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 (causse 1984 / larson 1960)
- Heterogenetic disease
- Polygenetic & multifactorial (causse 1980 / 1984)
- HLA – A3(RR 2.8), A9 (5.34), A11(3.14), B13 (4.26)M
- Male: A9 & 11           Female: A3
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

| (MV) Measles virus infection via Eustachian tube |
| Penetration into the bone or labyrinth via oval/round window, perivascular spaces, lymphatic vessels |
| Infection of fibrocytes, chondrocytes, osteoblasts |
| Expression of MV-antigens at cell surface |
| Cellular and humoral immune response |
| Result: inflammation causing otosclerosis (resorption lacunae) |
| Final stage: Scar formation, i.e. dense new bone (otosclerosis) |

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.
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
Most common sites of involvement

- Fissula ante fenestrum (80-90%)
- Round window niche (30%-50% of cases)
- Apical medial wall of cochlear labrynth 15%
- Stapes foot plate 12%
- Post to oval window 5-10%
- Walls of IAC
- Around vestibular & cochlear aqueducts
- Around SCC
- Around malleus & incus
Epidemiology

<table>
<thead>
<tr>
<th>Race</th>
<th>Incidence</th>
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<tr>
<td>Caucasian</td>
<td>10%</td>
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<tr>
<td>Asian</td>
<td>5%</td>
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<tr>
<td>African American</td>
<td>1%</td>
</tr>
<tr>
<td>Native American</td>
<td>0%</td>
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</tbody>
</table>
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: up to 30 dB
  - Localised bony ankylosis: 30-40 dB
  - Entire circumference: > 40 dB

✓ 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 ligament, & 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 Schwartze 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
AUDILOGICAL 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

[Image of CT scan with cochlear otosclerosis and 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 gadalamonium 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 > 15dB over .5,1& 2 KHZ
DIFFERENTIAL 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 diplioc layer
**Treatment**

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

SODIUM FLOURIDE:

- Antienzymatic action (proteolytic)
- Decreases osteoclastic Action & increases Osteoblastic action
- 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 Schwartzze’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 fluoride

<table>
<thead>
<tr>
<th>Daily Dose, NaF/mg</th>
<th>Duration of Rx/yr</th>
<th>Total Cases</th>
<th>Hearing improved % (10db or more)</th>
<th>Hearing Stabilized %</th>
<th>Hearing Worse, % (10db or more)</th>
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<tr>
<td><strong>Stapedial Fixation With Sensorineural Progression</strong></td>
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<tr>
<td>1.5</td>
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<td>88.13</td>
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<td><strong>Pure Cochlear Otospongiosis</strong></td>
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<td>34</td>
<td>8.82</td>
<td>85.29</td>
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Bisphosphonates

- Inhibit osteoclastic activity
- Primary enzymatic inhibition
- Promoting stable secondary new bone formation
- Pamidronate, Etidronate, Alendronate, Residronate, Zolendronate
- Cytokine inhibitors: suppress resorption in otosclerosis
  - Interleukin-1 receptor antagonist
  - TNF binding protein
- 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

Cup 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-oblitereation 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

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 (utricular 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

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

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

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 ≤ 10 dB
- 9.5% without change
- 6.3% decreased hearing ≥ 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!