PROMINENT EARS

The term prominent ears, for the purposes of this chapter, refers to ears that, regardless of size, “stick out” enough to appear abnormal. When referring to the front surface of the ear, the terms front, lateral surface, and anterior surface are used interchangeably. Similarly, when referring to the back of the auricle, the terms back, medial surface, and posterior surface are used synonymously.

The normal external ear is separated by less than 2 cm from, and forms an angle of less than 25 degrees with, the side of the head. Beyond these approximate normal limits, the ear appears prominent when viewed from either the front or the back.

Anatomic Causes of Prominent Ears

To correct prominent ears, the anatomic abnormality must be determined (Fig. 30.1). The three most common causes of prominent ears may be present alone or in combination:

1. Underdeveloped antihelical fold. As a result of inadequate folding of the antihelix, the scapha and helical rim protrude. This anatomic abnormality causes prominence of the upper third and, in many cases, the middle third of the ear.

2. Prominent concha. The concha may be excessively deep, the conchal mastoid angle may be excessive, or there may be a combination of these two factors. This anatomic abnormality causes prominence of the middle third of the auricle.

3. Protruding earlobe. The protruding earlobe causes prominence of the lower third of the ear.

Although most prominent ears are otherwise normal in shape, some prominent ears have additional deformities. The conditions enumerated below are examples of abnormally shaped ears that may also be prominent. The term macrotia refers to excessively large ears that, in addition to being large, may be “prominent.” Constricted ears (Fig. 30.2) are abnormally small but tend to appear “prominent” because the circumference of the helical rim is inadequate, causing the auricle to cup forward. The Stahl’s ear deformity (Fig. 30.3) consists of a third crus, in addition to the crus of the triangular fossa, which traverses the scapha. This may give the ear a “Mr. Spock” pointed appearance in addition to being prominent. Cryptotia (Fig. 30.4) describes the auricle in which the upper pole of the helix is buried beneath the temporal skin. Question mark ears emanate their name because deficiency of the supralobular region gives the ear the shape of a question mark.

Goals of Otoplasty

The goal of otoplasty is to set back the ears in such a way that the contours appear soft and natural, the setback is harmonious and there is no evidence of surgical intervention. When examined from the various angles, the corrected auricle should have the following characteristics:

1. Front view. When viewed from the front the helical rim should be visible, not set back so far that it is hidden behind the antihelical fold.

2. Rear view. When viewed from behind, the helical rim should be straight, not bent like a “C” or a “hockey stick.” If the helical rim is straight, the setback will be harmonious; that is, the upper, middle, and lower thirds of the ear will be setback in correct proportion to each other. If, for example, the middle third is set back too much relative to the upper and lower thirds, the helical rim will form a “C” when viewed from behind, creating the so-called telephone deformity. Similarly, if the earlobe is insufficiently set back, the rear view will reveal a hockey stick appearance to the helical rim contour.

3. Lateral view. The contours should be soft and natural, not sharp and “human-made.”

Timing of Otoplasty

There is no absolute rule about when otoplasty should be performed. In young children with extremely prominent ears, a reasonable age is approximately 4 years. In cases of macrotia associated with prominence, the author has performed the procedure as early as age 2 years, thinking that any restriction of growth is an advantage. Regardless of the exact age, the procedure requires general anesthesia. In other cases, usually more minor, the parents may choose to wait until the child can participate in the decision. This may allow the procedure to be performed under local anesthesia, although it is a rare child that can tolerate local anesthesia before age 10 years, and many not until they are adults.

Operative Procedure

Numerous methods have been described for correcting the anatomic abnormalities described above. The techniques that have stood the test of time are the simplest, most reliable, and least likely to cause complications or an “operated” look. The techniques described below are used alone or in combination depending on the anatomic deformity and the choice of the surgeon.
Antihelical Fold Manipulation

- **Suturing of cartilage.** Mattress sutures are placed from the scapha and/or triangular fossa to the concha, as described by Mustarde, and are tied with sufficient tension to increase the definition of the antihelical fold, thereby setting back the helical rim and scapha (Fig. 30.5).

- **Stenstrom technique of anterior abrasion.** The anterior surface of the antihelical fold cartilage is abraded, causing the cartilage to bend away from the abraded side (principle of Gibson) toward the side of intact perichondrium (Fig. 30.6).

- **Full-thickness incisions.** A single full-thickness incision along the desired curvature of the antihelix permits folding with slight force, creating an antihelical fold (Luckett procedure). Because the fold is sharp and unnatural

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**FIGURE 30.1.** Comparison of normal and prominent ear anatomy. A: Normal ear. B: Components of the prominent ear. (Reproduced with permission of Charles H. Thorne, MD. Copyright Charles H. Thorne, MD.)

**FIGURE 30.2.** Constricted ear. A: Mildly constricted ear. Otoplasty requires increasing the circumference of the helical rim by advancing the crus of the helix into the helical rim (see Fig. 30.7). B: Severely constricted ear. This degree of constriction can only be repaired by discarding some of the cartilage and performing an ear reconstruction as in microtia. (Courtesy of David Furnas, MD.)
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Conchal Alteration

- **Suturing.** The angle between the concha and the mastoid skull can be decreased by placing sutures between the concha and the mastoid fascia as described by Furnas (Fig. 30.5).
- **Conchal excision.** From either an anterior or posterior approach, a full-thickness crescent of cartilage is removed from the posterior wall of the concha (taking care not to violate or deform the antihelical fold), thereby reducing the conchal height. The conchal defect is meticulously closed with sutures to avoid a visible ridge within the concha. The excision is designed so that the eventual closure will lie at the junction of the floor and posterior wall of the concha where it is least conspicuous and causes the least distortion of the normal auricular contours (Fig. 30.5).
- A combination of Furnas suture and Conchal excision techniques (Fig. 30.5).

Correction of Earlobe Prominence

Earlobe prominence is not corrected by the above maneuvers. In fact, these maneuvers may increase the prominence of the earlobe, making earlobe repositioning the most difficult and neglected part of the procedure. An auricle that has been repositioned in its upper two thirds but still has a prominent lobule will appear just as abnormal and disharmonious as the original deformity. It has been said that suturing the tail of the helical cartilage to the concha will correct earlobe prominence. Unfortunately the tail of the helix does not extend into the lobule and setting it back does not reliably set back the earlobe. Other authors have described techniques involving skin excision and sutures between the fibrofatty tissue of the lobule and the tissues of the neck. The best technique in the author’s experience is the technique described by Gosain, or a variation...
Alteration of the Position of the Upper Auricular Pole

Depending on the degree of prominence preoperatively of the upper third of the ear, the antihelical fold creation may be inadequate to correct the position of the helical rim, near the root of the helix. An additional mattress suture between the helical rim and the temporal fascia may be required.

Choice of Otoplasty Technique

The final operative plan for an otoplasty is a combination of surgical maneuvers based in part on the anatomic diagnosis of the deformity, and in part on the surgeon’s personal preferences. The author’s preferred technique involves Mustarde sutures to recreate the antihelix and setback the upper and middle thirds of the ear. The abrasion techniques are unreliable, uncontrollable, and unnecessary and may result in sharp edges or an overdone appearance. In the conchal region, the author frequently uses both a conchal resection and Furnas conchal-mastoid sutures as shown in Figure 30.5. The combination allows the resection to be small (1–2 mm), minimizing iatrogenic deformity. When conchal excision is used alone, a deformity of the posterior wall of the concha may result. When Furnas sutures are used alone the correction may be inadequate, the patient may have pain, the external auditory canal can be narrowed, and the depth of the retroauricular sulcus is decreased. As mentioned above, earlobe repositioning is the most difficult part of the procedure. The Webster technique of repositioning the helical tail has not been effective in the author’s hands for correction of earlobe prominence. Rather, the Webster technique appears to reposition the ear just above the earlobe, exaggerating the earlobe prominence.

Other Deformities

Macrotia. To reduce the size of the ears, the incision is made on the lateral surface of the ear, just inside the helical rim. The scapha is reduced and a segment of helical rim is excised and closed primarily to avoid redundancy.

Constricted ear. In mild cases, the crus of the helix is advanced out of the concha and into the helical rim and standard otoplasty techniques are used in addition (Fig. 30.7). In severe cases, the cartilage is discarded and a complete auricular reconstruction performed as in microtia.

Stahl ear. Various techniques have been described to excise the extra crus. None is perfect.

Cryptotia. The superior aspect of the auricular cartilage is pulled out from under the scalp (Fig. 30.4). An incision is made...
around the now-visible helical rim, and the medial surface of the freed cartilage is resurfaced with a graft or flap. In some cases, the buried cartilage is quite normal, and in other cases, it is markedly abnormal.

Question mark ear. The deficiency is variable and is usually treated with a cartilage graft and a V-Y advancement flap from the retroauricular skin. Often there is excess in the upper third of the ear requiring reduction. In severe cases, the entire ear is reconstructed as in microtia.

Hematoma
Hematomas are one of the few early complications of otoplasty. Excessive pain or bleeding necessitates immediate removal of the dressing to rule out and, if necessary, evacuate a hematoma.

Complications
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Infection. Cellulitis is rare after otoplasty but is treated aggressively with intravenous antibiotics in an attempt to avoid chondritis. The latter may require debridement and leave the ear permanently disfigured.

Suture complications. By far the most common complication of otoplasty in the author's experience is related to suture extrusion in the retroauricular sulcus. Such sutures are easily removed but may be associated with unattractive and/or painful granulomas. The use of absorbable sutures might eliminate this complication but the author has not had the courage to abandon permanent sutures. Monofilament sutures are more likely to protrude but are less likely to create granulomas. Braided sutures are the opposite: Less likely to protrude but more likely to be associated with granulomas.

Overcorrection/unnatural contours. The most common significant complication of otoplasty is overcorrection. Attention to the principles outlined above will minimize overcorrection and the creation of unnatural contours. My personal thoughts about otoplasty are as follows:

1. Incision. The incision is best placed in the retroauricular sulcus, not up on the back of the ear. The latter is more convenient for the surgeon and more expeditious, but may leave a scar that is visible when the patient is viewed from behind. Specific indications (macrostia, constricted ear, or ears with inadequate helical rim) call for an incision on the front (lateral surface) of the ear, where it is ideally made just inside the helical rim.

2. Skin excision. Skin excision is unnecessary, does not contribute to the correction, and may lead to hypertrophic or undesirable scars. The only exception is the earlobe where it may be necessary. When performing the latter, care is taken to remove only enough skin, adjacent to the retrolobular sulcus, to allow repositioning and to leave a full, free earlobe for ear piercing and an aesthetically normal earlobe.

3. Techniques. The simplest techniques are best. Techniques that involve abrasion or full-thickness incisions and/or tubing to create the antihelical fold are unnecessary and should be avoided.

4. Choice of sutures. The author has returned to monofilament permanent sutures because of occasional granulomas associated with braided sutures such as Mersilene. A long-lasting monofilament suture such as polydioxanone (PDS) may be the best choice, but the author has no experience with this suture and therefore cannot credibly recommend it.
5. Degree of correction. Overcorrection of the ears is the most common problem. Contours should be soft, round, and natural rather than sharp and surgical in appearance.

PARTIAL ACQUIRED DEFECTS

Most auricular deformities are acquired, partial defects for which there is a good solution. The more superior on the ear the defect is located, the more choices there are for reconstruction. Reconstruction of the lobule is the most difficult and is aesthetically the most important.

Although some defects can be closed by soft tissue alone, cartilage is frequently needed for support. For smaller defects, a conchal cartilage graft may suffice. However, for larger defects the rules of Firmin are extremely helpful: Defects that consist of 25% or more of the helical rim or involve more than two planes (i.e., involve antihelix as well as helix and scapha) will require rib cartilage for support. Conchal cartilage will not provide sufficient support in these cases.

Specific Regional Defects

External Auditory Canal

Stenosis is best treated by a full-thickness graft applied over an acrylic mold, provided a reasonable recipient vascular bed can be prepared. Occasionally, multiple Z-plasties are used to relieve webbing of the orifice, or a local flap is used to line the canal and break up the contracture. An acrylic stent is then used for several months to counteract the inexorable tendency toward contracture.

Helical Rim

Acquired losses of the helical rim vary from small defects to major portions of the helix. The former, which usually result from tumor excisions or minor traumatic injuries, are best closed by advancing the helix in both directions, as described by Antia and Buch (Fig. 30.7). The success of this excellent technique depends first on freeing the entire helix from the scapha via an incision in the helical sulcus that extends through the cartilage but not through the posterior skin. The posterior auricular skin is undermined, dissecting just superficial to the perichondrium until the entire helix is hanging as a chondrocutaneous flap on the posterior skin. Extra length can be gained by a V-Y advancement of the crus helix, as described in the correction of the constricted ear, and defects up to 2 cm can often be closed with moderate tension. The surgeon can “cheat” by removing some of the scaphal cartilage, which will take tension off the reaproximated helical rim. Although originally described for upper-third auricular defects, this technique is also effective for middle-third defects, as well as for defects at the junction of the middle and lower thirds.

If the helical rim alone is missing, as may occur in burn injuries, a thin tube of retroauricular skin can be applied to the residual scapha with acceptable results (Fig. 30.8). This is one example where cartilage may not be necessary. The disadvantage of this technique is that it requires three stages to “waltz” the tube into place: (a) formation of the tube in the sulcus, (b) transfer and insetting of one end of the tube, and (c) transfer and insetting of the other end of the tube.

Upper-third Defects

Techniques available for upper-third defects in increasing order of size and complexity are as follows (Fig. 30.9):

1. Local skin flaps (Fig. 30.9A, B)
2. Helical advancement (Fig. 30.9C, D).
3. Contralateral conchal cartilage graft covered with a retroauricular flap (Fig. 30.9E, F).
4. Chondrocutaneous composite flap. (Fig. 30.9G, H).
5. Rib cartilage graft covered with retroauricular skin or temporoparietal flap/skin graft (see Fig. 30.11).

Middle-third Defects

Techniques available for middle-third defects are as follows:

1. Primary closure with excision of accessory triangles (Fig. 30.10).
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A,B C,D E,F G,H

FIGURE 30.9. Four techniques for repairing upper-third auricular defects. A and B: Preauricular flap. The flap is transposed to repair a minor rim defect. C and D: Antia-Buch helical advancement. E and F: The combination of a retroauricular flap and conchal cartilage graft. G and H: Chondrocutaneous conchal flap to reconstruct the helical rim. Of the upper-third techniques, the only one not shown is a rib cartilage graft, which is shown in Figure 30.11. (Courtesy of Burt Brent, MD.)

2. Helical advancement.
3. Conchal cartilage graft and retroauricular flap.
4. Rib cartilage graft and retroauricular flap and/or temporoparietal flap (Fig. 30.11).

Cartilage grafts can be inserted via the Converse tunnel procedure in which the skin is not detached at the junction of the residual ear and the retroauricular skin. The problem is that precise placement of the graft with exact coaptation to remaining cartilage is difficult using this approach, and a detached retroauricular flap (Fig. 30.11) is often necessary. Middle-third auricular tumors are excised and closed by either a wedge resection with accessory triangles (Fig. 30.10) or a helical advancement, as previously described.

A,B

FIGURE 30.10. Wedge resection and primary closure with excision of accessory triangles. A: Wedge excision performed and accessory triangles designed. B: Closure of the defect. The accessory triangles help prevent the auricle from cupping forward. (Reproduced with permission of Charles H. Thorne, MD. Copyright Charles H. Thorne, MD.)

A B

FIGURE 30.11. Reconstruction of a partial defect using rib cartilage framework and retroauricular flap. The technique is a workhorse for partial defects. A: The incision is designed. B: The cartilage has been placed and the flap closed over it. (Reproduced with permission of Charles H. Thorne, MD. Copyright Charles H. Thorne, MD.)
Lower-third Auricular Defects

Various techniques have been described to reconstruct earlobe defects using soft-tissue flaps. These techniques are not as effective as those that employ cartilaginous support. Like the alar rim, the normal earlobe does not contain cartilage. A reconstructed earlobe, however, maintains its shape better if cartilage is included, analogous to the nonanatomic alar rim grafts to the nose. The author prefers to use thin, flat cartilage obtained from the nasal septum. The cartilage is placed beneath the cheek/retroauricular skin in the first stage. In the second stage, an incision is made around the cartilage graft and the flap is advanced beneath the earlobe as in a facelift (Fig. 30.12).

MICROTIA

Microtia literally means small ear. The simplicity of the term belies the vast complexity of this entity, both in terms of the variable clinical presentation and the difficulty of surgical reconstruction.

History

Gillies is credited with the first use of rib cartilage for construction of an auricular framework in 1920. The importance of his contribution was temporarily obfuscated by several reports using allogeneic cartilage. The allogeneic cartilage, whether from a living donor such as the patient’s parent or preserved cadaver cartilage, always underwent gradual resorption.

The modern era of auricular reconstruction began with Tanzer who reintroduced the technique of autogenous costal cartilage grafts as a method of auricular reconstruction. Tanzer’s results inspired Brent who modified, improved, and standardized a four-stage technique of auricular reconstruction. Nagata developed a more complex technique that condensed microtia repair to two stages. The Nagata technique requires more cartilage and the construction of a higher profile, more detailed framework than the Brent technique. Firmin analyzed those characteristics of a “Brent ear” that fall short of a normal ear and reported a large series using her modification of the Nagata technique.

Although the technique of autogenous auricular reconstruction was evolving, silastic was also used, instead of rib cartilage, as the auricular framework. This material, as well as other artificial materials, led to a high incidence of extrusion. More recently, the use of porous polyethylene frameworks has been explored and has become the standard treatment offered by some surgeons. The largest series was reported by Reinisch. Early attempts were associated with a 42% incidence of framework extrusion leading to modifications of the original technique and coverage of the framework using a temporoparietal fascial flap. According to Reinisch, this drastically reduced the complication rate and is the technique of choice in his opinion.

Finally, an auricular prosthesis is another option. The introduction of titanium osseointegrated fixtures by Branemark has made prosthetic reconstruction of the auricle a more stable and user-friendly alternative. The role of prosthetic reconstruction in microtia will also be discussed below.

Anatomy and Surgical Challenge

The ear is composed of a delicate and complex-shaped cartilage framework covered on its visible surface with thin, tightly adherent, hairless skin. A reconstructed auricular framework...
must be more rigid than the cartilage framework of a normal ear. When the auricular framework is placed beneath the skin in the temporal region, a combination of the tight skin envelope and the progressive scar contracture will gradually obliterate the fine details if the framework is built to mimic the delicate framework of the normal ear. As such, any reconstructed ear that maintains its projection and definition in the long-term will be more bulky and will lack the flexibility of the normal ear.

Consequently, even the best result using current tech-

niques for auricular reconstruction is imperfect. The defi-
ciences of current techniques make it even more important that the reconstructed auricle be the correct size, be located in the proper position such that one earlobe is not higher than the other, and be properly angulated relative to the other facial structures.

**Embryology**

The middle and external ears are derived from the first (mandibular) and second (hyoid) branchial arches. Most pa-
tients with microtia have atresia (absence) of the external audi-
tory canal and tympanic membrane with variable deformities of the middle ear ossicles. Rarely a patient will present with microtia and a patent, stenotic canal. Least common but most difficult to repair are patients with an auricular vestige that is markedly abnormal in position. Because the meatus can only be moved a limited distance, the surgeon must consider complete excision of the canal.

The inner ear is derived from totally separate embryologic tissues from the middle/external ear and is, therefore, almost always normal in patients with microtia. In other words, the hearing loss in microtia/atresia patients is conductive in nature.

**Incidence/Genetics**

The incidence of microtia varies widely among ethnic groups. Textbooks cling to the figure of 1 in every 6,000 births. The incidence is higher in patients of Asian ethnicity. In addition, microtia is almost twice as common among males as females and almost twice as common on the right side compared to the left. Bilateral microtia occurs in somewhere between 10% and 20% of patients with microtia.

Most cases of microtia occur in an isolated fashion. Only rarely does microtia appear to run in families. One exception is Treacher Collins syndrome, which frequently presents with bilateral microtia and is inherited in an autosomal dominant fashion.

**Microtia in Hemifacial Microsomia**

Older publications suggest that isolated microtia and hemifa-
cial microsomas are distinct entities. In fact, microtia is part of the spectrum of hemifacial microsomia deformities, all of which owe their origin to maldevelopment in the first and second branchial arches. At one end of the spectrum is the patient with microtia who appears to have an otherwise symmetric face. At the other end of the spectrum is a patient who manifests underdevelopment of all tissues on one side of the face including microtia, aural atresia, underdevelopment of the mandible, underdevelopment of the soft tissues of the cheek, and underdevelopment of the facial nerve. Microtia and hemifacial microsoma should not be considered as separate entities (Chapter 26).

**Canaloplasty and Middle Ear Reconstruction**

Patients with unilateral microtia/atresia usually have normal hearing in the contralateral ear. This should be verified by an otologist as early as possible after birth. The main goal then becomes protection of the better hearing ear throughout de-

velopment. It is important that oto media in the ear with normal hearing be treated completely and that a hearing test be repeated after completion of treatment. Residual middle ear fluid in the only normal ear may result in hearing impairment and consequently interference with speech development.

Patients with unilateral microtia do well from a pathologic point of view. These patients have some difficulty localizing sounds but, in many cases, require no amplification device and no special treatment in the classroom. There is, however, a movement in the otologic community to be more aggressive with bone conduction aids that result in binaural hearing.

Patients with bilateral microtia/atresia are in an entirely dif-

dent situation. These patients are functionally deaf with com-
plete conductive hearing loss bilaterally. These patients are fit-
ted with a bone-conduction hearing aid as early as possible in life and benefit from a bone-anchored hearing aid retained with a titanium abutment when they get older. Approximately one-half of the patients with microtia/aural atresia have middle ear anatomy that can be reconstructed sur-
gically. In bilateral cases, this is extremely important and may eliminate the need for a hearing aid or at least decrease total dependence on such a device.

The issue in the unilateral case is not as clear because, as stated above, these patients function reasonably well. Most otologists around the world do not recommend canaloplasty in patients with unilateral microtia. The surgical results are prone to stenosis of the external auditory canal meatus as well as scarring of the reconstructed tympanic mem-
brae. The hearing in the reconstructed ear tends to worsen with time. This nonsurgical recommendation, however, is not universal and good results have been reported by Jahrs-
dorfer in unilateral cases. The timing of the auricular re-
construction relative to the canaloplasty is important. The auricular reconstruction is best performed before the canalo-
plasty. Auricular reconstruction is possible after canal surgery but the result is compromised by the scarring in the region.

**Classification**

The microtia deformity itself is enormously variable. At one end of the spectrum is an auricle that is slightly small but otherwise normal in appearance. At the other end of the spectrum is the patient with complete anotia. Various classifications have been proposed to deal with this vast variability in clinical presenta-
tion. The Nagata classification is useful because it correlates with the surgical approach.

- **Lobule type.** These patients have an ear remnant and mal-

positioned lobule but have no concha, acoustic meatus, or tragus.
- **Concha type.** These patients present with an ear remnant, malpositioned lobule, concha (with or without acoustic meatus), tragus, and antitragus with an incisura inter-

tragic a.
- **Small concha type.** These patients present with an ear remnant, malpositioned lobule, and a small indentation instead of a concha.
- **Anotia.** These patients present with no, or only a minute, ear remnant.
- **Atypical microtia.** These patients present with deformi-
ties that do not fit into any of the above categories.
Surgical Reconstruction

The following are the three options for reconstruction of microtia:

1. Autogenous reconstruction.
2. Composite autogenous/alloplastic reconstruction using an alloplastic ear framework.
3. Prosthetic reconstruction.

Autogenous Reconstruction

The two main techniques described for autogenous reconstruction of the auricle using a rib cartilage framework are the Brent technique and the Nagata technique.

The Brent technique involves four stages:

1. Creation and placement of a rib cartilage auricular framework (Figs. 30.13 and 30.14).
2. Rotation of the malpositioned ear lobe into the correct position (Fig. 30.15).
3. Elevation of the reconstructed auricle and creation of a retroauricular sulcus (Fig. 30.16).
4. Deepening of the concha and creation of the tragus (Fig. 30.17).

The Nagata technique is performed in two stages:

1. Creation of an auricular framework including the tragus and rotation of the lobule into the correct position (in other words, combining stages 1, 2, and 4 from the Brent technique) (Figs. 30.18 and 30.19).
2. Elevation of the reconstructed ear and creation of the retroauricular sulcus (Fig. 30.20).

Technical Details of the Two Techniques. The patient is examined standing and the location of the earlobe on the normal side is transferred to the affected side. This is the single most important marking because symmetrical earlobes is one of the primary goals of the procedure. The normal ear is traced on clear x-ray film and sterilized. Using this tracing, additional templates are made. A template of the desired framework is made, approximately 3 to 4 mm shorter and narrower than the eventual ear. If the Nagata technique is performed, additional templates are constructed of the antihelix/triangular fossa piece and the tragus/antitragus piece.

The exact location and orientation of the desired auricle are drawn on the patient. Decisions are made about the location of the incisions. In the Brent technique, an incision is designed that can be used again at the time of lobule rotation and at the time of tragus construction. If the Nagata technique is used, the incision is designed as shown in Figure 30.19, to allow rotation of the lobule. The incision is made and the cartilage remnant is removed, carefully preserving the skin and avoiding buttonholes if possible. The pocket is dissected beyond the outline of the eventual auricle. In the Nagata technique, a pedicle is maintained to the dissected flap to improve blood supply.

Attention is turned to the chest. Although a transverse incision will heal more favorably than an oblique incision, the latter provides better exposure. The rectus abdominis muscle is divided. In the Brent technique, two pieces of cartilages are harvested. In the Nagata technique, five pieces are required. In addition to the synchondroses of two cartilages and a free rib for the helical rim, the Nagata technique requires removal of a piece for the antihelix/triangular fossa, a piece for the tragus/antitragus, and a piece to be banked in the chest for the second stage. This piece is wedged into the sulcus at the second stage to provide projection of the auricle. Nagata harvests the cartilages in a subperichondrial plane, leaving the perichondrium in the chest when the cartilages are removed. The author tends to take the cartilages with the perichondrium and has not noticed a significant difference in the chest wall deformity. If a pneumothorax is created, a catheter is placed into the pleural cavity. After the incision is closed the catheter is withdrawn while the anesthesiologist applies positive pressure ventilation.

Details are applied to the base using gouges. In the Nagata technique, the antihelix/triangular fossa piece is attached. The helical rim is attached in a similar fashion in both techniques. The difference is that Nagata recommends waiting until

FIGURE 30.13. Fabrication of ear framework from rib cartilage. Brent technique, stage 1. A: The base block is obtained from the synchondrosis of two rib cartilages. The helical rim is obtained from a “floating” rib cartilage. B: Carving the details into the base using a gouge. C: Thinning of the rib cartilage to produce the helical rim. D: Attaching the rim to the base block using nylon sutures. E: Completed framework.
FIGURE 30.14. Insertion of the ear framework. Brent technique, stage 1. A: Preoperative markings indicating the desired location of the framework (solid line) and the extent of the dissection necessary (dotted line). B: Insertion of cartilage framework. C: Appearance after the first stage. A suction catheter is using to suck the skin into the interstices of the framework. (Courtesy of Burt Brent, MD.)

the child is 10 years old, which yields cartilages that are long enough to reconstruct the crus of the helix. Finally, the tragus/antitragus piece is attached in the Nagata technique. Nagata uses wire sutures. The author has used nylon sutures, rather than wire, for both the Brent and Nagata techniques, with adequate fixation and a low incidence of suture extrusion.

The framework is inserted into the pocket along with two suction drains. Once the closure has been accomplished and the dressing has been applied, the drains are attached to Vacutainer tubes. The tubes are changed every half hour for 2 hours, then every hour for 2 hours and then every 4 hours overnight. The dressing is removed on the second postoperative day and the patient is discharged.

Complications. Complications of the Brent technique are rare in experienced hands. Complications of the Nagata technique, at least in the author's hands, are relatively common. The most common complication is exposure of the cartilage framework. Management requires experience, but these wounds usually heal without surgical intervention unless they are large. Exposed areas of more than 1 cm in greatest dimension require urgent coverage with a temporoparietal flap and skin graft. In fact, if there is the slightest question about whether an exposed area will heal, then flap coverage is indicated.

grets performing flap coverage of an exposed area of cartilage framework, but one may certainly regret not performing such a procedure.

Elevation of framework. In the third stage of the Brent technique and the second stage of the Nagata technique, the previously placed framework is elevated and the retroauricular sulcus is resurfaced. Nagata adds a piece of rib cartilage covered with a temporoparietal flap. The cartilage is banked under the skin at the time of the first stage and is wedged into the sulcus to provide projection to the reconstructed auricle in the second stage. The fascial flap covers the graft and provides a bed for skin grafting. (Fig. 30.20) In both techniques the scalp is advanced into the depth of the sulcus and the medial surface of the elevated framework is resurfaced with a skin graft.

Both Nagata and Brent recommend a split thickness graft for this stage. The grafts contract significantly, however, in some cases obliterating the reconstructed sulcus. For this reason the author prefers a full thickness graft from the groin. The disadvantage is a visible scar but the full thickness graft resists contracture and is more likely to result in maintenance of the reconstructed sulcus.

Composite Autogenous/Alloplastic Reconstruction

In these patients, an auricular framework composed of porous polyethylene (Medpor) is used instead of costal cartilage. Reinisch originally reported a 42% incidence of implant exposure. He modified the technique, adding temporoparietal flap coverage of the framework, and reports a vastly decreased complication rate.

Prosthetic Reconstruction

Prior to the introduction of implant retention of prostheses, prosthetic reconstruction depended on adhesive retention and was impractical. Branemark osseointegrated titanium implants have made prosthetic reconstruction somewhat more practical but this technique remains, in the author’s opinion, a second choice to autogenous reconstruction (see Chapter 34).

Children are poor candidates for prostheses, often refusing to wear them regardless of the retention mechanism. Children also tire of the maintenance required of the abutments and the surrounding soft tissue. If adequate hygiene is not maintained, the skin/abutment interface becomes inflamed and use of the prosthesis must be discontinued awaiting resolution of the inflammation. Additionally, the daily removal and replacement of the prosthesis serves as a constant reminder of the deformity. In contrast, children with an autogenous reconstruction
incorporate the new ear into their sense of self. Finally, prostheses lack the warmth and texture of autogenous reconstructions and, despite the superior details, are not more “lifelike.”

It is important to note that prostheses require replacement every several years for the life of the patient and, therefore, prosthetic reconstruction is more expensive in the long-term than autogenous reconstruction.

To this author’s thinking, the only absolute indication for prosthetic reconstruction in a child with microtia is failed autogenous reconstruction with inadequate soft tissue for either a second autogenous reconstruction or a Medpor reconstruction. In such a patient, a prosthesis may represent the only salvage procedure available.

Relative indications for the use of prosthetic reconstruction include a very low hairline where a temporoparietal flap would be required to allow autogenous reconstruction or extreme hypoplasia of the tissues with a concavity where the auricle will eventually be located.

Personal Thoughts on Surgical Reconstruction

The author has extensive experience with both the Brent and the Nagata techniques of auricular reconstruction and it is on the basis of that experience that the following comparative statements are made.

The Nagata procedure was designed to address the perceived weaknesses of the Tanzer/Brent technique, particularly the region of the concha, crus of the helix, tragus, and incisure intertragica. As such, the best possible Nagata-type result may have superior details to the best possible Brent-type result. The problem is that the “best possible results” do not occur most of the time.

The Nagata procedure, at least in the hands of this author, is definitely associated with a higher complication rate. The framework is much higher profile, much more complex in its details, and contains many more sutures. As such, the chance of cutaneous necrosis with framework exposure is significantly greater using the Nagata technique. On the other hand, these areas of exposure are generally small and heal without further surgical intervention and do not necessarily compromise the result.

The individual surgeon must decide, factoring in his/her experience, whether the possibility of a superior result is worth the increased risk of the Nagata procedure. In his own practice, this author currently uses the Nagata/Firmin technique in most patients. In patients with extremely tight skin, or the presence
FIGURE 30.18. Fabrication of ear framework from rib cartilage. Nagata technique, stage 1. A: In a manner similar to Brent, the base and its details are carved from the synchondrosis of two adjacent ribs. B: The four pieces of cartilage that make up the cartilage framework are seen and numbered. The base and helical rim are present as they are for the Brent technique. There is an additional antihelix-triangular fossa piece and an additional tragus-antitragus piece that are unique to the Nagata procedure. (Reproduced with permission of Charles H. Thorne, MD. Copyright Charles H. Thorne, MD.)

FIGURE 30.19. Insertion of the cartilage framework. Nagata technique, stage 1. A: The incision is designed, robbing most of the skin on the medial surface of the lobule that will be necessary to line the concha. B: The pocket is dissected, leaving an intact “pedicle” at the caudal end of the flap. C: The framework is inserted. D: Appearance of the framework after stage 1. Suction drains are in place to coapt the skin to the underlying cartilage. (Reproduced with permission of Charles H. Thorne, MD. Copyright Charles H. Thorne, MD.)
FIGURE 30.20. Elevation of framework. Nagata technique, stage 2. A: The auricle is elevated, the scalp is advanced into the sulcus (arrows), the cartilage graft is wedged into the sulcus, and the graft is covered with a temporoparietal flap and skin graft. B: The skin graft is in place. Nagata described the use of split-thickness skin but this author has noted tremendous shrinkage of the thin grafts and recommends full-thickness graft. C: Cross-section showing the cartilage graft in place providing projection as well as the temporoparietal-flap covering the temporoparietal flap. (Reproduced with permission of Charles H. Thorne, MD. Copyright Charles H. Thorne, MD.)

of other scars, the Brent technique is used because of its safety and reliability.

The other issue involves the chest donor site. The Nagata technique requires harvesting twice as much cartilage as the Brent technique. While Nagata harvests all cartilage subperiosteally, no detailed study has been performed comparing the chest wall deformity created by the Nagata technique at age 10 years with the deformity created by the Brent technique at age 6 years. Although the donor site is an issue not to be ignored, it tends not to be an issue regardless of which technique is used. Patients simply do not complain about the chest unless they are extremely thin.

Proponents of the composite alloplastic/autogenous reconstruction using Medpor cite the lack of chest donor-site scars/deformity as an advantage. Although that is true, these same reports fail to mention the scars/deformity that replace the chest deformity. For example, the composite technique robs the contralateral normal ear of all the skin behind it, resulting in obliteration of the sulcus or a skin graft donor-site scar if the retroauricular defect is replaced with partial-thickness skin. Additionally, this technique requires a scalp scar to harvest the temporoparietal flap. These scars are frequently hypertrophic and/or associated with thin strips of alopecia, which may be more troublesome to the patient than a chest wall scar.

Severe Facial Asymmetry
Placing the reconstructed ear in the best location is straightforward if the face is symmetrical or near symmetrical. In cases of significant asymmetry, however, compromises must be made. The surgeon cannot rely on measurements from landmarks such as the lateral canthus or oral commissure, because the entire side of the face is so much smaller than the other side. If such measurements were used, the ear would be placed far too posteriorly, and would appear strikingly abnormal. Of equal importance, however, the ear must not be place too low or too anterior. The author attempts to place the ear in the correct craniocaudal position so that the earlobes are at the same level and then determines the anteroposterior positioning based on the relationship to the sideburn. No ear will look normal unless there is a sideburn in front of it.

Acquired Deformity versus Microtia
Total auricular reconstruction of the acquired deformity differs from congenital microtia. There is always less skin available. In microtia, removal of the cartilaginous remnant provides some supple, unscarred skin to supplement the retroauricular skin. In the acquired situation, there may be no residual ear skin and the presence of scarring from the traumatic or surgical removal of the ear restricts the skin pocket. In many cases, a temporoparietal flap with skin graft is required in addition to the native skin. The flap provides an unlimited amount of vascularized tissue, but the combination of the flap and the skin graft never has the definition or color match of the native skin. In addition, the presence of an external auditory meatus limits the access incisions, the extent of the skin pocket and the risk of infection. The canal is colonized with bacteria, frequently *Pseudomonas* species, which adds additional problems not encountered in microtia cases.

SPECIAL SITUATIONS

Acute Auricular Trauma and Cauliflower Ear
A hematoma may result from trauma and frequently occurs in wrestlers. Unless evacuated, the blood tends to become cartilaginous, resulting in the so-called cauliflower ear. Once fully developed, the cauliflower ear is extremely difficult to correct. Hematomas may require repeated aspirations or an incision to fully evacuate. Saturating gauze bolsters to the auricle to
compress the skin against the cartilage usually prevents reoccurrence (Fig. 30.21).

Amputated Ear
Most attempts to replace an amputated ear will fail, resulting in additional incisions/scars and “burning bridges” that may be useful for secondary reconstruction. The patient, however, will not easily accept the decision to discard the amputated part without an attempt at replacement. There is no easy answer.

Replantation of amputated ears has been reported and some excellent results have been obtained. The vessels are small, however, and failure is common. Any attempt at replantation must consider that success is unlikely and may result in scars that limit later reconstructive attempts. Incisions for exposure of recipient vessels are kept to a minimum.

Reattaching large pieces of auricular tissue as composite grafts is doomed to failure. The good news is that such an attempt does not disrupt the surrounding tissues, does no harm, and makes the patient feel that “something” is being done.

Removing the skin from the cartilage and burying it beneath retroauricular skin is a poor choice. The thin, delicate cartilage will not maintain its shape sufficiently against the forces of scar contracture. An alternative is to cover the de-skinned cartilage with a temporoparietal flap. The esthetic result will be poor for the reasons mentioned above and this useful tissue will not be available for secondary reconstruction.

Several successful cases have been reported in which the posteromedial skin was removed from the amputated part, the cartilage was “fenestrated,” retroauricular skin was excised, and the part was placed on the healthy bed. The anterolateral auricular skin is vascularized through the cartilage fenestrations by direct contact with this healthy, vascularized bed.

In the opinion of the author, the ideal scenario for an amputated ear is an attempt at microvascular replantation through the available wound, without additional incisions. If unsuccessful, secondary reconstruction with rib cartilage grafts is performed, with or without a temporoparietal flap. If replantation is not an available option, the part should be replaced as a composite graft (knowing it will fail), or the part should be discarded.

Acute Auricular Burns
Acute burns may result in chondritis. Characterized by tenderness, erythema, warmth, and induration, chondritis usually occurs several weeks after the initial injury. Once chondritis is diagnosed, aggressive steps are taken to eradicate the infection and prevent subsequent deformity. Drainage and placement of an irrigation system is an appropriate first step. If this therapy fails, the involved cartilage must be debrided. When the latter becomes necessary, incisions are planned judiciously to minimize the effect on secondary reconstruction.

Skin Cancer/Malignant Melanoma
Cutaneous malignancies of the helical rim can be excised and closed with helical advancement as described above (Fig. 30.7). Lesions in the concha or over the antihelix can usually be excised and skin grafted. If the cartilage is involved, it can be excised and the graft placed directly on the posterior skin. Malignant melanomas should be excised with the same margins as melanomas of the equivalent depth in other parts of the body. Melanoma in situ does not require a full-thickness excision. These lesions are excised with a 5-mm margin, preserving the perichondrium, and skin grafted. Invasive melanomas of the helical rim require wedge resection to achieve adequate margins, eliminating helical advancement as an alternative for closure. These defects may be large and require secondary reconstruction as in Figure 30.11.

Earring Complications
While ingenious techniques have been described to reconstruct traumatic clefts in the lobe caused by earrings, the most reliable method is to excise and close the defect in one stage and re-pierce the ears 6 weeks later, or whenever the induration subsides.

Another complication of earrings is keloid formation. Small keloids can be excised and closed primarily and may not recur.
If the patient is truly prone to keloids, then excision, triamcinolone injection, and pressure earrings are warranted. If the keloid recurs, excision with immediate irradiation offers the best chance of avoiding recurrence.

Finally, piercing through the cartilage in the upper portion of the ear can result in severe infections. While not common, chondritis can lead to severe, permanent disfigurement of the auricle. Infections therefore are treated aggressively. If cartilage requires debridement, it is performed early to limit the deformity and incisions are planned carefully to minimize these deformities.

**Suggested Readings**


