MIDDLE EAR CAVITY (MEC)

- SIX WALLS
  - Lateral (outside)
  - Posterior (back)
  - Medial (inside)
  - Anterior (front)
  - Superior (roof)
  - Inferior (floor)
LATERAL WALL OF MEC

- TM is the wall - separates the MEC from EAM
- Malleus is attached to TM
POSTERIOR WALL OF MEC

- Pyramid—prominence the contains the body of the stapedius muscle
- Stapedial tendon—enters MEC from pyramid and runs to stapes
- Fossa incudus—accommodates the short process of the incus
- Chorda tympani nerve—enters MEC from lateral and posterior wall junction—runs across the MEC—is a branch of seventh cranial (facial) nerve
Promontory—bulge caused by basal turn of cochlea

Oval window—holds footplate of stapes

Round window

Facial nerve canal prominence—bulge caused by FN canal
ANTERIOR WALL OF MEC

- Opening of Eustachian tube
- Internal carotid artery canal—located on other side of this wall, under the ET
- Tensor tympani semicanal—holds tensor tympani muscle
- Cochleariform process—tensor tympani tendon follows this and heads laterally toward the malleus
Epitympanic recess—accommodates the larger parts of the malleus and incus
A BIT ABOUT THE E.T.

- Eustachian Tube—runs from back of throat to middle ear area
  - Is typically closed (collapsed) to prevent bacteria from moving into middle ear from oral/nasal cavities
  - Is shorter, more narrow and horizontal in children
PURPOSE OF E.T.

- To equalize air pressure between middle ear and oral cavity
- To allow for some drainage if small amounts of fluid does build up in middle ear cavity
The tube is closed at rest. During swallowing, phonation, or the jaw being moved dramatically, the “Lavator and Tensor Palatini” muscles contract and create a pumping action which briefly creates an opening of the tube.
OSSICULAR CHAIN
OSSICLES

- Malleus
- Incus
- Stapes

These three smallest bones in the human body form a bridge from the TM to the Cochlea
MALLEUS

- **Manubrium**—embedded into TM
- **Head**—large ball-part that connects to incus via malleo-incudal joint
- **Neck**—narrow portion between manubrium and head
- **Lateral process**—produces the visible bulge on the eardrum
- **Anterior process**—near junction of neck and manubrium
INCUS

- **Short process**—posteriorly oriented
- **Long process**—descends from body of incus, then hooks medially at the lenticular process.
- **Attaches to the** stapes at the lenticular process.
STAPES

- Head—attaches to the lenticular process of incus
- Neck—narrowing beyond the head
- Crura—two strut-like structures that lead off of the neck over to the footplate
- Footplate—attaches into oval window via annular ligament
ME LIGAMENTS

- Superior malleal—from tegman tympani (roof of attic) to head
- Anterior malleal—from anterior tympanic wall to anterior process
- Lateral malleal—from NoR (notch in TM annulus) to neck
- Posterior incudal—(actually a fold of mucous membrane) from fossa incudus to short process
ME TENDONS & MUSCLES

- Tensor tympani muscle—
  - Innervated by trigeminal (Vth cranial) nerve
  - Housed in T.T. semicanal on anterior wall above the E.T.

T.T. tendon—bends around cochleariform process and runs laterally to attach to the top of the manubrium of the malleus

**Contraction pulls O.C. in anterio-medial direction**
Stapedius muscle—(smallest muscle in body)
- Innervated by facial (VIIth cranial) nerve
- contained within pyramidal eminence of posterior wall
- S. tendon exits apex of P.E. and runs anteriorly to neck of stapes
**Contraction pulls O.C. in posterior direction**
THE M.E. TRANSFORMER

- The middle ear mechanism not only transfers sound, but also modifies or transforms it!
- If sound moves from air to water, there would be a tremendous loss of energy!
- The M.E. mechanism not only eliminates a loss of energy, it actually boosts it!
THREE M.E. TRANSFORMER MECHANISMS

- Area ratio advantage
- Curved membrane buckling effect
- Lever action of O.C.
The T.M. has a much larger surface area than the oval window, and the force applied to the T.M. is transferred to the much smaller O.W. This creates a greater force at the O.W. because the area is so much smaller—think water-gun!

A 23 dB volume increase is created here!
The concavity of the T.M. causes greater displacement of the curved area and less displacement of the more center portion nearer the manubrium.
LEVER ACTION EFFECT

- The malleus represents the longer leg of the lever and the incus represents the shorter leg.

- This combined with the area ratio effect and the curved membrane effect creates an overall increase of 33dB from the TM to the Oval Window of the Cochlea!!
Middle Ear Infection

OTITIS MEDIA
PHYSIOLOGY OF OM

- Eustachian Tube—runs from back of throat to middle ear area
  - Is typically closed (collapsed) to prevent bacteria from moving into middle ear from oral/nasal cavities
  - Is shorter, more narrow and horizontal in children
**Purpose of E.T.**

- To equalize air pressure between middle ear and oral cavity
- To allow for some drainage if small amounts of fluid does build up in middle ear cavity
POTENTIAL PROBLEMS W/ E.T.

- Bacteria from adenoids can migrate into tube and cause inflammation
- May not open fully upon contraction of muscles
  - Can be caused by primarily horizontal orientation of ET in children
  - Also can be due to weakened musculature responsible for contracting the ET to open position
EFFUSION

- **Serous OM**—Accompanying thin watery liquid
- **Mucoid OM**—Accompanying thicker effusion
- **Suppurative OM**—ME is inflamed and contains infected fluid with pus
- **Adhesive OM**—A thickening of the fibrous TM tissue and retraction of TM into ME cavity (can lead to cholesteatomas)
Unchecked or untreated, OM can also spread to the mastoid bone via the attic of the ME cavity and turn to mastoiditis.
CLASSIFICATIONS

Based on

- Presence and state of fluid (effusion)
- Duration of occurrence
- Frequency of occurrences
ACUTE OM

- Frequently associated with infection that ascends the ET
  - Sudden onset of
    - Redness of TM
    - Severe ear pain
    - Fever
FREQUENCY & DURATION OF OM

- Recurrent—Occurs 3+ times in a six month period
- Chronic—Lasts for a period longer than 8 weeks
- Persistent—ME inflammation with fluid that lasts 6 weeks or longer after the initiation of antibiotics
MEDICAL TX FOR OM

- Antibiotics—oral and/or topical
- Myringotomy—incision and draining of fluid
- P.E. Tubes—inserted into myringotomy incision and used to aerate ME cavity—aids in resolution of effusion
EDUCATIONAL TX FOR OM

- Regular (monthly or bi-weekly) screening of child’s hearing
- All teachers should be in-serviced of child’s situation
- Classroom modifications should be made
  - Preferential seating
  - Visual aids when possible
  - Verbal/auditory checks for comprehension
  - FM amplification if hearing loss is severe enough to warrant
OM CAN CAUSE...

- TM perforations—leads to scarring and can become permanent if un- or mal-treated
- Incus Necrosis—erosion of lenticular process or lower half of long process of incus—if broken, up to 60dB loss
- Malleus head fixation—malleus attaches to attic wall
- Tympanosclerosis—Scarring builds up on ossicular chain
OM CAN CAUSE... CONT.

- Cholesteatomas—a cyst forms, usually in the attic of ME cavity and can range from mild to fatal. Erodes any bone it contacts. Can cause hearing loss, deafness, facial paralysis, and death.
  + Discharge usually has a strong smell
  + Dizziness and true vertigo can occur if lateral semi-circular canal is involved
  ~ ~ Demands surgical removal
CHOLESTEOMA'S

ACQUIRED CHOLESTEATOMA

Eardrum intact.

Cholesteatoma has eroded through bone of ear canal, exposing the bones of hearing.
CHOLESTEOMA'S

ACQUIRED CHOLESTEATOMA

Perforation of ear drum with destructive cholesteatoma
Other than OM...

MIDDLE EAR DISORDERS
CONGENITAL

- Bone fusions associated with congenital atresia
  - Fused malleus & incus
  - Incus fixed to posterior annulus
  - Stapes fixation due to grossly deformed stapes.
Otosclerosis

- Valsalva-1741-reported that ankylosis (fixation of stapes) could cause loss.
- Toynbee-1857-looked at great number of HOH pt’s, postmortem, and determined this as a common cause of hearing loss.
- Politzer-1893-determined that bone forming the otic capsule was diseased—not from recurrent ear infections, as previously thought.
OTOSCLEROSIS

- Boney growth around stapes footplate that causes fixation in the oval window.
  - Twice as often in women than men
  - Aggravated by pregnancy
  - Accompanied by tinnitus in 50% of cases
  - Average age of HL noticed is 36 yoa
  - Onset is insidious, slowly progressive, and is largely conductive


**OTOSCLEROSIS**

- Actual bone change consists of laying down of new bone with a concomitant resorption of the older bone—produces a spongy type of bone
Middle ear disorders can cause hearing loss that is
  + Purely conductive
  + Mixed
  + Sensorineural—in cases where the oval window, cochlea, or cochlear fluids are eventually compromised
  + Degree will depend on severity of pathology