Choices in attachment systems for the maxillary implant-supported overdenture

This chapter is an edited version of the manuscript:
Boven GC, Raghoebar GM, Van Dijk G, Slot JWA, Vissink A, Meijer HJA
Choices in attachment systems for the maxillary implant-supported overdenture. Two case reports.
Submitted
Abstract

**Background** Lack of retention and stability of a conventional maxillary denture can usually be solved by fabricating an implant-supported maxillary overdenture. Selecting the best fitting attachment system can be challenging however. Each system has its own advantages and disadvantages.

**Case presentation** These case reports illustrate when to use a bar attachment system and when to use a locator attachment system.

**Conclusions** Nowadays, planning software can be used to determine the available space and can be a really helpful tool to determine whether a specific system will fit properly.
Introduction
Nowadays, dental implants can eliminate many problems reported by conventional denture wearers. Totally edentulous ridges can be restored in various ways. An implant-supported overdenture is one of the options. It improves retention and stability of the denture and reduces or eliminates pain during mastication (1–3). Support by implants does not only eliminate problems, but also clearly improve patient satisfaction, improve chewing efficiency and increase maximum bite force (4). An implant-supported overdenture requires fewer implants than a fixed full denture, also oral hygiene is easier (5), better aesthetics and phonetics can be achieved and last but not least costs are lower. All these factors result in the overdenture being an attractive treatment solution to a large number of patients. Various attachment systems have been successfully used for implant-supported overdentures in recent years. These systems can be classified as bars, ball and locator attachments. Dental practitioners and technicians select attachment systems based on clinical outcomes (6), but also on available space (7).

Overdentures with a bar attachment system is a therapeutic option that offers many advantages for patients with a severely reabsorbed edentulous ridge. Bars offer good retention capacity, have low maintenance costs, provide correct dimensions, and allow simple insertion and removal of the denture (8).

Ball attachments can be used with different matrices. Attachment design and the choice of material used for the retentive part of the matrix influence the friction grip and thus the need for aftercare (9). It has been reported that for mandibular overdentures ball attachments need more aftercare than bar attachments (10,11). When comparing ball and locator attachments in the mandible and maxilla, the ball attachments also have more prosthodontics complications (12). There are no differences between ball or locator attachments for patient satisfaction and peri-implant parameters after 1 year (13). Therefore the locator attachment system is preferred over the ball attachment system.

The locator attachment system (Zest Anchors, Inc. homepage, Escondido, CA, USA) was introduced in 2001 and is a self-aligning implant attachment system. When maintenance, repair or replacement is needed, this can
be done quickly, the procedures are straightforward and it can mostly be done chair side (14). This in comparison to repair and replacement of a bar superstructure, which mostly takes more time and is more complicated. The amount of prosthetic complications for the different attachment systems seem to be equal for the maxillary overdenture (15). However, the amount of literature on this topic is limited, and therefore this cannot be said with certainty (1).

Amongst others, the reason for choosing a specific attachment system depends on available space. The height needed for the locator attachment system is less than for the bar attachment system. The total attachment height for the locator is about 4 mm (collar attachment, male and metal framework). The height for a bar is at least 7 mm (bar with clips and metal framework). However, a bar can be designed angulated and locator attachments are always straight. This straight design can cause problems if anteriorly placed implants are angulated to the buccal side, whereas an individually designed bar can also be angulated. So, the advantage of less height needed for a locator attachment, is sometimes cancelled out by limitations in the horizontal plane.

Digital planning software can be a helpful tool to get insight in available space. And ideally, the workflow should be in backward-planning beginning with an ideal position of future denture teeth. Two cases are described with different amounts of space available for attachment possibilities for overdenture treatment.

**Clinical case 1**
A 56-year old edentulous woman was referred by her dentist to the Department of Oral and Maxillofacial Surgery (University Medical Centre Groningen, University of Groningen, Groningen, The Netherlands) with complaints concerning her removable denture in the maxilla. Clinical and radiographic examination revealed a moderately resorbed maxilla, with adequate bone volume in the anterior area of the maxilla to place implants without a separate augmentation procedure. There was enough vertical and horizontal restorative space to house the full range of implant overdenture attachment systems (bar, ball and locator attachments). Implant-supported denture seemed to be reliable options to fulfil the patient’s demands. The patient provided informed consent for the
following treatment plan: the placement of 4 implants in the maxilla; and the fabrication of an implant-supported overdenture after a 3-months osseointegration period.

First stage surgery
An oral and maxillofacial surgeon inserted four dental implants (NobelActive™ Narrow Platform (Nobel Biocare USA, LLC, Yorba Linda, CA, USA)) with a diameter of 3.5 mm in the maxillary anterior region. In a two-stage procedure and with the help of a surgical template the implants were placed at crestal bone level (positions 13, 11, 21, 23). Bone harvested from the maxillary tuberosity, organic bovine bone (Bio-Oss®; Geistlich Pharma AG, Wolhusen, Switzerland), and a resorbable membrane (Bio-Gide®; Geistlich Pharma AG, Wolhusen, Switzerland) was used to cover small dehiscence’s and fenestrations. Amoxicillin was given to the patient, with the first dose orally one hour preoperatively (3 g Clamoxyl®; GlaxoSmithKline, Utrecht, the Netherlands) and postoperatively 3 times a day for seven days (500 mg Clamoxyl®; GlaxoSmithKline, Utrecht, the Netherlands). Also the patient received a 0.2% chlorhexidine mouth rinse (Corsodyl®; GlaxoSmithKline, Utrecht, the Netherlands) 1 minute, 2 times a day for 2 weeks. Two weeks after implant placement, the patient was allowed to wear her dentures again after adjustment of the denture with a resilient lining material (Soft liner; GC Corporation, Tokyo, Japan).

Second stage surgery
The oral and maxillofacial surgeon performed the second stage surgery after a 3-months of osseointegration and healing abutments were placed (NobelActive™ NP healing abutment; Nobel Biocare USA, LLC, Yorba Linda, CA, USA). The prosthodontist adjusted the denture in the area of the healing abutments and relined it again with a resilient lining material. The patient was given oral hygiene instructions to clean the healing abutments.

Prosthetic procedure
After this, prosthetic procedures were initiated. A preliminary impression was made by using a stock metal tray (Schreinemakers; Clan Dental Products, Maarheeze, The Netherlands) and irreversible hydrocolloid (Cavex CA 37; Cavex Holland BV, Haarlem, The Netherlands). The impression was poured with Type IV stone (GC Fujirock EP; GC Europe NV, Leuven, Belgium), and a custom acrylic resin impression tray (Lightplast base plates;
Dreve Dentamid GmbH, Unna, Germany) was fabricated with openings for screw-retained impression copings (NobelActive™ NP Impression Coping Open Tray; Nobel Biocare USA, LLC, Yorba Linda, CA, USA). These were placed on the implants and were attached with the integral positioning screw. The tray was placed over the impression copings and any contact between the copings and the tray was eliminated to allow the tray to rest firmly on the denture bearing mucosa with the positioning screws exiting through an opening in the tray. Border moulding of the tray was done using a resin material (ISO functional; GC Europe NV, Leuven, Belgium).

The final complete arch impression was made with polyether material (Impregum F; 3M ESPE, St Paul, Minn). The impression material around the impression copings was placed with a syringe. The tray was filled with impression material and placed on the alveolar process. During polymerization, the positioning screws of the impression copings were uncovered to facilitate removal of the impression. After removal of the tray, the copings were connected to implant analogs (Implant Replica Conical Connection RP, Nobel Biocare USA, LLC, Yorba Linda, CA, USA), and the definitive cast was poured with Type IV stone (GC Fujirock EP; GC Europe NV, Leuven, Belgium). In this way the implant location and the denture bearing area were reproduced. A composite resin record base (Lightplast base plates; Dreve Dentamid GmbH, Unna, Germany) with a wax occlusion rim was used to determine the occlusal vertical dimension and to record the maxillomandibular relationship. The position of the wax rim was stabilized with addition silicone paste (Futar D; Kettenbach GmbH, Eschenburg, Germany) and transferred to an articulator (Artex; Girrbach Dental GMBH, Pforzheim, Germany). Ceramic artificial teeth (SR Vivodent PE; Ivoclar Vivadent, Schaan, Liechtenstein) were selected and arranged on the record base for a trial arrangement. After completion of the tooth arrangement, the trial denture was evaluated and corrected, as needed. A balanced lingualized occlusion was developed with the ceramic teeth. The aesthetics, phonetics, centric relation, occlusion, and occlusal vertical dimension were verified and the final arrangement was approved by the patient. With the patient it was agreed to use a bar-clip attachment as first-choice option to support the overdenture. The patient already had a bar-clip attachment for the mandibular overdenture and was very satisfied with it.
Figure 1. 3D model of the maxilla

Figure 2. Lateral view of the 3D model with the designed bar
The dental laboratory technician digitized the casts and arrangement, and designed an ovoid bar, clips and reinforcement on the implant analogs (Exocad® GmbH, Darmstadt, Germany) (Figs. 1-4).

It appeared that there was enough restorative space to house bar, clips and reinforcement structure, confirming that the first-choice option of patient
and prosthodontist was possible. The file was sent to a superstructure milling company (ES Healthcare NV, Hasselt, Belgium) to mill the maxillary and mandibular bars from titanium. After receiving the milled titanium bar, they were placed on the original cast (Fig. 5).

Figure 5. Definitive model with the bar attachments in place

Gold retentive clips (Cendres & Métaux, Biel/Bienne, Switzerland) were selected to fit on the bars. A refractory duplicate cast was made by using a silicone template material (Elite Double 22; Zhermack SpA, Badio Polesine, Italy). The framework pattern was waxed on the refractory cast. The modelled framework was cast in cobalt chromium (Vitalium PH2; Elephant-Dental BV, Hoorn, The Netherlands). The retention clips were laser welded under direct vision onto the reinforcement structure. The reinforcement structure was integrated in the acrylic resin (MegaCRYL N, Megadental GmbH, Büdingen, Germany) of the overdenture. The denture was processed and finished (Fig. 6).

The milled bars were placed onto the implants, the attachment screws were tightened to 35 Ncm, and the denture was inserted. The patient was instructed in hygiene procedures associated with the dentures and the bars and scheduled for routine maintenance recalls. After one year the patient was still satisfied with her implant-supported denture.
Clinical case 2
A 65-year-old edentulous man was referred by his dentist to the Department of Oral and Maxillofacial Surgery (University Medical Centre Groningen, University of Groningen, Groningen, The Netherlands) with complaints concerning his removable denture in the mandible and maxilla.

Clinical and radiographic examination revealed a moderately resorbed maxilla and a moderately resorbed mandible. There was adequate bone volume in the maxilla to place implants in the anterior area. Vertical restorative space was not abundant. It was estimated that a bar attachment system would be too voluminous, so the patient was proposed to apply a solitary attachment system in both maxilla and mandible.

The patient provided informed consent for the following treatment plan: the placement of 4 implants in the maxilla and 2 implants in the mandible; and the fabrication of implant-supported overdentures after a 3-months osseointegration period. The locator attachment system was used due to the limited intermaxillary space.

First stage and second stage surgery
First and second stage surgery were performed, using the same protocol as described for the previous case. With the only difference that, besides the four implants (NobelActive™ Narrow Platform (Nobel Biocare USA, LLC,
Yorba Linda, CA, USA)) in the maxilla, also two implants in the mandible (NobelReplace™ Select Tissue Colar (Nobel Biocare USA, LLC, Yorba Linda, CA, USA)) were placed. In order to use the proposed solitary attachment type, it is most important to place the implants as parallel as possible. The retentive force of solitary attachment types decreases with an increase in implant inclination (16).

Prosthetic procedure
The prosthetic procedures are generally the same as for the previous case, but with a few exceptions. The first one is that after making the definitive cast, locator attachments of appropriate height were selected and placed on the implants. The Composite resin record bases (Lightplast base plates; Dreve Dentamid GmbH, Unna, Germany) were produced with black processing male nylon caps (Zest Anchors, Inc. homepage, Escondido, CA, USA) to attach to the locator attachments. And instead of gold retentive clips, locator denture caps were laser welded onto the reinforcement structure. The dental laboratory technician digitized the casts with locator attachments and arrangement, and checked available space for locator denture caps and the reinforcement structure (Sensible®, 3D systems Inc., Atlanta, GA, United States) (Figs. 7-9). It appeared that there was enough restorative space to house denture caps and reinforcement structure, confirming that the proposed option of solitary attachments was possible.

Figure 7. 3D model with locator attachments, reinforcement structure and denture in place
The locator attachments were placed onto the implants (Fig. 10), tightened to 30 Ncm with a calibrated torque wrench. Nylon elements in the negative form of the attachment connect the denture with the implant. The nylon male elements are available in different color-coded designs with different retention forces (blue 6.7 N [light], pink 13.4 N [medium], and clear 22.3 N [strong]). In this case, the patients was initially provided with two dual
retention pink males (3lbs; medium force) and two red extended range males (1lbs, medium force), providing possibilities for strengthening or loosening the retention force (Fig. 11).

The patient was instructed in hygiene procedures associated with the dentures and the locators and scheduled for routine maintenance recalls. After one year the patient was still satisfied.
Conclusions
This clinical report describes two edentulous patients treated with implant overdentures. The different reasons for choosing the appropriate attachment type are described. For one patient there was abundant intermaxillary space and it was chosen to use the bar attachment system. For the other patient there was limited space, the positioning of the implants was appropriate and the locator attachment system could be used. The use of planning software can be very advantageous to determine available space and definitive choice of attachment system for overdenture treatment.
References


