Surgical and prosthetic planning for a two-implant–retained mandibular overdenture: A clinical report

Cornell K. Lee, DDS,[a] and John R. Agar, DDS, MA[b]
Department of Oral Rehabilitation, Biomaterials and Skeletal Development, University of Connecticut, School of Dental Medicine, Farmington, Conn

A 2-implant–retained mandibular overdenture is considered by some to be the standard of care for mandibular edentulism. Compared to a conventional complete denture, an implant-retained overdenture requires more thorough planning. Careful consideration is necessary regarding the 3-dimensional orientation of the implants to ensure adequate horizontal and vertical space for prosthetic components. This clinical report describes a patient with a compromised mandibular overdenture in whom the position of the existing implants yielded insufficient space for prosthetic components. This report describes the concepts for treatment planning prior to fabricating a new mandibular overdenture, including considerations for the surgical removal of the existing implants, alveoloplasty to create the necessary space for prosthetic components, and placement of the new implants to ensure an esthetic and functional prosthesis. (J Prosthet Dent 2006;95:102-5.)

The introduction of dental implants has improved the quality of life for edentulous patients. A conventional complete mandibular denture is less favorable than a complete maxillary denture in terms of retention. However, the use of 2 implants to retain the denture significantly improves the prognosis of mandibular edentulism.[1,2] Recognizing this, some have considered a 2-implant–retained overdenture to be the standard of care for mandibular edentulism.[3]

An implant-retained overdenture requires more treatment planning than a conventional complete denture. An important consideration in fabricating a mandibular overdenture is ensuring sufficient space for the prosthetic components of the implant attachment system. Inadequate space for prosthetic components can result in an overcontoured prosthesis, excessive occlusal vertical dimension, fractured teeth adjacent to the attachments, attachments separating from the denture, fracture of the prosthesis, and overall patient dissatisfaction. Consequently, prosthetic space analysis is critical when planning for a successful mandibular overdenture, and this should be considered by both the prosthodontist and the implant surgeon.

The predominant categories of retention for mandibular overdentures are either bars or individual attachments. However, bars prescribed for mandibular overdentures complicate and increase the cost of the prosthesis. They are also more technique sensitive[4] and generally require more space than individual attachments.[5] One perceived advantage of the bar is that it can accommodate divergent implants,[6] but individual attachments can also be used for divergent implants.[7] Maintenance of the 2 attachment types is controversial. Some studies suggest that a bar attachment requires less maintenance[8,9] whereas others suggest the opposite.[10,11] Additionally, proper hygiene around the bar is more difficult than for individual attachments.

For a 2-implant–retained mandibular overdenture, placement of implants in the lateral incisor area rather than the canine position offers a mechanical advantage, providing better stability for the overdenture.[12] The implants act as a fulcrum with 2 potential lever arms: (1) from the fulcrum to the posterior extension of the denture, and (2) from the fulcrum anteriorly to the incisal edge. Forces on either lever arm will produce rotation. However, the primary and secondary bearing areas of the overdenture will resist occlusal forces placed on the posterior lever arm, but forces on the anterior lever arm, such as incisive movements, may cause more noticeable rotation. By moving the implants from the canine to the lateral incisor position, the effective anterior lever arm is reduced, thus minimizing the tipping forces on the overdenture. The aim of this clinical report is to describe the procedures for treatment planning a mandibular overdenture for optimal position of implants, and to emphasize the importance of prosthetic space analysis for attachment components prior to implant placement.

CLINICAL REPORT

A 76-year-old Romanian man presented in 2004 to the Graduate Prosthodontic Clinic at the University of Connecticut with a compromised 2-implant–retained mandibular overdenture opposing a metal-ceramic fixed complete denture. The left attachment was broken, and a perforation in the overdenture exposing the underlying abutment was noted. Moreover, the anterior lingual portion of the overdenture was overcontoured up to the level of the incisal edge (Fig. 1, *A*). Evaluation revealed that the implants were divergent in both mesiodistal and

Presented as a Table Clinic at the Greater New York Academy of Prosthodontists meeting, December 2005, New York, NY.
[a]Resident, Graduate Prosthodontics.
[b]Associate Professor, Prosthodontic Graduate Program Director.

Fig. 1. A, Exposed attachment in mandibular left canine position. **B,** Implants were situated in unfavorable position for implant-retained overdenture. (Photos courtesy of Marjorie Wood, DMD, MDSc.)

buccolingual orientation. Both implants were located in the canine positions at different heights, and both implants were too high occlusogingivally (Fig. 1, *B*).

A review of the patient's dental history indicated that the overdenture was fabricated in 1998 and a similar problem had occurred previously in 2003. At that time, the left overdenture attachment had separated, and the right gold matrix had become exposed. An acrylic resin tooth adjacent to the right implant had fractured as well. Because the patient preferred a conservative treatment approach, the gold matrix-ball attachment system was replaced with a lower-profile, but wider, resilient attachment system (Locator; Zest Anchors Inc, Escondido, Calif). The left attachment broke loose again within a year.

It was determined that the etiology of the problem should be addressed and a new mandibular overdenture fabricated. A diagnostic arrangement was made, and the esthetics, phonetics, and occlusal vertical dimension of the arrangement were evaluated and confirmed intraorally. Putty vinyl polysiloxane (Reprosil; Dentsply Caulk, Milford, Del) was adapted over the diagnostic

Fig. 2. Putty matrix formed from diagnostic arrangement revealed minimal prosthetic space.

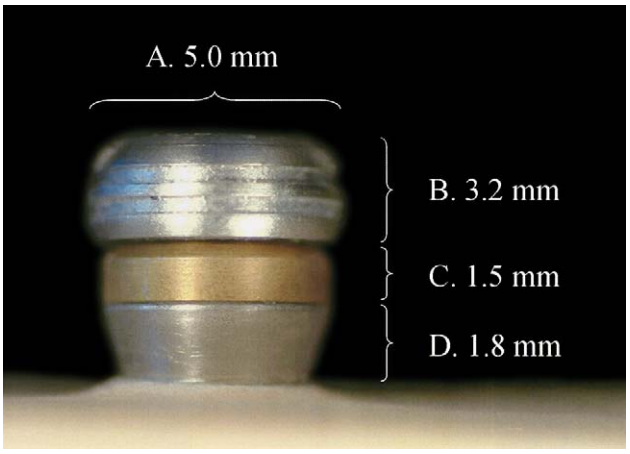

Fig. 3. Minimum dimensions for Locator attachment system and Standard Plus Straumann implants. **A,** Width of attachment. **B,** Height of attachment. **C,** Height of abutment. **D,** Length of implant above bone. Additional 2.0 mm of space required for acrylic resin to encase attachment.

arrangement on the diagnostic cast, and a matrix was formed. The putty matrix was sectioned at the position of the 2 lateral incisors to assist in assessing the available prosthetic space at those locations (Fig. 2). It is necessary to know at the diagnostic planning stage which attachment system and implant system will be used. Each system has unique vertical and horizontal space requirements.

The attachment system (Locator; Zest Anchors Inc) and implants (Standard Plus Straumann; Straumann, Waldenburg, Switzerland) selected for this patient occupy relatively minimal space. Space analysis indicated 2 mm of vertical space between the lingual surface of the diagnostic arrangement and the soft tissue of the residual ridge crest. Bone sounding revealed 2 mm of gingival thickness; therefore, the patient had 4 mm of vertical space from the bone to the external surface

Fig. 4. After using trephine, implants were luxated with elevator and extracted.

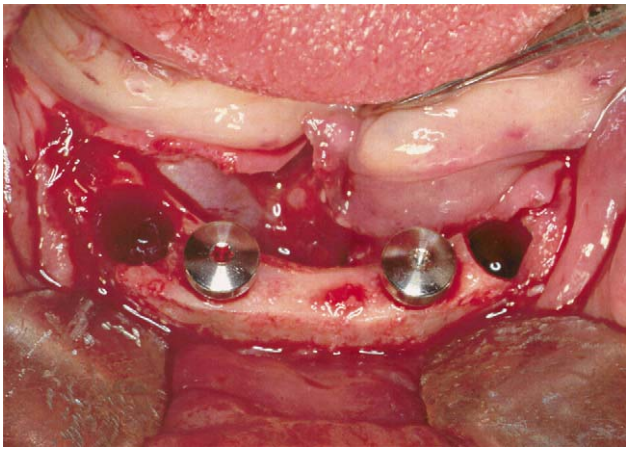

Fig. 5. Alveoloplasty was performed, previous implants were removed, and new implants were placed in lateral incisor positions.

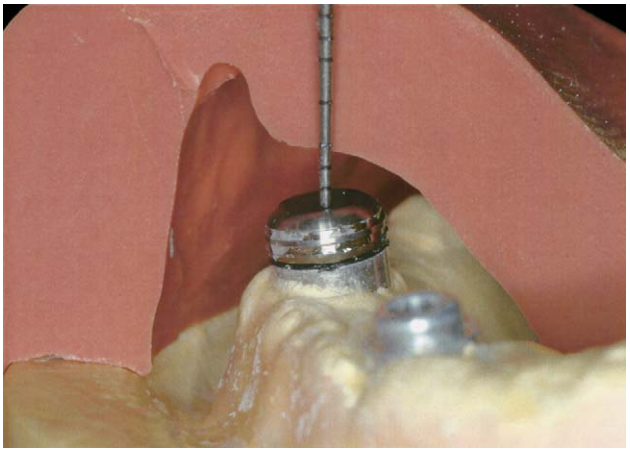

Fig. 6. New matrix made to verify space for 2 mm zone of acrylic resin surrounding attachment.

of the denture. However, the minimum vertical space requirement for the Locator attachment and Standard Plus Straumann implants is 8.5 mm from the osseous level to the superior surface of the acrylic resin. The calculation is derived from the following measurements: 1.8 mm from the osseous level to the shoulder of the implant, 1.5 mm for the shortest abutment including the bevel, 3.2 mm for the attachment and processing patrix, and 2 mm of acrylic resin above the attachment. The minimum horizontal space requirement is 9.0 mm, as the width of the attachment is 5.0 mm and 2.0 mm of acrylic resin is required on either side (Fig. 3). From experience, a thickness of 2 mm of acrylic resin is needed for sufficient bulk and strength of the material. Consequently, it was determined that a minimum of 4.5 mm of bone should be removed to create adequate vertical and horizontal space for the prosthetic components of the overdenture. In other words, the previous implants were placed approximately 4.5 mm too high.

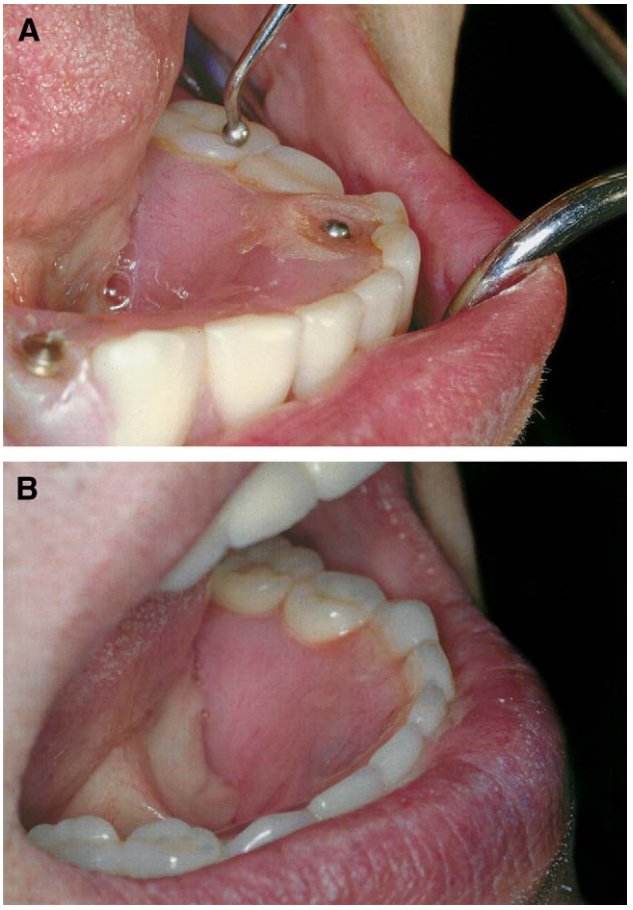

Fig. 7. A, Previous mandibular overdenture from 2003. (Photo courtesy of Marjorie Wood, DMD, MDSc.) **B,** New overdenture with more harmonious contours and well-enclosed attachments.

One possible solution was to use the existing implants but to increase the occlusal vertical dimension to create additional interocclusal space. However, it was

determined that the patient could not tolerate an increased occlusal vertical dimension. The possibility of submerging the existing implants by placing internal cover screws and placing new implants in the lateral incisor position was considered. Given the 4.5 mm of alveoloplasty necessary to create adequate interocclusal space, this conservative option was dismissed. A 4.5-mm step in osseous contour between the previous and new implants would not be desirable. Thus, the decision was made to remove the improperly placed implants using a trephine.

A surgical guide was not required, as the existing implants were used as a reference for osseous reduction. Initially, 5 mm of crown lengthening was performed around the implants. This was used as a depth cut to aid in proper osseous reduction, and it also reduced the amount of trephining that would be necessary. A 5.0-mm-diameter trephine (Straumann) was used to the depth of the 4.8-mm-wide implants, followed by simple luxation and extraction of the implants. The remaining osseous ridge was reduced with a mallet and chisel and recontoured using a motorized handpiece to the level of the initial depth cuts. The autogenous bone harvested from the osseous reduction was grafted in the extraction sockets. Using a surgical guide, 2 new endosseous implants (Straumann) measuring 4.8 × 12 mm were placed and allowed to heal for 7 weeks (Figs. 4 and 5).

Since a 2-implant–retained overdenture is both tissue and implant supported, proper buccal shelf extensions are necessary for posterior support. Adequate flange extensions are required to seal and prevent food impaction. At the wax try-in stage of making the denture, a new putty matrix was made to verify adequate space surrounding the attachment in all dimensions (Fig. 6). The overdenture was completed according to conventional denture processing techniques[13] and inserted (Fig. 7). Denture adjustments were performed as necessary. At the 6-month evaluation of the prosthesis, no further complications had occurred.

DISCUSSION

If prosthetic compensation for poorly positioned implants is not possible, trephine removal of these implants may be considered. However, the width of bone facial and lingual to the implant must be evaluated, as there is a risk of creating a 2-wall bony defect from this procedure. Because 5 mm of osseous reduction was performed and the width of the ridge was increased in a corono-apical direction, the resultant bony defect for the patient described was insignificant.

SUMMARY

This clinical report demonstrated the consequences of inadequate planning for a mandibular overdenture and the procedures necessary to correct the resulting problems. Implants for overdentures should be placed only after careful analysis of the space needed for the prosthetic components. The minimum space requirements differ according to the dimensions of the attachment and implant system used. Implants must be placed in the proper position mesiodistally, buccolingually, and occlusogingivally for a successful overdenture. Proper vertical placement of implants may require alveoloplasty.

The authors thank Dr Marjorie Wood and Dr Peter Barndt for their insight, and Dr Martin Freilich for his guidance during the implant surgery.

REFERENCES

1. Meijer HJ, Raghoebar GM, Van't Hof MA. Patient satisfaction with mandibular implant overdentures and conventional dentures: a 10-year prospective study of clinical aspects and patient satisfaction. Int J Oral Maxillofac Implants 2003;18:879-85.
2. Awad MA, Lund JP, Dufresne E, Feine JS. Comparing the efficacy of mandibular implant-retained overdentures among middle-aged edentulous patients: satisfaction and functional assessment. Int J Prosthodont 2003; 16:117-22.
3. Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. Int J Oral Maxillofac Implants 2002;17:601-2.
4. Naert I, Quirynen M, Theuniers G, van Steenberghe D. Prosthetic aspects of osseointegrated fixtures supporting overdentures. A 4-year report. J Prosthet Dent 1991;65:671-80.
5. Phillips K, Wong KM. Space requirements for implant-retained bar-and-clip overdentures. Compend Contin Educ Dent 2001;22:516-22.
6. Burns DR. Mandibular implant overdenture treatment: consensus and controversy. J Prosthodont 2000;9:37-46.
7. Wiemeyer AS, Agar JR, Kazemi RB. Orientation of retentive matrices on spherical attachments independent of implant parallelism. J Prosthet Dent 2001;86:434-7.
8. van Kampen F, Cune M, van der Bilt A, Bosman F. Retention and postinsertion maintenance of bar-clip, ball and magnet attachments in mandibular implant overdenture treatment: an in vivo comparison after 3 months of function. Clin Oral Implants Res 2003;14:720-6.
9. MacEntree MI, Walton JN, Glick N. A clinical trial of patient satisfaction and prosthodontic needs with ball and bar attachments for implant-retained complete overdentures: three-year results. J Prosthet Dent 2005;93:28-37.
10. Naert I, Alsaadi G, Quirynen M. Prosthetic aspects and patient satisfaction with two-implant-retained mandibular overdentures: a 10-year randomized clinical study. Int J Prosthodont 2004;17:401-10.
11. Gotfredsen K, Holm B. Implant-supported mandibular overdentures retained with ball or bar attachments: a randomized prospective 5-year study. Int J Prosthodont 2000;12:125-30.
12. Taylor TD. Indications and treatment planning for mandibular implant overdentures. In: Feine JS, Carlsson GE, editors. Implant overdentures as the standard of care for edentulous patients. Chicago: Quintessence; 2003. p. 71-81.
13. Zarb GA, Bolender CL. Prosthodontic treatment for edentulous patients. 12th ed. St. Louis: Mosby; 2004. p. 389-426.

Reprint requests to:
Dr Cornell K. Lee
Department of Oral Rehabilitation, Biomaterials and Skeletal Development
University of Connecticut, School of Dental Medicine
263 Farmington Ave
Farmington, CT 06030
Fax: 860-679-1370
E-mail: Clee@gde.uchc.edu

0022-3913/$32.00

doi:10.1016/j.prosdent.2005.11.017