Techniques for incorporation of attachments in implant-retained overdentures with unsplinted abutments

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A variety of techniques have been reported in the literature for the incorporation of attachments in implant-retained partial and complete overdentures with unsplinted or individual abutments. Three important elements that are necessary in describing any technique for incorporation of attachments are the type of final impression method (tissue-level impression, abutment-level impression, or implant-level impression), stage of overdenture fabrication (record base stage, denture-processing stage, or denture insertion stage) and nature of technique (direct or indirect). This article reviews 7 different techniques for the incorporation of attachments in implant-retained complete and partial overdentures. Discussion of indications, contraindications, advantages, and disadvantages of each technique is provided to aid the clinician in making an appropriate choice. (J Prosthet Dent 2012;107:288-299)

It is well known that implant-retained/supported overdentures provide improved retention, support, stability, function, and comfort for patients.[1-3] Multiple prosthetic designs, materials, and techniques have been extensively described in the literature.[4,5] No single method or technique has been proven to be superior and there is inconclusive evidence about the clinical superiority of using splinted (bars) versus unsplinted overdenture abutments.[4,5] Bars are advantageous when the implants are misaligned. However, the treatment cost, technique sensitivity, and prosthetic space requirements for bars are generally higher than for unsplinted overdenture abutments.[4,5] This makes the overdenture with unsplinted abutments a popular choice for patients and clinicians.

Prosthodontic maintenance requirements have been shown to be similar for the various attachment systems.[6] The attachment system used for an overdenture typically consists of a matrix and a patrix. A matrix is defined as the portion of an attachment system that receives the patrix, and patrix is defined as the extension of a dental attachment system that fits into the matrix.[7] The terms, extension and receives, in these definitions are the key terms for distinguishing the 2 components. The definitions can be confusing because, in some attachment systems (spherical/ball abutments), the patrix is actually the implant abutment itself, and the matrix is a part of the overdenture prosthesis that fits on to the patrix. In some other attachment systems (Locator; Zest Anchors, Escondido, Calif) the implant abutment has a depression and is therefore considered as the matrix, while the corresponding patrix has a protuberance and is a part of the overdenture prosthesis. Irrespective of the type of attachment system, the component that is part of the overdenture prosthesis generally includes a metal housing that mechanically accommodates the replaceable matrix or patrix, which are generally made of a plastic such as nylon. There are various techniques for incorporating these attachments to the overdenture. Broadly, they can be classified as direct techniques (performed by the clinician intraorally) or indirect techniques (performed by the technician in the laboratory).[8,9]

A processed denture base is defined as the portion of a polymerized dental prosthesis covering the oral mucosa of the maxillary and/or mandible to which artificial teeth are attached by using a second processing.[7] Brewer[10] first described this procedure in 1962 to verify the final retention and stability of the planned denture prosthesis, even before making maxillomandibular relationship records. Minimal adjustments in fit

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

1.	Choice of prosthetic design (splinted versus 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

and occlusion are generally needed at the denture insertion stage.[10] During fabrication of implant-retained overdentures, this procedure is advantageous because attachments can be incorporated during the fabrication of the processed base itself. This can provide accurate engagement of the attachments over the abutments because of the reduced distortion attributable to the reduced volume of acrylic resin used for fabrication. A processed denture base may be preferred over an interim record base in situations with unfavorable maxillomandibular relationships or complicated anatomy such as maxillofacial defects.[11] The disadvantage of the processed denture base includes the need for an additional laboratory step, resulting in increased treatment cost and time.

The 3 important elements necessary in describing any technique for incorporation of attachments are: 1) type of final impression method; 2) stage of overdenture fabrication; and 3) nature of technique. The choice of the final impression method is critical because it determines the subsequent clinical and laboratory steps and therefore dictates the method of attachment incorporation into the prosthesis. Depending upon the clinical situation, the final impression technique can be accomplished through: a) conventional tissue-level impression independent of the implants; b) abutment-level impression; or c) implant-level impression. The stage of overdenture fabrication is necessary for description of a technique because inclusion of attachments can be performed at: a) record base stage; b) denture processing stage; or c) denture insertion stage. Finally, the nature of technique is important for description because inclusion of attachments can be performed by: a) direct technique or b) indirect technique. Various factors affecting choice of technique for incorporating attachments for implant-retained overdentures are described in Table I. The purpose of this article is to review various techniques for incorporating attachments in implant-retained overdentures with unsplinted abutments, and discuss their indications, contraindications, advantages, and disadvantages.

TECHNIQUES FOR INCORPORATING ATTACHMENTS

Each technique listed below is described by the type of final impression method, stage of overdenture fabrication when attachments are incorporated, and inherent nature of the technique (Table II).

Tissue-level impression, record base stage, direct technique

1. After the preliminary impressions, perform border molding and final impression procedures independent of the implants and fabricate a definitive cast.

2. Adapt a 2-sheet thickness of baseplate wax on the definitive cast and fabricate the processed denture base according to conventional techniques.[12]

3. Confirm intimate adaptation of the processed denture base with the underlying tissues and any remaining teeth intraorally (for partial overdentures) by using a pressure indicating paste (Mizzy Inc, Cherry Hill, NJ).

4. Drill relief holes in the processed base in the recorded areas corresponding to the positions of the healing abutments of the implants (Fig. 1A).

5. Place the desired abutments and torque them according to implant manufacturer's instructions and then place the corresponding attachments on the abutments (Fig. 1B). For 2-stage implant surgeries, the exposure of the implant, placement of healing abutment, and tissue healing precede the final impression procedure.

6. Ensure the relief holes are large enough to establish a passive path of insertion and removal of the processed denture base over the attachments.

7. After appropriate moisture control and blockout procedures, inject autopolymerizing acrylic resin or light-activated acrylic resin into the relief holes. After polymerization, confirm stability and adequate encasement of the attachment housing in the acrylic resin (Fig. 1C). Similarly, for clinical situations with cast metal partial removable dental prostheses, use autopolymerizing acrylic resin to complete the record base on the metal framework and drill relief holes to incorporate the attachments. Ensure that retentive loops are used around the implants to allow space for the acrylic resin.

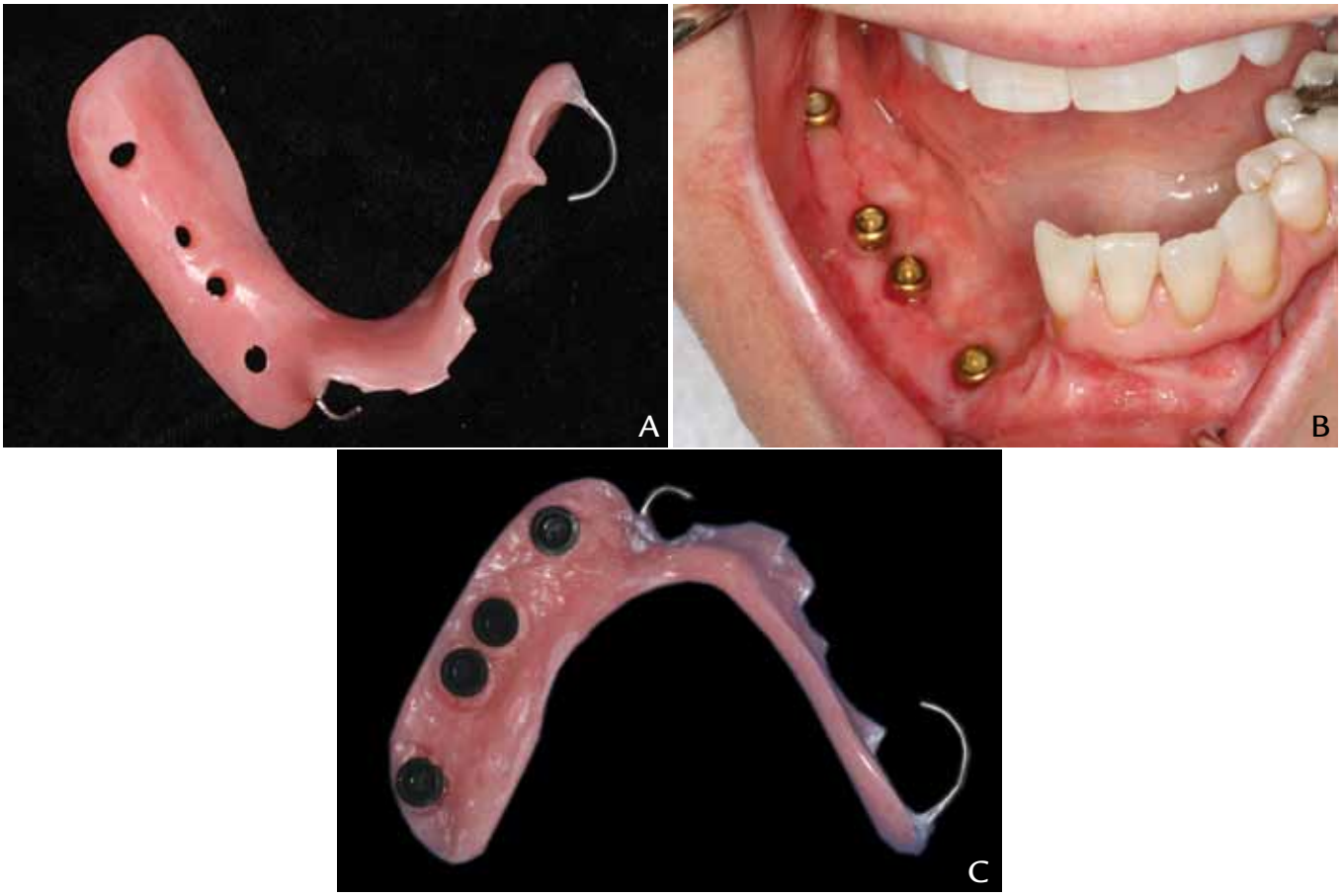
8. Insert the definitive attachment into the metal housing and confirm adequate engagement of the abutments intraorally.

TABLE 11. Summary of indications, advantages, and disadvantages of 7 different techniques for incorporating attachments in implant-retained partial and complete overdentures

Technique	Description	Indications
Tissue-level impression, record base stage, direct technique	Make tissue-level final impression independent of implants, fabricate processed denture base and directly incorporate attachments through relief holes	1. Presence of relatively parallel implants. 2. Situations with unfavorable maxillomandibular relationships or complicated anatomy such as maxillofacial defects. 3. Patient has normal range of mouth opening.
Tissue-level impression, denture insertion stage, direct technique	Make tissue-level final impression independent of implants, fabricate definitive denture and directly incorporate attachments through relief holes in denture.	1. When implants are planned on being placed after fabrication of denture, provided that no alveoloplasty will be performed. 2. When clinician desires to directly incorporate attachments after definitive denture has been fabricated. 3. Presence of relatively parallel implants. 4. Patient has normal range of mouth opening.
Tissue-level impression, denture insertion stage, indirect technique	Make tissue-level final impression independent of implants, fabricate definitive denture and indirectly incorporate attachments through laboratory reline of denture.	1. When clinician desires to incorporate attachments after definitive denture has been fabricated. 2. When implants are planned on being placed after fabrication of denture. 3. When alveoloplasty will be performed for prosthetic space purposes or when significant change in tissue morphology occurs after implant surgery.
Abutment-level impression, record base stage, indirect technique	Make abutment-level final impression and fabricate processed denture base incorporating attachments indirectly.	1. When clinician desires superior retention and stability of denture base for maxillomandibular relationship records. 2. Situations with unfavorable maxillomandibular relationships or complicated anatomy such as maxillofacial defects. 3. Additional support for interim prosthesis is needed during treatment period.
Abutment-level impression, denture processing stage, indirect technique	Make abutment-level final impression and incorporate attachments indirectly during final denture processing on definitive cast.	1. When there are fewer implants that are relatively parallel. 2. Additional support for interim prosthesis is needed during treatment period.
Implant-level impression, record base stage, indirect technique	Make implant-level final impression, choose attachment system and fabricate processed denture base incorporating attachments indirectly.	1. When implants do not appear to have acceptable angulations or if clinician is not sure of implant parallelism. 2. When prosthetic space needs to be determined or re-assessed before selection of attachment system. 3. When clinician does not have inventory of abutments of various heights. 4. Situations with numerous implants.
Implant-level impression, denture processing stage, indirect technique	Make implant-level final impression, choose attachment system and incorporate attachments during final denture processing indirectly.	1. When implants do not appear to have acceptable angulations or if clinician is not sure of implant parallelism. 2. When prosthetic space needs to be determined or re-assessed before selection of attachment system. 3. When clinician does not have an inventory of abutments of various heights. 4. Situations with 2 or fewer implants ideally. If not, metal base is needed to decrease amount of acrylic resin used for final denture processing and hence lesser distortion.

Table II. Summary of indications, advantages, and disadvantages of 7 different techniques for incorporating attachments in implant-retained partial and complete overdentures

Advantages	Disadvantages
1. Intimate contact of the denture base with underlying tissues can be achieved before incorporating the attachments. 2. Accuracy of attachment seating can be confirmed instantly. 3. No stains or porosity on the polished surface of definitive denture. 4. Final fit of denture can be confirmed early on. 5. Better stability of record bases for maxillomandibular relationship records and wax trial dentures. 6. Need for less acrylic resin during final denture processing, hence lesser distortion. 7. Less adjustments of fit and occlusion at insertion.	1. Additional laboratory procedure. 2. Increased time and expenses. 3. Cannot be used when denture should be made prior to implant surgery. 4. Can result in stains and porosity on intaglio surface of the denture. 5. Difficult to use in situations with non-parallel implants. 6. Need for stocking an inventory of abutments of various heights.
1. Accuracy of attachment seating can be confirmed instantly. 2. Single step procedure. 3. Allows occlusion-directed seating of definitive prosthesis over implant components. 4. Less expensive than indirect techniques. 5. Dentures can be made before implant placement.	1. Can result in increased chair time. 2. Can result in stains and porosity on the intaglio and polished surface of denture. 3. Difficult to use in situations with numerous implants or non-parallel implants. 4. Inadequate moisture control may result in weaker bond between attachment and resin. 5. Need for stocking inventory of abutments of various heights. 6. Cumbersome to perform technique when attachments are located underneath posterior denture teeth.
1. Long lasting and stronger bond between attachment and acrylic resin. 2. No stains and porosity on denture surfaces. 3. Can compensate for changes in tissue morphology due to implant surgery. 4. Relining procedure affords opportunity for improvement of inadequate extensions and fit of denture. 5. Allows occlusion-directed seating of definitive prosthesis over implant components. 6. Dentures can be made before implant placement.	1. Additional clinical and laboratory procedure. 2. Increased laboratory expenses. 3. Laboratory errors can result in additional procedures and increased time. 4. Need for stocking inventory of abutments of various heights.
1. No stains or porosity on polished surface of definitive denture. 2. Final fit and accuracy of denture can be confirmed early. 3. Better stability of record bases for maxillomandibular relationship records and wax trial dentures. 4. Need for less acrylic resin during final denture processing, so lesser distortion. 5. Lesser adjustments of fit and occlusion at insertion.	1. Additional laboratory procedure. 2. Increased time and expenses. 3. Laboratory errors may result in additional steps. 4. Cannot be used when denture should be made prior to implant surgery. 5. Difficult to use in situations with non-parallel implants. 6. Need for stocking inventory of abutments of various heights.
1. Single step procedure. 2. Less expensive. 3. No stains or porosity on polished surface of definitive denture.	1. Potential for misfit of attachments due to polymerization distortion during denture processing. 2. Difficulty of use in situations with numerous implants or non-parallel implants. 3. Cannot be used when denture should be made prior to implant surgery. 4. Need for stocking inventory of abutments of various heights.
1. Allows assessment of prosthetic space and implant angulations. 2. Provides opportunity to try various abutments and attachment systems in laboratory. 3. Stocking an inventory of abutments of various heights is not necessary. 4. Final fit and accuracy of denture can be confirmed early on. 5. Advantageous in situations with unfavorable maxillomandibular relationships or complicated anatomy such as maxillofacial defects. 5. Better stability of record bases for maxillomandibular relationship records and wax trial dentures. 6. Need for less acrylic resin during definitive denture processing, so lesser distortion. 7. Less adjustments of fit and occlusion at insertion.	1. Additional laboratory procedure. 2. Increased laboratory expenses. 3. Laboratory errors may result in additional steps. 4. Cannot be used when denture should be made prior to implant surgery.
1. Allows assessment of prosthetic space and implant angulations. 2. Provides opportunity to try various abutments and attachment systems in the laboratory. 3. Stocking an inventory of abutments of various heights is not necessary. 4. Less expensive (if no metal base is needed) 5. No stains or porosity on intaglio or polished surface of definitive denture. 5. If metal base is used, less acrylic resin during final processing, so minimal polymerization distortion.	1. Potential for misfit of attachments due to polymerization distortion during denture processing. 2. Difficult to use in situations with numerous and non-parallel implants unless a metal base is used. 3. Cannot make the denture prior to implant surgery.



1 A, Relief holes drilled into processed denture base fabricated for implant-supported mandibular resection prosthesis (partial overdenture). Holes were drilled based on positions of healing abutments recorded by tissue level impression. B, Locator abutments were selected for treatment and were torqued according to implant manufacturer's recommendations. C, Intaglio surface of processed denture base showing encasement of attachments in autopolymerizing resin that was injected into relief holes. Additional acrylic resin was added around deficient areas, and black processing caps were replaced by definitive patrices before proceeding with maxillomandibular relationships.

9. Lubricate the intaglio surface of the processed base with petroleum jelly, place corresponding analogs into the attachments, and then develop a remount cast before proceeding with subsequent steps of denture fabrication.

Tissue-level impression, denture insertion stage, direct technique

1. Perform routine border molding and final impression procedures independent of the implants and fabricate a definitive cast.

2. Fabricate the definitive denture according to conventional prosthodontic principles.[16] Verify the retention, stability, and occlusion of the definitive denture.

3. Place the desired abutments and torque them according to implant manufacturer's instructions and then place the corresponding attachments on the abutments.

4. Transfer the positions of the attachments to the intaglio surface of the denture with an ink stick (Dr. Thompson's Sanitary Color Transfer Applicators; Great Plains Dental Products Inc, Kingman, Kan).

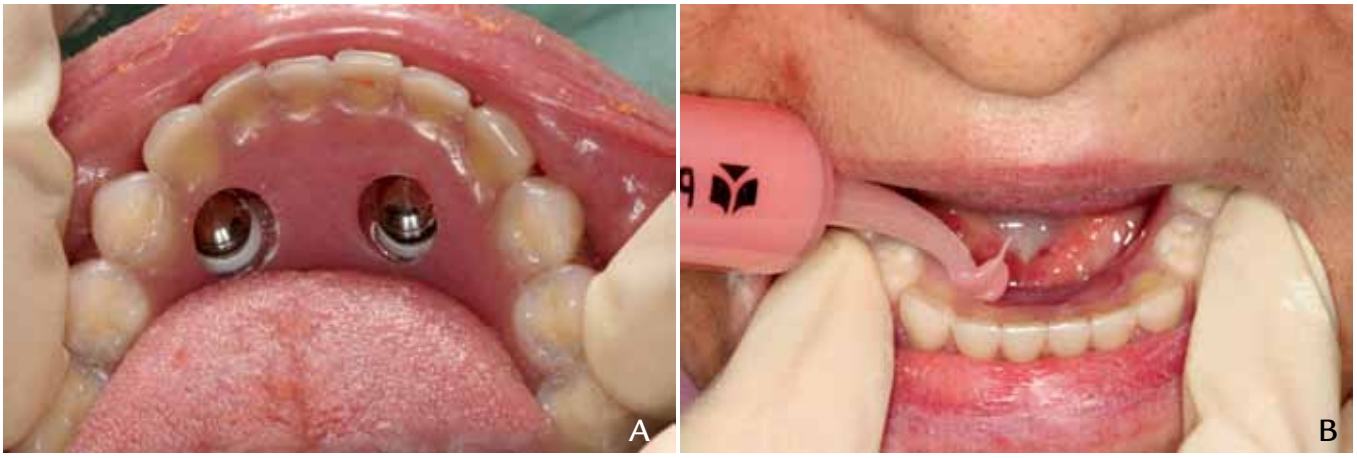
5. Drill relief holes in these positions and establish a passive path of insertion and removal of the denture over the attachments (Fig. 2A).

6. After appropriate moisture control and block-out procedures, inject autopolymerizing acrylic resin or light-activated acrylic resin into the relief holes while stabilizing the denture (Fig. 2B). Ask the patient to gently close into centric occlusion.

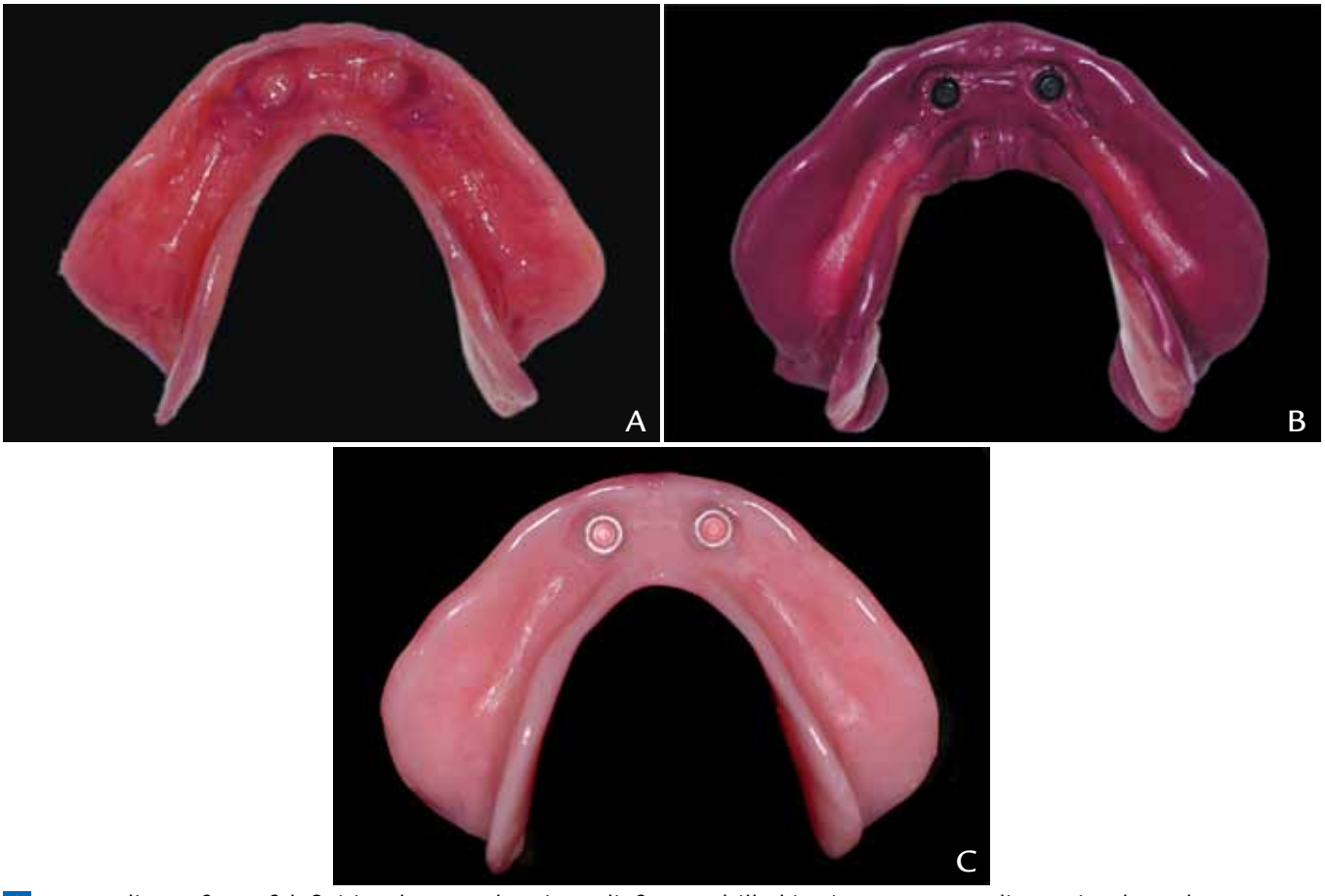
7. After polymerization, confirm stability and adequate encasement of the attachment housing in the acrylic resin.

8. Insert the definitive attachment into the metal housing and confirm adequate engagement of the abutments intraorally.

9. Adjust the polished surfaces of the denture for patient comfort. Instead of a relief hole, note that a relief area may be created inside the denture to create space for new acrylic resin to encase the attachment. Note that this procedure has the advantage of maintaining the integrity of the polished surfaces but has the disadvantage of not allowing visual confirmation of accurate placement of the attachment over the abutment as well as errors in occlusion.



2 A, Relief holes drilled into definitive denture shows passive seating over abutments and attachments. Also note use of block-out spacer material (white) to prevent acrylic resin from being locked in undercut areas. B, Autopolymerizing resin injected into relief holes to connect attachments to definitive denture. Manual stabilization of denture preceded patient's closure into centric occlusion during polymerization of acrylic resin.

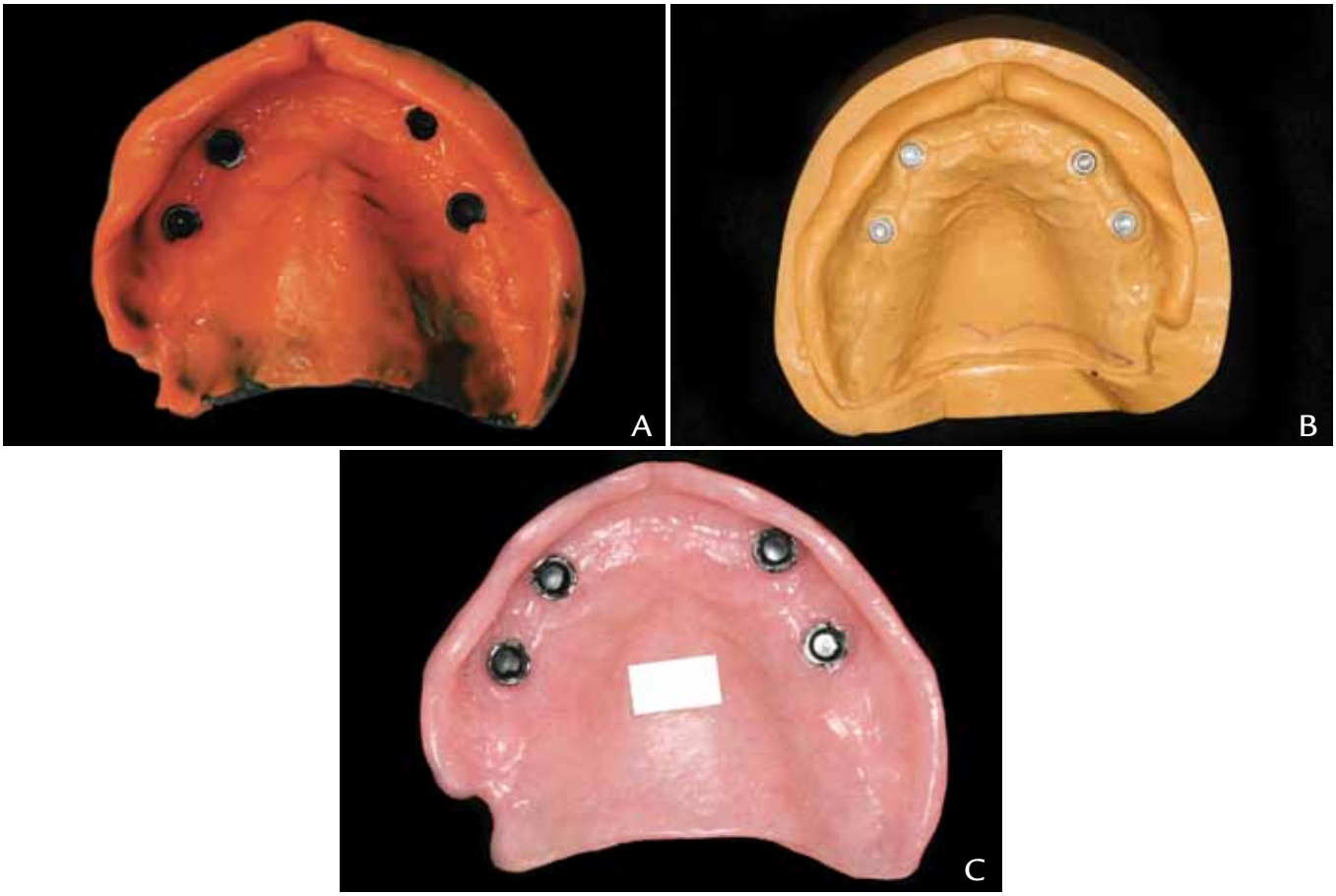


3 A, Intaglio surface of definitive denture showing relief areas drilled in sites corresponding to implant abutments and attachments. Polyether impression tray adhesive was applied on denture before relining. B, Denture relined with light-body polyether impression material incorporating Locator attachments with black processing caps. C, Intaglio surface of definitive denture after being relined with heat-polymerized acrylic resin incorporating Locator attachments. Black processing caps were replaced by definitive patrices at denture insertion.

Tissue-level impression, denture insertion stage, indirect technique

1. Make a conventional final impression of the tissues independent of the implants, and fabricate the definitive denture according to standard prosthodontic principles. Verify the retention, stability, and occlusion of the denture.

2. Place the desired abutments and torque them according to implant manufacturer's instructions and then place the corresponding attachments on the abutments.



4 A, Maxillary abutment-level final impression with light-body vinyl polysiloxane material showing impression encasement of impression copings placed on Locator abutments. B, Definitive cast with Locator analogs prepared for fabrication of processed denture base. This patient had maxillofacial surgical defect on left side. C, Intaglio surface of processed denture base showing incorporation of attachments. Black processing caps were replaced by definitive patrices before proceeding with maxillomandibular relationships.

3. Transfer the positions of the attachments to the processed base with an ink stick (Dr. Thompson's Sanitary Color Transfer Applicators; Great Plains Dental Products Inc).

4. Drill relief areas in these positions to allow sufficient encasement of the attachments by the impression material and apply impression tray adhesive on the intaglio surface of the denture (Fig. 3A).

5. Load the denture with light body impression material and place the denture over the tissues and implant attachments and ask the patient to gently close into centric occlusion.

6. After the material has polymerized, carefully remove the denture from the mouth and confirm stability and adequate encasement of the attachment in the impression material (Fig. 3B).

7. Insert abutment analogs into the attachments and pour a definitive cast. Perform denture flasking procedures and at wax elimination stage, separate the 2 halves of the flask and peel out the impression material from the denture. Replace the attachments on the analogs on the drag (lower) compartment of the flask.

8. Mix heat-polymerized acrylic resin and process the denture reline according to conventional laboratory procedures.[12]

9. At denture insertion, place the definitive attachment into the metal housing and confirm adequate engagement of the abutments. Evaluate the occlusion and intimate contact of the denture with the underlying tissue (Fig. 3C). If an attachment fails to seat accurately on the corresponding abutment, remove the acrylic resin around the attachment and carefully separate it from the prosthesis. Replace the attachment on the abutment and attach it to the denture using a direct technique.

Abutment-level impression, record base stage, indirect technique

1. After selection of the attachment system, torque the abutments according to the implant manufacturer's recommendations.

2. Perform border-molding procedures and place impression copings on the abutments (if indicated by the selected attachment system).

3. Make a final impression of the tissues and implant abutments (Fig. 4A).

4. Place corresponding analogs into the impression copings and fabricate a definitive cast (Fig. 4B).

5. Place the corresponding laboratory attachments (matrices or patrices) on the analogs and eliminate undercuts beneath the attachments to prevent excessive acrylic resin from polymerizing in this region.[19]

6. Adapt a 2-sheet thickness of baseplate wax on the definitive cast and fabricate the processed denture base according to standardized techniques.[12]

7. After polymerization, confirm stability and adequate encasement of the attachment housing (Fig 4C).

8. Insert the definitive attachment into the metal housing and confirm engagement of the abutments intraorally.

9. Lubricate the intaglio surface of the processed base with petroleum jelly, place corresponding analogs into the attachments, and then develop a remount cast before proceeding with subsequent steps of denture fabrication. If an attachment fails to seat accurately on the corresponding abutment, remove the acrylic resin around the attachment and carefully separate it from the processed base. Replace the attachment on the abutment and attach it to the denture using a direct technique.

Abutment-level impression, denture-processing stage, indirect technique

1. After selection of the attachment system, torque the abutments according to the implant manufacturer's recommendations.

2. Perform border-molding procedures and place the impression copings (if required) on the abutments. Make a final impression of the tissues and implant abutments (Fig. 5A).

3. Place corresponding analogs into the impression copings and fabricate a definitive cast (Fig. 5B).

4. Perform the subsequent steps of maxillomandibular relationship records and trial denture insertion and proceed with denture processing.[12] In clinical situations with cast metal partial removable dental prostheses, fabricate the metal framework with retentive loops around the implant abutments.

5. At the wax elimination stage, place the corresponding laboratory attachments (matrices or patrices) on the analogs and perform appropriate block-out procedures.[19]

6. Mix heat-polymerized acrylic resin and process the denture according to standard laboratory procedures.[12]

7. At denture insertion, place the definitive attachment into the metal housing and confirm adequate engagement of the abutments, occlusion, and intimate contact of the denture with the underlying tissue (Fig. 5C). If an attachment fails to seat accurately on the corresponding abutment, remove the acrylic resin around the attachment and carefully separate it from the prosthesis. Replace the attachment on the abutment and attach it to the denture using a direct technique.

Implant-level impression, record base stage, indirect technique

1. On a preliminary cast, fabricate a custom tray for an implant-level impression procedure.

2. Perform border molding procedures by using the custom tray.

3. Remove the healing abutments from the implants and insert appropriate impression copings and make an implant-level final impression.

4. Place corresponding implant analogs and tissue moulage and fabricate a definitive cast (Fig 6A).

5. Select the appropriate attachment system and hand tighten the abutments into the analogs on the cast.

6. Place the corresponding laboratory attachments (matrices or patrices) on the analogs and eliminate undercuts.

7. Adapt a 2-sheet thickness of baseplate wax on the definitive cast and fabricate the processed denture base according to conventional techniques.[12] In situations with cast metal partial removable dental prostheses, add baseplate wax to the framework and fabricate the processed denture base. Alternatively, use autopolymerizing resin to complete the record base. Then prepare relief holes and incorporate attachments directly intraorally.

8. After polymerization, confirm stability and adequate encasement of the metal housing and then place the definitive attachments into the metal housing (Fig. 6B).

9. Insert the selected abutments intraorally, and torque them according to implant manufacturer's instructions (Fig. 6C).

10. Lubricate the intaglio surface of the processed base with petroleum jelly, place corresponding analogs into the attachments and then develop a remount cast before proceeding with subsequent steps of denture fabrication. If an attachment fails to seat accurately on the corresponding abutment, remove the acrylic resin around the attachment and carefully separate it from the processed base. Replace the attachment on the abutment and attach it to the denture using a direct technique.

Implant-level impression, denture-processing stage, indirect technique

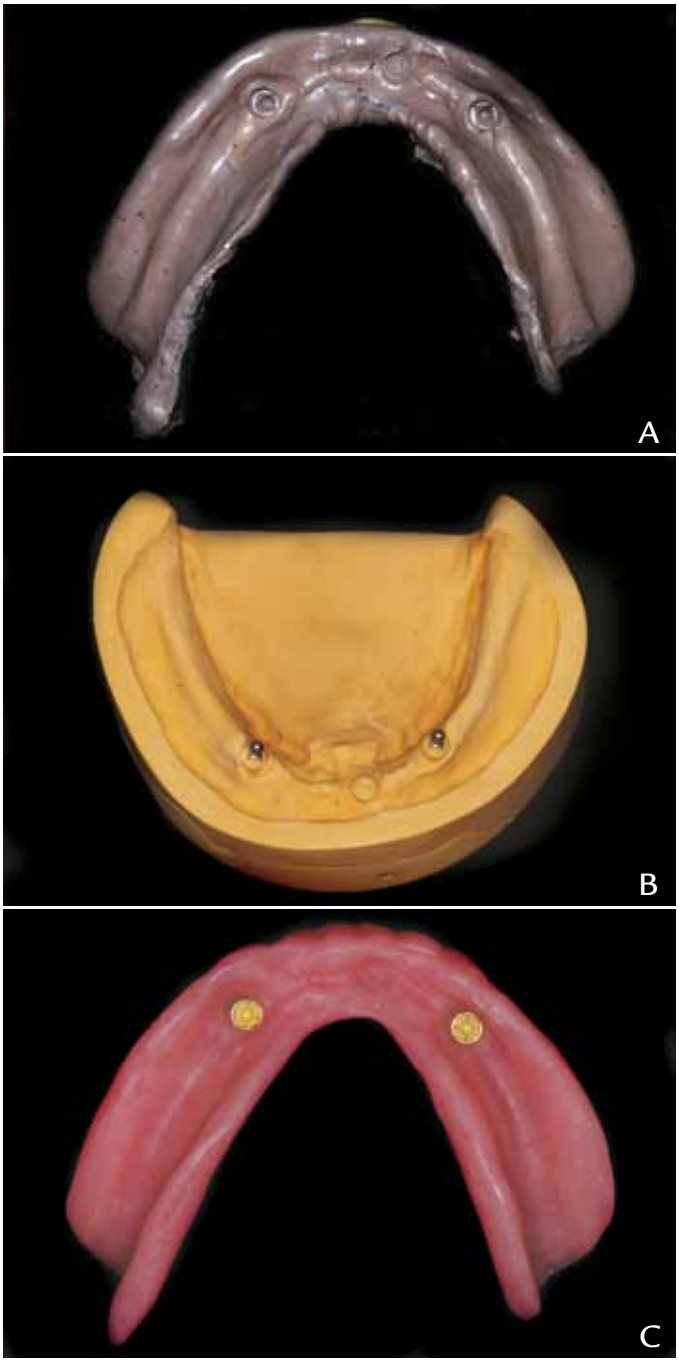
1. On a preliminary cast, fabricate a custom tray for an implant-level impression procedure.

2. Perform border-molding procedures with the custom tray.

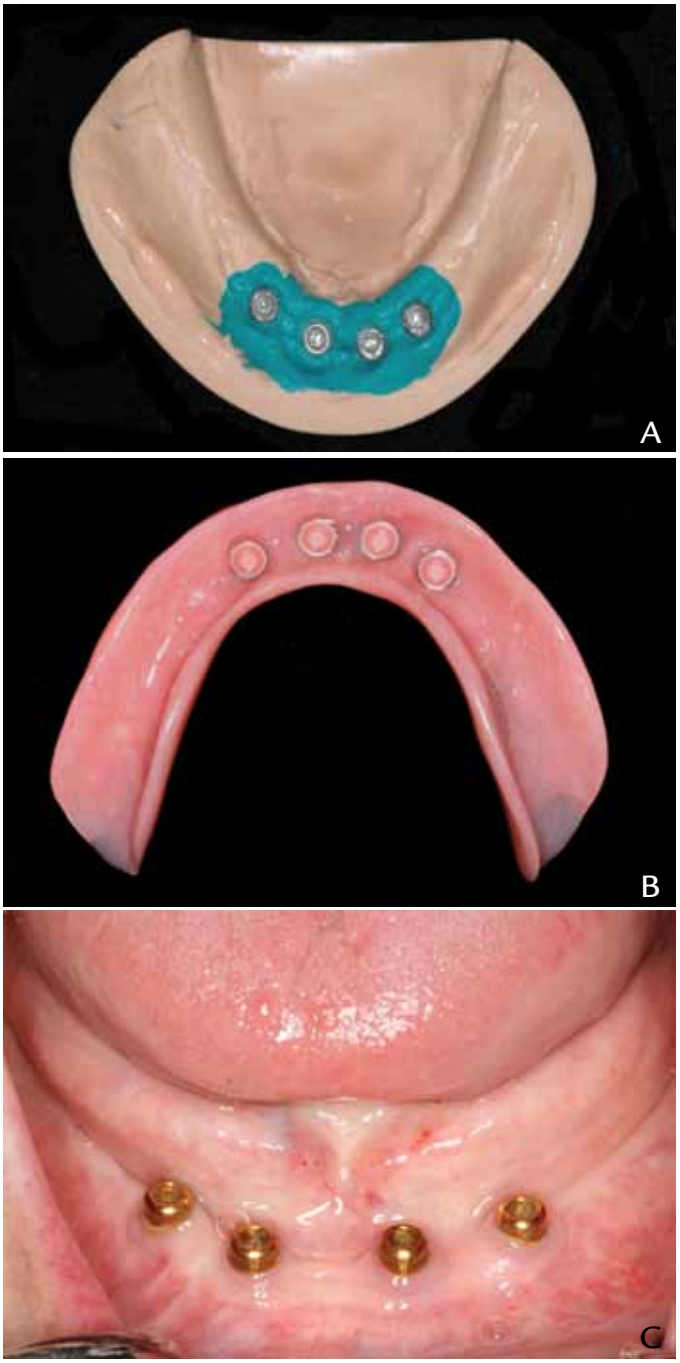
3. Remove the healing abutments from the implants, insert appropriate impression copings, and make an implant-level final impression.

4. Place corresponding implant analogs, tissue moulage, and fabricate a definitive cast and select the appropriate attachment system.

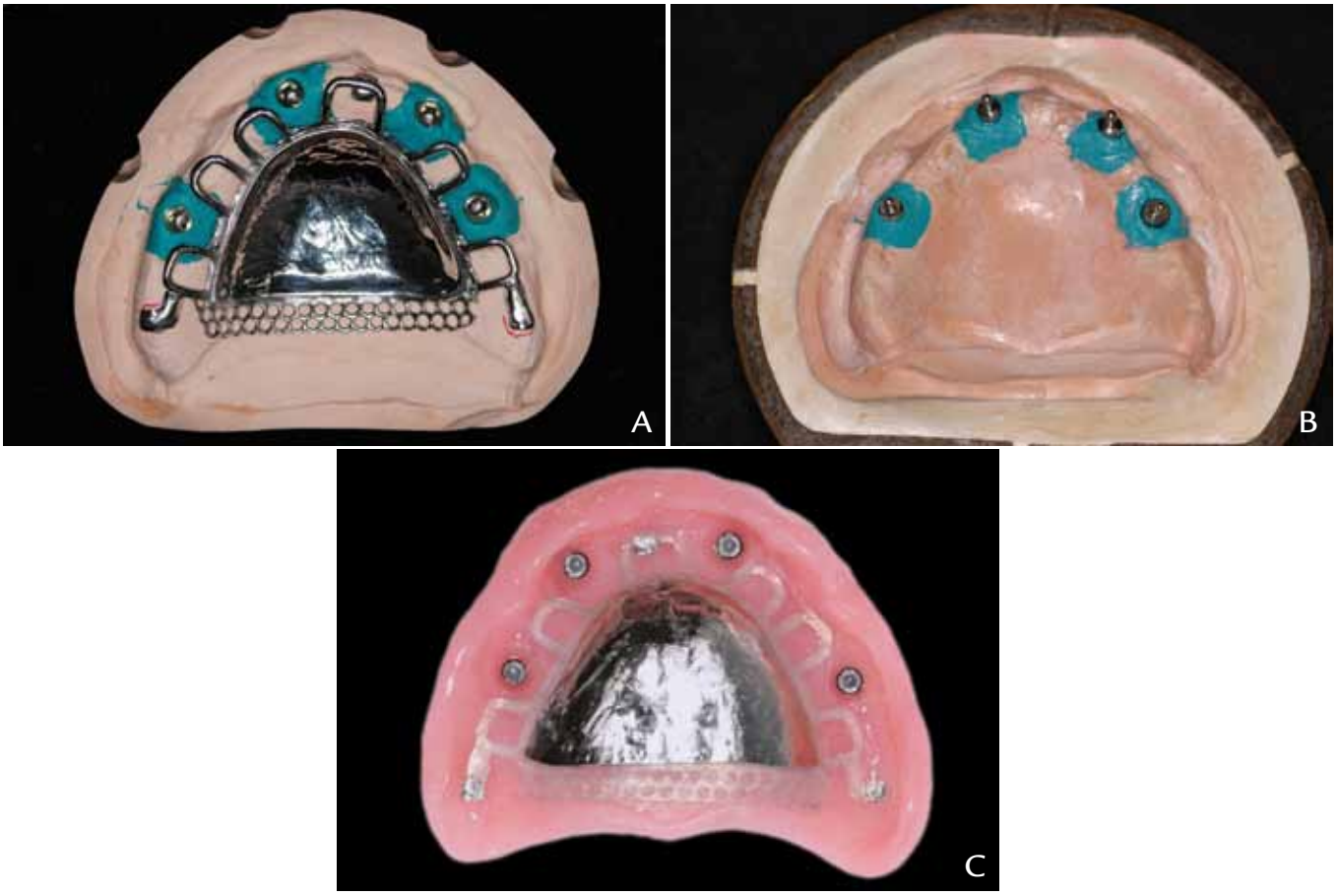
5. In situations with 1 or 2 implants, perform the subsequent steps of maxillomandibular relationship records and trial denture insertion and proceed with denture processing. In situations with more than 2 implants, fabricate a metal base on the definitive cast with retentive loops around the implants before proceeding with the subsequent steps and denture processing (Fig. 7A). Note that the metal base adds strength and also minimizes the amount of polymerization distor-



5 A, Mandibular abutment-level final impression with light-body polysulfide impression material showing impression of ball abutments and tissues. B, Definitive cast with ball abutment analogs prepared for fabrication of definitive denture. Note that median implant in patient was not used for retentive purposes, but only used as indirect retainer. C, Intaglio surface of definitive denture showing incorporating of attachments (Preci-Clix; Preat Corporation). Definitive matrices (yellow) have been placed into housings.



6 A, Definitive cast fabricated from implant-level impression to analyze prosthetic space and to choose appropriate attachment system before fabricating processed denture base. B, Intaglio surface of processed denture base showing incorporation of Locator attachments. Definitive patrices (pink) have been placed into metal housings before proceeding with maxillomandibular relationships. C, Locator abutments were torqued on 4 implants, before evaluating processed denture base with corresponding attachments.



7 A, Definitive cast fabricated from implant-level impression to analyze implant angulations. Metal base was fabricated to reduce amount of acrylic resin needed for definitive denture processing and minimized distortion. B, At wax-elimination stage, final abutments (spherical/ball abutments) were hand-tightened on definitive cast and corresponding attachments were placed on them before denture processing. C, Intaglio surface of definitive denture showing incorporating of attachments (Preci-Clix) Definitive matrices (white) placed into housings.

tion by reducing the volume of acrylic resin needed for denture processing, thus aiding with accurate seating of the attachment.[19,20] Similarly, for clinical situations with cast metal partial removable dental prostheses, note that the metal framework minimizes the amount of acrylic resin required for denture processing and thus reduces the chances of inaccurate seating.

6. At the wax elimination stage of denture processing, hand tighten the abutments into the analogs on the definitive cast (Fig. 7B).

7. Place the corresponding laboratory attachments (matrices or patrices) on the analogs and eliminate undercuts.

8. Mix heat-polymerized acrylic resin and process the denture according to conventional laboratory procedures.[12]

9. After polymerization, confirm stability and adequate encasement of the attachment housing.

10. Insert the selected abutments intraorally and torque them according to the implant manufacturer's instructions.

11. Insert the definitive attachment into the metal housing and confirm engagement of the abutments, occlusion, and intimate contact of the denture with the underlying tissue (Fig. 7C). If an attachment fails to accurately seat on the corresponding abutment, remove the acrylic resin around the attachment and carefully separate it from the prosthesis. Replace the attachment on the abutment and attach it to the denture using a direct technique.

DISCUSSION

Each of the 7 techniques reviewed in this article for incorporating attachments to the overdenture have unique indications, advantages and disadvantages. While the type of impression material, attachment acrylic resin and attachment system is the clinician's preference, understanding the rationale of each of these techniques can help making the appropriate choice for a given clinical situation. The direct technique can be performed at the record base stage or at the denture insertion stage. Both techniques are indicated when the implants are relatively parallel and the patient has an adequate mouth opening. They are not indicated when implants have severe misangulations, prosthetic space issues or when the

clinician does not have abutments of appropriate dimensions. An additional contraindication is an ill-fitting previous denture, which can result in dead spaces underneath the denture base, when connected to the abutments and cause soft tissue complications. The direct techniques offer the advantage of allowing the clinician for an intraoral control of the procedure and allowing an almost instant confirmation of the accurate seating of the attachment. However, using autopolymerizing resin for the direct procedure may result in porosity and staining of the overdenture prosthesis over time and a potential for debonding of the attachment from the denture.[8] The use of light-polymerizing resins may ameliorate some of these concerns.[9] The disadvantage of the direct technique is the increased chair time and the need for clinician to maintain an inventory of abutments and attachments of different sizes.

The indirect technique can be performed at the record base stage, denture processing stage or at the denture insertion stage. The indirect technique is indicated for a variety of reasons such as: changes in soft tissue morphology after implant surgery, improper implant positions and angulations, prosthetic space issues or when the clinician does not have an inventory of abutments of appropriate dimensions. Techniques incorporating processed record bases are indicated in situations with unfavorable maxillomandibular relationships or complicated anatomy such as maxillofacial defects. There are no absolute contraindications to the indirect technique. It offers the advantage of reduced chair time and precludes some of the disadvantages of autopolymerizing resin that is often used in direct techniques. It can also compensate for existing deficiencies in the prosthesis when there is a change in soft tissue morphology after implant surgery. However, an important disadvantage is the need for an additional laboratory step, potentially resulting in increased treatment cost and time. This may be compounded if there are errors in the laboratory procedures, requiring additional chairside corrective procedures. It can be argued that the expenses resulting from additional laboratory procedures may be less than the expenses incurred due to increased chair time by the clinician, when using a direct technique. The authors identified no studies in the literature that compare these experiences. However, a recent study on long-term prosthetic maintenance has shown that the direct technique has fewer maintenance issues than the indirect technique.[8]

SUMMARY

This article described indications, contraindications, advantages, and disadvantages of 7 techniques for incorporating attachments for implant-retained overdentures. The choice of attachment incorporation technique and the choice of a final impression technique for the overdenture are interrelated. This is because the selection of a final impression method determines the subsequent clinical and laboratory steps and therefore dictates the method of attachment incorporation into the prosthesis. The 3 different final impression methods used for overdentures include tissue-level impression, abutment-level impression, and implant-level impression. Depending upon the clinical situation, incorporating overdenture attachments can either be performed at the record base stage, denture processing stage, or denture insertion stage. Finally, inclusion of attachments can be performed by a direct technique or indirect technique. Each of the 7 techniques reviewed in this article has advantages and disadvantages, and a successful clinical outcome is dependent upon sufficient attention to detail.

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Noteworthy Abstracts of the Current Literature

Longitudinal clinical evaluation of undercut areas and rest seats of abutment teeth in removable partial denture treatment

de Aquino, AR, Oliveira Barreto, A, de Aquino, LM, Ferreira, AM, da Fonte Porto Carreiro, A. J Prosthondont 2011;20:639-42.

Purpose: Adequate preparation of abutment fir removable partial denture (RPD) rest seats appropriate masticatory force transmission, retention, and stability of supporting structures. It follows that careful preparation will be important for the longevity of the rehabilitation. The present study aimed to clinically evaluate rest seats and undercut areas of abutment teeth in RPD wearers after 2 years of use.

Materials and methods: A total of 193 occlusal, incisal, and cingulum rest seats were evaluated in terms of shape, rest adaptation, wear, caries, fractures, and surface type (enamel, composite resin, or amalgam). Two hundred and fourteen undercut areas were evaluated in terms of surface type (enamel or restoration) and integrity. This study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte, resolution 196/1996, protocol number 11/05.

Results: Intact preparations accounted for 92.2% of the total. Application of the Pearson test (P= 0.289) found no statistically significant differences among the materials on which the rest seats were prepared. For the undercut areas, 20.7% of those obtained on restorative material were nonintact. In addition, Fisher's exact test showed a statistically significant difference (P= 0.001) in surface type; enamel surfaces were shown to be 14 times more stable than restored surfaces.

Conclusions: The results of this study suggest that rest seats are stable, regardless of the material on which they are prepared. Retentive areas were shown to be more stable when they were located in enamel.