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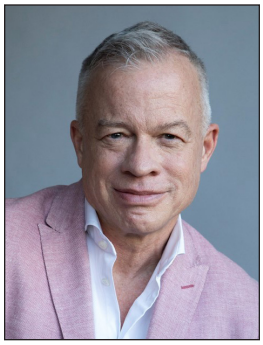

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Prosthodontics Newsletter™

Focusing on Dental Implants

Two-Implant Mandibular Overdentures: Bar vs Stud Attachments

Using 2 anteriorly positioned dental implants to support, retain and stabilize an overdenture is a desirable, perhaps even the preferred, method to restore the edentulous mandible. Indeed, improving the diminishing prosthodontic foundation with implants facilitates mastication, phonation, esthetics, comfort and overall quality of life. Mechanical retention of these prostheses can be improved by various commercially available and laboratory-manufactured attachment systems, generally categorized as either "stud" or "bar" attachments. This issue of Prosthodontics Newsletter *looks at clinical studies that compare various attachment systems to determine if any one attachment system is superior to the rest.*

Mandibular Overdentures: Long-term Results

Studies have shown superior function and satisfaction for 2-implant–retained mandibular overdentures in patients with mandibular edentulism when compared with conventional dentures. However, the patient and clinician must choose the attachment type that will be most effective over the long term.

In a 1-year study, Cune et al from University Medical Center Groningen, the Netherlands, established that patients strongly preferred bar-clip and ball-socket attachments to magnet attachments. The authors then extended their study for an additional 9 years to test whether the 1-year results would hold over a longer period.

The initial study included 18 edentulous patients, (aged 33–56 years and members of the Dutch military), all were randomly assigned to receive either magnet, ball-socket or bar-clip attachments for their denture prior to stage-2 surgery; the attachment type was randomly changed after 3 and 6 months. After 1 year, the participants chose which attachment they wished to have for their dentures and returned to their own dentists for aftercare and regular maintenance.

Members of the cohort were recalled after 10 years; 14 participants (7 with ball-socket attachments, 7 with bar-clip attachments) were available for follow-up. Each patient graded their overall satisfaction with their dentures using a 100-mm visual analog scale. The

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Mandibular Overdentures: Long-term Results

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health of the peri-implant mucosa was evaluated based on changes in probing depths and bleeding on probing from the initial evaluation; in addition, mesial and distal marginal bone levels were assessed.

Patient satisfaction remained nearly the same from the initial evaluation to the 10-year recall (88.7 vs 86.6). Clinical parameters were also statistically similar; only probing depths were significantly different between the ball-socket and bar-clip attachment groups (Table 1). Eight of the 14 patients received new dentures over the 10-year period, 4 in each attachment group, although that number included several participants who were given new dentures as a precautionary measure just before they left the armed forces.

Comment

These results indicated a high level of patient satisfaction with 2-implant–retained mandibular overdentures after 10 years of service. The choice of attachment system should be left up to the patient and practitioner.

Cune M, Burgers M, van Kampen F, et al. Mandibular overdentures retained by two implants: 10-year results from a crossover clinical trial comparing ball-socket and bar-clip attachments. Int J Prosthodont *2010; 23:310-317.*

Best Attachment And Loading Protocols

Compared with conventional removable mandibular complete dentures, implant-retained mandibular overdentures are associated with better ratings for overall satisfaction, comfort, stability, mastication ability and speech, along with improved oral-health–related quality of life scores. Yet, no consensus exists about which attachment system—bar-clip, ball, resilient stud, magnet or double-crown—works best. None is without disadvantages. Additional complications may come from single-stage surgery and immediate loading, which accelerates treatment without affecting implant survival rate, patient function or esthetics but may result in micromotions at the implant–bone interface that interfere with healing.

Aldhohrah et al from Sun Yat-sen University, China, conducted a systematic review and network meta-analysis of available evidence to address these issues. Each study had to have ≥12-month follow-up. They analyzed the results of 16 randomized controlled trials of 2-implant–retained mandibular overdentures, using either an immediate or a delayed loading protocol, for implant failure, prosthetic complications, marginal bone loss, probing depth, plaque index and bleeding on probing.

Implant survival rate for various attachment systems paired with immediate and delayed loading varied from 91.2% to 100%. There were no significant differences among the various combinations for mean bone loss, probing depth or implant stability. The use of a bar attachment combined with immediate loading had the least mean bone loss, while the combination of a ball attachment and delayed loading resulted in the lowest probing depth. Data gathering differences among the studies prevented a meta-analysis for prosthetic complications, plaque index and bleeding on probing. Overall, rank probabilities suggested that ball, bar and magnet attachment systems, combined with an immediate loading protocol, produced the best results.

Comment

The authors suggested that differences in probing depth between ball and bar attachment systems could be due to the difference in ease of cleaning, especially for bar attach-

Table 1. Mean scores for probing depth, marginal bone level and bleeding index values.

Measure	Initial evaluation	10-year evaluation
Probing depth		
Ball-socket	2.0	2.2
Bar-clip	2.5	2.9
Marginal bone level		
Ball-socket	1.5	1.6
Bar-clip	2.1	2.1
Bleeding index		
Ball-socket	0.03	0.04
Bar-clip	0.07	0.08

p = *.04 for probing depth difference between ball-socket and bar-clip attachment systems at 10 years. All other differences were not significant.*

ments. The limited follow-up time of the included studies may also limit the application of the findings. Nevertheless, the authors concluded that all types of overdenture attachments accompanied by either immediate or delayed loading showed a similar effect on peri-implant health.

Aldhohrah T, Mashrah MA, Wang Y. Effect of 2-implant mandibular overdenture with different attachments and loading protocols on peri-implant health and prosthetic complications: a systematic review and network meta-analysis. J Prosthet Dent *2022; 127:832-844.*

Maximum Bite Force and Muscle Activity

Patients typically report improved masticatory ability, better retention and increased stability after receiving implant overdentures. However, when a mandibular implant overdenture opposes natural maxillary teeth, problems with functional loading have been reported. Uçankale et al from the University of Marmara, Türkiye, evaluated the impact of implant-retained overdentures on maximum bite force and muscle activity using electromyography (EMG).

They studied 35 patients (aged 60–75 years); 25 were edentulous in both the mandible and maxilla, while the remaining 10 were edentulous only in the mandible. Patients were divided into 3 groups:

- 15 patients received 2 implants and ball-attachment–retained mandibular overdentures, along with a complete maxillary denture (BC group)
- 10 patients received 2 implants and ball-attachment–retained mandibular overdentures, along with maxillary fixed partial dentures (BF group)
- 10 patients received 4 implants and bar-attachment–retained mandibular overdentures, along with a complete maxillary denture (BRC group)

After adapting to their new dentures, patients underwent baseline EMG measurements of left and right masseter muscles during masticatory performance (involving the mastication of peanuts and the chewing of gum) and maximal biting pressure tests. Three months after osseointegration and placement of definitive restorations, the tests were repeated.

At baseline, the BF group showed the best masticatory performance. All groups showed a significant increase at recall, with the highest values recorded in the BF group. No statistically significant differences were found among the groups for maximum bite force at baseline; while all groups showed a significant increase at recall, no group performed significantly better than another. All groups showed a similar significant decrease in mean chewing time at recall.

Comment

This study suggested that the use of implant-retained mandibular overdentures significantly improves mean chewing time, EMG values of masseter muscles, mastication efficiency and maximum biting pressure, regardless of type of attachment or maxillary denture status.

Uçankale M, Akoğlu B, Özkan Y, Ozkan YK. The effect of different attachment systems with implant-retained overdentures on maximum bite force and EMG. Gerodontology *2012;29:24-29.*

Denture Base Deformation

It has been suggested that the minimum standard of care for the edentulous mandible is a 2-implant overdenture. Each attachment system—ball/stud, bar, magnetic and telescopic—has advantages and drawbacks that need to be evaluated for each patient. One factor for consideration is the resistance of the denture base to deformation from masticatory loads. While several in vitro studies have evaluated denture strain during different loading conditions, simulating natural conditions is challenging in a laboratory setting.

ELsyad et al from Mansoura University, Egypt, designed a crossover study to evaluate denture base deformation with bar, telescopic and stud attachments. Twenty-four edentulous patients each received 2 implants in the canine area of the mandible; 3 months later, each patient was randomly given 1 of 3 mandibular overdentures with a

- bar attachment (BOD group)
- telescopic attachment (TOD group)
- stud attachment (SOD group)

Six linear strain gauges were attached to the lingual polished surface of each mandibular implant overdenture in 2 rows opposite the implant abutments on the clenching side (Ch1 lower, Ch2 upper), nonclenching side (Ch5 lower, Ch6 upper) and midline (Ch3 lower, Ch4 upper). After 3 months, strain was measured during maximal voluntary clenching with soft food (cake), with hard food (carrot) and without food. Highest positive (tensile) and negative (compressive) strains were measured

Table 2. Comparison of microstrain values among clenching conditions (soft food, hard food, without food).

	p values					
Group	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6
BOD	.050[a]	.040[a]	.57	.036[a]	.20	.045[a]
TOD	.64	.050[a]	.74	.038[a]	.61	.050[a]
SOD	.67	.049[a]	.038[a]	.50	.042[a]	.46

[a]*Significant at* $p < .05$.

and the mean values converted into microstrain values.

The BOD group showed significantly higher total microstrain than the other 2 groups. Gauge Ch2 recorded the highest total strain during clenching hard and soft food. Significant differences were seen among the 3 groups for several different clenching conditions (Table 2). The higher strain levels in the BOD group may have been caused by the increased size of bar abutments' occupation of a larger prosthetic space inside the denture base, making the implant overdenture thinner opposite the abutments and more susceptible to rotation, deformation or fracture.

Comment

These findings suggested that 2-implant mandibular overdentures with telescopic and stud attachments are less likely to undergo denture base deformation than those using bar attachments. For patients fitted with bar attachments, regular periodic recall is critical for denture relining and denture base reinforcement at the midline to prevent dental base fracture.

ELsyad MA, Mahanna FF, Khirallah AS, Habib AA. Clinical denture base deformation with different attachments used to stabilize implant overdentures: a crossover study. Clin Oral Impl Res *2020;31:162-172.*

Stress Distribution In the Mandible

Functional stress transfer from implant overdentures to the associated prosthetic foundation may influence implant success. Variations in residual edentulous ridge anatomy can dictate implant location and subsequently alter stress transfer to the mandible. Yıldırım, a private practitioner, and Büyükerekmen of Necmettin Erbakan University, Türkiye, conducted a finite element analysis to model the stress on implants inserted in different regions of the mandible with 3 different types of bone.

They created 9 3-dimensional finite element models of the mandible, each with 2 implants located in the lateral incisor, canine or first premolar area placed in D1, D2 or D3 bone, supporting an overdenture using the locator attachment system. A force of 100 N was loaded vertically from the central fossa area of the mandibular first molar region and 45° obliquely from the mesiobuccal cusp of the mandibular first molar. Data on von Mises stresses in implants, tensile stress, compressive stress and displacement in cortical and trabecular bone were recorded.

The von Mises stress values were highest on attachments and implants in the premolar region and lowest in the lateral incisor region. Results were similar for tensile stress. Maximum principal stress values in trabecular bone were recorded in the lateral incisor region of D3 bone; the minimum values were recorded in the canine region of D3 bone. Cortical bone was stronger and less vulnerable to deformation than was trabecular bone. Stress increased in direct proportion to changes in bone type from D1 to D3. Use of the locator attachment kept all stresses well below the threshold for bone resorption.

Comment

Although implant placement in the canine region may be considered ideal, placement in the lateral incisor region was equally safe when placement in the canine region is inappropriate.

Yıldırım RS, Büyükerkmen EB. Finite element analysis of stress distribution in mandibles with different bone types loaded by implant-supported overdentures with different localizations of locator attachments. Int J Oral Maxillofac Implants *2021;36:851-862.*

In the Next Issue

Quality of life: fixed vs removable implant restorations

Our next report features a discussion of this issue and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.