

Pediatric Facial Plastic and Reconstructive Surgery

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Chapter 6: Otoplasty

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History

Otoplasty is surgery to correct protruding ears. Ely first wrote about otoplasty in 1881. In the *Archives of Otolaryngology* Ely described a 12-year-old boy who came to the Manhattan Eye and Ear Hospital with a complaint that his companions ridiculed him because of the prominence of his ears. Ely, through a postauricular incision, excised skin and cartilage to correct the protruding ear. In 1889, Keen of the Jefferson Medical College noted Ely's contribution but described a better approach to the deformity. Ely had advocated excising skin on the anterior as well as the posterior surface, which left an anterior scar. Keen described an operation solely removing posterior skin and cartilage and noted that cartilage as well as skin must be removed to obtain an adequate result. Lockett in 1910 noted the importance of the antihelical fold. Writing in *Surgery of Gynecology and Obstetrics*, this New York surgeon described again the common problem of a child being teased for his "donkey ears" and analyzed the anatomy of this deformity. He noted lack of an antihelix in these children and described a procedure to crease such an antihelix by excising a crescent-shaped piece of cartilage and closing the defect with buried mattress sutures. In addition to delineating the anatomical deformity, he very perceptively noted:

In an ear with a very thin flexible cartilage, I think it would be possible to reconstruct the antihelix and set the helix close to the head without excising a segment or even incising the cartilage, simply by fluting or folding the cartilage at the proper site, and passing the suture in such a manner as to maintain the fold.

Morestin in 1903 and Owen in 1965 described a technique of placing buried sutures to produce a controlled change in auricular shape. Mustarde, however, writing in the *British Journal of Plastic Surgery* in 1963 refined and popularized this method, which is now commonly attributed to him. Gibson and Davis' studies of the influence of incisions on the deformation of rib cartilage, and, more recently, Murakami's analysis of pig ear cartilage bending created by surgical incisions, have influenced the application of cartilage scoring techniques to otoplasty by Stenstrom and others. These authors have demonstrated that incisions made through perichondrium and into cartilage cause the area incised to become more convex.

Anatomy

Ears may be described in terms of their form, their proportions, and their position on the skull. Small discrepancies in these variables are immediately obvious to the observer, but ears do vary widely between individuals. The framework of the ear is a single, complex piece of fibrocartilage to which thin, translucent, well-vascularized skin is tightly adherent,

more so anteriorly than on the posterior surface. With increasing age, the cartilage becomes stiffer and less pliable, and the overlying skin becomes less tightly attached.

The *helix* is a gently curved incomplete oval, broader at its root or spine at the external auditory canal and thinning as it curls down toward the lobule. It is partially concave at its spine, becomes almost tubular in its mid-portion, and flattens out again at the lobule. The *antihelix* originates at the *antitragus* and follows the curve of the helix superiorly. Approximately two-thirds of the vertical distance toward the top of the ear, it divides into a sharp fold, the *inferior crus of the antihelix*, which proceeds anteriorly to dive under the overhang of the *spine of the helix*, and a less prominent broader fold, the *superior crus of the antihelix*, which fades out into the area under the superiormost part of the helix. The area between these two crura is the *fossa triangularis*. Posterior to the superior crus is the *scapha*, a narrow shelf between helix and antihelix. Medial to the antihelix is the kidney bean-shaped conchal bowl, divided by the spine of the helix into a superior portion, the *cymba conchae*, and a somewhat larger inferior portion, the *cavum conchae*. The anterior portion of the cavum conchae is the external auditory meatus. The *tragus* is a firm, thick plate of cartilage partially covering the opening to the ear canal, and is continuous posteriorly with the variably developed intertragal notch and antitragus, which itself blends into the antihelix. Between the tragus and the spine of the helix the ear cartilage is discontinuous. This *incisura terminalis* is useful for an endaural approach to the ear canal, which avoids cutting cartilage. The final part of the auricle to consider is the *lobule*. This dependent fibrofatty tissue lacks cartilaginous support and hangs from the framework of the ear. It is variable in size and shape and in its attachment to the skin of the cheek.

Several points can be defined on the ear as a whole to allow quantification of the internal proportions of the ear and its position on the skull. The most superior portion of the ear at the top of the curve of the helix is the *supraaurale*, and the inferiormost part at the tip of the lobule is the *subaurale*. Similarly, the most anterior and posterior points on the helix are termed the *preaurale* and *postaurale*. The attachment of the ear to the skull is called the *otobasion*, which is a line lying anterior to the tragus. Its superior extent where the helix blends into the skin superior to the zygomatic arch is the *otobasion superioris*, and the inferior attachment of the base of the tragus to the cheek skin is the *otobasion inferioris*.

The aesthetic proportions of the ear are difficult to describe, although disproportion is immediately evident to the casual observer. Generally, the width of the ear, defined as its widest part, should be approximately 55% of its length. The vertical midpoint of the ear is located at the root of the spine of the helix. One-third of the ear lies above the inferior crus of the antihelix. A line drawn through supraaurale to subaurale will make an angle of 15° to 30° to the vertical, and about 22° is ideal. This posterior angulation of the ear has been said to parallel the nasal dorsum; however, the nasal dorsum demonstrates a great deal of individual diversity itself. The otobasion lies at an angle of 8° to the vertical.

The ear's location on the skull is important. In the vertical plane, the top of the ear lies at brow level, whereas the subaurale lies at the level of the columella. In the anterior-posterior direction, the ear should lie one ear-length from the lateral orbital rim (or, about 6.5-7.5 cm). Finally, one must consider the projection of the ear from the mastoid plane. Although this has been described in terms of the angle the ear makes with this plane, it is generally easier to

measure the distance from the anterolateral portion of the helix. This distance should be between 15 and 20 mm.

Thus the ear as a whole should be positioned correctly on the skull in the superior-inferior and in the anterior-posterior places, and its angle of inclination should be correct. Finally, its protrusion from the skull should be neither too much (bat ears) or too little (pinned-back appearance). It is difficult to relate ear position to bony landmarks, but with these specifications as a rough guide, the eye of the surgeon as observer should be able to make the fine adjustments to produce an aesthetic placement.

Embryology

The precursors to the human ear appear in the 6th week of fetal life in the shape of six hillocks of condensed ectoderm and mesoderm surrounding the first branchial groove. Mesenchyma of the first and second branchial arches thus creates the external ear. About 85% of the external ear develops in the second branchial arch and its derivatives. The first arch contributes only to the anterior portion of the ear including the tragus, the helical tragal sulcus, and the crus of the helix. The conchal cartilage and intertragal notch develop from the mesoderm along the first branchial groove and do not derive directly from the auricular hillocks. The auricle develops in the region of the neck and later migrates to the side of the head. This accounts for some of the congenital anomalies where the auricle is significantly displaced inferiorly. In the 8th to 12th weeks of gestation the helix develops rapidly and therefore, projects forward and overlies the still underdeveloped antihelix. At this stage, it is normal for the ear to protrude; however, if in the succeeding 12th to 16th weeks the antihelix fails to unfold, the helix continues to overhang and the protrusion will persist. At birth, the normal ear is usually completely formed and rests at an angle of 30° from the head. The ear continues to grow following birth and attains approximately 85% of its adult size by 3 years of age. Slow growth may continue until approximately 6 years of age, at which time the ear has reached the average adult size of approximately 6x3 cm. The distance from the mastoid periosteum to the helical rim changes little after 10 years of age, although the ear may continue to elongate more than 1.5 cm along its vertical axis during the lifetime of the individual.

Surgical Concepts and Approaches

There is a plethora of deformities associated with the auricle, and any surgical approach must be quite individualized. There are, however, some common factors that need to be addressed in many otoplasties. The three most common problem areas in auricular deformities are (a) the lack of an antihelical fold, or the "unrolled" ear; (b) a deep conchal bowl or, perhaps more correctly, a high conchal wall; and (c) deformities, usually protrusion, of the lobule. These three problem areas are relatively distinct and can be addressed individually with a variety of surgical techniques. In this chapter we will describe some of these basic approaches and then present the approach of two surgeons to otoplasty to give an example of how these techniques can be combined.

There are three basic approaches to remodeling the auricular cartilage into a more desirable shape. The first of these is a suture technique that uses a permanent suture to remold and hold the pliable auricular cartilage in its desired shape. The various suture techniques are

most useful in children and young adults whose cartilage is quite pliable. They can give quite natural results, but are not always effective in individuals with more rigid cartilage. The best example of this technique is Mustarde's technique of otoplasty, which depends on the placement of permanent buried sutures both to create a new antihelical fold and to maintain the new shape of the ear. An antihelical fold is created by the surgeon and maintained with a bayonet forceps. Three to four points corresponding to the proposed position of mattress sutures are then marked with methylene blue. These marks are then tattooed into the ear cartilage with a needle and methylene blue. The actual surgical approach is posterior. An ellipse of skin is excised and the posterior auricular cartilage meticulously cleaned of all fibrous tissue, retaining the perichondrium. The mattress sutures are inserted through the full thickness of cartilage and perichondrium using the dye marks for guidance and then tightened to create a fold.

The problem of a prominent conchal bowl can also be addressed with a suture technique. This approach has been popularized by Furnas with his conchal mastoid sutures, which he uses to approximate the conchal cartilage to the mastoid periosteum and thus flatten the excessively deep conchal bowl against the mastoid cortex. Objections to the use of permanent, buried sutures include infection due to the presence of a foreign body, palpable or visible sutures, and ridging of the skin where the sutures cross the posterior sulcus.

The second basic approach to remodeling cartilage consists of full-thickness incisions or excisions of cartilage to correct the prominent ear. This is currently used most commonly in the concha through either an anterior or posterior approach. One can remove some aspect of the high conchal wall to allow the auricle to settle back to a more normal position. These cartilaginous defects can then be sutured to obtain the desired result. This type of excision allows one to reduce the size of the prominent concha to change the position of the auricle. In general, when full-thickness incisions or excisions are made to create an antihelical fold, one runs the risk of creating sharp edges and ridges. Most surgeons prefer to use the full-thickness cartilage incision or excision only in the concha.

The third basic approach to cartilage remodeling in otoplasty depends on the tendency of cartilage to bend toward intact perichondrium, and to bend away from a surface where the cartilage has been scored. Through a variety of approaches, both anterior and posterior, the cartilage is either abraded with light sandpaper, forceps teeth, dermabrader burrs, or special fine-toothed instruments designed specifically for this purpose in the area where the contour effect is difficult, leading to the occasional full-thickness incision with palpable sharp edges; thus, fine abrasion is preferred. To create a new antihelical fold, the surgeon will gain access to the anterolateral cartilage surface either through an anterior or posterior skin incision and lightly abrade the perichondrium and cartilage at the point where the new fold is desired. A major proponent of this approach has been Stenstrom, who has extensive clinical experience to show that abrasion with a rasp of the anterior antihelical area will cause furrowing and convexity to develop in this area and, thus, create an antihelix.

There can be multiple deformities of the lobule. The most common is a protuberance of the lobule, which can be addressed by either excising a small wedge of postauricular skin or doing some type of procedure on the cauda helix. Some advocate excising the cauda helix to produce a flat lobule. Excision can, however, result in protuberant skin with no structure to pull it medially. A cutting and repositioning of the cauda helix or a simple

suture placement to move it medially works better in most cases. A lobule that is too large and dependent can be treated by excising a full-thickness wedge in the preauricular crease. Similarly, a very large lobule can be reduced by simply excising a crescent-shaped piece of skin and subcutaneous adipose tissue just medial to the rim of the lobule.

Newborn Ear Taping

A variety of auricular deformities can occur prenatally either from abnormal development or malpositioning of the fetus in the utero. A large prospective study in Japan has shown that approximately 50% of these will spontaneously correct themselves in the first month of life. The process is actually more complex with about 45% of ears normal at birth and 84% normal at 1 year. Lop ears, for example, are present in 38% of babies at birth and only 6% at 1 year, whereas the incidence of protruding ears actually increases from 0.4% at birth to 5.5% at 1 year. The protruding ear may be caused by mechanical factors in the first year of life. Although many ears that are abnormal at birth will return to normal by 1 year, there is no way to predict which ones will. Thus, the simple nonsurgical correction described below is applicable in every case.

Recent reports have demonstrated that deformities involving malposition of a formed auricle can be corrected nonsurgically by splinting the ear in the correct position within a few days of birth. The new position is maintained for the first 2 weeks. On removal of the splint, the ear remains in its new position. The physiologic explanation for the ability of newborn auricular cartilage to be permanently remodeled in the immediate newborn period is unclear. Cartilage is an avascular network of chondrocytes embedded in a type II collagen-proteoglycan matrix. The proteoglycan matrix is stabilized by hyaluronic acid, a single polymer of which may be linked with as many as 100 proteoglycan monomers. The very high estrogen levels that exist in the neonate at birth and for the first few days of life directly increase hyaluronidic acid synthetase levels. The enzyme affects the production of hyaluronidic acid, possibly allowing remodeling of the cartilage in the new position. Relaxin, a polypeptide hormone involved in parturition, also demonstrates very high serum levels in the immediate pre- and postpartum period. Relaxin has a profound effect on the fibroblasts and collagen of the pubic ligament, and has been recently shown to have a demonstrable effect on skin during tissue expansion. This effect is thought to occur through a disruption of the cross-linking of collagen in the extracellular matrix. High relaxin levels might also allow the auricle to remodel in the immediate postpartum period. Clinical experience shows that, whatever the underlying cause, the splint must be applied in the first few days after birth to be effective.

Two Individualized Approaches to Otoplasty

Multiple techniques are available to address the anatomical problems seen in the deformed ear. Surgeons tend to select those techniques that work best in their hands. To obtain a practical approach to otoplasty, two individual surgeons' approaches will be discussed. Obviously, each surgeon's technique is an amalgamation of the individual creative contributions of the pioneers in this field.

In our practice (WFL) a careful analysis of the ear is first performed to describe the specific anatomical deformity that needs correction. In general, the ear or ears involved have

some combination of a prominent concha, a lack of antihelix, and a malposition of the lobule. The ear with a prominent concha only can be treated quite easily with the conchal setback or conchal reduction procedure, which is described below. The ear with solely a lack of an antihelix is treated with a Mustarde suture technique only. For the majority of ears there are a combination of these two problems and both techniques are utilized. Problems with the lobule are addressed independently. In the physical examination cartilage pliability as well as symmetry is noted. Any specific deformity in the area of the lobule is described. If there is a tendency toward a "telephone ear" where the midportion of the ear is closer to the head than the superior and inferior portions that is noted. Standard photographs are taken. These generally involve frontal, posterior, and lateral views. Measurements of the distance from the mastoid skin to the helix are made on both sides.

The procedure can be performed under either general or local anesthesia. Children are best done under general anesthesia and adults can usually be managed quite nicely with local. Children are not operated on until age 5 to 6. A subcutaneous field block is all that is required for the anesthesia. Careful aseptic technique is used throughout the procedure. The patient is usually given prophylactic antibiotics due to the incision of cartilage and the permanent sutures placed. A stockinette dressing is placed over the entire head with openings created for the ears and face. A plastic eye sheet drape is used to maintain sterility of the operative field. If a conchal prominence is present, one first manually places the ear in an appropriate position and places a few dots in the postauricular sulcus to define where the new sulcus should be located. These dots generate a small wedge of tissue for excision. It is important not to overexcise skin in this area and not to create too shallow a postauricular sulcus. Incisions are then made perpendicular to the perichondrium of the posterior aspect of the auricular concha, and all intervening soft tissue is removed. In children it is important to use care because of the more superficial location of the facial nerve. Simply removing the excess soft tissue allows the ear to lie in a more natural position. The depth of the soft tissue is frequently underestimated and as can be seen, it is considerable. Simply removing this soft tissue in many cases will provide adequate setback. Once the auricle is in position against the mastoid periosteum, the surgeon can then remove cartilage as needed from the concha to create the desired ear position. By using a #11 blade, one can carefully shave small segments of the apex of the concha (actually the eminentia) until the ear is appropriately placed. By shaving parallel to the ear with the finger on the anterior surface, an automatic contouring is performed so that no sharp edges are visible. This part of the operation is quite straightforward but must be individualized with variable amounts excised from the different prominences, depending on the patient. The eminentia cymba concha, eminentia cavum concha, and eminentia fossa triangularis are individually treated to achieve symmetry and appropriate position of the ears. Once the appropriate amount of setback has been achieved, attention can be turned to the antihelix. With the Mustarde suture technique, usually three horizontal mattress sutures are used to define the antihelix. Mustarde originally described the technique using white silk sutures. We prefer 4-0 Mersilene, as it is less reactive. It also has good holding characteristics when the knots are snugged individually. Three sutures are usually placed to create the antihelix; more or fewer may be required in a given case. To facilitate suture placement, it is sometimes helpful to fold the antihelix with the forceps into the desired position and then to mark the proposed suture sites externally on the skin. Using a 20-gauge needle with methylene blue dye, one can perforate through these holes and mark the underlying cartilage for the suture site. From the postauricular incision one can then carefully dissect the skin flap up to the helix and visually see the dye marks where the suture

should be placed. It is crucial to remove all soft tissue attachments from the perichondrium to allow remodeling of the fold. Sutures are best placed from the postauricular approach with one finger on the anterior aspect of the ear to ensure proper level of the needle. The needle should pass through the posterior perichondrium, cartilage, and the anterior perichondrium (but obviously not through anterior skin), and then back in the same fashion. It is quite important to pass through the anterior perichondrium or the suture may tear through and not maintain its position. After a single horizontal mattress suture is placed and tied with a surgeon's knot, it is snugged and visually examined to see if it is creating the fold of the desired position and contour. This individual suture is then loosened and the other sutures placed. If the sutures are tied after each individual placement, it becomes quite difficult to place the sequential sutures. Once all of the sutures have been placed, they are sequentially tied from superior to inferior while the ear is held in its new position externally. Care is taken not to include any unneeded soft tissue in the sutures themselves. The contour of the antihelix is then carefully inspected and if there are any asymmetries or problems the sutures are replaced at this time.

The majority of the problems with the antihelix can be quite nicely handled by the simple Mustarde technique. There are, however, times when the cartilage is thickened and will not easily conform with a suture technique. We are prepared at the time of surgery in these cases to proceed with an abrasion of the anterior surface of the antihelix similar to that described by Stenstrom. Stenstrom described the mechanical tendency of the ear to curl away from the area where perichondrium is excised. Thus, by using a small rasp to abrade the perichondrium and thin the cartilage slightly on the anterior part of the antihelix, one can facilitate bending with the Mustarde sutures if the cartilage appears somewhat intransient.

The ear is then set back into its new position against the mastoid cortex and three conchal mastoid sutures passed from the mastoid periosteum to the perichondrium of the auricle. It is a technical error to excise too much of the conchal bowl when doing a combined conchal and antihelical procedure because it may leave too little conchal bowl to obtain adequate purchase for the Mustarde suture.

After the ear has been placed into its new position the lobule is evaluated. If the lobule is slightly prominent, it can usually be corrected by excising a wedge of skin posteriorly. If this is not adequate or if the prominence is quite significant, a suture is placed from the cauda helix to the more medial soft tissue to pull the cauda helix and thus the lobule medially. Although the cauda helix can be excised in these cases, it sometimes leaves the lobule still protuberant with no firm structure with which to mobilize it. Other problems of the lobule such as excessive lobule size are then addressed at this point in the operation.

After obtaining hemostasis with the bipolar cautery, a rubber-band drain is placed in the postauricular area and the incision meticulously closed using a subcuticular 5-0 nylon or Prolene. The subcuticular suture is left long, so that it can be pulled out at a later date without pulling the ear forward. After the second ear is recontoured, careful examination is performed to ensure symmetry between the two ears and any corrections are made as needed. Although it is not necessary to significantly overcorrect the ear, there is usually some minor overcorrection initially as the ear does tend to uncurl slightly from the scalp over the first few weeks after surgery. A dressing is then placed over the ear. Mustarde initially used wet lamb's wool, which when dry would form a stiff cast for the ear. We usually pack the ear with

bacitracin-impregnated cotton. This is packed anatomically with a deeper piece of cotton in the conchal bowl and a more superficial roll lying between the antihelix and the helix. A final, single piece of cotton is placed over this. A mastoid dressing is then placed over both ears. Though many surgeons leave these dressings in place for 4 or 5 days or more, we routinely change them on the first day to inspect the ears for hematomas or other problems and then replace the dressing. The second mastoid dressing is left in place for about 5 days. The suture is removed at 7 to 10 days by simply pulling out the subcuticular nylon. We ask the patient to wear a simple headband at night for another 4 to 6 weeks postoperatively to ensure the area is not accidentally damaged during sleep.

This combination of techniques - the conchal setback and/or reduction, Mustarde suture technique, and occasional rasping of the anterior antihelix - is adequate for the vast majority of cosmetic auricular procedures. The Mustarde technique is especially good in younger children where the ear cartilage is pliable and easily molded. It is more difficult in older patients. We have had very occasional episodes where the ear has partially unfurled at some stage after the operation, usually months or years later. It is relatively straightforward to replace the suture in those cases. Conservatism is essential with the conchal setback technique to avoid the all too common "telephone ear" appearance with the midportion of the ear being further back against the head than the superior and inferior poles. A major advantage of the technique described is that individual minor variations in the antihelix, concha, or lobule can be addressed without difficulty at the time of surgery.

The approach of Feuerstein and Adams is somewhat different and demonstrates that various approaches can be used to achieve similar results in otoplasty surgery.

The anesthesia employed depends on the age of the patient. Most parents or guardians of children under 10 years of age request general anesthesia, whereas older children and adults may comfortably be operated on under local anesthesia. The periauricular hair is not cut. Following surgical preparation of the skin, towels are sutured around the ear. An auricular-mastoid pedicle flap is then created, but no skin is removed initially. Skin excision should be reserved for the conclusion of the procedure so that careful tailoring of the postauricular skin can help prevent formation of the "telephone ear". That is, one may wish to leave a wider strip of postauricular skin in the middle third, and this need may not be appreciated until the very end of the procedure.

Next, one attempts to create two auricular "compartments". That is, an incision should be made along the margin between the concha and the antihelix, starting at the mastoid-conchal area inferiorly and continuing upward, carefully following the conchal curvature just medial to the antihelix into the inferior crus and then along the lower margin of the inferior crus to the level of the crus helicis. At this point the helical rim should be separated from the inferior crus by excision of a segment of cartilage. One effects complete severance of the concha from the antihelix so that the antihelix with its scaphoid portion and superior crus will easily fold and decrease the conchal-scapal angle to a normal 90°. Because an adequate fold of the superior crus may still not be attained, further manipulation may be necessary in the superior crus and body of the antihelix. The use of a rotating wire brush to thin the cartilage may be useful.

Normally this crus has a gentle curve, which blends with the inferior crus as it reaches the level of the concha. One should not allow the cartilage incisions in this region to extend through to the perichondrium on the lateral surface. Such care will prevent formation of "sharp" lines, telltale evidence of otoplastic surgery.

Following complete mobilization of the conchal and antihelical auricular components, one must decide whether buried sutures of the Mustarde type are required for further correction. It is recommended that such sutures be used only to hold the repositioned cartilage in place until sufficient scar tissue has formed. Figures demonstrate the insertion of two types of sutures. The first demonstrates the conchal mastoid suture, which is indicated when a conchal setback is required; this suture passes from the conchal cartilage into the mastoid periosteum. The second suture demonstrates the vertical mattress Mustarde suture placed along the antihelix and its superior crus. As mentioned previously, it may be preferable to utilize a strong absorbable suture to obviate future "spitting" of sutures, granuloma formation, and secondary infection.

On completion of the otoplasty procedure, one should carefully evaluate the frontal appearance of the auricle to determine whether there is excessive residual protrusion of the antitragus or lobule. Antitragal prominence can readily be reduced by excision of a wedge of cartilage from the apex through the postauricular wound. The lobule may be accurately tailored to balance with the remainder of the ear by appropriate resection of skin wedges on the posterior aspect of the lobule. Actually the initial postauricular incision may be extended into the lobule. During surgery all bleeding vessels should be carefully cauterized. Use of fine bipolar cautery prevents excessive damage to the cartilage. In addition, a small Penrose drain inserted through the inferior aspect of the postauricular incision should be used routinely. The drain may readily be removed in 24 hr.

Interrupted silk sutures are recommended. The use of absorbable catgut for skin closure, although it obviates the necessity for removing sutures, is not suggested because of the increased incidence of keloid formation. Nonabsorbable sutures, such as silk or nylon, should be used. They may be removed in 8 to 10 days. A soft cotton and gauze dressing moistened with warm saline is used to maintain proper mobilization of auricular cartilage during the postoperative period. The dressing should routinely be changed in 24 hr and the auricular skin examined for its color and any evidence of hematoma formation. If, indeed, a hematoma has formed, the wound must be opened and the hematoma evacuated.

There are multiple other individualized approaches to otoplasty surgery but these two show the diversity possible and demonstrate the basic concepts. Readers are referred to the original works of those who have created these techniques, particularly Mustarde, Stenstrom, Furnas, Elliott, Davis, and Becker.

Otoplasty Complications

Otoplasty complications may be divided into postsurgical complications, and into a category of the unfavorable cosmetic results.

Surgical Complications

Infection

Postoperative wound infections in otoplasty are uncommon, and occur on the 3rd to 5th postoperative day as in other soft tissue infections. They are usually the sequel to an unrecognized or inadequately treated hematoma. The most significant symptom is pain, occurring as early as 12 hr postoperatively. Erythema, swelling, and purulent drainage may be noted on removal of the dressing. Removal of skin sutures should be considered to provide adequate drainage for necrotic debris, if present, and antibiotic therapy instituted on the basis of culture and sensitivity. Hospitalization for severe or progressive symptoms may be warranted. Delay in treatment or a rapidly progressive infection may lead to chondritis and deformity. Infections are relatively uncommon, probably because the auricle, like the face, is a relatively privileged area surgically with its rich blood supply and extensive anastomotic network.

Chondritis

The most significant sequela of infection is chondritis. Once started, it is difficult to eradicate, probably because cartilage is avascular and antibiotic therapy cannot penetrate to the locus of infection. Sequestra of dead infected cartilage form, leading to the necessity for potentially deforming debridements, and prolonged antibiotic treatment based on culture and sensitivities. Some progress has been made in the local delivery of antibiotics to problem areas such as infected bone or cartilage. Fibrin glue, bioresorbable polymer beads, and other devices have been used as vehicles that release the antibiotic in a controlled fashion over time, and are implanted into the infected area at the time of surgical debridement.

Hypertrophic Scars and Keloid Formation

Unsatisfactory scars are uncommon on the ear. They can be prevented to some extent by adhering to the principle of tensionless skin closure, and, once formed, they are treated in standard fashion with intralesional steroids, and on occasion excision and reclosure. Recombinant human interferon-gamma injected intralesionally has been used with success in keloids.

Suture Complications

Most suture complications may be avoided by the appropriate choice of suture material and by correct placement. A relatively unreactive material such as a nonabsorbable monofilament synthetic may be placed such that the knots are hidden under the thicker skin cover posteriorly. Most suture complications such as visible bridging, granulomas, and extrusion may be treated with removal of the offending suture at a time when the ear has healed into its new position and is unlikely to move, usually after 2 months.

Hypoesthesia

Decreased sensation over the auricle is a common postoperative complaint. Return of sensation usually occurs over a period of months as fine sensory nerve endings from the rich

circumaural network grow back in to replace those sectioned at surgery.

Unfavorable Cosmetic Result

Sharp Ridges

These may be produced by the cartilage cutting techniques; they are permanent and should be avoided. Stenstrom's work has shown that gentle abrasion of the anterior perichondrium alone is enough to create a tendency of the cartilage to curve toward the intact perichondrium of the posterior surface. This tendency can be enhanced and reinforced with Mustarde-Furnas-type sutures.

Deformities of the Antihelix-Helix Curvature

The placement of sutures is done in a radial fashion to recreate the normal antihelical curvature. Failure to create a cosmetically appropriate curve may lead to a "vertical post" deformity where the ear appears folded back about a vertical line. The sutures need to be tightened sequentially and equally to ensure that the setback of the new antihelix is uniform from superior to inferior. The new antihelix may be placed anywhere in the scapha by current surgical techniques, and thus the procedure should be designed such that the antihelix lies in a natural position with a scapha of the appropriate width. The actual roll of the antihelix may be made too wide or narrow depending on the amount of cartilage spanned by the sutures.

Position

Ideally the ear should lie approximately 18 mm from the mastoid as measured from the lateral surface of the helix; thus, an ear may be incompletely corrected, over-corrected ("pinned-back" appearance), or asymmetric from side to side.

Obliteration of the Postauricular Sulcus

Blunting of the sulcus is a result of excessive skin excision, producing tension on the wound closure and allowing tenting of the skin across the sulcus. Evidently, avoidance of the problem is achieved by excising only the skin that is in excess.

Telephone Ear and Reverse Telephone Ear

These are wonderfully descriptive terms that refer to an abnormally pinned-back-appearing concha in the first case, and an abnormally prominent-appearing concha in the second case. It usually occurs because of either over- or undercorrection of a deep conchal bowl.

Summary

Otoplasty is a challenging procedure. The techniques available - cartilage excision, sutures, and cartilage scoring or rasping - must be creatively combined to address the specific problems of each individual patient. The goals are a natural appearance and symmetry. Conservatism in cartilage excision is the rule and the operated look should be avoided.

Newborns with auricular deformities can be successfully treated with simple molds in the first few days of life.