

# OTOSCLEROSIS : PATHOGENESIS & MANAGEMENT



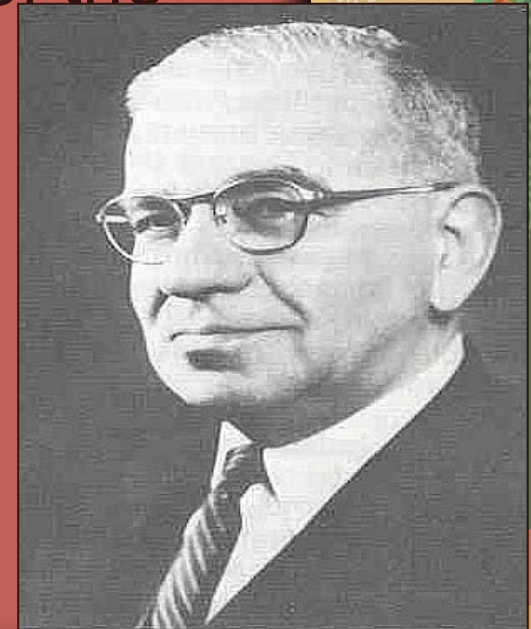
# DEFINITION

- Localized hereditary disorder affecting enchondral bone of otic capsule characterized by disordered resorption & deposition of bone.
- ✓ Bone resorption
- ✓ New bone formation
- ✓ Vascular proliferation
- ✓ Connective tissue stroma



# HISTORY

- Valsalva - 1735 - autopsy
- Politzer - 1894 - “otosclerosis”
- Samuel Rosen
  - 1953 – first suggest mobilization of the stapes
    - Immediately improved hearing
    - Problem with re-fixation



# Three distinct eras

## 1 : The mobilization era

■ Kessel 1800s stapes mobilization

■ Jack removed the stapes,

✓ leaving the oval window open

✓ No ossicular chain reconstruction

fatal meningitis

temporary re-fixed



## 2 : The fenestration era

■ Holmgren (1923)

✓ fistula in HSCC

✓ sealed it with periosteum

■ Lempert 1938 “Father of otosclerosis surgery”

One stage Surgery

Endaural + dental drill



### 3 : The stapedectomy era

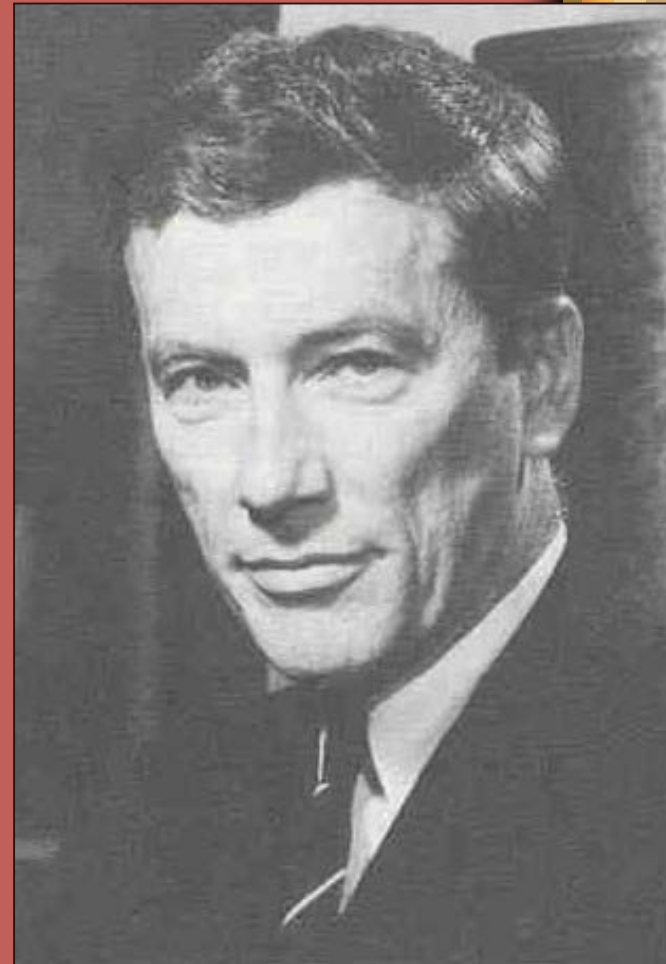
#### John Shea

- 1956 – first to perform stapedectomy
  - Oval window vein graft
  - Teflon prosthesis from incus to oval window

➤ Fowler – anterior crurotomy mobilisation

➤ Myers – stapedotomy

➤ Perkins - Laser for stapedotomy



# PATHOLOGY

## INITIAL THEORIES

- Alteration of vascularity (witmaack 1930)
- Mechanical stress (mayer 1917 )
- Mesenchymal hypoplasia ( fowler 1949)
- Shunts between otosclerotic foci & inner ear ( ruedi 1963 )




# GENETIC BASIS

- Tonybee ( 1861 )
  - Autosomal dominant transmission with incomplete penetrance ( cause 1984 / larson 1960 )
  - Heterogenetic disease
  - Polygenetic & multifactorial ( cause 1980 / 1984 )
  - HLA – A3(RR 2.8) ,A9 (5.34) ,A11(3.14), B13 (4.26)M
- Male : A9 & 11                      Female : A3
- Singhal et al ( 1999 )



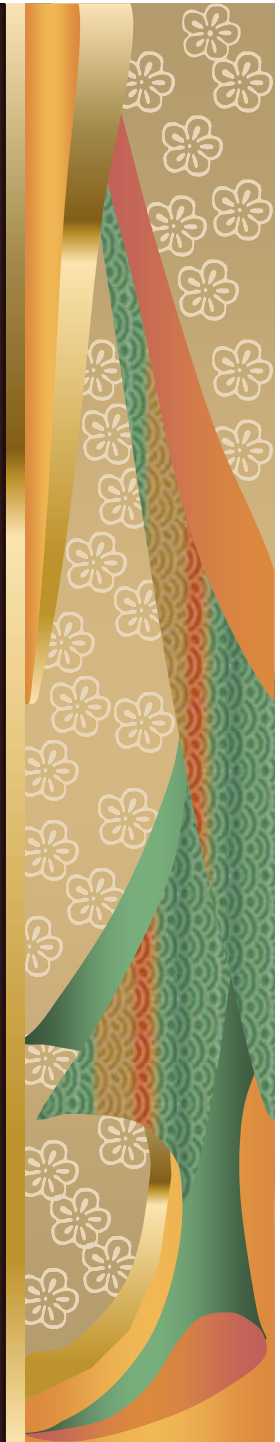


 Tomek et al(1998) : 15q chromosome

 Thalmann et al(1987)

COL1A1 gene allelic expression

( type 1 collagen ) 10-20% pts with  
clinical otosclerosis

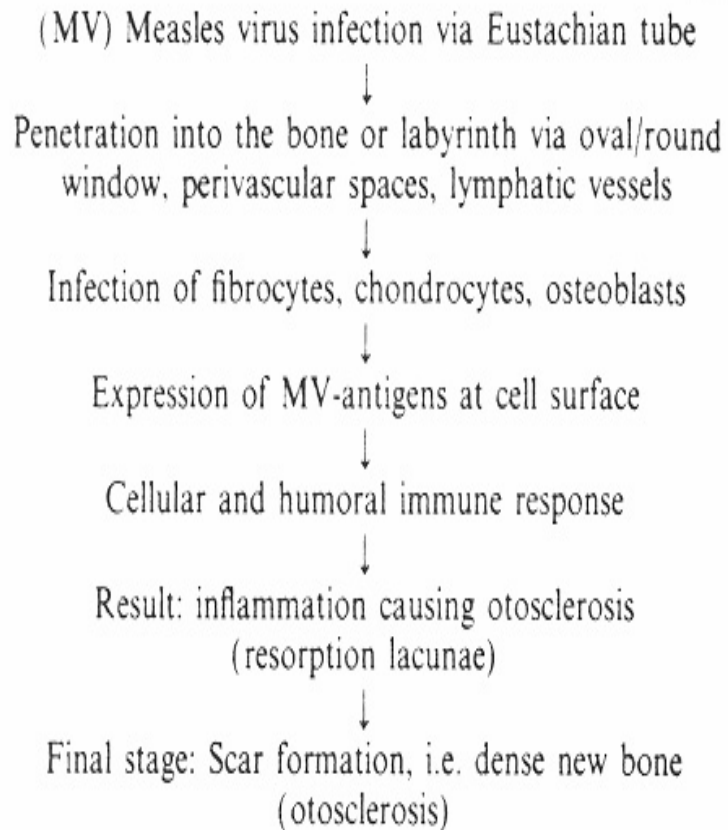


# Etiology- Measles?

Mckena & Mills 1989

Co-factor

Table III. *Possible pathomechanism in otosclerosis*



# AUTOIMMUNITY

■ Causse et al (1991) : Humoral autoimmunity to type -2 collagen

Tissue bound IgG in active areas

Causse 1982 : alpha 2 macroglobulin had synergistic relationship with alpha1 antitrypsin in balance with trypsin. Low levels of alpha anti trypsin levels.

Bone lysis →  
pseudohaversian bone rebuilding



# BIOCHEMISTRY

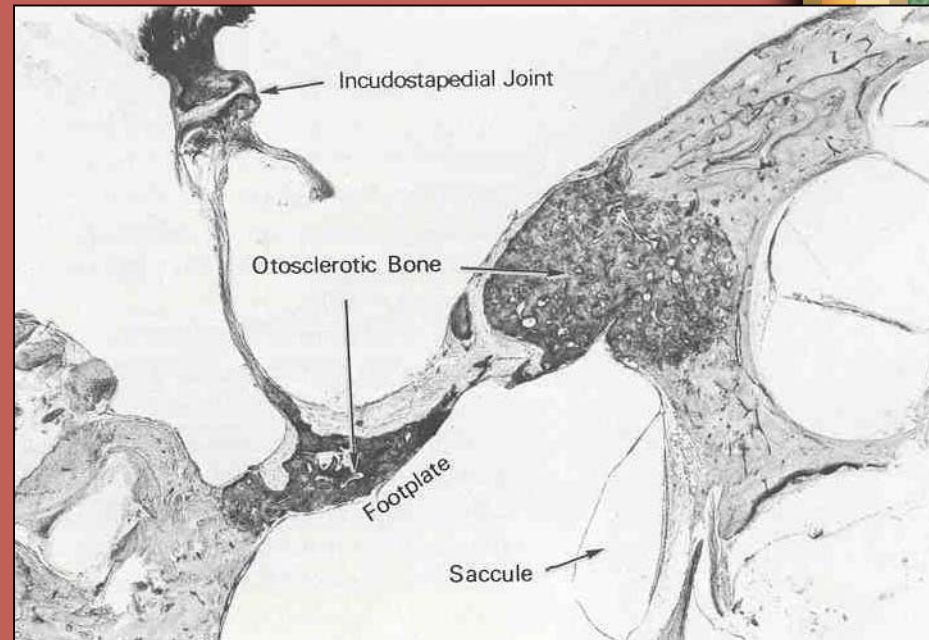
- Lesser levels of glycosaminoglycans than control bones ??????
- May be just associated with the remodelling process

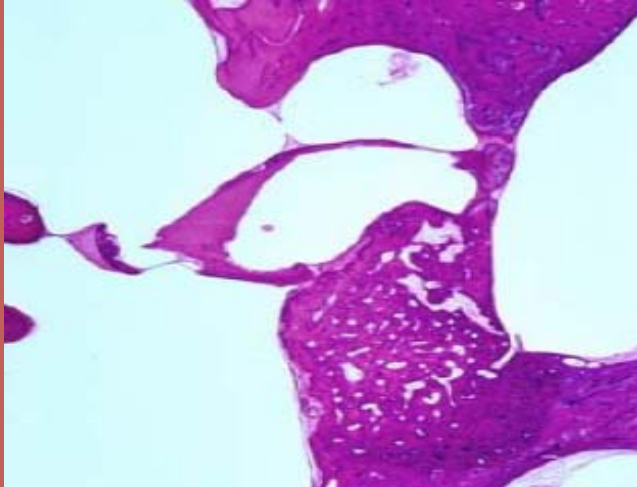


# HISTOPATHOLOGY

- 10% histologic prevalence of otosclerosis
- 1% clinical prevalence
- 'BLUE MANTLE'  
Earliest histological alteration

Globuli interossei



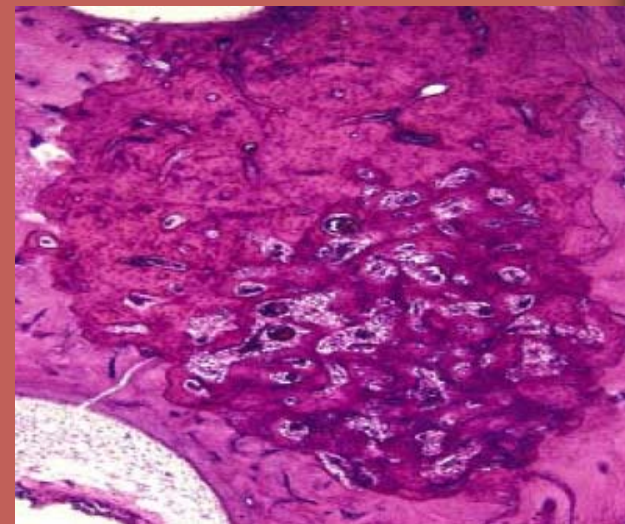


### Active (otospongiosis)

- ✓ Osteocytes, histiocytes,
- ✓ Active resorption of bone

### Mature (sclerotic phase)

- ✓ Deposition of new bone
- ✓ osteoblast



Resorption of enchondral bone



Enlargement of perivascular spaces



Deposition of woven bone



Remodelling



Mature (lamellar ) bone

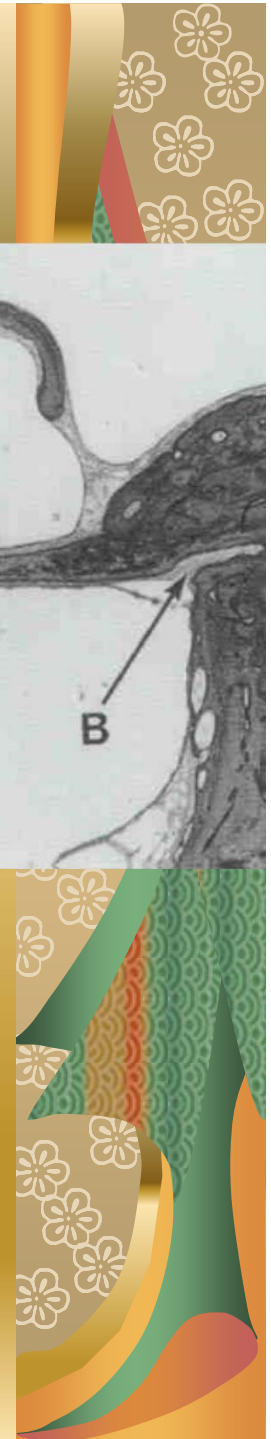
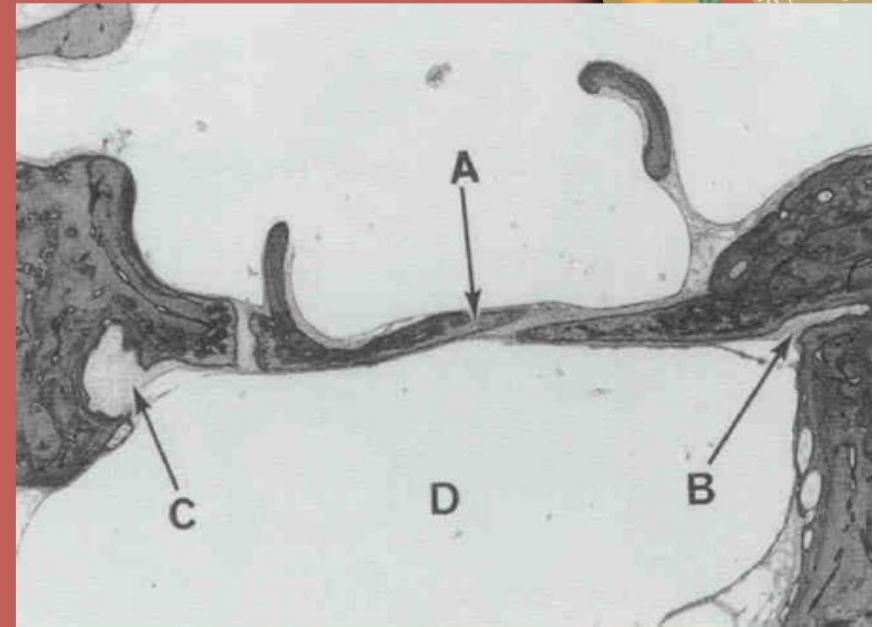
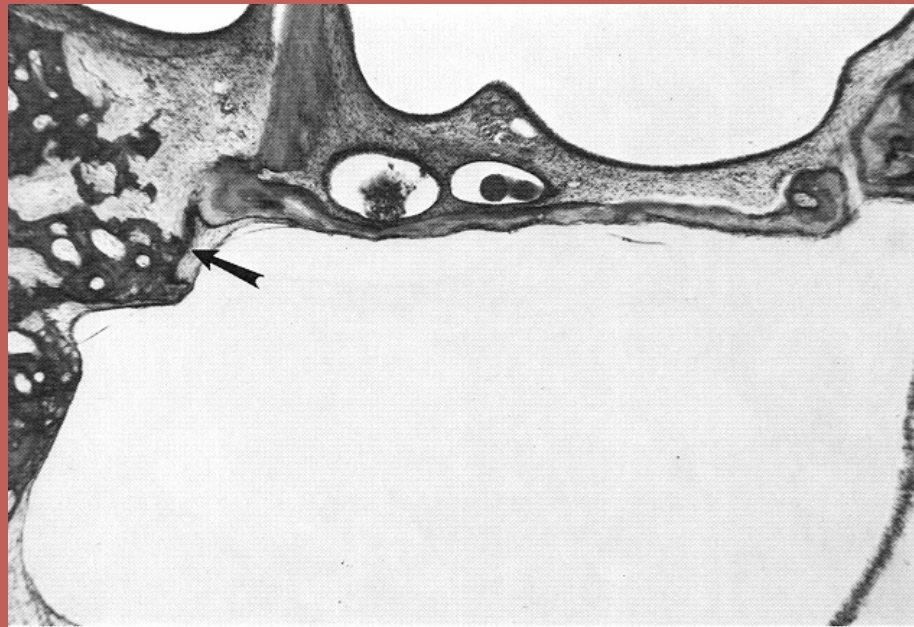
- Blood vessel proliferation & large vascular spaces
- Connective tissue : fibroblasts & histiocytes

Osteoblasts  
&  
osteoclasts



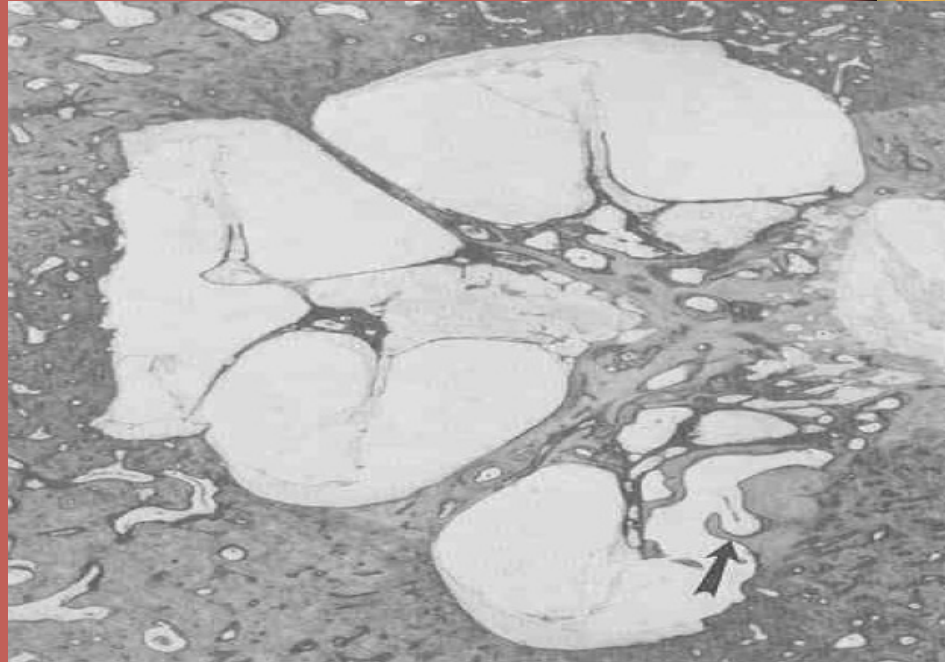
# Most common sites of involvement

- Fissula ante fenestrum (80-90%)
- Round window niche (30%-50% of cases)





- Apical medial wall of cochlear labyrinth 15%
- Stapes foot plate 12%
- Post. to oval window 5-10%
- Walls of IAC
- Around vestibular & cochlear aqueducts
- Around SCC
- Around malleus & incus






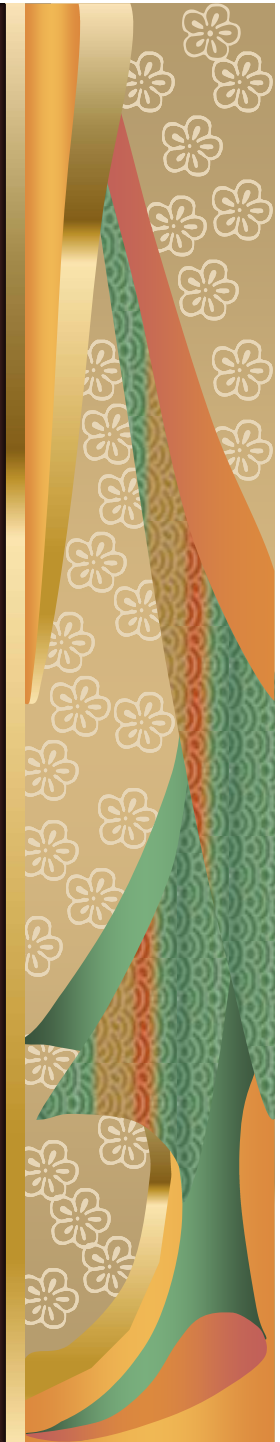
# Epidemiology

<u>Race</u>	<u>Incidence</u>
Caucasian	10%
Asian	5%
African American	1%
Native American	0%







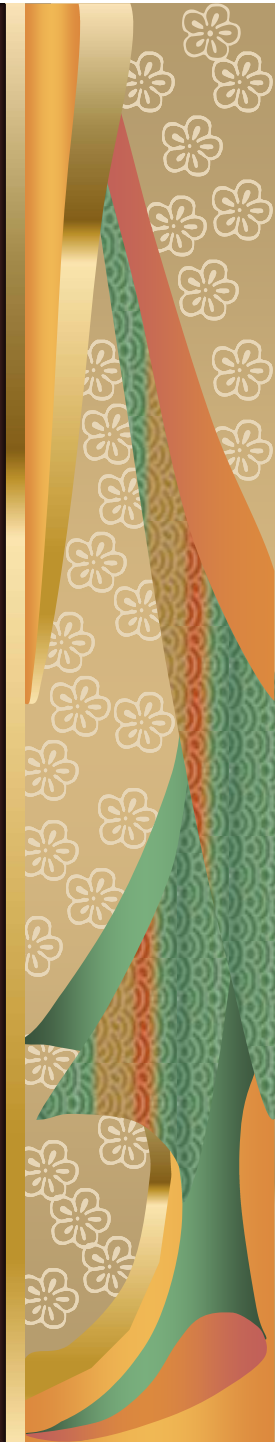
## Gender

-  Histologic otosclerosis – 1:1 ratio
-  Clinical otosclerosis – 2:1 (W:M)
  -  Possible progression during pregnancy (10%-17%)
    - Studies demonstrating changes during pregnancy usually retrospective or lack audiometric data
    - Studies comparing multigravid –vs- nulligravid women with otosclerosis fail to show audiometric differences







## Age

-  15-45 most common age range of presentation
-  Youngest presentation 7 years
-  Oldest presentation 50s
-  0.6% of individuals < 5 years old have foci of otosclerosis



# PRESENTATION

## History

-  Gradual onset with slow progression over several years
-  Typically presents during late teens or twenties
-  70% are bilateral
-  Family history usually positive

## Paracusis of Willis



# CONDUCTIVE HEARING LOSS

❖ 5-60 dB

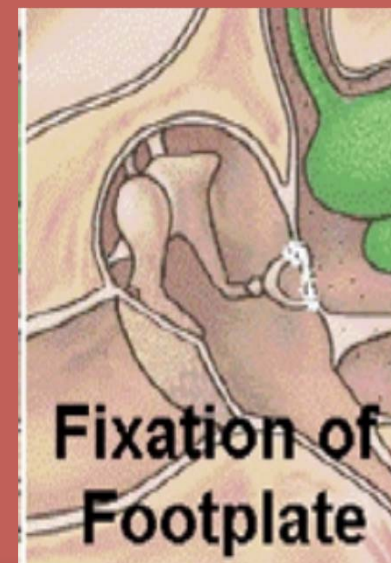
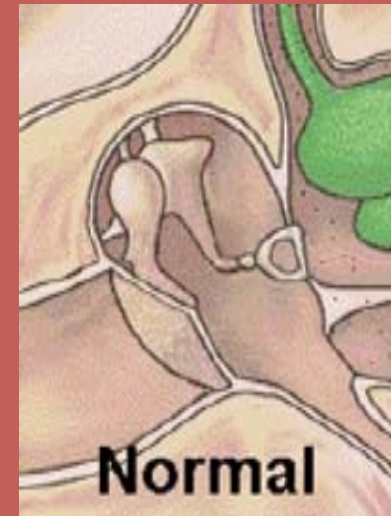
Fibrous ankylosis : upto 30dB

Localised bony ankylosis : 30-40dB

Entire circumference : > 40dB

✓ Clinical observations show that it is not possible to predict the extent of ankylosis based on A-B gap.

✓ Impairment primarily is caused by narrowing & impairment of the annular ligament .



# S.N.H.L

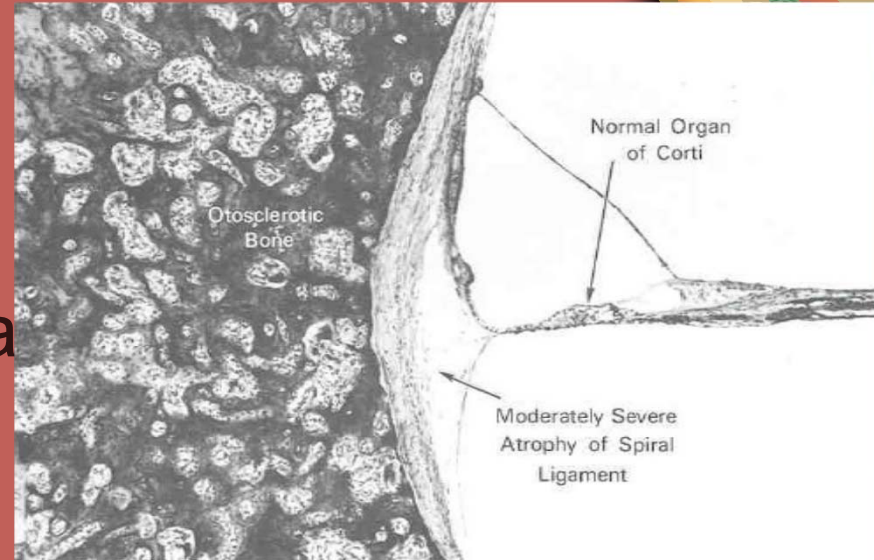
1 Toxic metabolite injury to neuroepithelium  
(Causse et al 1978 )

2 Vascular compromise  
(Ruedi et al 1966 )

3 Direct extension to cochlea  
( Linthicum et al 1975 )

4 spiral ligament

➤ Demonstrated a relationship between endosteal involvement ,hyalinization of spiral lig. & SNHL



■ Tinnitus in 75% ( Wiet et al 1991 )

Severe SNHL + stapedial fixation

Older age or in those with early age or cochlear involvement

➤ Keleman & Linthicum (1969 )SNHL is most commonly associated with basal turn involvement & are invariably present with endosteal involvement .





# VESTIBULAR SYMPTOMS

- 10 – 30%
- Dizziness / vertigo
- Scarpa's ganglion cell counts were significantly lower in pt's with vestibular symptoms  
(Saim et al 1996)
- ✓ Toxic substances
- Type 1: mild dysequilibrium
- Type 2: acute rotational vertigo + tinnitus + SNHL
- Type 3: meniere's disease + cochlear otosclerosis



# Physical examination



- Otoscopy (often with the operating microscope)
  - look for Schwartz sign: red blush over the promontory or area anterior to oval window
- Pneumo-otoscopy
  - evaluates for middle ear effusion or small perforation
- Tuning fork exam
  - may confirm or dispute finding of conductive hearing loss on audiometry



■ Initial phase → Rinne - ve may be limited to 256 Hz

■ Footplate fixation → Rinne - ve at 512 Hz & 1024 Hz

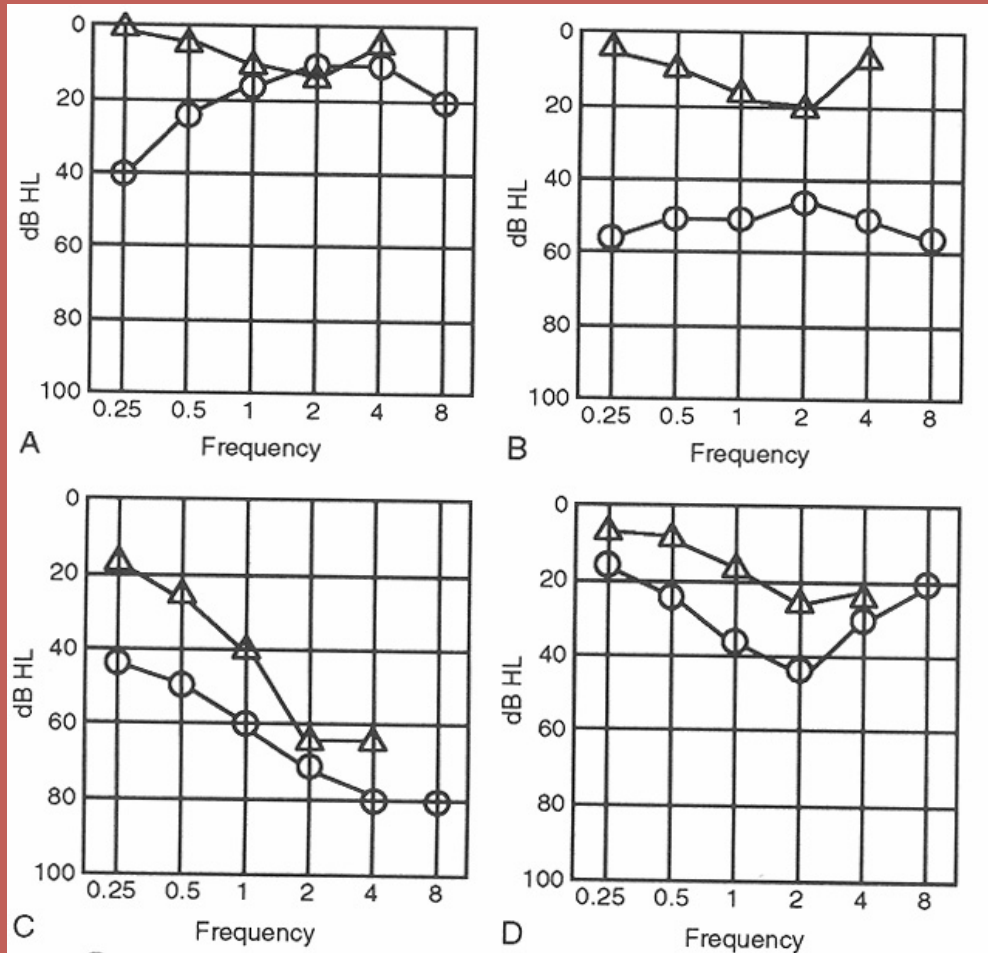
■ Rinne – ve :

air-bone gap ~ 10-15 dB at 256 Hz

~ 20-25 dB at 512 Hz



# AUDIOLOGICAL EVALUATION



'STIFFNESS TILT'- CHL  
'COOKIE BITE' - SNHL



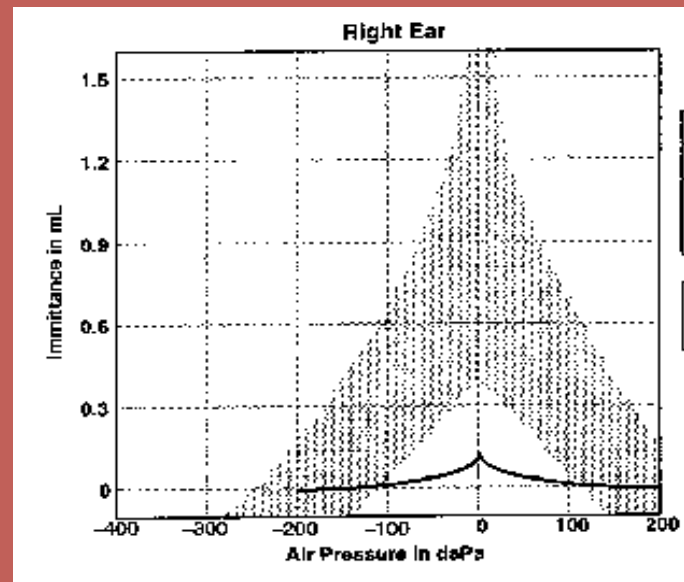
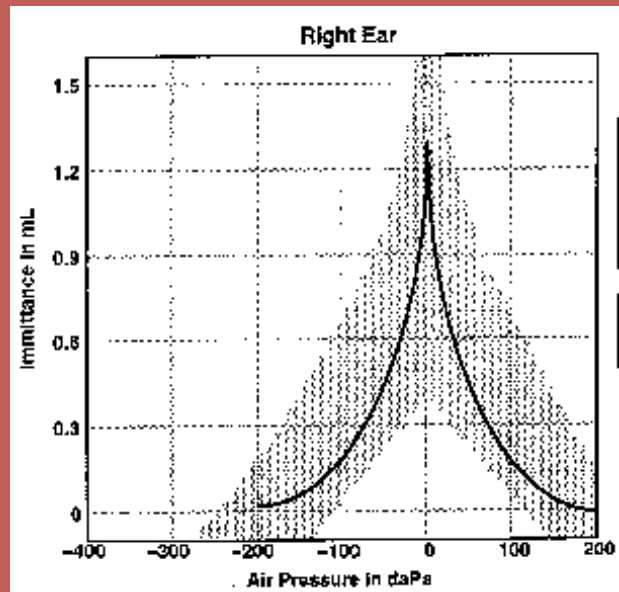
# Carhart's notch

- Decrease in bone conduction thresholds
  - 5 dB at 500 Hz
  - 10 dB at 1000 Hz
  - 15 dB at 2000 Hz
  - 5 dB at 4000 Hz

Proposed theories:

- FP fixation disrupts ossicular resonance (2KHz)
- Perilymph immobility
- Mechanical artifact





 Static compliance :

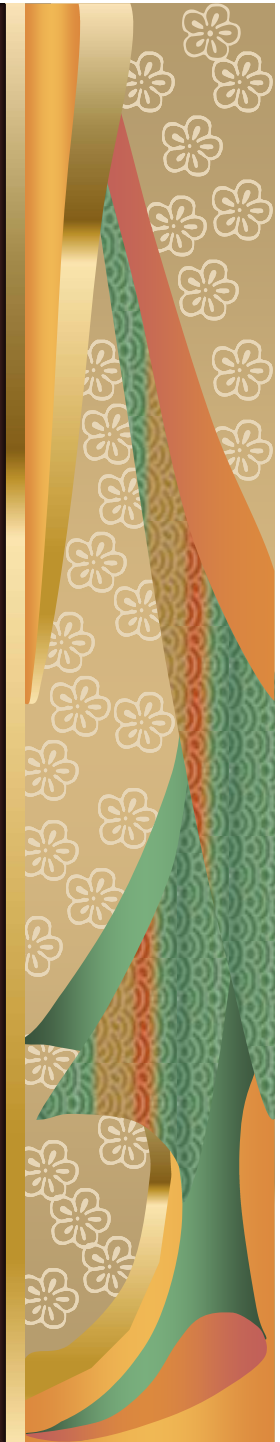
{ Peak compliance – Compliance  
(200daPa) }

0.3 – 1.6 cc

< 0.3 – conductive app. Stiffness

>0.6 – thin footplate

0.2 - ? Obliterative focus



✓ Acoustic reflexes : Biphasic pattern  
( earliest evidence )

Early stages – vertical pattern

Progressive lesion – inverted ‘L’ pattern

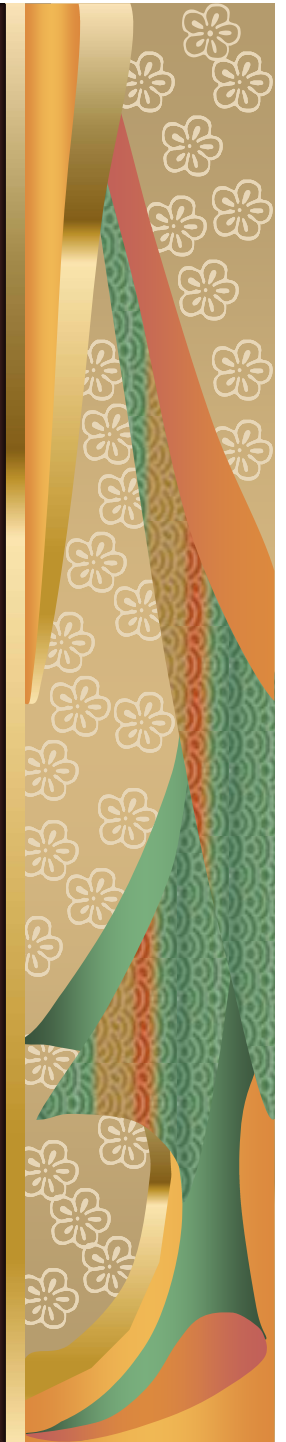
✓ Nonacoustic reflexes : tensor tympani  
activity ( malleus fixation )

Cornea / tragus

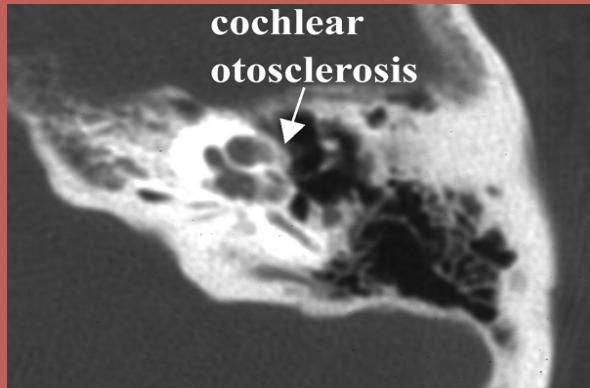




- Speech audiometry :
- Otoacoustic emissions : non-specific



# RADIOLOGY

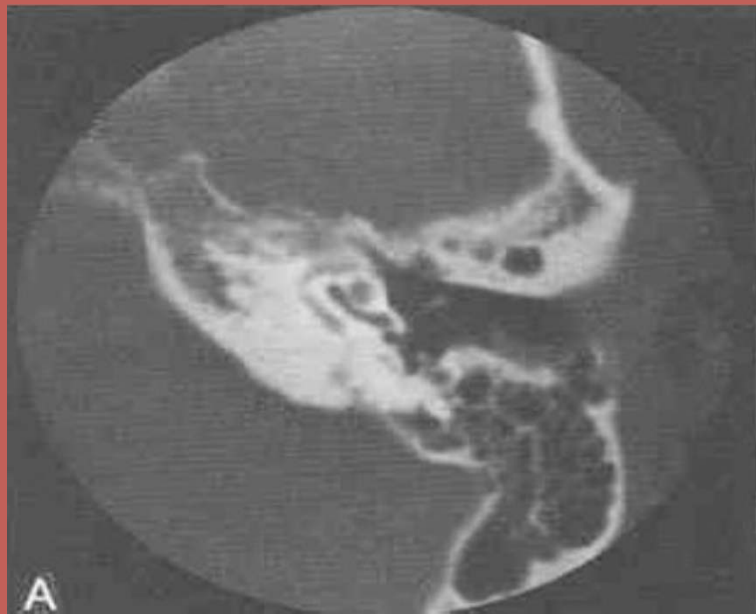


C.T scan

Gray scale : 4000 HU

Small collimation

Pixel size < 0.25 mm



HALO SIGN



Sensitivity : 34 – 90 %  
(early – advanced )


Valvasorri ( 1996 ) :

- ✓ Focus > 1mm diameter
- ✓ Density of focus must differ from rest of otic capsule
- ✓ Sclerotic focus can be detected only when they are close to the periosteal or endosteal surfaces of the otic capsule



- C.T desitometry : variations in density exceeding standard deviations of 10-15% for each point indicate cochlear involvement
- MRI : contrast enhancement in T1 gadalonium enhanced images



 SPECT scintigraphy : dynamic technique , study of bone metabolic activity (diphosphonate in petrous bone & also radioactivity)

Mean UI : 2.214 in otosclerosis

3hrs interval

Sensitivity – 97.2%

✓ Structural & functional data of the labyrinth



# COCHLEAR OTOSCLEROSIS

- 22.9% ( Causse et al 1991 )
- F > M
- Periods of activation & remission
- Association with hormonal change
- PTA – ‘cookie type’
- SD- 80-90%
- Stapedial reflex - present



■ Causse et al 1975

■ Criteria of presumption :

- slowly progressive SNHL + family h/o
- Women aggravated by pregnancy / OCP / menstrual variation / estrogen t/t
- With H.A good S.D, better hearing in noisy surrounding



## Criteria for probability :

- ✓ + schwartze sign
- ✓ Cookie bite PTA
- ✓ Radiological evidence

## Criteria of certainty :

- ✓ Diphasic impedance with SNHL
- ✓ AB gap in one ear & replacement of on-off effect with disappearance of stapedial reflex
- ✓ CT scan







 British National Study Of Hearing

Presumptive clinical otosclerosis:

- ❖ Normal Tm
- ❖ Normal tympanogram peak
- ❖ AB gap  $> 15\text{dB}$  over .5, 1 & 2 KHZ

# DIFFRENTIAL DIAGNOSIS

- Any CHL “Intra-operative Dx”
- Ossicular discontinuity
- Malleus head fixation (0.5%)
- Paget’s disease
- Osteogenesis imperfecta
- Osteopetrosis
- Congenital FP fixation\*

\*Apert



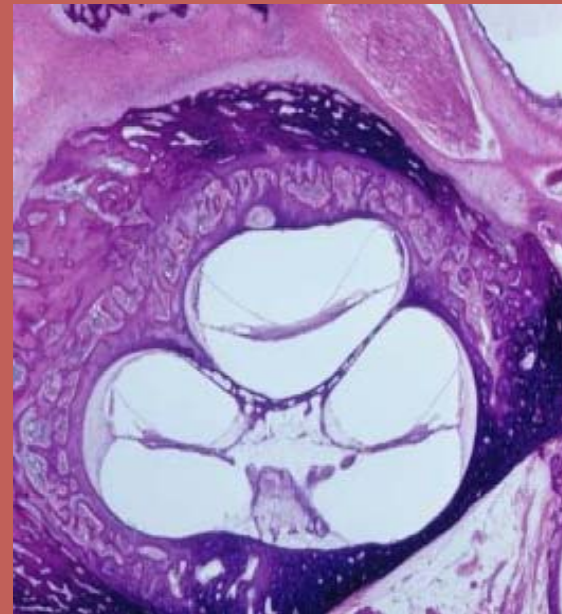
# *Osteogenesis imperfecta*



30 Y  
Bilateral HL  
Fractures



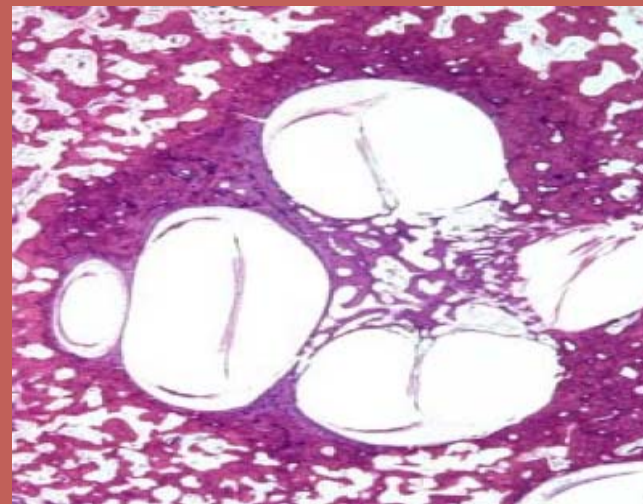
- Translucent sclera → choroid membrane → The blue sclera
- Endochondral layer contains abnormally large rests of cartilage



# Paget's disease

80 Y

Bil mix-HL



## Otic capsule

- Extensively eroded
- Replaced by pagetic bone
- Normal FP



- SNHL is not caused by compression of VIII nerve fibers
- CHL is not caused by ossicular fixation
- ? bone mineral density
- Sx correction of CHL are generally not considered worthwhile



# *Paget's disease vs otosclerosis*

## **Distinguishing features**

- late onset (sixth decade)
- Greater SNHL (with a descending pattern)
- enlarged calvaria
- enlargement and tortuosity of the superficial temporal artery and its anterior branches
- elevated serum alkaline phosphatase level
- radiographic evidence in the temporal bones



# Osteopetrosis

- No osteoclastic activity with preserved osteoblastic activity
- Uniformly increased density of all the bones and the lack of any cortical medullary differentiation
- Thickening of the calvarium with obliteration of the diploic layer





# *Treatment*

1. Do nothing
2. Medication
  - Sodium fluoride
  - Vitamin D
  - Calcium carbonate
3. Amplification
4. Surgery
  - Stapedectomy
  - Stepedotomy (+/- Laser)



# MEDICAL TREATMENT

## SODIUM FLUORIDE :

Antienzymatic action  
(proteolytic)

Decreases osteoclastic  
Action & increases  
Osteoblastic action

Active focus

Replaces hydroxyl group  
forming fluorapatite

Causes maturation  
otosclerosis



■ Dose – 20-120mg

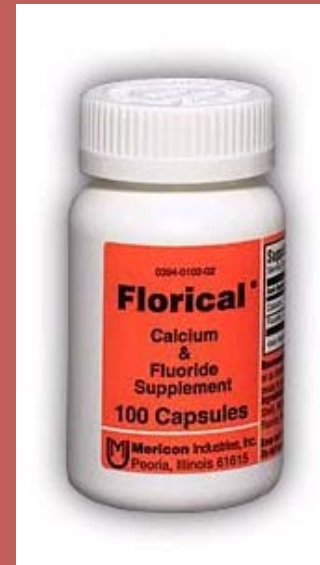
■ Hearing results

50% stabilize

30% improve

■ Re-evaluate - 2 yrs with CT and for  
Schwartz's sign to resolve

■ If fluoride are stopped – expect reactivation  
within 2-3 years



## Indications :

- Surgically confirmed otosclerosis with SNHL
- Cochlear otosclerosis
- Radiological changes
- Schwartze's sign
- Secondary hydrops
- Refused surgery



## Contraindication :

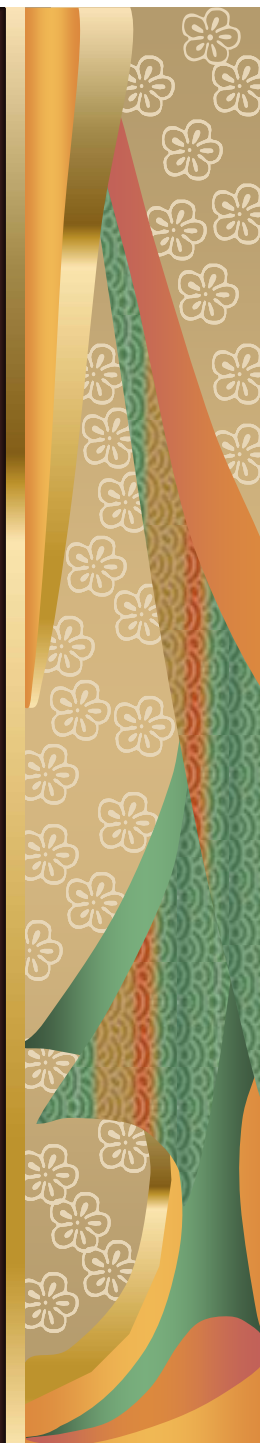
- Chronic nephritis with nitrogen retention
- Chronic rheumatoid arthritis
- Pregnant / lactating women
- Children who have not achieved skeletal growth
- Skeletal fluorosis
- Allergy to flouride



**Computerized Data from Cause Clinic  
on NaF Therapy for Cochlear Otospongiosis**

<b>Daily Dose, Naf/mg</b>	<b>Duration of Rx/ yr</b>	<b>Total Cases</b>	<b>Hearing improved % (10db or more)</b>	<b>Hearing Stabilized %</b>	<b>Hearing Worse, % (10db or more)</b>
<b>Stapedial Fixation With Sensorineural Progression</b>					
<b>1,5</b>	<b>1-4</b>	<b>212</b>	<b>1,06</b>	<b>86,79</b>	<b>11,79</b>
<b>45</b>	<b>1</b>	<b>59</b>	<b>5,08</b>	<b>88,13</b>	<b>6,77</b>
<b>Pure Cochlear Otospongiosis</b>					
<b>1,5</b>	<b>1-4</b>	<b>325</b>	<b>8,61</b>	<b>82,46</b>	<b>8,92</b>
<b>45</b>	<b>1</b>	<b>34</b>	<b>8,82</b>	<b>85,29</b>	<b>5,88</b>

Bretlau P et al (1985): over a period of 2yrs, no evidence of air conduction threshold levels between placebo & tretment group.

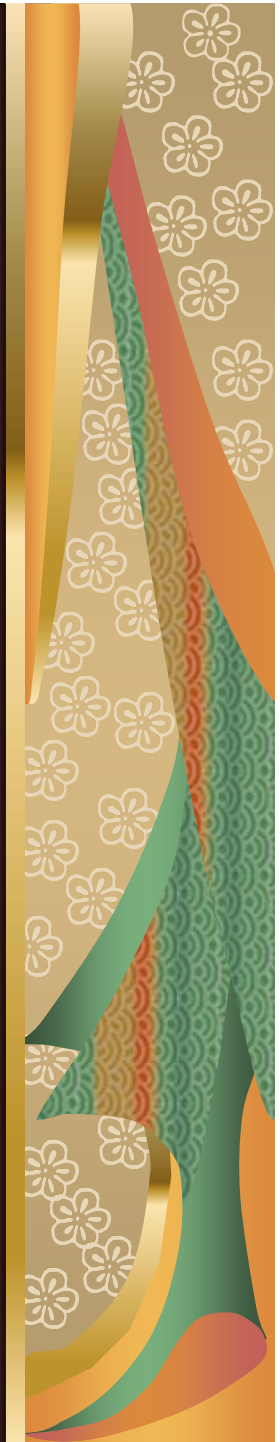


# Bisphosphonates

- Inhibit osteoclastic activity
- Primary enzymatic inhibition
- Promoting stable secondary new bone formation
- Pamidronate , Etidronate , Alendronate , Residronate , Zolendronate



- ❑ Cytokine inhibitors : suppress resorption in otosclerosis
  - o Interleukin -1 receptor antagonist
  - o TNF binding protien
- ❑ Vitamin D
- ❑ Calcium carbonate





# Amplification

## Indications :

- ✓ Major systemic illness
- ✓ Only hearing ear
- ✓ Poor S.D
- ✓ Congenital fixation of stapes
- ✓ Pt.does not want Sx
- ✓ Mild cond.hearing loss
- ✓ Unsuccessful Sx
- ✓ Associated menier's disease
- ✓ Has stapedectomy for advanced lesion



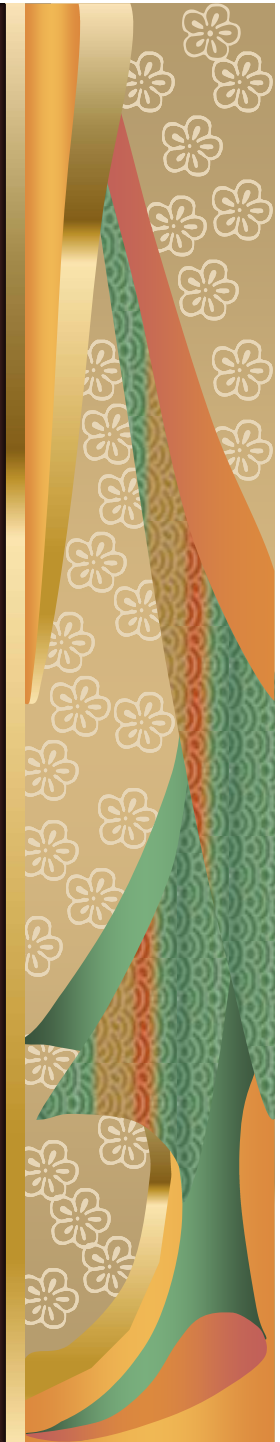
 BAHA

 In pt with severe to profound SNHL  
→ cochlear implant



# Stapes surgery

- Total Stapedectomy
- Partial Stapedectomy
- Anterior crurotomy
- Stapedotomy



## Best surgical candidate

- Previously un-operated ear
- Good health
- Negative Rinne test
- Excellent discrimination
- Desire for surgery



# *Contraindications*

## **A HYDROPS**

- Active disease
- Hydrops Coexistent Ménière
- Young
- Dilation CA or VA on CT scanning or MRI
- Round window obliteration
- Only hearing ear + Otitis media or externa
- Perforation + Pregnancy
- Silent < 20dB



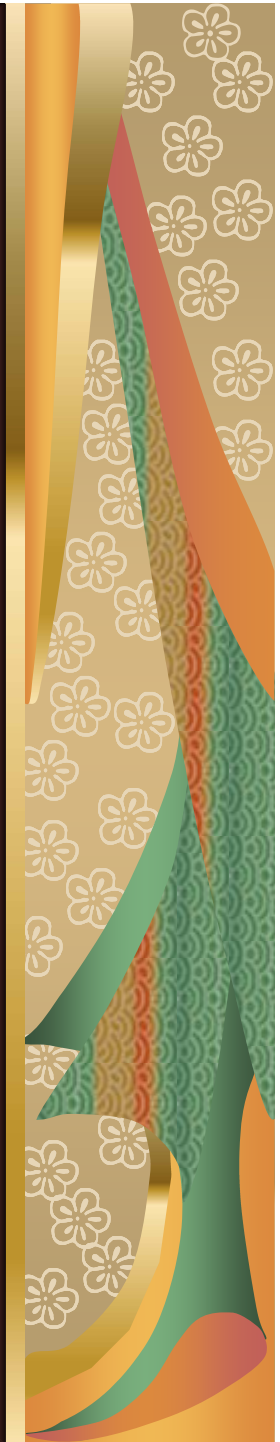
# Informed consent

- Total sensorineural hearing loss occurs 0.2% of cases
  - Less than 2% chance of further hearing loss
- Dizziness may occur post-operatively
  - Usually transient and brief
  - May persist for short time
  - Rarely could be permanent
- Possible facial paralysis/palsy
- Tinnitus
- Recurrent conductive hearing loss



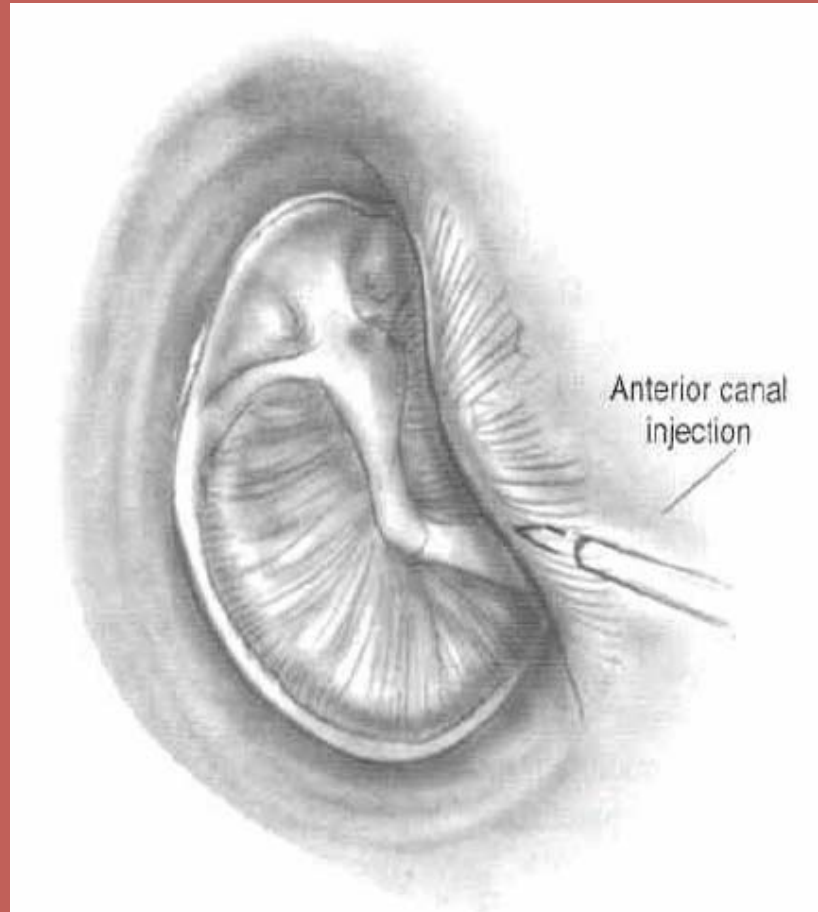
## ❖ Anesthesia

- LA : slightly less bleeding & can assess intraoperative hearing
- GA : pt prefer
- In the young pt → anomalies of malleus or incus
- In older pt → post op poorer result in High frequency range



# Canal Injection

- 1% lidocaine with 1:100,000 epinephrine
- 4 quadrants
- Bony cartilaginous junction





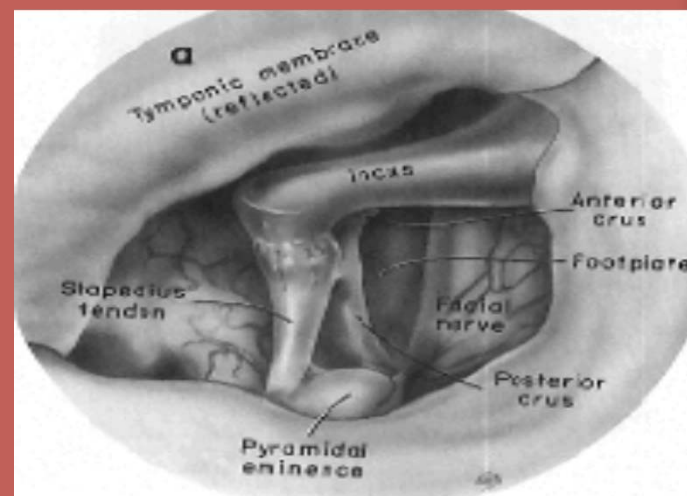
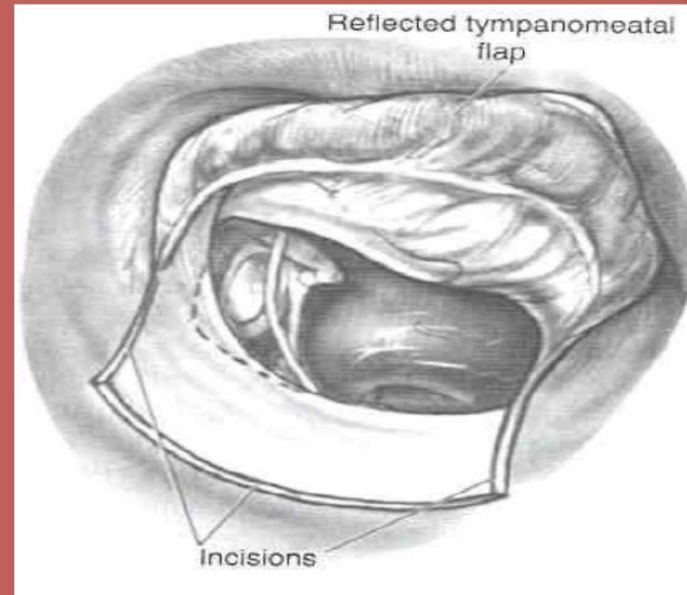
# Raise Tympanomeatal Flap

6 and 12 o'clock positions

6-8 mm lateral to the annulus

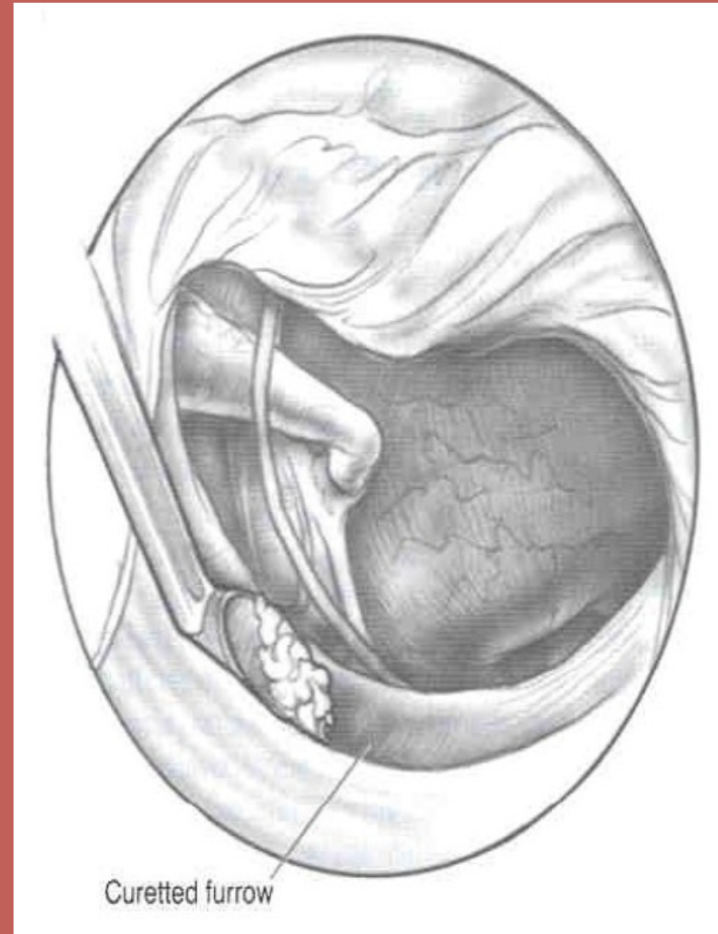
Curettage of the scutum

Exposure - Lt ear



# Curettage of Scutum

- Curettage a trough lateral to the scutum, thinning it
- Then remove the scutum (incus to the round window)
- Visualize the pyramidal process and facial n.



# *Middle ear examination*

## Mobility of ossicles

- **Confirm** stapes fixation
- Evaluate for malleus or incus fixation

## Abnormal anatomy

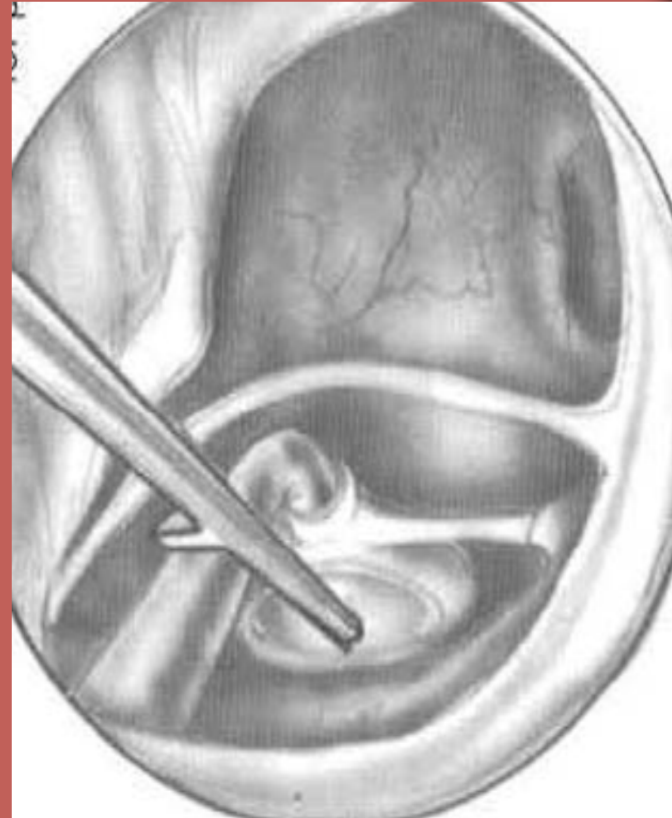
- Dehiscent facial nerve
- Overhanging facial nerve
- Deep narrow oval window niche



# *Measurement for prosthesis*

Lateral aspect of the long process of the incus to the footplate

- ✓ Add 0.25 mm
- ✓ Average 4.5 mm
- ✓ Diameter 0.6 / 0.8 mm

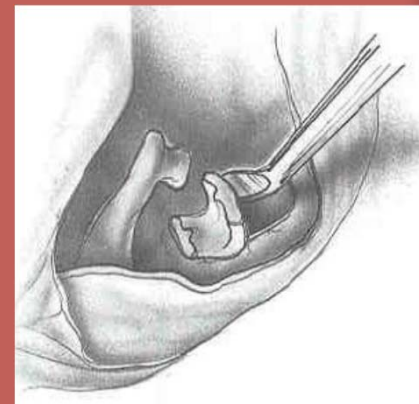
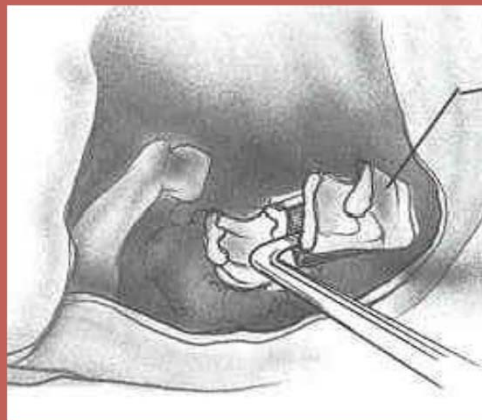
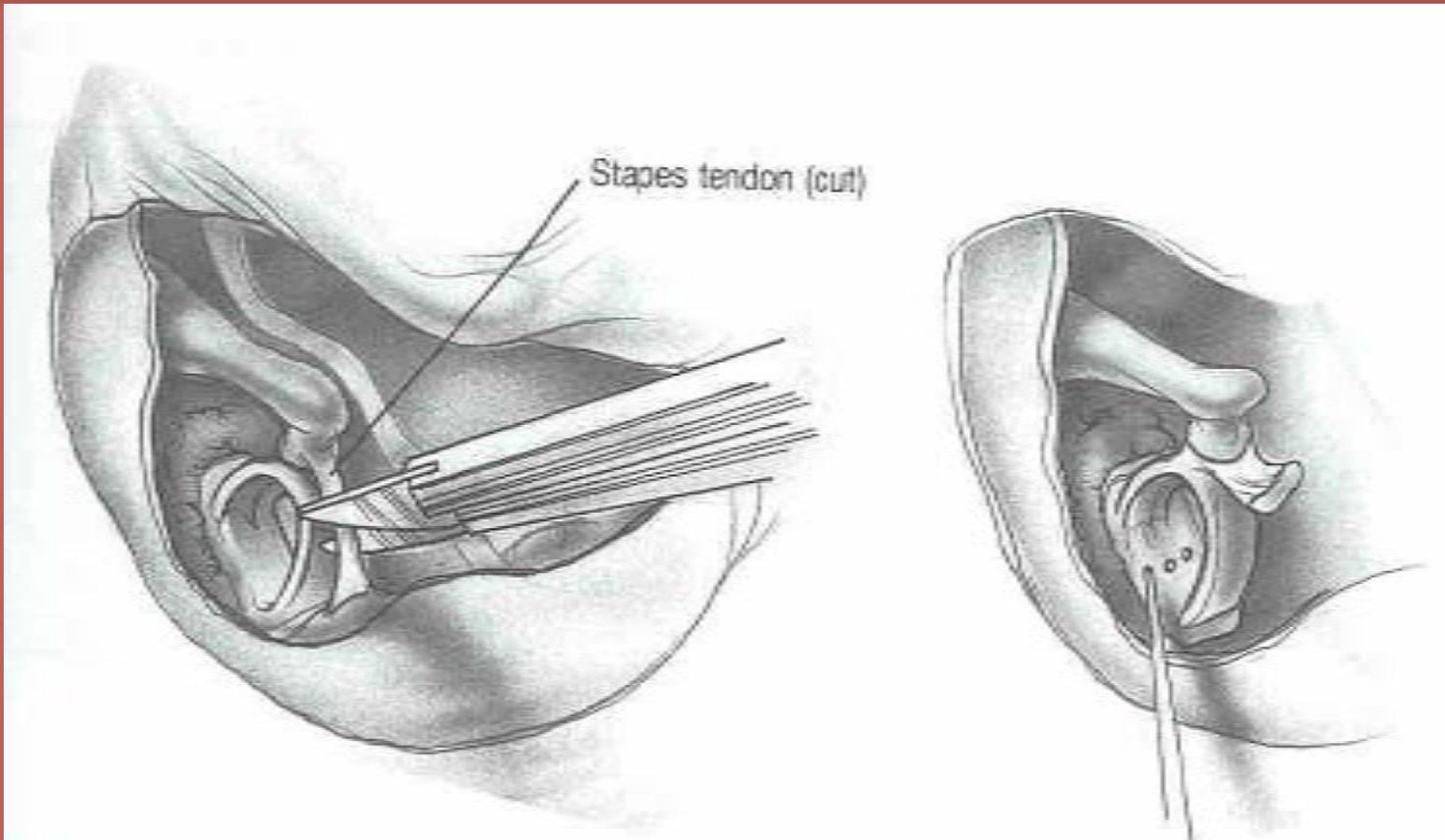


# *Total Stapedectomy*

## ❖ **Obtaining the tissue graft**

- **Vein** ; harvested from back of hand
- **Fat** ; harvested from ear lobule
- **Temporalis fascia** ; harvested through a small incision above & behind ear
- **Perichondrium** ; harvested from tragus





# Stapedotomy

## Tissue Seal of the Oval Window

- Tissue seal : vein , perichondrium , fascia
- No living tissue :

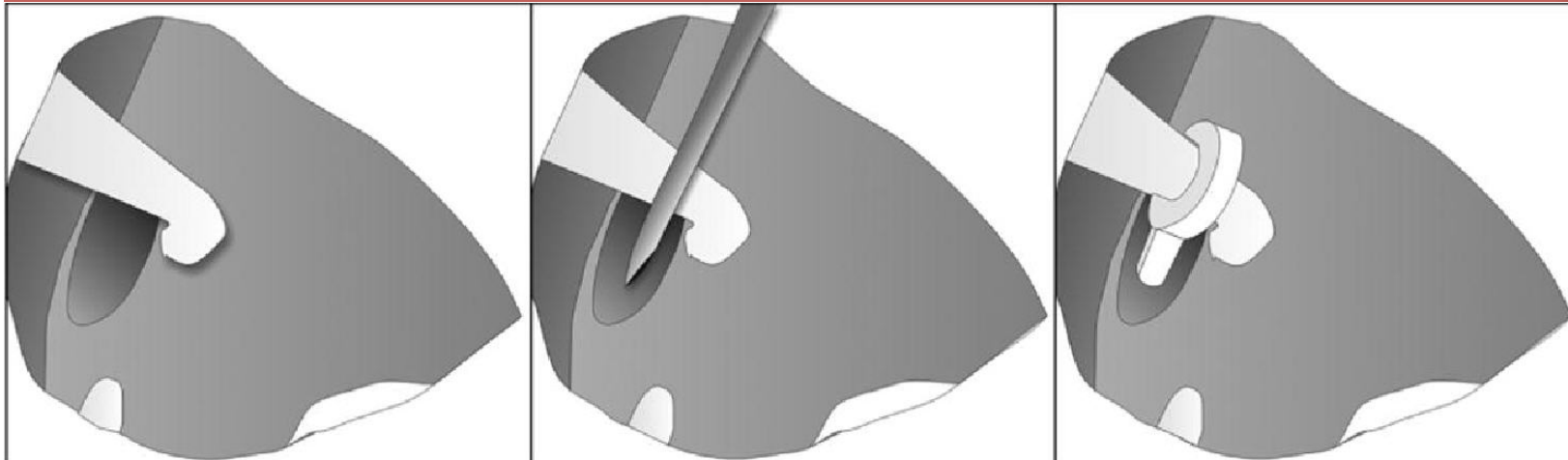
## Gelfoam Microdrill

- ❖ 0.7mm diamond burr
  - ❖ Motion of the burr removes bone dust
  - ❖ Minimizes smoke production/surrounding heat production



# Classic Stapes Surgery Approach

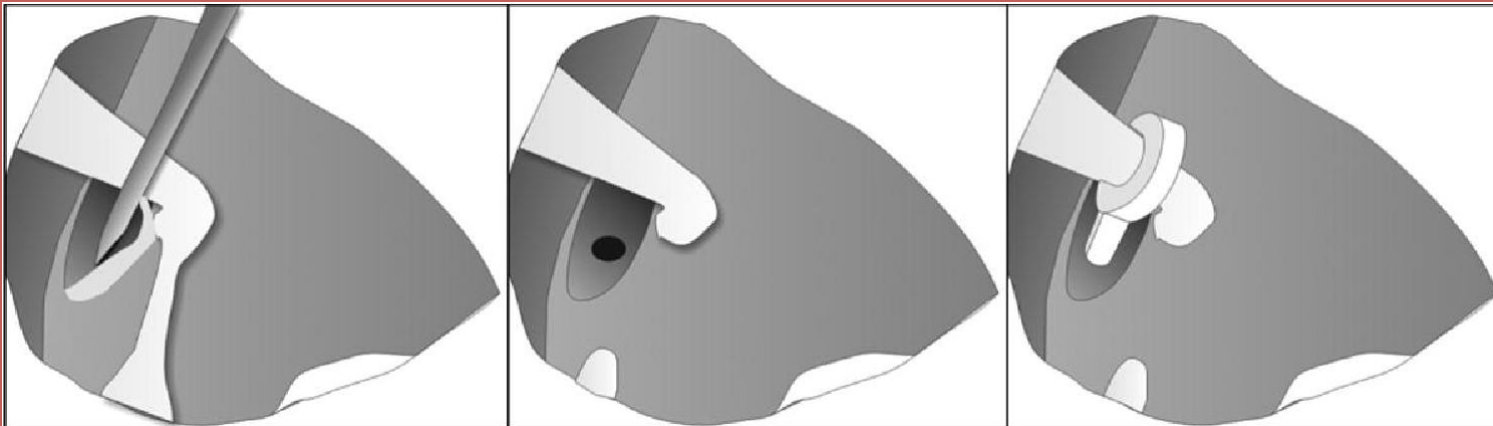
1. Stapes superstructure removed
2. Fenestration of footplate
3. Prosthesis placement





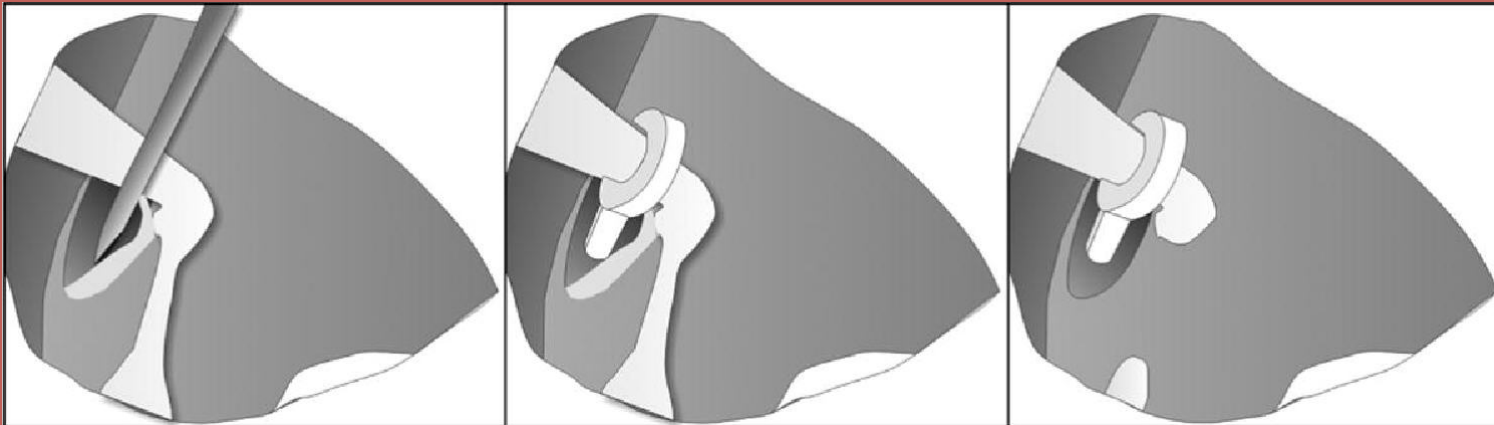
# Modified Stapes Surgical Approach

1. Fenestration of footplate
2. Stapes superstructure removal
3. Prosthesis placement



# Modified Stapes Surgical Approach

1. Fenestration of footplate
2. Prosthesis placement
3. Stapes superstructure removal



# Sequence of Stapes Surgery

## ■ Retrospective review

- 376 patients
- 420 stapedotomies

## ■ Measured incidence of:

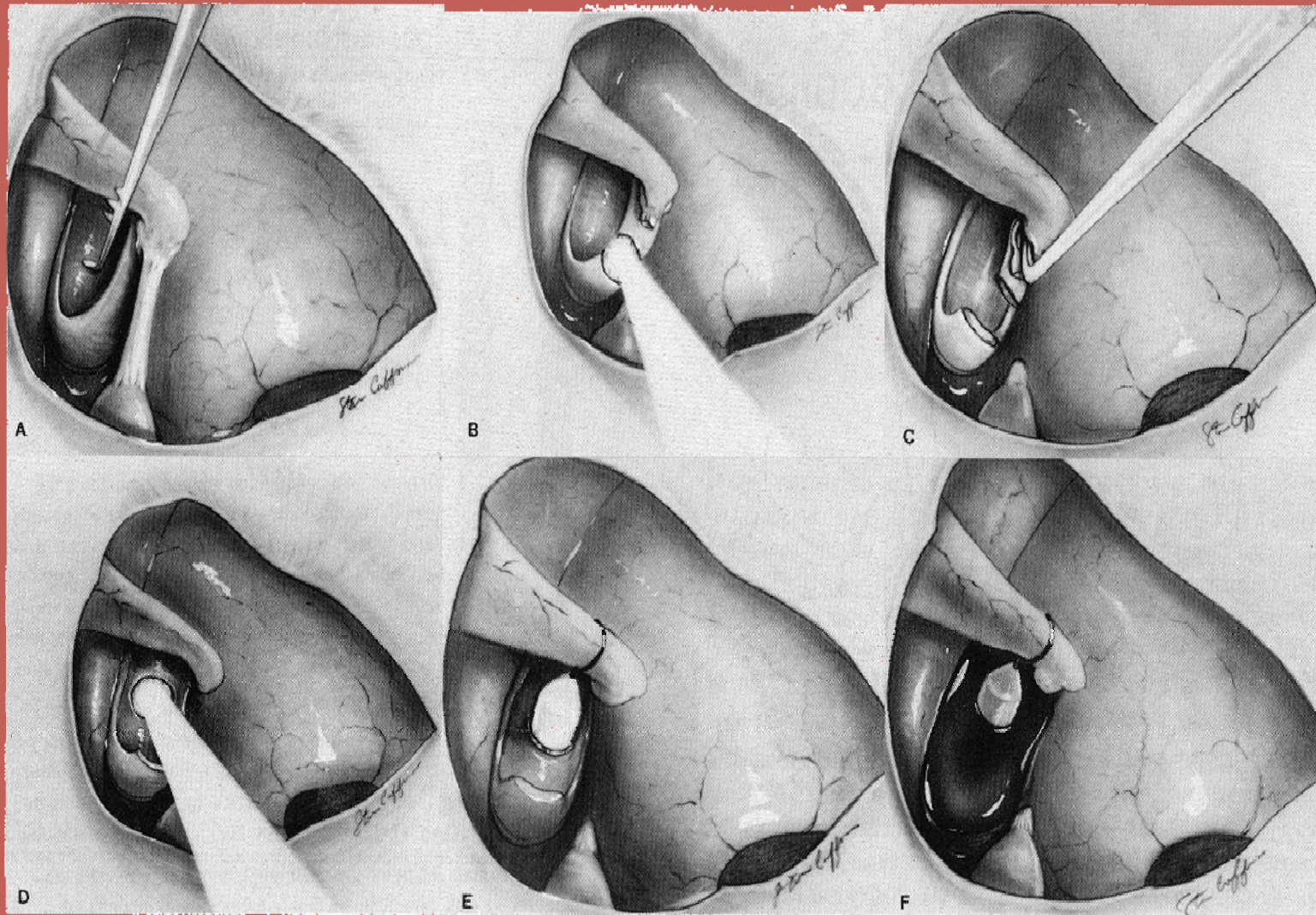
- Incus subluxation
- Floating footplate

## ■ Results

- Footplate perforation before stapes arch removal ↓ risk of floating footplate
- Incus subluxation ↓ when prosthesis placed prior to stapes arch removal



# LASERS IN OTOSCLEROSIS



# Advantages

- Precise fenestra
- Avoids trauma surrounding structures
- Avoiding floating foot plate
- Good hemostasis

➔ Presently there is no ideal laser . visible lasers, especially argon laser has excellent optical precision & superior to co2 laser. But a pulsed co2 laser is preferred for revision cases as collagen absorbs infrared rays better.



Visible lasers : argon , KTP

Infrared lasers : Co2 laser

Advantages of Co2 laser :

➤ Energy is absorbed by water

Disadvantage :

➤ Cumbersome

➤ Increased working distance

➤ Less focus & decreased microscopic light.



■ Laser assisted endoscopic stapedioplasty :  
Poe(2000)

■ Gradient index endoscopies



### Advantages

- Small
- Brightness
- Cost

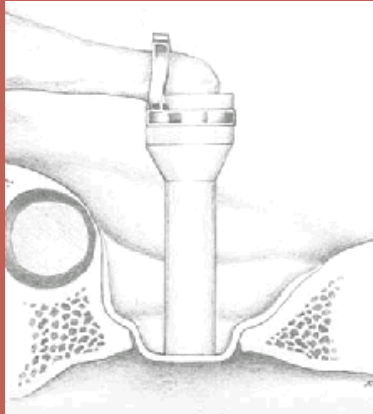
### Disadvantages

Reduced field  
Vignetting

Reduced resolution



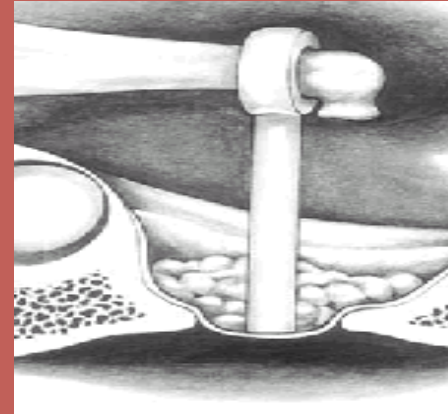
# Prosthesis Placement



Shea platinum Teflon cup piston prosthesis.

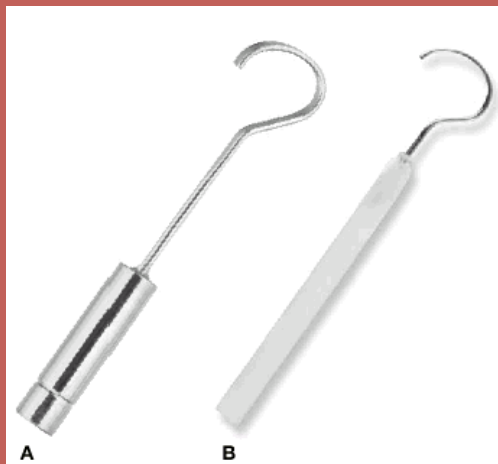


Cup piston prosthesis



Shea Teflon piston prosthesis.

Original Shea Teflon piston prosthesis



McGee/Fisch-type piston prosthesis



House wire prosthesis





# Postoperative care

1. Given adequate analgesic
2. Avoid straining or blowing nose
3. Antibiotic are not routine
4. Keep dry ear until healing TM
5. Avoid 2wheeler travel



# Stapedectomy –vs- Stapedotomy

## Stapedectomy

### ■ Uses

- Extensive fixation of the footplate
- Floating footplate

### ■ Disadvantages

- Increased post-op vestibular symptoms
- More technically difficult
- Increased potential for prosthesis migration

## Stapedotomy

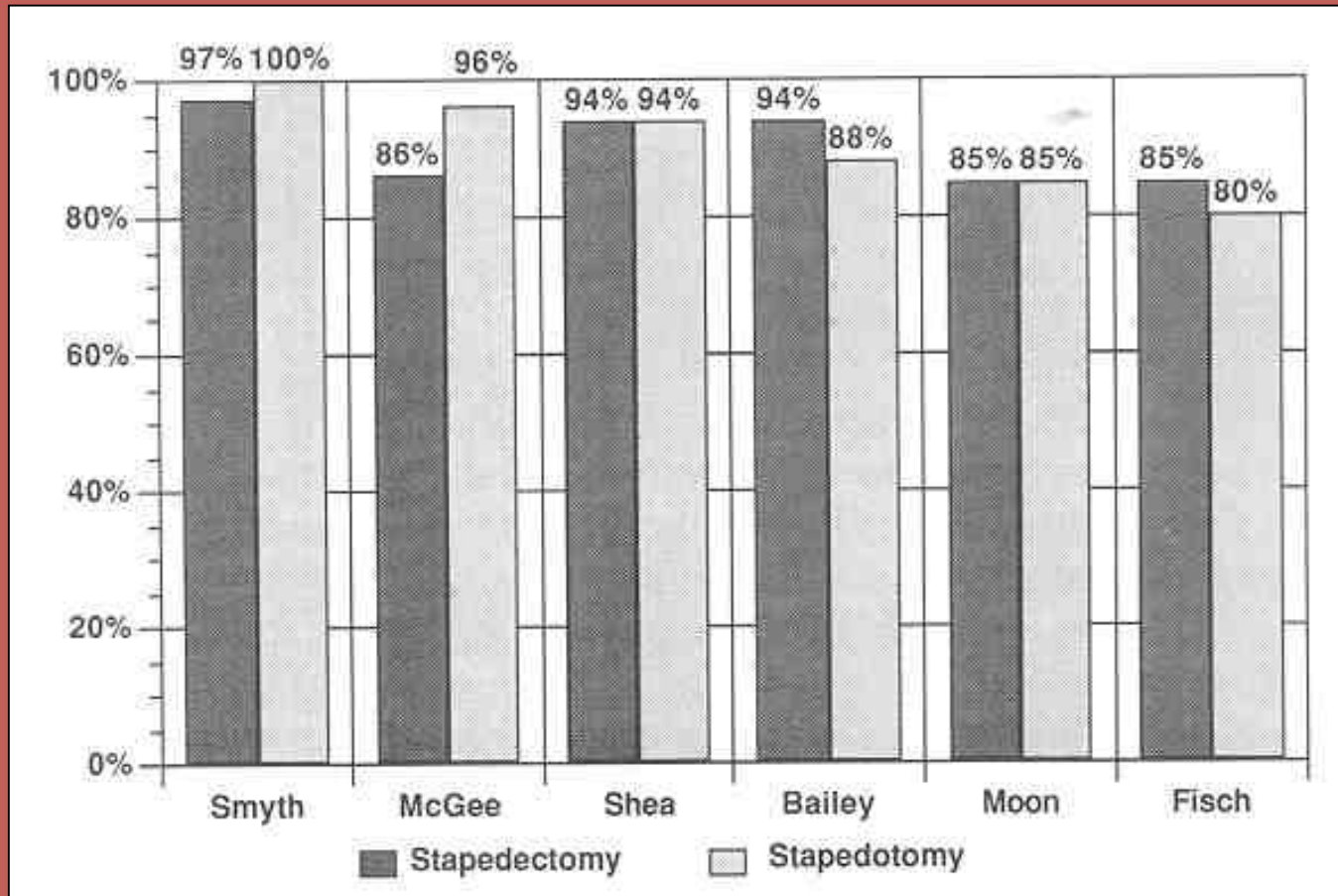
### ■ Originally for obliterated or solid footplates

- Europe
- 1970-80
- First laser stapedotomy performed by Perkins (1978)



# Stapedectomy –vs– Stapedotomy

■ ABG closure < 10dB (PTA)



# Problems During Stapes Surgery

## Exposed overhanging facial nerve

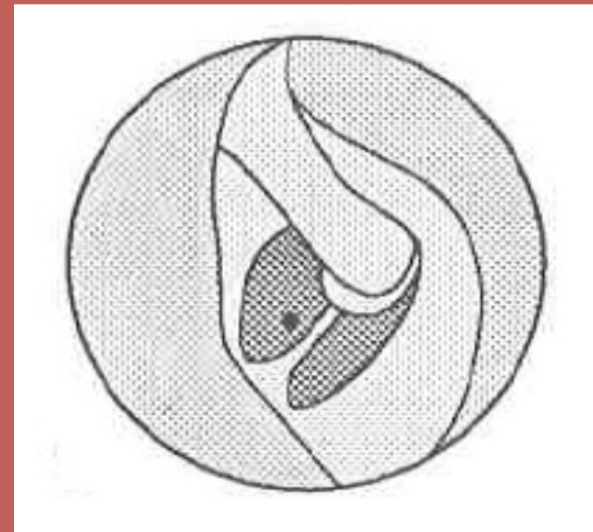
- Occurs ~9% of stapes procedures
- May block footplate access making completion impossible
- Prosthesis touching facial nerve generally does not create problem
  - May displace nerve superiorly while performing stapedotomy



# Problems During Stapes Surgery

## Floating Footplate

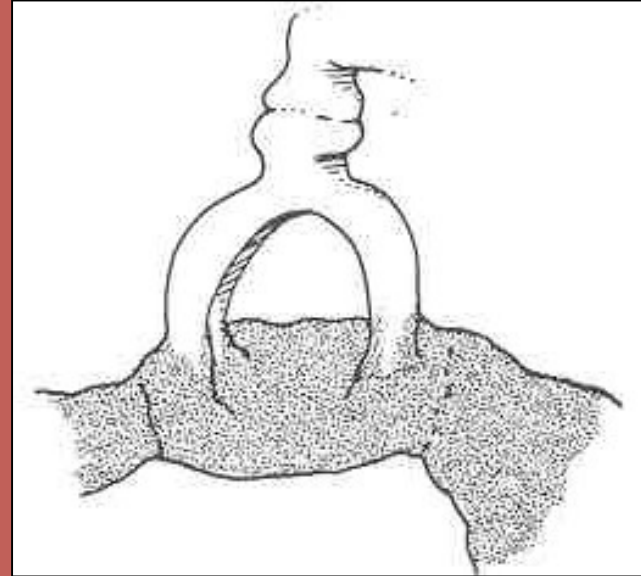
- Footplate dislodges from surrounding oval window niche
  - Usually iatrogenic
  - Incidental finding
- Prevention
  - Laser
  - Footplate control hole
- Management
  - Abort
  - Proceed
    - Total stapedectomy
    - Laser fenestration/microdrill fenestration



# Problems During Stapes Surgery

## Diffuse Obliterative Otosclerosis

- Occurs when footplate, annular ligament, and oval window niche are involved
- Closure of air-bone gap < 10 dB less common
- Refixation commonly occurs
- Fenestra created with microdrill



# Problems During Stapes Surgery

## Fixed malleus

- Rare problem
- Must always check
- Must check mobility of prosthesis after placement



# Problems During Stapes Surgery

Perilymph Gusher - profuse flow of perilymph immediately upon opening vestibule

- Rare – 0.03% incidence
- Associated with congenital footplate fixation
- Possibly due to:
  - Widened vestibular aqueduct
  - Defect in IAC fundus
- Management
  - Tissue graft over oval window
  - Complete procedure if possible
  - Consider lumbar drain





# Problems During Stapes Surgery

## Intraoperative vertigo

### ■ Causes

- Prosthesis too long
- Checking prosthesis mobility

### ■ Management

- Shorter prosthesis (try 0.25mm shorter piston)



# Post-operative Complications

## Sensorineural Hearing Loss

- Most devastating complication of stapes surgery
- Ranges from mild to total loss or may be isolated to high frequencies
- <1% - 3% incidence of profound permanent SNHL
  - Surgeon experience
  - Extent of disease
    - Cochlear
  - Prior stapes surgery



# Post-operative Complications

## Sensorineural Hearing Loss (cont.)

### ■ Temporary

- Serous labyrinthitis
- Reparative granuloma

### ■ Permanent

- Suppurative labyrinthitis
- Extensive drilling
- Basilar membrane breaks
- Vascular compromise
- Sudden drop in perilymph pressure

### ■ Management

- Prednisone taper started immediately



# Post-operative Complications

## Recurrent Conductive Hearing Loss

### ■ Slippage or displacement of the prosthesis

■ Most common cause of failure

#### ■ Immediate

■ Technique

■ Trauma

#### ■ Delayed

■ Slippage from incus narrowing or erosion

■ Adherence to edge of oval window niche

■ Stapes re-fixation

■ Progression of disease with re-obliteration of oval window

■ Malleus or incus ankylosis



# Post-operative Complications

## Recurrent Conductive Hearing Loss (cont.)

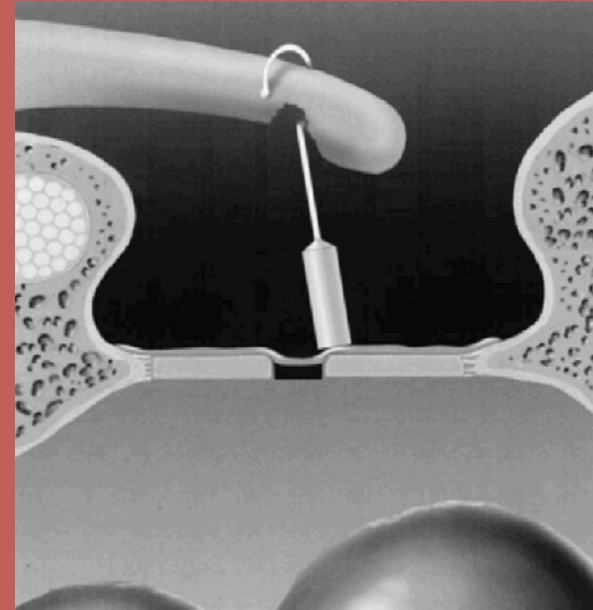
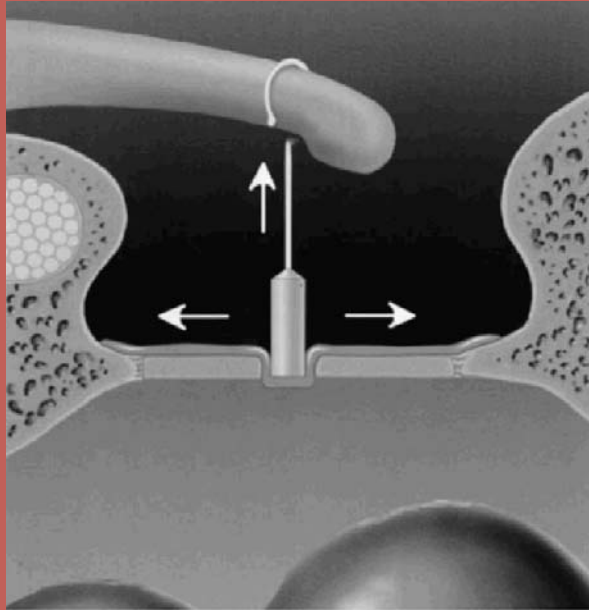
### ■ Recommendations

- Laser stapedotomy
- Teflon/platinum stapedotomy prosthesis
- Prosthesis 0.25mm longer than distance between incus undersurface and footplate
- Clotted blood oval window seal
- Minimize mechanical trauma
- Use tissue seal
  - Perilymph gusher
  - Footplate fracture
  - When stapedotomy too large

Lesinski SG. Otol Neurotol 2002.



# Conductive Hearing Loss Mechanism: After Stapedotomy

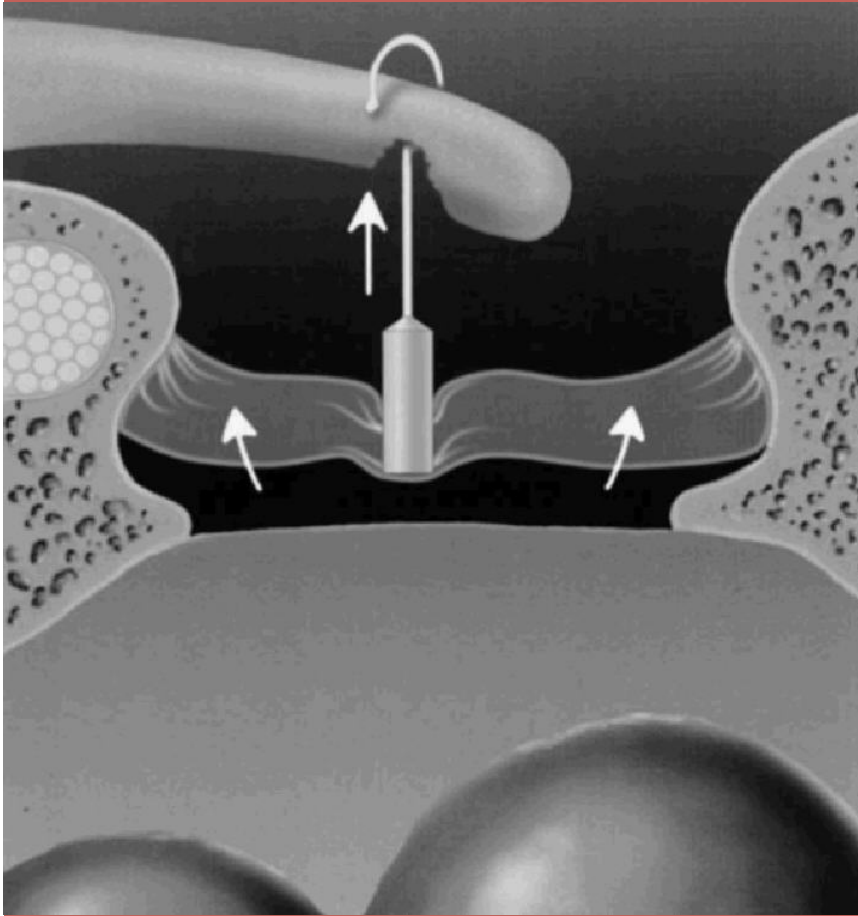


- Collagen tissue seal contracts
- Prosthesis lifts out of stapedotomy
- Prosthesis migrates to fixed stapes footplate



# Conductive Hearing Loss

## Mechanism: After Stapedectomy



- Neomembrane lateralizes
- Erosion of incus causing loosening of wire loop



# Post-operative Complications

## Serous labyrinthitis

- Common following surgery secondary to inner ear inflammation
- Symptoms
  - Unsteadiness
  - Positional vertigo
  - Slight high frequency hearing loss
- Management
  - Expectant





# Post-operative Complications

## Vertigo

- More common with stapedectomy than stapedotomy
  - Due to serous labyrinthitis
- Occurs ~5% of cases
- Rarely prolonged or severe
- Usually lasts a few hours to one week
  - Rapidly subsides
- Supportive management



# Post-operative Complications

## Vertigo (cont.)

■ Intraoperative or immediately post-op: lasts up to 1 week without intervention

■ Inner ear trauma

- Prosthesis/instrument contact with membranous labyrinth (utricle macula)
- Perilymph aspiration

■ Isolated delayed vertigo

- Trauma to otolith organs creating BPPV-like picture
- Perilymphatic fistula



# Post-operative Complications

## Delayed Vertigo

- Retrospective review
- 9 pts with delayed vertigo (1 month to seven years post-op) underwent exploratory tympanotomy
  - Suspected perilymph fistula in all pts
  - 3 pts had perilymph fistula
- Fibrin glue placed in oval window area in all pts
- No post-operative vertigo

Albera R et al. Laryngoscope 2004.



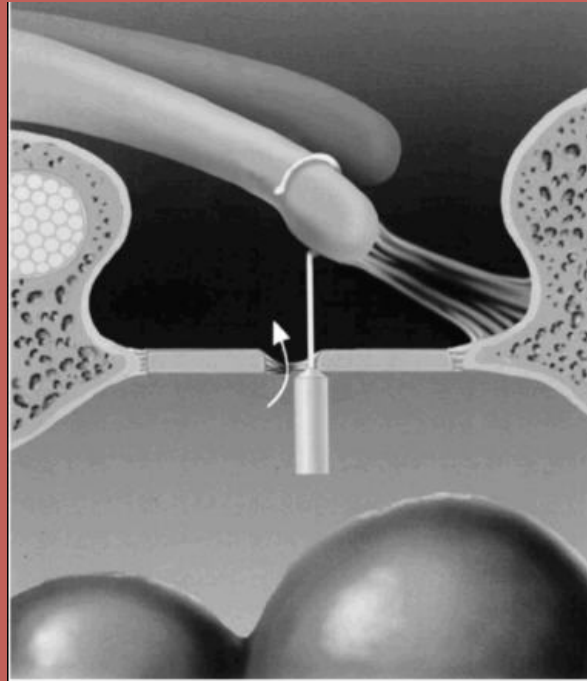
# Post-operative Complications

## Perilymph Fistula

- Rare complication after stapes surgery
- Presents with:
  - Mixed hearing loss
  - Vague unsteadiness
  - Vertigo
- Management
  - Remove prosthesis carefully → tissue seal the oval window → prosthesis replaced



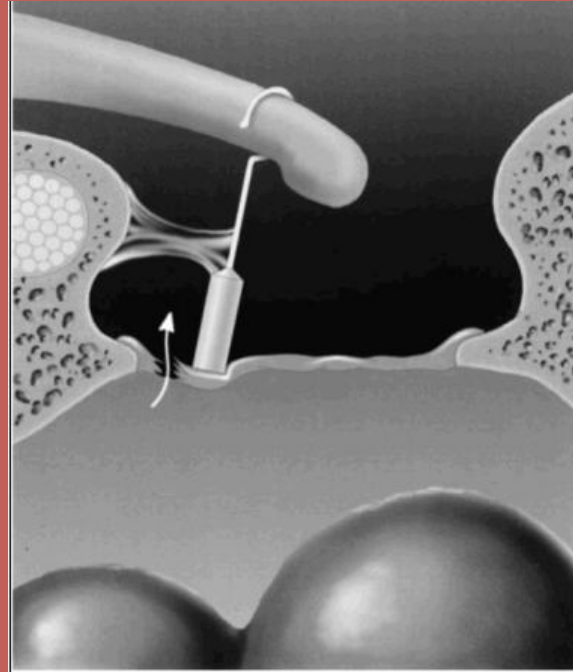
# Mechanism of Post-operative Perilymph Fistula: Stapedotomy



- Incus medially displaced by contracture adhesions between incus and promontory
- Prosthesis medializes into vestibule



# Mechanism of Post-operative Perilymph Fistula: Stapedectomy



- Prosthesis migration from center to edge of oval window
- Vibration tears weaker shortened edge of membrane



# Post-operative Complications

## Tinnitus

- Possibly related to serous labyrinthitis
- Management
  - Reassurance
  - Routine tinnitus measures



# Post-operative Complications

## Facial paralysis/palsy

- Rare
- Delayed onset
- Typically lasts several weeks
  - Occurs in 5-day post-op setting
- Usually incomplete paralysis
- Management
  - Prednisone- usually complete response





# Post-operative Complications

## Facial paralysis/palsy (cont.)

- Retrospective review
- 2152 stapes surgeries (2106 pts)
- 0.51% delayed facial palsy
- Occurred 5-16 days post-op
- Measurements
  - House-Brackmann grade
  - Serum antibody titer (HSV1, HSV2, VZV)
- Conclusion
  - Serology suggests activation of latent herpesvirus

Shea JJ et al. Otol Neurotol 2001.



# Post-operative Complications

## Reparative granuloma

Very rare- associated with Gelfoam use

### Patient presentation

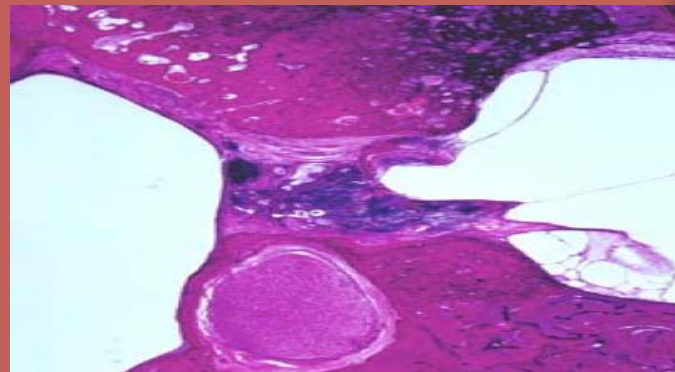
Initial hearing improvement followed by gradual/sudden deterioration over 1 to 6 weeks

Reddish discoloration in posterosuperior quadrant

Occasional vertigo

### Management

Granuloma removal



# Post-operative Complications

## Chorda Tympani damage

- Occurs ~30% of cases due to nerve stretching/mobilization
- Causes temporary (3-4 months)
  - Dry mouth
  - Tongue soreness
  - Metallic taste
- Symptoms less severe with sectioning of nerve



# Post-operative Complications

## Tympanic membrane perforation

- May occur during elevation of tympanomeatal flap
- Does not preclude completion of operation
- Repair involves myringoplasty or tympanoplasty with either synthetic material or autologous tissue



# Post-operative Complications

## Psychiatric complication

### ■ Case report

- Underlying schizoaffective disorder
- Stapedectomy performed with complete closure of ABG
- Pt believed surgery resulted in:
  - Improved sound perception
  - Thought broadcasting

Mevio E et al. *Auris Nasus Larynx* 2000.



# Revision Stapes Surgery

- Retrospective review
- 63 surgeries (56 pts)
- Revision reason
  - Recurrent or persistent ABG > 20dB post-surgical treatment for otosclerosis
- Prosthesis malfunction was primary failure cause



# Revision Stapes Surgery

## Results

- 52.4% ABG  $\leq$  10 dB
- 9.5% without change
- 6.3% decreased hearing  $\geq$  5 dB

## Recommendations

- Examine
  - Prosthesis attachment to incus
  - Oval window niche
- Pistons can be removed easily
- Tissue wire prostheses
  - Difficult to remove- laser helps with removal
  - Increased risk of SNHL



THANK YOU

