Treatment Options for the Edentulous Mandible

Authored by Steven Kendrick, DDS and David Wong, DDS

Upon successful completion of this CE activity 1 CE credit hour may be awarded
Treatment Options for the Edentulous Mandible

LEARNING OBJECTIVES:

After reading this article, the individual will learn:

- Treatment options available today for the edentulous mandible.
- The importance of mandibular anatomy in determining implant position, prosthesis selection, and cantilever length.

ABOUT THE AUTHORS

Dr. Kendrick is in private practice in Midwest City, Okla, and is an instructor at the Tulsa Implant Institute. He can be reached via e-mail at skend22@hotmail.com.

Disclosure: Dr. Kendrick reports no conflicts of interest.

Dr. Wong is in private practice in Tulsa, Okla, and is an instructor at the Tulsa Implant Institute. He is a Board Certified Periodontist and can be reached via e-mail at david@tulsagums.com.

Disclosure: Dr. Kendrick reports no conflicts of interest.

INTRODUCTION

The treatment of the edentulous mandible is one of the most challenging to the dental practitioner in regards to patient satisfaction.¹ The number of edentulous arches in the United States is expected to increase. It is estimated that by the year 2020 there will be 61 million edentulous arches.² As this segment of the population grows, there will be an increasing demand on dentistry for edentulous prosthetic treatment. This article discusses the treatment options available today for the edentulous mandible and the importance of mandibular anatomy in determining implant position, prosthesis selection, and cantilever length.

ANATOMIC CONSIDERATIONS

The anatomy of the edentulous ridge provides challenges to the adaptive process of patients to conventional denture therapy. One of the anatomical considerations is the mandibular ridge, which provides less than one quarter the support offered by the periodontium to the natural teeth (Figure 1).³ It is from this compromised situation that the clinician must build the prosthesis. An understanding of the anatomy of the edentulous mandible will allow the clinician to make decisions on implant placement and any ancillary procedure that will need to be performed in order to obtain a satisfactory result for the patient.

The implant retained/supported prosthesis will be affected by the location of the mental foramina and the inferior alveolar canal (Figure 2). The distance between these areas will determine the number of possible implant sites as well as inter-implant spacing. The distance between the foramina is variable based on ethnicity, sex, and skull size. The average interforamen distance for African-American males is 45.8 mm; white males is 45 mm; African-American females is 43.8 mm; and white females is 41 mm.⁴

Figure 1. The edentulous mandibular ridge provides limited support for a conventional prosthesis.

Figure 2. The position of the mental foramina and the inferior alveolar canal will determine the space available for implant placement.
This space can be divided into 5 equal columns of bone serving as potential implant sites, labeled A, B, C, D, E, starting from the patient’s right side (Figure 3). If fewer than 5 implants are being placed at the initial surgery, the implants are placed in different positions depending on the type of prosthesis being designed, leaving the appropriate columns empty for future implant placement should the patient want/need additional implant support.\(^5,6\)

As a general rule, when 5 implants are placed in the anterior mandible between the foramina, the cantilever should not exceed 2.5 times the anteroposterior (A-P) spread with all other force factors being low.\(^7\) The A-P distance is obtained by connecting a line drawn from the distal aspect of the most posterior implants and a parallel line drawn through the center of the most anterior implant (Figure 4). The greater the A-P distance the more favorable the situation for the posterior cantilever.\(^8,9\)

The existing arch form will affect the amount of A-P spread possible. There are 3 types of arch forms: (1) ovoid, (2) tapering, and (3) square. The square arch form provides the shortest A-P spread, with an A-P dimension often of 2 to 5 mm. Conversely, the tapering arch form will result in the largest A-P spread, with an A-P distance greater than 8 mm. The ovoid, which is the most common, will often have an A-P distance of 6 to 8 mm.\(^10\) By evaluating the arch form, the doctor will have an idea of the potential A-P spread and the amount of cantilever possible to support the prosthesis (Figure 5). Patient force factors will ultimately determine the amount of cantilever to be used for the definitive prosthesis.\(^11\)

The treatment plan will also consider the alveolar ridge height and width. A minimum alveolar height of 9 mm is recommended if conventional endosseous implants are expected to be used to ensure predictability.\(^12\) In the anterior mandible the inferior cortical plate can be perforated but it is not recommended. Posterior to the mental foramen a safety zone of 2 mm superior to the inferior alveolar canal is suggested.\(^13\) The minimum width of the edentulous mandible is dependent on the type of implant used. A 1 mm thickness of bone buccal and lingual to the implant ensures sufficient bone thickness and blood supply around the implant for predictable survival.\(^14\)

The crown height space available will determine the type of attachment, material selection, or whether additional procedures must be performed to obtain the appropriate space for the desired prosthesis. This dimension will be the least with an implant attachment retained prosthesis (7 mm). The space required for the current lowest vertical height of an attachment (abutment plus male) is 3.17 mm on an externally hexed implant, and 2.5 mm on a nonhexed implant.

The bar retained implant overdenture will require 15 to 17 mm of crown height space depending on the type of
attachment used (Figure 6). When considering an implant retained fixed prosthesis the amount of crown height space present will determine the materials to be selected.

The amount of keratinized tissue present will determine if any soft tissue augmentation procedures will need to be performed either at the time of implant placement or in the future. Factors such as active/hyperactive gag reflex and parafunctional habits will also need to be considered.

**PSYCHOLOGIC CONSIDERATIONS**

Edentulous patients can present with some psychological challenges related to their condition. Some edentulous patients cannot cope with their prosthesis regardless of how well it is made. This does not mean that all edentulous patients fall into this category. Just as with dentate patients, a pre-clinical interview where the clinician and patient can discuss expectations is mutually beneficial.

**CONVENTIONAL DENTURE**

Conventional denture therapy is also an option for the patient, but often provides the least favorable outcome for patients when compared to implant supported prosthesis. Patients report the most important qualities of a denture to be comfort, stability, the ability to chew and speak normally, and aesthetics. Multiple studies have compared conventional dentures to implant retained overdentures. In these studies patients had higher satisfaction scores with implant retained dentures as compared to conventional dentures.

However, there are factors such as financial and/or health related limitations in which a conventional denture meets the need of that person and should not be considered inferior treatment.

**MINI-IMPLANT RETAINED OVERDENTURE**

A mini-implant retained mandibular denture should be considered as a treatment option when there is insufficient buccal-lingual width of the alveolar ridge for standard size endosseous implants and the patient cannot undergo grafting procedures, whether due to financial or health risk factors (Figure 7). There will also be a percentage of patients who will not consent to the grafting procedure due to a perceived negative risk/benefit ratio. Current mini-implants on the market range from 1.8 to 3.0 mm in diameter and length ranging from 10 to 18 mm. The number of implants recommended in the mandible is a minimum of 4 with a spacing of 5 to 8 mm between implants. The manufacturers also recommend a minimum distance of 7 mm anterior to the mental foramina. The total number of implants possible will be determined by the distance between the mental foramina. Immediate loading of the implants is recommended only when the implants are able to resist 30 to 35 ncm of load (as per manufacturer's instruction). At that time the mandibular denture is connected to the mini-implants using a chairside pick-up technique, or an impression is taken and a laboratory reline process is performed.

**ATTACHMENT-RETAINED IMPLANT OVERDENTURE**

Implant overdentures can be supported by as many as 5 implants in the anterior mandible, to as few as one implant (Figures 8 to 10). The McGill Consensus Statement on Overdentures stated that the mandibular 2-implant overdenture is the minimum standard of care for edentulous patients. This is where the treatment plan discussion with
the patient should begin. The patient's desires for stability and the ability to remove or not remove the prosthesis will determine the final number of implants and type of prosthesis. An attachment-retained overdenture will require implants in different positions depending on the amount of retention and stability required by the patient. A 2-implant-retained overdenture will have implants placed in the B-D positions. This provides an anterior stop and minimizes anterior-posterior rocking. A patient requiring more stability will have implants placed in the A-C-E position. This will increase retention with an additional implant and will create a tripod effect to further minimize anterior-posterior rocking. The patient requiring more stability and who is transitioning to a fixed prosthesis in the future or cannot afford the expense of a bar-retained overdenture will have the treatment option of a 4-implant-retained prosthesis with implants in the A-B-D-E positions.

The attachment-retained overdenture has the main advantage of cost over the bar-retained implant overdenture and the implant retained fixed prosthesis. However, it does not address posterior bone loss and will have less stability than a bar-retained overdenture or a fixed prosthesis.

**BAR-RETAINED IMPLANT OVERDENTURE**

The bar-retained implant overdenture provides more support for the edentulous patient compared to the attachment-retained implant denture. The same implant placement options are available but the ability exists to cantilever the bar posteriorly due to A-P spread (Figure 11). The B-D, A-C-E, and B-C-D options are generally not cantilevered due to the limited implant support and short A-P distances. The A-B-D-E option in a tapering arch is often 10 mm, and 8 mm in an ovoid arch. If all other factors are favorable this would allow a cantilever in the ovoid arch of up to 12 mm, and up to 15 mm in the tapering arch. The square arch form would only allow 4 mm of cantilever.

If the patient requires more support an additional implant can be placed in the C position, which will increase the A-P distance in an ovoid or tapering arch. An implant can also be placed in the molar region on either side to increase the A-P distance. This is a primary option for increasing A-P spread in a square arch from.
**IMPLANT-RETAINED FIXED PROSTHESIS**

Patient desires will also dictate the fabrication of an implant-retained fixed prosthesis. The 5 columns of bone are still available to be used, with the option of placing implants above or behind the mental foramina to reduce cantilever lengths.

This prosthesis also has the potential of an increase of posterior bone height. One to 4 additional implants can be placed in the mandible after the A-B-D-E positions have been filled to gain the maximum A-P distance and increase implant support.

Further, crown height space will play a role in material selection for the prosthesis. If the distance from the implant platform to the occlusal table is less than 15 mm, then the prosthetic material indicated is PMF (Figure 12). If the distance is greater than 15 mm, then a hybrid prosthesis should be used (Figure 13). The distance of 15 mm is important because of the physical properties of the restorative materials. Acrylic is a material that requires bulk for strength. If there is less than 15 mm of distance from the implant platform to the occlusal table there will not be sufficient space to achieve the bulk of acrylic necessary to provide strength for the prosthesis.

Likewise, PFM restorations have difficulties when too much space is available. At dimensions greater than 15 mm from the implant platform to the occlusal table, the control of surface porosity across the metal substructure becomes difficult due to variations in cooling and heating rates across the metal. Because of this it becomes difficult to bake porcelain to the substructure. The result is the high possibility of future porcelain fracture.

**CONCLUSION**

An understanding of the anatomy of the mandible along with an understanding of the concept of A-P spread will allow the clinician to treatment plan patients with an edentulous mandible. Treatment options should be based on the patient's wants/desires for the final prosthesis. The 2-implant overdenture should be the starting point for treatment options, not the end point. If the patient is unable or unwilling to undergo grafting procedures, then the mini-implant option should be discussed, but it should not be seen as a treatment for every edentulous patient. The patient will ultimately make the decision based on what treatment option is in their best interest at that given point in their life. By understanding what is necessary to provide each of the treatment options discussed in this article, the clinician can formulate a plan to phase treatment for the patient and help them arrive at their ultimate goal once they have been informed of the pros/cons and consequences of no treatment.

**REFERENCES**

POST EXAMINATION INFORMATION

To receive continuing education credit for participation in this educational activity you must complete the program post examination and receive a score of 70% or better.

Traditional Completion Option:
You may fax or mail your answers with payment to Dentistry Today (see Traditional Completion Information on following page). All information requested must be provided in order to process the program for credit. Be sure to complete your “Payment”, “Personal Certification Information”, “Answers” and “Evaluation” forms. Your exam will be graded within 72 hours of receipt. Upon successful completion of the post-exam (70% or higher), a “letter of completion” will be mailed to the address provided.

Online Completion Option:
Use this page to review the questions and mark your answers. Return to dentalCEtoday.com and sign in. If you have not previously purchased the program select it from the “Online Courses” listing and complete the online purchase process. Once purchased the program will be added to your User History page where a Take Exam link will be provided directly across from the program title. Select the Take Exam link, complete all the program questions and Submit your answers. An immediate grade report will be provided. Upon receiving a passing grade complete the online evaluation form. Upon submitting the form your Letter Of Completion will be provided immediately for printing.

General Program Information:
Online users may login to dentalCEtoday.com anytime in the future to access previously purchased programs and view or print “letters of completion” and results.

POST EXAMINATION QUESTIONS

1. The edentulous mandibular ridge provides less than ________ the support offered by the periodontium to the natural teeth.
   a. one third  
   b. one fifth
   c. one half  
   d. one quarter

2. The implant retained/supported prosthesis will be affected by the anatomic location of the __________ and the __________.
   a. mental foramina; inferior alveolar canal
   b. hyoglossis; inferior alveolar canal
   c. mental foramina; hyoid bone
   d. hyoglossis; hyoid bone

3. The anteroposterior distance is obtained by connecting a line drawn from the ________ aspect of the most ________ implants and a parallel line drawn through the center of the most anterior implant.
   a. distal; posterior  
   b. mesial; posterior
   c. distal; anterior  
   d. mesial; anterior

4. The _______ arch form provides the shortest A-P spread with an A-P dimension often of ________ mm.
   a. ovoid; 8 to 9
   b. square; 2 to 5
   c. tapered; 1 to 2
   d. square; 8 to 9

5. What is the minimum distance required for an implant attachment retained overdenture, measured from the alveolar crest to the inner aspect of the lingual denture base?
   a. 5 mm  
   b. 6 mm
   c. 7 mm  
   d. 8 mm

6. The vertical component of the bar retained overdenture requires at least ________ of crown height space.
   a. 10 to 12 mm  
   b. 13 to 15 mm
   c. 15 to 17 mm  
   d. 18 to 20 mm

7. If the distance from the implant platform to the occlusal table is less than 15 mm, then the prosthetic material indicated for a fixed prosthesis is:
   a. PFM.  
   b. acrylic-pressed-to-metal.
   c. composite resin.  
   d. all metal.

8. The attachment-retained overdenture has the advantage of cost compared to the bar-retained implant overdenture. However, the former has less stability than the latter.
   a. The first statement is true, the second is false
   b. The first statement is false, the second is true
   c. Both statements are true  
   d. Both statements are false
PROGRAM COMPLETION INFORMATION

If you wish to purchase and complete this activity traditionally (mail or fax) rather than Online, you must provide the information requested below. Please be sure to select your answers carefully and complete the evaluation information. To receive credit you must answer at least six of the eight questions correctly.

Complete online at: www.dentalcetoday.com

TRADITIONAL COMPLETION INFORMATION:

Mail or Fax this completed form with payment to:

Dentistry Today
Department of Continuing Education
100 Passaic Avenue
Fairfield, NJ 07004
Fax: 973-882-3662

PAYMENT & CREDIT INFORMATION:

Examination Fee: $20.00  Credit Hours: 1.0
Note: There is a $10 surcharge to process a check drawn on any bank other than a US bank. Should you have additional questions, please contact us at (973) 882-4700.

☐ I have enclosed a check or money order.
☐ I am using a credit card.

My Credit Card information is provided below.

☐ American Express  ☐ Visa  ☐ MC  ☐ Discover

Please provide the following (please print clearly):

Exact Name on Credit Card

/  
Credit Card #  Expiration Date

Signature

PERSONAL CERTIFICATION INFORMATION:

Last Name (PLEASE PRINT CLEARLY OR TYPE)
First Name
Profession / Credentials  License Number
Street Address
Suite or Apartment Number
City  State  Zip Code
Daytime Telephone Number With Area Code
Fax Number With Area Code
E-mail Address

ANSWER FORM: COURSE #: 118.2

Please check the correct box for each question below.

1.  ☐ a  ☐ b  ☐ c  ☐ d
2.  ☐ a  ☐ b  ☐ c  ☐ d
3.  ☐ a  ☐ b  ☐ c  ☐ d
4.  ☐ a  ☐ b  ☐ c  ☐ d
5.  ☐ a  ☐ b  ☐ c  ☐ d
6.  ☐ a  ☐ b  ☐ c  ☐ d
7.  ☐ a  ☐ b  ☐ c  ☐ d
8.  ☐ a  ☐ b  ☐ c  ☐ d

PROGRAM EVALUATION FORM

Please complete the following activity evaluation questions.

Rating Scale: Excellent = 5 and Poor = 0

Course objectives were achieved.

Content was useful and benefited your clinical practice.

Review questions were clear and relevant to the editorial.

Illustrations and photographs were clear and relevant.

Written presentation was informative and concise.

How much time did you spend reading the activity & completing the test?