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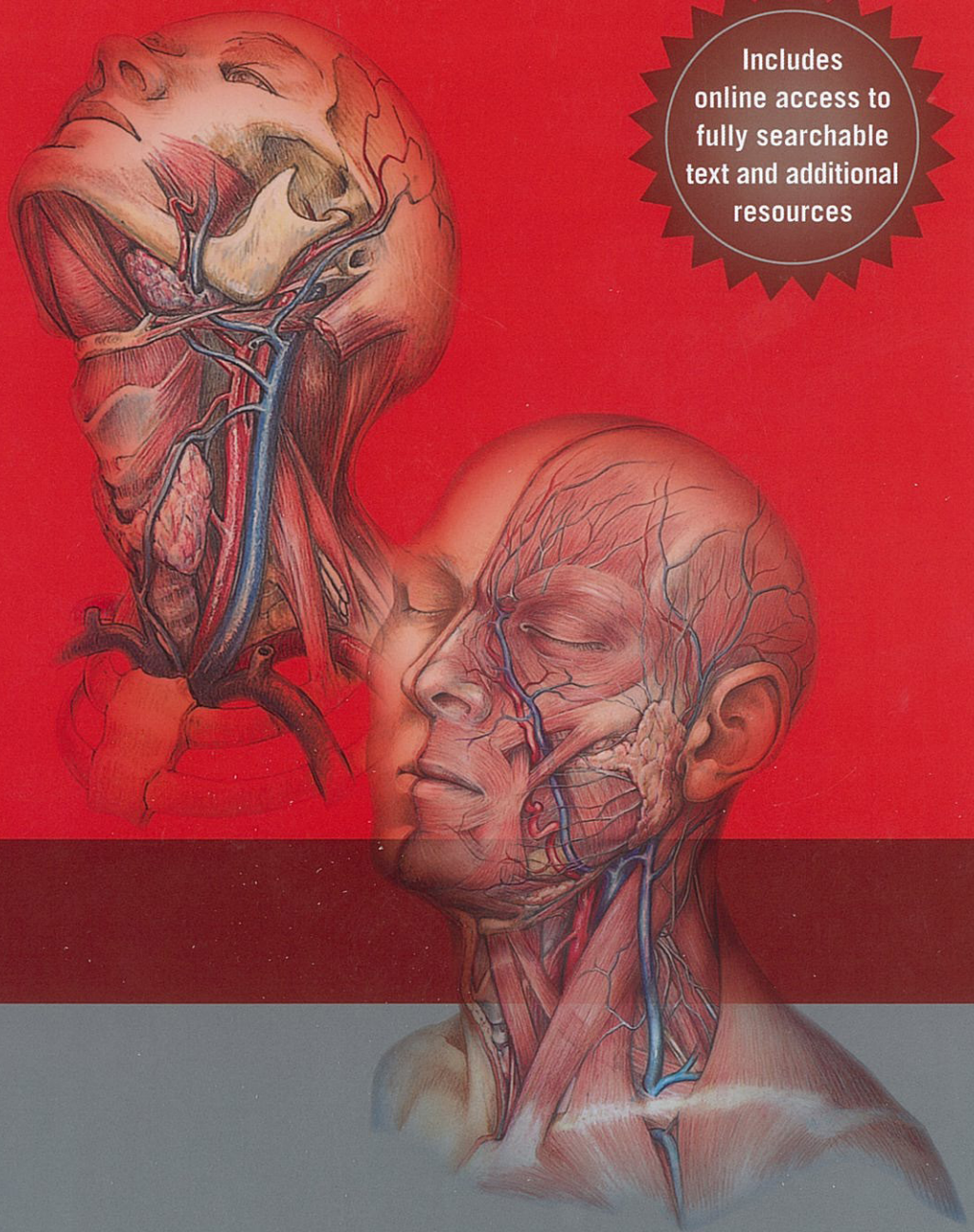

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190 Otoplasty: Anatomy, Embryology, and Technique

Steven Ross Mobley *Nathan Todd Nelson Schreiber*

In addition to its function in directing sound to the tympanic membrane, the ear plays a complementary role in one's appearance. If abnormal in appearance, however, the ear can command unwanted attention, drawing an observer's eyes away from the rest of the face. Classically, auricular anomalies have resulted in significant social stigma. In a criminology text from 1876, author Cesare Lombroso wrote, "nearly all criminals have jug ears" (1); a number of overtly discriminatory texts from this period contain overtly belittling references to prominent ears as well (2). Although such beliefs are, for the most part, not consciously encouraged today, they persist in more subtle forms. In popular culture, large ears are often exaggerated in jest for cartoons and caricatures. For children especially, prominent or malformed ears may be the subject of ridicule, possibly affecting self-esteem and psychosocial development. It is for this reason that surgical correction of the anomalous ear is often sought.

The goal of otoplasty is to create a more natural appearance and position of the ear. Its origins can be traced back to India in 800 BC, when reconstruction of the lobule using a local cheek flap was first described by Indian surgeon Sushruta (3). Reconstruction of larger ear defects using postauricular scalp flaps was not described until centuries later in textbooks, by Italian surgeon Gaspare Tagliacozzi in 1597, and again by Prussian surgeon Johann Friedrich Dieffenbach in 1845 (4–6). The first truly cosmetic otoplasty, however, was performed in 1881, by American surgeon Edward Ely, on a 12-year-old boy who was ridiculed for having a prominent ear (7,8). In the ensuing years, multiple variations of this operation have been described and provide a number of techniques that may be used to create a more anatomically natural-appearing ear. Given the multitude of techniques, one must understand normal auricular anatomy as well as the goals of surgery in order to successfully perform otoplasty.

ANATOMY AND EMBRYOLOGY

The auricle is essentially an extension of fibroelastic cartilage from the external auditory canal that is covered by perichondrium and a thin layer of skin. The skin is directly adherent to perichondrium anteriorly but is separated from perichondrium by loose areolar tissue posteriorly. Cartilage is deficient at the lobule as well as between the tragus and the beginning of the helix anteriorly. Projections of cartilage from the anterior and inferior ends of the helix are called the spina helicis and the cauda helicis, respectively. Attached to portions of the cartilage itself are six internal auricular muscles: the helicis major, helicis minor, tragicus, and antitragicus along the lateral side of the cartilage and the transversus auriculae and obliquus auriculae along the medial side of the cartilage. Three external auricular muscles, anterior, superior, and posterior, provide additional fixation to the temporal bone and, through the facial nerve, the ability to move one's ear. Auricular sensation is provided by multiple nerves. C2 and C3 through the greater auricular nerve provide sensation posteriorly at the helix, antihelix, and lobule. Cranial nerves IX and X provide sensation to the conchal bowl and posterior external auditory canal. The auriculotemporal branch of the mandibular division of the fifth cranial nerve provides sensation to the tragus, superior helix, and superior and anterior external auditory canal. The superficial temporal, posterior auricular, and occipital branches of the external carotid artery provide the auricle's arterial supply, while the superficial temporal vein, retromandibular vein, external jugular vein, and, in some cases, the mastoid emissary vein provide venous drainage. Lymphatic drainage occurs through the parotid, posterior auricular, and cervical levels 2 and 5 lymph nodes (9). The normal anatomy of the auricle is shown in Figure 190.1.

The external ear develops from six swellings called hillocks of His, which are present at 6 weeks' gestation. The first

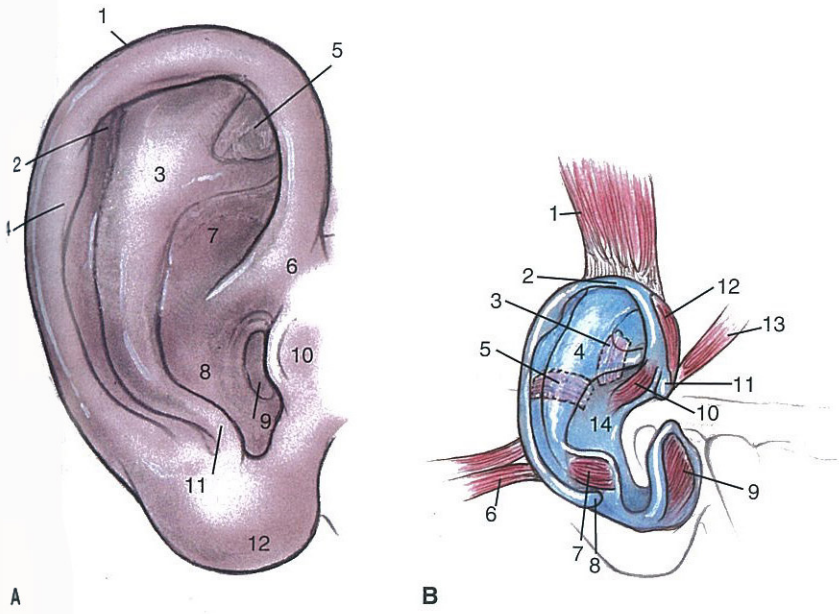


Figure 190.1 **A:** Normal external auricular anatomy. *1*, Helix; *2*, scaphoid fossa; *3*, antihelix; *4*, auricular (Darwin) tubercle; *5*, triangular fossa; *6*, crus helicis; *7*, cymba concha; *8*, cavum concha; *9*, external auditory meatus; *10*, tragus; *11*, antitragus; *12*, lobule. **B:** Normal external and internal auricular musculature. *1*, Auricularis superior; *2*, helix; *3*, obliquus auriculae; *4*, antihelix; *5*, transversus auriculae; *6*, auricularis posterior; *7*, antitragicus; *8*, cauda helicis; *9*, tragicus; *10*, helicis minor; *11*, spina helicis; *12*, helicis major; *13*, auricularis anterior; *14*, concha.

three hillocks of His develop from the first branchial arch into the tragus, helical crus, and helix, while the second three hillocks of His develop from the second branchial arch into the antihelix, antitragus, and lobule (Fig. 190.2). The hillocks of His are fused by 12 weeks' gestation and reach a final shape around 20 weeks' gestation (9,10).

The ear generally reaches 85% of its ultimate vertical height, 5 cm, by 3 years of age and is nearly full size, 6 cm, by 5 years of age. From this point on, the helix will grow relatively little, while the lobule will grow to a much greater degree, disproportionately lengthening with advancing age (9,11). In general, men have a slightly larger pinna and greater distance from the lateral orbital rim to helical root than do women; these distances are usually equal for each individual and on average measure 6 cm. Ear width, on the other hand, is usually just over half its height. Ear protrusion can be measured by either its distance from or angle to the scalp. The average distance from the helical rim to the scalp is 1.5 to 2 cm while the average auriculocephalic angle is 20 to 35 degrees (Fig. 190.3) (12,13).

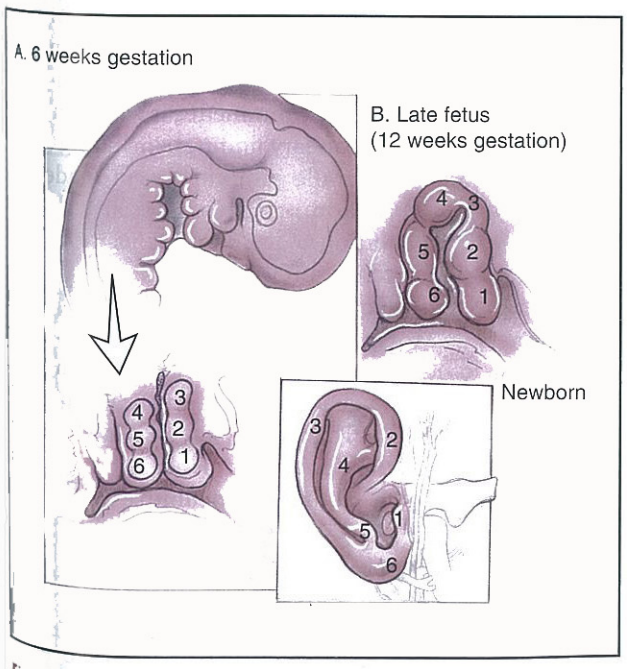


Figure 190.2 Normal ear development from the hillocks of His.

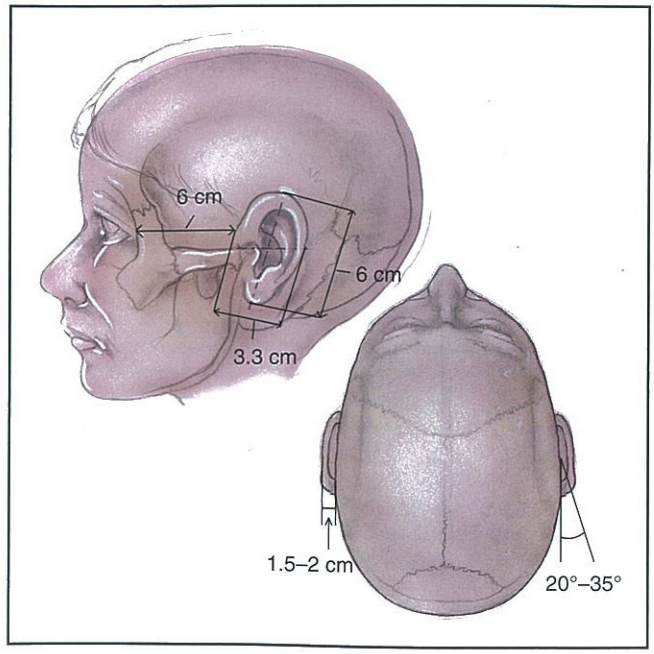


Figure 190.3 Normal ear dimensions.

AURICULAR ANOMALIES

Etiology and Classification

Auricular anomalies occur in approximately 5% of the population, either in isolation or as part of a syndrome (14). Most auricular anomalies are sporadic, but some are hereditary. Their etiologies include genetic mutations, *in utero* insults from exogenous factors, compression from external forces, and abnormal intrinsic ear musculature. There is a wide range of degree to which these anomalies can occur, and there are a number of classification systems, based on extent of anomaly and extent of surgical intervention, that have been devised to group them. Many of the early classification systems were combined by Weerda in 1988, dividing anomalies into first-, second-, and third-degree dysplasia (Table 190.1) (15). In 1997, Tan et al. proposed an even more simplified system that takes ear molding techniques into account and divides anomalies into two groups: deformational auricular anomalies and malformational auricular anomalies. Deformations result from external forces that cause abnormal architecture of tissue that is otherwise normal, while malformations result from abnormal tissue development that leads to abnormal architecture. Deformational auricular anomalies can be manually reduced to create a nearly normal appearance and can be treated early on with ear molding techniques or later with surgery. Malformational auricular anomalies, on the other hand, cannot be manually reduced to a normal appearance. These anomalies require surgery but can, in some cases, be partially treated with ear molding techniques if they also contain deformational components (16,17). In general, these classification systems are useful in clinical evaluation and determining the types of intervention that will be most helpful. However, it is important to keep in mind that auricular anomalies do not always fit cleanly within a single category and a number of treatment options should be considered in every case.

TABLE 190.1 AURICULAR DYSPLASIA CLASSIFICATION SYSTEM BY WEERDA

	Anatomic Definition	Surgical Definition
First-degree dysplasia	Most structures of the normal auricle are recognizable Minor deformities	Reconstruction does not require the use of additional skin or cartilage
Second-degree dysplasia	Some structures of the normal auricle are recognizable Moderate deformities	Partial reconstruction requires the use of additional skin and cartilage
Third-degree dysplasia	None of the structures of the normal ear are recognizable Severe deformities	Total reconstruction requires the use of additional skin and large amounts of cartilage

Deformations

Stahl Ear

Stahl ear, alternatively known as Satyr ear, Spock ear, and Vulcan ear, is a first-degree or deformational auricular anomaly characterized by an abnormal transverse crus from the antihelix to the posterior superior helical rim and, often times, an absent superior crus (Fig. 190.4). It may be caused by external forces *in utero* or perhaps an abnormal course of the transversus auriculae, one of the intrinsic muscles of the ear (18). Stahl ear can be treated with molding techniques, suturing techniques, or excision of abnormal cartilage (19,20).

Cryptotia

Cryptotia, a term that means hidden or pocket ear, is a condition in which the superior helical cartilage is buried under the skin (Fig. 190.4). This deformity is thought to be caused by an abnormal attachment of the superior auricular muscle to the scapha rather than to the triangular fossa as well as a shortened transversus auriculae, effectively pulling the superior helix under the skin during development. This condition can be treated with molding or by releasing the superior helix from the scalp with skin grafting, advancing the resulting postauricular defect, performing a Z-plasty, or performing a trefoil flap, a flap consisting of three symmetric triangles based at the superior auricle that is used to cover the posterior cartilage upon release (21,22).

Prominent Ear

The prominent ear is a type of deformational auricular anomaly characterized by an absent antihelical fold and deep conchal bowl (Fig. 190.4). These deformities increase the auriculocephalic angle and the distance from the scalp to the helix. In addition, the prominent ear will often demonstrate a number of secondary findings, including a large helical root, excessive lobule projection, and inadequate helical curl. This condition has been associated with an abnormally distal insertion of the antitragicus muscle that extends along the anterior surface of the ear from the antitragus to the antihelix, pulling the helix laterally during development (23). Ear molding techniques may be successful early in life but, unlike with certain other ear deformities, often fail to adequately treat this condition if older than 3 months (16,24). This failure may be related to resistance created by the antitragicus muscle. In many cases, surgical intervention is required for definitive treatment.

Malformations

Constricted Ear

Constricted ears are characterized by partial absence of cartilage at the upper third of the helical rim and sometimes

the concha, resulting in a purse-string effect at the helix (Fig. 190.4). This type of malformation can be classified as either first- or second-degree dysplasia depending on its severity. Constricted ears will demonstrate a combination of helical lidding, protrusion, low position, and decreased size. This category is variably labeled as cup, lop, and cockleshell ear, among other names, in various sources. This malformation can be found in a number of inherited syndromes but is usually sporadic when isolated.

The findings in constricted ears can be divided into three groups based on severity and the treatment that is needed for correction. Mild constriction involves the helix only and can often be corrected with molding techniques as a neonate or later with an otoplasty technique similar to that used for prominent ears. Moderate constriction and severe constriction, however, are defined by hypoplasia of both the helix and scapha and require surgical intervention. Moderate constriction often requires a V-Y helical

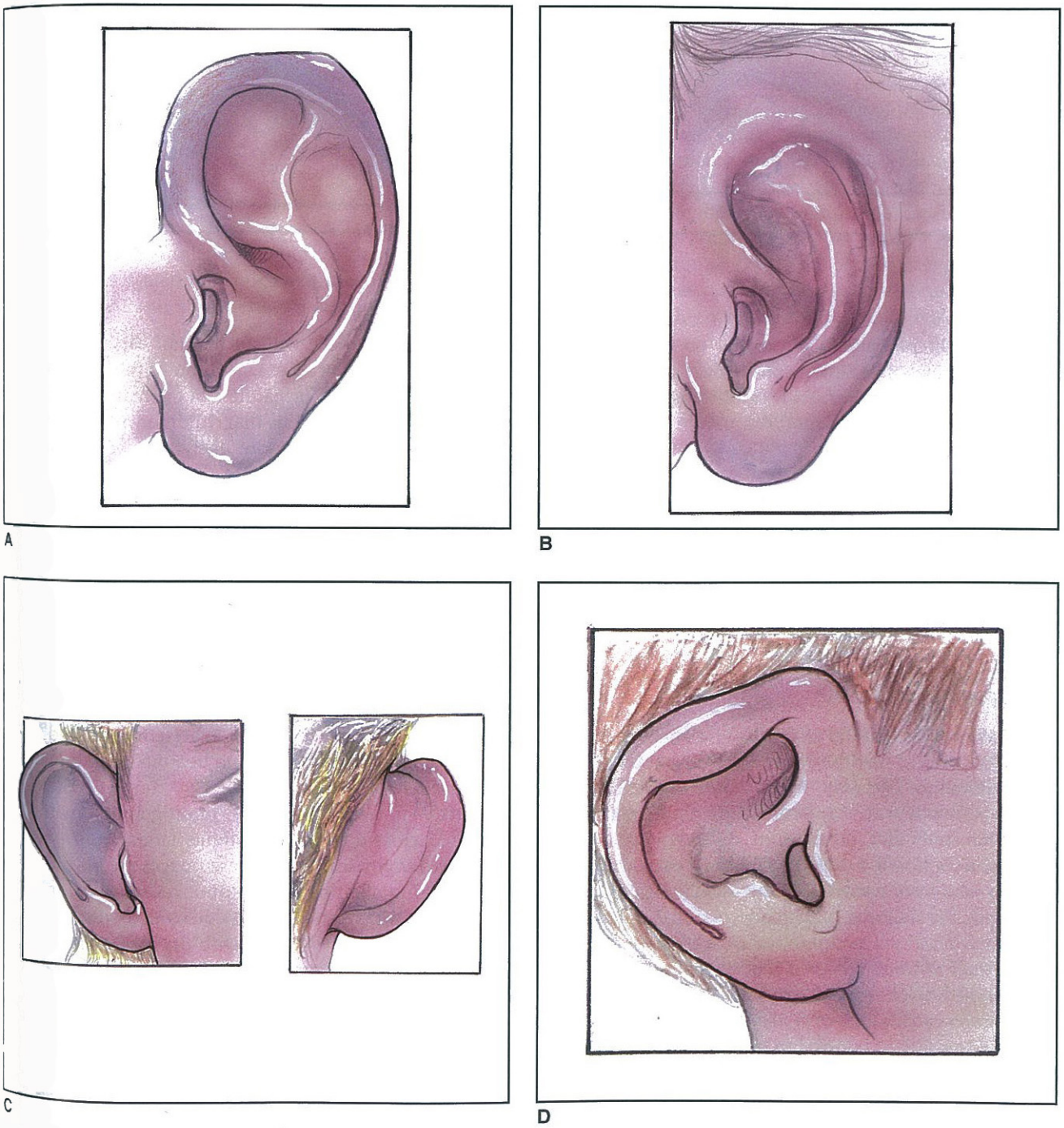
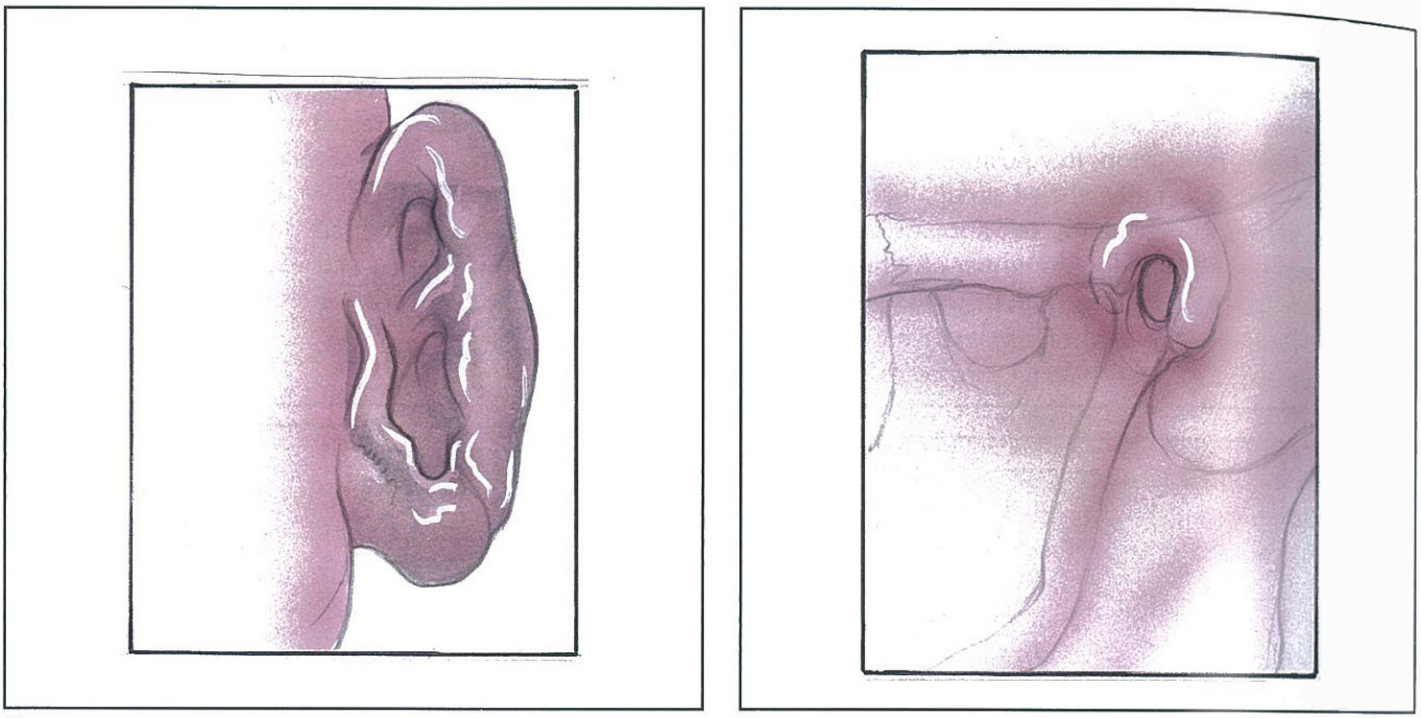


Figure 190.4 **A:** Stahl ear. **B:** Cryptotia. **C:** Prominent ear. **D:** Constricted ear.



E F

Figure 190.4 (*Continued*) **E:** Microtia. **F:** Anotia.

root advancement as well as conchal or sometimes rib cartilage grafting (25). Severe constriction requires subtotal auricular reconstruction with rib cartilage grafting and postauricular skin recruitment (26,27).

Microtia

Microtia is hypoplasia of a majority of the pinna, while anotia is the complete absence of the pinna (Fig. 190.4). These malformations may or may not spare the external auditory canal and are types of third-degree dysplasia. Total auricular reconstruction for microtia and anotia is not addressed in this chapter.

Psychosocial Issues

There have been a handful of studies and anecdotal observations regarding the psychosocial impact of various facial anomalies. The majority of these studies, however, concern children with significant craniofacial malformations. One study that did examine children with isolated ear anomalies noted a 40% incidence of ear anomaly in children who were residents of the Mental Health Center of Norfolk, the majority of which were noted to have had adjustment reactions in childhood or adolescence (12). It is important to note, however, that no evidence of causation could be determined. A more recent study by Sheerin et al. compares children with prominent ears to children with facial port-wine stains and suggests that self-esteem, social, and attention problems may be even more severe in the group with prominent ears. Although the groups were small, the study's authors believe this difference could in part be due to decreased familial support and recognition of deformity in those with prominent ears, who may be thought of as having an exaggeration of the normal rather than a true deformity. Regardless of the reason for this difference, this study suggests that children who are bothered by their ears are much more likely to have psychosocial problems (28). Further studies may help to determine if otoplasty can help to improve psychosocial adjustment in this population.

PATIENT SELECTION

Initial Evaluation

There are several steps that should be performed when evaluating a patient with auricular dysplasia. The patient's unique ear anatomy should be analyzed, goals and expectations should be addressed, and treatment options should be considered that best meet the agreed-upon goals.

First, the ears should be photographed with full-face and close-up frontal, oblique, lateral, and posterior views. After physical exam, these images are an important adjunct for evaluating the anatomic causes of deformity as well as any differences on one side compared to the other. These images can be viewed with the patient to facilitate a discussion about goals and expectations for treatment, realistic outcomes, and the appropriate techniques that could be employed to achieve this result. In addition, measurements of ear height, width, and distance from the scalp as well as the auriculocephalic angle are useful. Together, these images and measurements can be used to objectively document postoperative and long-term follow-up changes (29).

Nonsurgical Treatment

If a deformational auricular anomaly is identified in a neonate or, according to some, select older individuals, molding techniques should be considered. These techniques usually involve placing a bendable splint along the helical rim, antihelix, and conchal bowl and taping it in place to hold the ear in an appropriate position for 2 to 12 weeks. Molding is able to correct up to 90% of deformational auricular anomalies if started within the first week of life (30,31). Most authors only advocate molding for neonates, but there have been some reports of successful treatment of older children (32). In general, after 3 weeks of age, molding is less successful. Yotsuyanagi noted that improvement declines from 80% if molding is started at 1 to 3 months of age, to 33% if molding is started after 9 years of age. In general, molding failures in this study were most common with moderately and severely constricted ears as well as prominent ears (24,33).

In 2011, Leclere et al. reported a series of 17 patients with prominent ears and an average age of 34.5 years who underwent laser-assisted cartilage reshaping, a new technique in which the ear is treated with an erbium/glass laser to reshape the cartilage without any anesthesia and molded into the desired shape with a silicone splint. The splint is then worn at all times for 2 weeks and then at night only for 4 weeks. At a 30-month follow-up appointment, two patients had incomplete shape correction, which was thought to be related to incorrect splint design and contact dermatitis, and five patients had slight ear asymmetry. Overall, 10 of 17 patients obtained the desired result (34). Although only small series have been published about this technique, it may become a preferred method of treatment in the future.

Ear molding is certainly an attractive option for neonates and perhaps select older children or adults who do not wish to undergo surgery. Importantly, one must gauge a patient's ability to tolerate the discomfort, time, and effort required to wear an ear splint consistently for a period of time. In the future, laser-assisted cartilage reshaping may significantly increase the success rate of molding, although more studies are needed. Surgery can always be performed at a later date for those who do not achieve the desired correction with molding alone.

Surgical Candidates

Prominent ears generally result from a combination of insufficient antihelical fold and excessively large conchal bowl and have been defined in a number of ways. Some define ear prominence as an auriculocephalic angle greater than 40 degrees or a helix to scalp distance greater than 2.5 cm (35). Of the two major components of prominent-ear deformity, unfolding of the antihelical fold has been found to contribute to 73% of ear prominence.

Regardless of published standards, prominent ears, for many people, are primarily a psychological concern, and most will present with their own ideas of how their ears should be. For example, men may present wanting ears very close to the scalp because of balding or a desire to wear their hair short. Women, on the other hand, may tolerate less correction because of longer hair and a greater ability to cover their ears. Alexander et al. (36) found discordance between researcher- and subject-defined ear prominence, with the principal investigator reporting ear prominence in 10% of subjects, but self-reported ear prominence in only 2%, leading the authors to conclude that an ear is prominent when the patient says it is. In a minority of patients, however, prominent ears may interfere with the ability to perform a job or wear safety equipment. Salgado reported a case series of U.S. Army soldiers who underwent otoplasty because of the inability to wear Kevlar helmets without developing skin breakdown along the lateral surfaces of their ears (37). When prominent ears interfere with safety in such a manner, otoplasty is certainly indicated. Constricted ears, however, will often demonstrate more noticeable deformity and are not as subjective of a finding as are prominent ears. Nevertheless, they are apt to produce the same psychological concerns.

Otoplasty has traditionally been delayed until 5 years of age, at which point the ear has nearly reached its adult size, reducing concern for postoperative growth disturbance, and the child has not yet entered grade school, a time before peer ridicule becomes a significant concern. This convention has been challenged, however, and much younger patients, as young as 9 months, have undergone otoplasty without any evidence of altered cartilage growth over a course of several years. The rationale for otoplasty at an earlier age is the observation of excessive caregiver and family focus upon the ears as well as the development of self-image prior to 5 years of age (38,39). Performing otoplasty at an earlier age, however, remains controversial. In a survey of surgeons, psychologists, and parents with children who had undergone otoplasty in the United Kingdom, a majority recommended otoplasty after 6 years of age (40). Regardless, when considering otoplasty in a child, it is imperative to stress to the parents the importance of postoperative care and protective dressings. If it is unlikely that the postoperative care will be tolerated, otoplasty might be best deferred to a later time.

SURGICAL TECHNIQUES

Otoplasty for the Prominent Ear

The main goals of otoplasty for the prominent ear are to create an antihelical fold and reduce the auriculocephalic angle to about 15 to 25 degrees. In addition, a prominent, lateralized helical root and lobule can worsen with otoplasty and often require reduction as well. A wide variety of techniques have been described to achieve these goals and a selection of landmark and novel modifications is presented below, followed by our preferred technique.

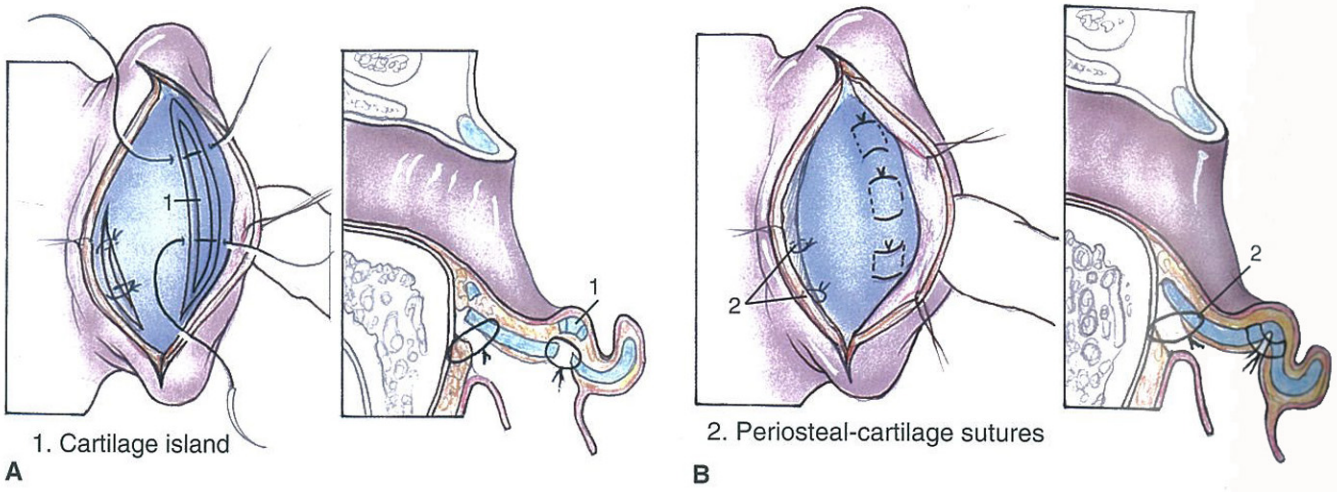


Figure 190.5 Comparison of cartilage-cutting **(A)** and cartilage-shaping **(B)** otoplasty techniques.

In 1955, Converse et al. (41) recreated the antihelical fold by making two parallel incisions on either side of the planned antihelix and suturing the edges from either side of the cartilage island together (Fig. 190.5A). In 1959, Farrior (42) described a modification of this technique, excising thin, longitudinal wedges of cartilage posteriorly at the superior crus and antihelical fold; creating a cartilage island at the planned antihelix; and stabilizing the new folds with suture. Hatch (43) noted that the helical root was often displaced laterally in otoplasty and, in 1958, reported securing the helical root to the temporalis fascia to alleviate this problem.

In 1963, Mustarde (44) described a less invasive technique of recreating the antihelical fold, using three permanent horizontal mattress sutures to secure the auricular cartilage to itself without making any cartilage incisions (Fig. 190.5B). In 1967, Kaye (45) described anterior cartilage scoring at the planned antihelical fold with toothed forceps, followed by suture fixation as well as removal of an ellipse of conchal cartilage if needed. In 1968, however, Furnas described a less invasive technique of conchal bowl reduction, simply securing the conchal cartilage to the mastoid periosteum posteriorly. The lobule was reduced by excising a posterior ellipse of skin (46). In 2001, Erol (47) described an anterior approach to otoplasty, placing their incision along the conchal bowl rim, excising a portion of conchal cartilage, scoring the anterior surface of the cartilage to create an antihelical fold, and securing these changes with horizontal mattress sutures.

Incisionless otoplasty was first described by Fritsch in 1994 and involves percutaneously scoring the anterior surface of the cartilage at the planned antihelical fold, creating a small opening at the postauricular sulcus and removing soft tissue for a conchal setback if needed, percutaneously placing horizontal mattress retention sutures from the posterior side of the pinna to create the antihelical fold and pull the concha posteriorly and burying the knots by pulling skin over them with a single-prong skin hook. The lobule is brought posteriorly by percutaneously dissecting the cauda helicis from the pinna and using the same percutaneous suture technique to secure it to the posterior conchal bowl (48).

In 1999, Epstein et al. (49) described the use of electrocautery to perform partial-thickness ablation of a thin, longitudinal strip of cartilage along its posterior surface at the planned antihelix. The new antihelix was then stabilized with horizontal mattress sutures. Ragab (50) described a modification to this technique in 2010, using the carbon dioxide laser instead of electrocautery in an attempt to curl the cartilage in a controlled fashion.

In general, these techniques fall into one of two categories: cartilage-cutting or cartilage-shaping. Cartilage-cutting techniques involve the incision or scoring of cartilage to create a permanent change to the cartilage shape. These techniques may be best suited for thick, stiff cartilage and often allow greater control over the end result. However, there is greater risk of creating sharp edges and irregularities that are extremely resistant to revision. Cartilage-shaping techniques, on the other hand, involve repositioning the cartilage with sutures to create a more natural shape without the risk of sharp, unnatural-appearing cartilage edges. The end result can easily be adjusted but carries with it the risk of a suture breaking and the ear springing back to its original position.

The surgeon must understand the risks and benefits involved with these techniques. Whenever possible, the senior author (SRM) prefers to use the cartilage-shaping techniques originally described by Mustarde, Furnas, and Hatch. The following is a detailed description of this procedure.

DESIGNING THE INCISION

Prior to injection of local anesthesia, three key landmarks must be identified.

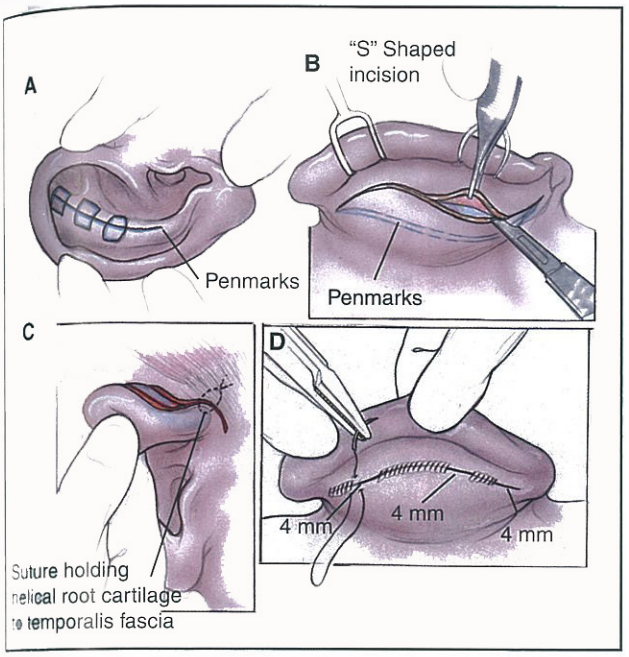


Figure 190.6 Otoplasty incision planning using Mustarde, Furnas, and Hatch techniques. First, the ear is manipulated to create an antihelical fold and Mustarde-type horizontal mattress sutures are planned **(A)**. The ear is then pushed against the scalp and an ellipse of skin that can be excised is marked **(B)**. The planned postauricular incision is extended to the helical root for repositioning to prevent persistent superior ear prominence **(C)**. When closing the postauricular incision, three 4-mm gaps are left (marked by arrows) as a controlled drainage pathway to prevent hematoma **(D)**. It is important that these gaps not overlie any stitches.

1. Antihelical fold: The ear should be gently squeezed to identify a naturally appearing antihelical fold (Fig. 190.6A). It is important to mark the central portion of the antihelical fold. This line should not be straight but a gentle anteriorly sloping curve that will create a more natural antihelical fold. We prefer to mark out the future placement of our Mustarde-type horizontal mattress sutures at this time.
2. Conchal setback: A cotton-tipped applicator can be used to press the conchal cartilage against the mastoid to determine where the conchal setback sutures will be placed (Fig. 190.7A and B).
3. Helical root: The placement of the helical root suture should be determined by gently pushing the helical root anteriorly and superiorly against the soft tissue of the scalp in order to determine the location of the relaxed skin tension line in this location (Fig. 190.6C).

With these three landmarks identified, one should design the postauricular incision. With a finger on the area of the future Mustarde-type horizontal mattress sutures, a small dot can be made on the back side of the ear corresponding to the location of each suture. This same technique can be used to identify where the Furnas-type conchal setback sutures will be placed. This will create two lines, which form the basis of the incision (Fig. 190.6B). These two markings can then be connected with an "S"-shaped line. Now the ear can be pressed back against the scalp and an estimation of how much excess of skin should be removed can be made and the above drawn line can then be converted to a simple ellipse. A dumbbell shape is often advocated for this incision in order to decrease the chances of developing telephone ear deformity, which is discussed later in this chapter. A simple elliptical skin excision, however, can also allow one to address the helical root and lobule and perform a straightforward closure at the end of the procedure.

Injection

Despite the common medical teaching to the contrary, there is no proven contraindication specific to the ear for injecting a local anesthetic containing epinephrine. It is important to keep in mind, however, that epinephrine injection can result in a hypertensive crisis in patients who are taking certain vasoactive medications or have underlying cardiovascular disease, uncontrolled hypertension, hyperthyroidism, or pheochromocytoma (51,52). Patients with cardiovascular disease should be injected with no more than 0.2 mg of epinephrine (20 mL of 1:100,000 epinephrine); some advocate even lower maximum doses of 0.04 mg of epinephrine (4 mL of 1:100,000 epinephrine) up to every 30 minutes in patients with severe cardiovascular disease (53,54). In comparison, doses of 0.3 to 0.5 mg of epinephrine are used for treatment of anaphylaxis.

In the senior author's experience, 1:50,000 concentrations of epinephrine can be used in otoplasty without causing damage to the skin and cartilage. With this technique, the anterior and posterior sides of the ear are each injected with 2 to 3 mL of a custom mixture of 0.25% bupivacaine with 1:50,000 epinephrine. When the procedure is performed under local anesthesia alone, it is helpful to inject 1% lidocaine with 1:50,000 epinephrine followed by 0.25% bupivacaine with 1:50,000 epinephrine after initial anesthesia has been achieved. Firm pressure should be held on the anterior and posterior surfaces of the ear after injection to minimize soft tissue distortion.

Surgical Procedure

The initial skin incision is performed with needlepoint electrocautery, which helps to minimize bleeding, decreases operative time, and results in a very acceptable scar that is well hidden in the postauricular sulcus. Once the incision is complete, the ellipse of skin is excised either sharply or with electrocautery. The converse scissors are then used to undermine the skin in the supraperichondrial plane along the superior half of the ear where the Mustarde-type horizontal mattress sutures will be placed. This dissection should be mostly avascular as long as one remains in this plane. Once this step is complete, a second round of hemostasis is performed with the electrocautery.

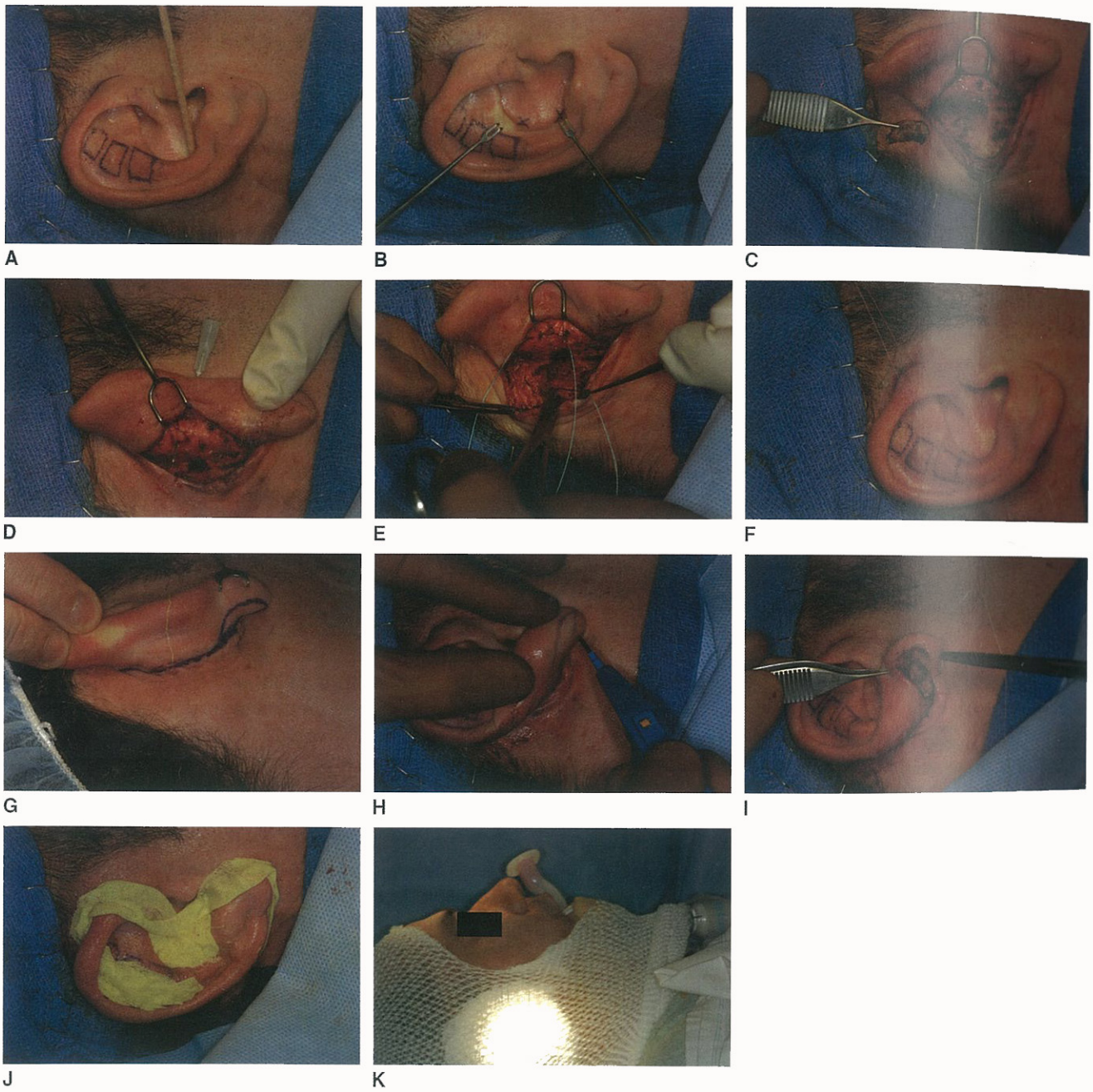


Figure 190.7 Otoplasty technique. Conchal setback sutures are planned by pushing the conchal bowl against the scalp **(A)** and marking the optimal location for suture placement **(B)**. A small amount of soft tissue overlying the mastoid is removed to allow for an appropriate conchal setback, leaving the periosteum for suture placement **(C)**. A 27-gauge needle is placed through the conchal bowl where the suture will be placed and the conchal bowl is secured to the mastoid periosteum **(D,E)**. The helical root can then be secured to temporalis fascia through an incision in a skin fold just anterior to the helical root **(F)**. The lobule can be reduced through an elliptical soft tissue excision **(G–I)**. Once complete, the ear is dressed with petrolatum gauze and wrapped with elastic net bandage **(J,K)**.

In a majority of cases, it may be easier to place Mustarde-type horizontal mattress sutures prior to Furnas-type conchal setback sutures. The reason for this is that once the conchal bowl setback sutures are placed, access to the postauricular cartilage for Mustarde suture placement may be more visually limited. However, in cases where ear prominence mostly results from a large conchal bowl, Furnas-type conchal setback sutures may be placed first without significant visual limitation. It is extremely important to modify one's technique based on each patient's unique anatomy.

Working with the surgical assistant, a repetitive set of maneuvers is then performed: A 27-gauge needle is passed

from the anterior to posterior surface in what will be a corner of the Mustarde-type horizontal mattress suture. On the back side of the ear, a cotton-tipped applicator is used to dry the cartilage, and the surgical marker is used to place a very fine dot where the needle will pierce the cartilage. This process is then repeated. In most cases, three Mustarde-type horizontal mattress sutures will be required, but two or four may be appropriate depending on the deformity. The surgeon then places Mustarde-type horizontal mattress sutures (we prefer 4-0 polyester suture), being careful to pass the needle through the full thickness of the cartilage without violating the anterior auricular skin. The initial suture is tightened to ensure that the resulting antihelix is desirable, but is then relaxed and tagged to the surrounding surgical drapes without cutting. The above process is repeated until the desired number of sutures has been placed postauricularly. The Mustarde-type horizontal mattress sutures can be tied from inferior to superior or superior to inferior depending on the case; by gently bending the pinna to create the antihelical fold, it is often evident that bending begins in one direction more naturally. Once the first Mustarde-type horizontal mattress suture is secured with a surgeon's knot, the first assistant gently pinches the edges of the newly formed antihelical fold with a penetrating towel clamp. This will allow the shape to be held in place while the operating surgeon continues to tie the sutures from the posterior side. In order to prevent the postauricular skin from catching as the suture is tied, a side-to-side "windshield wiper" motion can be performed as each knot is tied.

Preparation for Conchal Setback

Before the conchal bowl set back can be performed successfully, there must be a recipient site created into which the conchal bowl can be set. This site is created by using electrocautery to undermine a thin postauricular skin flap and remove a disc of muscle and fascia overlying the mastoid (Fig. 190.7C). It is important to leave a thin layer of tissue over the mastoid periosteum so that the conchal setback suture can be placed securely. The amount of soft tissue that is removed varies based on the amount of setback that is needed, but in general, a region of soft tissue about the diameter of a nickel or quarter and 1 to 4 mm thick should be removed.

Placement of the Furnas Sutures

Furnas-type conchal setback sutures pass through the conchal cartilage and mastoid periosteum. We begin at the conchal cartilage in a backhanded fashion such that the needle can be passed through the mastoid periosteum in a forehanded fashion, allowing better needle control for the second, more technical needle pass (Fig. 190.7D and E). Based on the cartilage rigidity and force that needs to be applied for the conchal bowl setback, the surgeon may use a combination of one or three 4-0 or 3-0 sutures. For example, in a younger patient with more elastic cartilage, two 4-0 polyester sutures are usually adequate, but in an adult patient with more calcified cartilage, two or three 3-0 polyester sutures may be indicated. It is always best to place the sutures loosely initially and tie them later, just as in creating the antihelical fold. The first assistant can hold the conchal bowl in correct position with a cotton-tipped applicator while the operating surgeon throws surgeon's knots, again with a "windshield wiper" motion.

Helical Root Positioning

An observant surgeon will notice that often after a combination of Mustarde and Furnas sutures, the helical root will almost always protrude laterally. If not corrected, this result will persist postoperatively and is the upper component of the telephone ear deformity. This area of the ear may be overlooked in cosmetic otoplasty but is as important of an area to control as the antihelical fold and the conchal setback. When needed, a helical root incision should be marked prior to the injection of local anesthetics along a natural skin crease (Fig. 190.6C). A small, 6- to 10-mm stab incision is made with a number 11 blade scalpel, and a 4-0 polyester suture is placed deep in the temporalis fascia in a forehanded fashion. The suture should be well seated such that the surgeon should feel that the head could almost be lifted off the table with the suture alone. In a backhanded motion, the suture is now passed through the inferior cartilage of the helical root and tied to bring the antihelical fold into a more natural orientation relative to the newly created antihelical fold and conchal setback (Fig. 190.7F).

Closure

Because the incision at the helical root incision could leave a perceptible scar, it should be closed meticulously with either 6-0 polypropylene or 6-0 fast-absorbing catgut suture. We have achieved good results by everting the skin edges with a few horizontal mattress sutures. As the postauricular incision is closed, three 4-mm gaps are left open to allow for the egress of blood, decreasing the risk of hematoma. The three gaps are placed 5 mm from the apex of the incision, at the midportion of the incision, and at the inferior 4 mm of the incision near the lobule. Closure can be performed in a running fashion between each gap (Fig. 190.6D).

Management of the Lobule

In cosmetic otoplasty, the lobule can sometimes be one of the more challenging structures to shape and position; this is particularly true of large, fleshy lobules that lack rigidity. When the lobule needs to be positioned closer to the scalp, which occurs approximately one-third of the time, a wedge excision can often be the simplest and most direct way to proceed (Fig. 190.7G–I). The amount of tissue that must be excised can be determined by pinching the lobule along its posterior surface. An elliptical wedge of skin should

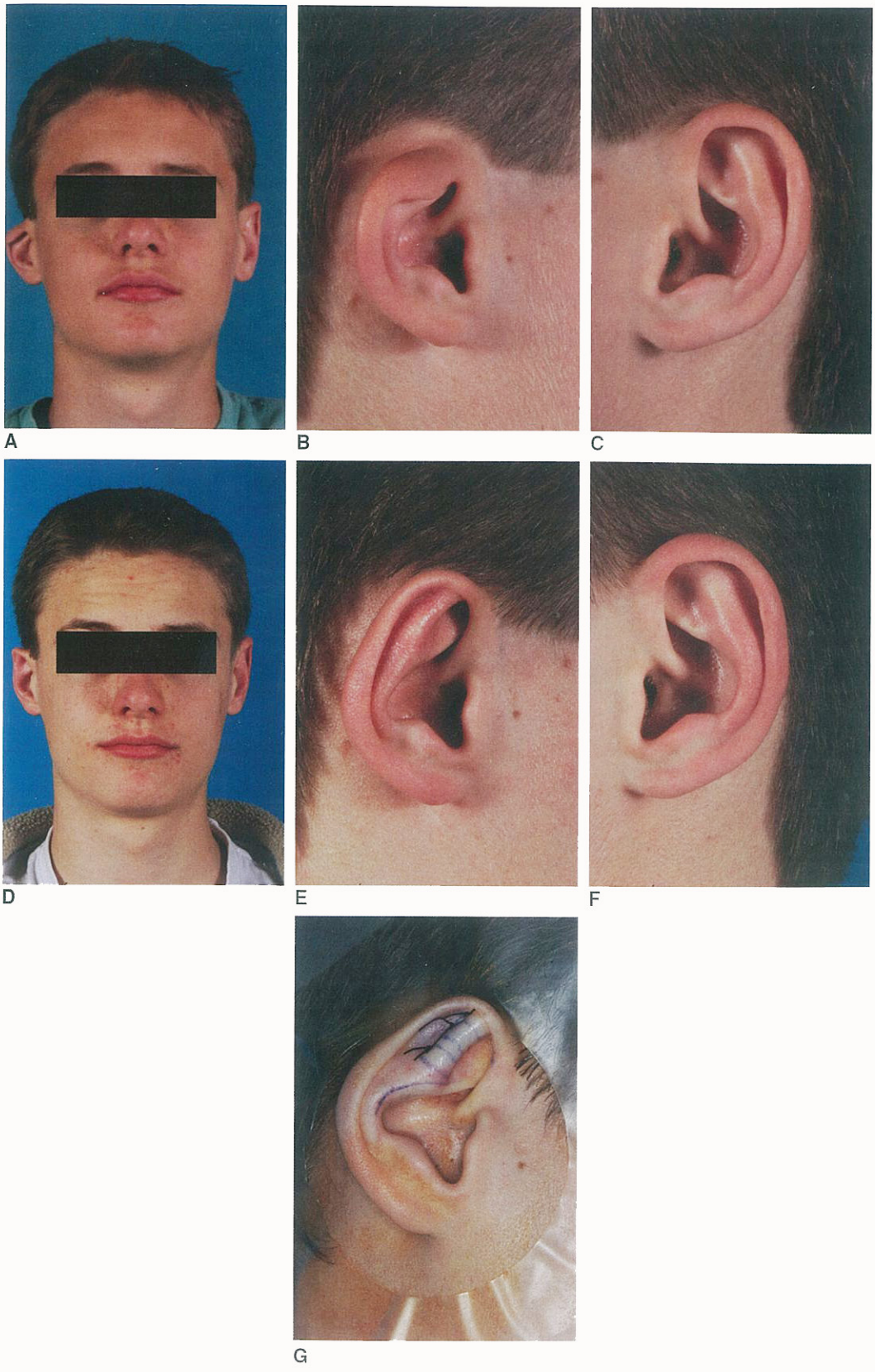


Figure 190.8 Mild to moderately constricted ear. In this 16-year-old with a mild to moderately constricted ear, the ear could be unfurled, but with a significant amount of force (**A–C**). Because the patient was older and able to tolerate an office procedure, through-and-through 4-0 silk sutures were placed transcutaneously to ascertain if they alone would hold the ear in the correct position (**G**). If these sutures had failed, the next treatment option would have been an auricular reconstruction with a partial shaved rib graft. The sutures were placed approximately 1 week preoperatively and held the ear in position. Intraoperatively, a postauricular incision was created, and several, strong Mustarde-type sutures were placed along the superior helix. This patient had a satisfactory result at the 6-week postoperative appointment and ultimately did not require a rib graft as the ear height result was a close enough match to the opposite side that the patient did not feel further surgical intervention was warranted (**D–F**). This suturing technique allowed for better preoperative decision making and demonstrates the difficulty that can be encountered when deciding on a treatment strategy for patients with constricted ears.

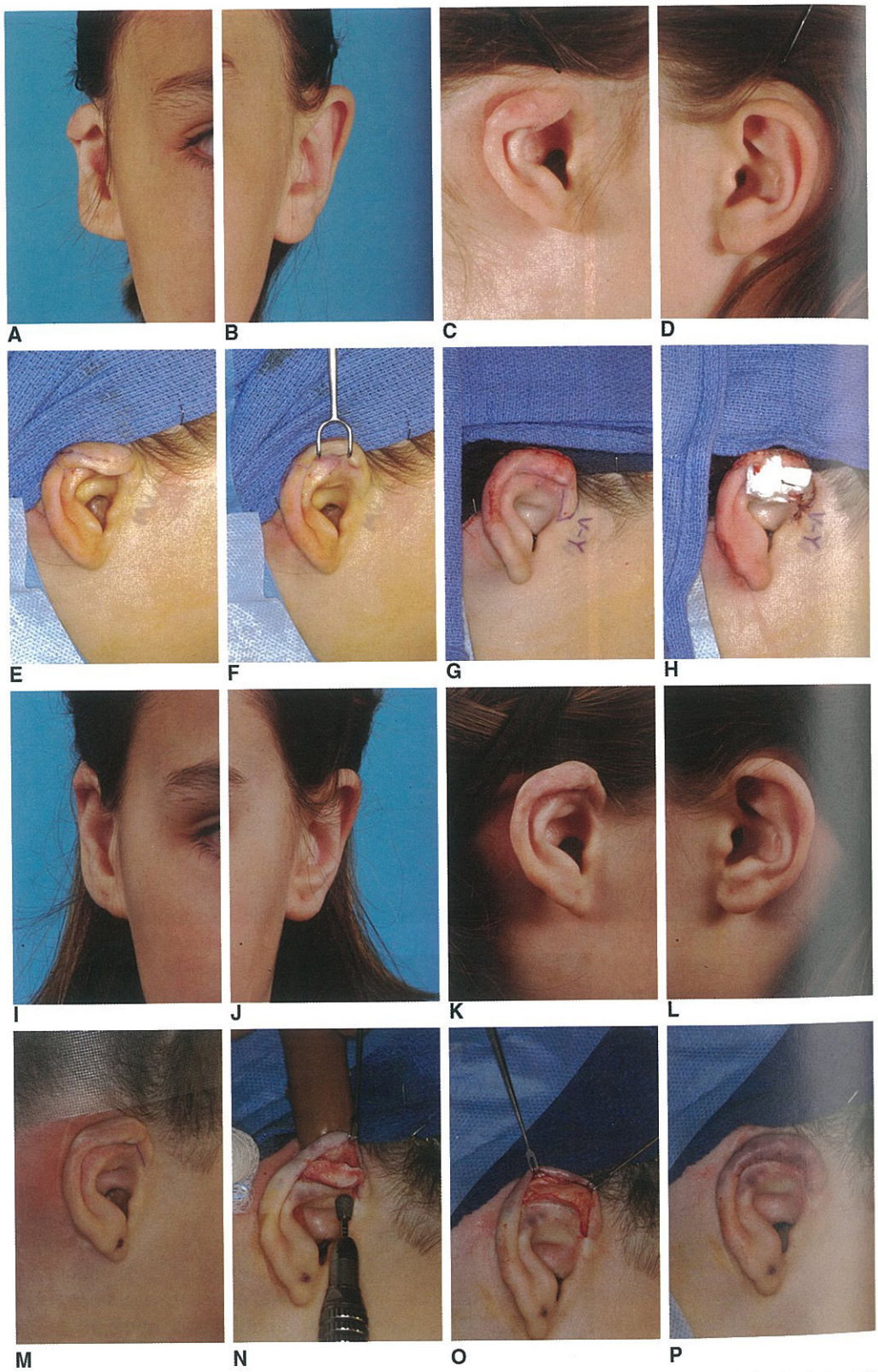


Figure 190.9 Moderately constricted ear. This 7-year-old presented with a constricted upper one-third of the ear that had been attempted to be repaired using standard otoplasty-type techniques twice without success **(A–D)**. The ear was able to be nearly completely unfurled, but was excessively cupped and seemed to be held in place at the helical root **(E,F)**. In addition, the ear had an irregular appearance, and plans were made for a two-stage procedure: the first to correct the height and shape and the second to remove the ear's contour irregularities. In the first stage, an incision was created just posterior to the helical rim along the upper one-third. The cartilage in this region was degloved along its anterior and posterior surfaces, providing broad exposure and allowing the placement of standard Mustarde-type horizontal mattress 4-0 polyester sutures to unfurl the ear. Once unfurled, the skin was brought back over the cartilaginous structure of the ear and a V-Y release of the helical root was performed, allowing the ear to achieve greater vertical height **(G,H)**. A standard bolster dressing was applied because of the wide undermining that was required. About 1 year later, the second-stage surgery was performed to improve the irregular contour of the cartilage. This delay allowed us to ensure that the ear was completely healed and had achieved adequate vertical height correction **(I–L)**. The cartilage was, again, widely degloved, and a diamond-tipped dermabrader was used to correct contour irregularities **(M–O)**. A 1 × 4 cm thick piece of AlloDerm was then evenly spread over the entire upper one-third of cartilage to provide a soft tissue cushion to the overlying skin **(P)**. A bolster dressing was again placed because of wide skin undermining.

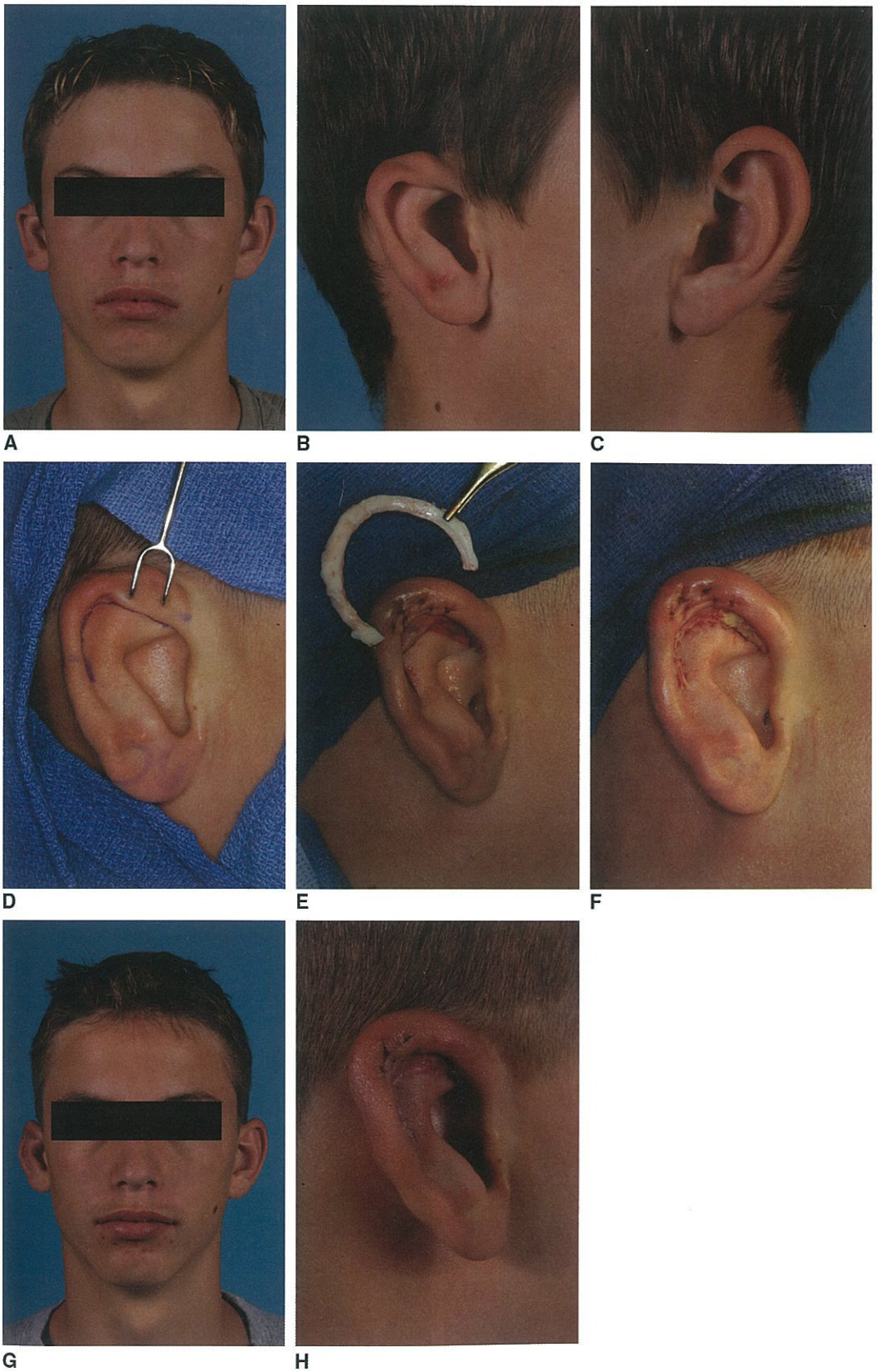


Figure 190.10 Moderate to severely constricted ear. The following 17-year-old had a moderate to severely constricted upper one-third of the ear that would not unfold in the office **(A–C)**. The patient was taken to the operating room shortly thereafter for a rib graft to obtain adequate ear height and stability. First, the anterior portion of the helix was incised to allow the ear to release. A template was made of the contralateral ear using sterilized x-ray film, similar to a standard microtia repair, in order to determine the goal for ear height. Next, 5-cm-long, 2- to 3-mm-wide partial-thickness rib graft was harvested, leaving a majority of the rib in the patient's chest, a technique that significantly decreases postoperative pain. The rib was then placed in normal saline while a standard closure of the chest incision was performed and the ear was unfurled. A soft tissue pocket was then created near the root of the helix to the midbody of the helical rim. The rib was then placed in this soft tissue pocket and held in place with through-and-through sutures **(D,E)**. Once the ear was completely unfurled and the vertical height of the contralateral ear matched, the anterior auricular skin defect where the ear had been unfurled was measured and a postauricular skin graft harvested for coverage and secured in place **(F)**. In the end, a reasonable ear was obtained and the patient was pleased with the result **(G,H)**.

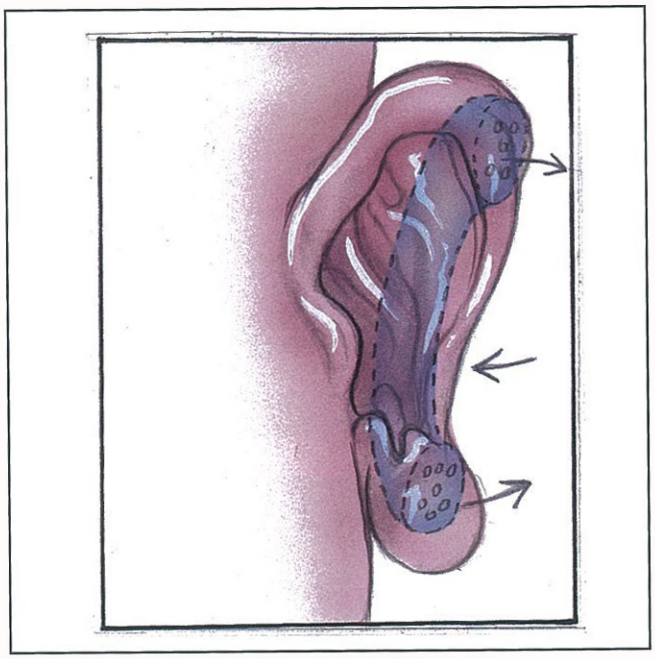


Figure 190.11 Telephone ear deformity is a postoperative result of adequate correction of ear projection in the middle one-third, but inadequate correction of ear projection in the superior and inferior one-third.

contours, keloids, suture granulomas, and extruded or broken sutures. The most common of all complications is inadequate correction of the deformity, often related to the antihelical fold or conchal setback. This problem can be addressed through revision surgery. Telephone ear deformity can be thought of as a type of inadequate correction. This problem is caused by a failure to address a laterally protruding helical root and lobule, both of which are accentuated by the creation of an antihelical fold and conchal setback (Fig. 190.11). This constellation of findings gives the ear a telephone-shaped appearance and can be addressed through revision surgery. Telephone ear deformity can be prevented by the astute surgeon by performing a helical root setback and lobule reduction at the time of initial surgery. Abnormal ear contours may result from cartilage-cutting techniques in which sharp cartilage edges can result. Revision surgery may be required to smoothen these contours. Keloids may form after otoplasty, especially in darker skinned individuals who are prone to them. Keloids can be treated with triamcinolone injection as in any other location. Suture granulomas can occur at any time postoperatively and are often noticed as a subcutaneous lump. These granulomas are treated by incising the skin and removing the suture underneath. Finally, cartilage-shaping techniques are most susceptible to sutures breaking and the ear springing back to its original position (Fig. 190.12). These sutures may also extrude and need to be removed without breaking. Revision surgery may be required in these cases as well (55–58).

LONG-TERM RESULTS

In general, the anatomic results and patient satisfaction for otoplasty are excellent (Figs. 190.13 and 190.14). Some of the immediate postoperative medialization is expected to be lost over time and seems to occur to a greater degree in cartilage-shaping techniques. Messner and Crysdale, using a cartilage-shaping technique similar to the technique described in this chapter, found that 0.9 to 5.8 mm of medialization was lost 1 year after surgery with the greatest amount of loss along the middle and superior thirds of the ear. Overall, 29% of ears returned to their preoperative positions, 28% of ears remained in their immediate postoperative positions, and 43% of ears were found

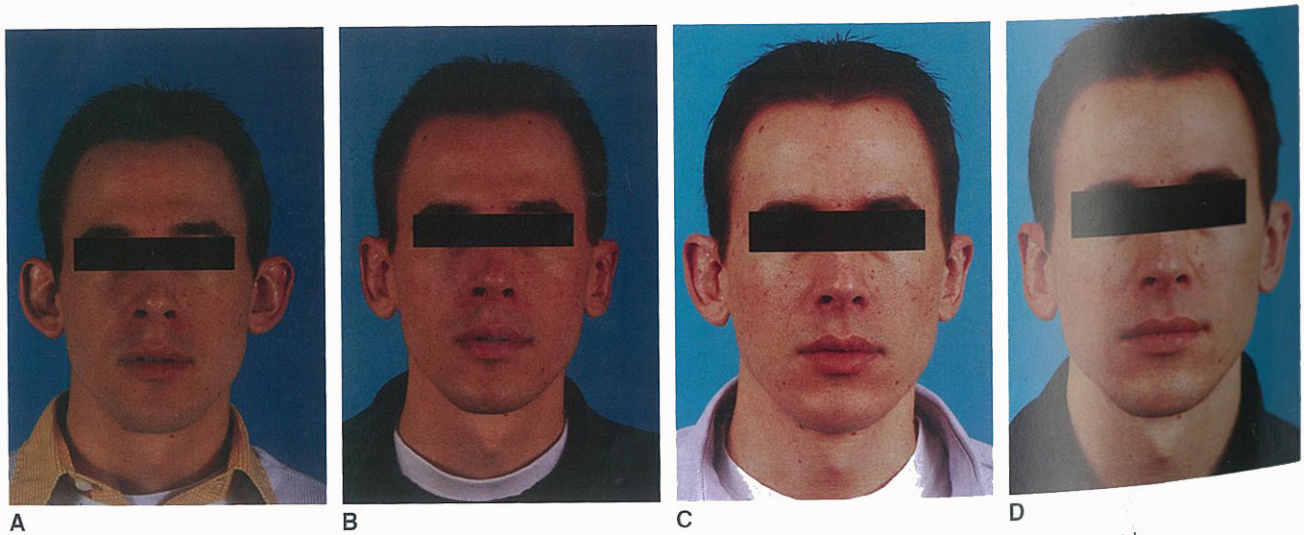


Figure 190.12 Example of suture breaking after otoplasty. **A:** Preoperative image of patient with prominent ears. **B:** Initial postoperative ear projection. **C:** Ear projection after Mustarde-type horizontal mattress suture failure at right ear. **D:** Ear projection 1 year after revision surgery for suture failure.

Figure 190.13 Result of otoplasty for prominent ears in a child. Preoperative **(A–C)** and 2-week postoperative results **(D–F)**.

...e somewhere in between. Despite a 29% return to ...perative position, 85% of patients ... happy with the results, but only 73% would choose to ...go otoplasty again (59). Schlegel-Wagner et al., using ...terior cartilage-scoring technique with posterior suture ...on, found that 2 mm of medialization was lost by ...rs postoperatively, with the majority of recurrence ... the superior third of the ear. Overall, 90% of patients and families reported either a "good" or "very good" result (60). Using a cartilage-cutting technique that involves removing a diamond-shaped section of cartilage and suturing it into a tube to create a new antihelix, Lee and Bluestone (61) found that all patients and their families were either "very satisfied" or "extremely satisfied" with the results at 4.6 years postoperatively; however, no measurements were provided.

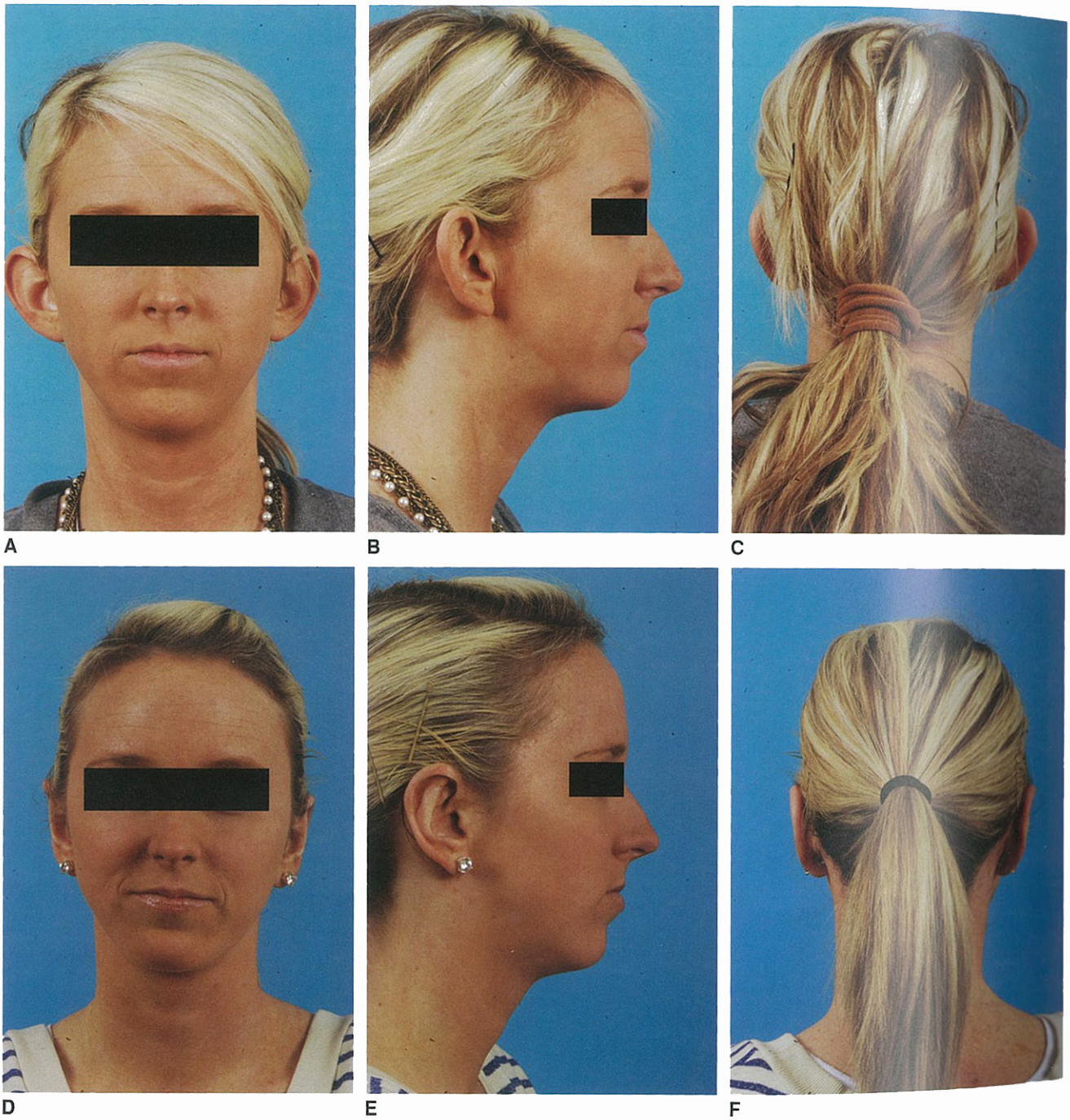


Figure 190.14 Result of otoplasty for prominent ears in an adult. Preoperative **(A–C)** and 6-month postoperative results **(D–F)**.

CONCLUSION

In treating a patient with an anomalous ear, one must consider several factors. Adequate counseling and understanding patient expectations and psychosocial concerns are paramount to patient and family satisfaction. Molding techniques should certainly be considered in newborns with ear deformities but are more controversial in older children. Laser-assisted cartilage reshaping may significantly increase molding success rates, especially in older children and adults, and become a preferred method of treatment in the future. If molding techniques do not adequately correct the deformity or if a child has a mild to moderate malformation, the otoplasty techniques discussed in this chapter may be appropriate. Otoplasty has traditionally been performed after 5 years of age, but this timing has been challenged and otoplasty potentially may be performed at an earlier age. There are a number of otoplasty techniques

that have been devised, broadly categorized as cartilage-cutting or cartilage-shaping, and the surgeon should be aware of the pros and cons of these techniques in order to adequately counsel patients preoperatively. Some degree of postoperative lateralization is likely to develop over time, and although the most common complication of otoplasty is inadequate correction, patients and their families can generally expect to be satisfied by the result. Thorough knowledge of auricular anatomy and tailoring surgical technique to each individual ear can help to achieve better, longer-lasting results.

HIGHLIGHTS

- The external ear develops from six hillocks of His that are derived from first and second branchial arch mesoderm.
- The ear reaches 85% of its adult size by 3 years of age and nearly its full adult size by 5 years of age.
- Prominent ears are characterized by an absent antihelical fold and large conchal bowl.
- There is no absolute definition of prominent ear; an ear is prominent when a patient says it is.
- Constricted ears are characterized by a purse-string appearance caused by a lack of cartilage at the upper one-third of the helix and sometimes concha.
- Auricular anomalies may impact psychosocial development.
- Ear molding techniques are most effective in neonates less than 3 weeks old and lose effectiveness with age and increasing cartilage rigidity.
- Most otoplasty surgical techniques can be broadly categorized as either cartilage-cutting or cartilage-shaping.
- Inadequate correction is the most common complication of otoplasty.
- Telephone ear results from failure to address a laterally prominent helical root and lobule.

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