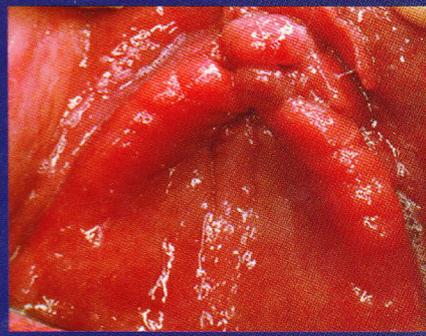


Prosthodontic Treatment for Edentulous Patients

Complete Dentures
and Implant-Supported Protheses

Thirteenth Edition



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Several compelling conclusions can be drawn from earlier chapters.

- Treatment outcomes with complete dentures depend on dentist-mediated and patient-mediated considerations. The former include clinical judgment and technical skills combined with expert laboratory technological support. The latter are defined by each individual patient's adaptive traits, systemic and local health considerations, and morphological characteristics.
- An adaptive denture experience is the frequently achieved treatment goal when complete dentures are made. However, an ongoing long-term continuum of adaptation is unpredictable, because of inevitable time-dependent anatomical and physiological changes. These include severe residual ridge reduction, an increased mucosal vulnerability, reduced salivary flow, and compromised motor skills. Nonetheless, clinical experience suggests that time-dependent denture-wearing problems can be frequently solved by making new optimized dentures for these patients.
- The older preprosthetic surgical techniques prescribed for maladaptive denture patients sought to enlarge the denture-bearing area via sulcus-deepening procedures, ridge augmentation, or both. The approach failed to yield beneficial results that were predictable, long-term, and without adverse consequences.
- Overdentures supported by natural tooth roots have been a long-standing and integral part of treatment planning for potentially edentulous patients. Regrettably, their short-term and long-term treatment outcomes are unpredictable because of caries and periodontal disease affecting the tooth root abutments.
- The introduction of the preprosthetic osseointegration technique ushered in a new era of versatile, predictable, and virtual morbidity-free fixed prosthodontic treatment. This significantly enhanced the quality of life of edentulous patients although associated costs precluded routine fixed full-arch prescriptions. However, extrapolation of the merits of the traditional overdenture technique, coupled with a reduced number of prescribed implants, quickly led to a more cost-effective version of implant-supported prostheses—the implant overdenture.

- Overdentures supported by “ankylotic-like” osseointegrated implant abutments demonstrate a positive influence on adjacent periimplant bone levels. There also appears to be some sensorimotor feedback that seems to also facilitate the overall functional experience with implant abutments under overdentures. This observation has now been supplemented with studies on patient satisfaction with improved masticatory function, bite forces, and chewing activity.

It is therefore tempting for dentists to also conclude that optimal prosthodontic management of most edentulous patients, even those without a maladaptive denture-wearing experience, should be implant-supported prostheses. Moreover, fiscal realities in the context of aging populations with fixed incomes, as well as socioeconomic realities in underdeveloped countries, demand a more financially accessible approach while offering similar advantages. This chapter describes the application of the implant overdenture protocol as a routine measure for managing the edentulous predicament by enhancing a complete denture's retention and stability.

GENERAL OVERDENTURE TREATMENT CONSIDERATIONS

When planning implant overdenture treatment, the following considerations should be noted:

- Mandibular overdentures have been extraordinarily successful irrespective of the diversity of residual ridge morphologies encountered. However, patterns of resorption in the moderate to severely resorbed maxilla present greater treatment challenges when planning maxillary overdentures.
- Although the diversity of commercially available attachment systems for implant overdentures differs slightly from those for natural tooth/root abutments for overdentures, the prosthodontic role of these attachment systems is similar.
- Implant abutment availability that ensures denture retention and stability should not be relied on to exclusively compensate for technically or functionally

inadequate dentures. Therefore the need for traditional and optimal complete denture fabrication techniques should still be followed.

- Esthetic denture design should not be compromised by the planned location of implants and their connection to attachment systems. Consequently, it is difficult to accomplish routine esthetic results with maxillary full-arch fixed implant prostheses, especially in the maxilla, when moderate residual ridge resorption has occurred. On the other hand, overall esthetic objectives can be addressed and achieved with greater ease by using the overdenture technique.
- Very close cooperation is necessary between surgical and prosthodontic planning and actual treatment to maximize the merits of the placement of implants to support overdentures.

INCLUSION AND EXCLUSION CRITERIA

Implant treatment decisions must be made for each patient according to their individual circumstances. The major inclusion criteria underscore the quasi-universal patient eligibility for the method (Box 17-1). Age itself is not an exclusion criterion; however, age-related factors may frequently influence treatment planning in elderly patients. Common challenges encountered include communication difficulties (e.g., compromised hearing and cognitive skills) with consequent lack of cooperation, the likely need for short appointments, special attention to presurgical measures such as general health status and information, the oral hygiene state, and home care provision. Poor general health is often found in elderly patients with consequent deterioration in biological health that is far beyond their chronological age. Medical consultation is frequently required and mandatory for all systemically compromised patients. The patient's family physician should be routinely consulted for these patients and any suspicion of risk or unclear information is revealed.

Problems with wearing complete dentures or adaptation to new ones are multifactorial and include age-related considerations. Patient selection criteria must therefore be established with respect to a broad range of local and general

Box 17-1 Inclusion Criteria for Implant Prosthodontic Treatment

- Patient desire for implant treatment
- Systemic health status, which permits a minor surgical procedure
- Sufficient bone quantity to accommodate prescribed implant dimensions
- Patient willingness and ability to maintain oral health status

aspects. Clinical experience supports specific exclusion criteria (Box 17-2) but also reveals that patients with a history of cardiovascular disease, osteoporosis, and certain endocrine disorders (e.g., diabetes) are still able to undergo a successful implant operation as long as their systemic condition is not a brittle one. Surgical treatment should only be carried out when the patient's health status allows it and when a patient feels well enough and able to undergo the procedure.

PRESURGICAL EVALUATION AND TREATMENT PLANNING

The treatment planning protocol is identical for all edentulous patients and is a result of clinical and radiographic assessments that yield the information contained in Box 17-3. The clinical oral assessment provides information about shape, width, and height of the residual ridges and

Box 17-2 Exclusion Criteria for Implant Prosthodontic Treatment

- Patient's current prosthetic experience is an adaptive one
- Residual ridge dimensions do not accommodate preferred implant dimensions
- Communication with patient is not possible because of his or her compromised cognitive skills
- Patient has a history of substance abuse
- General health conditions preclude a minor surgical intervention
- Local anesthesia with a vasoconstrictor is contraindicated
- Immunosuppressive therapy, prolonged intake of antibiotics or corticosteroids, or brittle metabolic disease history

Box 17-3 Specific Objectives of Treatment Planning for a Patient with Implant-Supported Overdentures

- To determine the optimum location and number of implants in the context of the morphological aspects of the residual ridge
- To design a favorable distribution for occlusal stresses on the implants and the prostheses-bearing tissues
- To avoid discrepancies among the design of the dentures, the implants' location, and the dentures' attachment systems
- To ensure an optimal esthetic result and hygiene protocol

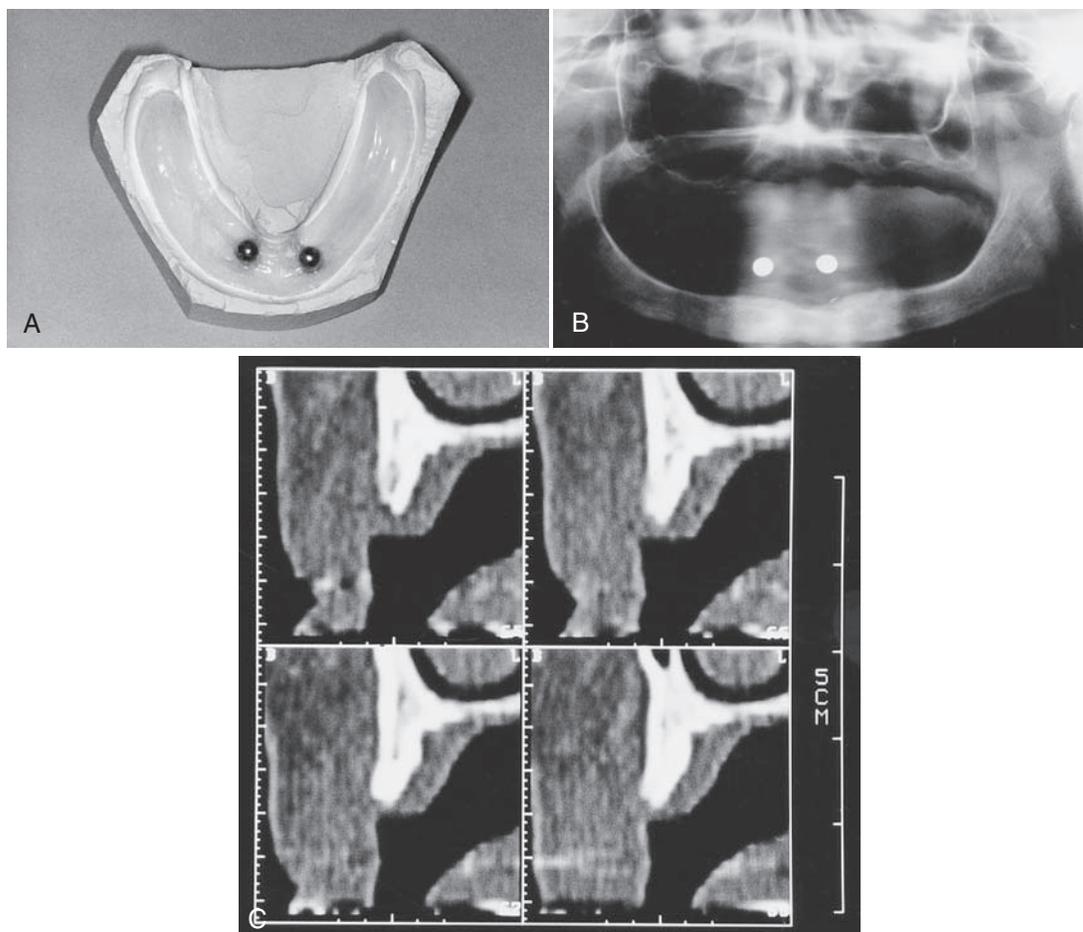


Figure 17-1 Correct imaging of potential host bone sites requires a mix of radiographs, which can be rendered more accurate by using a template with metallic markers of known dimensions (A). These markers will show up on a frontal (B) or sagittal image and allow for measurement adjustments in bone height or width. Required sagittal views of anterior edentulous zones are provided by means of cephalometric films, computed tomograms, or cone-beam radiography (C).

soft tissue conditions. Horizontal and vertical relationships of the residual ridges are examined, and available space for the proposed implants and attachment systems is assessed. Most edentulous patients who are treated with implants frequently show advanced residual ridge reduction without a wide band of attached mucosa. This does not seem to adversely affect the soft tissue health around implants; hence, gingival-mucosal grafting procedures are rarely prescribed.

Panoramic radiographs are made to overview required bone dimensions, to “scout” anatomical structures, to discover possible pathological findings, and to obtain information on bone quality (density) and quantity. Since panoramic films are not entirely reliable, additional radiographic imaging is usually requested for the maxilla. Simple templates with metallic markers of known diameter may be used to measure the available bone height on panoramic radiographs. They also predetermine a favorable location of the implants with respect to the topography of the residual ridge

and adjacent anatomical landmarks, such as the mandibular nerve or the maxillary sinus (Fig. 17-1). Cephalometric radiographs can provide information about faciolingual dimensions, plus the lingual aspect of the residual mandibular bone and the shape of the maxillary ridge. Tomographic or cone-beam images are not necessarily used for mandibular interforaminal implant placement; however, they are indicated for determining maxillary implant placement.

Examination of patients’ existing complete dentures helps the dentist decide whether they are adequate for temporary use during the postsurgical healing phase. New or optimized dentures can be made before surgery if stability of old dentures cannot be achieved by minor routine adjustments or modifications. Old dentures also are examined regarding their esthetic merits, plus the presence of loss of vertical dimension of occlusion. Consideration is given to the type of planned surgical approach, implant system selection, and loading protocol because components such as transmucosal healing abutments may be used, and they



Figure 17-2 Mandibular overdentures have been shown to perform well when supported by only two implants. These prostheses are implant/ridge supported and can be so designed when implants are placed around 22 to 27 mm apart between the mental foramina. **A to C**, Freestanding or unsplinted design using ball abutments or magnets (**D**).

influence decisions on the option of using old dentures during the healing period.

The number and distribution of implants is influenced by residual jaw shape and planned variations of mucosal- and implant support or exclusive implant support. The following two planning concerns of prosthodontic treatment for implant overdentures must be considered:

1. Number of implants prescribed and their location
2. Preferred denture retention devices—the attachment systems

Current and most frequently prescribed treatment options for mandibular overdentures (usually opposing complete maxillary dentures) involve using either two (sometimes more) unsplinted implants with a selected attachment method from the diverse systems available (Fig. 17-2) or bars that connect and splint two or more implants via their abutments (Fig. 17-3). When the anterior mandibular ridge



Figure 17-3 Use of a connecting bar splints two implants and allows for rotation of the prosthesis around the interimplant axis. This can be achieved if the anterior residual ridge shape is only slightly curved and parallel to the arbitrarily determined hinge axis. The functional result simulates the effect of a class I Kennedy removable partial denture (RPD).

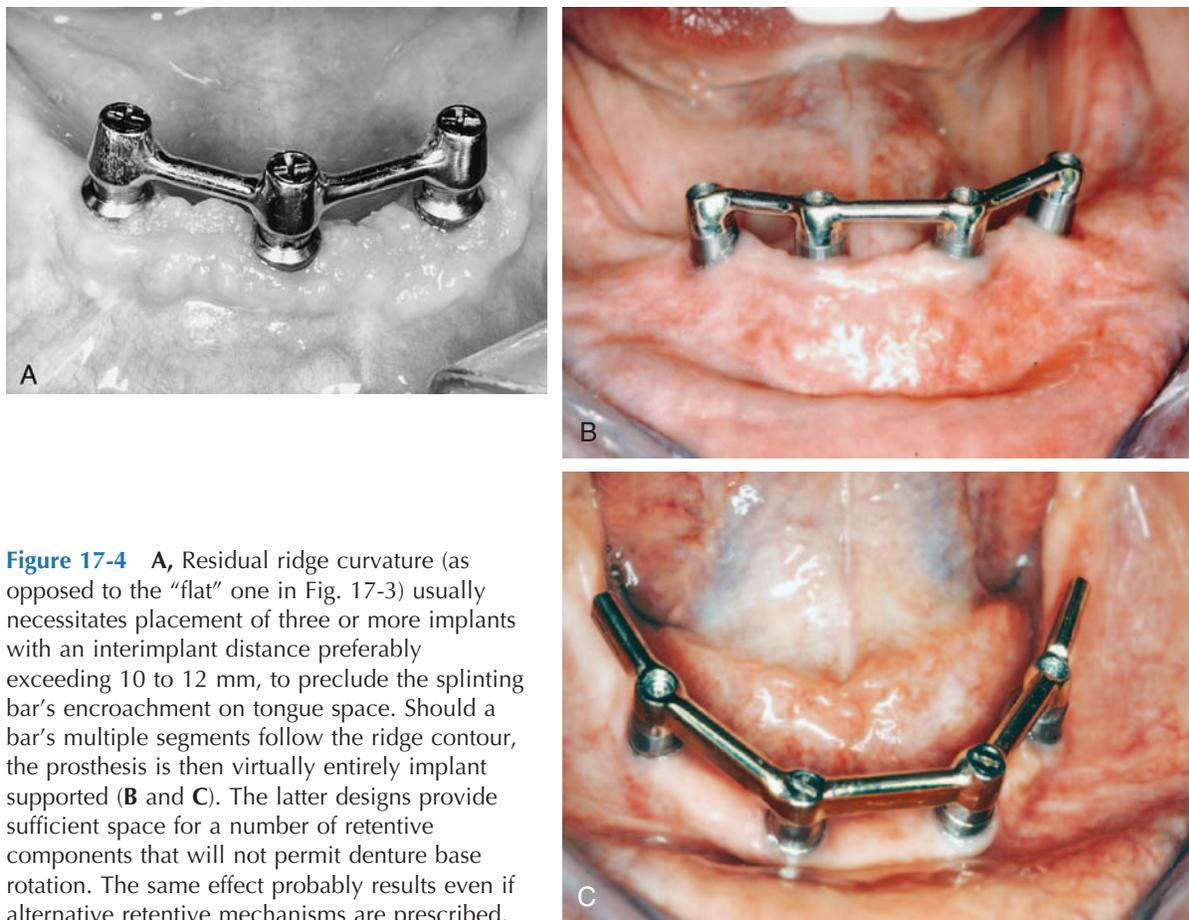


Figure 17-4 A, Residual ridge curvature (as opposed to the “flat” one in Fig. 17-3) usually necessitates placement of three or more implants with an interimplant distance preferably exceeding 10 to 12 mm, to preclude the splinting bar’s encroachment on tongue space. Should a bar’s multiple segments follow the ridge contour, the prosthesis is then virtually entirely implant supported (B and C). The latter designs provide sufficient space for a number of retentive components that will not permit denture base rotation. The same effect probably results even if alternative retentive mechanisms are prescribed.

shows a slight curvature or an ovoid shape, a bar can splint two implants on its shortest distance and preferably parallel to the patient’s arbitrary hinge axis (Fig. 17-4). The interimplant distance should exceed 10 to 12 mm to provide sufficient space to accommodate retentive components. With advanced mandibular residual ridge resorption or a pronounced curvature (a U-shape) of the mandibular ridge, three or preferably four implants can be prescribed. Short implants less than 10 mm in length also can be used in the anterior mandible as per reduced morphological dictates. Reducing the number of implant abutments further for selected patients (especially elderly ones) with a single midline implant to retain a mandibular overdenture is also possible. This is currently regarded as the minimum surgical intervention needed to obtain the benefit of implant overdentures (Fig. 17-5).

The recommended treatment option for maxillary overdentures (usually opposing a natural dentition or a restored one) is commonly four to six implants and infrequently connected using a bar. In maxillary ridges, short bar segments connecting multiple implants are suggested with a segmented bar more likely to follow the ridge without encroaching on the palatal space (Fig. 17-6). Implant length should preferably be 10 mm or longer, and several implants

should be prescribed when resorbed host bone sites preclude placement of 10 mm or longer fixtures. Reducing the proposed number of implants to retain maxillary overdentures is not recommended.

SURGICAL PROTOCOL AND THE OSSEOINTEGRATION PHASE

The surgical procedure is particularly well documented and seeks to place implants into predetermined host sites addressing prosthodontic design objectives. A surgical template or guide is recommended to ensure optimal implant location and alignment. This is facilitated by duplicating the previous denture and trimming it as needed. The patient’s informed consent is obtained, and appropriate premedication is prescribed. The patient’s operation is carried out under local anesthesia as atraumatically as possible. In the mandible, dense cortical bone frequently encloses a tightly structural cancellous structure. In the maxilla, loosely structured trabecular or cancellous bone without a dense cortical layer is often encountered. As a result, the implants are usually self-tapped into such bone of compromised quality. The postoperative phase is almost always

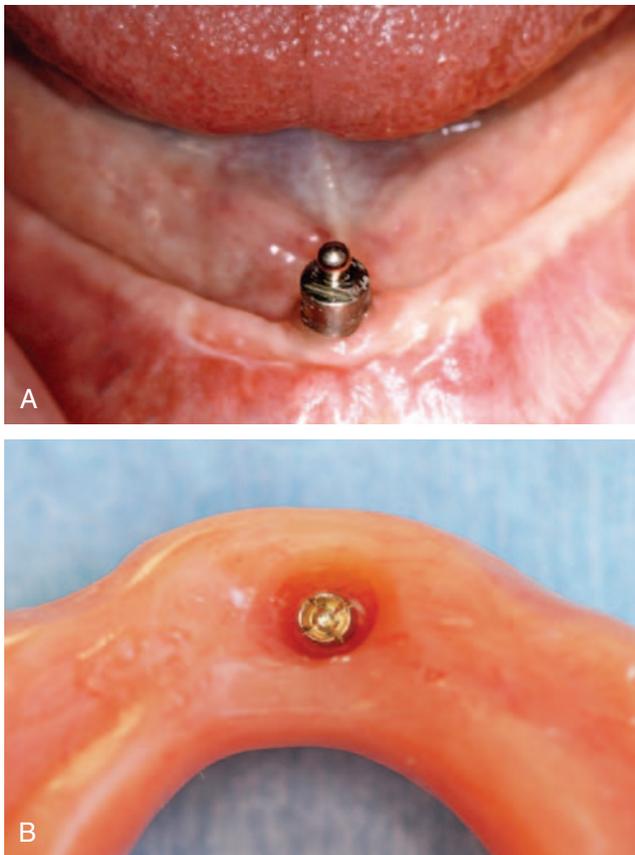


Figure 17-5 A and B, Application of a mandibular midline implant to support an overdenture.

uneventful and is ensured by means of standard analgesia medication plus use of postoperative ice packs and chlorhexidine mouth rinses.

Whenever a two-stage surgical approach is performed (a particularly prudent consideration for the maxilla), the denture is provisionally refitted with a soft liner either right away, or after a few days, depending on the wound healing process supplemented with resorbable sutures. With the one-stage surgical approach, the implants should be protected from contact with the temporary relined denture base, and therefore the dentures are generously relieved overlying the implant before the soft liner is placed. The latter should be changed at regular intervals and patients are instructed about careful hygienic procedures with small soft brushes and the use of a chlorhexidine mouthwash to facilitate plaque removal.

A healing period of 3 to 4 months for mandibular implants and 6 months for maxillary implants (conventional loading) has been traditionally observed—a protocol supported by long-term outcome studies. A longer interval is prescribed for compromised bone quality sites because published research suggests that the healing process is a very individual response that may be accelerated or delayed in different sites in different patients. Evidence suggests that the healing interval also may be abbreviated to permit

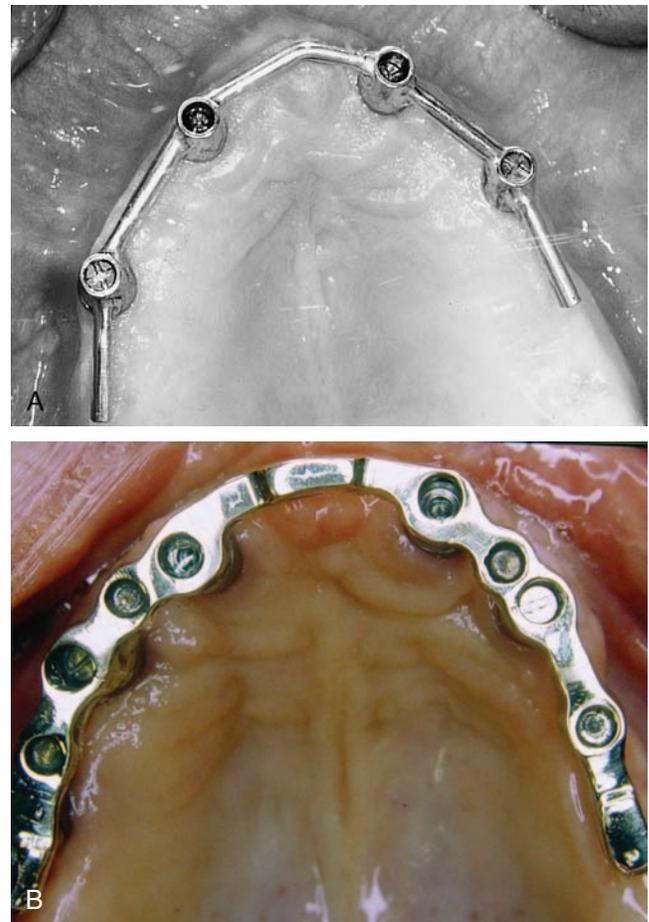


Figure 17-6 A, The maxilla's ridge contour is reflected in a segmented bar soldered to four implant abutments. B, Rigid splinting of multiple implants using a cast milled bar. Retentive clips or attachments can engage any or all of the available segments, ensuring good retention, optimal prosthetic teeth placement, and nonrestriction of tongue space.

either an early loading or immediate loading protocol for mandibular overdentures in selected cases (see Chapter 22). Caution is recommended for a similar approach with maxillary overdentures, given the absence of long-term evidence regarding the effectiveness of such an approach.

PROSTHODONTIC PROTOCOL

GUIDELINES FOR SELECTING ATTACHMENT SYSTEMS

Attachment systems for implant overdentures consist of two parts: the matrix being the receptacle component, and a corresponding patrix that fits closely within the matrix, either mechanically or with a friction fit. One part of the attachment system is usually connected to the implant and the other is incorporated within the undersurface of the overdenture. The patrix designs take the form of a

Box 17-4 Prosthodontic Approaches and Philosophies Used for Implant Overdentures

Single Elements (unsplinted)

- Single ball abutments (stress-breaking mechanism)
- Single magnet abutments (stress-breaking mechanism)
- Individually cast telescopic copings (rigid mechanism)

Connected Elements (splinted)

- Egg-shaped Dolder bar (stress-breaking mechanism)
- Round clip bar (stress-breaking mechanism)
- U-shaped bar (rigid)
- Customized precision-milled bars (rigid)

connecting bar or bars or freestanding ball/magnetic abutments. The matrix designs are adjustable and/or replaceable; can be mechanical, friction fit, or magnetic; and usually take the form of clips for bars. They have metal lamellae, plastic/nylon cap springs, or rubber O-rings for ball abutments and keepers or retainers for magnetic abutments. The overwhelming selection of attachment systems available today invariably leads to dentists selecting a retentive mechanism based on personal experience and patient considerations such as digital dexterity.

Considerations influencing the choice of attachment system include: (1) number of supporting implants and their distribution over the ridge, (2) type and size of ball abutments or the bars, (3) length of the bar segments, (4) number of matrices, and (5) degree of residual ridge resorption. Much empirical discussion exists regarding the benefits of different prosthodontic approaches and philosophies (resilient versus rigid) (Box 17-4). The resilient retention mechanism is widely recommended for anchorage of overdentures to implants, based on the assumption that this will protect implants from overload. In vivo research measurements of patients with two mandibular implants supporting an overdenture do not reveal a preference of one type of anchorage device or retention mechanism over another. They are all arguably equally efficient. A popular belief among dentists is that bars may contribute to load sharing.

Indications for Ball or Magnetic Attachments

Ball or magnetic attachments offer an easy way to retain implant overdentures and are frequently recommended when implants are placed underneath a patient's presently worn dentures, that is, ones that do not have to be remade. Denture-wearing problems of elderly patients with impaired manual dexterity also may be readily resolved using this approach. They should not be used to compensate for

unfavorable and nonparallel alignment of the implants. Examples of matrices of some attachment systems are shown in Fig. 17-7 (see matrices in Figs. 17-2 and 17-3).

Indications for Bar Attachments

These are routinely recommended for maxillary overdentures, atrophic residual ridges in the mandible, and mandibles with more than two implants due to pronounced ridge curvature. The bars can be soldered, cast, or made using milled precision bars as part of an attachment system. Short distal extensions from rigid bars can contribute to stabilization and prevent horizontal shifting of the overdenture. Because splinted multiple implants with a bar usually are prescribed for the maxilla, a horseshoe design is possible (Fig. 17-8). As a consequence, this type of maxillary overdenture will resemble a fixed full-arch prosthesis with regard to stability and function. It is therefore understandable that this may not be regarded as a realistic and economic alternative to a tooth-supported overdenture or complete denture, as is the case with mandibular overdentures supported by only two implants.

IMPLANT OVERDENTURE DESIGN

The design and fabrication of implant overdentures follow previously described principles of fabricating complete dentures as described in Part IV. Stability and retention of complete dentures are enhanced by provision of a well-fitting denture base and properly extended flanges. However, should a patient object to prosthesis bulk, it is reasonable to reduce the denture's peripheries or palatal coverage because of the prosthesis' relative immobility. Relatively easy replacement of lost soft tissue and restoration of facial support are compensated for by the denture base's design and the established vertical dimension of occlusion.

The arrangement of anterior teeth follows basic guidelines as determined by facial esthetic needs, whereas the arrangement of posterior teeth contributes to retention and stability of the dentures. Individual patient preferences frequently can be fulfilled, but anterior teeth positions should not interfere with the circumoral musculature. It is presumed that a stable occlusal scheme (see Chapter 10) is likely to contribute to the protection of implants from overloading.

CLINICAL AND LABORATORY PROCEDURES

Ball or magnetic abutments facilitate simple procedures, as opposed to making a bar. Preliminary impressions are made with alginate in metal stock trays. The custom acrylic resin trays are made either with space relief using ball/magnetic abutments or with openings accommodating transfer copings placed on the implants with the bar design. The final impression is made, it is removed from the mouth, and

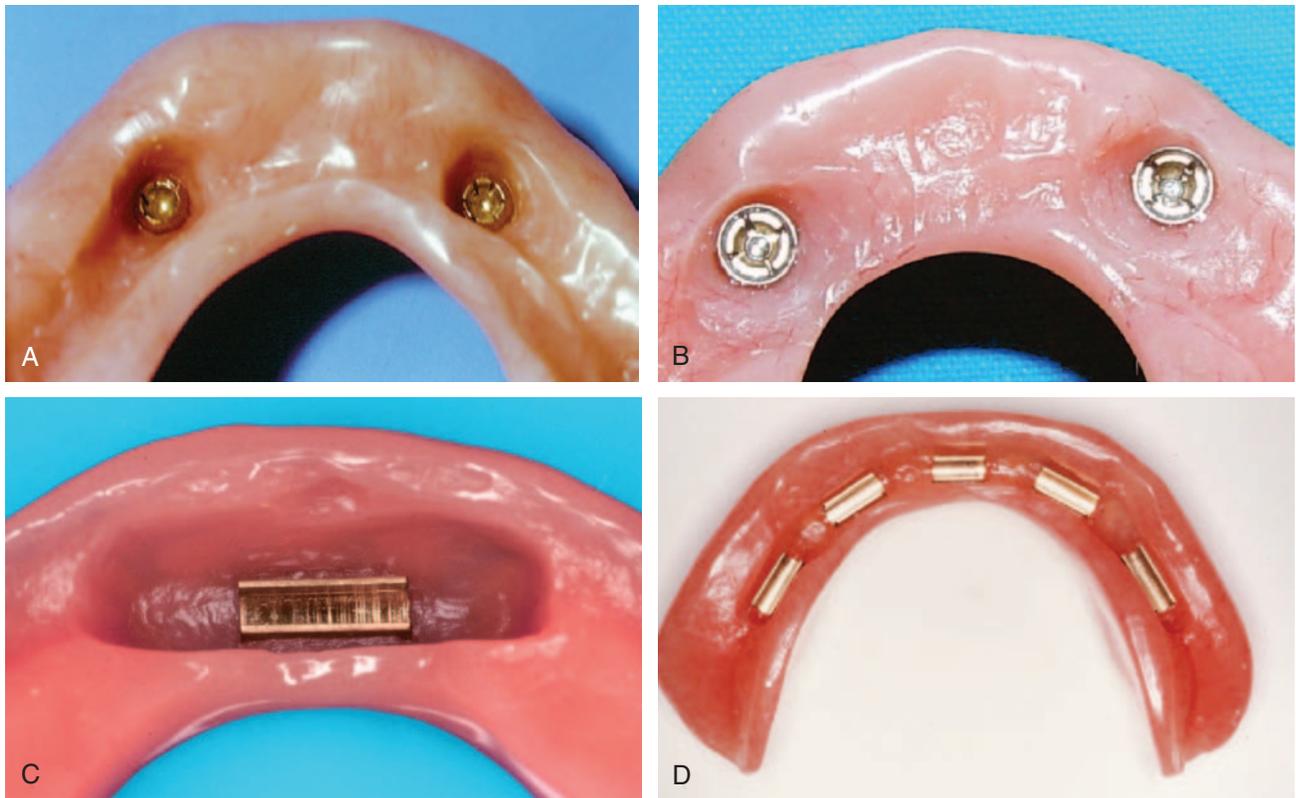


Figure 17-7 A to D, Numerous attachment matrices have been commercially produced in an attempt to enhance or diversify claims for optimal implant/prosthesis retention. These methods are backed by strong anecdotal support.

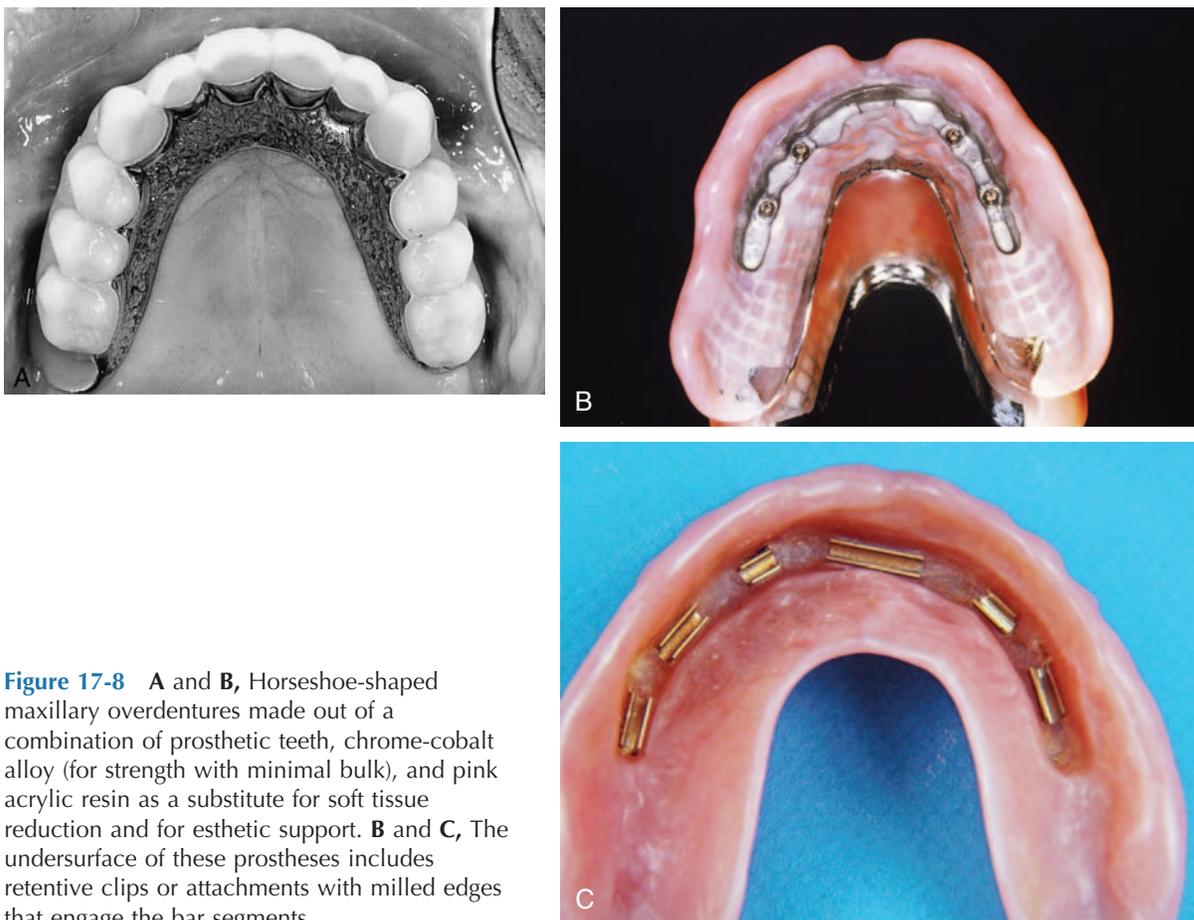


Figure 17-8 A and B, Horseshoe-shaped maxillary overdentures made out of a combination of prosthetic teeth, chrome-cobalt alloy (for strength with minimal bulk), and pink acrylic resin as a substitute for soft tissue reduction and for esthetic support. B and C, The undersurface of these prostheses includes retentive clips or attachments with milled edges that engage the bar segments.

laboratory replicas are placed directly into the impression surface for ball or magnetic abutments or connected to the transfer copings for a bar design. The master cast is poured with the laboratory replicas in place. Whenever a bar is used, the bar (1) follows the shape of the ridge in straight segments, (2) respects the position of the prosthetic teeth, and (3) provides access for oral hygiene procedures.

The subsequent clinical/laboratory protocol is identical to that used for complete denture fabrication. The exception is the inclusion of the selected matrices directly in the undersurface of the overdenture base during the laboratory processing procedures. Some clinicians prefer to use a cobalt-chromium framework embedded in the acrylic resin denture base; this appears to be a subjective decision, although it has economic implications (see Fig. 17-8). The matrices for bar designs (retentive clips) are processed in the acrylic resin denture base. The same orientation index is used to cast a metal framework after final soldering of the bar. The bar is soldered to the prosthetic copings and tried in the mouth. Matrices should not be soldered to the metal framework. They are retained in the denture base with acrylic resin to facilitate future changes or repairs. Step-by-step clinical and laboratory procedures for fabricating the implant overdenture are shown in Box 17-5.

MAINTENANCE

The objective of regular recalls for patients with overdentures is twofold: (1) to check the overdenture for minor denture adjustments, retention, stability, occlusal adjustments, and maintenance of the attachment system, and (2) to monitor implant osseointegration with marginal bone loss and the health of the oral and periimplant tissues. Both matrix activation and replacement are common events during the first year of service. Replacement of denture teeth, relining, or remaking of the implant overdenture together with wear and tear of the ball abutments or connecting bars (patrices) become prevalent over time. The type of attachment system used can influence the frequency of prosthodontic maintenance events required.

The cleaning of implants and overdentures is easier when compared with fixed full-arch prostheses (Fig. 17-9). The majority of patients with overdentures who are in special need of oral health care are frequently elderly because they tend to have to cope with impaired manual skills and reduced visual capacity. They are likely to have difficulties in following cleaning instructions and therefore rely on their care providers for professional assistance. They have to be taught individual hygienic procedures that best correspond to their abilities. The wearing of overdentures certainly enhances plaque accumulation and risk of inflammatory soft tissue reactions, but it is not as ominous a concern where implant abutments are used. Periimplant tissues do not appear to be as vulnerable to plaque

Box 17-5 Step-by-Step Prosthodontic Procedures

One

- Preliminary impression with irreversible hydrocolloid

Laboratory: custom trays closed with space relief (ball abutments) or with openings over implants (bar design)

Two

- Abutment components placed
- Mounting of transfer copings (bar design only)
- Definitive impression with closed custom tray (ball abutments) or open custom tray (bar design)

Laboratory: master cast with implant analogues, wax occlusion rims

Three

- Jaw relation records
- Tooth selection

Laboratory: mounting the casts on the articulator, preliminary tooth setup

Four

- Verification of occlusal records
- Esthetic and functional assessment of tooth setup with the patient
- Indexing of denture tooth position (bar design only)

Laboratory: corrections as determined at try-in appointment; bar fabrication

Five

- Complete try-in, obtain consent of the patient
- Try-in of bar assembly, correction of casting if a passive fit is not obtained

Laboratory: final corrections, preparation for processing: assembly of attachment system components

- Processing the denture, occlusal equilibration on articulator to rectify processing errors

Six

- Delivery of dentures
- Instruction about insertion and removal of the implant overdenture
- Cleaning instructions for implants, attachment systems, dentures
- Information about and enrollment in the maintenance care program
- Baseline radiographs for monitoring marginal bone changes (optional)

by-products as periodontal tissues are, yet a variety of nuisance type gingival responses may develop and can be avoided with good hygiene protocol. Asymptomatic growth of hyperplastic soft tissue around implants and particularly underneath bars is common and usually rectified by a program of vigorous massage.

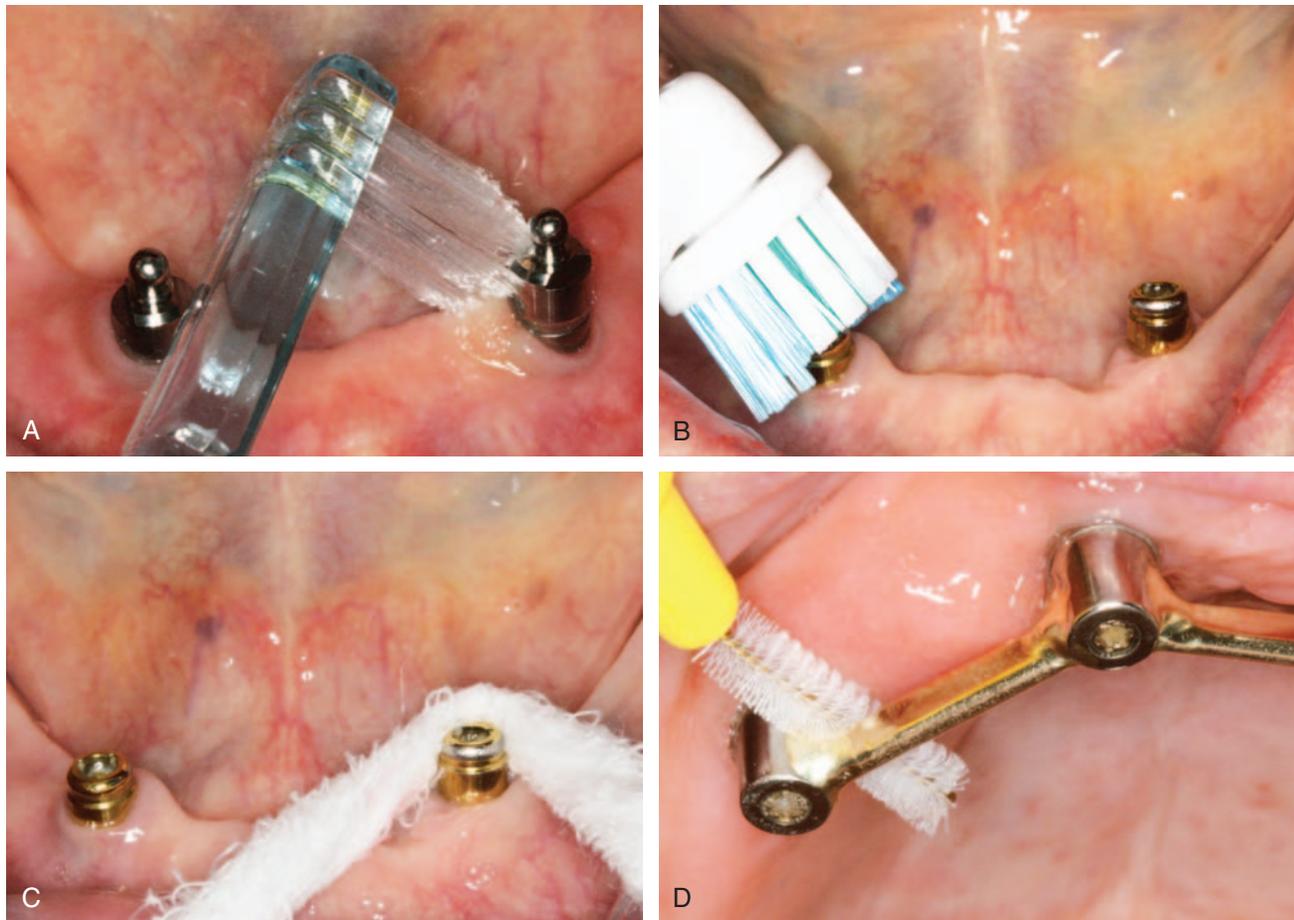


Figure 17-9 A to D, Popular manual or electric adjuncts for ensuring continued soft tissue health include brushing and stimulating periimplant tissues. The objective is plaque- and deposit-free implant components.

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