Implant Overdenture Attachments: Selection and Application

As patient awareness of implant dentistry increases, expectations of benefits realized from dental implant therapy also increase. At the heart of implant overdenture performance is the attachment system used to facilitate prosthesis retention, support and stability during functional and parafunctional activity. With ever-advancing technology driving implant overdenture attachment development, the practitioner’s ability to follow and understand subtle improvements in this area is critical to patient well-being. This issue of Prosthodontics Newsletter represents a synopsis of information important to implant overdenture attachment systems.

Bar or Stud Attachments: Which Work Better?

Attachments for implant-retained overdentures can be divided into 2 groups: bars and studs. Trakas et al from Tufts University, Massachusetts, reviewed the literature on the attachment systems’ impact on implant survival rate, marginal bone loss, soft tissue complications, retention, stress distribution, space requirements, maintenance complications and patient satisfaction—factors necessary for successful outcome and long-term prognosis.

**Implant survival rate:** Bone quality and quantity, arch morphology, and implant length are more important to implant success than the type of attachment used.

**Marginal bone loss:** Although some evidence exists that mean bone loss values appear higher in patients with ball attachments, no significant difference in mean bone loss has been found between patients with ball and with bar attachments.

**Retention:** Bars and clips appear to provide more retention. Discrepancies in results exist between in vitro studies and clinical experience. However, both types supply sufficient retention for the typical patient.

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**Stress distribution:** Ball attachments more evenly distribute stress, transferring minimal stress to the implants under vertical forces. Rigid designs and cantilever bars increase the force transmitted to implants.

**Space requirements:** Although bar and stud attachments have similar vertical dimensions, some bar attachments require specific distances between implants due to limitation of bar length and excessive stress on longer cantilevered segments.

**Maintenance complications:** No definitive evidence exists as to whether bar or stud attachments require more maintenance. Most maintenance issues arise during the first year in service.

**Patient satisfaction:** Because there is no difference between the bar or ball attachment methods, the authors concluded that both mechanisms seemed to satisfy most patients more than did the magnet attachment method.

**Comment**

Treatment planning decisions should be based on many factors, including cost-effectiveness, available bone, expected level of oral hygiene, interimplant distance, maxillomandibular relationship and patient expectations. Either attachment may be a good choice for an individual patient.


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Choosing the Best Technique For Incorporating Attachments

The use of implant-retained overdentures to treat the edentulous mandible is now the standard of care, but no single technique has proven superior in all situations. Bidra et al from the University of Connecticut Health Center reviewed the advantages and disadvantages of various techniques to incorporate attachments in implant-retained prostheses.

The choice of final impression method determines subsequent clinical and laboratory procedures, dictating the method of attachment incorporated into the overdenture. Overdentures may be fabricated concurrent to 3 different stages of treatment, and attachments can be included using either a direct or an indirect technique.

These 3 options create 7 different techniques:

- tissue-level impression, record base stage, direct technique
- tissue-level impression, denture insertion stage, direct technique
- tissue-level impression, denture insertion stage, indirect technique
- abutment-level impression, base stage, indirect technique
- abutment-level impression, denture processing stage, indirect technique
- implant-level impression, record base stage, indirect technique
- implant-level impression, denture processing stage, indirect technique

Factors influencing technique choice are shown in Table 1. Tissue-level impressions may be favored to incorporate attachments after the definitive denture has been fabricated; implant-level impressions may be needed when issues with implant placement arise or prosthetic space needs to be reassessed before attachment system selection.

Table 1. Factors affecting choice of technique for incorporating attachments for implant-retained partial and complete overdentures

| 1. Choice of prosthetic design (splinted vs unsplinted abutments) |
| 2. Chronology of implant placement with respect to prosthesis |
| 3. Number and position of implants |
| 4. Angulations of implants |
| 5. Prosthetic space availability |
| 6. Choice of attachment system |
| 7. Need for processed denture bases |
| 8. Complexity of maxillomandibular relationships |
| 9. Changes in tissues after implant surgery |
| 10. Operator preference |
| 11. Availability of inventory for prosthetic components |
| 12. Cost |
The direct technique gives the clinician intra-oral control of the procedure and immediate confirmation of accurate seating but requires increased chair time and is contraindicated in several scenarios, such as changes in soft tissue morphology after implant surgery as well as improper implant positions and angulations.

Comment
Each technique has advantages and disadvantages. A successful clinical outcome requires the clinician to have broad, specialized knowledge of the rationale for and likely result of decisions made during the process.


Rotational Freedom of Overdenture Attachments

Studies highlighting their advantages to treat the edentulous mandible have supported the acceptance of implant-retained removable prostheses, but the abutment selection’s impact on freedom of rotation has not been extensively studied. Rotation at the implant is a double-edged sword: too much rotation during mastication may lead to a loss of prosthesis retention from compression of the posterior denture-bearing mucosa; too little rotation may create uneven stress concentration on the implant, potentially compromising the bony structure around it.

To determine levels of resistance to rotation, Chen et al from the University of Washington designed an in vitro study that subjected the components of 3 commonly used types of stud-resilient matrices to the expected levels of rotation in clinical use. Components of the most and least retentive versions of 3 attachment systems, as defined by the manufacturers, were studied:

➤ ERA (metal jacket and black nylon/patrix)
➤ Locator (metal housing and black processing patrix and spacer)
➤ O-ring (retainer ring and regular red O-rings for processing)

Each attachment system and retention level was tested with a single implant system and a 2-attachment parallel implant system (Figure 1). Regardless of attachment system or number of implants, rotational freedom was greater for the Locator system than it was for the ERA. Among the least retentive components, the O-ring provided the most rotation, followed by the Locator and the ERA. One-implant systems allowed significantly greater rotation than did 2-implant systems.

Comment
Of the attachment systems tested in this study, the O-ring with the least retentive component would be the choice of a clinician who wishes to use a prosthesis with the greatest degree of rotational freedom.


Comparison of Overdenture Attachment Systems

To date, no consensus exists regarding the ideal number of implants to treat the edentulous mandible or the best choice of attachment mechanism between the implants and the denture base. To evaluate 3 mandibular implant overdenture treatments for prosthesis retention and stability, peri-implant tissue response, patient satisfaction and preference, and complication rate, Burns et al from Virginia Commonwealth University conducted a crossover clinical trial of 30 adults (mean age, 58.9 years).

The participants had adequate bone quantity to minimally accommodate 4 3.75-mm diameter implants. After successful integration, the patients randomly received overdentures using 1 of 3 attachment systems:
➤ an independent O-ring attachment using 2 implants (2I)
➤ a bar attachment using 2 implants (2B)
➤ a bar attachment using 4 implants (4B)

After 12, 24 and 36 months, patients received a different attachment system; all patients received each of the 3 attachment systems for either 1 or 2 12-month periods.

Tested with a force gauge, the 4B attachment system demonstrated the greatest retention with no difference in stability. Probing depth was greatest for the 4B attachment, while gingival and plaque indices were most favorable for the 2I attachment. Other parameters, including supporting tissue, keratinized tissue and attachment level, were equivalent for all 3 systems. Patients with the 2I and 4B attachments provided more favorable answers to masticatory ability and denture complaint questionnaires. In general, more patients found the 2I system preferable, followed by the 4B and the 2B; however, none of the differences reached statistical significance.

Comment
Increased retention demonstrated by the 4B attachment system did not translate to increased patient preference. The systems’ equivalence suggests that the choice of design for mandibular implant overdentures should be made with patient input on an individualized basis.


Locator vs Bar Attachments: Patient Satisfaction

Studies have shown no difference in patient satisfaction with mandibular overdentures retained by ball, bar or magnet attachments. While ball attachments are easily replaceable, bar attachments have demonstrated better stability. Locator attachments combining the best results of both systems may provide an alternative.

Cordaro et al from Eastman Dental Hospital, Italy, compared treatment results and quality of life in 39 edentulous patients (age range, 49–81 years; mean age, 62 years) receiving mandibular overdentures retained by either Locator attachments or milled bars. The patients were divided into 2 groups:

➤ **Locator group** (*n* = 19): overdenture retained by the Locator attachment system
➤ **Bar group** (*n* = 20): overdenture retained by computer-aided design/computer-aided manufacturing (CAD/CAM) milled bars

Three independent dentists evaluated implants for peri-implant soft tissue health, implant mobility and implant success. Patients completed a 9-item questionnaire to measure their perception and attitude toward their implant-supported prostheses.

The Locator group had less plaque but more sites with bleeding on probing. General satisfaction, ability to chew, ability to speak, stability, comfort, appearance, pain around implants and pain on gingiva were not significantly different for the 2 groups. Regarding ease of cleaning, patients showed a significant preference for the Locator attachment. The independent dentists found significantly better results for the Locator attachment in retention, oral hygiene and soft tissue condition.

Comment
The primary difference in clinical performance between Locator and bar attachments for mandibular overdentures relates to hygiene maintenance. Patient satisfaction was very high in both groups.