Fabrication and use of a surgical template for placing implants to retain an auricular prosthesis

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A procedure is described for the fabrication of a 3-dimensional surgical template to guide the placement of implants to retain an auricular prosthesis. This procedure requires a diagnostic wax pattern that is checked while on the patient to ensure it is positioned correctly and is also the correct size. The wax pattern is processed into a clear, methyl methacrylate resin, 3-dimensional surgical template. The most effective type of surgical template for planning implant placement is a 3-dimensional acrylic template that closely resembles the final prosthesis. This template will direct the implant placement where the retentive elements are most easily concealed, under the thickest areas of the prosthesis, which are the antihelix and antitragus. This location allows the best esthetic and functional results. An additional advantage of this technique is that it allows the retrieval of the diagnostic wax pattern of the auricle so that it can be used to fabricate the definitive prosthesis. (J Prosthet Dent 1999;81:228-33.)

Ideal placement of bone integrated implants to retain a prosthesis is critical for a successful final prosthetic restoration. Several sources described the importance and use of surgical templates for the optimal placement of extraoral implants.[1-3] The literature is replete with information explaining the use of surgical templates for intraoral implant placement.[4-6] Indeed, correct placement of implants facilitates creating a prosthesis that functions well and looks natural. To ensure proper implant placement, considerable effort should go into presurgical planning. By planning, the implant–abutments and retentive elements will be hidden under the prosthesis and will not interfere with the esthetic contours of the final result.

It is clear that extraoral surgical templates aid in proper implant placement, yet the literature describing fabrication is limited. Types of surgical templates that have been described in the literature range from vacuum-formed templates[1,7] to modified face-bows[8] and 3-dimensional acrylic resin templates in the form of the final prosthesis.[2] The most effective type of surgical template for planning and positioning is one that most closely resembles the final prosthesis, which is a 3-dimensional acrylic resin template. When the template is in the form of the prosthesis, it is easier to reposition correctly during surgery because it engages the patient's anatomy, such as the external auditory meatus. Also, if the surgical site lacks an external auditory meatus or other definite anatomic topography, a 3-dimensional template facilitates the visual confirmation of the correct position by comparing the template's position to that of the contralateral ear. The proper position would then be marked before surgery.

This article describes a procedure for the fabrication and use of a 3-dimensional surgical template made of a clear acrylic resin. The diagnostic wax pattern for the auricular prosthesis is used as the pattern for the template, which is processed into the clear heat-polymerizing methyl methacrylate resin. An important advantage of this procedure is that it allows the retrieval of the wax pattern from the mold so it can be used for the fabrication of the definitive prosthesis.

PROCEDURE

1. Fabricate an accurate master cast of the cutaneous defect site. Before making an impression to obtain the cast, mark the position of the future prosthesis on the defect site. Mark the planned anterior, superior, and inferior extent of the prosthesis with color transfer applicators. Mark the proposed location of the tragus when it is absent. Use the contralateral ear as a guide for the position of these marks. Transfer these marks from the patient's skin to the impression, and subsequently to the stone cast.[9] (The patient should be lying down when the impression is made so that the cast more closely

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replicates the position the tissues will be in at the time of surgery.) Make an impression and cast of the contralateral ear for reference when sculpting the diagnostic wax pattern. (A properly mixed type III dental stone is suitable for pouring into the impressions to form the casts.)

2. Sculpt a diagnostic wax pattern of the missing auricle on the properly lubricated cast of the defect. (A silicone spray lubricant works well for this purpose and allows the wax pattern to be easily removed from the cast and tried on the patient.) Keep the wax pattern properly oriented within the marks that have transferred to the cast. A baseplate wax is suitable for sculpting an auricle. If necessary, custom tint the wax to a flesh tone by using oil pigments.[10] (Unaltered baseplate wax is very translucent and bright, which makes it difficult to judge the form of the wax pattern. A wax that has the proper color and translucency allows one to more effectively determine the form of the diagnostic wax pattern.[11] A flesh-tone wax also aids the patient in objectively assessing the wax pattern.) Use the cast of the contralateral ear as a guide when sculpting the wax pattern. Other techniques such as the use of tracing paper,[12] photocopier,[13] or flatbed computer scanner,[3] can aid the sculpting process when reversing the contralateral ear. (The use of "donor ears" has been commonly advocated as an easy way to obtain an auricular pattern.[1,11,14]) Completely flame polish the final wax pattern with an alcohol torch to create a smooth surface, which is desired on the surgical template.
3. When the diagnostic wax pattern is finished, try it on the patient to confirm proper position before template fabrication. (The diagnostic wax pattern should be in the form of the planned final prosthesis and can be used to assess whether any surgical manipulation of the defect site is necessary. All members of the multidisciplinary rehabilitative team should be involved in presurgical planning. For patients with congenital deformities, auricular remnants may be an issue. Decisions regarding these remnants should be discussed with the patient.[1])To enhance the esthetic contours of the final prosthesis and to improve patient hygiene, minimize the soft tissue thickness over the implants. Patients who have had reconstruction with skin grafts after ablative cancer surgery should ideally have had a split-thickness skin graft. Patients may require the debulking of subcutaneous tissues if a full-thickness skin graft or soft tissue flap were used to resurface the surgical bed after ablative procedures. Tissue reduction may also be necessary in patients with congenital malformations.

   The final position of diagnostic wax pattern should appear visually balanced with the patient's face. Use major landmarks such as the external auditory meatus, the ramus of the mandible, and the contralateral ear when positioning the wax pattern. (Other good landmarks to judge position are the lateral canthi, ala, corners of the mouth, and mastoid process.) Relate the landmarks to the position of the diagnostic wax pattern by using the contralateral ear as a guide.

   The best position for a prosthetic auricle is the position where the prosthesis appears balanced with the patient's facial features, a position which is usually, but not necessarily the exact opposite position of the contralateral auricle. Slight facial asymmetry is a human characteristic but it may be pronounced in patients with congenital deformities, or who have experienced trauma or major ablative surgery. This asymmetry must be minimized when positioning the wax pattern. For example, if a patient's facial features droop on the defect side then the best position to place the prosthesis would be slightly lower than the opposite ear, which will help visually balance the patient's features. When the position is confirmed correct from all angles, place the wax pattern on the cast in the corresponding position, then begin fabrication of the surgical template. The diagnostic wax pattern will serve as the wax pattern for the surgical template.
4. Lute the wax pattern to the cast with hot wax. Before luting, lubricate the cast with a silicone spray to facilitate retrieval of the wax pattern when the flask is opened. (The cast is now invested in a maxillary denture flask.) Orient the wax pattern so the helix portion of the auricle is toward the anterior of the flask. The investing dental stone in the drag of the flask should be even with the tissue surface of the cast.
5. To create a mold that allows for the retrieval of the diagnostic wax pattern, yet is rigid enough to compression pack heat-polymerizing methyl methacrylate resin, use a polyvinyl siloxane laboratory putty to invest the wax pattern. Catalyze 2 scoops of laboratory putty and press it under the posterior part of the pattern. Form the laboratory putty into a wedge with a smooth surface and allow the material to polymerize. Use a thin layer of petroleum jelly on the polymerized wedge to prevent the second layer of laboratory putty from adhering to the wedge. Next, invest the rest of the wax pattern with another 2 scoops of catalyzed laboratory putty, pressing the material into the surface details of the sculpted pattern (Fig. 1). The entire wax pattern is now covered with a layer of laboratory putty. There should be no severe undercuts on the nonanatomic surface of the putty because large undercuts will cause the laboratory putty and wax

Fig. 1. Laboratory putty being pressed into wax pattern. Already polymerized wedge is seen on posterior of wax pattern.

Fig. 2. Putty and wax pattern removal with laboratory knife.

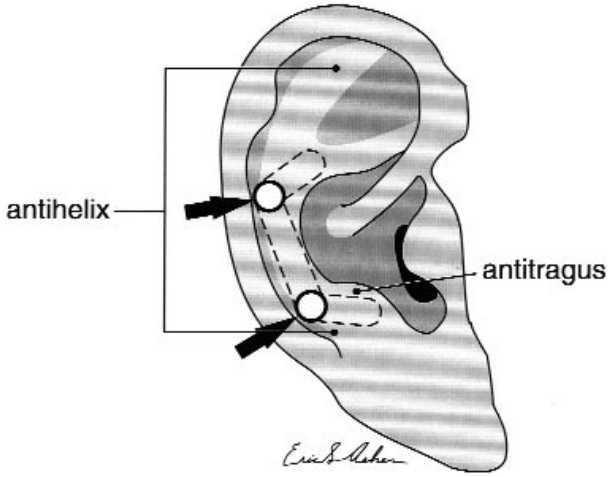

Fig. 3. *Arrows* point to areas in antihelix where holes should be drilled in template for ideal implant placement. *Dashed outline* indicates where retentive components can be effectively hidden in final prosthesis.

pattern to lock into the second pour of dental stone and preclude retrieval of the wax pattern.

6. Before investing the laboratory putty covered pattern, apply a film of tinfoil substitute as a stone separator to any exposed dental stone. Invest the laboratory putty–covered pattern in the flask with a second pour of dental stone. Allow at least 45 minutes for the final pour of dental stone to set and cool.
7. Pry open the mold without heating. The wax pattern will have probably separated from the master cast and be in the cope portion of the mold. Use a laboratory knife to pry the pattern out by inserting it under the laboratory putty and gently lifting it out (Fig. 2). (The laboratory putty will then separate easily from the intact wax pattern that can be used again as the pattern for the final prosthesis.)
8. Clean the 2 pieces of laboratory putty of any wax residue with rubbing alcohol and then fit them back into the mold. Clean the stone portion of the mold of wax residue with boiling water and then coat with a tinfoil substitute. It is not necessary to use a separator on the laboratory putty portions of the mold.
9. Once the tinfoil substitute has dried, cast the template with a clear heat-polymerizing methyl methacrylate resin. Mix the acrylic resin according to the manufacturer's directions, usually 30 cm^3 of powder to 10 mL of liquid (3:1 ratio of powder to liquid) will be enough for most auricular templates. Allow the material to set to the point of not being sticky, yet still soft, and do a trial flask closure. Complete the process according to established compression packing and curing procedures.[15,16]
10. Pry open the flask. (No fracturing of stone is necessary to deflask the template. The acrylic resin template usually adheres to the cast when the flask is pried open.) Peel off the laboratory putty and carefully lift the template off the cast with a laboratory knife. (The cast will be intact if there are no gross undercuts; most of the time the mold can be reused if necessary.)
11. Drill implant guide holes in the antihelix portion of the template. The retentive components will be best hidden under the antihelix and the antitragus of the final prosthesis (Fig. 3). Use these locations to conceal the retentive components and to provide the best esthetic results when the prosthesis is seen from all angles. The rehabilitative team should decide on the number of implants and the type of retentive components to be used before implant placement. Usually 2 implants are enough

Fig. 4. Polished template with 2 holes in antihelix.

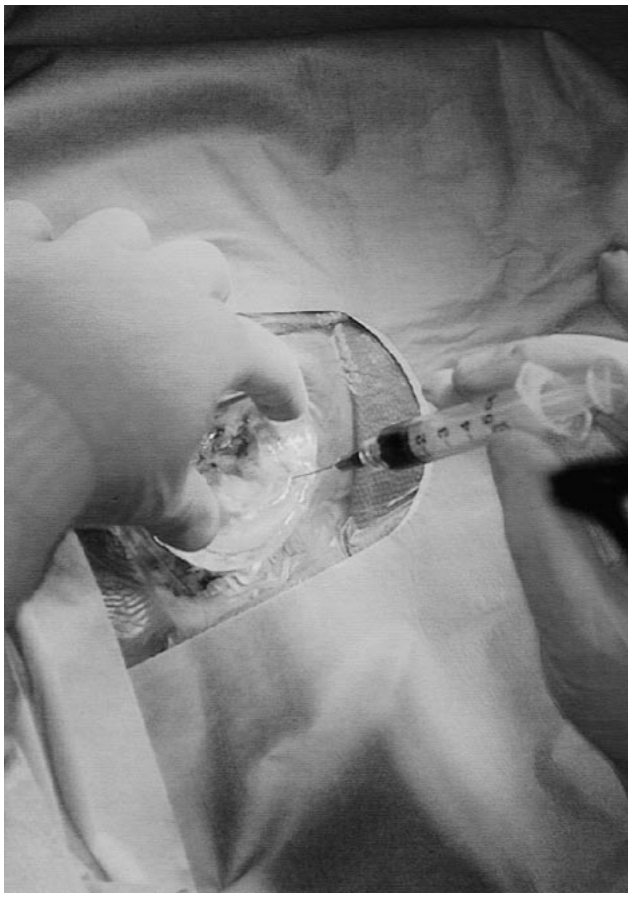

Fig. 5. Methylene blue dye is injected through template and skin into periosteum.

for an auricular prosthesis as the success rates for osseointegration are very high in the mastoid region.[17] Accordingly, drill 2 holes through the template in the desired locations with a no. 8 round bur. Make these holes at least 15 mm apart, which is the ideal distance between implants for an auricular prosthesis. (Adequate space between implants is necessary for proper gold bar construction to support the prosthesis. Also, the space allows the patient to perform appropriate periabutment hygiene.) Polish the template to a crystal clear finish according to standard acrylic resin polishing procedures (Fig. 4).

DISCUSSION

For surgery, either cold sterilize the template in a glutaraldehyde solution or gas sterilize it. In the operating room, the tissue surface of the template orients itself by engaging the patient's surface anatomy and external auditory meatus. If there is not an external auditory meatus and there is a lack of other observable surface anatomy, place the template before surgery and mark the correct position with an indelible surgical marker. When finished, the template should be sterilized again. The marks will not wash away when the surgical site is scrubbed and can be used to reorient the template. Mark the periosteum through the surgical template and the skin before reflecting the flap to expose the bone. The marking is accomplished by using a 1.5-inch 22-gauge needle and a 3-cc syringe filled with methylene blue dye (Methylene Blue Inj., USP 1%, Hope Pharmaceuticals, Santa Ana, Calif.). Pass the needle through the holes in the template and through the skin into the periosteum and inject a very small amount of dye (Fig. 5).[18] The marks created by the dye will be visible on the periosteum when the skin is reflected and the other anatomic landmarks are obscured. The surgeon then drills the guide holes in the location of the marks. It is recommended that the maxillofacial prosthetist and maxillofacial prosthodontist are present during the placement of the implants to insure that the surgical template is properly positioned. They can also help the surgeon choose alternative implant sites if the original sites are not available because of the lack of viable bone. Consider alternative sites within the antihelix and antitra-

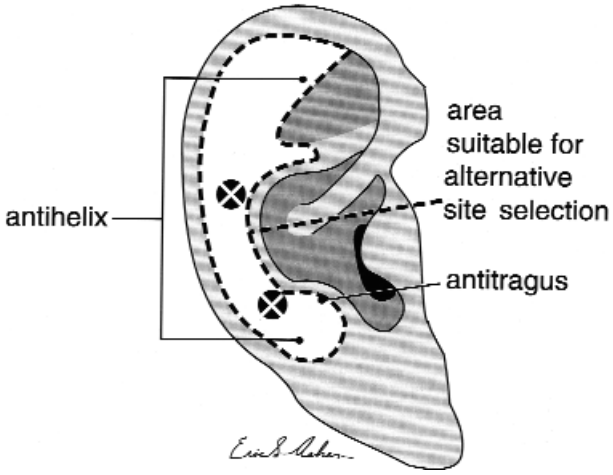

Fig. 6. Representation of possible alternative sites within antihelix and antitragus should original site be determined unsuitable during surgery. *X*s indicate original sites that are not available. Area within *dashed outline* is suitable for alternative implant sites that will not interfere with contours of final prosthesis.

gus before surgery. The alternative sites must not interfere with the contours of the final prosthesis (Fig. 6).

Penetration into mastoidal air cells, which is not uncommon in the inferior portion of the mastoid, may necessitate selecting other implant sites. It is also possible to expose the sigmoid sinus or the dura during implant placement surgery. In cases of severe congenital malformations, exposure of the sigmoid sinus or the dura is more likely.[19] Computed tomographic (CT) scans may be used before surgery to assess bone thickness and the proximity of the dura and sigmoid sinus. Care is taken not to penetrate either of these structures; however, the implants may sit safely adjacent to them. Once placed, the implants are allowed to integrate and the periabutment tissue is allowed to heal before the prosthetic phase of the patient's rehabilitation.

Another area of concern, particularly in congenital deformities is an aberrant position of the facial nerve. A detailed CT scan of the temporal bones with axial and coronal views helps visualize the course of the facial nerve canal. Dissection of the soft tissue around the mastoid tip and stylomastoid foramen area is performed with close monitoring of the facial movements for detection of any facial nerve stimulation. These procedures are preferably performed without paralytic agents if general anesthesia is used.

SUMMARY

Having a surgical template at the time of implant placement is necessary for optimal placement of bone-integrated implants, which will enhance the prosthetic rehabilitation. The retentive elements will be most easily concealed under the thickest areas of the prosthesis, which are the antihelix and the antitragus. The surgical template is the result of the planning process. Together, the surgical planning and template virtually eliminate the chance of placing titanium fixtures in areas that interfere with the contours of the final prosthesis.

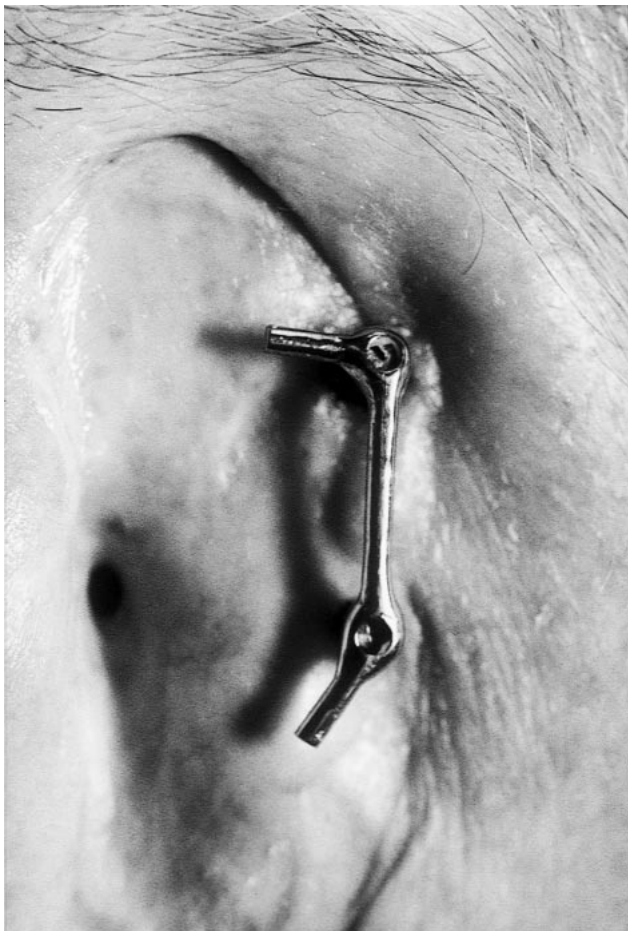

Fig. 7. Implants placed in ideal location so retention components will be concealed by prosthesis.

Presurgical planning and the creation of a surgical template are necessary for the placement of implants to provide the patient with the best possible prosthetic rehabilitation. All members of the multidisciplinary rehabilitative team should be involved in presurgical planning. A radiologic study may be performed to assess the patient's anatomy and bone thickness before surgery. The diagnostic wax pattern used for surgical planning is also used as the wax pattern for the surgical template mold creation. The wax pattern has been preserved to be used again as the wax pattern for the definitive prosthesis. The procedures explained in this article provide the readers with a sound technique for the fab-

rication and use of a surgical template for placing implants in an ideal location to retain an auricular prosthesis (Figs. 7 and 8).

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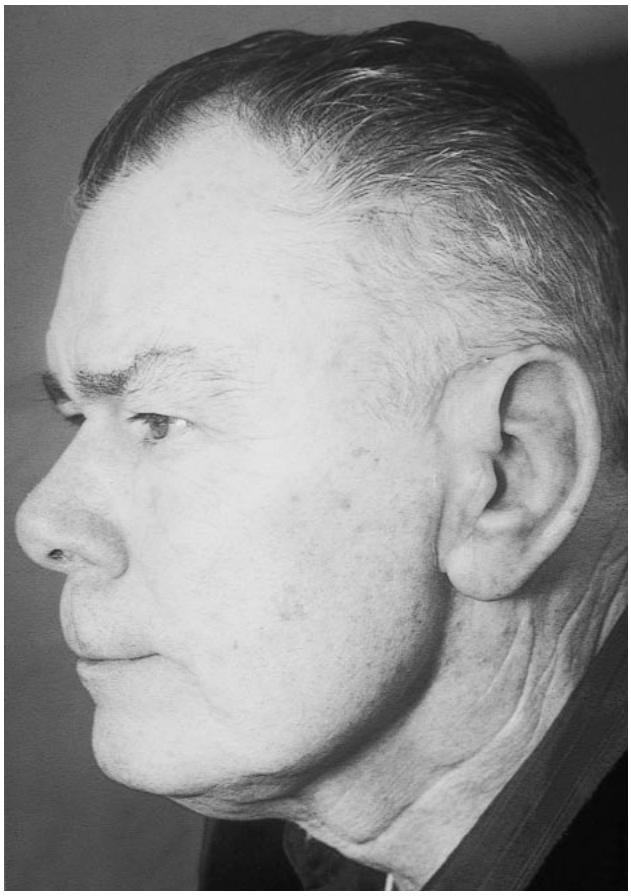

Fig. 8. Ideal implant placement facilities good functional and esthetic results.

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