Fabricating auricular prostheses using three-dimensional soft tissue models

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This article describes a method for fabricating an auricular prosthesis. This procedure uses the contours of the soft tissue surface from computerized tomography scans to fabricate a computer-generated, side-inverted 3-dimensional soft tissue model from a solid block of polyurethane using an Endoplan milling machine. The resultant 3-dimensional soft tissue model can then be used as the basis for a wax sculpture. This procedure facilitates the planning of the prosthesis; symmetrical modeling, especially for large, hemifacial defects; and the impression, which can be made on the model itself. (J Prosthet Dent 1999;82:482-4.)

There are several techniques for sculpting an auricular prosthesis.[1-3] The reverse image of the ear of a family member or of a morphologically compatible person has been used for fabricating an ear prosthesis. In other situations, mirror-image or presurgical casts of the patient's remaining ear have been used. Among these techniques, the use of individual, life-sized, 3-dimensional models is relatively new.

Anatomic models based on 3-dimensional–computerized tomography (CT) have been valuable in oral and maxillofacial surgery procedures.[4-9] Bony tissue models have been used in preprosthetic, orthognathic, tumor, reconstructive, and craniofacial surgery, and they have been used for the insertion of extraoral implants. However, because the soft tissue covers the underlying bone, making the production of a combined model impossible, neither soft tissue models nor models combining bony and soft tissue have been used extensively. In 1993, Nakajima et al[10] presented a procedure for both soft and bony tissues in 2 infants with cleft lip and palate. The entire soft tissue of the head was reconstructed in a stereolithographic model, and the cavity that represented the bone was filled with plaster. The disadvantage of soft tissue models using a mold is that they cannot be produced side inverted. However, advanced data processing of CT scans allows for the production of enlarged and side-inverted models.

This article describes a procedure that uses a soft tissue model for the fabrication of an auricular prosthesis. The outlines of the soft tissue surface are taken from CT scans and a computer-generated, side-inverted 3-dimensional soft tissue model is milled from a solid block of polyurethane. The 3-dimensional model not only enables the precise localization of the defect and planning of implant insertion, but it also allows for a symmetrical reproduction of the missing structures. Rehabilitation of large facial defects by means of a facial prosthesis is facilitated by using this procedure.

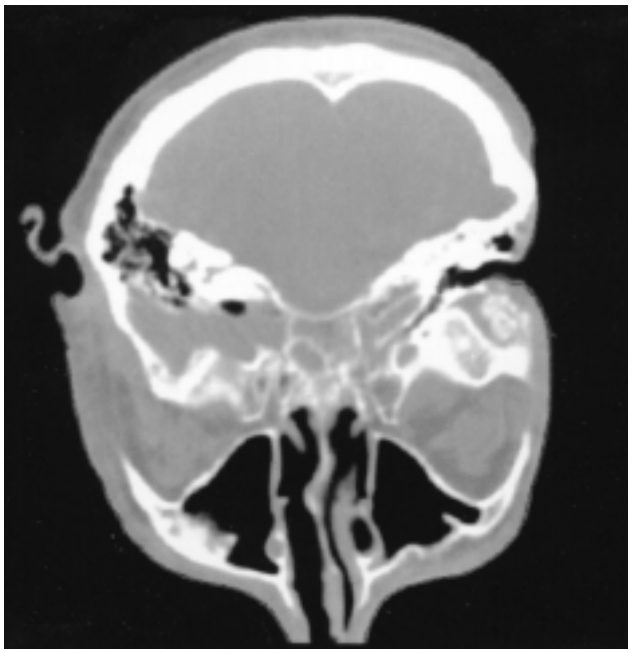

Fig. 1. Evolution-UltraFast-CT with representation of both soft and bony tissue and contours of soft tissue surface.

PROCEDURE

The treatment of a patient is used to illustrate this procedure.

1. Scan the patient in an electron beam tomograph (Evolution-UltraFast-CT, Siemens, Erlangen, Germany) with a scan feed of 3 mm (Fig. 1).
2. Transfer the CT data to an Endoplan-workstation (Medical Diagnostic Computing [MDC], Zeiss Group, Kiel, Germany) and use a semiautomatic

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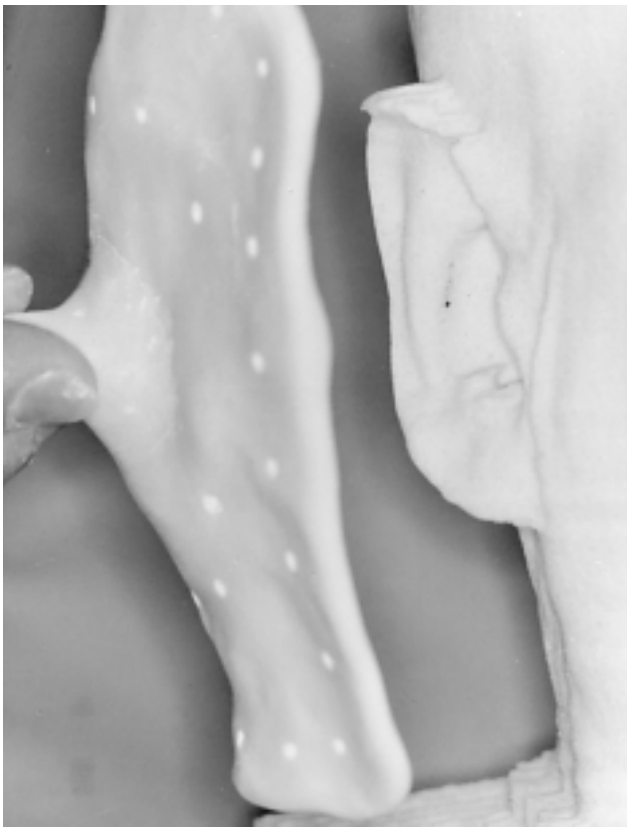

Fig. 2. Side-inverted, computer-generated 3-dimensional model of ear and autopolymerized acrylic resin custom tray for impression of auricular defect.

contouring program for outline detection of the entire soft tissue with a hounsfield threshold of –200 HA. After interpolation of additional layers between CT scans, calculate the data for controlling the computer numerical controlled milling machine (Endoplan MDC) side-invert and mill the model from a block of polyurethane.

3. Fabricate an autopolymerized acrylic resin custom tray (Formatrey no. 60863, Kerr GmbH, Karlsruhe, Germany) and make an impression of the side-inverted, computer-generated ear with irreversible hydrocolloid (Xantalgin select, Bayer Dental, Leverkusen, Germany) to avoid destruction of the soft tissue model (Fig. 2).
4. Melt wax and pour it into the impression. After the wax has cooled, remove the wax duplicate from the impression, finalize the margins, and add skin texture according to the patient's skin (Fig. 3).
5. Try the wax duplicate and adjust it to the patient's defect by thinning out the base. Make a final impression of the auricular defect using the adjusted wax sculpting base and polyvinyl siloxane (Epiform-Flex, Dreve-Dentamid GmbH, Unna, Germany) (Figs. 4 and 5).

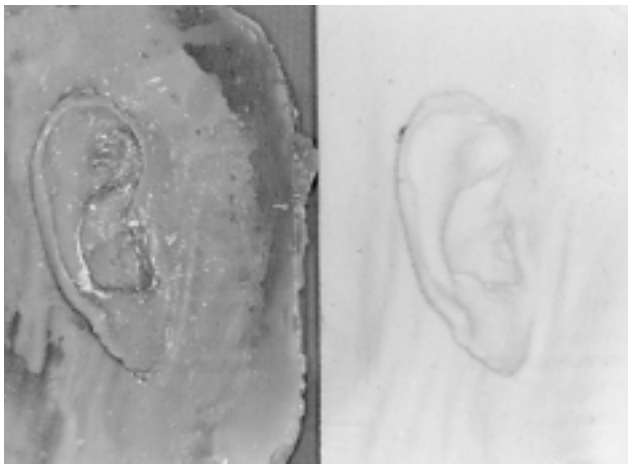

Fig. 3. Side-inverted, computer-generated 3-dimensional model of ear and wax duplicate.

Fig. 4. Adjustment of wax duplicate to patient's defect and final impression.

6. Pour hard dental stone (Suprastone, Kerr GmbH) into the final impression of the master cast, invest the sculpture in stone for the mold, and fabricate the auricular prosthesis in the usual fashion (Fig. 6).

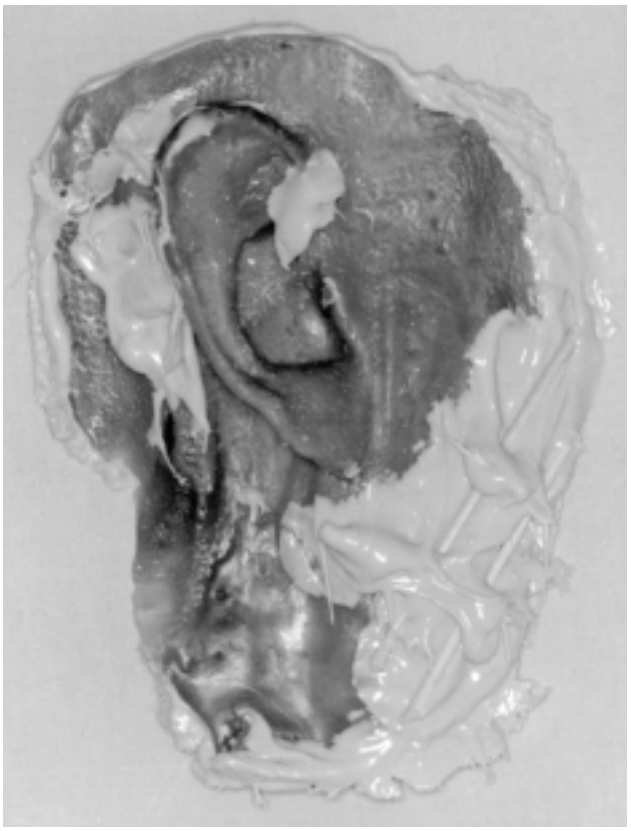

Fig. 5. Final impression with adapted wax-sculpting base and polyvinyl siloxane.

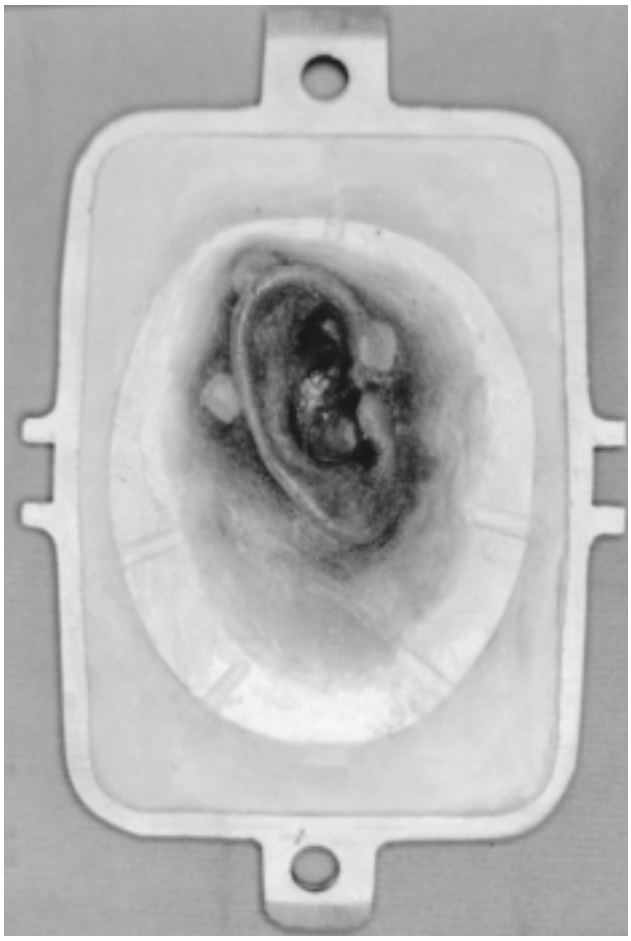

Fig. 6. Wax sculpting invested in dental stone.

DISCUSSION

This article describes a procedure for fabricating an auricular prosthesis. The main advantage of this procedure is that it is 3-dimensional so it can reproduce the anatomy of the entire head. The 3-dimensional aspect facilitates the planning of prosthesis that is to cover the defect (point of insertion of extraoral implants, margins of the facial prosthesis). Furthermore, the procedure allows for symmetrical modeling, which is especially helpful for patients with large, hemifacial defects. Another advantage lies in the fact that the first impression can be carried out on the model itself. The disadvantages of this procedure are that it is time-consuming and expensive, and it can be used only under certain conditions.

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