe that an implant-supported overdenture is not the main treatment of choice. A fully implant-supported prosthesis is also undesirable, because it can in some situations cause symptoms described by Kelly\textsuperscript{17} as the "combination syndrome." It is comparable to the situation in which lower anterior teeth are opposed by a complete maxillary denture. Bone loss in the anterior maxilla and the posterior region of the mandible and downgrowth of the maxillary tubera are some of the sequelae possible with this prosthesis choice. Jacobs et al.\textsuperscript{18} reported maxillary bone loss to be higher in patients wearing fixed prostheses on oral implants as opposed to overdentures supported by two implants. Barber\textsuperscript{19} reported that in patients with an implant-supported overdenture on a transmandibular implant, the amount of anterior maxillary alveolar bone resorption was comparable to the amount of bone resorption with a complete maxillary denture that opposes natural mandibular anterior teeth and a removable partial denture. Most practitioners have recommended a balanced occlusion for this patient scenario and believe that in the absence of this occlusal concept, the patient can have some of the symptoms of the combination syndrome.\textsuperscript{1}

However, the authors suggest the lingualized occlusion concept,\textsuperscript{20-22} in which the lingual cusps of the maxillary posterior teeth contact the fossae of the mandibular teeth, and a balanced occlusion is created between these elements of the opposing teeth with freedom of movement (long centric) and clearance of the anterior teeth (Fig. 3). This concept is simple and can be easily arranged and verified (Fig. 4). Other occlusal concepts such as monoplane occlusion have also been suggested.\textsuperscript{23}

In patients in whom a restricted freedom of occlusion is desirable, for example, in a patient with a craniomandibular disorder, sequential canine guidance is suggested.\textsuperscript{24, 25} This concept is based on a combination of balanced occlusion and mutually protected occlusion. For the first 2 mm of eccentric movements, the articulation is balanced, but when this range of movement goes beyond this 2 mm range, the balanced articulation is replaced with a group
function and finally a mutually protected occlusion. This concept is suggested when the maxilla is large and excellent retention of the maxillary denture is achievable.

**The fully dentate maxilla**

When the opposing jaw has a full complement of teeth, we recommend a minimum of four implants on which a fixed implant prosthesis is constructed. The implants should be positioned appropriately in the arch to permit distribution of the occlusal forces that are transferred from the fully dentate maxilla to the implant-bone interface. When the opposing jaw is edentulous, an implant-supported overdenture is suggested. The mutually protected occlusion or an occlusion based on group function would also be the appropriate occlusal concept.

Every attempt should be made to ensure that the occlusal forces introduced by the opposing natural dentition are spread over the largest possible implant-bone interface. This implies that a minimum of four implants is the standard for these patient situations.
A partially edentulous maxilla

When the maxilla is partially edentulous, the situation is quite different. The four Kennedy classification groups of partial edentulism that should be considered are (1) Kennedy class I (bilaterally free-end), (2) Kennedy class II (unilaterally free-end), (3) Kennedy class III (teeth-bound open spaces), and (4) Kennedy IV (a teeth-bound open space crossing the midline).

The Kennedy class I situation, with natural teeth in the anterior region of the maxilla (canine to canine) and edentulous bilateral posterior segments restored with a removable partial denture is, from the occlusal point of view, to be compared with an edentulous jaw (Fig. 5). Balanced occlusion is the preferred concept when articulated with the opposing arch with implants. If the edentulous sections of the maxillary jaw are restored with a cantilever fixed partial prosthesis or a prosthesis supported by implants, or if more natural teeth are present (premolar to premolar), the situation is similar to an arch with a complete dentition opposed to the edentulous mandible.

For the Kennedy class III or IV situations, when the dental restoration is rehabilitated with a fixed prosthesis or with a clasp retained tooth-supported removable partial denture, the arch is also considered a complete dentition. In these situations a fully bone-anchored fixed prosthesis or an implant-supported overdenture are indicated. Mutually protected occlusion or group function are appropriate concepts of occlusion that can be applied.

For the patient classified in a Kennedy class II situation, a dentate and an edentulous quadrant create a complex situation. The choice of the occlusal concept is dependant on the rigidity of the reconstruction of the edentulous quadrant. These predisposing factors can lead to a reconstruction in which the dentate quadrant requires a mutually protected occlusion or group function, whereas the re-

Table 1. Guidelines for the choice of reconstruction and occlusal concept when rehabilitating the edentulous mandible with oral implants and an overdenture

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<tr>
<th>Maxillary condition</th>
<th>Mandibular reconstruction</th>
<th>Occlusal concept</th>
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<td>Kennedy class II</td>
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<td>Kennedy class I,</td>
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<td>FPD</td>
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<td>Kennedy class III/IV</td>
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RPD, Removable partial denture; FPD, fixed partial denture.

*If indicated sequential guidance can be used in these cases.

construction that opposes the edentulous quadrant should be in balanced occlusion. Another option would be to place implants and a fixed prosthesis in the edentulous quadrant of the maxilla, which would result in rigidity of both quadrants.

An outline of the mandibular rehabilitation and the choice of occlusal concepts for the different antagonistic situations is presented in Table 1.
CONCLUSIONS

The relationship between maxilla and mandible is of the utmost importance when choosing an appropriate concept of occlusion for therapy that involves dental implants. The condition of the opposing jaw influences the concept chosen. The importance of equalizing the forces in both jaws is extremely important. When the opposite jaw is edentulous, the implant-supported fixed prosthesis may not be the first choice of treatment, although this prosthesis is advocated by many. A mandibular overdenture supported by two implants with a resilient attachment may be more desirable. However, if the opposing arch is a complete natural dentition, the overdenture should be avoided. Table I identifies the occlusal concept, taking the number, the length, and the location of the implants into consideration.

When the maxilla is edentulous, it is important not to have any contacts between the anterior teeth of maxilla and mandible in centric occlusion to avoid overloading the anterior region of the maxilla. Only during eccentric movements are minimal contacts between the anterior teeth allowed. For that reason the authors avoid the use of acrylic resin teeth in the overdentures. The resistance to wear of acrylic resin teeth is in our experience insufficient. A regular checkup every 6 months is essential for the patients with implants. Wear, mucosal resilience, and residual ridge reduction in the course of time change the occlusion in all overdenture situations, leading to premature anterior contacts and thus loss of the planned occlusal relationships.

It must be clearly understood that it is extremely important that the type of overdenture and the occlusal concept are considered before treatment is begun.

Each patient has his or her own specific problems and needs an individual approach. The guidelines for the choice of the type of reconstruction and occlusal concept as presented in this article are therefore not to be interpreted as "golden standards." They have been phrased as a path of thought for practitioners to follow when planning prosthetic treatment in patients receiving implants.

REFERENCES


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