Otoplasty & Other Techniques of Auricular Reconstruction

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Introduction

- Auricular surgery encompasses various kinds of surgical techniques, based on the initial defect, that can present challenges to the surgeon.
- It is important for head and neck surgeons to have some knowledge of these techniques.
Overview

- Anatomy & Embryology
- Aesthetic Evaluation of the Ear
- Auricular Defects: Congenital and Acquired
- Otoplasty
- Techniques of Auricular Reconstruction (Flaps, Grafts)
- Complications
Embryology

- Onset of ear development: Week 5 to 6 of gestation
- Process: Formation of 6 mesenchymal swellings called hillocks around the 1\textsuperscript{st} branchial groove.
- The hillocks originate from the 1\textsuperscript{st} and 2\textsuperscript{nd} branchial arches
  - Anterior 3 hillocks: Arise from the 1\textsuperscript{st} branchial arch; gives rise to the tragus and helical root.
  - Posterior 3 hillocks: Arise from the 2\textsuperscript{nd} branchial arch; gives rise to the helix, scapha, antihelix, antitragus, and the lobule.
- The hillocks grow and fuse to form the auricle. This is completed by week 8 of gestation.
Anatomy

- KEY POINT: An understanding of the topographic landmarks of the ear is integral to guide preoperative planning as to clear identification of the defect and the appropriate techniques to be used.

- Cartilage & Skin:
  - Cartilage = elastic fibrocartilage, uniformly thick throughout the ear.
  - Anterior skin = fine, thin, and closely adherent to the underlying cartilaginous framework, scant amount of subcutaneous fat but a diffuse subdermal vascular to support flap viability.
  - Posterior skin = less adherent skin, bi-layered subcutaneous fat, larger subdermal plexus of nerves, arteries, and veins.
Topographic Landmarks of the Ear

- Superior crus
- Triangularis fossa
- Inferior crus
- Antihelix
- Scapha
- Concha
  - Cymba
  - Cavum
- Anti-Tragus
- Lobule

Anatomy: Muscle

a) Helix.
b) Spina helices.
c) Crura anthelicis.
d) Crus superius anthelicis.
e) Crus inferius anthelicis.
f) Fossa triangularis (s. fossa innominata).
g) Scapha (s. fossa navicularis).
h) Tragus.
i) Antitragus.
j) Incisura intertragica (s. incisura auriculae).
k) m. Concha auris.
l) m. Auricularis superior (s. m. attolens).
m) m. Auricularis anterior (s. m. attrahans).
P) m. Auricularis posterior s. m. retrahentes).
q) m. Helicis major.
r) m. Helicis minor.
s) m. Tragicus.
t) m. Antitragicus.
Anatomy: Neurovascular Supply

Vascular Supply:

*Anterior ear:* Superficial Temporal

*Posterior ear:* Posterior auricular and contributions from the occipital artery

Neurologic Supply:

*Inferior auricle:* greater auricular nerve of C2 - C3. NOTE: It is an important surgical landmark as it travels 8mm posterior to the post-auricular sulcus and can cause significant anesthesia to the ear if damaged. Conversely, regional anesthesia to the auricle can be readily accomplished by instilling anesthetic along its base anteriorly and posteriorly.

*Posterior superior auricle (cranial surface):* lesser occipital nerve from the ventral rami of C2 and C3

*Anterior auricle:* auriculotemporal nerve of the mandibular branch of CN V

*Conchal bowl and the tragus:* Arnold’s nerve, which is a distal branch of the vagus nerve aka auricular branch of CN 10
Aesthetic Evaluation of the Ear

1. Standard preoperative photography: frontal view, right and left lateral views, and right and left oblique views, close up left lateral and right lateral views
2. About 85-90% of ear growth is achieved by 5-6 years of age.
3. The average ear is 65mm long and 35mm wide.
4. The ear width is 50-60% of the height.
5. On the lateral view:
   1. superior aspect of the helix lies at the level of the lateral eyebrow (superior orbital rim).
   2. The inferior aspect lies at the level of the base of the nasal alae (nasal spine).
   3. The ear is situated roughly 6 cm from the lateral orbital rim
   4. slopes 15-20° posteriorly from the vertical axis to approximate the nasal dorsum within 15°.

Aesthetic Evaluation of the Ear

- **Frontal view**: The helical rim should be seen lateral to the lateral most exposure of the antihelix.

- **Auriculocephalic angle**: Seen on posterior view; angle between the auricle and the scalp set by a combination of the angle of the posterior wall of the conchal bowl (90°) and scapha-conchal angle formed by the antihelical fold (90°); should be 20-30° in measurement. The distance between the helical rim and the scalp should be slightly less than 2cm with this angle.

Congenital Defects

- Are a result of genetics or be secondary to environmental exposures.
- Can be indicative of a genetic syndrome such as: Goldenhar, Treacher Collins, and brancho-oto-renal syndromes; should prompt a complete head and neck examination to rule out other congenital abnormalities.
Prominauris

- Occurs in 5% of the population.
- Autosomal dominant
- Protrusion of the auricle greater than the normal auriculocephalic angle (> 30-40°).
- Two most common defects:
  - Poorly developed antihelical fold (most common)
  - Formation of excessive conchal cartilage (next common).
- Precise recognition of the specific defect causing prominauris is paramount preoperatively as it will guide surgical technique.
- Well documented psychological influence of Prominauris:
  - Studies comparing data before and after corrective surgery for prominent ears reveal improved QOL, improvements of self esteem, decreased psychosocial anxiety
- Ideal age for surgical correction: between the ages of 5-6 years.
Acquired Defects

- **Trauma:**
  - Superficial location – prone to traumatic injury
  - Types of injury:
    - Falls, animal bites, car accidents, and sports etc.

- **Burn injury:**
  - Challenging:
    - Successful reconstruction of the ear after burn injury depends on the extent of the burn injury and availability of unscarred, healthy tissue to achieve an appropriate construct.

- **Moh’s :**
  - Indications:
    - recurrent or incompletely excised BCC and SCC
    - lesions located in high-risk areas or embryonic fusion planes (the eyelids, nose, ear, nasolabial folds, upper lip, vermillion border, columella, periorbital, temples, preauricular and post-auricular areas)
    - clinically and histologically aggressive tumors
    - tumors in cosmetically or functionally important areas,
    - tumors arising in sites of previous radiation
    - tumors in patients with basal cell nevus syndrome.
  - Ideal for recurrent BCC > 2cm
Otoplasty

- Surgical correction of prominent ears
- First described by Diffenbach in 1845, adapted from Edward Ely’s technique described in 1841
- Various techniques have since developed. Those most commonly referenced:
  - Mustarde Technique, 1962 – Permanent suturing technique, conchoscaphal sutures
  - Furnas Technique, 1959 – Permanent suturing technique, conchomastoid sutures
- Cartilage sparing vs. cartilage manipulating techniques
Technique of Mustarde

- Corrects a poorly developed antihelical fold by creating an antihelix and securing it permanently with suture.

**Procedure:**

1. Mark projected antihelical fold – apply gentle pressure to ear (A)
2. Through-and-through markings – assists with suture placement on posterior side, 7mm width (B)
3. Local injection: 1% lidocaine w/ epi; hydrodissection of the anterior skin.

Technique of Mustarde: *Procedure*

5. Posterior skin undermined and raised over helix, antihelix, and conchal cartilage. (D)

6. **Antihelical tunnel and cartilage scoring:** Anterior skin undermined by access gained via a “slot” at the helical root (Freer or scissors). Cartilage in this tunnel scored for pliability (otodebrader, nasal rasp, Adson-Brown forceps, etc.) (E)

7. **Securing antihelical fold:** permanent (4-0 Mersilene), horizontal mattress, conchascaphal sutures. (F)

4. Suture through perichondrim and cartilage
5. Medial to lateral – knot will be along the medial surface
6. DO NOT pierce the anterior skin.
7. The sutures should be placed perpendicular to the demarcated antihelical fold so when they are tightened a well-rounded antihelical fold is created. They should be parallel to the helix at the lateral extent of the antihelical fold, as the helix and antihelix run parallel in fashion.

Technique of Furnas

- Corrects excessive conchal cartilage, does not involve cartilage resection (Davis method).
- Often done in conjunction with Mustarde technique.

**Procedure:**
1. Steps 4 and 5.
   A. The width of the incision can be estimated by manually pushing the concha toward the mastoid.
   B. Excess skin is excised (including the underlying soft tissue and muscle)
2. Three to four permanent horizontal mattress (3 or 4-0 Mersilene) conchomastoid sutures in the lateral third of the concha cavum and cymba (parallel with the natural auricular curvature)
   1. Through the cartilage and lateral perichondrium to the mastoid periosteum.
   2. DO NOT pierce the anterior conchal skin
   3. When these sutures are tightened, the conchal wall is now the new floor of concha.

Cartilage sparing vs. cartilage manipulating techniques


- Retrospective = Level 4 (retrospective review)
- Investigation: As EBM is becoming the standard of care, restrospective review of the literature was done to determine a level of evidence to support certain techniques over others as an beginning attempt to propose guidelines for otoplasty.
- Method: A literature search was performed of the Medline, EMBASE, CINAHL and Cochrane databases for all articles published in English language journals between 1977 and 2002;
  Inclusion criteria: Inclusion criteria were as follows:
  - (i) postoperative follow-up of a minimum of 6 months;
  - (ii) consistent surgical technique applied to all cases;
  - (iii) primary rather than revision surgery;
  - (iv) postoperative results should be analysed with consistent, quantifiable criteria.
- 12/149 papers met criteria; Various techniques for restoring the antihelix grouped into rasping alone, sutures alone, rasping and sutures, and cartilage cutting techniques
- The published papers in the review utilized such varying subjective and objective postoperative assessment criteria that no meaningful comparison could be made between them. Therefore, results were reclassified into satisfactory and unsatisfactory to allow some comparison to be made.
Cartilage sparing vs. cartilage manipulating techniques

- Discussion: The greatest problem in comparing the results of the different surgical techniques is the lack of conformity thus when looking only at satisfactory vs unsatisfactory & when doing so they found:
  - Large majority of patients are satisfied with their results regardless of technique (present table)
  - Pts/parents tend to be more satisfied than the surgeon with their results (avg 7.7 v 4.3% dissatisfaction – p = 0.15 – not stat sig)
- Limitations: Therefore, despite including all the available data in the current literature the review remains underpowered, specifically due to a lack of unanimous objective measure.
- Conclusions:
  - To show a statistically significant outcome the authors suggest measuring the cephaloauricular distance at a standardized point, the Frankfort line, as described by Messner & Crysdale. (The Frankfort line is = horizontal line drawn from the infraorbital rim to the superior aspect of the external ear canal, and is used by medical photographers to align clinical photographs).
  - *It appears therefore that the technique used is not crucial, but that the individual surgeon should be comfortable with their preferred technique.*
Techniques of Auricular Reconstruction

- Secondary Intention
- Full thickness skin grafts
- Post-auricular Island Flap or “Flip flop flap”
- Antia Buch condrocutaneous advancement flap
- Bipedicled “tubed” flap
- Banner transpositional flap
- Mladik Pocket Principle
- Double lobed flap
Secondary Intention

- Ideal candidate:
  - Concerns for microvascular insufficiency: previous radiation therapy, smokers, diabetics, etc
    - Compromise of flap circulation
  - Coagulation disorders necessitating anticoagulation:
    - Hematoma → pressure induced failure and ischemia
  - Absolute contraindications: medical problems which prohibit surgery.

- Ideal location:
  - Concavities of the ear: concha, triangular fossa
  - Antihelix: flat not concave, acceptable result
  - Not ideal: convexities of the ear (helix)

- Ideal characteristics:
  - Smaller defects (<1cm) > larger defects
  - Lighter skin > darker or telangiectatic skin
  - Superficial > deeper lesions

Full Thickness Skin Graft

- Preferred for defects of the conchal bowl and antihelix that are generally < 2.0cm.
- FTSG preferred over STSG:
  - Better color match, texture, & thickness
  - Lower potential for contracture
  - STSG still an alternative
- Harvest sites:
  - contralateral pre or post-auricular skin or the supraclavicular area.
- Grafting over exposed cartilage:
  - Cartilage is poorly vascularized
  - It is recommended that areas of conchal cartilage without sufficient perichondrium should be excised to allow for well-vascularized area for the graft (will not compromise auricle integrity).

Post-auricular Island Flap or “Flip Flop Flap”

- First described by Masson in 1972 in plastic surgery literature.
- Use:
  - Primarily defects of the anterior conchal cartilage
  - Other: scaphoid fossa and antihelix
- Size of defect: 2cm or less.
- Vascular supply: Post-auricular artery.
  - Myocutaneous transpositional flap vs fasciacutaneous flap: The post-auricular muscle and fascia are incorporated into this flap and perforators from the post-auricular artery supplies these components.

Post-auricular Island Flap or “Flip Flop Flap” Con’t

- Template of defect (Telfa) is outlined in the post-auricular skin (include post-auricular sulcus).
- Skin is incised to create an island of skin with a subcutaneous pedicle.
- **Slit incision**: A slit incision begun at that posterior aspect of the defect and carried to the post-auricular sulcus is created through-and-through defect for passage of the flap from posterior to anterior.
- **Undermine**: This incision is extended to the base of the flap (plane of the mastoid periosteum). Undermining is then carried out in this plane.
- “Flip Flop”: The flap and its pedicle are pulled through the slit incision, laid on the anterior defect, and closed with fine nonabsorbable sutures.
- The secondary post-auricular defect is closed primarily.

“Flip Flop Flap” con’t

A: The flap and pedicle before being pulled through the slit incision.

B: Flap set into the defect.

C: Flap sutured into place.

D: Two-month follow-up visit.

Antia Buch Chondrocutaneous Flap

- First described in 1967 by Antia and Buch
- Use: reconstruction of helical defects of 3 cm diameter or less. (A)
- Anterior skin and cartilage are incised at the base of the helical rim forming chondrocutaneous flaps; posterior skin is NOT incised (B)
- Posterior skin is elevated from the perichondrium & serves as the vascular pedicle
- The chondrocutaneous flaps are raised unilaterally or bilaterally (depending on the defect). The ends of these helical margins are brought together. Posterior standing cone deformities formed are corrected with Burrow’s triangles. (B, C, D)

Banner transpositional flap

- Use: Defects of the helical root or superior helical rim.
- This is a supra- or pre-auricular based flap
- Single staged (helical root): flap base is contiguous with defect. (A)
- Double staged (superior helical rim): Both flaps are elevated and secured to the anterior and posterior aspects of the helical rim defect. The pedicle is divided three weeks later. (B,C)

Bipedicled “Tubed” Flap

- longer helical rim defects >2.5cm in size
- based in the pre, post, or retro-auricular skin, depending on the location of the helical defect (D)
- three-staged process

Mladik Pocket Principle

- First described by Mladik et al in 1971
- Used for reattachment of partial avulsions of the ear lobe
- The amputated auricle is de-epithelialized
- Reattachment of the stump
- Pocket is elevated in the retroauricular skin and the amputation stump is reattached and buried
- Three to eight weeks later, the ear is elevated and the posterior aspect is skin grafted if not already re-epithelialized.

NOTE: The avulsed auricle should be placed in saline or water and then be placed in ice. Do not place it in ice directly as this can lead severe frostbite.

Double lobed flap

An absent lobule can be reconstructed using this anteriorly-based auriculomastoid flap. A bilobed shaped flap is delineated on the auriculomastoid skin and raised with its base functioning as the anterior attachment of the neo-lobule. The neo-lobule is formed when the raised flap is folded in on itself and attached the superior auricle. The secondary defect is closed primarily.
General Complications

- **Early Complications (24-96 hours): 5% risk**
  - Hematoma → skin and/or cartilage necrosis with ear disfigurement
    - Ear tightness or pain → prompt inspection of the ear.
    - Prevention: adequate hemostasis intraop, pressure dressings postop
  - Infection
    - POD 3 or 4
    - Treatment should be prompt to avoid suppurative chondritis: systemic antibiotics with coverage for staphylococci, streptococci, and Pseudomonas aeruginosa.
    - Chondritis is heralded by signs of obvious infection including severe edema and pain.
      - Tx: IV antibiotics, drainage, debridement, and a wound culture.
  - Skin necrosis: pressure necrosis, inappropriately undermined flaps (too superficial); Tx: antibiotic cream
  - Venous congestion: clot, venous compression; Tx: hyperbaric oxygen, removal of obstructive sources, or medicinal leeches

- **Late Complications: 20% risk**
  - Suture extrusion and suture granuloma formation (otoplasty), can be early as well
  - External canal stenosis
  - Keloid/Hypertrophic scar formation: closure under tension (post-auricular sulcus high risk area), Tx: intrallesional steroid injection, prevention with TENSION-FREE CLOSURE. Excision alone is a/w 45-100% recurrence.
Late Complications: Aesthetics

- Aesthetic Complications of Otoplasty
  - Hidden helix
  - Sharp cartilaginous edges
  - Telephone & Reverse Telephone deformity
  - Undercorrection

- Ear Asymmetry
- Collapsed ear
- Close-fitting auricle
- **Tx:** revision surgery

Left: Hidden Helix

Middle: Sharp cartilaginous edge

Bottom: Telephone ear deformity
Auricular reconstructive surgery encompasses a variety of techniques for congenital and acquired defects. It is important for the surgeon to understand some of the prevalent techniques of surgical repair and have them in their arsenal of surgical repair options. Furthermore, it is my recommendation that the aforementioned techniques along with others be reviewed in conjunction with pictures/diagrams to obtain a complete understanding of the procedures.