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## Creating an adaptable anterior margin for an implant-retained auricular prosthesis

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**Achieving complete adaptation of the anterior margin of an auricular prosthesis often presents a challenge. Conventional solutions to this problem address soft tissue movements at static positions and do not necessarily reflect how the margin will adapt throughout a complete range of motion of the mandible and head. A technique is presented for creating an adaptable margin for an auricular prosthesis throughout a complete range of motion. This technique can be applied once adaptation of the diagnostic wax margin to the master cast is successful.** (J Prosthet Dent 2001;86:233-40.)

Achieving complete adaptation of the anterior margin of an implant-retained auricular prosthesis can be a challenge. Factors such as dynamic facial expressions, mandibular movements, head posture, and facial asymmetry can compromise the integrity of a prosthetic margin. Changes in soft tissue contours associated with these factors can compromise the esthetics of a prosthesis. Conventional solutions to this problem[1,2] address soft tissue movements at static positions and do not necessarily reflect how the prosthesis will adapt throughout a complete range of motion associated with the mandible and head.

This article presents an alternative technique for creating a flexible margin that will maintain tissue contact, without distortion, throughout a complete range of motion. The procedures needed to produce a duplicate master cast with an acrylic bar and optimally planned relief and aeration, without the need for a second impression, are presented. The duplicate cast becomes part of a permanent mold that can be used to fabricate spare or additional prostheses.

Current literature suggests that a functional impression should be made with the mouth open at a predetermined position to detail the maximum amount of soft tissue depression.[1] This technique can be problematic when the mandible is captured at an extreme position. Figure 1 shows the anatomic relationship of the temporomandibular joint (TMJ) to the overlying soft tissue when the mandible is in an open position. The shaded box indicates where a depression of the soft tissue base will occur. Figure 2 shows a lateral view of a patient's prosthesis with the patient lying on his side. The shaded area indicates where changes in the soft tissue base will occur when the mandible is in an open position.

A functional impression will record a depression in the tissue that serves as a base for the prosthesis. Recording this depressed anatomy results in a distorted shape of the anterior base of the prosthesis where it is too thick to be highly flexible, especially in patients with severe asymmetry. When the mandible is returned to its physiologic rest position, the prosthesis may buckle, displace, or irritate the underlying soft tissues. Dumbrigue et al[2] noted that it is difficult to correctly orientate a nonflexible diagnostic wax pattern between the patient and a cast obtained from a functional impression. They proposed the use of an altered cast impression technique once the initial adaptation of the preliminary diagnostic wax pattern is complete. The problem with this technique is that the impression material will indiscriminately record all soft tissue depressions, which may extend posterior to the conchal margin. The recording of these depressions will result in a distorted shape of the prosthesis; as previously mentioned, the prosthesis will be too thick to be highly flexible (Figs. 1 and 2).

When an impression of the residual anatomy is made after loss or lack of development of an auricle, the patient's head and mandible should be in the physiologic rest position. Most people spend the majority of their day in the physiologic rest position. It is important that the prosthesis be fabricated to relate accurately to the patient in this position. Once this is achieved, then space created by movement of the jaw and head in the region of the anterior margin can be compensated for by creating an anterior dam on a duplicate of the master cast.

The objective of this technique is to create an anterior dam in the preauricular soft tissue to compensate for soft tissue displacement away from the anterior margin of the prosthesis associated with mandibular

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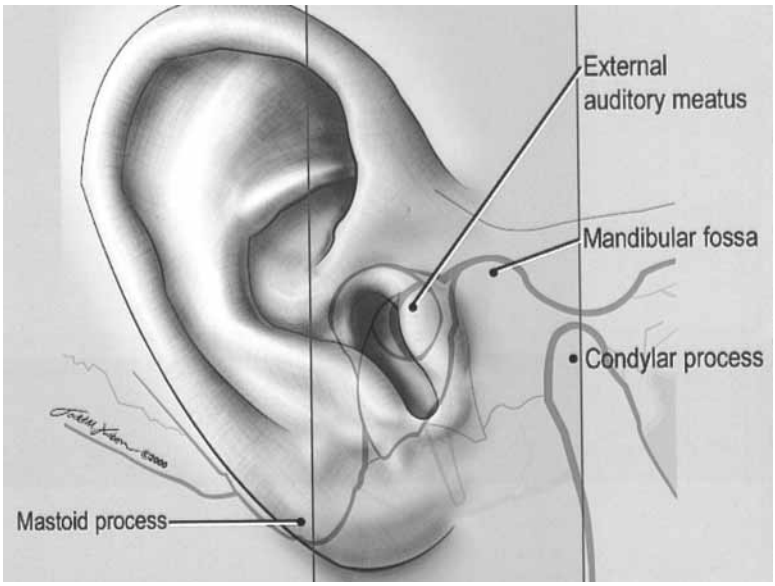


**Fig. 1.** Anatomic relationship of TMJ to overlying soft tissue while TMJ has translated anteriorly. *Central box* indicates where changes in soft tissue base occur beneath prosthesis.

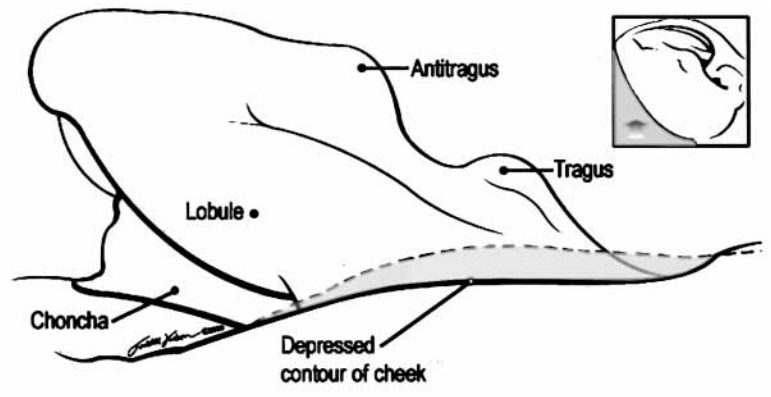


**Fig. 2.** Inset provides orientation to lateral view of patient's prosthesis when patient is lying on his side. *Shaded area* of larger image indicates where change in soft tissue base occurs beneath prosthesis when mandible is in function or head movement occurs.

function and head posture. The use of selective cast reduction to achieve margin adaptation has been previously documented but not described in the literature.[3,4] Previous arguments against selective cast reduction include the idea that this technique is arbitrary and does not always produce the desired result.[1,2] This problem can be adequately addressed through the use of a controlled method for selective cast reduction based on clinical soft tissue evaluation and measurement. This technique allows for continual contact of a thin, flexible margin overlying the preauricular soft tissue throughout a complete range of motion; it also allows the underlying tissue posterior to the margin to remain camouflaged and move freely.

## TECHNIQUE

1. Make an impression of the residual auricular implant site. When the impression is made, the patient should be relaxed and in an upright position with the head unsupported. Alternately, the head may be supported if the patient bites on a tongue depressor (approximately 1.5 mm) in the premolar region to approximate the correct intercuspal distance at the physiologic rest position. Having the patient lie on his or her side is not recommended, as this will cause additional depression of the soft tissue because of the increased weight of the impression materials against the skin.
2. If the diagnostic wax pattern was not preserved

**Fig. 3.** Undercut beneath bar was blocked out with wax. Wax was applied to master cast to accommodate aeration space and provide relief of prosthesis from tissue base.

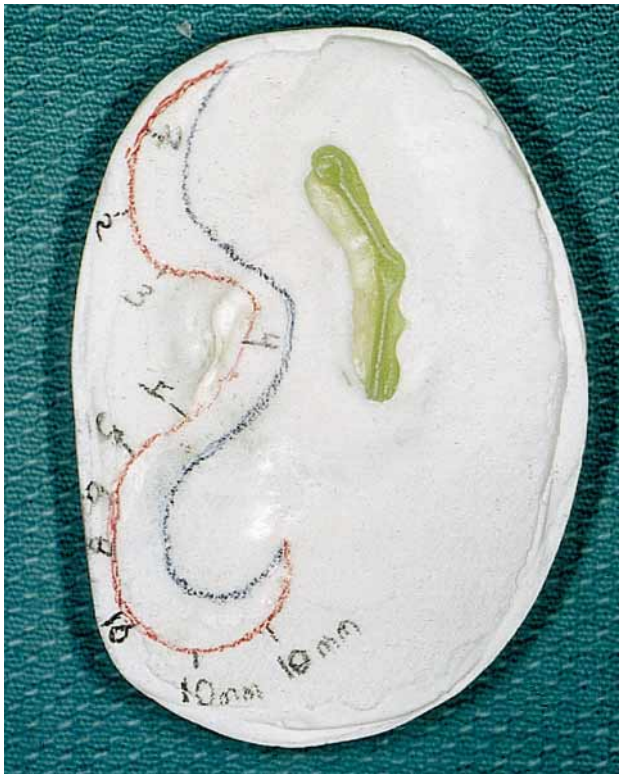

**Fig. 4.** Duplicate master cast with duplication of bar in autopolymerizing acrylic. Red line defined intended edge of anterior margin of prosthesis. Corresponding millimeter measurements for reduction were noted numerically in lead pencil. Blue line defined posterior limit for cast reduction.

from the fabrication of the surgical template for implant placement,[5] convert the template into a diagnostic wax pattern with the auricular wax pattern duplication procedure described by Wang.[6] A soft, pliable wax (NeoWax Baseplate Wax, Dentsply Int Inc, York, Pa.) is needed for this technique. (The NeoWax used for the photographs that accompany this article was custom tinted to match the patient's overall skin tone.)

3. Fabricate the gold bar and acrylic substructure on the master cast obtained from the impression made of the auricular defect site.
4. Incorporate the acrylic substructure into the diagnostic wax pattern. This will maintain the orientation of the wax pattern between the patient and master cast. Verify the diagnostic wax pattern between the patient and cast for accuracy of fit, orientation, and esthetics with the patient in the physiologic rest position.
5. Return the gold bar to the master cast. Clip the ear in place, and outline the wax pattern on the master cast in lead pencil.
6. Remove the wax pattern, and block out the undercuts of the bar with wax (Wax Square Ropes White, Heraeus Kulzer Inc, South Bend, Ind.). Clip the ear back on and off the cast to index a space for the clips. Apply baseplate wax (NeoWax Baseplate Wax, Dentsply Int Inc) to the master cast to accommodate for approximately 2 mm of aeration space posterior and/or superior to the abutments. Apply a minimal amount of wax over the remaining area of the soft tissue base, stopping 3 to 5 mm posterior to the pencil line. The diagnostic wax pattern of the auricle can be used as a visual guide to plan the appropriate amount of relief so as not to compromise the esthetics of the prosthesis (Fig. 3).
7. Duplicate the master cast with a silicone polymer duplicating material (Silflex III, Austenal, Chicago, Ill.). Duplication of the master cast with the bar in place will allow the sculpting process between the patient and cast to be verified without continual removal of the bar. The duplicate cast with permanent acrylic bar can also be used for fabrication of a permanent processing mold.
8. Inject autopolymerizing resin (orthodontic resin, Caulk/Dentsply, Milford, Del.) with the use of a syringe (3 mL syringe, Becton Dickinson & Co,


**Fig. 5.** Extent of opening was measured along margin edge with millimeter ruler.

**Fig. 6.** Proper anterior extension and thickness of anterior wax margin.

Franklin Lakes, N.J.) into the silicone polymer impression of the bar, leaving mechanical loops and undercuts for retention. (The resin used in this technique was tinted green for easier identification in the photographs.) Polymerize the resin according to the manufacturer's directions. After the resin is polymerized, box the silicone polymer duplicating material in the usual manner and pour it in type IV stone (GC Fujirock EP, GC Europe, Leuven, Belgium).

9. Once the stone has set, apply a separating medium (Coe-Sep Tinfoil Substitute, GC Lab Technologies Inc, Alsip, Ill.) to the duplicate master cast. This will help ensure complete separation of the thin wax margin from the cast when the diagnostic wax pattern is removed for clinical assessment.
10. Remove ample wax from the undersurface of the diagnostic wax pattern. Clip the ear onto the duplicate cast, and flow hot wax under the ear with a hot No. 31 wax instrument until the wax readapts to the cast.
11. Begin the margin adjacent to the anterior-most aspect of the helix, lobe, and tragus if present. The marginal thickness at this point should be approximately 2 mm. Outline the beginning of the margin on the cast with blue pencil (Fig. 4). Verify the diagnostic wax pattern between the patient and cast for accuracy of fit, orientation, and esthetics with the patient in the physiologic rest position.
12. Instruct the patient to go through a complete range of head and mandibular movements; observe any opening between the anterior margin and preauricular soft tissue (Fig. 5). Palpate the preauricular soft tissue adjacent to the anterior margin for compressibility. Soft tissue compressibility can be used as one indicator in determining the extent of cast modification. Excessive reduction of the cast where the skin is thin and overlays a bony surface may result in blanching of the skin and excessive pressure when the prosthesis is seated. Conversely, an additional reduction of 1 mm where the skin is soft and overlays a non-bony surface may help ensure complete margin adaptation during function. Measure the maximum extent of opening with a millimeter ruler along the entire anterior edge of the wax ear pattern (Fig. 5). These measurements will be used to define the extent and depth of cast modification for the anterior margin. Record a measurement for every 1-mm change in the opening.
13. Place the ear back on the duplicate cast. In creating the extent of the margin, allow for an adequate amount of anterior extension to cover the distance of space created between the ear and soft tissue base. The margin should be extended anteriorly at least 1 mm for every mm of reduction. For example, at the point where a 3 mm reduction is to be made, the length of the margin should be extended a minimum of 3 mm anterior to the blue line. The margin should be sculpted as thinly as possible, yet not so thin that it will tear. The margin should be no more than 2 mm at the thickest point to ensure flexibility and then taper to a finish (Fig. 6). The ideal average marginal thickness is approximately .2 mm and can be measured with a precision wax caliper (Buffalo Dental, New York, N.Y.)
14. Use a red pencil to outline the most anterior extent of the margin. This identifies the limits of the area intended for reduction (Fig. 4).

15. Place the wax pattern back on the patient, and instruct the patient to go through a complete range of head and mandibular movements. Measure the maximum extent of opening with a millimeter ruler along the complete margin edge (Fig. 5), and transfer the corresponding measurements to the cast with a lead pencil (Fig. 4). Record a measurement for every 1-mm change in the opening. These measurements will be used to define the extent and depth of cast modification for the anterior margin.
16. Make sure that the margin remains intact before reduction (Fig. 6). The diagnostic wax pattern is the only indication of the intended extent of the margin when the reduction is performed. Use round burs (steel or laboratory carbide burs, Ash Temple, Toronto, Ontario, Canada) to gauge the accurate amount of reduction along the red pencil line. The diameter of the bur should be equal to the depth of the gauge being made. A depth gauge should be made for every change in measurement that was recorded. When creating a depth gauge, the edge of the bur should be placed anterior to the red pencil line (Fig. 7). Slowly drill the bur until the head is just below the surface of the cast. Alternately, a single 2-mm diameter round bur (Jet carbide bur No. 6 HP, Ash Temple) can be used to make each depth gauge. Indicate the distance of the depth gauge to be made on the shaft of the bur by measuring from the tip of the bur down the shaft and marking it with a lead pencil. Slowly drill the bur until the mark made on the shaft has reached the surface of the cast. Make sure to keep a record of the depth of the gauge for each hole made on the cast for subsequent verification.
17. Use a tapered bur (Lathe carbide bur B-3/8, National Keystone Products Co, Cherry Hill, N.J.) to reduce the cast in a uniform manner, connecting the depth gauges until a shelf is created (Fig. 8). The cast should not be reduced posterior to the red line. The depth of the gauge can now be verified with a millimeter ruler to measure down the back wall of the shelf.
18. Use the same type of tapered bur to create a transitional slope back to the level of the record base, just short of the blue pencil line. This ensures that positive pressure is created over the extent of the margin and not the thicker portions of the prosthesis.
19. Use various grits of sandpaper to create a perfectly smooth transition (Fig. 9). Start with a 100 medium grit garnet sandpaper (Mastercraft Canada, Toronto, Ontario, Canada), and finish with a 400 superfine waterproof sandpaper (Mastercraft Canada). Apply the sandpaper with a circular motion to ensure an even and smooth reduction of the cast.
20. Apply separating medium (Coe-Sep Tinfoil

**Fig. 7.** Placement of round bur used to gauge depth for cast reduction.

**Fig. 8.** Depth gauges connected to further develop cast modification.

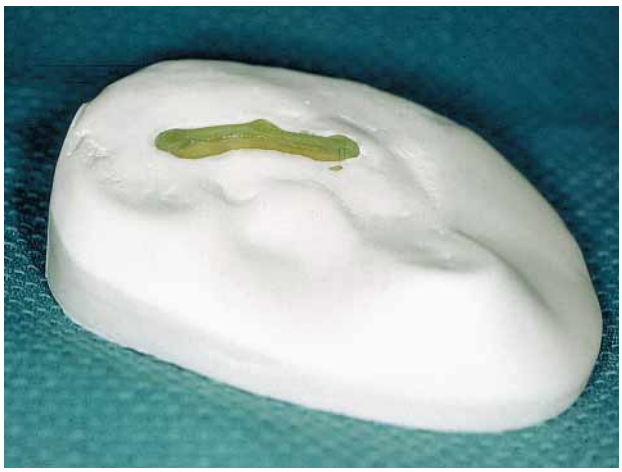

**Fig. 9.** Completed cast reduction after sanding procedure.

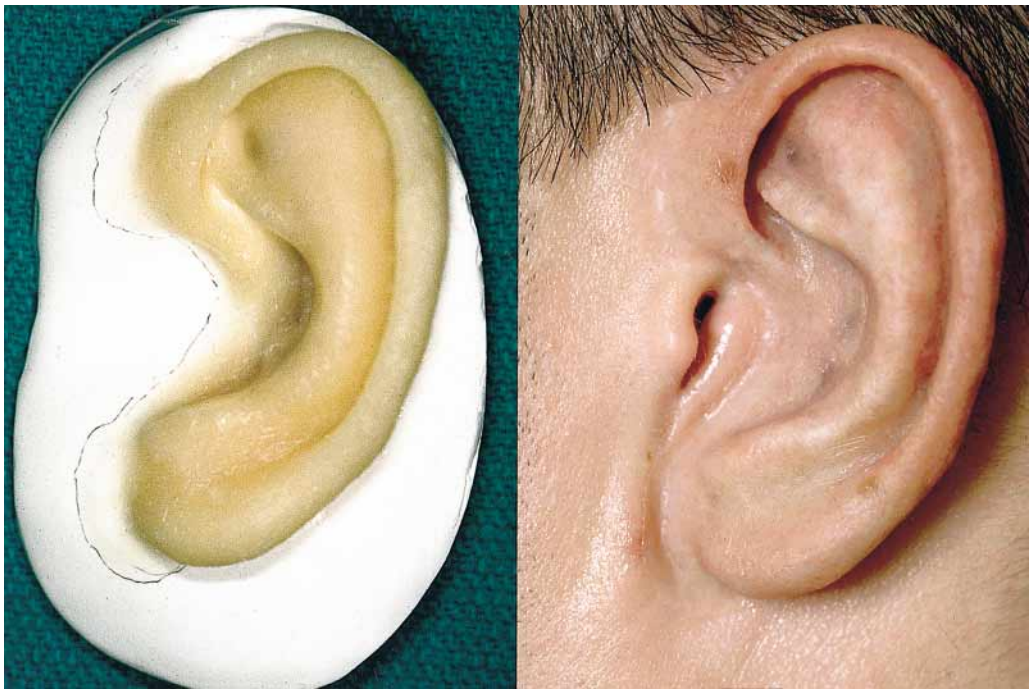

**Fig. 10.** Final wax pattern and prosthesis.

Substitute, GC Lab Technologies Inc) to the cast. Place the wax ear pattern on the cast. The amount of cast reduction will be obvious. Carefully readapt the edges of the margin onto the altered cast surface, and retrace the edge with a lead pencil. Warm the wax margin, and approximate it to the cast with a hot 7A wax instrument up to the lead pencil line.

21. At the next patient evaluation appointment, verify the changes made to the position of the margin by instructing the patient to hold his or her head and/or mandible in the positions at which the measurements for reduction were recorded. Fit the diagnostic wax pattern into place. There should be no observable opening of the anterior margin. (If any opening is present, repeat steps 14 through 20.) Instruct the patient to return the mandible to the physiologic rest position. The wax margin should bend into place, indicating an optimal margin thickness.
22. Return the wax pattern to the duplicate cast. Readapt the edges of the margin to the cast. The margin can now be luted and finished just short of the pencil line for processing (Fig. 10). This will allow approximately 1 mm silicone flash to be used for the transition from prosthesis to skin.
23. Invest the diagnostic wax pattern of the ear in the usual manner to create a reusable 3-piece mold.[3] After all wax residues have been removed and the mold is thoroughly clean, process the prosthesis with a 30 Durometer, shore A silicone elastomer (A-2186-F Silicone Elastomer Fast Setting; Factor II Inc, Lakeside, Ariz.). Figure 10 illustrates how the waxed margin translates into an adaptable translucent silicone margin.
24. Cut excess flash from the anterior margin of the prosthesis, leaving approximately 5 mm flash. The remaining excess should be trimmed after the prosthesis is evaluated on the patient.
25. Apply a thin coat of white petroleum jelly onto the entire anterior margin. Place the prosthesis on the patient, and instruct him or her to go through a complete range of head and mandibular movements. Trim the remaining flash in the places where it curls off of the skin. The end result should allow for marginal adaptation in both the physiologic rest position (Fig. 11) and in an extreme right mandibular postural position that would accentuate opening of the anterior margin (Fig. 12).

## DISCUSSION

Making an impression of preauricular soft tissue movements that often are associated with exaggerated mouth and head positions can impact the outcome of an auricular prosthesis, especially as it relates to the anterior margin. When the patient returns to the physiologic rest position, he or she often experiences an uncomfortable amount of pressure on the underlying tissue. This pressure can cause irritation of the tissue, extreme sweating, blanching of the skin, hearing dis-

**Fig. 11.** Adaptation of anterior prosthetic margin with patient in physiologic rest position.

**Fig. 12.** Extreme right mandibular postural position demonstrates range of motion that would accentuate opening of anterior margin of prosthesis.

tortion, buckling of the anterior margin, and/or loss of retention.

The use of the diagnostic wax pattern to plan the appropriate amount of aeration space and tissue relief results in a better environment for the underlying soft tissue. Minimizing prosthetic contact with the underlying tissue can provide a healthier environment for the peri-implant abutment tissue. Adequate relief can reduce the amount of perspiration that a patient may experience and provide better aeration of the tissue underneath the prosthesis. Moreover, minimizing prosthetic contact with the underlying tissue may increase the longevity of the prosthesis because less absorption of sweat and body oils will occur.

Duplication of the master cast with the bar in place allows for verification of the sculpting process between the patient and cast without the need to continually remove the bar. In addition, the duplicate cast with acrylic bar can be used for the fabrication of a permanent mold; thus, the need to remove the bar for fabrication of subsequent prostheses is eliminated.

Although the concept of cast reduction to achieve complete anterior margin adaptation is not new, this modified technique offers a remedy to the less predictable results experienced with previously proposed arbitrary scoring and sanding techniques. The use of a bur to gauge depth provides for controlled cast reduction based on clinical measurement; thus, the inherent contour of the preauricular tissue can be maintained. A controlled application of pressure in the anterior margin alone can help achieve an improved esthetic result.

The available amount of preauricular soft tissue and the extent of space that must be accommodated can limit the successful application of this technique. The preauricular soft tissue can be identified as the area adjacent to the helix, lobe, and tragus and limited by the TMJ (or where the sideburn of the hairline would normally appear). This area represents approximately 10 mm of anterior extension in the average adult patient. The available amount of preauricular soft tissue varies depending on the patient's anatomy; surgical, traumatic, or developmental compromise; implant location; and whether ideal placement of the auricular prosthesis is possible. Because an equal length of anterior margin extension is needed to cover the space created between the prosthesis and preauricular soft tissue, some extreme positions may not be accommodated by this approach. If the length of the margin exceeds the angle of the mandible, certain jaw movements in the direction toward the prosthesis may cause the margin to curl off of the skin. Although it may not be possible to accommodate for every extreme head and mandibular movement, this technique will accommodate for natural postural positions and mandibular movements associated with eating and conversing.

The ability to maintain an adaptable anterior margin throughout a complete range of mandible and head movements depends on the flexibility of the material used to fabricate the prosthesis. The prosthetic material that best meets this criterion is silicone. However, silicone loses its flexibility as its thickness increases. The use of lower durameter silicones with greater flexibility may accommodate increased ranges of head and jaw movement.

The success of this technique is also dependent on the experience and the observational and technical skills of the clinician.

## SUMMARY

A procedure for creating an adaptable anterior margin for an implant-retained auricular prosthesis has been described. This technique can be applied once adaptation of the diagnostic wax margin to the master cast is successful. The master cast is duplicated with the bar in place so that it can be incorporated into a permanent, reusable mold. A controlled reduction of the duplicate cast in the anterior margin alone can help achieve an improved esthetic result. This approach helps address problems that have been encountered with exaggerated postural impressions, which often result in compromised adaptation of the anterior margin of an implant-retained auricular prosthesis.

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