

Presurgical confirmation of craniofacial implant locations in children requiring implant-retained auricular prosthesis

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Early prosthetic treatment is believed to be psychologically beneficial to children who have an ear defect resulting from congenital malformation. Lack of soft tissue landmarks and minimal bone thickness in deformed auricular areas are sometimes problematic for craniofacial implant placement in these children. This article describes procedures to confirm locations of craniofacial auricular implants by using computed tomographic scan information and a surgical stent. The procedures can also be applied to children and adults to identify locations for auricular implant placement. This method ensures precise locations for implant placement and it also provides a better prosthodontic prognosis for auricular defect patients. (J Prosthet Dent 1999;81:492-5.)

Surgical reconstruction of auricular defects remains a great challenge to surgeons because of the complex shape and size of the human ear. The implant-retained ear prosthesis has become a viable treatment alternative for auricular deformed patients because of its predictable results. Congenital auricular defects in children are often related to Treacher Collins Syndrome (TCS) or hemifacial microsomia (HFM), which is the second most common craniofacial malformation after cleft lip and palate.^{1,2} HFM children have an extraordinarily wide range of phenotypic expression.³ The cause is unresolved and probably complicated. It is believed that the incomplete development of the first and second branchial arches during the embryonic stage causes hemifacial anomalies.⁴⁻⁶

Clinical manifestations of facial deformities of HFM vary greatly. Maxillary, temporal, and malar bones on the involved side are somewhat reduced in size and flattened (Fig. 1). Further flattening of the face may result from aplasia or hypoplasia of the mandibular ramus and condyle. Some patients exhibit an underdeveloped mastoid region. The ipsilateral eye may be at a lower level than the uninvolved eye on the opposite side.^{3,7} Malformation of the external ear may vary from complete aplasia to a crumpled, distorted pinna that is displaced anteriorly and inferiorly.⁸ Bilateral anomalous pinnae are noted occasionally. Conduction deafness due to middle ear abnormalities and/or absence of the external auditory meatus has been reported in 30% to 50% of patients.⁹ Supernumerary ear tags may occur anywhere from the tragus to the angle of the mouth.

The benefits of early treatment, including reconstruction of facial deformities, to the psychologic well-being for children when they reach school age has been demonstrated.^{10,11} Ear deformities of TCS or HFM in children often exhibit an absent external auditory canal, inadequate soft tissue landmarks, and minimal thick-



Fig. 1. Clinical manifestations of hemifacial microsomia: hypoplasia of mandibular ramus and condyle with mixed flattening of mastoid region.

ness of temporal and mastoid bone. The small sizes of ear prostheses for auricular defect children from age 6 to 12 years make the location of craniofacial implant placement critical and demanding.

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Fig. 2. Diagnostic ear that is made of wax and covers soft tissues around defect auricular area.

The purpose of this article is to describe a diagnostic procedure to confirm craniofacial implant location presurgically for small children who require osseointegrated auricular prosthesis.

PROCEDURE

1. Should the patient have an absent external auditory canal and inadequate soft tissue landmarks on the defect side, a prototype face-bow can be used to locate the external auditory canal on the deformed side. Mark the imaginary ear canal on the skin with indelible pencil.
2. Make an impression of the defect and normal side of the auricular regions with an irreversible hydrocolloid or elastomeric impression material.
3. Fabricate a diagnostic ear as a mirror image to the patient's normal ear on the working cast with wax or clay material (Fig. 2).
4. Try-in the diagnostic ear (Fig. 3) to modify the size, shape, and angulation of the ear and to confirm the final contours with the patient and parents.
5. Duplicate the diagnostic ear pattern with dental autopolymerizing resin and radiopaque barium sulfate powder. The ratio of the resin powder, the barium powder, and the resin liquid should be 1:1:2 by volume.



Fig. 3. Clinical diagnostic wax ear try-in to verify location, shape, size, and angulation of prosthetic ear.

6. Make a trough (groove) on the stent just posterior to the antihelix area using a tapered, long shank carbide bur with a head size diameter of 6 mm. The trough should start at 1-o'clock position and end at 5-o'clock location for left ear, and from the 11-o'clock position to the 7-o'clock position for the right ear (Fig. 4). (This trough represents the area the implants will be placed.)
7. Use double-sided adhesive tape to attach the diagnostic ear onto the defective side skin at the correct position and angulation. Send the patient for a computed tomographic (CT) scan to be used in determining implant locations (Fig. 5).
8. Inform the radiologist that coronal-sectional CT images are needed.

Figure 6 is a lateral view of a patient with a radiopaque ear stent in place. The trough that is the specific site for implant locations is shown on the lateral view image. The 2 arrows indicate the beginning and the end of the trough. A lateral view image allows the radiologist to adjust the patient's head to a proper position so that the CT scans will be parallel to the Frankfort horizontal plane. Figure 7 illustrates some of the CT series of the coronal-sectional images of the patient in Figure 6. Figure 7, A, shows the beginning of the

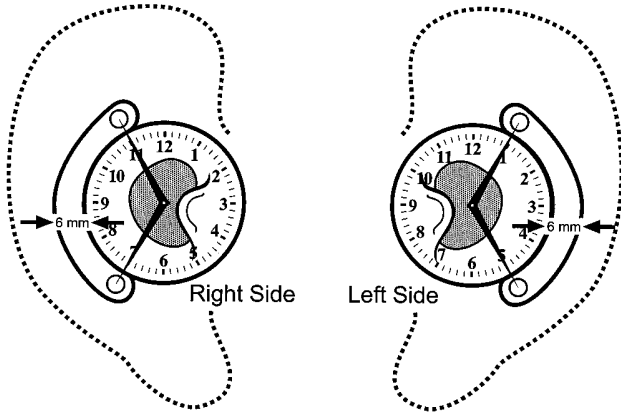


Fig. 4. Schematic of right and left ears with troughs and clock faces. Troughs represent areas implants will be placed.



Fig. 5. Diagnostic prosthetic ear taped on defect side for computer tomograph imaging. Diagnostic prosthetic ear is made of acrylic resin and radiopaque barium powder material.

radiopaque ear stent in the coronal direction and Figure 7, C and D, shows the beginning of the trough. Each successive image is 2 mm apart from the previous scan from superior aspect at the cranium to the inferior. For example, Figure 7, A, is viewed 2 mm superiorly to Figure 7, B. The scale bar on the right-hand side of the figure of each image is 60 mm in total and each tick mark on the scale bar is spaced 5 mm apart. Bone thickness

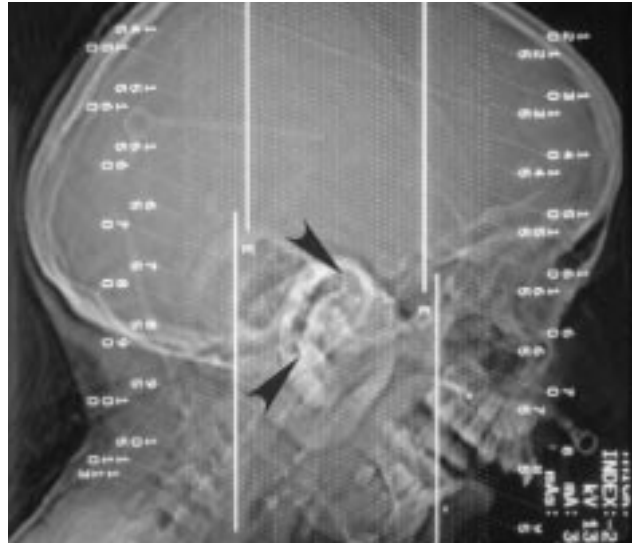


Fig. 6. Lateral view of CT scan. Radiopaque stent and trough for implant locations are shown on CT image.

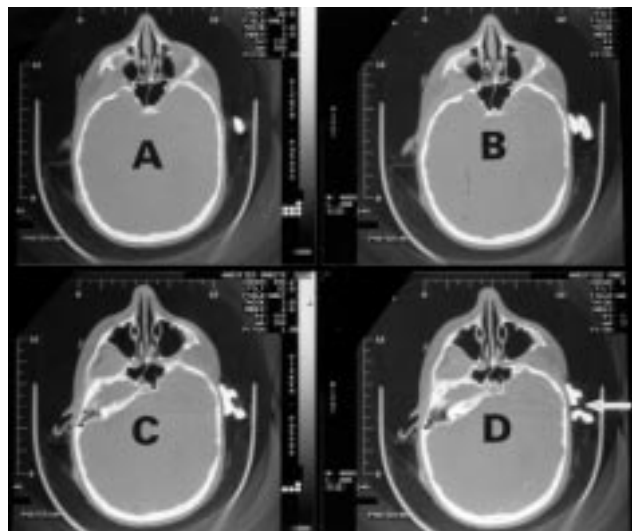


Fig. 7. CT series of coronal-sectional images of patient in Figure 6. **A,** Beginning of radiopaque ear stent in the coronal direction. **B,** Image of coronal slice 2 mm inferior to Figure 7, A. **C,** Continuation of CT slice. **D,** Beginning of trough, with bone thickness underneath trough (arrow).

underneath the trough (Fig. 7, D, arrow) can be measured and converted to life-size, based on the ratio to the scale bar. If the bone thickness is desirable on a specific image for implant placement, the distance of this location to the beginning of the trough can be calculated by $2 \text{ mm} \times \text{the number of the slices from the beginning of the trough}$. This location can be transferred and marked on the stent by a permanent marker for the convenience

for the surgeon. Ideally, 2 craniofacial implants should be at least 15 mm apart¹² and placed at the 1-o'clock and 4-o'clock positions for a left ear and the 11-o'clock and 8-o'clock positions for a right ear (Fig. 4). This should be discussed and agreed between the surgeon and the prosthodontist.

9. Soak the marked surgical stent in a chemical disinfectant. The patient is now ready for a surgical implant placement.

SUMMARY

Although surgical reconstruction is the treatment of choice for auricular deformities in young patients, the implant-retained ear prosthesis is an acceptable option when surgical reconstruction cannot be performed. Early prosthetic treatment is believed to be psychologically beneficial to children who have an ear defect, resulting from congenital malformation. Common problems for locating the implant positions for those young children are lack of soft tissue landmarks and minimal bone thickness. They often have abnormal bony structures around the defect areas. Therefore the diagnostic and treatment planning stage becomes more important for these patients compared with adult patients with auricular defects.

This article described stepwise procedures to confirm locations of craniofacial auricular implants by using CT scan information and a surgical stent. The procedures can also be applied to adults to identify locations for auricular implant placement. This method ensures precision locations for implant placement and also provides a better prognosis for the prosthetic treatment of auricular defect patients.

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