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Chapter 85 – Reconstruction of Microtia

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Auricular reconstruction for microtia is challenging, yet rewarding. Many lessons about the limitations of surgery may be learned as a surgeon acquires the skills and judgment required for successful auricular reconstruction. For example, the competing goals of a well-projected, detailed auricular graft and a thin, intact, vascularized skin flap to show that detail must be accommodated through compromise. The limitations of blood supply and tension on the skin flap must not be exceeded to avoid the complications of flap loss and infection, which may necessitate the creation of an auricle with a thicker skin flap than would be ideal for aesthetic purposes. Meticulous attention to detail and atraumatic tissue handling are critical for achieving excellent results, with the caveat that an auricle constructed by a surgeon may fail to rival that of normal embryonic development.

Most cases of microtia are unilateral, with an 8 : 1 ratio of unilateral to bilateral cases. The majority of patients are male. Microtia usually, but not always, occurs in conjunction with aural atresia. In general, reconstruction of the microtia is completed before reconstruction of the aural atresia.

PATIENT SELECTION

The best chance for successful auricular cartilage grafting is when the blood supply to the recipient site has not been impaired by previous surgery and scarring. Although some surgeons have advocated starting mi-crotia reconstruction as early as 2 years of age, most surgeons prefer to wait until the child is older. Reconstruction may be started as early as 4 years of age in a large boy with bilateral microtia. In contrast, for a petite child with unilateral microtia, one may wait to begin reconstruction at 7 years of age. The longer the surgeons waits to begin, the more rib cartilage is available and the more cooperative children are because they understand the surgical process. However, the longer the surgeon waits to begin reconstruction, the more psychological trauma may occur because of ridicule from the other children and the longer the child has to wait for possible reconstruction of aural atresia with the associated limitations of maximal conductive hearing loss. Nonetheless, the recent availability of the bone-anchored hearing aid gives the surgeon a new option for improving hearing at an age as early as 3 years with minimal impairment of the potential for auricular cartilage grafting.[1]

Most patients with microtia are candidates for reconstruction. Exceptions are those with previous extensive surgery in the area of the auricle, burns, tumors, or radiation in the area. Relative contraindications to reconstruction include highly uncooperative children and those with very severe hemifacial microsomia. In the setting of severe hemifacial microsomia, formal angiography may be required to ensure that the blood supply from the superficial temporal and occipital arteries is adequate. No major surgery should be performed if the blood supply is inadequate because of congenital absence of the vessels. A small, minimally projecting graft may be placed in the case of severe hemifacial microsomia with slightly diminished blood supply if one takes into consideration the limited capacity of the recipient area to support a large graft.

PREOPERATIVE EVALUATION

At the initial consultation for an infant with microtia, the focus should be on hearing function. Audiologic testing of the normal ear should be undertaken with determination of sound-field response and otoacoustic emissions. If testing is inconclusive and for bilateral cases, auditory brain stem response testing may be required. Bone-anchored hearing aids are available and worn as an external headband device for infants and children who are too young for definitive reconstructive surgery. Computed tomography of the temporal bones is performed late in the first year of life to determine whether the child has adequate anatomy for consideration of aural atresia reconstruction in the future. Computed tomography is also important to detect the occasional case of congenital cholesteatoma that requires surgical removal at an early age. The child is evaluated at 6- to 12-month intervals until it is de-termined that that child is ready for definitive reconstruction.

The parents must be made aware that the reconstructed auricle will be a great improvement over the microtic vestige but it will not be completely normal. Realistic expectations are important. Photographs depicting the various stages of surgery are valuable for educating families. The timing of reconstructive surgery is discussed, with most children beginning between the ages of 4 and 7 years, as discussed earlier. The surgical process of staged procedures is explained, with most children requiring four stages of reconstruction as described later. Two to 3 months is allowed for healing between stages. Thus, the overall process may be completed in about 1 year. Additional surgery for scar revision or refinement of cosmetic results may be necessary. The possibility of

bleeding, infection, pneumothorax, flap loss, cartilage graft loss, scarring, and poor cosmetic results must be discussed with the parents.

The parents and child should be informed that after each stage of reconstruction a mastoid dressing will be worn for approximately 2 weeks. Tape will be used to fix the dressing to the child's hair to make it less likely that an uncooperative child will pull the dressing off, which can lead to complications. The family needs to know that the child will not like the frequent dressing changes with pulling of the hair during tape removal, but it will be worth the struggle in the long run. A very short haircut is recommended.

A template of the normal ear (if present) is made from x-ray film and will be used to determine the dimensions of the reconstructed auricle. The optimal position of the reconstructed auricle is determined by the distance from the lateral canthus, the brow, and the position of the normal ear. The axis of a normal auricle is about 30 degrees from the vertical position, with the superior aspect of the auricle being in a more posterior position. With hemifacial microsomia, considerable judgment is required to select the best position for the new auricle because the two sides of the head and face are not symmetrical.

SURGICAL APPROACHES

Most surgeons prefer grafting of costal cartilage for auricular reconstruction and use the method of Brent as described later.[2] Alternatives include prefabricated implants instead of cartilage and osseointegrated implants for a clip-on prosthetic auricle.

Stage 1

Sculpting an auricle out of costal cartilage takes skill and practice. Preoperative practice carving a block of soap or soft wood is recommended. Prophylactic perioperative antimicrobials are administered before all stages of microtia reconstruction. Figure 85-1 shows grade 2 microtia with a well-formed lower auricle and deficiency of the upper two thirds of the auricle. For harvest of costal cartilage, a curvilinear incision is made along the lower medial border of the *contralateral* rib cage because it has a more favorable curve for reconstruction of the auricle. The upper portion of the rectus abdominis muscle is dissected, preserved, and retracted laterally to allow exposure of the intercostal muscles and ribs. Preservation of the rectus abdominis muscle, rather than transecting it, decreases the chance of future chest wall deformity caused by a depression at the rib harvest site.[3] The two lowest floating ribs are harvested along with the synchondrosis of the sixth and seventh ribs (Fig. 85-2). With the floating ribs, cartilage is harvested all the way laterally until the bony-cartilaginous junction is reached. A suction drain is placed through a separate incision.
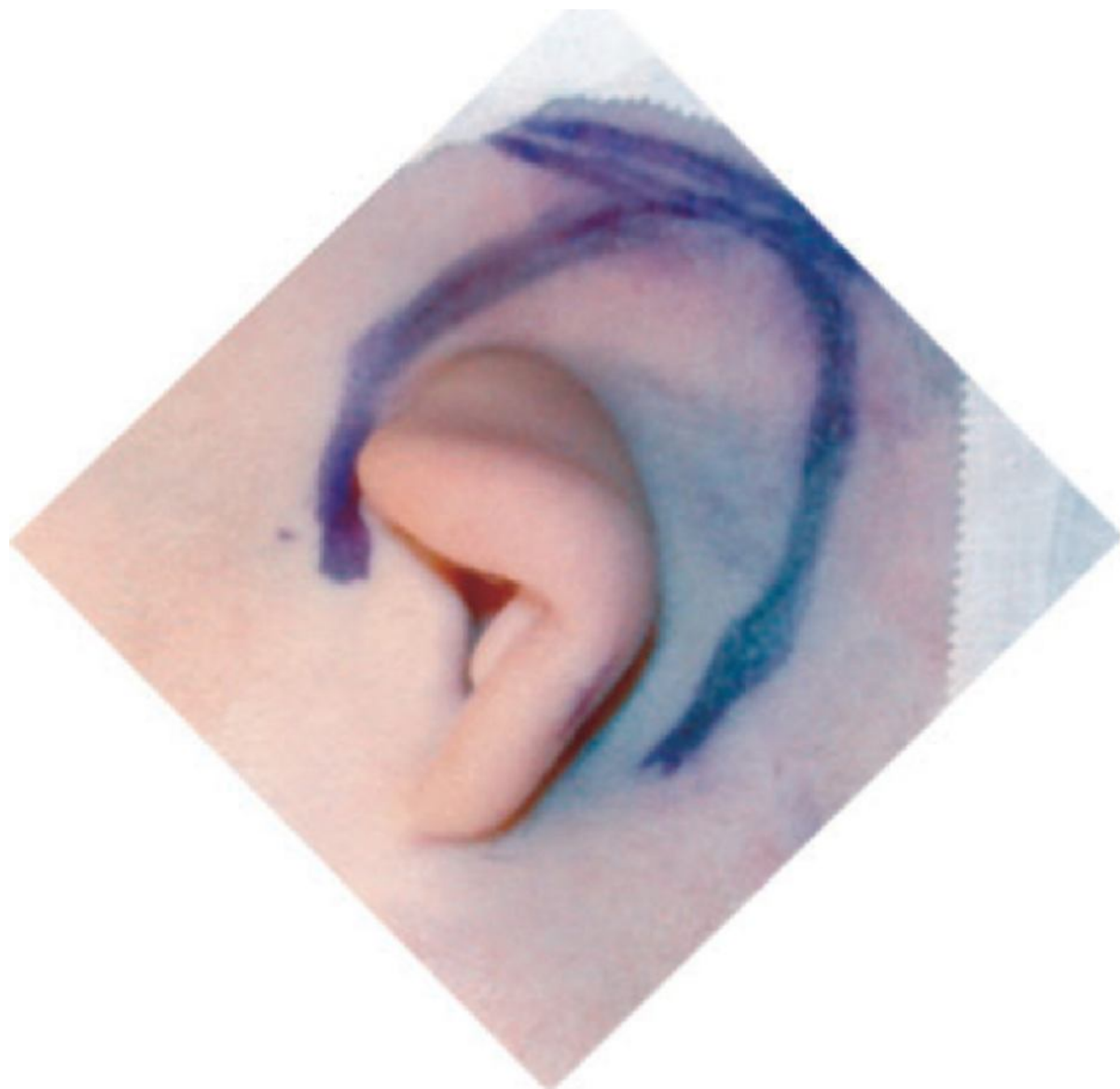
Figure 85-1 Grade 2 microtia with deficiency of the upper two thirds of the auricle. The planned site of placement of an auricular graft is marked.

Figure 85-2 The cartilaginous portions of the two lowest floating ribs have been harvested along with all but the superior 4 mm of the synchondrosis of the sixth and seventh ribs.

Young children have a relative deficiency of cartilage, and therefore pieces of cartilage are often stacked up to provide adequate bulk and lateral projection for details of the reconstructed auricle. In the occasional teen or adult with a generous amount of rib cartilage, the cartilage may be carved as a solid block, with adequate thickness and projection and little or no stacking required. This is called a closed or solid framework. In younger children, the various pieces of cartilage are carved and stacked with open spaces between the portions. This is called an open framework. The perichondrium is harvested along with the ribs, with great care taken to not enter the pleural space. The portion of rib cartilage containing the synchondrosis is used as the body or central portion of the framework. The helix is created by attaching a long floating rib segment around the perimeter of the body. This floating rib may be trimmed to achieve the proper projection and contour. The perichondrium and cartilage around the outer rim of the helix can be scored with partial-thickness incisions to "break the spring" so that the helical cartilage can wrap around the body with less tension. The various pieces of cartilage are attached via 4-0 clear nylon mattress sutures with the knots tied on the deep side of the graft, or superficially placed knots may later extrude through the skin flap. Additional pieces of cartilage may be stacked for creation of the antihelix and crura (Fig. 85-3). Occasionally, if adequate cartilage is available, the tragus may be attached to the main auricular cartilage graft with sutures during the first stage of reconstruction. The overall cartilage graft for the auricle is fashioned to be 2 to 3 mm smaller than the template from the opposite auricle. The additional 2 to 3 mm will be provided by the overlying skin flap.

Figure 85-3 An open-type framework has been created from rib cartilage segments. Note how the cartilage fragments have been stacked to increase detail and lateral projection. Also note how the surface details are separated to allow the skin flap to drape in between the details or they will not be seen as separate entities.

To create the recipient bed for the cartilage graft, an incision is made anterior to the microtic vestige, and a thin flap is created just deep to the subdermal plexus. The flap is elevated for approximately 2 to 3 cm past the position marked for the auricle to allow a loose pocket without tension. This decreases the chance of flap loss and improves the details seen in the graft as the loose skin of the flap drapes into the depressions between the prominent areas of the cartilage graft. Two tiny suction drains are placed through separate incisions. The wounds are closed and the suction drains are activated. One drain is placed around the helix and the second is placed in the space between the anterior and posterior crura (Fig. 85-4). The microtic vestige is not resected at this time because if there is partial loss of the skin flap, the skin of the vestige may be used as a graft to cover the defect. A sterile mastoid dressing is placed. The drains are removed when the drainage has tapered off.

Figure 85-4 An auricular cartilage graft has been implanted and the two suction drains have been activated. Note how one drain is placed between the crura to drain that space.

Stage 2

After 8 to 12 weeks, if healing has been complete, the second stage of microtia reconstruction may be undertaken. If there have been areas of skin breakdown or tenuous blood supply after any stage of microtia reconstruction, it is wise to defer the next stage until healing is complete.

Figure 85-5 shows the auricle of a child with initial grade 3 microtia who has healed after the first stage of reconstruction with implantation of an auricular cartilage graft. The microtic lobule is too anterior and superior and needs to be transposed to a more posterior and inferior position. The second stage of microtia reconstruction is essentially a Z-plasty. The skin at the recipient site is elevated and transposed to the site where the lobule had been. The cartilaginous reconstructed auricle has developed a fibrous capsule around it, and flap elevation should be performed in a plane outside this capsule. The lobular and skin flaps are elevated sufficiently to allow transposition and closure of the wounds without tension. The microtic vestige is resected during the second stage of reconstruction. The lobular flap is carefully thinned and beveled to allow a smooth and natural transition from the helix of the cartilage graft to the lobule. Resection of tissue and beveling the lobule medially decrease the natural lateral rotation of the lobule (Fig. 85-6). Insufficient thinning and beveling will result in a "stuck-on" appearance of the lobule. No drains are required. The mastoid dressing and activity limitations are the same as described earlier.

Figure 85-5 Second stage of reconstruction for a child with grade 3 microtia. Incisions have been made and flaps have been elevated for Z-plasty.

Figure 85-6 Completed reconstruction of second stage microtia with transposition of the lobule. Note how the lobule flap has been tapered and beveled to provide a smooth transition from the lobule to the rest of the auricle.

Stage 3

After the second stage, an additional 2 to 3 months is required for healing. The third stage of microtia reconstruction involves elevation of the auricle, which is in a pocket under the scalp. Elevation increases the lateral projection of the auricle and defines the helix and postauricular sulcus. Figure 85-7 shows the auricle of a child who has completed the first two stages of reconstruction and is ready for elevation of the auricle. An incision is made approximately 4 mm superior and posterior to the reconstructed helix (Fig. 85-8). The incision is carried down to the plane of the temporalis fascia. The auricle is elevated in this plane with a generous, undisturbed anterior pedicle left for the blood supply. The excess skin attached to the auricular graft is gently tacked down to the helical rim with 4-0 chromic suture. Excessive tension on the helical skin is avoided to prevent skin flap loss. The scalp is undermined via the postauricular incision in posterior and superior directions in the plane of the temporalis fascia (Fig. 85-9). Heavy sutures are used in a horizontal mattress fashion to advance the elevated scalp in anterior and inferior directions. Lighter sutures are used to further advance the skin edges. The goal is to hide the free edge of the scalp incision under the auricular cartilage graft for cosmetic purposes and, at the same time, decrease the size of the area requiring skin grafting on the scalp medial to the auricle. A split-thickness skin graft is harvested from the hip area or upper, inner aspect of the arm. The skin graft is cut to the appropriate size and shape. A few perforations are made in the skin graft to allow drainage of blood and serous fluid. The skin graft is then sewn in place in the postauricular area with 4-0 chromic suture. One end of all these sutures is left long for later use in tying down the bolster over the postauricular skin graft. An iodine-impregnated bolster is fashioned in the shape of an orange wedge and packed into the postauricular area. The ends of the sutures are tied over the bolster

securing the skin graft (Fig. 85-10). The mastoid dressing is placed as described earlier. The bolster is removed in the office after 8 to 12 days.

Figure 85-7 Auricle of a child who has completed the first two stages of reconstruction and is ready for elevation of the auricle.

Figure 85-8 For elevation of the auricle, an incision is made 4 mm superior and posterior to the helical rim.

Figure 85-9 The scalp has been undermined in superior and posterior directions and heavy mattress sutures have been placed to advance the scalp flap in inferior and anterior directions. Such advancement hides the scalp incision medial to the auricle and decreases the size of the area requiring skin grafting.
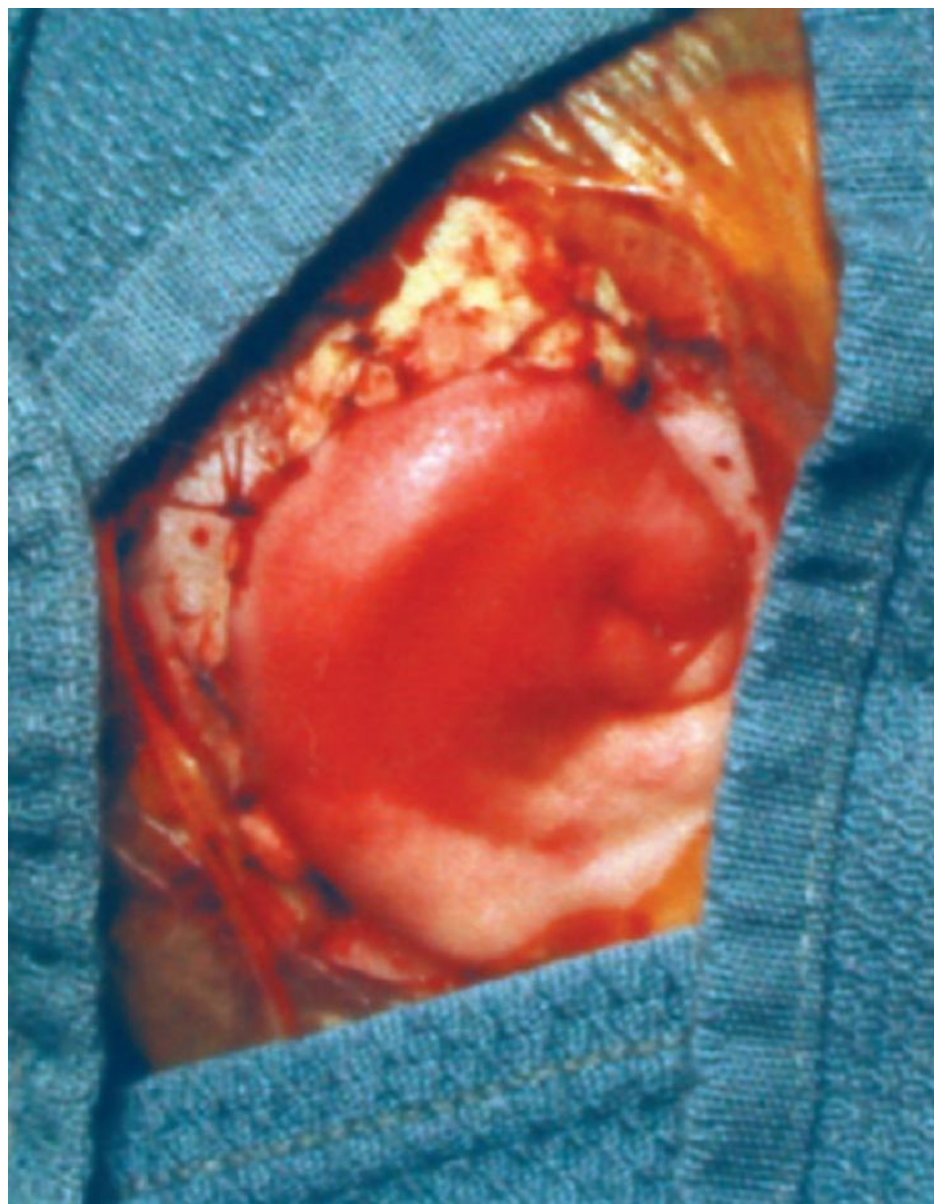
Figure 85-10 A wedge-shaped bolster has been tied in over the postauricular skin graft to secure it.

Stage 4

The tragus may be attached to the main auricular cartilage graft during the first stage of reconstruction if adequate cartilage is available, as described previously. If this was not possible, the final stage of microtia reconstruction is creation of the tragus and conchal bowl. This stage is performed after 2 to 3 months have elapsed for healing after the third stage. Two methods have been described for creation of the tragus during the final stage. One method, originally described by Tanzer,[4] involves creation of an anteriorly based flap in the area of the future tragus (Fig. 85-11). This method may be used for bilateral microtia reconstruction or when the family does not want the normal ear to be operated on in cases of unilateral microtia. A rectangular-shaped piece of cartilage is harvested from the conchal area of the auricular cartilage graft. The conchal area is carefully excavated and deepened while taking care to watch out for the occasional superficial aberrant facial nerve. The rectangular cartilage graft is placed at the base of the anteriorly based flap (Fig. 85-12). The skin flap is folded over the rectangular cartilage graft, and a 3-0 nylon mattress stitch is placed through all layers to create the tragus (Fig. 85-13). A full-thickness skin graft is placed in the conchal bowl. An iodine-impregnated bolster is tied in place with sutures. The mastoid dressing is placed and the bolster is removed in the office after 8 to 12 days. Figure 85-14 shows the final result.

Figure 85-11 A U-shaped incision is used for creation of the tragus by the anteriorly based flap method.
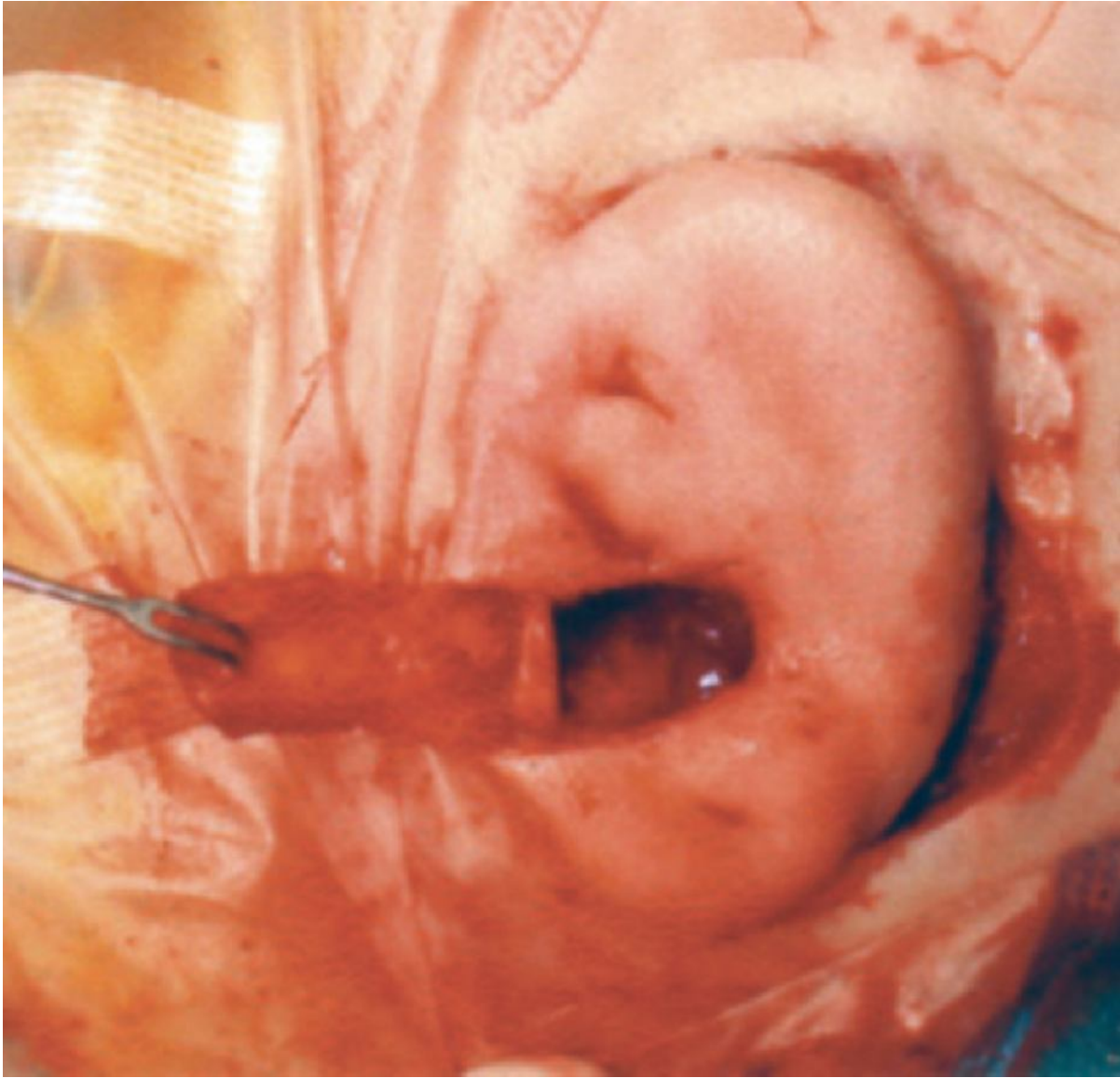
Figure 85-12　A rectangular cartilage graft for the tragus has been harvested from the conchal area of the reconstructed auricle and placed at base of the anteriorly pedicled skin flap.

Figure 85-13 The anteriorly based flap has been folded over the rectangular cartilage graft and secured with a nylon mattress suture to create the tragus.

Figure 85-14 Final result after completion of stage 4 of reconstruction with the anteriorly based flap method of tragal reconstruction.

Another method of tragal reconstruction was described by Brent[2] and is used for unilateral cases of microtia. The reconstructed auricle is usually flatter than the normal auricle. A chondrocutaneous graft is harvested from the lateral posterior aspect of the concha of the normal ear (Fig. 85-15). Harvesting of this graft decreases the projection of the normal ear, which serves to improve bilateral frontal symmetry of the auricles (Fig. 85-16). A J-shaped incision is made at the site of the planned tragus (Fig. 85-17). The skin in the conchal area is elevated and some of the soft tissues are resected by careful blunt and sharp dissection as described earlier to deepen the conchal bowl. The surgeon must be alert to the possibility of the occasional aberrant facial nerve (Fig. 85-18). A full-thickness skin graft is placed. The previously harvested chondrocutaneous graft is placed into the J-shaped incision and fixed in place with a 3-0 nylon mattress suture. The graft is placed in a manner that allows the composite graft to be angled from a more anterior position medially and a more posterior position laterally. This serves to create a shadow in the conchal bowl that mimics an ear canal (Fig. 85-19). A bolster is placed for 8 to 10 days, and the mastoid dressing is placed as described previously. The bolster is removed in the office after 8 to 12 days (Fig. 85-20).

Figure 85-15 Planned incisions for otoplasty and the chondrocutaneous graft that is harvested from the lateral posterior aspect of the concha of the normal ear.

Figure 85-16 Otoplasty and harvest of the chondrocutaneous composite graft are performed to decrease lateral projection of normal auricle. This serves to improve frontal symmetry of the two auricles. The composite graft will be used for tragal reconstruction.
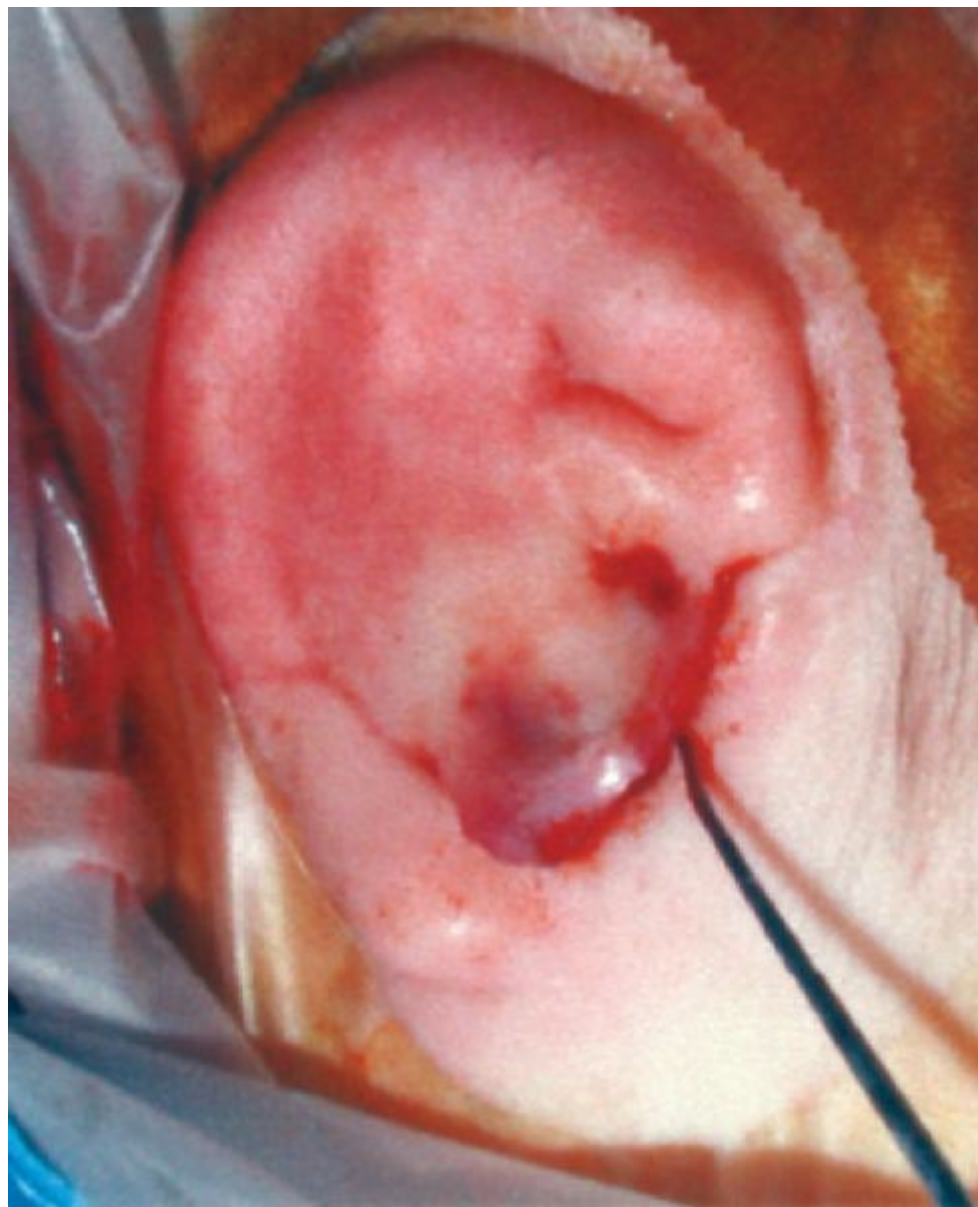
Figure 85-17 A second method of tragal reconstruction requires a J-shaped incision at the site of the planned tragus.
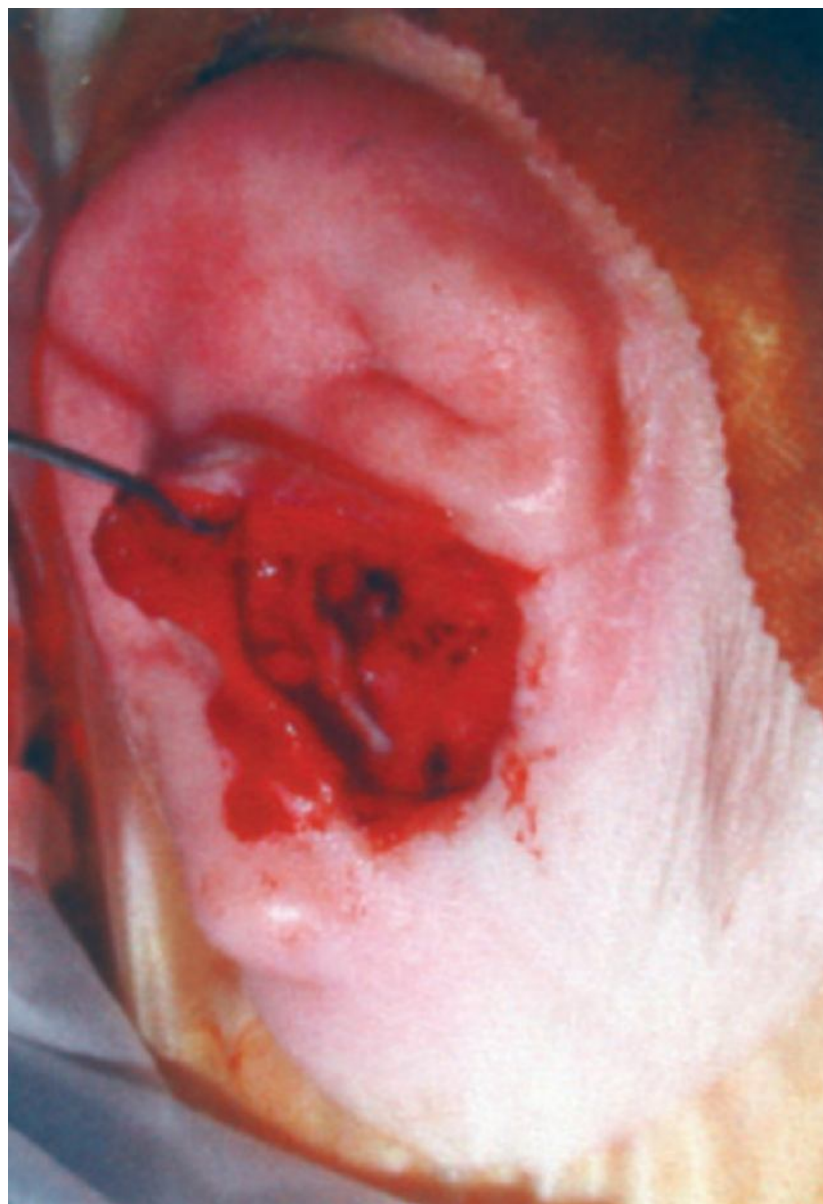
Figure 85-18   The conchal bowl has been excavated after the skin flap was elevated. Care is taken to avoid a possible aberrant facial nerve during excavation.

Figure 85-19 The chondrocutaneous composite graft has been positioned to create the posterior border of the tragus. The skin flap has been draped into the conchal bowl. A full-thickness skin graft has been sewn into the conchal bowl between the pedicled skin flap and the composite graft. Note how the reconstructed tragus casts a shadow that gives the appearance of an external auditory canal.

Figure 85-20   Final result after completion of four stages of microtia reconstruction with a J-shaped incision and a chondrocutaneous composite graft for tragal reconstruction.

Staging of Surgery for Bilateral Microtia

Auricular cartilage grafts for first-stage microtia reconstruction are performed as unilateral procedures because of the extensive nature of these surgeries. Third-stage microtia reconstruction with auricular elevation is also performed as a unilateral procedure because the posterior scalp tissue can be advanced only to one side at a time. Second-stage microtia reconstruction with lobule transposition and fourth-stage reconstruction with creation of the tragus by the anteriorly pedicled flap method may be performed bilaterally during the same anesthetic because of the more limited areas involved in these stages.

Revision Surgery

Revision surgery may be performed to enlarge the size of the postauricular sulcus with a full-thickness skin graft. A scar band with partial obliteration of the sulcus often occurs at the junction of the superior two thirds and inferior third of the sulcus because of skin graft loss secondary to limited blood supply in this area. A second area that may require revision is the transition of the lobule to the auricle. If the transition of the lobule to the auricular graft is not smooth and the lobule has a notched or "stuck-on" appearance, revision may be needed.

POSTOPERATIVE MANAGEMENT

Most surgeons prefer to continue prophylactic perioperative antimicrobial agents for 10 days. It is critical to fix the mastoid dressing to a young child's hair with tape to avoid having the child remove the dressing. Without taping to

hair, young children will nearly always remove their dressing, which can lead to complications of infection, bleeding, and flap loss. The discomfort of hair pulling during dressing changes is well worth the avoidance of complications and preservation of good results. The dressing is changed on postoperative days 1, 3, and 7, and it is removed after 14 days. Contact sports are avoided for a total of 6 weeks.

PEARLS

- The surgeon should invariably choose to preserve the blood supply to avoid complications when balancing aesthetics versus blood supply.
- To minimize bleeding and to save time, bipolar scissors are excellent for removing intercostal muscles from the ribs. Retraction of the ribs with a two-pronged skin hook improves exposure during rib harvest.
- Small areas of flap loss usually respond to antimicrobials and gentle local wound care.
- Reducing the lateral projection of the cartilage graft to permit closure without tension allows healing of moderately sized areas of flap loss.

PITFALLS

- Unless a bridge of approximately 4 mm of cartilage is left in situ at the superior aspect of the synchondrosis, the undesirable late chest wall deformity of splaying out of the ribs may occur.[2]
- If the pleural space was entered but the visceral pleura of the lung has not been violated, a red rubber suction tube is placed while the anesthesiologist provides positive pressure to evacuate the pleural air. The catheter is withdrawn and the wound is closed. No chest tube is required unless the visceral pleura was violated.
- If the cut edges of the ribs remaining in the chest are not beveled so that the edges are smooth, painful irritation of the pleura and intercostal muscles may result.
- If adequate space between the surface details of the auricular graft is not provided, the skin will not drape in between the details and the details will not be seen as separate entities.
- Large areas of flap loss require a temporoparietal pedicled flap with a full-thickness skin graft to provide adequate blood supply and coverage.
- Unless Doppler or angiographic evaluation of the superficial temporal and occipital arteries is used to identify and preserve the vascular pedicle of the temporoparietal flap,[5] flap loss is more likely to occur.