# Ear Reconstruction

# 35

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## 35.1 Introduction

The human ear is a vital and distinctive feature of the face, and therefore, its deformity confers a significant impact on self-esteem and mental development in affected patients. Microtia is the commonest congenital ear malformation. The management of ear malformations can be challenging, because of its complex 3D structure. To achieve proper reconstructive results, it is first essential to understand the basic anatomy and architecture of the ear [1]. Materials used for reconstruction of the ear include autogenous cartilage, alloplasts like silicone, Medpor, and osseointegrated materials. Surgical reconstruction of the ear with autogenous grafts is a unique marriage of science and art [2]. Good results depend not only on surgical skill but also on conforming to the basics of plastic surgical principles and tissue transfer. The gold standard for external ear reconstruction even today is the use of autogenous cartilage frameworks.

## 35.2 Incidence and Etiology

The incidence of microtia is around 1 in 10,000 live births. It appears to be more frequent at higher altitudes, especially above 2000 m, due to the low oxygen levels. The condition is 2.5 times more common in boys than in girls and more commonly affects the right ear. Unilateral cases are four times as common as bilateral ones. Aural atresia is found with microtia in 75% of cases. Microtia usually occurs if there in an abnormality in the embryologic development of the six auricular hillocks. These develop at 4–12 weeks of gestation. Microtia may be associated with other birth defects. The exact cause behind the abnormal embryologic development remains unknown. However, certain teratogens like isotretinoin and thalidomide have also been implicated in this [3].

Microtia may occur in association with other malformations, including facial nerve weakness, cardiac defects, urogenital defects, hemifacial macrosomia, and spine defects. It has also been associated with syndromes like Goldenhar syndrome and Treacher-Collins syndrome [4].

## 35.3 Surgical Anatomy

It is crucial to understand the external auricular anatomy and architecture before proceeding with reconstruction (Fig. 35.1a). The ear has certain definite structural elements. The overall outline of the ear is oval shaped and is slightly flattened posteroinferiorly. A distinct line can be made out that defines the helical rim, arising from its root and ending at the crus helicis. Another line forms the concha, which consists of the tragus and antitragus. The fossa triangularis is the final defining structure that defines the ear (Fig. 35.1b). A complete understanding of these structures allows the microtia surgeon to use these basic components to reconstruct the complex three-dimensional structure.

When viewed in the horizontal plane, the ear is divided into three parts. The superior portion starts at the top of the helical rim and ends at the helical root at the superior border of the concha cymba. The midportion starts at the upper border of the concha cymba and ends at the upper aspect of the antitragus. The lowest portion extends from the tip of the lobule to the superior border of the antitragus. The length of the ear is defined as the distance between the highest point (supraaurale) and the lowest point (subaurale). This may vary between patients in accordance with the differences in the shape of the patient's face and their lobule characteristics. For instance, the ear lengths vary from 55 mm to 65 mm, with a

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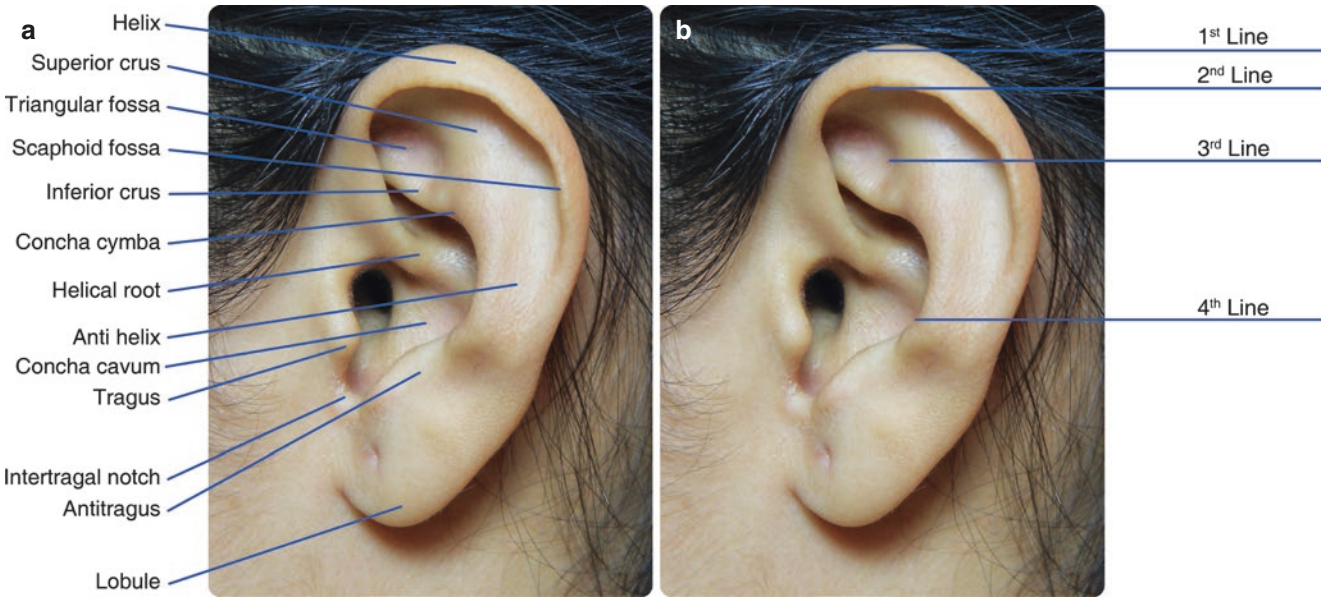



**Fig. 35.1** Normal external auricular anatomy and architecture

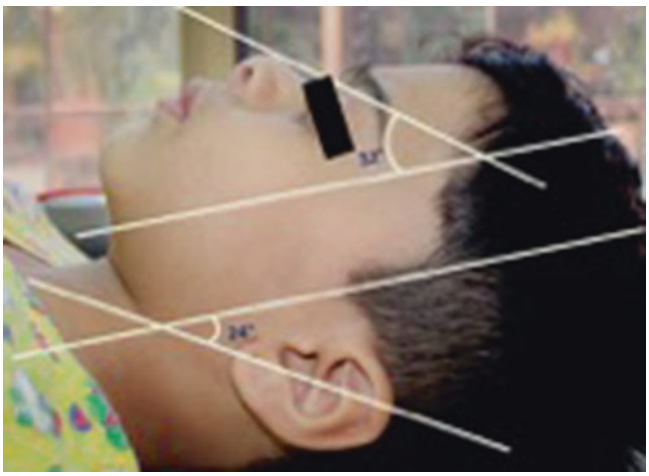


**Fig. 35.2** Relation of ear to nose and facial plane

mean of 62.4 mm in males and a mean of 58.4 mm in females. The width is approximately 55% of the ear length and is around 35.5 mm in males and 33.4 mm in females. The protrusion of the ear, also called the auriculocephalic angle, ranges from 15° to 20°. This is the angle between the mastoid skin and the posterior surface of the auricle. Again, this may show variation between patients. However, this angle should remain the same in both the normal and the reconstructed ears [3]. The angle between the vertical axis of the face and the longitudinal axis of the ear is referred to as the ear inclination. It must be measured with the patient oriented to the Frankfort horizontal position. This is around 24° with the face, but is 32° in relation to the nasal dorsum (Fig. 35.2).

## 35.4 Classification

There are four grades of microtia, depending on the severity. These are as follows:

Grade 1: The ear has anatomically normal characteristics, but may be slightly smaller than normal. An external auditory canal is usually present, but may demonstrate atresia.

Grade 2: The size of the ear is than in grade 1, and it may be less developed. Although a part of the helix may be formed, the triangular fossa, scaphae, and antihelix are under-developed. Atresia of the external auditory canal may or may not be an associated feature.

Grade 3 or classic: This is the commonest grade seen and usually consists of a vertical remnant of skin. There is a superior component that contains the malformed cartilage, and an inferior component that forms the displaced earlobe. This grade is almost always associated with atresia.

Grade 4 or anotia: The outer ear structure is completely absent, and atresia is always present.

There is another simplified classification, in which microtia is divided into the lobular type (ear remnant and lobule


**Fig. 35.3** (**a**) Lobule-type and (**b**) conchal-type microtia



are present) or conchal type (presence of concha, external canal, and tragus with lobule) (Fig. 35.3).

## 35.5 Evaluation and Management

The management of a child with microtia should ideally be discussed with parents shortly after birth, to reduce parenteral stress and offer them reassurance. The audiologic testing should be performed before discharge. In cases of unilateral microtia, treatment is not urgent because the other side will have normal hearing. Treatment can be thoughtfully planned after consulting with relevant specialists. However, in bilateral cases, brainstem auditory-evoked response testing must be performed as soon as possible so that the child can be fitted with a bone-conduction headband. The microtia surgeon can discuss about all the possible option with the family, including observation, autologous costal cartilage, alloplasts, and prosthetics. Each method of management has a different timing, and therefore, all optins must be discussed at an early stage. In addition, the microtia surgeon must also coordinate ear reconstruction with auditory management, so that the timing of the hearing correction may be optimized [4].

## 35.6 Timing

Timing of repair is governed by both physical growth and psychological consideration. The ears reach much of their mature size by age 7. Generally, by the age of 6, cartilage is sufficiently developed to provide an optimal primary framework. However, the older the child, the more cartilage is available for reconstruction. On the other hand, waiting for cartilage growth must be weighed against the psychological and social effects of the missing ear on the child. Studies show that psychological effects usually manifest only around the age of 7–10. However, by age 6, most children are aware of the problem and want to get it corrected [3]. The timing can also depend on the method of reconstruction chosen. The Brent method, which requires less cartilage, may be performed as early as 6–7 years of age. On the other hand, the Nagata method can be done only after 10 years of age, when the chest measures at least 60 cm at the xiphisternum. This is because it needs larger amounts of cartilage [1].

## 35.7 History

Tanzer et al. first established the technique for total auricular reconstruction. The technique was modified by Brent, who utilized more defined surgical techniques such as fabrication of the framework and reconstruction of the tragus using composite chondrocutaneous grafts. These techniques were three stages and four stages, respectively. Nagata and Park outlined techniques that involved just one or two stages for ear reconstruction [5]. Allolastic implants were tried since the 1960s. Initially, silicone implants were used, but these were associated with complications such as implant failure following minor trauma or abrasions. In 1993, Wellisz reintroduced the prefabricated alloplastic implant for microtia reconstruction. This was constructed from PHDPE [6].

## 35.8 Principle and Planning (Video 35.1)

The Microtia surgeon should begin with proper planning and achievable goals for successful auricular reconstruction. It is important to discuss the details of surgical procedure and

limitation of surgical repair with the family during preoperative consultation. The surgeon must prepare the family for multiple stages, long preoperative and postoperative care, and complications. The reconstructed ear will possess some deficits as compared to the normal ear and will be less flexible and elastic. The reconstructed ear can also be prone to complications, including hematoma, poor healing, infection, or skin breakdown. These complications can compromise the definition and contour of the reconstructed ear [3].

If the patient has coexisting anomalies, such as clefts, early surgery must be done first to correct these. For instance, in cases of Treacher Collins syndrome and other first and second branchial arch defects (craniofacial microsomia, Goldenhar's syndrome, etc.), the bone reconstruction must be achieved first, with scars peripheral to the proposed ear [7].

The precise positioning and dimensions of the reconstructed framework will define the end result of the surgery. The reconstruction must be symmetrical to the contralateral ear in the unilateral case. In bilateral cases, the parent's ear is used as a reference. Visual examination may not be reliable, and it is essential to make exact measurements, after properly positioning the patient. For an ideal position, the superior extent of the ear must be placed parallel to the Frankfort's horizontal plane, at the level of the lateral brow (Fig. 35.4). The root of the helix may be positioned at the level of the subnasale, approximately one ear-length behind the lateral brow. Measurements must be taken carefully, particularly from the lower one-third of the face, in cases of facial asymmetry (seen in about 88% of patients with microtia). The asymmetries can range from mild differences in gonial position to full-blown hemifacial macrosomia and can lead to inaccuracies in measurement [3].

The final outcome also depends on the skin quality around the ear area. If the skin is scarred, natural expansion cannot take place, and the final ear may have a poor definition. In such cases, supplemental tissue in the form of flaps (e.g., temporoparietal fascia flap) may be considered to augment the supple skin envelope. In general, skin elasticity varies for each individual, and this can influence the final definition of the ear [8]. In cases of tight skin, a lower-profile 3D framework (1 mm) may be created, to avoid strain on the skin.

## 35.9 Simulation Training

The surgeon must obtain enough training in plastic and reconstructive surgery, including skills such as gentle flap dissection, delicate wound closures, and skin grafting, to achieve optimal outcomes. In addition, surgeons must be familiar with precise carving that is required for forming the 3D framework for the ear. Potato, carrot, or pumpkin can be used to learn and perfect the art of sculpting a framework [8]. Silicone dental impression material provides a convenient replica of costal cartilage, as it has the same consistency and texture. An exact replica of the rib cartilage and a precise template of the ear will allow the simulation to mimic the clinical situation. Creating the framework can be done using wood carving instruments. These techniques aid the novice surgeon in improving their results during the actual surgery [9].

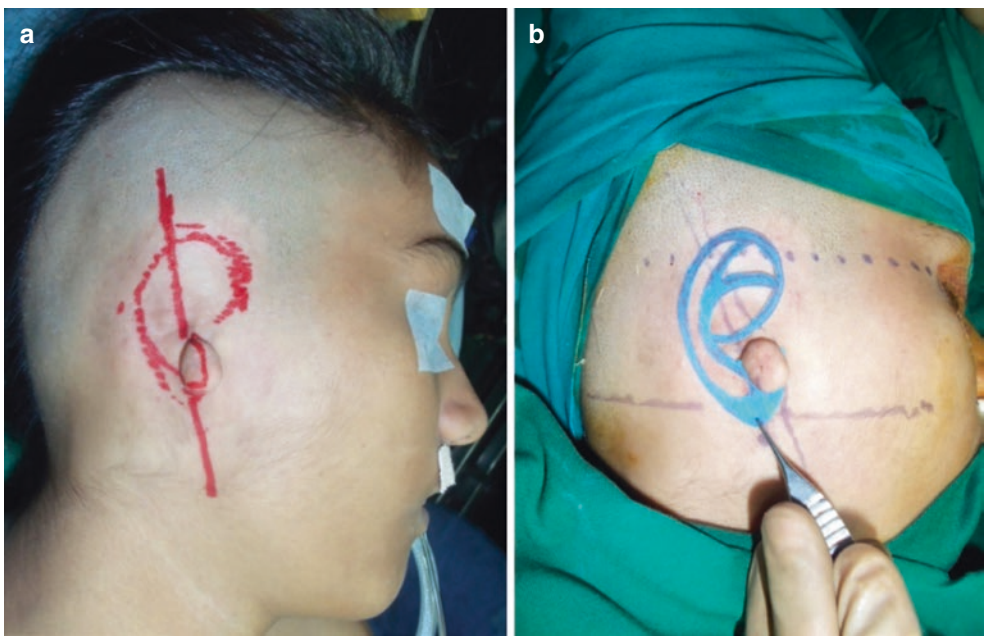


**Fig. 35.4** Future position and size of ear

## 35.10 Template

Preoperative photographs should be obtained, and measurements of the normal ear must be obtained when the patient is awake. The surgical template is prepared from radiograph film using normal ear as a guide. In the beginning, an outline of the helical rim, lobule, antitragus, tragus, and conchal bowl is created from the opposing ear as the first template [3]. This template needs to be reversed to plan the ipsilateral ear. Another mirror image template is created based on the first one, which is smaller in dimension. This would allow for the extra thickness following insertion of cartilage under the skin (Fig. 35.5). The inferior pole on the framework is created much smaller in size, to accommodate the transposition of the earlobe. If the patient does not have usable earlobe tissue, this can be carved into the lower end of the framework. A second template is created, this time minus the helical rim. This template is used as a guide for creating the base of the framework from the sixth and seventh ribs, after which the rim of the helix can be added. The templates must be chemically sterilized prior to intraoperative use. A third template, made along with the first, has markings at the lateral canthus of the eye and commissure of the mouth. This allows ideal framework positioning and orientation. The distances marked on the template must be verified by measuring the distance between the lateral canthus and the root of the helix [3].



**Fig. 35.5** Final surgical template of ear made from x-ray film

## 35.11 Auricular Reconstruction Using Autologous Rib Cartilage

### 35.11.1 Harvesting Rib Cartilage

For harvesting the rib cartilage, an incision, 4–5 cm long, is placed obliquely on the ipsilateral side, at the level of the synchondrosis of the sixth and seventh ribs [10]. The incision is carried down through the muscle, to expose the costal cartilages. It is safer to harvest the cartilage without perichondrium because leaving the perichondrium behind offers one more layer of protection to pleura. The perichondrium also allows for the regeneration of the cartilage/bone matrix. Removing perichondrium can not only offer less protection but also lead to significant depressive chest deformities [8]. After harvesting is complete, intercostal nerve blocks may be administered. Closure of the muscle and deep fascial layers is done, and a large piece of cartilage may be banked in a subcutaneous pocket for the second stage [10]. Smaller cartilage pieces may be diced and placed inside the sutured perichondrial pocket, where it can aid in cartilage regeneration (Fig. 35.6).

### 35.11.2 Framework

The supporting framework is a living sculpture that serves as the foundation for the repair. Rather than carving the framework to exactly mimic auricular cartilage, the surgeon must make allowances for the abnormal skin coverage that is present. These limitations include skin-volume shortage and greater skin thickness, both of which produce excess skin tension. To prevent the flattening of the ear's rim that this tension might cause, one must carve a somewhat thicker and more substantial helix. This exaggeration of the cartilaginous framework will compensate for the thickness of the overlying skin. The 3D framework must be at least 9.5–10.0 mm high in the case of primary reconstruction and further augmented by 1.0–2.0 mm for secondary reconstruction [8].

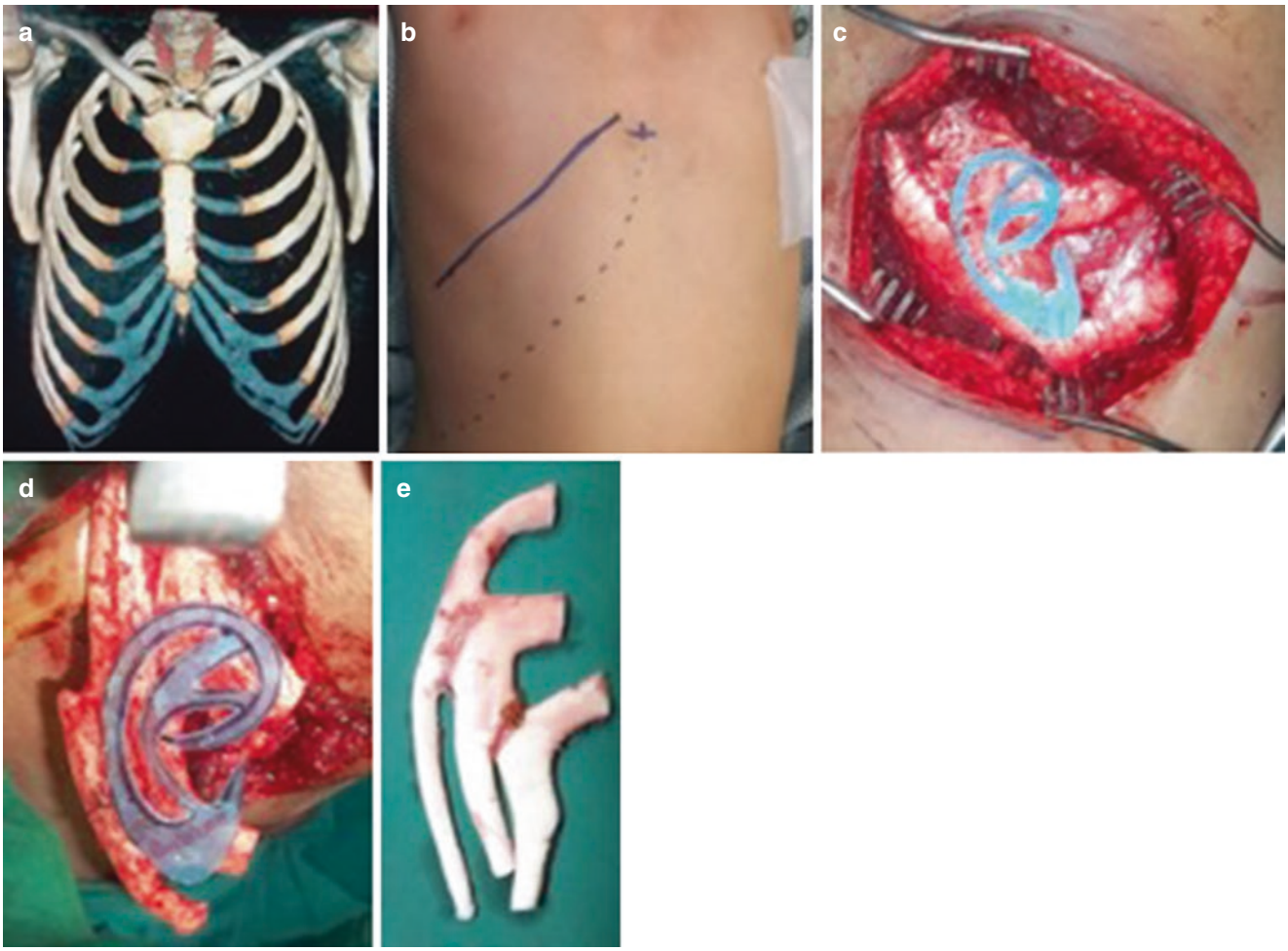




**Fig. 35.6** (**a**) 3D CT scan of Rib cage. (**b**) Incision for cartilage harvest. (**c**) Exposure of rib cartilage. (**d**) Template used to harvest cartilage. (**e**) Harvested cartilage

The cartilaginous framework is constructed from the synchondrosis of the sixth and seventh ribs (Fig. 35.7b, c, d). Cartilage wedges from these ribs are used to create the helical sulcus and the triangular fossa. The helix itself is formed from the eighth rib because it is longer. If additional length is required, the ninth rib can also be harvested (Fig. 35.7e) [10]. While carving the helix, it must be ensured that superior portion is higher than the inferior portion. The part of the helix that will be continuous with the lobule must be trimmed at the lower end, until it is long enough to receive the lobule attachment. The constructed helix is then affixed to the basal cartilage. On doing this, an outward inclination of 10–15° is maintained, at the middle one-third of the ear. The entire length of the lower part of the basal cartilage, at the outer end, is trimmed [5]. The floating rib cartilage that is used to create the helix must be thinned on its outer convex surface. This causes the cartilage to warp in a favorable direction and creates an acute angle that resembles the helix. This cartilage is then fastened to the body of the framework with 5-0 Stainless steel suture. The thickest parts of the remaining segments of cartilage are used to create the rest of the auricle, namely, the antihelix and antitragus-tragus complex, which surround the conchal bowl (Fig. 35.7f). The highest point of the antihelix is the middle, and this slowly tapers down to the helix. The superior and inferior crura are created, at the slope toward the lowest portion of the base frame. Enough space must be secured between the upper helix and superior and inferior crura, in order to accommodate the skin envelope. Otherwise, an effect of continuity between 2 crura and helix is created, which is undesirable [8]. The components of the framework are then assembled and secured together using 5-0 stainless steel wires. To achieve a snug fit, a small incision is placed in the cartilage and the wire is pulled gently toward the incision without burying it [10]. The position of the antihelix within the antitragus must be high, and trimming must be done at a lower level toward the superior and the inferior crura. In order to augment the antihelix, cartilage may be added in a vertical manner near the conchal area.

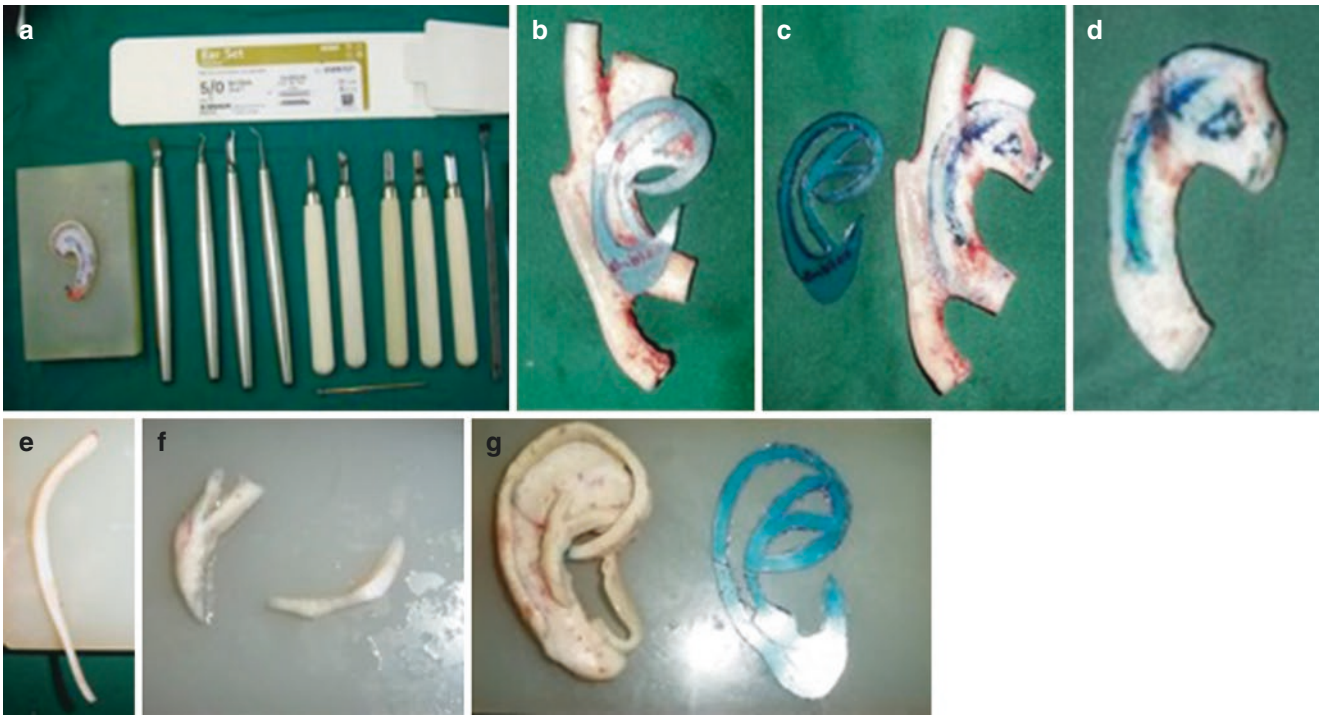




**Fig. 35.7** (**a**) Armamentarium for carving, (**b**–**d**) preparation of base of the cartilaginous framework from the synchondrosis of the sixth and seventh ribs, (**e**) helix prepared from eighth rib cartilage, (**f**) antihelix and tragus, and (**g**) Final framework

This gives an effect of deepening of the concha. The antihelix is also trimmed in the region of the scaphoid fossa, so that it develops a slight inclination that resembles the natural convolution. Finally, the surfaces of the entire framework must be tapered smoothly tapered, and block-like corners must be removed, to ensure that the covering skin fits on smoothly (Fig. 35.7g). Throughout the process, isotonic saline solution is used to irrigate the cartilaginous framework. This helps preserve chondrocytes. The use of rotary and power tools must be avoided to prevent chondrocyte damage [7].

### 35.11.3 Skin Pocket

A pocket must be created within the skin in a meticulous fashion. This will provide proper vascular covering to receive the framework. As per the level of the lobular remnant, the level of the incision line for rotating the lobule may be determined. A small part of the lobular remnant is transposed posteriorly and separated from the microtic remnant. Then, the lobule is dissected and rotated to create a pocket that will accommodate the caudal end of the cartilage framework. This causes the lobule to be brought down and results in a smooth interface between the lobule and the framework. Creation of the skin pocket preserves the subdermal vascular plexus. The amount of dissection (at least 2 cm beyond the outline) must be wide enough to allow proper draping of the skin flaps over the framework with minimal tension. Any cartilage, if present in the vestigial remnant, is removed. Meticulous hemostasis must be achieved [5]. An incision is placed at the posteroinferior border of the vestigial remnant, and the cartilaginous framework is placed in the subcutaneous pocket. The tail end of the framework is inserted into the lobule first, followed by suturing of the outer incision. In order to let the skin adhere to the framework, two polyethylene drains with multiple perforators must be inserted beneath the framework. These are secured to the skin using 5/0 nylon sutures. A syringe (50-cc) may be connected to the drain. After final suturing of the subcutaneous pocket, the skin flap is approximated, and the piston of the syringe may be fixed in activated position using two wooden tongue depressors (Fig. 35.8) [5]. If skin blanching is noticed at this stage, the pocket must either be enlarged or the framework must be inserted at a lower position. The use of pressure dressings must be avoided as these can compromise the vascular supply. The entire reconstructed ear must be layered in petrolatum gauze, which must be placed loosely and left in place for 3 days [3]. The syringe with the activated piston may be changed frequently in the postoperative perio, ensuring that proper tension is maintained. The drains may be removed on the fourth or fifth postoperative, provided that the volume of fluid drained is less than 1-cc. Petrolatum gauze may be left in place until suture removal, on the sixth postoperative day [5].

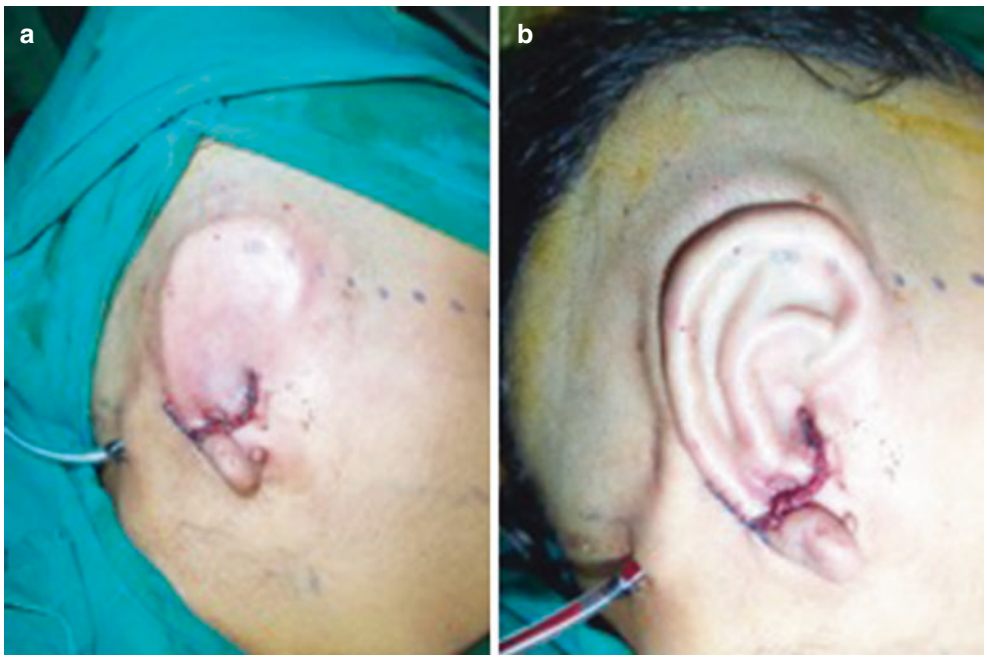


**Fig. 35.8** (**a**) Before activation of suction and (**b**) after activation of suction



### 35.11.4 Second Stage

The second stage of surgery involves elevating the auricle from the head, which creates the auriculocephalic angle. This procedure should ideally be performed 6–9 months following the first stage. In the conventional method, the incision lies several millimeters away from the margin, and reconstructed ear is gently lifted from the base. Care must be taken to preserve connective tissue on the undersurface of the ear, as well as on the bony floor. The posterior part of the auricle and the skin defect overlying the mastoid are grafted with skin. Since the ear lacks skeletal support, it contacts the mastoid skin and is not elevated. This creates a narrow space, which may be difficult for the patient to clean [8].

In the Nagata technique, the second stage is more complex than the conventional one. This involves the following steps: (1) separation of the auricle from the mastoid, (2) The banked subcutaneous rib cartilage or an alloplast is used to create a wedge-shaped block, which is placed underneath the auricle, (3) A temporoparietal fascia (TPF) flap is then harvested to cover the posterior part of the auricle, and (4) A split skin graft harvested from the scalp to cover the fascial flap. Scalp skin is preferred as it has better color match as compared to groin skin (Figs. 35.9 and 35.10) [8].

### 35.11.5 Complications

- During the harvest of Rib Cartilage

The two commonest complications at this stage are pneumothorax and atelectasis. If detected intraoperatively, pneumothorax can be easily treated and may not require chest tube placement. Positive pressure ventilation is used after irrigating the wound to see if there is any leak. If there is no leak, the wound is closed in layers. If a leak is seen, it indicates the presence of pneumothorax. In this case, a red rubber catheter is inserted into the pleural opening to which a syringe is attached to this to evacuate residual air. Following this, the chest may be closed and an intraoperative chest radiograph is asked for to rule out residual pneumothorax. If this is absent, the wound may be closed, the catheter may be removed and follow-up may be done with serial films [3]. Atelectasis is best prevented by frank preoperative preparation of the patient and vigorous postoperative respiratory therapy.

- Skin Flap Necrosis

The first 10 postoperative days are critical to check for any skin flap necrosis. It is essential to achieve a balance between the thickness of the skin flap and the size of the pocket with the contouring of the cartilage framework. To prevent skin necrosis, it is advisable to minimize or completely avoid the use of epinephrine in the flap. The status of vascular supply can be tested by placing the framework in the pocket, activating the suction drain, and observing any for blanching along the rim of the helix. If blanching is present (indicating vascular compromise), the size of the pocket may be enlarged until blanching disappears. If needed, the skin supply may be increased by placing a tissue expander 2 months prior to insertion of the framework and skin adhesion [1]. If skin necrosis is observed, it must be attended to immediately, as it can cause infection of the underlying cartilage

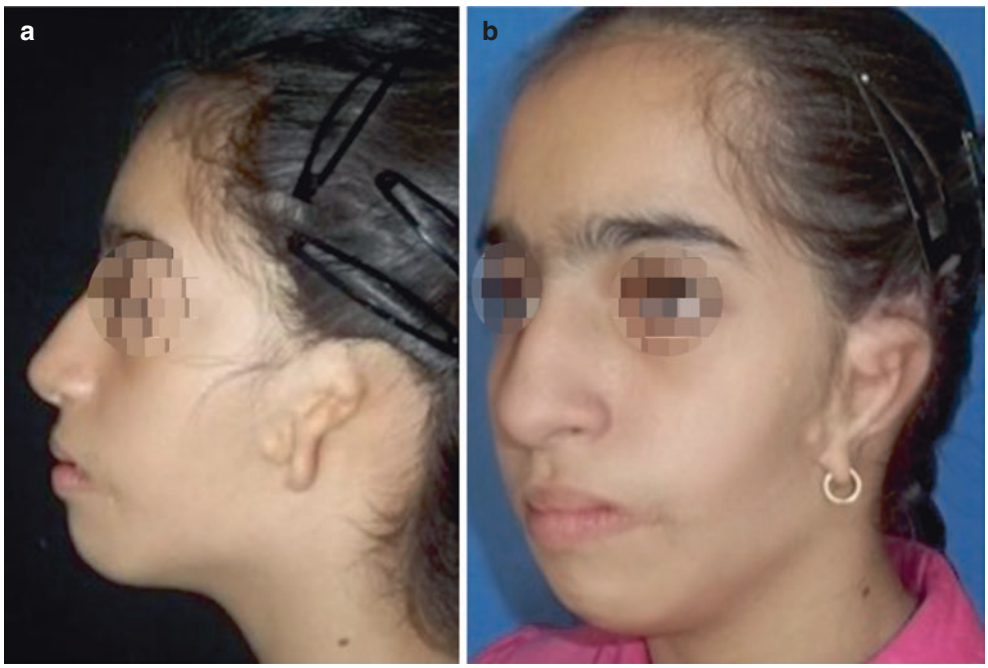


**Fig. 35.9** Ear reconstruction in hemifacial microsomia associated with microtia. (**a**) Preop and (**b**) Postop



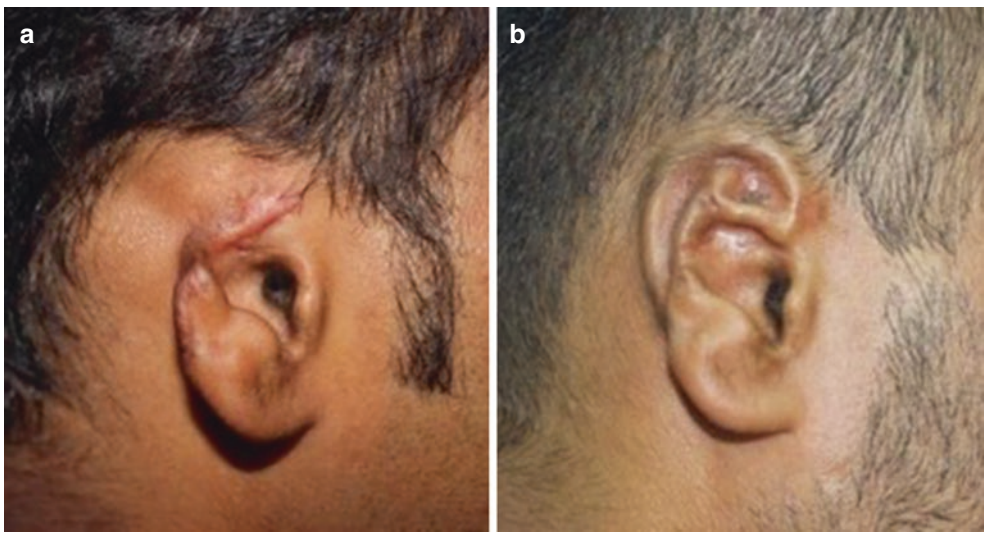


**Fig. 35.10** Ear reconstruction after traumatic amputation of upper half of ear. (**a**) Preop and (**a**) Post op



and framework resorption. The damage can be minimized by covering with a local skin flap or fascial flap (Fig. 35.11).

- Infection

This is uncommon in the autologous reconstruction. If it occurs, along with appropriate systemic antibiotics, vigorous irrigation of the surgical site must be done.

- Cartilage Resorption

If there is either ischemia or infection, there are chances that the cartilaginous framework can get resorbed or deformed. This can also occur if the skin envelope is too tight, especially at the hairline border. To avoid this, dissection of the skin pocket around the hairline must be done carefully. Any tight fibrous band that exists along the hairline must be released.

- Wire Extrusion

If any wires extrude from the framework, they can easily be removed at the outpatient facility. It is necessary that the wire must be removed as soon as extrusion is noticed, and the patient/family must be educated accordingly. Otherwise, there are chances that the exposed wires can cause resorption of cartilage around the wire.

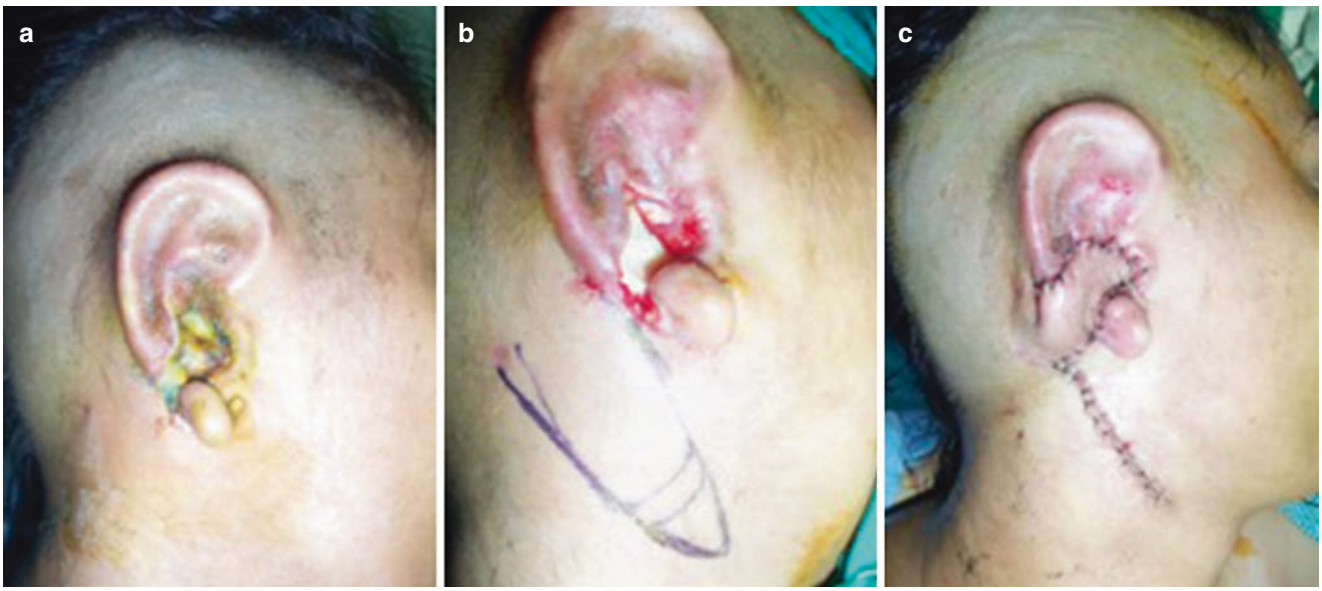




**Fig. 35.11** (**a**) Necrosis of skin at near suture line, (**b**) debridement and marking for local flap, and (**c**) flap in situ

## 35.12 Auricular Reconstruction Using Alloplast

The material used for creating framework has been a subject of debate and research. Autologous costal cartilage is still the most preferred material in microtia repair. However, some surgeons consider using alloplasts because of the following advantages.

1. Donor site morbidity is avoided,
2. Reconstruction can be done at a younger age,
3. Reduction in the number of interventions,
4. More predictable outcome,
5. The structural limitations associated with the use of autologous rib may be avoided
6. The ability to tailor reconstruction to individual patient needs (such as low hairline and bilateral malformations) [11].

The ideal alloplast for auricular reconstruction should have the following features: cost-effectiveness, ability to be implanted safely, ability to resist infection, and capability to undergo customization to resemble the contralateral normal ear. To date, more than 40 different materials have been used for creating the auricular framework. These include ivory, nylon, wire mesh, and silicone. Silicone was thought to show good results since it could mimic the flexibility and form of the native ear cartilage. However, it had a high rejection rate, especially when placed under thin skin flaps. pHDPE (Fig. 35.12) is a modestly flexible, robust enough to withstand microtrauma, and easily shapable and allows soft tissue ingrowth. This permits it to be protected against extrusion and infection. It also allows targeted drug delivery to the implant [11].

### 35.12.1 Technique

It is crucial to assess the age of patient, dimension of contralateral ear in the case of unilateral microtia, and the dimensions of their gender-matched parent's ear preoperatively for achieving equal dimensions between the normal ear and the reconstructed pHDPE ear. The ear created must be adult sized as the alloplast does not increase in size.

The vascular Doppler is used for marking superficial temporal artery. The incision is given in the postauricular area few millimeters behind the new helical rim of the microtic ear to approach TPF flap. Incision is extended in a curvilinear fashion over the TPF flap to improve the exposure and also helps to harvest the distal flap of recommended length. Other approaches may be used, including an Y incision (Fig. 35.13a), which extends superiorly from the mastoid area, and the Z incision, (Fig. 35.13b) which exposes the TPF. These approaches also allow better access to the fascia.



**Fig. 35.12** Porous high-density polyethylene (PHDPE) framework for auricular reconstruction

However, they increase the risk of alopecia at the incision lines and at the apex of a triangular flap.

An anteriorly based skin flap of minimum thickness is elevated meticulously, and microtic cartilage is excised. Usually, the inferior portion of the flap is attached initially to the lobular remnant. If this is malpositioned, this skin flap may be removed and used as a free graft to improve skin coverage. A TPF flap, based inferiorly, of approximately 10.5 by 13.0 cm is raised off the deep temporal fascia and periosteum beneath, superior to the level of the temporal line. The base of the flap is made wide (around 6 cm) to include additional vascular supply (branches of the occipital artery, postauricular artery, and the mastoid emissary vein), and the base of the flap is made wide, around 6 cm. The flap must be made as robust as possible, and loose areolar tissue on the deep surface of the TPF must be included in it. This tissue, which lies deep to the skin graft, allows the skin to slide over the underlying tissue. This resists surface trauma and implant exposure. The pHDPE framework is then sculpted, fused, and matched to contralateral ear. Prior to implant placement, two flat suction drains are inserted through the skin of the mastoid. One drain lies deep to the pHDPE, while the second lies in the posterior part of the donor site on the scalp. The implant is placed over the mastoid area and covered with the TPF flap after checking its anatomic orientation, projection, and axis. The flap is made to wrap tightly around the implant by the negative pressure generated by the first drain. The second drain functions to remove any serous exudate from the donor site. The skin flap, which is based anteriorly, is draped over the TPF. It may also be removed and used as a free skin graft. Sometimes, the skin at the ipsilateral mastoid may not be sufficient to cover the surface of the reconstructed ear entirely. In such cases, a full-thickness skin graft may be harvested from the opposing side postauricular region. A graft taken from this region would provide the best color and texture match. To cover the back of the ear, a larger skin graft may be required, which can be harvested from the inguinal region. After activating the drains, the ear may be coated with a layer of antibiotic cream and the concave regions may be dressed with gauze. The entire ear is then covered in a customized cast made of silicone. This cast prevents seroma, hematoma, or shearing trauma, which may compromise the viability of the skin graft. This cast should not be under pressure. A pressure dressing to prevent seromas can be applied over the donor site. All suction drains may be removed following extubation [11].

### 35.12.2 Complications

The complications of this procedure may be minor, such as a simple wound infection, or major, such as total flap necrosis with exposure of the Medpor framework beneath. In case the implant is exposed or infected, removal may rarely be required. Late complications include traumatic excoriations to the re-constructed ear, which should be managed with good wound toileting or with local skin flaps if required.

## 35.13 Prosthetic Ear

Certain traumatic, congenital, or surgical defects may benefit from auricular prostheses. The choice between surgical and prosthetic reconstruction is controversial, particularly for patients. The ideal age for prosthetic treatment is the same as the age for surgical reconstruction, namely, between 6 and 9 years. The child must be capable of caring for the prosthesis. In cases of unsuccessful surgical outcome, the prosthetic ear is one of the options. Prosthetic ear is a suitable option for the ear defects caused by trauma and disease in adult populations.

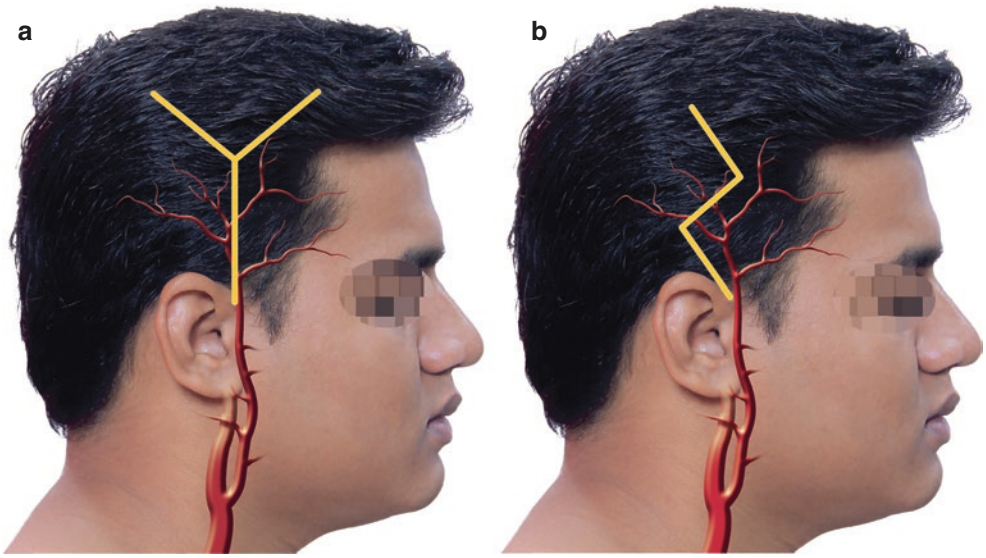




**Fig. 35.13** Approach for temporoparietal flap. (**a**) Y shape Incision. (**b**) Large Z incision

### 35.13.1 Retention of the Prosthesis

Tissue adhesives are used conventionally for ear prosthesis retention because of their low cost and quick results. Tissue adhesive is an old method and causes skin reaction. It is difficult to wear and take off adhesive while bathing and swimming. Osseointegrated implant is superior option for retention, and because of nature sense of prosthesis, ease of use, long lifetime and retention during daily activities, it is accepted by patients. An implant-retained prosthesis is preferred when there is hair on the surface of the defect or when the patient has excessively oily and perspiring skin. The prosthesis may be attached to the implant screws using precision attachments or magnets. Osseointegrated implants are contraindicated during radiation therapy, as the bone is demineralized and prone to hard tissue vasculitis, fibrosis, persistent infections, reduced tissue perfusion, and oxygenation. Osseointegration in such patients is difficult, but may be attained with hyperbaric oxygen treatment [12].

### 35.13.2 Prosthetic Technique

Impressions are made of both the defect and contralateral normal ear. Usually, rubber silicone material is used and plaster models are prepared. The plaster models of contralateral side are used as a reference to sculpt the framework. This is done using wax or clay. Next, a negative mold is obtained when the wax is removed, leaving behind a void. Medical-grade silicone usually of clear shade is mixed with pigments to create the skin colors of the individual patient. This silicone is packed into the void and cured. After removal from the mold, the texture and the color of the skin can be reproduced to match the contralateral side and adjacent skin [12].

## 35.14 Future

Regardless of the method used, ear reconstruction cannot provide an appearance that equals auricular prostheses. Future techniques must focus on emerging tissue engineering technologies that can create bone, cartilage, skin, and blood vessels. This can provide a novel direction for the treatment of patients with microtia. The creation of a natural ear using cultured chondrocytes on a prefabricated cartilaginous framework is an area of active research, but still holds some challenge [1]. Creating functional and durable tissue through tissue engineering can remove the need for donor sites and revolutionize reconstructive surgery.

## 35.15 Conclusion

The human ear is a unique structure that is difficult to replicate owing to its complex cartilaginous structure and thin overlying skin. The ultimate goal of total ear reconstruction should be creation of an auricle that closely matches the normal ear in appearance. Several surgical techniques are available for ear reconstruction. Since microtia is a rare condition, cases are limited, but at the same time, only a high case volume can improve success rates. The learning curve is long and might be at the expense of the patient. Although this learning curve is unavoidable, it is imperative to curtail its steepness. Prior to embarking on ear reconstruction, surgeons must be familiar with the principles and techniques involved. It is important to remember that repetition helps us master the technique.

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## 35.16 Case Scenarios

**Case 1** (Fig. 35.14a–g)

24 year-old male with Unilateral Left side Grade 3 or Lobule type microtia. On audiometry testing, hearing was normal with conductive hearing on left side. External auditory meatus is absent. He was planned for auricular reconstruction using autologous costal cartilage. Costal cartilage was harvested from ipsilateral side. Synchondrotic junction and floating rib were harvested from the seventh, eighth, and ninth rib. Framework was prepared as shown in photo (b). Tragal component is added in framework. Skin pocket was prepared, and lobule was transposed posteriorly. Framework was inserted in pocket, and suction was applied for close adaptation of skin to framework. Stage II surgery was done after 1 year. Ear was elevated, and cartilage graft was placed for support. Graft was covered with temporoparietal fascia flap and skin grafting done. 6 months postop shows symmetric projection of both ears.




**Fig. 35.14** (**a**) Preop, (**b**) Framework, (**c**) Postop, (**d**) 3 months postop, (**e**) and (**f**) Comparison between normal and reconstructed ear after elevation of ear, and (**g**) Projection of reconstructed ear

**Case 2** (Fig. 35.15a–f)

21 year-old male with Unilateral Left side Grade 4 or Anotia. On audiometry testing, hearing was normal with conductive hearing on left side. He was planned for auricular reconstruction using autologous costal cartilage. Costal cartilage was harvested from ipsilateral side. Synchondrotic junction and floating rib were harvested from seventh, eighth, and ninth rib. Simple Framework was prepared as shown in photo (b). Skin pocket was prepared using Z-plasty incision. Framework was inserted in pocket, and suction was applied for close adaptation of skin to framework. Stage II surgery was done after 1 year. Ear was elevated, and cartilage graft was placed for support. Graft was covered with temporoparietal fascia flap and skin grafting done. 8 months postop shows symmetric projection of both ears.




**Fig. 35.15** (**a**) Preop, (**b**) Framework, (**c**) Postop, (**d**) 3 months postop, (**e**) and (**f**) Comparison between normal and reconstructed ear after elevation of ear

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