Tympanoplasty

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Tympanoplasty is a surgical procedure aimed at (i) eradicating disease from the middle ear and (ii) reconstructing the hearing mechanism. This operation may be performed with or without mastoid surgery and may or may not involve tympanic membrane grafting. When the procedure is limited to the repair of the tympanic membrane, it is referred to as **myringoplasty**. Conversely, when the focus is solely on the reconstruction of the ossicular chain, it is termed **ossiculoplasty**. If both procedures are performed concurrently, the operation is classified as **tympanoplasty**. This procedure can be combined with either an intact canal wall (ICW) or a canal-wall-down (CWD) mastoidectomy to effectively eradicate disease from the mastoid region.

Effects of Tympanic Membrane Perforation on Hearing

Tympanic membrane perforation significantly impacts auditory function through several mechanisms:

1. **Loss of Transformer Mechanism**: The presence of a perforation disrupts the transformer mechanism of the ear. The larger the size of the perforation, the lesser the transformer ratio. Total perforation can result in a hearing loss of approximately 40 to 45 dB.
2. **Sound Protection**: A perforation removes the protective barrier of the tympanic membrane over the round window, allowing sound to reach both the oval and round windows simultaneously. This can lead to the cancellation of resultant movements of the perilymph.
3. **Interrupted Ossicular Chain**: An interrupted ossicular chain has a minimal effect on hearing in cases of large perforations. However, an interrupted ossicular chain behind an intact tympanic membrane can lead to a maximum conductive hearing loss of 60 dB. This is due to the inability of vibrations from the ossicular chain to reach the oval window, as well as the protection provided to both the oval and round windows by the intact tympanic membrane.

Aim of Tympanoplasty

The primary objectives of tympanoplasty are to restore and achieve the following:

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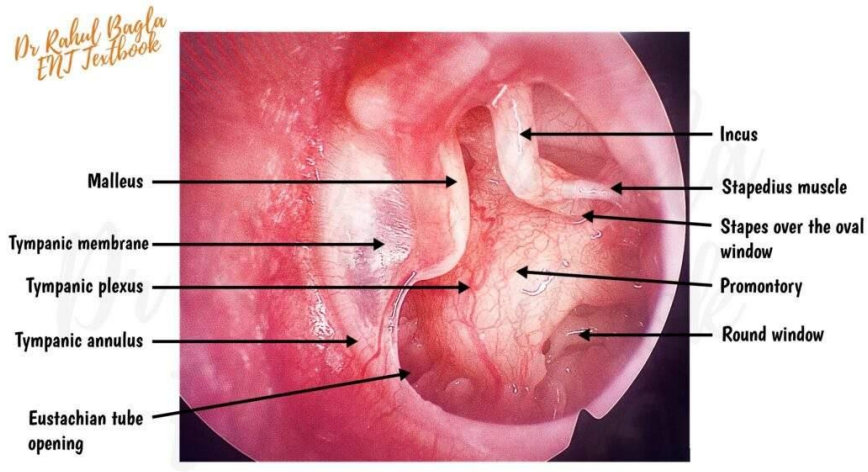
1. **Dry Ear and Hearing Improvement**: Closure of any tympanic membrane perforation through grafting and/or ossicular reconstruction to provide a large hydraulic ratio between the tympanic membrane and stapes footplate.
2. **Sound-Pressure Transformation Mechanism**: Restoration of the sound-pressure transformation mechanism for the oval window by ensuring an intact tympanic membrane and connecting it to the stapes footplate, either via an intact or reconstructed ossicular chain.
3. **Sound Protection**: Establishment of acoustic separation between the oval and round windows by creating a closed, air-containing middle ear.

Indications

Tympanoplasty is indicated for tympanic membrane perforations and associated hearing loss, with or without underlying middle ear pathology, such as tympanosclerosis.



Endoscopic picture showing middle ear through large central perforation

Contraindications

The following conditions contraindicate tympanoplasty:

1. Acute suppurative otitis media (ASOM)
2. Actively discharging ear
3. Otitis externa
4. Complicated chronic suppurative otitis media (CSOM)
5. Uncontrolled cholesteatoma
6. Only hearing ear
7. Eustachian tube obstruction
8. Malignant tumors of the outer or middle ear

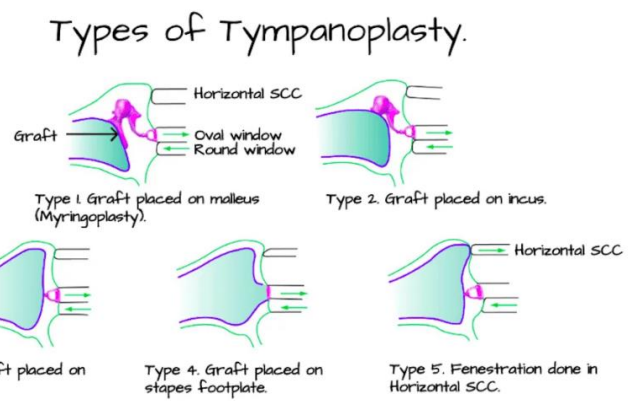
9. Unusual infections, such as malignant otitis externa
10. Poor general health

Complications of Tympanoplasty. Potential complications associated with tympanoplasty include:

1. Intraoperative bleeding, particularly from an uncovered jugular bulb
2. Facial nerve palsy
3. Wound infection or perichondritis
4. Wound hematoma
5. Injury to the chorda tympani nerve
6. Graft failure
7. Sensorineural hearing loss or dizziness

Types of Tympanoplasty. Wullstein classified tympanoplasty into five types.

Table: Types of Tympanoplasty (Wullstein's)	
Type I	There is only perforation in the tympanic membrane which is repaired with a graft and ossicular status is checked.
Type II	Defect is perforation of tympanic membrane with erosion of malleus. Graft is placed on the incus or remnant of malleus.
Type III	Malleus and incus are absent. Graft is placed directly on the stapes head. It is also called ***myringostapediopexy*** *or* ***columella tympanoplasty***.
Type IV	Only the footplate of stapes is present. It is exposed to the external ear, and graft is placed between the oval and round windows. A narrow middle ear (cavum minor) is thus created to have an air pocket around the round window. A mucosa-lined space extends from the eustachian tube to the round window. Sound waves in this case act directly on the footplate while the round window has been shielded.
Type V	Stapes footplate is fixed but round window is functioning. In such cases, another window is created on horizontal semicircular canal and covered with a graft. Also called ***fenestration operation***.



Anaesthesia. General anaesthesia is preferred for all chronic ear surgery procedures.

Tympanoplasty Approaches. Tympanoplasty is a surgical procedure aimed at repairing the tympanic membrane (eardrum) and the middle ear structures. Various approaches are utilized depending on the specific clinical scenario, including the size and location of the perforation, the condition of the ear canal, and the presence of any associated pathology. The following sections outline the primary tympanoplasty approaches, their indications, procedural steps, and associated considerations.

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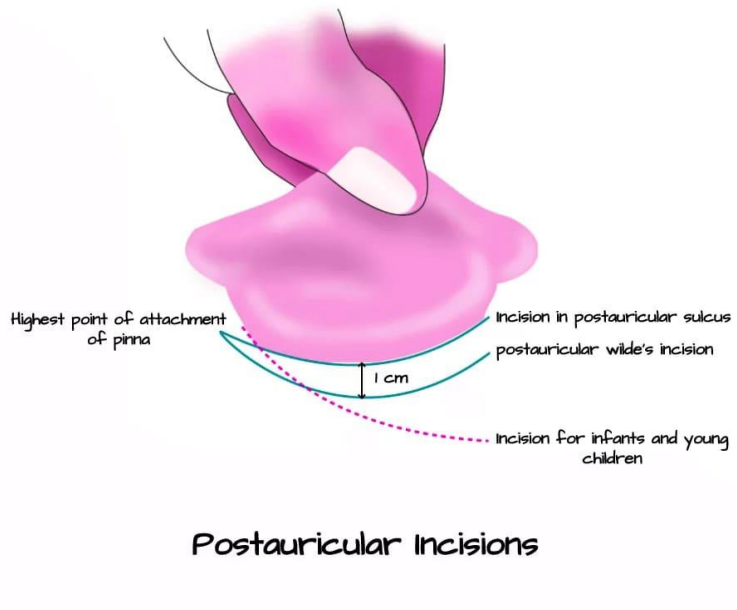
1. Postaural (Wilde's) Incision. The postaural incision is the preferred approach for large perforations, particularly those located anteriorly or in cases where the ear canal is small. The incision begins at the highest attachment of the pinna, follows the curve of the retroauricular groove approximately 1 cm posterior to it, and terminates at the mastoid tip. In infants and children under two years of age, the incision is adjusted to avoid the lower part of the mastoid due to the proximity of the facial nerve.

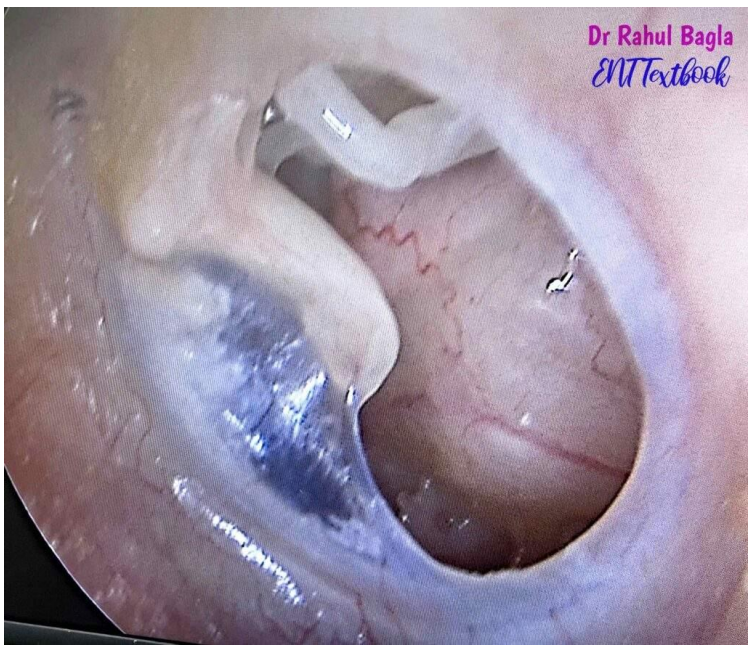


Indications: The postaural approach is utilized for:

- Cortical mastoidectomy
- Modified radical and radical mastoidectomy
- Tympanoplasty, especially when the perforation extends anterior to the handle of the malleus
- Exposure of cranial nerve VII in the vertical segment
- Surgery of the endolymphatic sac

Procedural Steps:

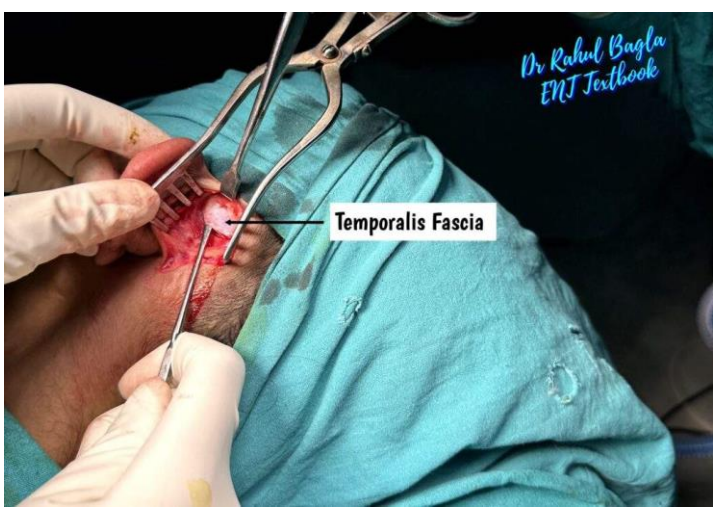
1. **EUM:** Examination under the microscope is done to confirm the clinical findings.



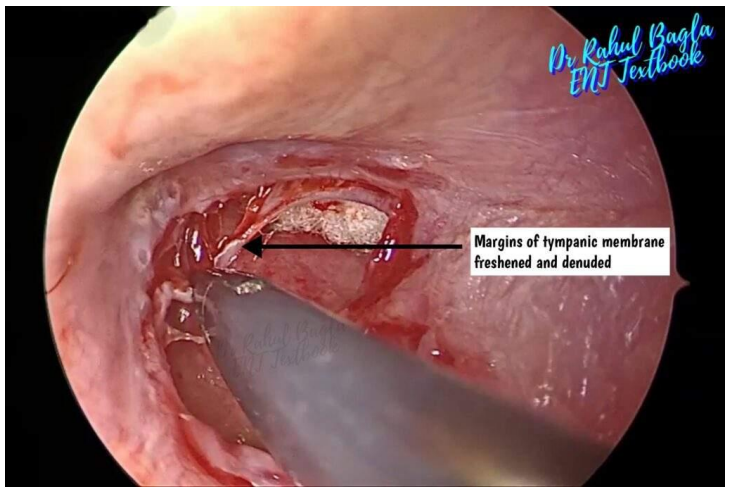
2. **For local anaesthesia**, 2% xylocaine with adrenaline is injected in the postaural region (from the root of the helix to the mastoid tip) and external auditory canal.

3. **Wilde's incision:** A postaural incision is given from the root of the helix to the mastoid tip.

4. **Temporalis fascia** graft is harvested.



5. The **margins of the perforation** are freshened.



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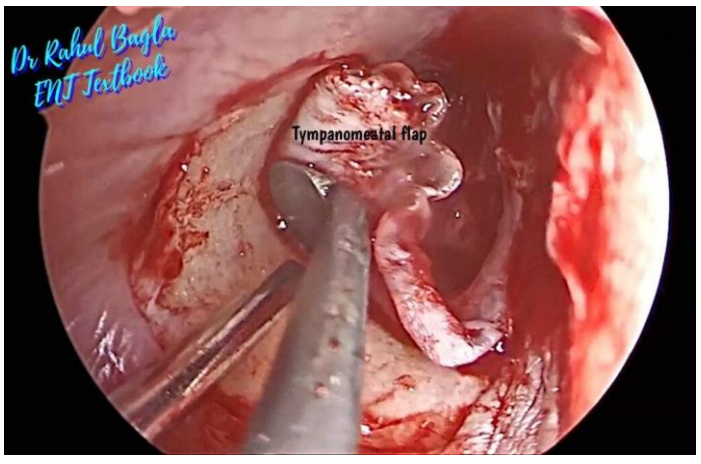
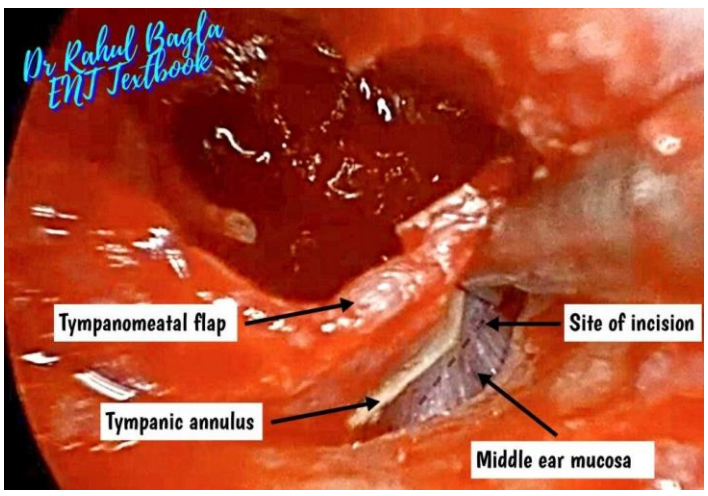
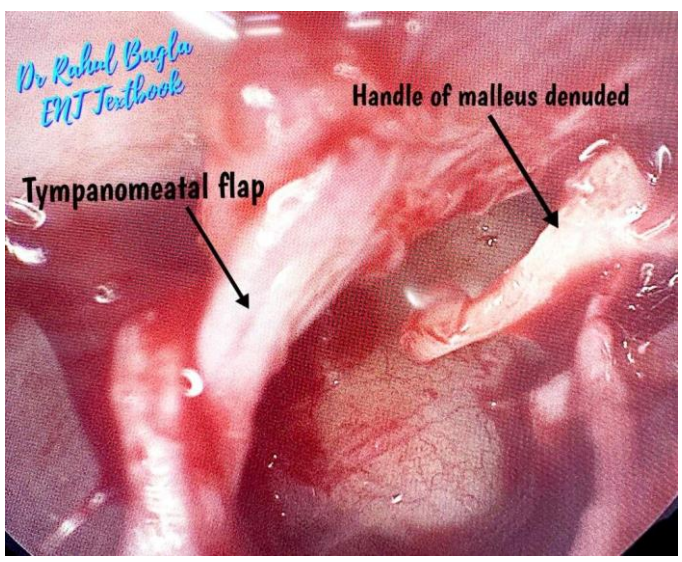
6. A tympanomeatal flap, consisting of the posterior meatal canal skin, is elevated which is made in continuity with the tympanic membrane after dislocating the annulus from the sulcus.



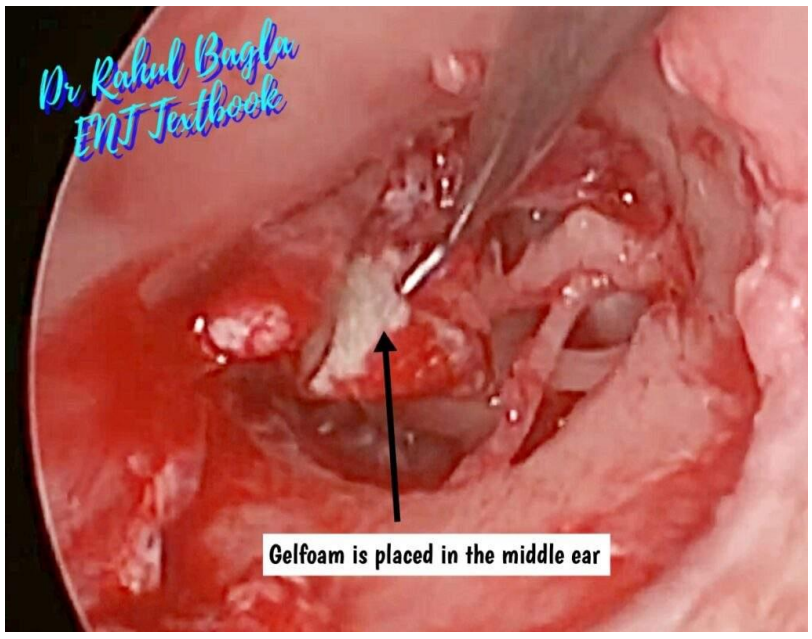
7. The incision is given in the middle ear mucosa below the annulus and the tympanomeatal flap is elevated.



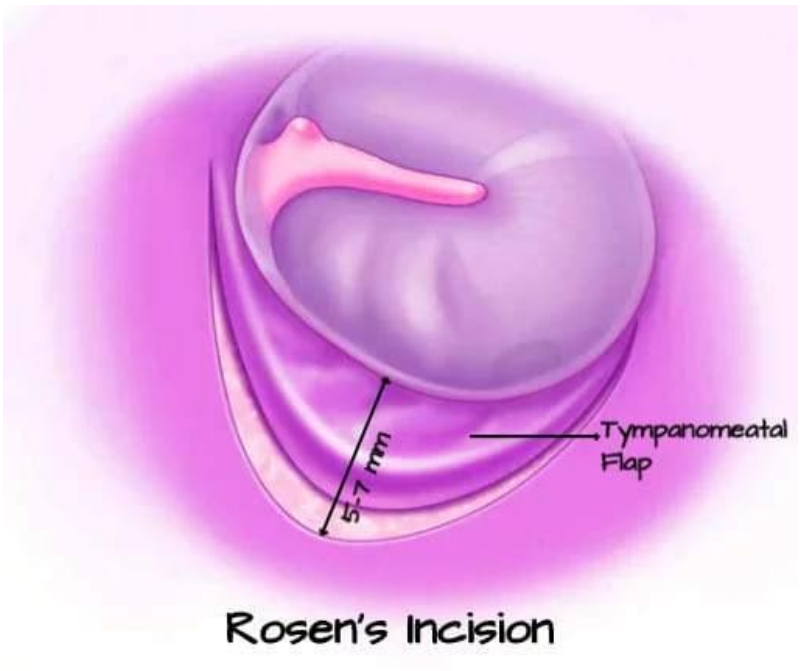
8. The handle of the malleus is denuded.



9. The middle ear and ossicular chain are inspected and repaired as necessary.
10. Any posterosuperior overhang of the bony meatus, if present, is removed to enhance the visibility of the ossicles.
11. The middle ear is packed with gelfoam.



12. The graft is placed medial to the tympanic membrane remnant or tympanic annulus, and lateral to the manubrium of the malleus.
13. The tympanomeatal flap is returned to its original position, and the medial aspect of the ear canal is packed with gelfoam impregnated with antibiotic ointment.



Rosen's Incision: Rosen's incision consists of two components:

- A small vertical incision at the 12 o'clock position near the annulus.
- A curvilinear incision that begins at the 6 o'clock position and meets the first incision in the posterosuperior region of the canal, approximately 5–7 mm away from the annulus.

2. Endomeatal or Transcanal Approach. The endomeatal or transcanal approach is indicated for small posterior perforations and is particularly suitable when the ear canal is sufficiently large. This approach offers the advantage of avoiding a postauricular incision scar and the need for mastoid dressing during the postoperative period. Common indications for this approach include:

- Exploratory tympanotomy to identify the cause of conductive hearing loss
- Inlay myringoplasty
- Ossicular reconstruction

Procedural Steps:

1. The margins of the perforation are denuded.
2. A tympanomeatal flap, consisting of the posterior meatal canal skin, is elevated using **Rosen's incision**, which is made in continuity with the tympanic membrane after dislocating the annulus from the sulcus.
3. The middle ear and ossicular chain are inspected and repaired as necessary.
4. Any posterosuperior overhang of the bony meatus, if present, is removed to enhance visibility of the stapes.
5. The middle ear is packed with gelfoam.
6. The graft is placed medial to the tympanic membrane remnant or tympanic annulus, and the manubrium of the malleus.
7. The tympanomeatal flap is returned to its original position, and the medial aspect of the ear canal is packed with gelfoam impregnated with antibiotic ointment.

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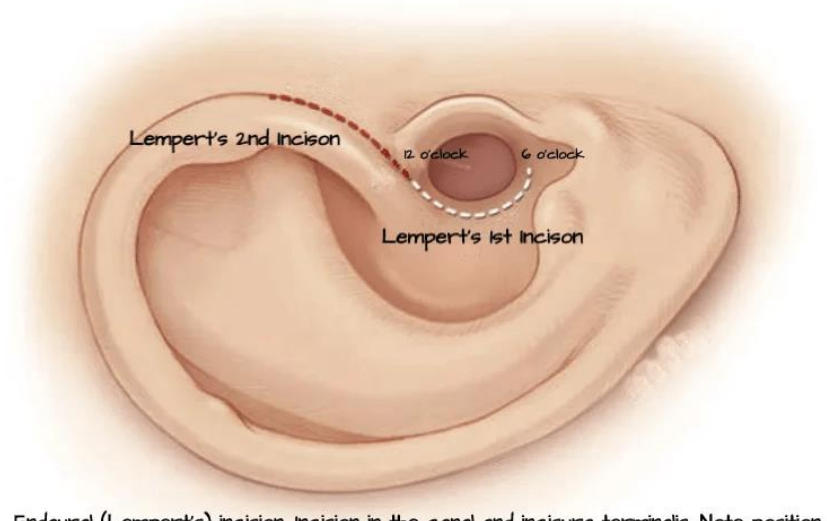
3. Endaural Approach. The endaural approach is less commonly employed today due to concerns regarding scar visibility and limited posterior exposure. However, it is indicated for specific conditions, including:

- Excision of osteomas or exostoses of the ear canal
- Large tympanic membrane perforations
- Attic cholesteatomas with limited extension into the antrum
- Modified radical mastoidectomy when the disease is confined to the attic, antrum, and part of the mastoid

Procedural Steps: The endaural approach is characterized by two incisions:

1. **Lempert 1st Incision**: A semi-circumferential incision made along the posterior half of the ear canal at the bony-cartilaginous junction, extending from the 12 o'clock to the 6 o'clock position.
2. **Lempert 2nd Incision**: This incision begins at the 12 o'clock position of the first incision and ascends vertically in a curvilinear manner between the tragus and the root of the helix, passing through the incisura terminalis to avoid cutting the cartilage.



Endaural (Lempert's) incision. Incision in the canal and incisura terminalis. Note position of Lempert I and Lempert II incisions.

Grafting Materials

The most commonly used graft materials in myringoplasty include the temporalis fascia or perichondrium (tragal or conchal) harvested from the patient. **Temporalis fascia** is the most commonly used graft for all perforations given its availability, the abundance of tissue and ease of use. **Tragal perichondrium** is preferred for the permeatal approach. **Cartilage from the tragus or concha** is becoming increasingly popular as a reliable material for repairing tympanic membrane perforations. One effective technique for smaller perforations, those less than 6mm, involves creating a cartilage "butterfly." In this method, a cartilage disc is circumferentially incised by 1mm. This groove is then fitted into the perforation rim, stabilizing the graft and ensuring a secure fit. Occasionally, homografts such as dura mater, vein, fascia, or cadaver tympanic membrane may be utilized.

Graft Placement Techniques

There are two primary grafting techniques in tympanoplasty: underlay and overlay. Both techniques can yield excellent outcomes when performed by experienced surgeons.

- **Underlay Technique**: The graft is positioned medial to the inner mucosal layer of the tympanic membrane remnant and hence over the fibrous annulus, stabilized by gelfoam in the middle ear. The underlay technique is considered superior for several reasons. It offers technical ease during the procedure, results in a shorter post-operative healing time, has fewer complications, and provides better hearing gain for patients. This technique is relatively straightforward but may lead to graft medialization and reduced middle ear space. It is essential to avoid nitrous oxide gas during graft placement, as it can diffuse into the middle ear and displace the graft.
- **Overlay Technique**: The graft is placed lateral to the middle fibrous layer of the tympanic membrane remnant and hence over the fibrous annulus. This technique requires careful removal of the outer epithelial layer of the tympanic membrane remnant. Although the overlay technique can provide good results, it is associated with a higher incidence of complications, including the formation of epithelial pearls, anterior sulcus blunting, granulation tissue formation, and graft lateralization. It is considered a more technically demanding procedure.

—— End of the chapter ——