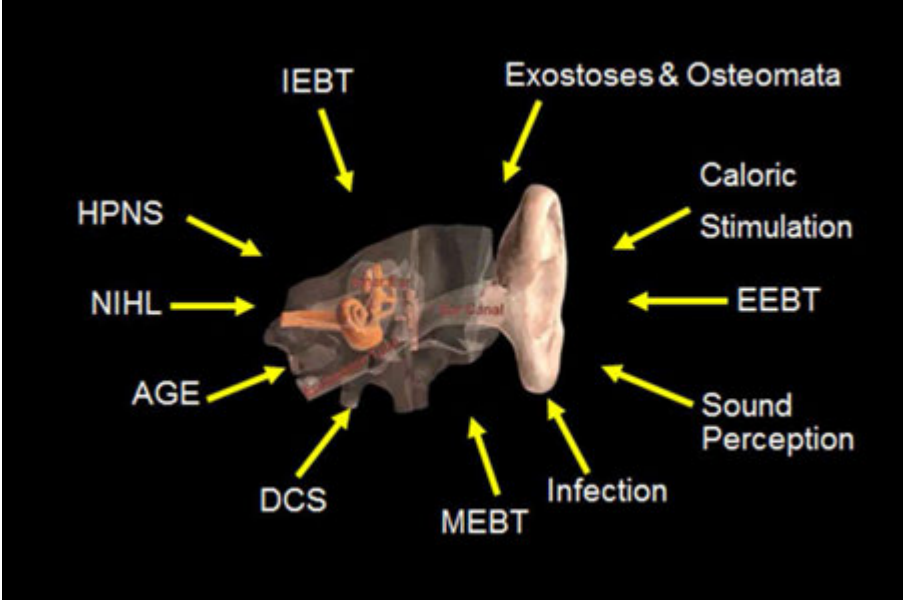
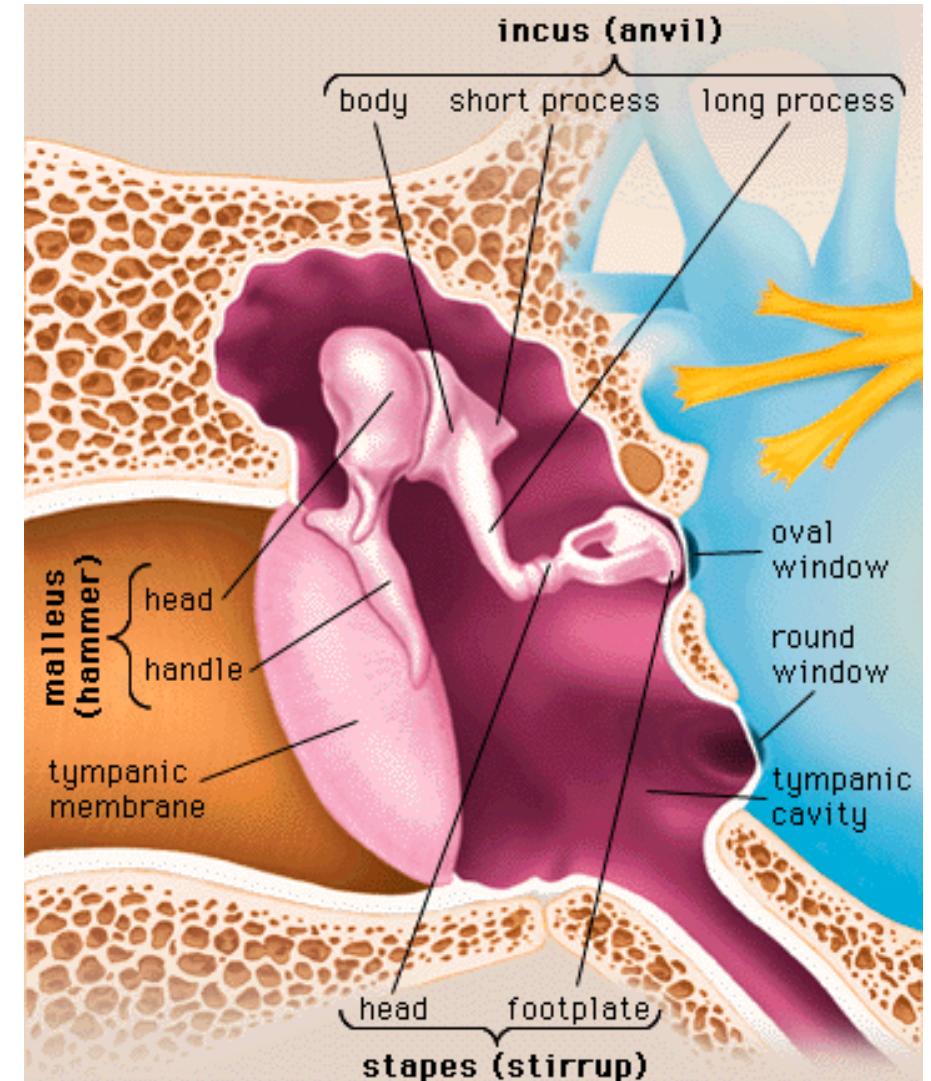
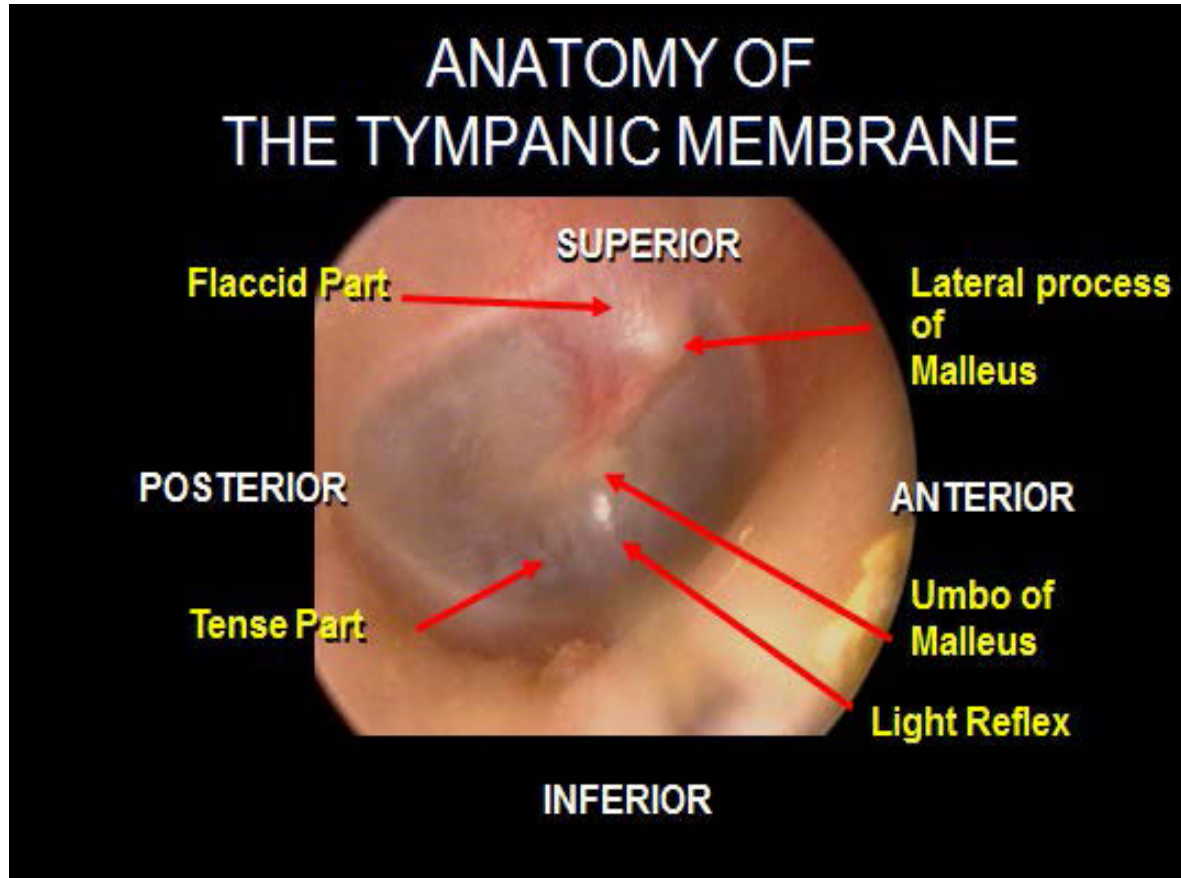


Systems Focus: ENT



Physiology



Otitis Externa

- Prevention
 - No Q-Tips
 - Olive oil/2% acetic acid/domeboro/tea tree oil
- Tx
 - +/- gentle irrigation
 - VoSol HC
 - Cortisporin/Cipro HC/CiproDex/Garasone
 - Wick (betnovate 0.05%, gentamicin sulfate 0.1%, tolnaftate 1%)



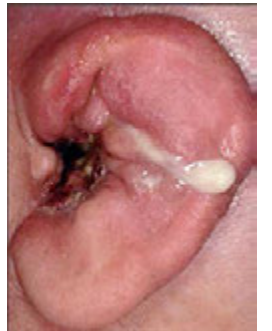
Fungal Otitis Externa

- Aspergillus/Candida
- Can cause malignant OE
- Tx
 - H₂O₂ irrigation, wick
 - Clotrimazole 1%/Locacorten-Vioform otic gtts
 - Lamisil/Sporanox PO



Malignant (necrotizing)

- Pseudomonas
- Osteomyelitis/erosion skull base, CN paresis
- Cipro IV 400mg q8h or 750mg PO BID
 - Levoflox if increase resistance to Cipro



Barotitis Externa

- Canal occluded
 - Hood, cerumen, exostoses
- Doc's ProPlugs
 - Blocks water from entering ears in <20 fsw
 - Vented plug reduces abrupt press changes, ?easier equalization

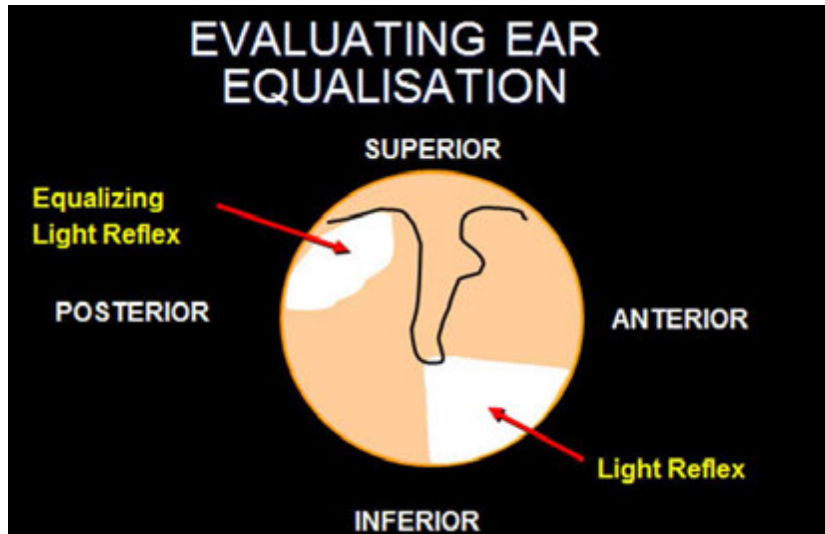
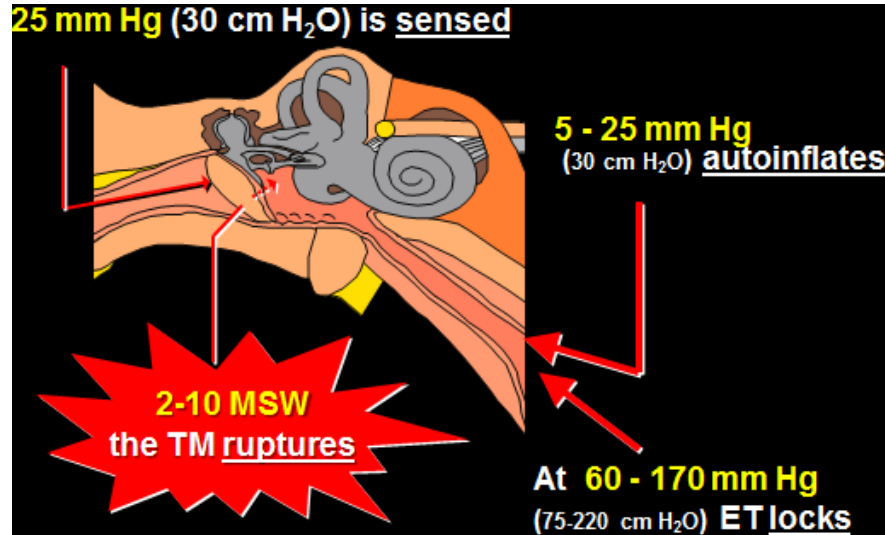


Exostoses & Osteoma

- Periosteal rxn to cold water
 - “Surfer’s ear”
 - Benign bony neoplasms
 - Typically single osteoma, multiple exostoses
- Occlusion -> hearing loss, infection, difficulties equalizing
- Surgical excision has high rate of associated HL & recurrence



Equalization



• Equalization

- First equalization press felt at ~30cm
 - ET collapses if not equalized by 1.5msw
 - TM rupture if not equalized by ~10msw

• General Principles

- Start early, blow gently
- Don't smoke, avoid agents causing vasomotor rhinitis (PDE -5)
- Consider polyposis/deviated septum if persistent probs
- Don't dive when congested
 - Decongestants may allow descent and become ineffective for ascent
- Don't use if:
 - Unable to equalize without them
 - New diver
 - >4-5d continuously
 - CI present (anxiety, HTN...)
 - ↑ pO₂ / ↑ pN₂ (deep / mixed gas)

Equalization Techniques

- Beance Tubaire Voluntaire (BTV)
 - Voluntarily open ET by “twitching” throat
 - Tensore veli palatini muscle
 - 30% pop can perform consistently
- Swallow/yawn
- Valsalva
 - Mod forceful attempted exhalation against closed airway
 - Never on ascent, never >5s
- Toynbee
 - Pinch nose & swallow
 - Small pressure diff, safe on ascent
- Frenzel
 - Closed glottis, move the tongue backwards quickly and forcefully against soft palate
 - Pinch nose for better effect
 - Gentle, safe for ascent
- Edmonds
 - Jut jaw forward
 - Combine with other techniques
- Lowry
 - Pinch nose, gentle blow against blocked nose & swallow
 - Difficult to perform
- Head tilt (bad ear up)
 - Combine with other techniques

MEBT

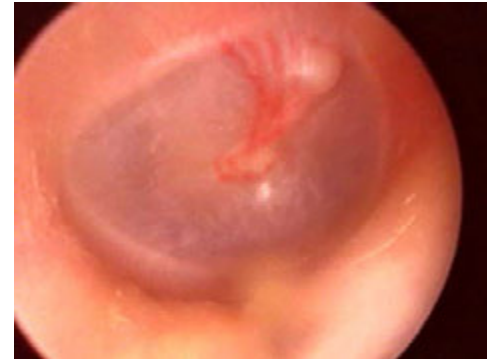
- TEED 0

- Sx of fullness/pressure with no otoscopic findings
- Resolves in 2-24hrs
- No Tx required
- +/- decongestants



- Teed 1

- Pressure, typically no pain
- Erythema, retraction of TM
- Resolves 24-48hrs
- +/- decongestants



MEBT

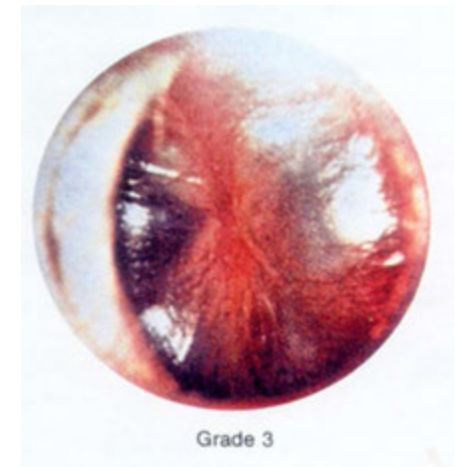
- Teed 2

- Pressure > pain
- Mild hemorrhage within TM
- Erythema extending to umbo
- Resolves 48-72hrs
- Decongestants recommended



- Teed 3

- Pain & pressure
- More extensive hemorrhage within TM
- Resolves 4-5 days
- Decongestants recommended



MEBT

• Teed 4

- Prominent pain
- Blood behind TM, TM bulge
- Resolves 5-14d
- Decongestants recommended
- +/- Abx if secondary infection
- Consider myringotomy if not resolved at 7d



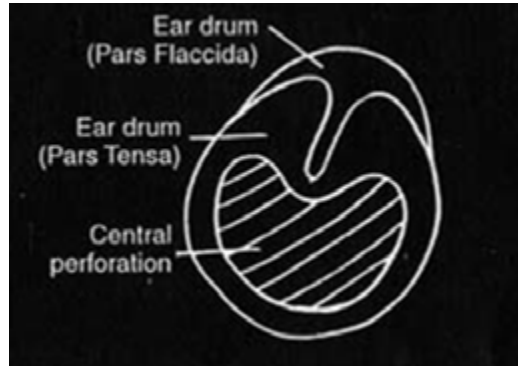
• Teed 5

- TM rupture
- Often initial relief of pain, resumes several hrs later
- +/- acute dizzy/vertigo
- Usually diminished hearing
- Avoid diving until TM healed (2-6 weeks)
- Abx drops (Cipro, Floxin) vs PO vs observation
- ?serial audiograms
- ENT referral if fails to heal
 - 90% heal within 90d

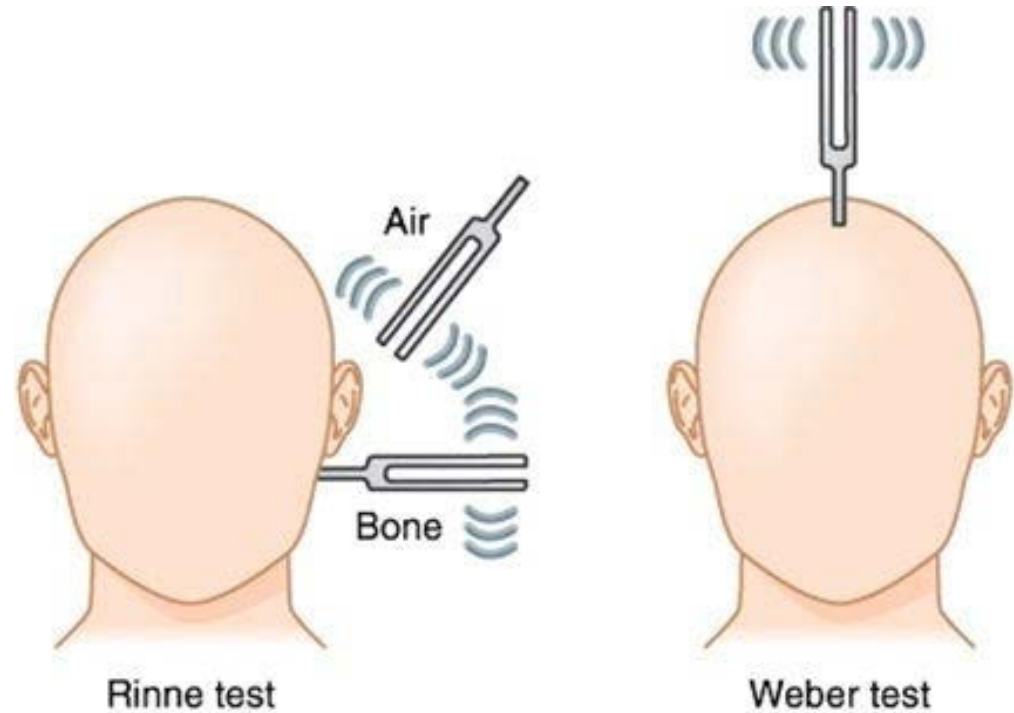
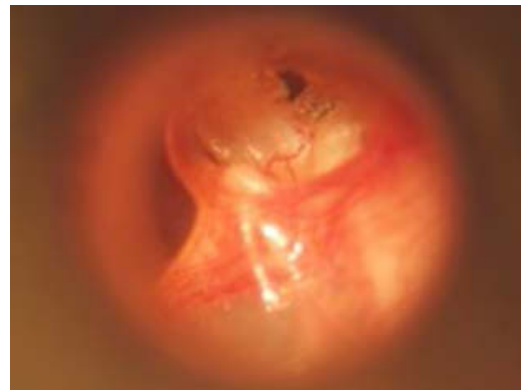
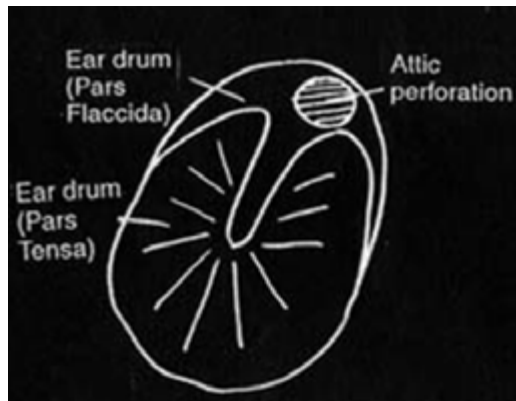


TM Perforation

- Central perf = 'good' perf

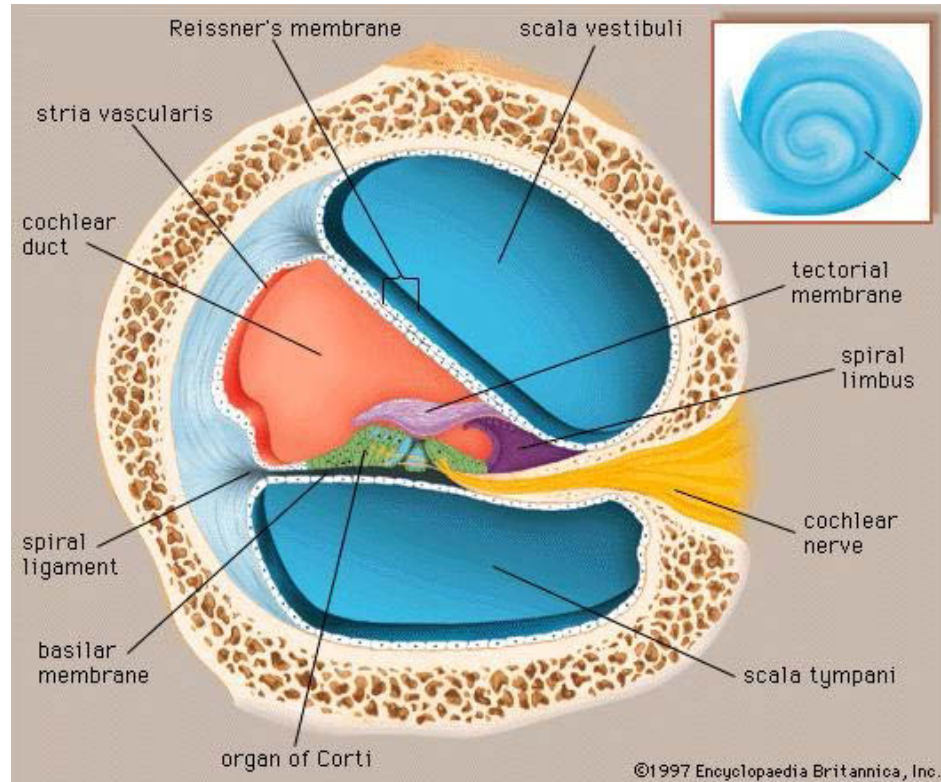


- Attic Perf = 'bad' perf



Hearing loss	Rinne test (Conduction)	Weber test (Localization)
None	Air > bone	Midline
Sensorineural	Air > bone	Normal ear
Conductive	Bone > air	Affected ear

IEBT



- May present
 - At time of forced equalization
 - At depth or immediately post dive with exertion (lift gear)
 - During otherwise normal ascent
 - Days later (usually hx of strain)
- Pathophys theories (likely combo)
 - Perilymphatic fistula (explosive or implosive force on windows 2° to press wave generated by TM or CSF)
 - Intralabyrinthine membrane tear
 - IE hemorrhage & gas
- RFs
 - URI or active allergy, hx of difficulty equalizing or poor equalizing technique (too late, too hard)
 - Forced Valsalva on ascent = sudden equal & implosion of stapes -> round window explosion
 - Wave trauma
 - Removing wetsuit hood
 - Heavy lifting (during, post dive)
 - Enlarged aqueducts (bigger wave)
 - Weakness of annular ligament of stapes

IEBT

- S/Sx
 - Constant disequilibrium, loss of balance, ataxia, positional vertigo, nystagmus, N/V
 - Subjective ear fullness, high pitched tinnitus
 - Hearing loss of various degrees (progressive, fluctuating or positional)
 - Divers tend to have vertigo > SNHL compared to other causes IEBT
 - Acoustiphobia
- Initial Exam
 - Otoscopy: N, +/- MEBT
 - Neuro exam
 - Hennebert (cough, sneeze, Valsalva) & Tullio (noise)
 - Serial audiometry
 - Gen global (conductive) or HF SN loss
 - Positional – hearing gain of >10dB when supine with affected ear turned up
 - Special Investigations
 - VNG/VEMP – may show vestibular dysfx
 - ABR – differentiates central from peripheral
 - HRCT of temporal bones – consider for divers without other defined RFs
- Tx – involve ENT!
 - Bed rest with head elevated 30° until 7days post plateau of sx (~1-2 weeks)
 - Avoid cough, sneeze, Valsalva, strain at stool, sex, air travel, loud noises
 - Anti-nauseants, decongestants, sedative, laxatives – OK
 - Steroids – no evidence for IEBT, but make sure to consider SSNHL when HL is the only s/sx
 - NSAIDS CONTRAINDICATED
- Surgery – tympanostomy and window graft
 - Severe sx (repair within 48hrs), no improvement @ 7-10d, serial audiometry shows deterioration, co-existing TM rupture
 - ~90% successful vestibular sx, improve vertigo & tinnitus >HL (10% recurrence post surgery)
- RTD may be ok - CAF case-by-case
 - No non-compensated vestibular sx
 - HL stable, narrow, doesn't affect speech band
 - No anatomical risk factors, no issues equalizing
 - 6-12 weeks post injury (min no diving x 6 weeks post sx resolution or sx plateau)

IE DCS

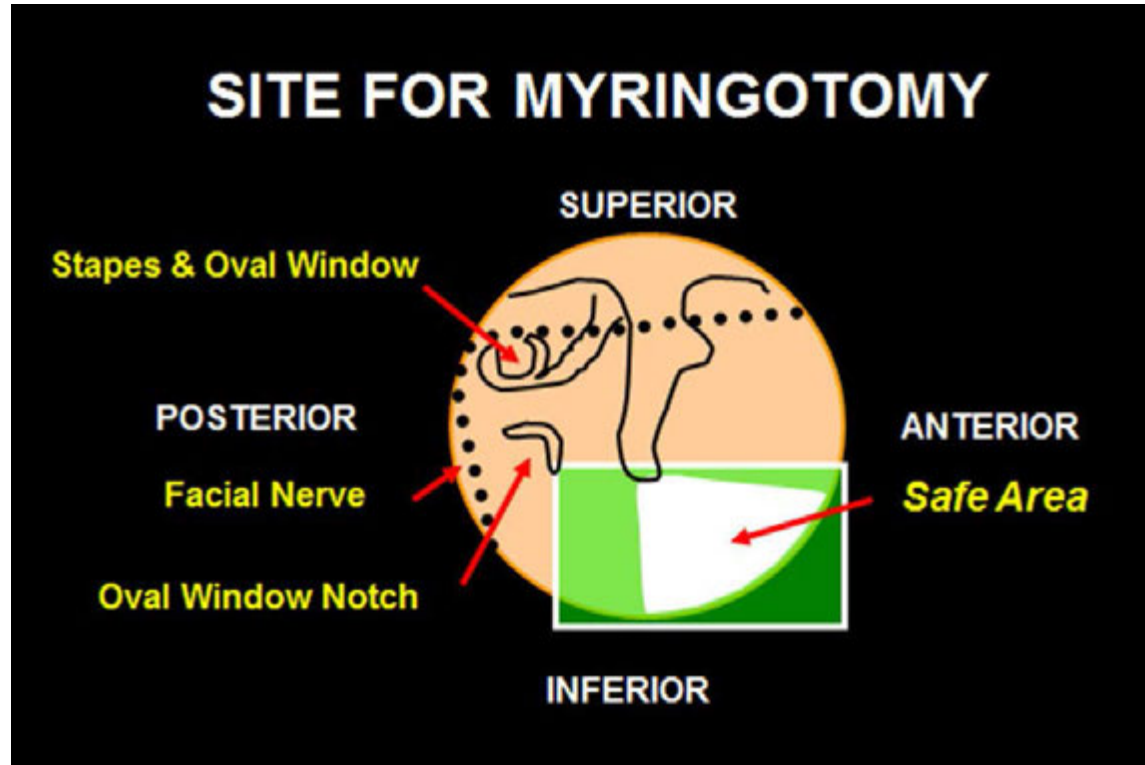
- Typically deep and deco dives, deco violation, mixed gas
- Pathophys theories:
 - Bubbles in osteoclasts – rupture bone lining otic spaces
 - Inert gas into perilymph from both blood and diffusion from ME via windows = supersaturation
 - Vascular emboli
 - Autochthonous bubbles arise in organs of inner ear
 - **Counterdiffusion -> total inert gas supersaturation
 - Gas switch from He to air – N₂ diffuses in vascular space from blood, He from ME
- S/Sx
 - Usual onset near surface, on deco stop, or v. shortly after surfacing
 - Vertigo & SNHL > tinnitus
 - N/V, staggers, nystagmus
 - +/- presence of other DCS sx (<50%)
 - Usually MEBT absent
 - Neg Dix-Hall-Pike, Henneberts, Tullio
- Tx
 - Rxn reasonably well to early RCC (TT6)
 - High rate of residual sx if Tx delayed
- If unsure IE DCS vs. IEBT vs both:
 - Myringotomy then RCC, slow ascent
 - Some evidence ok to compress without myringotomy if no prob equalizing

IEBT vs. IEDCS

IEBT	IE DCS
More common	More rare
Typically during descent (+/- delay)	Typically ascent (+/- delay)
Hx of trouble equalizing, shallow dive, pain +/- HL, tinnitus, N/V	Hx – painless, no issues equalizing, typically deep/mixed gas (Heliox) dive +/- HL, tinnitus, N/V
Signs of MEBT, abnormal TM/perf Hennebert/Tullio	No external signs
Tx -No RCC -Head elevated, avoid ↑CSF, steroids	Tx -Urgent RCC -?steroids

- Delay situation = Valsalva after surfacing (ie. carrying tanks, lifting weights)
- When in doubt - myringotomy & recompress

Myringotomy



- Myringotomy

- Don't do it for the first time on your own, with a diver requiring immediate RCC
- Procedural otoscope, 22G spinal needle
- Anesthesia
 - 10 drops of 8% tetracaine base in 70% isopropyl alcohol applied to TM for 15 mins or 1cc of 5% EMLA applied to TM for 60 mins
 - Then dab incision site with 20-25% phenol

Alternobaric Vertigo

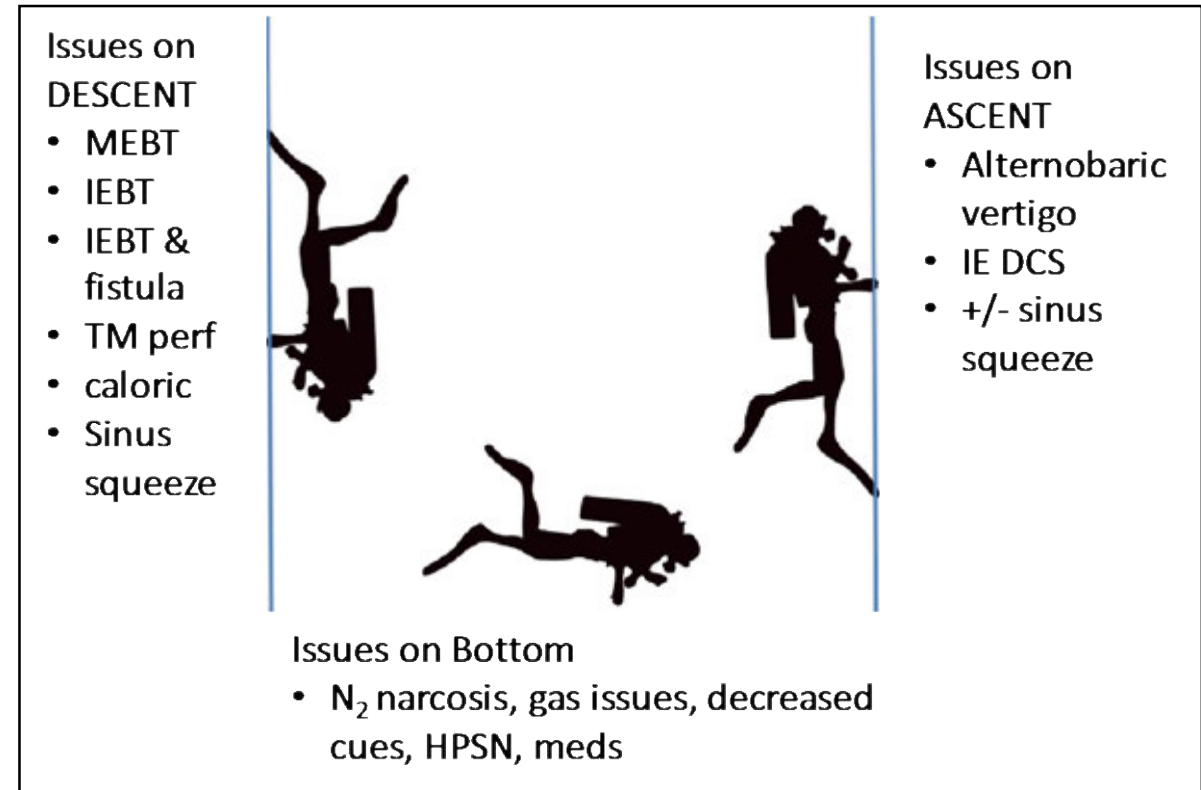
- Up to 25% divers, females 4x> males
- Due to press diff between two ME spaces
 - $\Delta 0.6\text{msw}$ sufficient
- Rotational vertigo, nausea, nystagmus
 - Spinning toward side with related ETD dysfx
 - Resolves in mins(usually) to hours (v. unusual)
 - No HL or tinnitus
- Prevention:
 - Don't dive with sticky ears
 - Descend little bit until sx resolve then ascend slowly
 - Toynbee or Frenzel, NOT Valsalva
- Recurrence may be indication to discontinue diving – case-based

Transient Caloric Stim

- Unequal vestibular caloric stimulation
 - Cold water enters one ear
 - Esp. if horizontal canal is in vertical position – supine with head elevated 30° /prone head depressed 30°
 - Can also occur if TM perf with MEBT
- Common RFs
 - Obstruction one canal (cerumen, FB, exostoses, OE, ear plug, diving hoods)
 - TM perf

"Dizzy" Diver DDX

- Disorientation
 - Impaired vision/proprioception, N₂ narcosis, hyper/hypocapnia, hyper/hypoxia, gas contaminants (CO), HPNS
- Diving Causes Vertigo
 - Caloric (poor fitting hood, unilat canal obstruction, TM perf)
 - Positional (prone with head down)
 - Pressure Δ (ABV)
 - MEBT, IEBT, IEDCS
 - HPNS
- Non-Diving Causes
 - BPV, Meniere's, vestibular neuronitis, labyrinthitis
 - Acoustic neuroma, MS, migraine
 - AOM
 - Motion sickness
 - Meds
 - Factitious



Facial Baroparesis

- Facial n. runs through facial canal along walls of middle ear cavities
 - Bony canal separates n. from middle ear space
- ~50% of people have “dehiscences” where nerve is covered by soft tissue/mucosa rather than bone
 - $P\Delta$ of only 0.8msw can cause relative ischemia of n.
 - Compression lasting >3.5 hrs can lead to permanent damage
- S/Sx
 - Setting of difficult equalization
 - LMB facial palsy, always unilateral
 - Onset shortly after surfacing
 - s/sx of MEBT usually evident
 - +/- coexist with IEBT
- Tx
 - 100% O₂
 - Toynbee or Frenzel, no Valsalva
 - Decongestants
 - Dive (or RCC) to 1-2msw on O₂, slow ascent
 - Some authorities opine that HBOT at >10msw may be detrimental
 - Myringotomy – rarely if ever required
 - No evidence to support corticosteroid
 - Usually resolves within 1-2 hrs after equalization (unless compression >3,5hrs)
- DDx
 - DCS – provocative profile, no signs of MEBT, +/- other signs of DCS
 - Never reported as isolated DCS finding
 - CAGE/Stroke – UMN vs LMB
 - Able to frown and close eye normally = UMN