

The Biotes conversion prosthesis: a provisional fixed prosthesis supported by osseointegrated titanium fixtures for restoration of the edentulous jaw*

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Introduction

The installation of titanium fixtures (implants) into the edentulous jaw with subsequent tissue integration has been termed *osseointegration*.¹ Brånemark et al. have demonstrated that the use of the screw-type, machined, noncontaminated titanium fixtures in conjunction with specific and extremely gentle surgical technique and highly precise prosthodontic procedures can predictably convert patients from the edentulous state to dentate function.² The prosthetic restoration on osseointegrated fixtures to maximize oral function is referred to as *Biotes treatment*; scientifically it is known as the *tissue integrated prosthesis (T.I.P.)*³

For osseointegration to occur between the surgical placement of the fixtures and the subsequent surgical uncovering and final prosthesis construction, an unloaded healing interval of three to four months in the mandibular arch and a minimum of six months in the maxillary arch is required. During the healing period, the patient may be prosthodontically managed with the use of transitional dentures. The transitional prosthesis must have the correct occlusal vertical dimension and fulfill all requirements of a fully balanced denture occlusion. The removable prosthesis should set the stage for Biotes, with the transitional denture functioning as a prototype for the final prosthesis. Garver has recommended the use of a cusplless occlusion supported by a resilient denture base.⁴ These allow for a minimum of vertical, tangential, and horizontal forces to the residual bony ridge, and undisturbed and unloaded in situ healing process around the fixture essential for osseointegration to occur.⁵

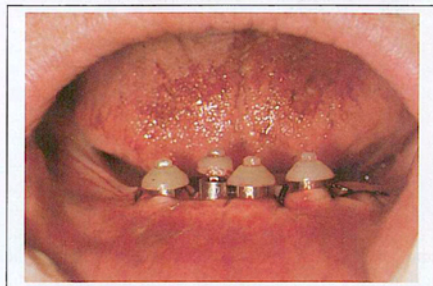


Fig. 1 Plastic healing caps serve to hold periodontal packing securely in place immediately following the abutment connection.

The prosthesis conversion visit

Conversion of the transitional denture occurs at the second surgical visit. At the abutment connection visit (second surgical visit) the traditional method of treatment requires the placement of plastic healing caps and periodontal pack to compress and hold mucosal tissues in place against the titanium abutment connectors (Fig. 1). Firm but gentle control of the mucosal tissues is necessary for proper healing and soft tissue integration to occur.

Complete soft tissue healing could be expected four to six weeks following the second surgical visit. Previously, complete healing was required prior to the final impression and fabrication of the tissue integrated prosthesis. Generally periodontal pack remained in place for the first one or two weeks following the abutment connection visit. Patients would either continue using their interim removable denture after extensive modification, or use no denture at all while the plastic healing caps remained in place.

The conversion prosthesis provides the patient with an immediate fixed prosthesis at the second surgical

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visit. The technique permits patients to experience stable function and enjoy the advantage of a fixed prosthesis immediately following the abutment connection procedures. Use of the conversion prosthesis eliminates the need for the plastic healing caps.

Sequence of treatment

Uncovering of the osseointegrated fixtures: the second surgical visit

Primarily, there have been two techniques employed to uncover the titanium osseointegrated fixtures. In one technique, individual soft tissue plugs are removed from the occlusal surface of the fixtures after exploratory probing is used to identify the central position of the cover screw.

A second surgical technique to uncover the osseointegrated fixtures uses a mucoperiosteal flap dissection. An incision is made directly over the implants connecting the distal aspects of each of the terminal fixtures. The flap design has proven to be quite successful. It allows increased visibility to permit accurate seating of the abutment cylinder. The soft tissue punch instrument may be used in conjunction with the continuous incision technique to remove excess tissue directly over the fixture prior to placing the abutment cylinder.

Soft tissue healing appears to occur sooner when only soft tissue plugs are removed. However, patients have reported no significant difference in comfort following either approach.

Connecting the abutment cylinder

Once the abutment connection cylinder has been placed and securely fastened to the fixture, osseointegration is verified by tapping the cylinder with a metal instrument. A high-pitched metallic sound resonates when the titanium fixture is integrated in bone. If a dull sound is heard, the abutment cylinder should be carefully reinspected to make certain it is completely seated over the fixture and is securely fastened. If the abutment cylinder is secure, the dull sound indicates failure of the fixture to integrate with the bone.

Nonintegrated fixtures should be removed at the abutment connection visit. The removal site is allowed to heal. Replacement of the nonintegrated fixtures at a later date may be accomplished if additional biomechanical support is required to sustain a fixed prosthesis. Three months' healing of the removal site is

the minimum recommended before the fixture is reinstalled. However, Sullivan and Krogh recommend a one-year healing period.⁶

Frequently soft and hard tissue will grow between the top of the fixture and the healing screw. Before seating the abutment cylinder, careful inspection under magnification is recommended to assure total removal of all hard and soft tissues over the fixture.⁷

A firm grasp of the abutment cylinder with special titanium-tipped forceps ensures appropriate counter forces while the abutment connector screw is tightened. This minimizes excessive torsion and rotational forces to the uncovered fixture. With the abutment cylinder securely in place, the mucosal tissue is sutured tightly around the cylinder.

Great emphasis is placed on accurate seating of the abutment cylinder. Should an abutment cylinder be seated improperly, appropriate load distribution to fixture anchors will not occur. This condition may lead to excessive loading on selected fixtures which may ultimately cause a loss of osseointegration and fixture mobility.

Whenever possible a long-lasting local anesthetic with analgesic effects such as Marcaine® is recommended, since additional time is required for the prosthetic phase of this treatment.

Gold cylinder connection

The gold alloy cylinders are securely fastened to the abutment connection cylinder with the small gold or medium-length steel screws (Fig. 2). Each gold metal alloy cylinder should be checked to verify its positioning and ascertain any possible looseness. Digital examination of the gold cylinder copings should verify secure fixation to the abutment cylinder.

Identify fixture location on the transitional denture

The position of the gold alloy cylinders related to the tissue-bearing surface of the denture is identified by using the transitional denture which the patient has been wearing. This can be accomplished by several methods.

1. One simple method is visual identification of position of the gold alloy cylinders relative to the denture-bearing surface of the transitional denture. Indicating marks should start with the most distal aspect of the terminal fixture on one side and end with the distal aspect of the terminal fixture on the opposite side of the arch (Fig. 3).

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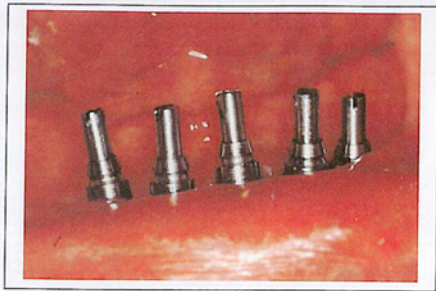


Fig. 2 Gold cylinders with medium-length screws.

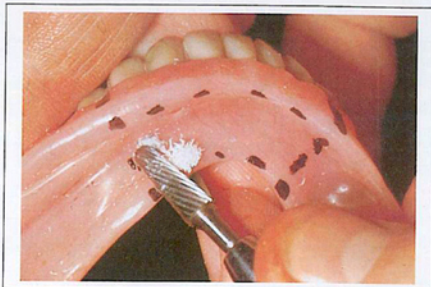


Fig. 3 Implant support area outlined for relief.

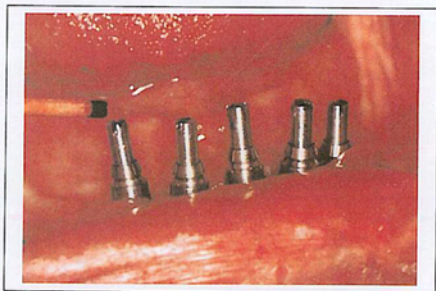


Fig. 4 Transfer ink is used to identify position of implants on transitional denture surface or on the rubber dam.

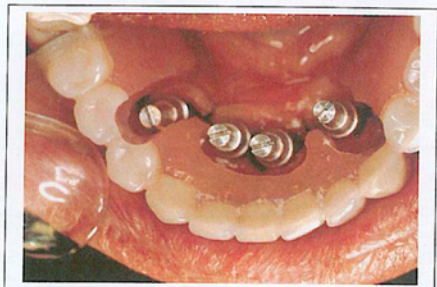


Fig. 5 Complete relief around the implants.

- Another method of identifying fixture location in relation to the denture is to paint the occlusal aspect of the gold alloy cylinders with indelible transfer ink. The denture is inserted over the coping and the posterior aspect of the denture is positioned by approximating the opposing occlusal surfaces. The patient then closes into the denture, leaving the transfer ink marks on the tissue-bearing surface of the denture in the area of the gold copings.
- A third method is to place an occlusal indicator wax on the inside of the denture. Once again the denture is positioned appropriately and the patient is asked to close. The gold cylinders will pierce holes through the wax, identifying the location of the fixtures.
- Identifying fixture location may also be achieved by using a thin covering of a silicone bite registration

material such as Ramitec[®] inside the denture. Before the material is allowed to completely set, the denture is placed in the mouth with the appropriate occlusal references and the jaw is closed into position.

When the fixture location has been established, the acrylic denture base is relieved (Fig. 5). In the mandibular arch this will most often be on the lingual aspect of the denture. The proper position of the nonremovable replacement teeth has been established while constructing the transitional denture. Generally the anterior denture teeth are positioned labial to the crest of the remaining residual alveolar ridge.

Once adequate relief is provided, the denture is reinserted in the mouth, relying on complete soft tissue

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Fig. 6 Inadequate relief in the area of teeth 33 and 45 prevents reseating the transitional denture.

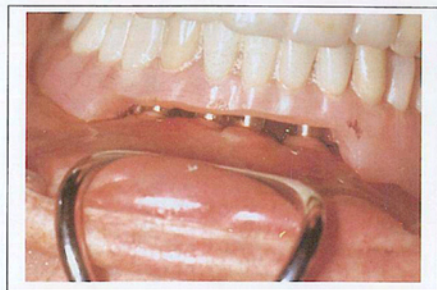


Fig. 7 Occlusion verified following denture relief.

support in the posterior areas. The fixtures and gold copings should not contact the transitional denture (Fig. 6). The occlusion is again verified to assure accurate posterior and anterior positioning of the denture (Fig. 7).

Soft tissue protection

Protecting the freshly sutured soft tissues adjacent to the abutment cylinder is important to assure proper healing. Cut a small section of rubber dam to cover the area of the abutment connection incision. The rubber dam should extend distally beyond the incision line only 2 to 3 mm on the residual ridge, allowing accurate reseating of the posterior denture-bearing area. Coverage should be extended labially and lingually to the labial vestibule and floor of the mouth, respectively.

To identify the precise location of the hole to be punched in the rubber dam, indelible transfer ink is applied to the top of either the gold cylinders or the screws (Fig. 4). The rubber dam is pressed over the ink to mark the exact location of the fixtures. Small holes are cut using the rubber dam punch (Figs. 8a to 8c).

The rubber dam is now seated over the gold cylinders and the edges adjacent to the fixture are inverted using a retraction cord packing instrument (Fig. 9). Whenever possible the dam should be placed below the gold cylinder, and should completely adhere to the abutment cylinder (Fig. 10). Fig. 11 shows the rubber dam securely in place on the abutment cylinders with the gold cylinders removed.

Check screw interference

The small gold screws securing the gold alloy copings to the abutment connection are removed and replaced

with the intermediate-sized screws which normally accompany the impression transfer copings. These screws will usually extend above the lingual and occlusal surface of the denture (Fig. 12). Care must be taken to determine whether these screws will impinge upon the opposing dentition or soft tissues, or any surface of an opposing prosthesis. If so, the screw should be shortened and the top reslotted with a thin rotary disk.

Gold coping pick-up

Once the denture has been accurately repositioned in the mouth to be certain the bearing areas will hold the rubber dam against soft tissues (Fig. 13), the gold cylinders are now ready to be attached to the transitional denture. A small amount of autopolymerizing resin is placed around the circumferential indentation of the gold cylinders (Fig. 14). A second mix of acrylic is placed in the denture, filling the region where the denture was relieved (Fig. 15).

Before the putty-mix of acrylic resin begins to set, the denture is replaced in the mouth and the patient asked to close in the previously established centric occlusal position (Fig. 16). Before the acrylic sets completely, finger pressure is used to assist in molding the soft acrylic resin around the gold copings. The screws must be completely visible, not buried in the soft acrylic. In Fig. 17 only one screw is readily visible; others must be exposed before the resin sets. The patient is once again allowed to close while the acrylic continues to set (Fig. 16).

Before the acrylic resin hardens, and most certainly prior to any detectable heat from the exothermic reaction, the medium-sized screws are removed from

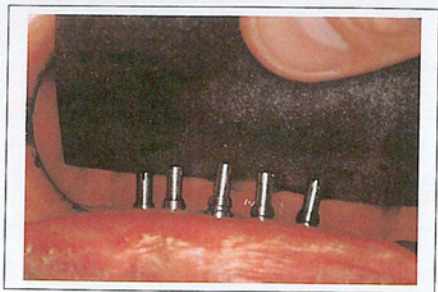


Figure 8a

Figs. 8a to 8c Implant location transferred to rubber dam.



Figure 8b

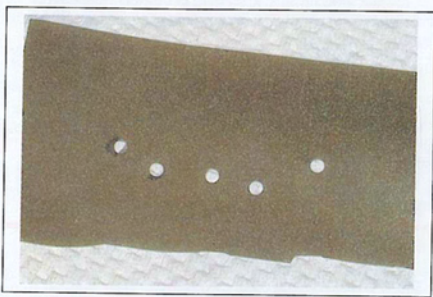


Fig. 8c shows the small holes punched.

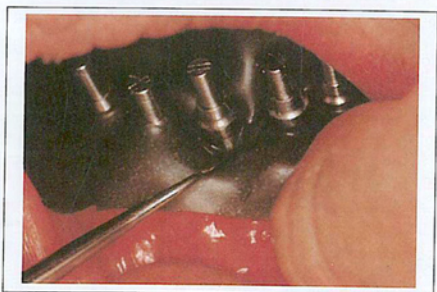


Fig. 9 Careful instrumentation is required to invert the rubber dam.

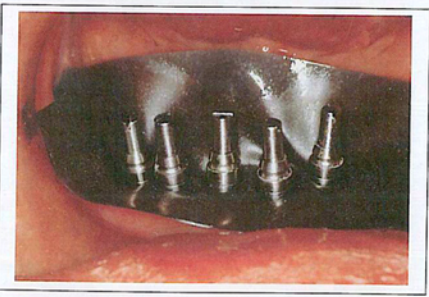


Fig. 10 Rubber dam is placed below the gold cylinders on the abutment cylinder.



Fig. 11 Rubber dam with gold cylinders removed.

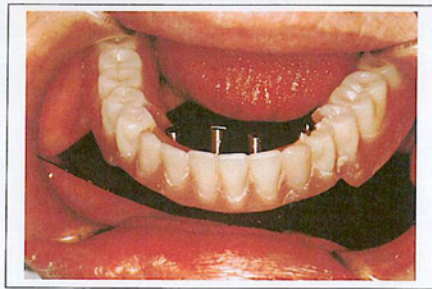


Fig. 12 Medium-length screws extend above the denture surface.

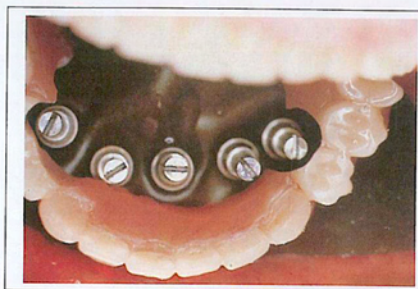


Fig. 13 Denture-bearing areas help hold rubber dam against soft tissues.

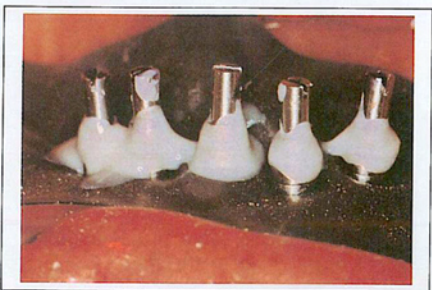


Fig. 14 Autopolymerizing acrylic resin applied to gold cylinders.

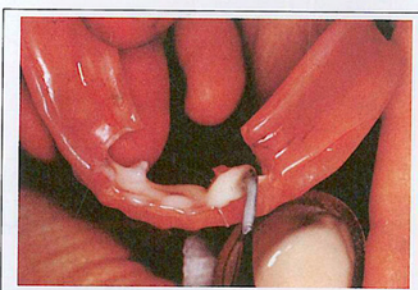


Fig. 15 Acrylic applied to transitional denture.

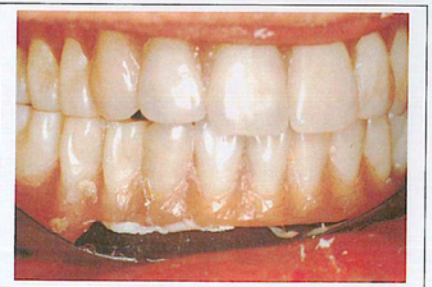


Fig. 16 Centric occlusion with soft acrylic around gold cylinders.

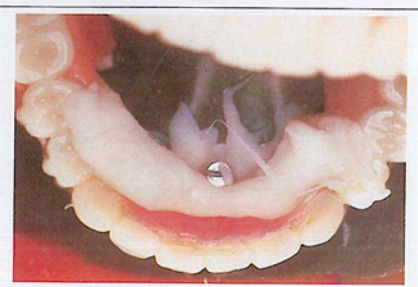


Fig. 17 Only one screw is visible; others must be exposed.



Fig. 18 Denture placed in chairside Pressure Pot.



Fig. 19 125° F water with 30 p.s.i. for ten minutes.

the abutment cylinders allowing the gold cylinders to disengage. The denture with the gold cylinders attached in acrylic resin is removed from the patient's mouth and immediately placed in a chairside Pressure Pot[®] which is filled with water at 125° F (Figs. 18 and 19). The acrylic resin sets under 30 p.s.i. pressure for ten minutes.

Close inspection of the denture will show areas where the acrylic has not been completely adapted to the gold cylinders. A small brush is used to add acrylic resin to any voids between the "pick-up" acrylic and the gold alloy cylinders (Fig. 20). The prosthesis is again placed in the pressure pot for curing. Excess acrylic (Figs. 21a and 21b) is trimmed. The denture is then reinserted in the mouth to verify the position of the gold cylinders (Fig. 22).

Radiographic verification

The position of the abutment cylinders and the gold cylinders can be reverified through radiographic examination (Fig. 23). If a gold cylinder has moved during the pick-up procedure, a small space may be evident between the gold cylinder and the abutment cylinder during radiographic examination. If the movement of the gold cylinder away from the abutment cylinder has been significant, this will be clinically evidenced by the inability to place the connecting screw. The misaligned gold cylinder should be removed from the denture base and the pick-up procedure repeated.

Conversion of the interim denture

Modification of the transitional denture is required after verifying the position of the denture and the

stable connection between the prosthesis and the abutment. This is accomplished by completely removing all of the flange and most of the denture-bearing areas distal to the position of the titanium fixtures (Fig. 24). Only the crest of the denture base is allowed to remain in contact with the residual ridge. This now becomes the cantilevered pontic contact with the residual ridge. The author generally recommends that dentures using four posterior teeth be shortened to no more than three posterior cantilevered pontics for the conversion prosthesis. Some clinical trials have included a second molar cantilevered pontic to sustain a freely balanced occlusion of the conversion prosthesis. Short-term satisfactory results have been encouraging for exceptionally thick dentures.

The conversion prosthesis is highly polished to minimize plaque retention (Fig. 25). Once final polishing is completed the conversion prosthesis is repositioned in the mouth using two of the abutment screws. The occlusion should be verified and the patient should inspect the new prosthesis for any unusual rough spots or angles that might prove annoying to the tongue. When modifications of the conversion prosthesis are completed, the rubber dam should be removed and the sutures rechecked.

Placement of periodontal dressing

A small amount of Perio-Pak[‡] is mixed and rolled into a thin string about the diameter of an eight-gauge wax rod. Using a figure-eight pattern the Perio-Pak is placed around the gold coping cylinders on the bottom (implant-facing) surface of the conversion prosthesis (Fig. 26). The prosthesis is then securely fastened to the osseointegrated fixtures using the small gold con-

[®] Vic Pollard Dental Products, Westlake Village, Calif.

[‡] Cooper Care, Palo Alto, Calif.

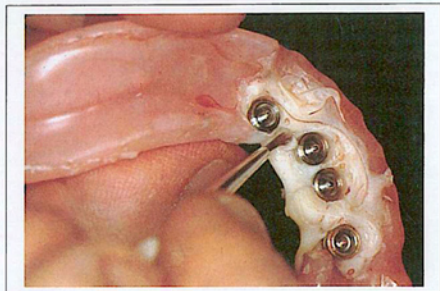


Fig. 20 Additional acrylic added to voids.

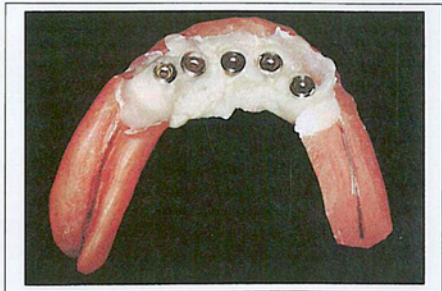


Figure 21a

Figs. 21a and 21b Excess acrylic resin.



Figure 21b

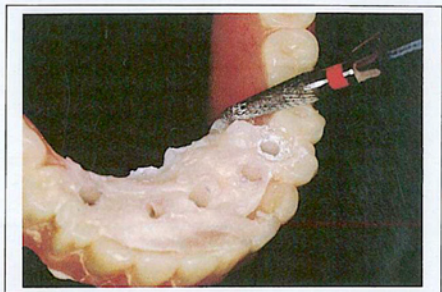


Fig. 22 Excess acrylic trimmed.

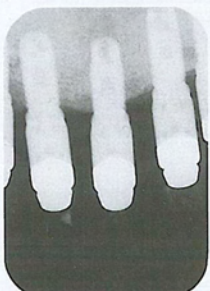


Fig. 23 Radiographic verification: gold cylinders, abutment cylinders, and fixtures securely connected.

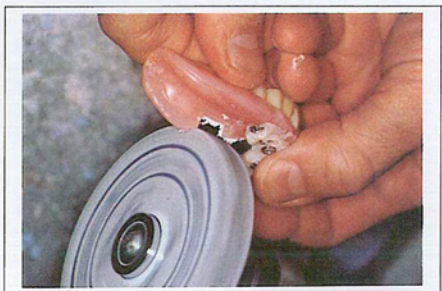


Fig. 24 Removal of flange area.



Fig. 25 Conversion prosthesis is contoured and highly polished.

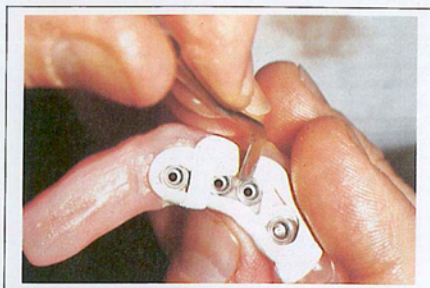


Fig. 26 Periodontal dressing applied to conversion prosthesis.

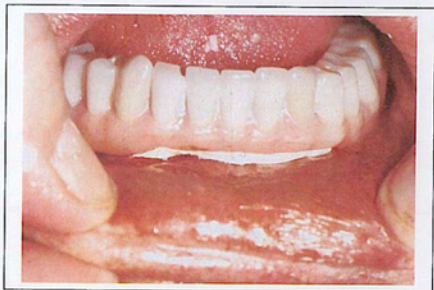


Fig. 27 Periodontal dressing with conversion prosthesis in place.

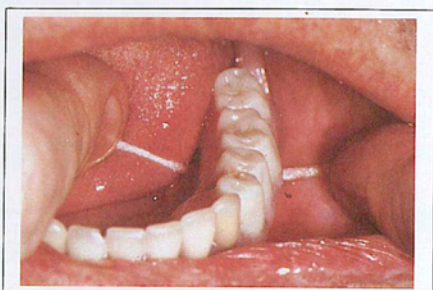


Fig. 28 Super floss being used to clean pontic area.

necting screws. Any excess Perio-Pak exuding from between the conversion prosthesis and the soft tissue is carefully removed (Fig. 27). Once again, the occlusion is checked.

Plaque control

Prior to dismissing the patient, a specific plaque control procedure for the conversion fixed prosthesis is taught. Various toothbrushes are used to cleanse all the areas that can be reached by the bristles. Knitting yarn[®] or Oral B Super Floss[®] (Fig. 28) is used to clean the cantilevered pontic areas distal to the osseointegrated fixtures. Gauze sponges, opened to one layer thick, are also used to cleanse the distal cantilevered pontics (Fig. 29). The patient is informed that cleaning

devices cannot be used in the area immediately adjacent to the fixture while the Perio-Pak is in place.

Ten days following the abutment connection the conversion prosthesis, Perio-Pak, and the sutures are removed. The master impression suitable for fabrication of the final prosthesis may be made at this time; however, if additional healing is required, impression-taking should be postponed for a future visit.

If the patient is comfortable with the occlusion and aesthetics of the conversion prosthesis, the same form and position can be duplicated in the final restoration. Previous plaque control procedures are again reviewed. In addition, the patient is given instruction on using a special nonmetallic abutment "scaler." The instrument will not scratch or gouge the surface of the titanium abutment cylinder. This instrument is designed to clean the lingual surface of the abutment

[®] Cooper Care, Palo Alto, Calif.

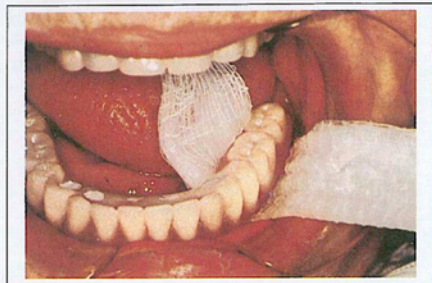


Fig. 29 Gauze used to remove plaque in larger cantilever pontic areas.

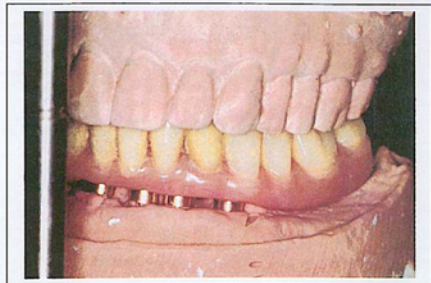


Fig. 30 Conversion prosthesis on master cast used as centric registration for articulation.

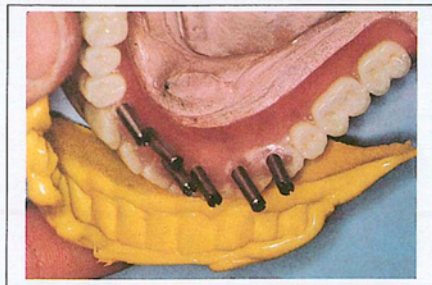


Fig. 31 Silicon seating records tooth position.

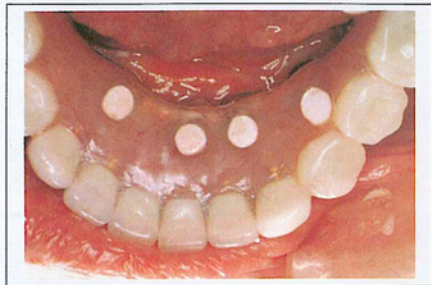


Fig. 32 Cavit used to seal screw hole openings.

cylinder with instrument access from the labial direction. The opposite end of the instrument is designed to clean the labial surface of the abutment cylinder.

A facebow transfer and appropriate bite registrations are made while the conversion prosthesis is in place. After the replica or master cast is completed the conversion prosthesis is removed from the mouth and securely fastened to the brass replica abutments on the master cast. The master cast and conversion prosthesis are then articulated directly to the opposing cast (Fig. 30). Before removing the conversion prosthesis from the replica cast a silicone index of the labial surface and relationship of the teeth to the opposing dentition should be made to assist the technicians in placement of the prosthetic teeth for the final restoration (Fig. 31).

The conversion prosthesis is removed from the replica fixtures, polished, and resecured to the tissue-integrated abutment fixtures.

A small cotton pellet is placed in the access openings to cover the gold screw. Cavit[®] is then used to seal the openings (Fig. 32).

At the casting try-in or placement of the final restoration, the conversion prosthesis is removed and retained for future reference. Should additional treatment be required, this prosthesis can be easily modified, allowing change with the final prosthesis to occur without requiring the patient to rely on the use of a removable appliance.

Discussion

A method for converting the interim removable prosthesis to a conversion prosthesis, or provisional fixed prosthesis supported by osseointegrated titanium fixtures as part of the Biotes treatment method, affords

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patient and prosthodontist many advantages. The conversion prosthesis is obtained by transforming the transitional removable interim denture into a fixed prosthesis. This is accomplished by connecting the gold alloy cylinders supported by the osseointegrated fixtures to the denture, followed by radical modification of the tissue-bearing areas of the removable denture.

Advantages of the conversion prosthesis

The advantages of using the conversion prosthesis are:

1. It permits the patient to enjoy the benefits of a fixed dentition immediately following the abutment connection surgical visit.
2. There is no need to modify the removable transitional denture to fit over the plastic healing caps.
3. It avoids requiring the patient to function without the use of a prosthesis.
4. It protects the sutured mucosal tissues surrounding the abutment cylinders, holding the periodontal dressing securely in place.
5. It eliminates the need for plastic healing caps.
6. It provides the patient with comfort, function, and aesthetics while allowing the patient to preview the effect of the final tissue integrated prosthesis.

Disadvantages

The disadvantages of the abutment connection/conversion prosthesis visit are minimal. They include:

1. The use of a longer-lasting local anesthetic since the treatment itself requires additional time.
2. A possibility, although unlikely, that heat from the exothermic reaction of the setting acrylic may exceed reasonably safe levels and be transmitted through the titanium fixtures injuring the adjacent tissues.

3. A need for presurgical fabrication of a precisely fitting transitional denture to be used as the conversion prosthesis following the second surgery. There is a possibility of the conversion prosthesis fracturing, especially where cantilevered pontics join the gold cylinders.

Summary

A technique for converting the transitional removable prosthesis to a fixed prosthesis as part of the Biotes treatment has been described. The advantages of using this technique far outweigh the potential disadvantages. Patient comfort, aesthetics, phonetics, and function are all very distinct advantages to using the conversion prosthesis.

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