Bobby R. Alford Department of
Otolaryngology – Head and Neck Surgery

Core Curriculum Syllabus

BCM
Baylor College of Medicine

The Core Curriculum Syllabus was developed by Donald T. Donovan, M.D. and the faculty of the Bobby R. Alford Department of Otolaryngology – Head and Neck Faculty of the Baylor College of Medicine as a guide to otolaryngology for medical students. The information contained within this syllabus is not a substitute for professional medical advice, and there are no guaranties or warranties, expressed or implied, with respect to the accuracy of this material.

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Comments or corrections should be sent to: oto@bcm.edu

Learning Objectives for the Otolaryngology Selective

Students should be able to perform a basic head and neck exam with equipment available to a primary care practitioner (flashlight, tongue blade, otoscope).

It is not expected that students will become proficient with a mirror exam. However, if at all possible, they should have an opportunity to observe, but not perform, a fiberoptic exam of the larynx.

Students should be acquainted with the risk factors for head and neck cancer and know the early signs that would precipitate a referral to an otolaryngologist-head and neck surgeon. If possible, they should have an opportunity to see some examples of head and neck cancers, especially of the oral cavity.

Students should be familiar with an ear exam including tympanometry and have an opportunity to compare an exam performed with the otoscope and an exam using binocular microscope.

Although exposure to the operating room is not emphasized, it would be very useful for students to observe common procedures like PE tubes and tonsillectomy. It would also be ideal if students become familiar with tracheostomy tubes.

Students should be familiar with typical clinical presentation, key physical findings, initial treatment, and referral indications for common otolaryngological diseases listed below:
Acute otitis media
Deviated nasal septum
Serous otitis media
Tonsillitis
External otitis
Allergic rhinitis
Ruptured eardrum (acute)
Sinusitis
Cerumen impaction
Epiglottitis
Presbyacusis
GE reflux
Tinnitus
TMJ arthritis
Vertigo
Neck mass (acute, child)

Epistaxis
Neck mass (acute, adult)

Note that as part of the surgery core, students receive five didactic lectures covering allergic rhinitis, sinusitis, AOM, SOM, OE, epistaxis, facial fractures, hearing loss, dizziness, and swallowing disorders.

Review of Anatomy

The anatomy of the head and neck can be divided into the following sections:
Temporal Bone
Ear
Nose.
Paranasal Sinuses.
Oral Cavity.
Pharynx.
Larynx.
Salivary Glands.
The Neck.

Review of Anatomy: The Ear and the Temporal Bone:

The temporal bone contains the sensory organs of hearing and balance, and structurally contributes to the cranial vault. The temporal bone consists of five parts: the squamous, the mastoid, the tympanic, zygomatic and petrous segment. It contains portions of the carotid artery and jugular venous drainage system, and is intimately related to the dura of the middle and posterior fossa. Anteriorly, it articulates with the condyle of the mandible. Posteriorly, and superiorly, the mastoid air cell system communicates with the middle ear. The facial nerve passes through the temporal bone en route to the muscles of facial expression.

Review of Anatomy: The Ear

Both functionally and anatomically, the ear can be divided into three parts.
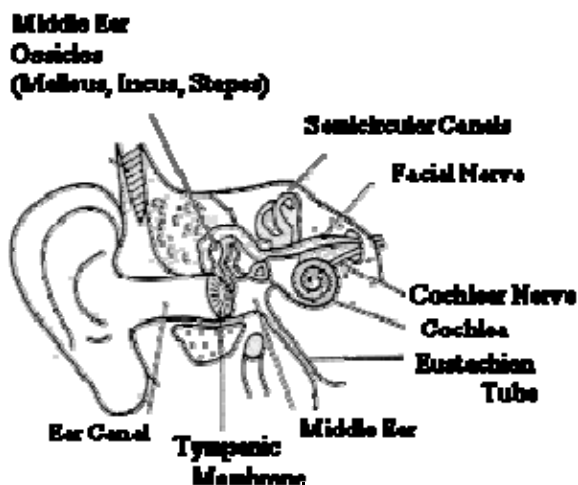
1. **External Ear** - that portion external to the tympanic membrane. It serves chiefly to protect the tympanic membrane, but also collects and directs sound waves and plays a role in sound localization. The skin of the external ear normally migrates laterally from the umbo of the malleus in the tympanic membrane to the external auditory meatus (at a rate of 2-3 mm per day). This is a unique and essential mechanism for maintaining patency of the canal.

   - **The Auricle** - elastic cartilage covered with closely adherent skin. The configuration is intricate, and extremely difficult to duplicate.
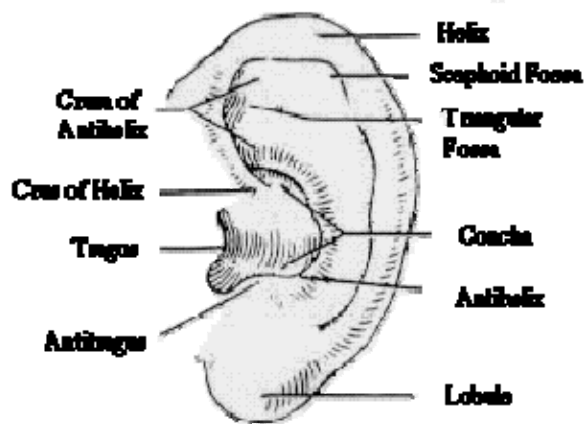
   - **External Auditory Canal**
     - **Lateral Portion** - cartilaginous with thick, loosely applied skin containing ceruminous and sebaceous glands.

     - **Medial Portion** - very thin skin directly over bone, no skin appendages. Curves anteriorly and medially in adults, which may obscure the anterior tympanic membrane. It comprises two-thirds of the total canal in adults, less in infants and children.

2. **The Middle Ear** - This is an air-containing space which communicates with the nasopharynx via the eustachian tube. It is normally sealed laterally by the tympanic membrane. Its function is to transmit and amplify sound waves from tympanic membrane to the stapes footplate converting energy from air medium to a fluid medium of the membranous labyrinth. The relationship of the three ossicles is depicted below.
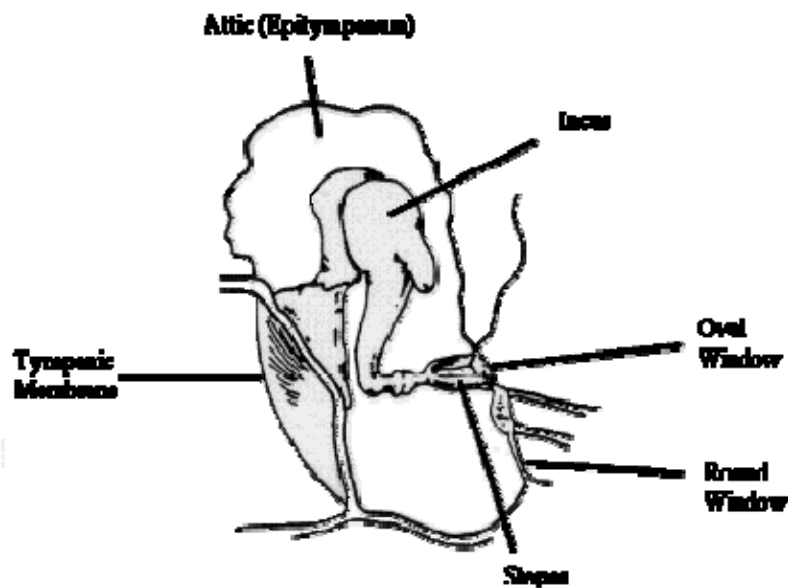
The Middle Ear is depicted here, detailing the relationship between ossicles, the round and oval windows, and the attic or epitympanum. Left ear viewed posteriorly.

- **The tympanic membrane** is an ovoid, three-layered structure consisting of squamous epithelium laterally, respiratory mucosa medially, and an intervening fibrous layer. It normally has a conical shape, with the apex maintained medially by the support of the malleus. The fibrous layer thickens laterally to form the annulus, an incomplete ring which is attached to surrounding bone. Superior to the lateral process of the malleus, this ring is deficient, and this area is known as the pars flaccida. The majority of the drum is composed of the pars tensa.

Middle Fossa Dura

Mastoid Air Cells

Annulus

Eustachian Tube

Sigmoid Sinus

Jugular Bulb

Round Window
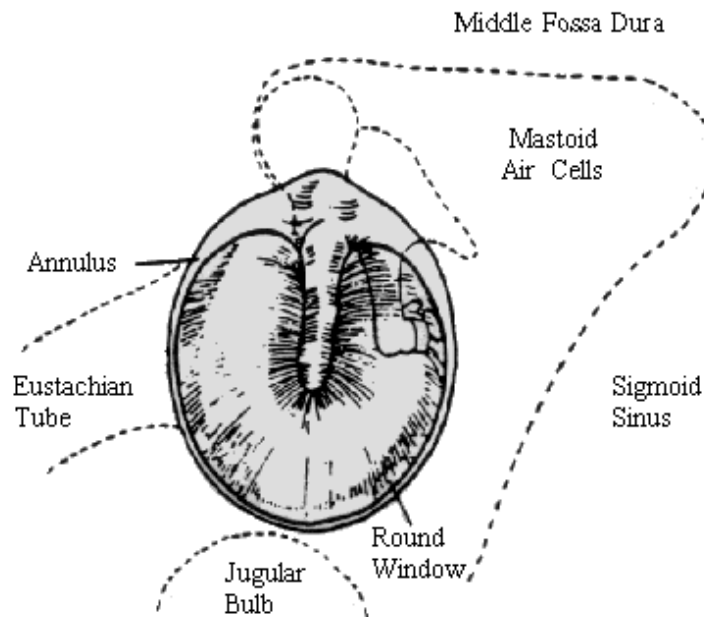
This illustration depicts the relationship of the tympanic membrane to other deeper structures, represented here in by dotted lines. Left ear viewed externally.

- **Ossicles** - three small bones which are involved in sound conduction. From lateral to medial, these are the malleus, the incus, and the stapes. The handle and lateral process of the malleus is attached to the tympanic membrane and can be easily seen on physical exam. The long process of the incus can often be seen through the posterior superior quadrant of the membrane. The stapes is attached to a foot plate which is in direct contact with the fluid of the inner ear. (See figures 1 and 3).

- **Spaces** - the middle ear cleft is wider than the tympanic membrane, and is conventionally divided into spaces in reference to the annulus.

  - **Epitympanum** - superior to the tympanic membrane. Contains the body of the incus and the head of the malleus. Communicates with the mastoid via the aditus.

  - **Mesotympanum** - on a level with the ear drum. The oval and round windows, located posterosuperiorly on the medial wall, communicate with the inner ear. The long process of the incus projects into the posterior quadrant to articulate with the stapes which sits in the oval window. The

facial nerve, usually covered by a bony canal, crosses the posterior superior quadrant superior to the stapes, then courses inferiorly between the middle ear and mastoid air cells.

- o **Protympanum** - in this anterior recess of the middle ear, the eustachian tube exits to communicate with the nasopharynx. This tube runs in close proximity to the carotid artery.

- o **Hypotympanum** - the jugular bulb curves through the hypotympanum. It is usually covered by bone, but may be dehiscent and extend into the middle ear space.

3. **Inner Ear** - consists of a fluid-filled labyrinth which functions to convert mechanical energy into neural impulses. The bony labyrinth is subdivided into smaller compartments by the membranous labyrinth. Fluid surrounding the membranous labyrinth is called perilymph; fluid within is called endolymph. There are three main divisions of the bony labyrinth.
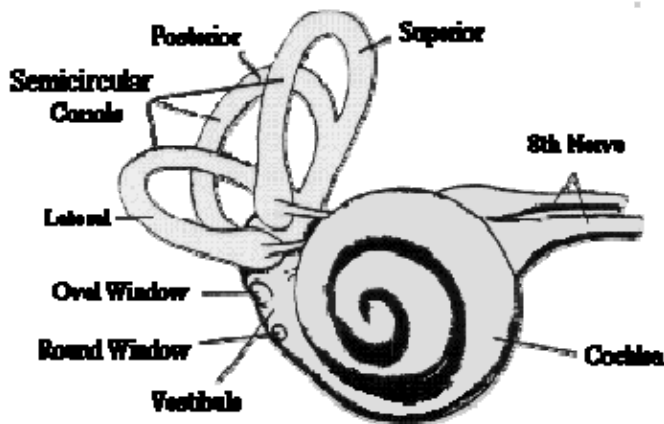
Figure 5: The relationship between the vestibule, cochlea, and semicircular canals is shown in this drawing.

- • **Vestibule** - just medial to the oval window, and contains the utricle and the saccule, two organs of balance. The vestibule is an antechamber, leading to both the cochlear and the semicircular canal.

- • **The Cochlea** - a snail-shaped chamber anterior to the vestibule. It bulges into the middle ear and its bony covering is the promontory. The cochlea also communicates with the middle ear via the round window. In this organ, sound waves are converted into neural impulses with elaborate coding.

- **The Semicircular Canals** - three in number; project posteriorly from the vestibule. These organs detect angular acceleration. They consist of a superior, posterior and lateral, or horizontal canals.

The nerve fibers from the labyrinth make up the auditory nerve which consists of a cochlear nerve and a superior and inferior vestibular with both afferent and efferent fibers from the respective sensory end organs. This nerve enters the cranial cavity via the internal auditory canal.

Review of Anatomy: The Nose

The nose is the air conditioner of the body, responsible for warming and saturating inspired air, removing bacteria and particulate debris, as well as conserving heat and moisture from expired air. Nasal breathing is important for optimal pulmonary function. It is also a prominent cosmetic feature of the face.

External Nose - the anterior, caudal portion of the nose is cartilaginous, while posteriorly and superiorly it is bony.

- **Framework:**
  - Cartilages: greater alar (lower lateral), septal, lateral nasal (upper lateral), lesser alar, sesamoid.
  - Bones: Nasal, maxillary, frontal

- **Musculature:** Nasalis, depressor septi, procerus, dilator naris.

- **Blood supply:**
  - External carotid
    - External maxillary: lateral nasal, angular, alar, septal, external nasal.
  - Internal carotid: Ophthalmic, which gives rise to anterior ethmoid, posterior ethmoid, and dorsal nasal vessels.

- **Lymphatics:** facial artery, submandibular, parotid nodal drainage.

- **Nerve supply:**
  - Sensory trigeminal
    - Ophthalmic division: Nasociliary, external nasal, infratrochlear.
    - Maxillary division: infraorbital
  - Motor facial: Buccal, zygomatic branches

Internal Nose:

- **Floor** - the floor of the nose is formed by the hard palate. The nasal cavity extends as far back as the soft palate, where the posterior choanae opens into the nasopharynx.

- **Roof** - the roof of the nose is adjacent to the anterior cranial fossa. The cribriform plate contains numerous tiny perforations which transmit sensory fibers to the olfactory bulbs. The sensation of smell is limited in man to a very small area of mucosa in the superior recesses of the nose. Posteriorly, the roof slants downward as the anterior wall of the sphenoid sinus.

- **Lateral Walls** - the turbinates, three or sometimes four bony shelves covered by erectile mucosa, project from the lateral wall of the nose. These processes serve to increase the interior surface area of the nose to facilitate heat and water exchange. They constantly engorge or shrink to accommodate changing physiologic requirements. They are also the chief structures involved in pathologic obstruction. A series of spaces are created by the overhanging edge of these turbinates.
  - **Inferior Meatus** - inferior to the inferior turbinate. Contains orifice of nasolacrimal duct.
  - **Middle Meatus** - inferior to the middle turbinate. Contains semilunar hiatus, with openings of the maxillary, frontal, and anterior ethmoidal sinuses.
  - **Superior Meatus** - drains posterior ethmoid cells.
  - **Spheno-ethmoid recess** - orifice of sphenoid sinus.

- **Blood Supply**
  - **Anterior ethmoid** - to roof and anterior superior portion of septum and lateral wall.
  - **Sphenopalatine** - to lateral wall of nose
  - **Nasopalatine** - supplies roof, septum, and floor
  - **Lateral nasal** - supplies lateral nasal wall anteriorly.
  - **Descending palatine** - supplies the lateral nasal wall posteriorly.
  - **Pharyngeal** - supplies roof posteriorly
  - **Posterior ethmoid** - supplies septum and lateral nasal wall superiorly
  - **Septal** - supplies septum inferiorly and floor

- **Nerve supply**
  - **Medial internal nasal** - to septum, anterosuperiorly
  - **Lateral internal nasal** - to lateral wall, anterosuperiorly
  - **External nasal** - to skin of back of nose

- o **Posterior superior nasal** - supplies septum and lateral wall posteroinferiorly, to middle turbinate
- o **Posterior inferior nasal** - to floor and inferior turbinate
- o **Pharyngeal** - to choana
- o **Anterior superior alveolar** - to inferior meatus
- o **Infraorbital** - to vestibule

- **Lymphatics:** drained by
  - o **Facial venous drainage**
  - o **Retropharyngeal**
  - o **Superior deep cervical**
  - o **Submandibular**

Review of Anatomy: Paranasal Sinuses

These are air-filled, mucosal-lined cavities which develop in facial and cranial bones. The spaces communicate with the nasal airway. Their function is unknown but has been subject to a great deal of speculation. They could serve to decrease the weight of the skull or to function as resonators for the voice. In lower animals with a more acute sense of smell, the sinuses are largely lined by olfactory epithelium. Sinuses may have originally developed to increase the available surface area for the sense of smell. Therefore, in humans, with olfaction limited to a much smaller area, sinuses may be vestigial anachronisms.

Though their function is obscure, their medical significance is not. Sinuses frequently become infected due to obstruction of normal drainage, and negative pressure in a sinus can cause headache. Neoplasms which arise in the sinuses can be occult for quite a long time, so that they are usually very advanced at the time of diagnosis. There are four groups of sinuses:

1. **Frontal** - Paired, in frontal bone. Posterior wall is adjacent to anterior cranial fossa. Usually asymmetrical, occasionally absent.

2. **Maxillary** - Paired, in maxilla. Superior wall - floor of orbit. Medial wall - lateral wall of nose. Inferiorly related to tooth-bearing area of maxilla.

3. **Ethmoid** - Numerous cells in superior and lateral walls of nose, and in medial walls of orbits.

4. **Sphenoid** - Paired, in sphenoid bone. Sella turcica projects into this space.

Review of Anatomy: Oral Cavity

Designed for articulation in speech and mastication of food, the oral cavity. Also functions as an alternate airway.

- **Boundaries:**
  - **Anterior** - the lips
  - **Posterior** - the anterior tonsillar pillars
  - **Roof** - hard and soft palate
  - **Floor** - mucosa overlying sublingual and submandibular glands.
  - **Walls** - buccal mucosa

- **Contents:**
  - **Alveolar processes and teeth**
  - **Anterior tongue to circumvallate papilla**
  - **Orifice of parotid gland** (Stenson's duct) in buccal mucosa opposite upper second molars
  - **Orifice of submandibular duct** (Wharton's duct) in anterior floor of mouth
  - **Orifices of sublingual glands**

Review of Anatomy: Pharynx

- **Nasopharynx** - extends from posterior choanae of the nose to the soft palate. Related posteriorly to the base of the skull. Contains adenoid tissue and the orifices of the Eustachian tubes. This area is not accessible to direct inspection and must be examined by mirrors or optical instruments.

- **Oropharynx** - that portion which is visible via the mouth. Extends from soft palate superiorly to vallecula inferiorly. Posterior and lateral walls are formed by the superior and middle pharyngeal constrictors.

- **The Palatine Tonsils** are lymphoid aggregates between the mucosal folds created by the palatoglossus and palatopharyngeus muscles. They are covered by stratified squamous epithelium, which continues down into deep crypts. Tonsils vary widely in size and may be sessile or pedunculated.

- **Hypopharynx** - Is the portion of the pharynx that lies inferior to the tip of epiglottis. The posterior and lateral walls are formed by middle and inferior pharyngeal constrictors. It extends inferiorly to the cricopharyngeus, where the pharynx empties into the cervical esophagus. Anteriorly, it extends from the valleculae and contains the epiglottis and the larynx. Lateral to the larynx are the pyriform sinuses, two mucosal pouches whose medial borders are the lateral walls of the larynx. The posterior aspect of the hypopharynx contains the posterior pharyngeal wall and post cricoid mucosa.

Review of Anatomy: Larynx

The larynx is a valve separating the trachea from the upper aerodigestive tract. It is primarily thought of as an organ of communication - the "voice box" - but it is also an important regulator of respiration, and is necessary for an effective cough or valsalva maneuver, and prevents aspiration during swallowing.

- Skeleton
  - **Hyoid Bone** - attachment to epiglottis and strap muscles.
  - **Thyroid Cartilage** - anterior attachment of vocal folds. Posterior articulation with cricoid cartilage.
  - **Cricoid Cartilage** - complete ring. Articulates with thyroid and arytenoid cartilages.
  - **Arytenoids** - two cartilages which glide along the posterior cricoid and attach to posterior ends of vocal folds.

Articulated Elements

Cricoid cartilage — Hyoid bone

Epiglottis

Corniculate cartilage

Arytenoid cartilage — Thyroid cartilage

Thyroid horn — Cricoid cartilage
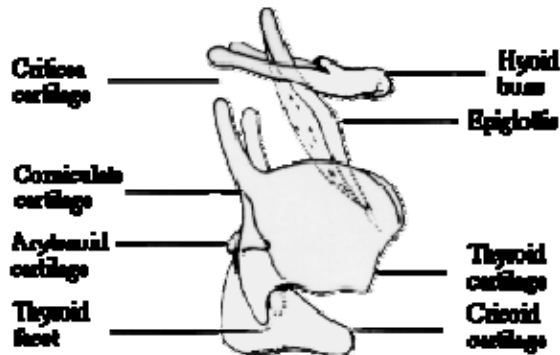
- Division
  - o **Supraglottis** – usually covered with respiratory epithelium containing mucous glands.
  - o **Epiglottis** - leaf-shaped mucosal-covered cartilage, which projects over larynx.
  - o **Aryepiglottic folds** - extend from the lateral epiglottis to the arytenoids.
  - o **False vocal cords** - mucosal folds superior to the true glottis. Separated from true vocal folds by the ventricle.
  - o **Ventricle** - mucosal-lined sac, variable in size which separates the supraglottis from the glottis.
  - o **Glottis** - the true vocal folds attach to the thyroid cartilage at the anterior commissure. The posterior commissure is mobile, as the vocal folds attach to the arytenoids. Motion of the arytenoids effects abduction or adduction of the larynx. The bulk of the vocal fold is made up of muscle covered by mucosa. The free edge is characterized by stratified squamous epithelium. The vocal folds abduct for inspiration and adduct for phonation, cough, and valsalva.
  - o **Subglottis** - below the vocal folds, extending to the inferior border of the cricoid cartilage.
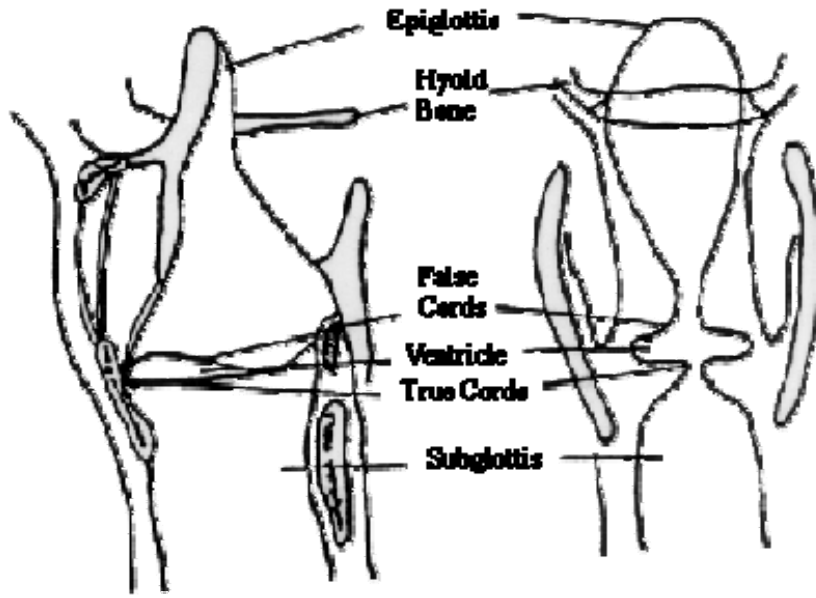
- **Innervation** - branches of the vagus nerve.
  - **Superior Laryngeal Nerve** - sensation of the glottis and supraglottis. Motor fibers to the cricothyroid muscle, which tenses the vocal folds. This nerve leaves the vagus high in the neck.
  - **Recurrent Laryngeal Nerve** - sensation of the subglottis, and motor fibers to intrinsic muscles of the larynx. This nerve branches from the vagus in the mediastinum, then turns back up into the neck. On the right, it travels inferior to the subclavian artery and on the left, the aorta.

Review of Anatomy: Salivary Glands

- **Parotid Gland**
  - Located on side of face, anterior to mastoid tip and external auditory canal, inferior to zygomatic arch, and superior to the lower border of the angle of the mandible. Anteriorly, it overlaps the masseter muscle.
  - Stenson's duct enters oral cavity through buccal mucosa opposite upper second molar.
  - Parasympathetic secretory afferents to the parotid leave the inferior salivary nucleus with the glossopharyngeal nerve and travel via Jacobson's plexus in the middle ear to synapse in the otic ganglion. Post-synaptic fibers are distributed to the parotid by the auriculotemporal nerve.
  - Facial nerve passes through this gland.

- Submandibular Gland
  - Beneath floor of the mouth, inferior to mylohyoid muscles and superior to digastric muscle.
  - Marginal mandibular branch of the facial nerve travels in the fascia on the lateral surface of this gland.
  - Parasympathetic secretory afferents to the submandibular gland arise from the superior salivatory nucleus, and leave the brainstem in the facial nerve. They exit the facial nerve at the geniculate ganglion and travel via the chorda tympani to the lingual nerve. Fibers synapse in the submandibular ganglion, and post-synaptic fibers then enter the gland.
  - The lingual and hypoglossal nerves lie deep to this gland.
  - Wharton's duct enters the floor of the mouth near the lingual frenula.

- **Sublingual Glands** - located below the mucous membrane of the floor of the mouth, adjacent to mandible and mylohyoid muscle. Ten to twelve small caliber ducts drain the gland, some emptying into the submandibular duct, and others draining directly into the floor of the mouth.

- **Minor Salivary Glands** - small collections of salivary gland tissues are scattered throughout.

Review of Anatomy: Neck

The neck contains important communications between the head and the body, including air and food passages, major blood vessels and nerves, and the spinal cord. Many vital structures are compressed into a narrow area, which is engineered for maximal mobility to permit variation in head position relative to body.

- **Skeleton** - primarily composed of the vertebral column. Anteriorly, the hyoid bone, and laryngeal and tracheal cartilages support the aerodigestive spaces. These are suspended from the mandible and base of skull by a system of muscles and ligaments.

- **Muscles** - anteriorly, strap muscles connect the respiratory skeleton and sternum. There are also muscular attachments from the hyoid to the tongue, mandible, and styloid. The digastric muscle passes forward from the mastoid, attaches to the hyoid, and then ascends to the anterior mandible. The sternocleidomastoid (SCM) divides the neck into anterior and posterior triangles. The posterior triangle is largely muscular. The anterior triangle which contains most of the vital structures, can be divided into smaller triangles by muscles.

- o   The anterior and posterior bellies of the digastric form the submandibular triangle. The submental triangle is in the midline, between the anterior bellies. The vascular or carotid triangle is inferior to the digastric and hyoid.

- o   The omohyoid is a small muscle, running at roughly 90 degrees to the SCM, from the hyoid to the scapula.

- **Nerves** - the neck contains major branches of cranial nerves, as well as cervical roots.
  - o   **Cranial Nerves**
    - ▪   **VII** - the marginal mandibular branch dips down into the neck in the fascia overlying the submandibular gland. In addition to the muscles of facial expression, branches of VII innervate the platysma, the stylohyoid and the posterior belly of the digastric.
    - ▪   **X** - the vagus nerve exits the jugular foramen and travels inferiorly in the carotid sheath. It carries the parasympathetic fibers of the thoracic cavity and much of the GI tract, as well as laryngeal and pharyngeal sensory and motor branches.
    - ▪   **The Spinal Accessory Nerve (XI)** - supplies the trapezius and sternocleidomastoid muscles. It exits the jugular foramen, then runs posteriorly.
    - ▪   **The Hypoglossal Nerve (XII)** - supplies the muscles of the tongue. The nerve exits the skull through its own canal, runs downward in the carotid sheath, and then curves forward superficially to the carotid at the level of the occipital artery to reach the tongue.
  - o   **Cervical Nerves**
    - ▪   **Cervical plexus** - anterior roots of C1-4
      - •   Ansa cervicalis - to strap muscles (some travel with XII)
      - •   Branches to phrenic nerve
      - •   Sensory
    - ▪   **Phrenic nerve** - C3-5
    - ▪   **Brachial Plexus** C5-T1
    - ▪   **Posterior rami** - to posterior muscles and skin
    - ▪   **Cervical sympathetic chain** - travels in carotid sheath

- **Major Vascular Structures**

- **Carotid Artery** - bifurcates into:
  - o   **Internal (intracranial)** - no branches in the neck
  - o   **External (extracranial)** - branches:
    - ▪   Superior thyroid
    - ▪   Ascending pharyngeal

- - - Lingual
      - Facial
      - Occipital
      - Post-auricular
      - Superficial temporal
      - Internal maxillary
  - **Thyrocervical trunk**
      - Suprascapular
      - Transverse cervical
      - Inferior thyroid
  - **Vertebral artery**
  - **Internal jugular vein** (within carotid sheath)
  - **External jugular vein**

- **Visceral Column** - pharynx, larynx, trachea, and esophagus.

- **Thyroid Gland**
  - Developmentally derived from pharyngealy floor.
  - Located anterior and lateral to the trachea.
  - Closely related to recurrent laryngeal nerve and parathyroid glands.
  - Blood supply
      - Arterial
          - Superior thyroid artery (branch of external carotid)
          - Inferior thyroid artery (branch of thyrocervical trunk)
          - Thyroid "ima" artery (variable)
      - Venous
          - Superior thyroid vein
          - Middle thyroid vein
          - Inferior thyroid vein

- **Parathyroid Glands**
  - Four glands: two on each side.
  - Derived from branchial pouches III and IV: Superior parathyroid glands from pouch IV and inferior parathyroid gland from pouch III.
  - Glands usually related to posterior surface of thyroid gland, but may be found as inferior as mediastinum.

- **Anatomic triangles** (superimposed on superficial neck anatomy):

Digastric:
Posterior Belly
Anterior Belly

Omohyoid,
Superior Belly

Anterior Triangle

Sternocleidomastoid :
Sternal Head
Clavicular Head

Posterior Triangle

Trapezius

Omohyoid, Inferior Belly
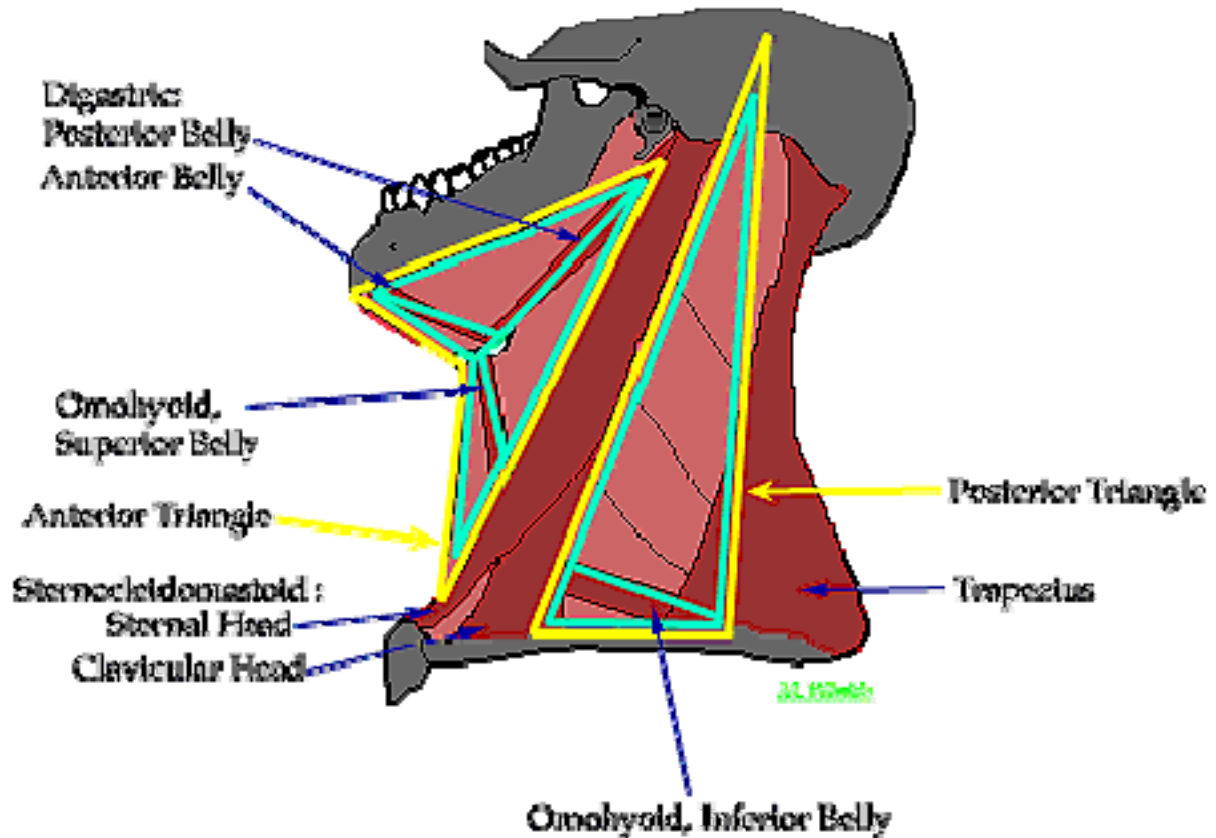
- The neck can be divided into two major triangles, with multiple smaller triangles:
  1. **Anterior triangle** bordered by the anterior border of the SCM, midline of the neck, and the mandible.
     - **muscular triangle** - formed by the midline, superior belly of the omohyoid, and SCM.
     - **carotid triangle** - formed by the superior belly of the omohyoid, SCM, and posterior belly of the digastric.
     - **submental triangle** - formed by the anterior belly of the digastric, hyoid, and midline.
     - **submandibular triangle** - formed by the mandible, posterior belly of the digastric, and anterior belly of the digastric.
  2. **Posterior triangle** - bordered by the posterior border of the SCM, trapezius, and clavicle.
     - **supraclavicular triangle**--formed by the inferior belly of the omohyoid, clavicle, and SCM.
     - **occipital triangle**--formed by inferior belly of the omohyoid, trapezius, and SCM.

Lymphatic Drainage: major head and neck lymph node groups. The lymph nodes of the neck can be divided into six levels within the defined anatomic triangles. These groups and the areas that they drain are particularly important when locating and working up a "neck mass" or possible malignancy. The groups and drainage areas are as follows:
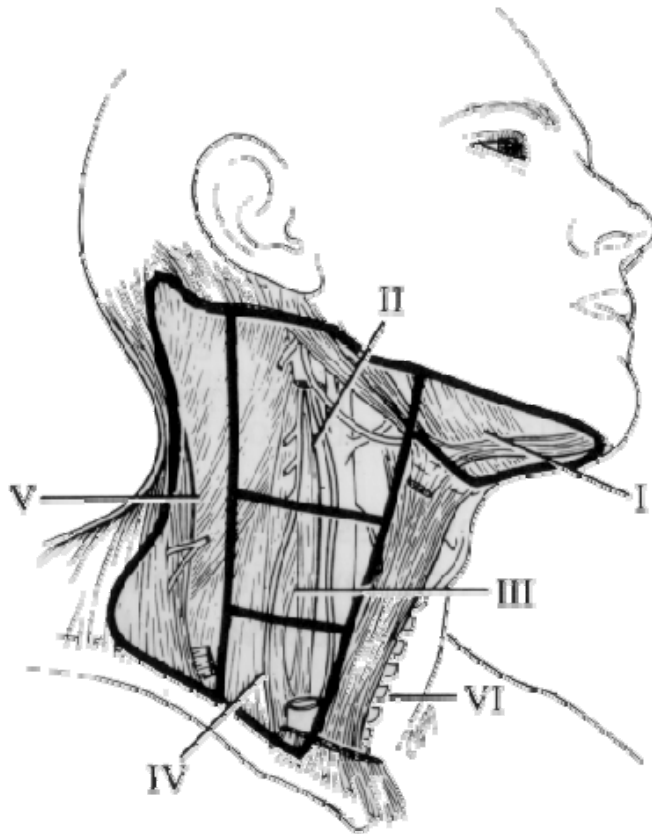
I - **Submental and submandibular nodes**
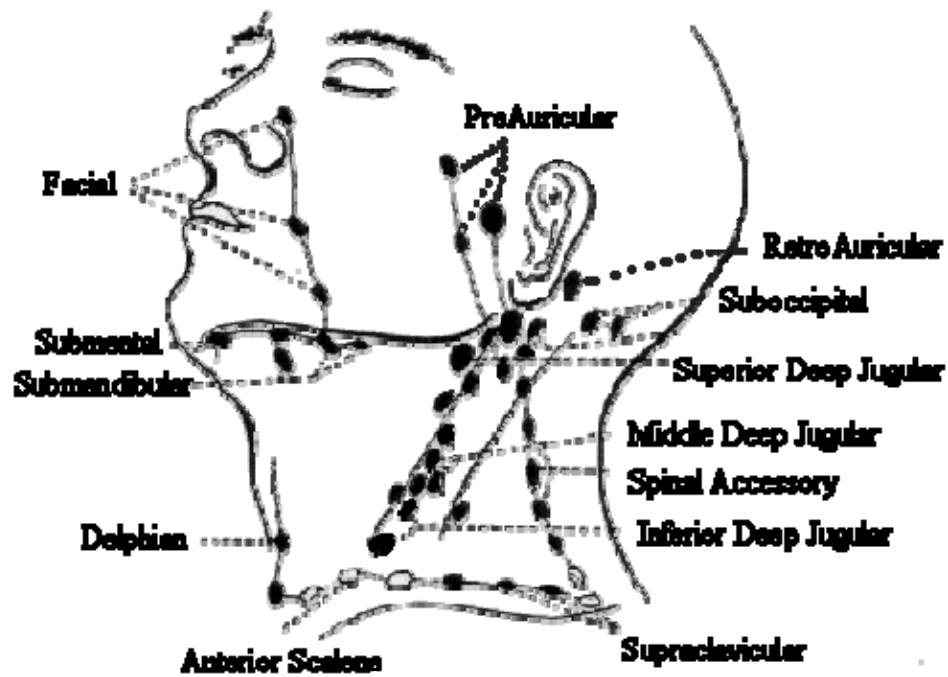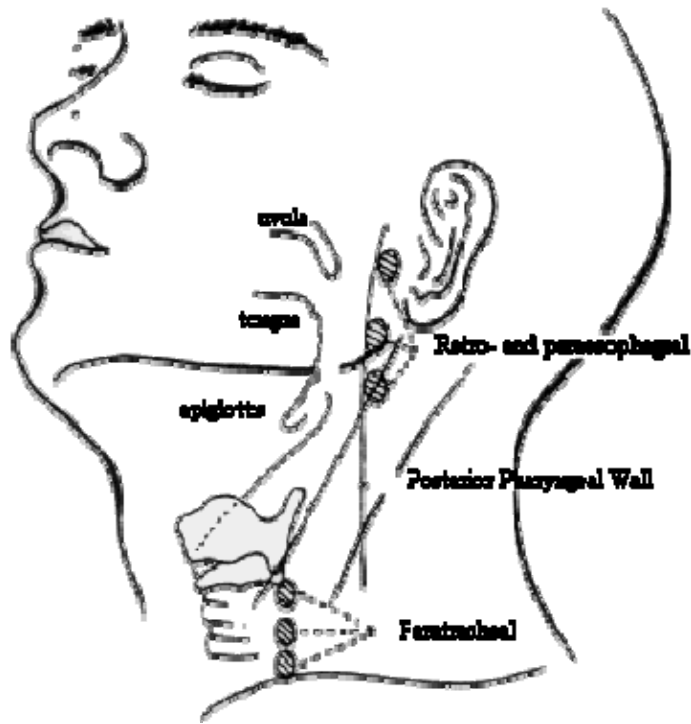
II - **Upper jugulodigastric group**

III - **Middle jugular nodes** draining the naso- and oropharynx, oral cavity, hypopharynx, larynx.

IV - **Inferior jugular nodes** draining the hypopharynx, subglottic larynx, thyroid, and esophagus.

V - **Posterior triangle group**

VI - **Anterior compartment group**

Individual Lymph Nodes in the Head and Neck:

Examination of the Head and Neck

The head and neck exam involves observation of all surface features and careful palpation. In addition, many interior surfaces must be inspected, which makes adequate illumination essential. A hand-held light is commonly used by most physicians to examine the mouth, but head mirrors or head lights provide much brighter light and free both hands for the examination. The otoscope is the basic instrument used to evaluate the ear.

Several techniques are used by otolaryngologists to better assess the ears, nose, and throat. The operating microscope provides an enlarged three-dimensional view of the ear canal and tympanic membrane, which is vastly superior to the monocular image obtained with the hand-held otoscope. The microscope also permits the bimanual removal of wax and foreign bodies. Indirect mirror exam permits examination of the larynx, hypopharynx, and nasopharynx. Fiberoptic and telescopic instruments are also useful.

Many structures are not accessible to direct examination, such as the sinuses, portions of the pharynx, and the middle and inner ear. The condition of these can often be inferred from a combination of a careful history and the physical examination of adjacent, more visible areas. For example, acute sinusitis can be diagnosed on the basis of characteristic history, the observation of purulence draining into the nose, and often, tenderness over the affected spaces. The inflamed sinus mucosa cannot be viewed directly. X-rays may demonstrate opacification of the sinuses, but in the absence of the patient history, accurate diagnosis cannot be made.

Examination of the Head and Neck: The Ear

External Auricle: Congenital deformity such as microtia and accessory tragus can be associated with middle and inner ear malformations. Assess patency of external auditory meatus. Look for preauricular pits which may indicate sinus tracts.

Otoscopy: The canal should be thoroughly cleaned, and the largest speculum which will comfortably fit should be used. The external ear canal is normally curved, which limits the visibility of the eardrum and medial canal. Gentle traction on the auricle will move the cartilaginous canal and afford a better view. In adults, the auricle should be pulled superiorly, laterally, and inferiorly. In infants, the bony canal has not yet developed, and the auricle should be pulled inferiorly.

The external canal may be swollen due to external otitis or filled with cerumen or debris. Subcutaneous bony masses (exostoses) may project into the lumen. Note the condition of the skin and any lesions. The anterior canal wall commonly obscures the anterior portion of the

ear drum. The tympanic membrane is normally pearly gray, shiny, translucent and concave. Changes in the appearance of this structure may indicate pathology in the middle ear, mastoid, or eustachian tube. White patches, called tympanosclerosis, can frequently be seen and provide evidence of prior significant infection. A dull, blue ear drum indicates hemotympanum. A red bulging tympanic membrane indicates acute bacterial otitis media. A dull, retracted, amber drum is seen in serous otitis. If a perforation is present, then the middle ear mucosa may be viewed directly. Healed perforations are often more transparent than the surrounding drum and may be mistaken for actual holes.

Pneumatic otoscopy refers to examining the tympanic membrane via an airtight speculum and observing movements with the gentle insufflation of air. Mobility may be limited by scarring, middle ear effusion, or perforation.

Eustachian tube function may be assessed by watching the ear drum as the patient swallows with the nose pinched off (Toynbee maneuver) and then swallows with the nose unobstructed. The first step normally causes the ear drum to retract, while the second step releases it.

Tuning forks can be used to grossly assess hearing, but more importantly, to differentiate between conductive and sensorineural hearing loss. A tuning fork placed in the center of the skull will normally be perceived in the midline (Weber). With a conductive hearing loss, the sound will appear to be on the side of the bad ear. If there is a sensorineural loss, the sound will be perceived in the better ear. The Rinne's test compares air conduction hearing (tuning fork tines in the air just outside external auditory canal) to bone conduction hearing (base of tuning fork over mastoid process). In conductive hearing loss, bone conduction is more sensitive than air conduction.

A proper, complete assessment of hearing requires audiometry. This is indicated in any patient with chronic hearing loss, or with acute loss that cannot be explained by canal occlusion or middle ear infection. It is also an integral part of the evaluation of the patient with vertigo.

Unilateral hearing loss due to serous otitis in an adult may be the presenting symptom of cancer of the nasopharynx, due to occlusion of the Eustachian tube. All such patients should have a thorough nasopharyngeal exam, and careful palpation of the neck to detect possible metastasis from an occult tumor.

Complete evaluation of the ear includes assessment of the facial nerve and vestibular function.

Examination of the Head and Neck: The Nose

The nose is a very narrow space, and it is impossible to completely examine the inner surface in the intact patient. Anterior rhinoscopy with a bivalve speculum usually discloses the anterior ends of the inferior turbinates and the septum. Topical vasoconstriction permits a somewhat more thorough examination. Nasal patency may be compromised by swollen turbinates, septal deviation, or intranasal masses, such as tumors, or nasal polyps. A perforation of the nasal septum can cause symptoms such as a whistling noise during breathing, epistaxis, and excessive crusting of the nose.

The sense of smell is rarely tested due to the difficulty in objectively quantifying responses, but by presenting common odors (lemon, coffee, vanilla) one can assess the patient's ability to detect an odor or identify it. Ammonia fumes will stimulate trigeminal endings, and thus produce a response in the absence of any olfaction; thus it is useful for distinguishing true anosmics from malingerers.

Examination of the Head and Neck: The Mouth

An adequate light and tongue blade are necessary for examining the mouth. The blade should be used to systematically expose all teeth and mucosal surfaces, including those recesses inferior and posterior to the tongue, and the gingivobuccal sulci. Dentures should always be removed to permit a complete examination. The parotid duct orifice can be seen on the buccal mucosa opposite the upper second molar, and massage of the gland should express clear fluid. The submandibular and sublingual glands empty into the floor of the mouth. Complete examination of the mouth includes bimanual palpation of the tongue and the floor of the mouth to detect possible tumors or salivary stones.

Examination of the Head and Neck: The Pharynx

The posterior wall of the oropharynx can be visualized easily via the mouth, by depressing the tongue. Inspection of the hypopharynx, larynx, and nasopharynx requires use of indirect mirror exam. Mirrors should be prewarmed to minimize fogging. To examine the nasopharynx, use a small mirror. The patient should be instructed to open his mouth as widely as possible, RELAX his tongue, and try to breathe via the nose. The posterior tongue blade is depressed as much as possible to provide a space for the mirror above the tongue and posterior to the soft palate. Concentrating on nasal breathing causes the soft palate to relax and drop, providing a view of the nasopharynx. Only a small portion of the nasopharynx can be visualized in the mirror at once; therefore, it must be moved about to show the posterior choanae of the nose, the posterior nasopharyngeal wall, and the Eustachian tube orifices.

The hypopharynx is examined with a large mirror. The patient is asked to lean forward slightly from the hips, with back straight and neck slightly extended (sniff position). The tongue is protruded as far as possible, and the examiner grasps the tip with a gauze sponge. Gentle anterior traction is applied. The patient must voluntarily relax and protrude his tongue, or else excessive traction (which may be painful!) may be required. The mirror is placed against the soft palate and used to push it posteriorly. The mirror is rotated as necessary for visualization of the base of the tongue valleculae, posterior and lateral pharyngeal walls, pyriform sinus openings, and larynx. At rest, the epiglottis normally overhangs and obscures the glottis. If the patient tries to produce a high pitched "Eeeee", the epiglottis usually lifts sufficiently to expose the cords. Vocal fold mobility should be assessed by asking the patient to alternately phonate, and inspire deeply. The glottis opens with inspiration and closes for phonation.

In patients with a hyperactive gag reflex or extremely overhanging epiglottis, mirror exam may not be feasible and a fiberoptic nasopharyngoscope may be inserted via the nose. A right-angle telescope is useful for close-up inspection and for photography.

Examination of the Head and Neck: The Paranasal Sinuses

Since direct visualization is difficult, one must rely on indirect physical assessment and radiology. Purulent drainage from the sinuses may be noted in the nose. Tenderness may be elicited by tapping over the frontal or maxillary sinuses or applying pressure under the supraorbital rim or near the medial canthi. The frontal and maxillary sinuses can be transilluminated by placing a bright light under the supraorbital rim and inside the mouth in a dark room. This method is not commonly used due to the availability and greater reliability of sinus x-rays. In addition, the availability of fiberoptically illuminated endoscopes now allow better direct visual assessment of the middle meatus and maxillary sinuses.

Examination of the Head and Neck: The Salivary Gland

The parotid and submandibular glands should be inspected and palpated to detect enlargement, masses, and/or tenderness.

Examination of the Head and Neck: The Neck

The normal neck is supple, with the hyoid, larynx and trachea easily palpable in the midline. A complete examination should include external observation for symmetry and possible masses by thorough palpation of all tissue and auscultation. The exact position and size of any mass should be carefully noted, along with any relationship to the thyroid, carotid, or airway. A neck mass may be an inflammatory lymph node, an aneurysm, a thyroid mass, a

dermoid, or a thyroglossal duct cyst. It may also be a metastasis from cancer in the head, neck or lung. With the exception of supraclavicular nodes, the neck is an uncommon site of metastasis from below the diaphragm.

Audiology

Accurate assessment of hearing (audiometry) is vital to the diagnostic evaluation of patients with suspected otologic disorders for the determination of the underlying process, as well as in the planning of rehabilitation of hearing loss. Originally, audiometry was limited to the psychophysical measurement of the sensation of hearing; thus, patient cooperation was essential. However, other tests have been developed over the years which permit more objective assessment of hearing even in infants, small children, malingerers, and hysterics.

Human Hearing

Most humans hear sounds in the range of 20 to 20,000 Hz. Sensitivity varies as a function of frequency, with sounds in the middle frequencies being heard best. The ability to hear higher frequencies declines with age.

For a discussion of the causes of hearing loss, see the section on diseases of the middle ear, or diseases of the inner ear.

Basic Audiometry

Adequate testing requires an audiometer (device for presenting sounds to the patient at precisely controlled intensity), a sound-proof environment, a competent audiologist, and a cooperative patient. The standard testing battery includes **Pure Tone Audiometry, Speech Audiometry**, and **Immittance Audiometry**.

- **Pure Tone Audiogram**: This is a graphic plot of the patient's thresholds of auditory sensitivity for pure tone (sine wave) stimuli. Threshold hearing levels are indicated for each frequency tested. By convention, normal hearing levels are shown at top of the graph; a decrease in hearing sensitivity is indicated by larger values of hearing level. Hearing level is plotted on a logarithmic decibel scale. Sounds are tested with presentation by air conduction (earphones) as well as bone conduction (skull vibrator). An air bone gap indicates a conductive component of hearing loss. A decrease in threshold sensitivity by bone conduction reflects a sensory or neural loss.

  The format for recording **audiometric findings** is shown in the legend below:

Key to Symbols

	Unmasked	Masked
AC	○	●
BC	△	▲
SAL		◇
Acoustic Reflex		■
SSI	□	■
PB	○	●

Air conduction thresholds are represented by circles, and bone conduction by triangles. A solid symbol indicates that masking noise was presented to the opposite ear to minimize the chance of responses due to crossover of sound.

This sample audiogram indicates normal hearing in the right ear, and a conductive loss on the left.

Normal Hearing   Conductive Hearing Loss
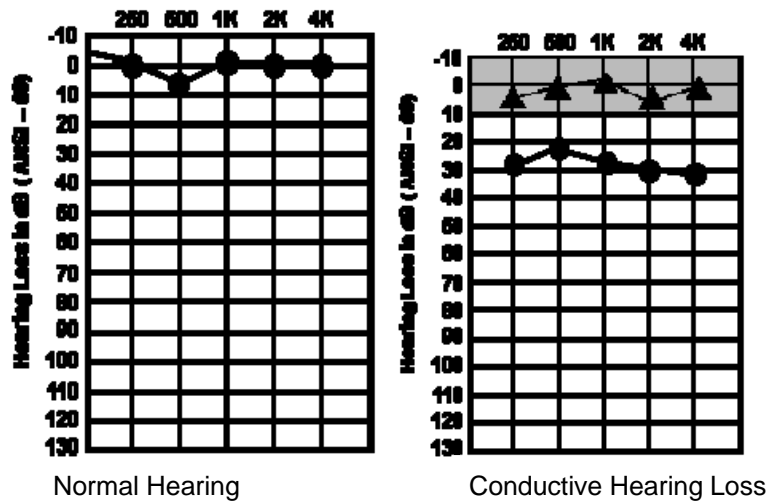
The second audiogram demonstrates a sensorineural loss in the right, and a mixed loss on the left.

Sensorineural Hearing Loss   Mixed Hearing Loss
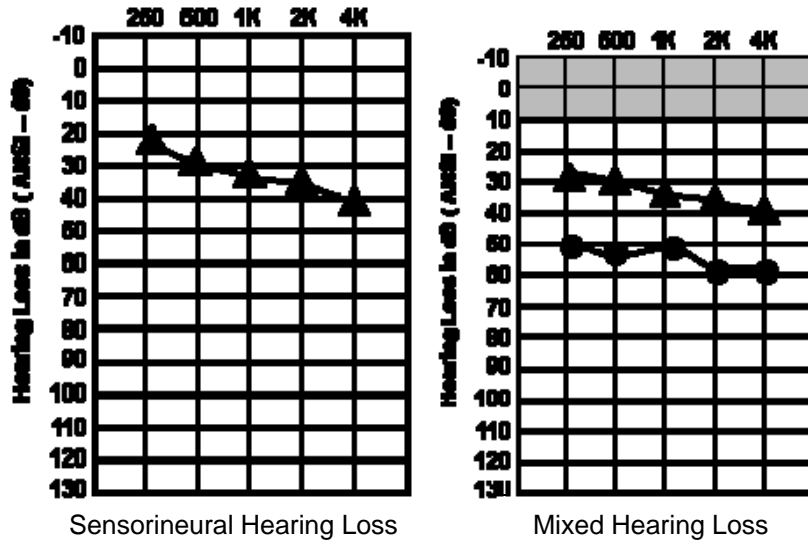
- **Speech Audiometry**: These tests utilize spoken words and sentences rather than pure tones. Tests are designed to assess sensitivity (threshold) or understanding (intelligibility).
  - Threshold - the level at which the patient can correctly repeat 50% of test materials--phoneme-balanced words (PB), synthetic sentences, etc.
  - Intelligibility - by convention, the percentage of words or sentences a patient can correctly repeat when presented at supra-threshold levels.
    - Provides information about hearing handicap. Problem maybe worse than indicated by pure tone average (PTA) for the speech frequencies.
    - Useful to determine candidacy for hearing aid.
    - Very poor results, out of proportion to PTA, suggests probable retrocochlear cause of hearing loss.

- **Immittance Audiometry**: These hearing tests utilize the electroacoustic immittance bridge, as shown in this schematic diagram below. This device is designed to quantify the impedance (resistance to movement) of the conductive mechanism of the ear by bouncing a probe tone off the tympanic membrane and measuring the proportion of reflected sound.

The electroacoustic impedance bridge
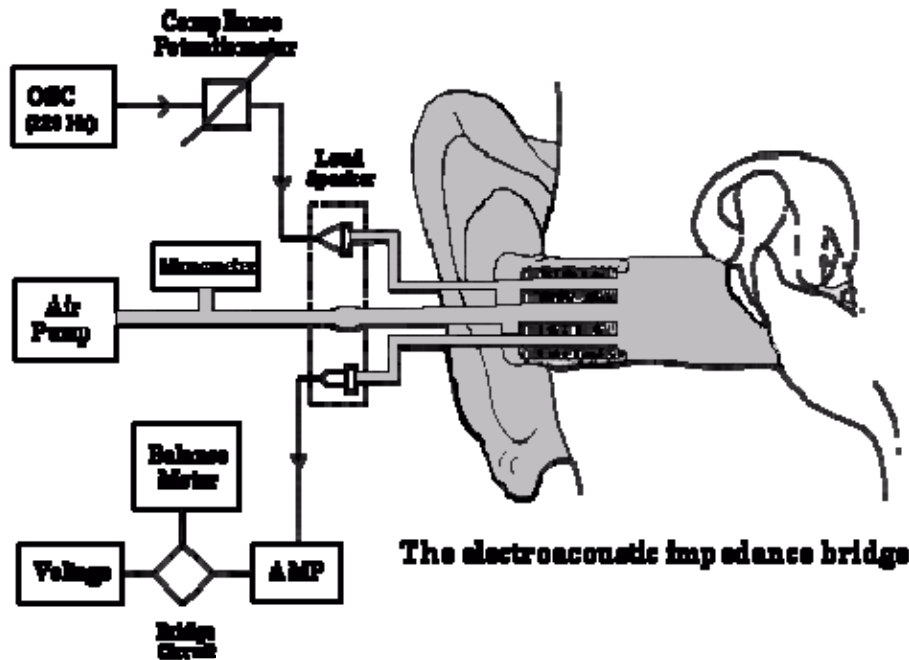
Maximal reflection of sound occurs when the mechanism is very stiff, while a compliant system transmits more sound and reflects less. There are two principal applications of this device.

- **Tympanometry**: A tympanogram is a graphic representation of the relationship of external auditory canal air pressure to impedance; the latter is usually reported in terms of tone of its derivatives, compliance in arbitrary units. Pressure in the external auditory canal is varied from -200 daPa (daPa = decaPascal = mm H_2O) through +200daPa while monitoring impedance. Impedance is lowest (maximal compliance) when pressure in the canal equals pressure in the middle ear. Ears can be classified into three basic groups on the basis of the configuration of the tympanogram.
    - **Type A**. The peak compliance occurs at or near atmospheric pressure indicating normal pressure in the middle ear. There are three subgroups.
        - A - normal shape reflects a normal mechanism
        - AD - A deep curve with a tall peak indicates an abnormally compliant middle ear, as seen in ossicular dislocation or erosion, or loss of elastic fibers in the tympanic membrane.
        - AS - A shallow curve indicates a stiff system, as in otosclerosis.
    - **Type B** - No sharp peak, with little or no variation in impedance over a wide range, usually secondary to non-compressible fluid in the middle ear (otitis media), tympanic membrane perforation or obstructing cerumen.
    - **Type C** - Peak compliance is significantly below zero, indicating negative pressure (sub-atmospheric) in the middle ear space. This finding is often indicative eustachian tube dysfunction.
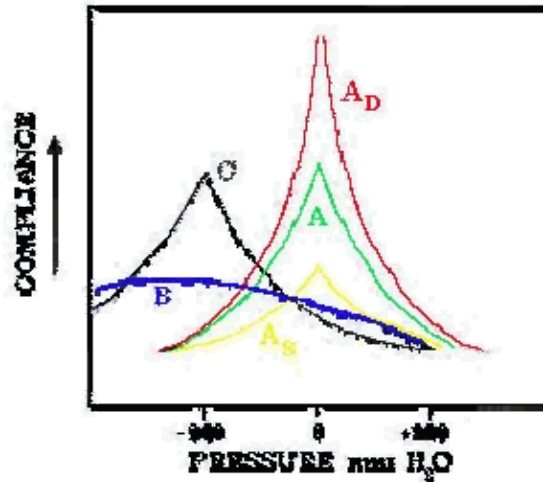
One system of tympanogram classification.
A = normal
As = stiffened tympano-ossicular system
AD = disarticulation
B = Middle ear effusion, tympanic membrane perforation or impacted cerumen
C = negative middle ear pressure.

- **Acoustic Reflex measures (AR)**: Contraction of the stapedius muscle occurs with loud sounds, producing a measurable change in compliance. Abnormalities of hearing may be suspected by the following results:
  - Elevated threshold - indicates cochlear sensitivity loss or VIII nerve disorder
  - Absent reflex
    - Abnormal middle ear system
    - Severe sensitivity loss
    - VIII nerve lesion
    - Ipsilateral VII nerve lesion
    - Some otherwise "normal" ears
  - Threshold low in proportion to sensitivity level ("recruitment")- seen in cochlear loss
  - Abnormal "shape" of reflex.

Diagnostic Audiometry

A battery of tests intended to determine the site of lesion inpatients with otologic or neurotologic disorders. The constellation of tests varies according to the available test battery and provisional diagnosis.

- **Immittance audiometry** (see above)

- **PI-PB functions** - Speech discrimination is plotted as a function of sound intensity. Normally, discrimination improves with intensity up to a maximal level, then plateaus. In VIII nerve disorders, discrimination often declines dramatically as intensity increases above the level yielding maximum performances.

PI-PB Function

Right Ear	Left Ear

HL in dB
Normal PI - PB

HL in dB
Rollover
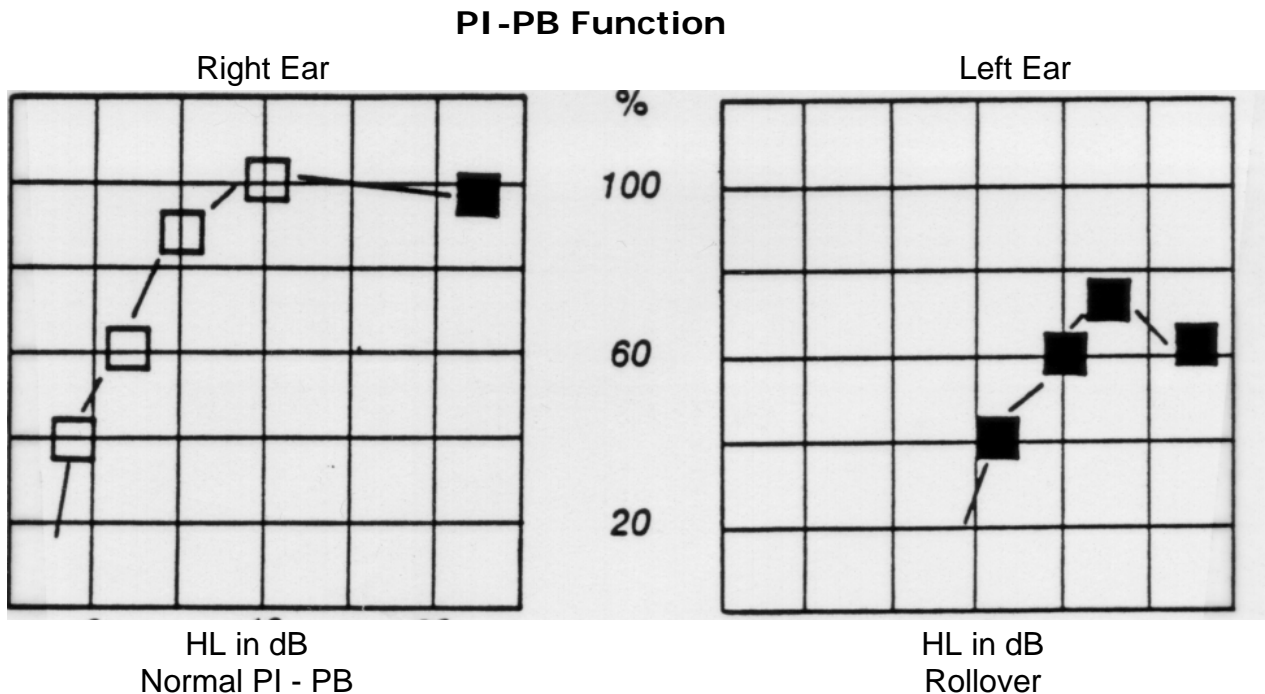
- **Bekesy Audiometry**: This test has significant historical interest in development of assessment of hearing. However, today it is used predominately only in industrial and military hearing screening situations. Patient traces his own auditory threshold by means of a self-recording audiometer. Tracings are obtained for pulsed as well as continuous tones. The relationship between the two categories can be categorized into diagnostic patterns.

  o Type I: interwoven - normal or cochlear
  o Type II: slight separation, especially in high frequencies- cochlear
  o Type III: initially interwoven, but continuous sensation falls off dramatically at higher frequencies - VIII nerve lesion
  o Type IV: continuous tracing at markedly lower level than that for pulsed signal - usually associated with VIII nerve lesion

- **Tone decay tests**: Abnormal adaptation to a continuous tone is seen in retro-cochlear lesions.
- **Stenger Test**: Performed to detect malingering of unilateral loss. If sound is presented to both ears, patient will deny hearing in the ear with the feigned loss. If sound is

presented to the good ear at a suprathreshold level, simultaneous to a louder sound in the questionable ear, a malingerer will localize the sound to his "bad" ear, and therefore deny hearing anything at all.

- **ABR - evoked auditory brainstem responses**: Scalp electrodes measure electrical activity in response to sound clicks. The response is quite small in relation to other ongoing brain activity, but by presenting a large number of clicks and averaging the responses by computer, unrelated events can be canceled out.
    - This is useful for documenting hearing in uncooperative or unresponsive patients. The disadvantage is that it tests mainly the 1,000-4,000 Hertz frequency range of hearing and is a poor indicator of the overall auditory function.
    - Abnormal ABR is seen in VIII n or brainstem lesions.

PNormal Auditory Brainstem Response
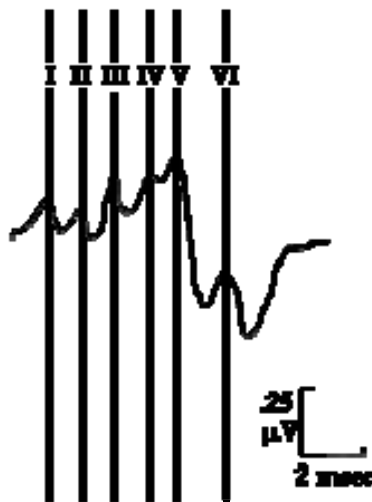
Wave I: Action potential, auditory nerve
Wave II: Cochlear nucleus
Wave III: Superior olive
Wave IV,V: Inferior colliculus
Wave VI,VII: Unclear

- **ECOG (electrocochleography)**: Electrical activity is measured from the promontory, and responses to a large number of clicks are averaged. These will be abnormal in eighth cranial nerve lesions and certain cochlear disorders.

Emergencies in Otolaryngology-Head and Neck Surgery

Many otolaryngological problems can be handled electively; however, there are emergencies, especially those associated with airway obstruction and facial trauma, for which proper initial assessment and management are crucial in preserving life and minimizing disabling or disfiguring sequelae. In this section, these emergencies are divided into the following categories:

Airway Obstruction
Inspired or Ingested Foreign Bodies
Sore Throat or Difficulty Swallowing
Epistaxis
Ear Complants
Head and Neck Infections
Laryngeal and Tracheal Trauma
Facial Trauma

Epistaxis and ear complaints are covered in more detail in other sections.

Emergencies in Otolaryngology-Head and Neck Surgery: Airway Obstruction

Airway obstruction will be covered separately in the adult, child, newborn or infant. Although the etiologies and treatment of airway obstruction may vary between different age groups, some common principles of evaluation and treatment are worth emphasizing. First, try to anticipate airway problems before the patient's airway becomes completely obstructed and mobilize support quickly. After assessing the patient's potential for airway compromise, look for a cause. The patient will often require multiple endoscopy (laryngoscopy, bronchoscopy and esophagoscopy), which in addition to helping identify an etiology may also help establish an airway. Then the airway may be secured by either intubation or tracheotomy.

Emergencies in Otolaryngology-Head and Neck Surgery: Adult with Airway Obstruction

History

- **Precipitating event**
  - Aspiration
  - Trauma
  - Allergic reaction
  - Systemic illness
- Time course
- Previous intubation or neck trauma

Physical Examination

- Total obstruction - without any air movement, aphonic, no choking or coughing
- Stridor
  - Inspiratory - glottic or supraglottic
  - Expiratory - subglottic or intrathoracic
  - Biphasic - subglottic or tracheal; severe higher or lower obstruction may also be biaphasic
- Suprasternal or intercostal retractions
- Fatigue with decrease in stridor may herald impending decompensation
- Cyanosis
- Mirror or fiberoptic exam of hypopharynx

Ancillary Studies

- Soft tissue lateral of neck
- Chest x-ray
- Tomograms, xeroradiograms
- CT scan

Endoscopy

- Direct laryngoscopy, rigid bronchoscopy and esophagoscopy
- May simultaneously establish airway

Etiology

- Traumatic
    - Laryngeal or tracheal fracture
    - Oropharyngeal laceration
    - Edema from injury to head and neck
    - Subglottic stenosis or granulation tissue secondary to intubation
- Infectious
    - Epiglottitis (more supraglottitis in adult)
    - Peritonsillar abscess
        - Signs & Symptoms: sore throat, fever, "hot potato" voice, drooling, bulging tonsil
        - Treatment: aspiration vs I&D vs tonsillectomy (noninvolved side tends to bleed more than usual)
    - Deep neck abscess
    - Parapharyngeal space
    - Prevertebral space
    - Submental space - Ludwig's angina
- Mechanical
    - Foreign body
    - Blood
    - Vomitus
- Neoplastic
    - Tumors occluding airway
    - Tumors eroding into major vessels with massive blood loss into airway
- Allergic

Treatment

- Oropharyngeal obstruction
    - Heimlich maneuver for total obstruction (aphonic, no choking or coughing)
    - Remove blood, vomitus, etc.
    - Extend head (if you are sure there is no cervical spine injury) and apply anterior traction to mandible, and/or tongue as needed
    - Oro or nasopharyngeal airway
    - If unsuccessful, proceed to intubation or tracheotomy
- Laryngotracheal obstruction
    - Conservative: close observation, steroids, racemic epinephrine, oxygen, humidification
    - Intubation: Often difficult in severe airway or facial trauma due to distortion and bleeding. Contraindicated in laryngeal or tracheal fracture.

- Standard tracheotomy - Indicated in any patient with upper airway obstruction who cannot be safely or successfully intubated.
  - Technique
    1. Horizontal skin incision
    2. Separate strap muscles in midline
    3. If necessary, mobilize or divide thyroid
    4. Visualize tracheal rings, **identify level**
    5. Incise trachea under direct visualization. Do not incise first tracheal or cricoid ring
    6. Create inferiorly based tracheal flap
    7. Put traction suture through tip of flap
    8. Insert tube under direct visualization
    9. Confirm proper placement of tube by inspection and auscultation
    10. Prevent early dislodgement because reinsertion even with traction suture can be difficult
    11. May change after 2 to 3 days when tract formed

Sideview of larynx and trachea with head in extention
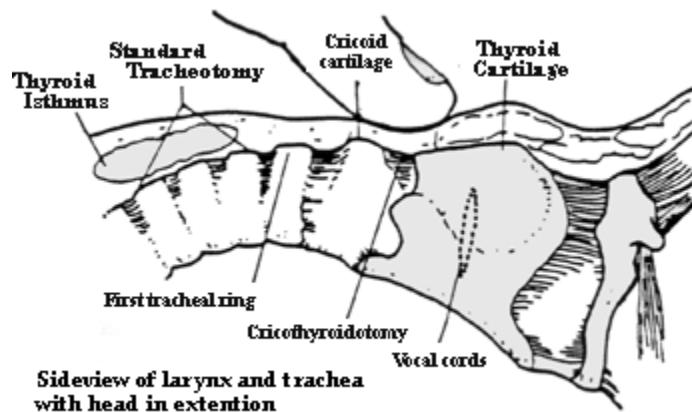
- Cricothyroidotomy - Indicated in emergency situation when standard tracheotomy not feasible or advisable
    1. Incision through skin and cricothyroid membrane
    2. Insert tube or stent incision open
    3. Requires PRECISE surface identification of anatomy. If landmarks ambiguous, proceed with standard tracheotomy or needles.
    4. Contraindicated in laryngeal or tracheal trauma or infection and in young children.
    5. Conversion to standard tracheotomy if prolonged airway support is needed
- Large bore needles inserted percutaneously into trachea. Not procedure of choice, but can be life saving as a temporizing measure.

Emergencies in Otolaryngology-Head and Neck Surgery: Child with Airway Obstruction

History

- Stridor - inspiratory, expiratory, biaphasic
- Fever
- Difficulty swallowing
- Foreign body
- Trauma, including prior intubation

Physical Examination

- Supraclavicular/intercostal retractions, cyanosis
- Positional changes
    - Epiglottitis - breathing is better sitting up

Ancillary Studies

- Soft tissue lateral of neck
- Chest x-ray
- Airway management overrides importance of x-rays

Endoscopy

- Direct laryngoscopy, rigid bronchoscopy and esophagoscopy
    - Bronchoscope sizes: 6 months to 3 years - 4 mm; 3 to 12 years - 5 mm; over 12 years - 6 mm
- May be needed to establish airway

Etiology

- Congenital
    - May have both a congenital and an acquired problem
- Infectious
    - Epiglottitis
        - Febrile, toxic appearing child who prefers sitting up and cannot swallow his own saliva
        - Inspiratory stridor
        - Tonsils okay

- - - Blood cultures - H. influenza
      - To OR to make diagnosis, intubate
  - Acute tonsillitis
    - R/O mono, possibility even in children
  - Peritonsillar abscess
    - May have to take child to OR to drain or perform tonsillectomy, but intubation can be treacherous so have a good anesthesiologist and a trach set available
  - Laryngotracheal bronchitis (croup)
    - concentric narrowing of airway
    - monitor closely; may need to intubate
  - Papillomata
    - More common in young children, but all ages affected
    - DNA virus - Human papilloma virus subtypes HPV 6 & 11
    - Palliation - CO2 laser
    - Many spontaneously regress, but in a small percentage of patients papillomas recur for many years
  - Viral Respiratory Infection
    - In a child with some airway obstruction, any additional airway compromise such as the edema resulting from a URI may lead to frank airway distress
- Mechanical
  - Foreign body
    - **ALWAYS SUSPECT IN CHILD WITH RAPID ONSET OF AIRWAY PROBLEMS**
    - Do not turn child upside down
    - Rigid bronchoscopy with removal of foreign body is the treatment of choice
    - Rarely may need to perform tracheostomy or thoracotomy to remove
- Traumatic
  - Prior intubation - subglottic stenosis
  - Laryngeal or tracheal fracture

- Neoplastic
  - Submucosal mass effect
    - Rhabdomyosarcoma
      - Tonsillar masses
    - Neurofibroma
      - Macroglossia
      - Supraglottic mass
- Allergic

Treatment

- Conservative: close observation, steroids, racemic epinephrine, oxygen, humidification
- Intubation: tube about the size of the patient's little finger, prevent movement of the tube after intubation
- Tracheotomy: 1 to 1.5 years - size 1; 1.5 to 4 years - size 1 or 2; 4 to 7 years - size 2 or 3; 7 to 12 years - size 3 or 4; over 12 years - size 5 to 8

Emergencies in Otolaryngology-Head and Neck Surgery: Newborn with Airway Obstruction

History

- Stridor
    - Inspiratory - glottic or supraglottic
    - Expiratory and biaphasic - subglottic
    - Present from birth - laryngomalacia, unilateral vocal cord paralysis, webs, cysts and vascular rings
    - Later - bilateral vocal cord paralysis and others
- Atypical cry
    - Muffled - supraglottic obstruction
    - High-pitched, weak - webs and vocal cord paralysis
    - Croupy - subglottic stenosis
- Feeding difficulty
    - Laryngotracheoesophageal clefts, neurogenic dysfunction and laryngeal webs
    - Can lead to aspiration induced pneumonia
    - Choanal atresia - infants are obligate nasal breathers
- Failure to thrive

Physical Examination

- Supraclavical/intercostal retractions, cyanosis
- Positional changes
    - Laryngomalacia - worse with supine vs prone
- Other anomalies - Assess for presence of:
    - Cranial anomalies
    - Pectus excavatum
    - Cardiopulmonary anomalies
    - Imperforate anus

Ancillary Studies

- Cervical X-rays - lateral and AP
- Barium swallow - cinefluoroscopic studies

Endoscopy

- Direct laryngoscopy, rigid bronchoscopy and esophagoscopy
- Bronchoscope sizes - less than 5 pounds - 3 mm; average newborn to 6 months - 3.5 mm

Congenital Etiologies

- Laryngomalacia
  - Most common
  - May be associated with pectus excavatum, retrognathia or subglottic stenosis
  - Inspiratory stridor, severe in supine position, usually present from birth
  - Endoscopy - flexible or rigid
    - Long narrow epiglottis with floppy aryepiglottic folds
    - Venturi effect - airway narrows from oropharynx to trachea, as airway becomes smaller air moves more rapidly creating negative pressure which causes loose aryepiglottic folds and arytenoids to collapse first which narrows airway more causing floppy epiglottis to fold blocking the airway
  - Treatment rarely required, outgrown in 18 months
- Vocal cord paralysis
  - Second most common
  - Unilateral more frequent than bilateral with unilateral left more common than right
    - Left associated with cardiovascular or pulmonary defect
    - Right usually solitary finding
  - Unilateral symptoms can be minimal
  - Bilateral abductor paralysis causes severe inspiratory and expiratory stridor
  - Endoscopy - flexible or rigid (place tip of laryngoscope in vallecula to avoid distortion of endolarynx)
  - Treatment unilaterally generally not required, movement may return within three to six months
  - Bilateral abductor paralysis requires a trach and in event of no return of function, additional surgery
- Congenital subglottic stenosis
  - Third most common

- o White male infants most commonly affected
- o Associated abnormalities include cleft palate, imperforate anus and tracheoesophageal fistula
- o Greatest obstruction usually 2 to 3 mm below vocal cords, involves either abnormally shaped or small cricoid cartilage or redundant submucosal fibrous tissue
- o Biaphasic stridor, cyanosis and barking cough suggest croup or laryngotracheal bronchitis, but subglottic stenosis follows a more protracted course
- o Treatment - gentle dilation, CO_2 laser with or without stenting, for mild stenosis. Cricoid split and laryngotracheoplasty with costal cartilage or hyoid bone interposition may be required in more severe stenosis.
- Laryngeal webs and atresias
  - o Incomplete epithelial breakdown during the 10th week of embryogenesis
  - o Most common location between cords, but can be in supraglottic or subglottic spaces
  - o Treatment - CO_2 laser lysis, occasionally more extensive procedures required
  - o Atresias - rare, trach at delivery is imperative
- Laryngotracheoesophageal clefts and fistulas
  - o Tracheal atresia with TE fistula is not compatible with sustained life
- Laryngeal cysts (fluid) and laryngoceles (air)
- Tracheomalacia
  - o Rare, usually associated with other anomalies like vascular rings
  - o Wide, flat arch not as strong as more circular one
- Hemangioma
  - o Worse when infant cries
  - o Treatment - CO_2
- Vascular rings
- Choanal atresia
  - o A newborn is an obligate nasal breather capable of exchanging air through his nose while he feeds
  - o Can be mimicked by mucosal swelling from viral respiratory infection or nasal decongestant drops
- Laryngeal cysts/neoplasms
- Macroglossia
  - o Relative macroglossia because of underdevelopment of the mandible in patients with the Pierre Robin Syndrome

Treatment

- Varies with etiology - Intubation, rigid bronchoscopy or tracheotomy may be indicated depending on the nature of the problem.

Foreign Bodies: Inspired or Ingested

Symptoms are related to the site of the foreign body and its composition.

Laryngeal or Supraglottic Foreign Bodies

Presentation - Sudden total or near total obstruction, usually during eating. Also known as "cafe coronary." Very common cause of death.

- Heimlich maneuver (sudden, vigorous abdominal compression) has been recommended to dislodge objects from the larynx; however, this technique may convert a partial airway obstruction to a total occlusion; therefore, use this ONLY in the setting of TOTAL OBSTRUCTION.
- Removal by direct laryngoscopy may be feasible in partial laryngeal obstruction, but only when equipment for emergency laryngoscopy or bronchoscopy are immediately at hand.
- Tracheotomy is the most reliable treatment. Cricothyroidotomy may be performed with any available sharp object.

Tracheal or Bronchial Foreign Bodies

Presentation - Choking episode, usually followed by asymptomatic interval. Late symptoms and signs are related to air trapping distal to object(s).

- Unilateral expiratory wheeze
- Recurrent infections in one lobe
- Air trapping

Diagnosis - Characteristic history and physical is suggestive and requires bronchoscopic evaluation. X-ray may demonstrate air trapping, localized infection, or in chronic cases, bronchiectasis. Foreign body seen only if it is radiopaque

Treatment - Rigid bronchoscopy. Removal of tracheal or bronchial foreign body is an extremely hazardous procedure, particularly in children; therefore, an optimal situation is imperative in regard to anesthesia, equipment, nursing staff. The worst objects are ones like pinto beans that can swell or ones like nuts and crayons that can fragment into smaller pieces with attempts to remove them.

Pharyngeal Foreign Bodies

Presentation - Sensation of something "sticking" in throat, typically following fish meal.

Diagnosis - Must be differentiated from superficial mucosal abrasion, which presents identically.

- Soft tissue lateral x-ray - rarely helpful.
- Direct oral and mirror pharyngeal exam. Typical site of fish bone is in base of tongue or tonsil. Fish bone may be mistaken for a strand of saliva.

Treatment

- Perform oral removal as out patient - if object visible and easily accessible.
- Endoscopy - if object visible but not accessible or if no foreign body seen and symptoms persist beyond 4-5 days.

Esophageal Foreign Bodies

Presentation - Sensation of something "sticking" after swallowing. This may result in severe dysphagia with inability to swallow even saliva.

Diagnosis

- Mirror exam to rule out pharyngeal foreign body.
- Plain films - for radio opaque foreign bodies, such as coins.
- Barium swallow - Barium "burger", marshmallow, or barium soaked pledgets.

Treatment

- For mild symptoms and nonhazardous objects, watchful waiting. Many foreign bodies pass spontaneously, and mild symptoms may be secondary to local trauma, rather than an actual foreign body. Those foreign bodies that fail to pass into the stomach are usually trapped in the cervical portion of the esophagus below the cricopharyngeus muscle. If the foreign body reaches the stomach, it will, in most cases, pass completely through the remainder of the gastrointestinal tract.
- For severe or persistent symptoms, or hazardous objects, rigid esophagoscopy. A meat bolus lodged in the esophagus can sometimes be pushed into the stomach or removed endoscopically, but do not use a meat tenderizer because it may injure the esophagus.
- Follow carefully for possible perforation and mediastinitis.

- After initial resolution, rule out underlying cause of impaction, such as stricture or tumor.

Emergencies in Otolaryngology-Head and Neck Surgery: Sore Throat or Difficulty Swallowing

Many patients go to an emergency room complaining of a sore throat or difficulty swallowing and not all have major problems such as an obstructed airway or an inspired or ingested foreign body; however, each patient should be examined carefully.

History

Sore throat

- Duration
- Associated complaints
    - Fever
    - Neck nodes
    - Oral lesions
    - Hoarseness
- Systemic infection, immunodeficiency
- History of smoking or chewing tobacco

Difficulty Swallowing - above questions plus the following:

- Type
    - Large bolus to liquids - intrinsic or extrinsic obstruction
    - Liquids only - neurologic involvement
- Aspiration or nasal regurgitation
- Odynophagia
- Referred otalgia
- Vomiting
- History of foreign body or caustic ingestion
- Weight loss
- Reflux
- History of neck or chest surgery

Physical examination

- Good light source important
- Anesthetize palate, pharynx and base of tongue if necessary

- Bimanual palpation of floor of mouth, base of tongue
- Indirect mirror exam and / or flexible nasopharyngoscopy
- Assess
  - Dental hygiene
  - Tongue mobility
  - Palatal competence
- Look for
  - Drooling
  - Presence of lip or oral lesions
  - Pooling of secretions in pyriform sinuses
  - Hidden neoplasms on palate, tonsillar fossa, base of tongue, epiglottis, pyriform sinus and post cricoid region

Ancillary Studies

- Barium swallow with cine-esophagram
- Chest x-ray
- CT scan
- Endoscopy and biopsy

Treatment

- Correct dehydration, especially important in children
- Caustic ingestion
- Do not induce vomiting
- Do not perform a gastric lavage
- Do not order a barium swallow
- Early, aggressive endoscopy and resection of nonviable tissue

Emergencies in Otolaryngology-Head and Neck Surgery: Epistaxis

- Usually located on anterior septum
- Try 15 minutes of pressure. Get hypertension under control
- Topical epinephrine/neosynephrine on pledgets as vasoconstrictor
- Pull pledgets out and look fast for the bleeding site
- Suction away blood and cauterize with silver nitrate
- Try packing nose lightly with Surgicel or gelfoam sponges soaked with topical thrombin

- Vigorous bleeds must be packed with antibiotic ointment-soaked gauze strips. Need good lighting and instruments for an adequate job. Avoid packing patients with coagulopathies who will invariably re-bleed when the pack is removed
- Intranasal balloons (e.g. Epistat) are easier to use but less consistently effective
- Persistent bleeding is then treated with posterior and anterior packs
- Leave packs in three days. Cover with antibiotics to prevent sinusitis
- If packing fails vessels must be ligated. If the responsible vessel cannot be identified then both maxillary artery and ethmoid arteries are ligated
- Blood supply of the lateral nasal wall.

Emergencies in Otolaryngology-Head and Neck Surgery: Ear Complaints

The External Ear

Infection

- External Otitis ("Swimmer's Ear")
  - Symptoms: pruritus, otalgia varying from sense of fullness to throbbing pain, hearing loss.
  - Signs: Edema and erythema of canal skin, tenderness of tragus, foul-smelling secretions, possible periauricular cellulitis.
  - Treatment: Clean EAC; Topical otic neosporin-polymyxin B (or colistin)-hydrocortisone for gram negative bacilli (most commonly *Pseudomonas aeruginosa*) for 10 days; impregnated wick for severe edema; **adequate** analgesic.
  - Preventive Measures for Recurrent Otitis Externa: Ethyl alcohol drops (70%) or acetic acid - nonaqueous solutions (2%) after swimming or bathing. Avoid self-instrumentation.
- Necrotizing External Otitis (Malignant External Otitis)
  - Symptoms & Signs: Progressive pain and drainage from the EAC. Granulation tissue often present. *Pseudomonas aeruginosa* invasion of soft tissue, cartilage and bone. Occasional facial nerve palsy.
  - Treatment: Radical surgical debridement with combination semi-synthetic penicillin and aminoglycoside for 4-6 weeks. Significant mortality in diabetics who acquire disease.
- Perichondritis
  - Symptoms: Pain and warmth of the pinna following trauma or infection.

- o Signs: Erythema, induration, and possible fluctuance of part or all of the auricle.
  - o Treatment: Most common organism: *Pseudomonas aeruginosa.* Betadine or boric acid wet-to-dry dressings to open wound. If perichondritis progresses to chondritis with abscess, then incision, drainage, and debridement of non-viable cartilage is necessary.
  - o Obtain cultures.
- Otomycosis
  - o Symptoms: Itching or mild otalgia. Secondary bacterial infection may produce intense pain.
  - o Signs: *Aspergilla nigrans* produces a grayish membrane with hyphae visible under microscope. Erythema of underlying epithelium.
  - o Treatment: Clean EAC. Topical cresyl acetate or 1% gentian violet and/or boric or acetic acid and alcohol drops.
- Bullous Myringitis
  - o Symptom: otalgia.
  - o Signs: Hemorrhagic blebs on TM and adjacent canal.
  - o Treatment: Incision of blebs if severe pain. Prophylactic oral antibiotics to prevent otitis media. Anesthetic otic drop.
- Herpes Zoster Oticus (Ramsey Hunt Syndrome)
  - o Symptoms: Otalgia, malaise, headache, possible dizziness.
  - o Signs: Vesicular eruption of distal canal and concha. Occasional 7th CN paralysis.
  - o Treatment: Analgesics. Middle cranial fossa decompression of facial nerve if progressive degeneration.

Allergy

- Contact Dermatitis
  - o Symptoms: Burning, itching, pain
  - o Signs: Variable. Range from erythema to hyperpigmentation of skin. Fissures with weeping.
  - o Agents incriminated: Shampoos, hair sprays, perfumes, ear plugs, and earrings. Most common: Nickel allergy to earrings.
  - o Treatment: Remove allergen. Topical corticosteroids.
- Eczema
  - o Symptoms and signs: Itching, scaling, and fissuring: More aggressive forms will present with weeping, crusting, and secondary bacterial infections.
  - o Predisposing factors: Seborrheic dermatitis, atopic dermatitis, psoriasis, and other skin conditions.
  - o Treatment: Topical steroid lotions and creams.

Trauma

- Hematoma of Auricle
    - Etiology: Blunt trauma results in accumulation of blood between perichondrium and cartilage.
    - Differential Diagnosis: Perichondritis, cellulitis, and relapsing polychondritis.
    - Treatment: Repeated aspiration under sterile conditions and mastoid pressure dressings.
    - Complication: Organization and calcification of clot with necrosis of underlying cartilage leads to "cauliflower ear".
- Laceration of Auricle
    - Simple: Thorough cleaning of wound with antiseptic solutions. Conservative debridement of necrotic skin edges and cartilage that cannot be covered with perichondrium. Closure of perichondrium to prevent notching. Cosmetic closure of skin. Prophylactic antibiotics.
    - Complicated: Same principles. Contaminated or extensive wounds may require staging with use of grafts or reconstructive flaps.
    - Avulsion, Treatment: Amputated parts should be cleaned and placed in iced physiologic saline until reconstruction. Anticoagulants and prophylactic antibiotics may improve success.
- Burns
  Treatment similar to general burn management except:
    - Prophylactic antibiotics are indicated to prevent suppurative perichondritis; and,
    - Stenting of a burned meatus necessary to prevent stenosis.
- Lacerations of External Canal
  Injury predisposed to stenosis. Canal should be carefully examined, cleaned, and debrided under microscope. Skin of meatus should be reapproximated and denuded areas covered with split thickness skin graft supported in place with rosette of antibiotic impregnated gauze and packing.
- Foreign Bodies of EAC
    - Insects. Immobilize with topical 2% lidocaine or ether and remove with gentle irrigation or alligator forceps under direct vision.
    - Materials: All shapes and sizes in all age groups! Key to successful removal is use of proper instruments: microscope, alligator forceps, right-angle hook, suction, and local anesthesia. Young children often require general anesthesia to remove impacted objects without further injury. Topical otic antibiotics if localized reaction to foreign body.

Cysts and Tumors

- Cysts
  - Pilar (Sebaceous) cysts arise in hair follicles. Present as discrete, mobile masses frequently with overlying orifice. May become secondarily infected. Treatment is complete excision.
  - Epidermal cysts derived from layer of epithelium. Filled with keratin debris. Treatment consists of complete excisional biopsy.
  - Preauricular cyst and fistula
    - Results from faulty fusion of mesodermal hillocks that form the auricle. Fistula opening located in front of the incisura. Recurrent infection can be troublesome. After injection of methylene blue into the fistulous tract, the tract and cyst are excised.
- Benign Lesions
  - Keloids
    - Predisposition among Blacks. Hypertrophy of connective tissue in traumatized areas. Most common area: ear lobe secondary to ear piercing. Treatment is complete excision followed with injections of cortisone.
  - Exostosis
    - Periosteal outgrowths in the osseous canal of cold-water swimmers. On rare occasion will cause a conductive hearing loss or impact cerumen. In those cases, surgical removal is indicated.
- Malignant Lesions
  - Precancerous: Actinic Keratosis
    - Flat, scaling lesions on the sun-exposed regions of face, neck, and hands. Tend to occur in those with fair complexion. May give rise to squamous cell carcinoma. Treatment with topical 5-fluorouracil or liquid nitrogen is very effective.
  - Basal Cell Epithelioma
    - Classically presents as discrete nodule with smooth, raised edges and central crater. Superficial telangiectasias occur on edges. Locally invasive. Poor control may result in invasion of EAC, middle ear, TMJ, or parotid. Treatment of choice is wide surgical excision or Mohs chemosurgery. Invasion of EAC requires *en bloc* resection of the canal.
  - Squamous Cell Carcinoma
    - Most commonly presented as raised, ulcerated lesions on helix. Preferred treatment is wide surgical excision or Mohs chemosurgery. Pre- or postoperative radiation therapy is reserved for advanced lesions. Invasion of EAC or temporal bone requires temporal bone resection.

Nodal metastasis occurs in extensive lesions. Parotidectomy and radical neck dissection performed to control clinically evident metastasis.

The Middle Ear

The symptoms of middle ear pathology are limited to otalgia, tinnitus, and hearing loss. When proper otologic examination fails to reveal the etiology of otalgia, one should think of **referred pain**. Sensation to the ear is provided by cranial nerves V, VII, IX, X, and the C1-2 plexus; hence, diseases elsewhere in the head and neck may refer pain to the ear. A useful mnemonic is the "10 T's of otalgia":

1. TMJ
2. Tonsils
3. Throat
4. Tube (Eustachian)
5. Teeth
6. Tongue
7. Tics (Glossopharyngeal)
8. Trachea
9. Thyroid
10. Tendons

Inflammation and Infection

- Serous otitis media (otitis media with effusion) refers to the accumulation of non-purulent middle ear fluid due primarily to eustachian tube dysfunction and secondarily to metaplasia of mucosa.
    - Etiologies
        - Nasopharyngeal obstruction: adenoid hypertrophy, neoplasia, iatrogenic.
        - Intratubal obstruction: URI, allergy, sinusitis.
        - Middle ear obstruction: chronic otitis media, cholesteatoma, tumor.
        - Failure of physiological opening: cleft palate, submucous cleft, some neurological disorders.
        - Other Contributing Factors: Metaplasia due to recurrent or chronic infection, hypothyroidism, diabetes mellitus, immune deficiency syndromes, connective tissue disorders.
    - Symptoms: Mild otalgia, stuffiness, autophony, hearing loss.
    - Signs: Retracted, discolored TM. Diminished TM mobility.
    - Medical Treatment:
        - Treat nasal congestion or drainage.

- Treat concurrent infections - adenoids, middle ear, sinuses, pharynx.
- Antibiotics for OME.
- Control allergies.
- Valsalva maneuvers for insufflation.
- Politzerization.
  - o Sequelae of Persistent SOM:
    - Conductive hearing loss (10-30 dB).
    - Recurrent suppurative otitis media.
    - Impaired auditory processing with impaired socialization and delayed speech and language development in young children.
    - Ossicular erosion, tympanosclerosis, cholesteatoma formation.
  - o Surgical Treatment of SOM:
    - Pressure equalization tubes. Recent studies have demonstrated that adenoidectomy may provide additional benefit but there is still some controversy regarding this
  - o When to Recommend Tubes:
    - SOM for more than 3 months.
    - Three-four episodes OM/year in an ear with chronic or recurrent SOM.
    - Hearing handicap.
- Acute Suppurative Otitis Media
  Refers to an acute exudative middle ear disease secondary to bacteria.
  - o Clinical Stages of Acute Suppurative Otitis Media
    - Hyperemia
    - Exudation
    - Suppuration
    - Resolution
    - Coalescence
    - Complications:
      - Acute surgical mastoiditis
      - Facial nerve paralysis
      - Acute labyrinthitis
      - Sigmoid sinus thrombophlebitis
      - CNS infection
  - o Pathogens:
    - Infants: gram negative enteric bacilli
    - Under age 5: pneumococcus, H. influenza, streptococci
    - Over age 5: pneumococcus, H. influenza (less prevalent), streptococci
  - o Drugs of Choice
    - According to appropriate cultures
    - Amoxicillin (30-40 mg/kg/d) in 3 doses-every 8 hours
    - Cefaclor (20-40 mg/kg/d) in 3 doses-every 8 hours

- Trimethoprim (6-12 mg/kg/d) and Sulfamethoxazole (30-60 mg/kg/d) in 2 doses q 12 hrs
- Erythromycin (50 mg/kg/d) and Sulfisoxazole (150 mg/kg/d) in 4 doses- q 6 hrs

- Chronic Suppurative Otitis Media
COM refers to a permanent tympanic membrane perforation with associated middle ear and mastoid disease. Intermittent or continuous otorrhea usually exists.
  - Types of Perforations:
    - Central
    - Marginal
    - Attic - usually association with cholesteatoma
    - Perforations are often accompanied by purulent drainage and otic polyps
  - Evaluation:
    - Pure tone and speech audiology
    - Mastoid films
  - Treatment:
    - Clean under microscope
    - Topical otic antibiotics
    - Treatment of predisposing conditions: smoking, allergy, chronic sinusitis, chronic tonsillitis, uncontrolled diabetes mellitus, etc.
    - Surgery
  - Goals of Surgery (Tympanomastoidectomy)
    - Eradicate infection
    - Restore hearing
    - Close middle ear cleft
- Tympanosclerosis
Submucosal hyaline degeneration in the tympanic membrane and middle ear mucosa. Extensive involvement of the TM and ossicles may result in conductive hearing loss. On rare occasion middle ear surgery is advised to restore hearing. Medical therapy and PE tubes do not prevent progression of disease.

Cholesteatoma

- Definition: A confined epithelial sac which expands by collection of desquamated cells and debris
- Classifications:
  - **Congenital**: Very rare. Cholesteatoma results from entrapment of an epithelial cell rest within the temporal bone during embryological differentiation of the temporal bone. No TM perforation. Usually presents as pearly white mass behind intact TM or as facial weakness.

- o **Primary acquired**: Perforation or retraction pocket in the pars flaccida. Different theories of pathogenesis
  - o **Secondary acquired**: Marginal pars tensa perforation allows squamous epithelium to migrate inward
- Complications: Erosion of ossicles, sensorineural hearing loss, labyrinthitis, facial nerve paralysis, meningitis, brain abscess, sigmoid sinus thrombophlebitis, petrous apicitis, neck abscess (Bezold's)

Trauma

- Tympanic Membrane Perforations
  - o Etiology
    Sudden alteration of air pressure in the EAC: Compression (slap, hit, skiing), blast, instrumentation (Q-tip), burn, skull fracture, or lightning
  - o Danger signs:
    CSF otorrhea implies basilar skull fracture. Vertigo, nausea and vomiting, nystagmus, may be due to oval or round window fistula, labyrinthine or brain concussion.
  - o Management:
    - Baseline audiograms
    - Keep ear dry
    - Antibiotics if infection develops. Labyrinthine fistulae may require exploration and repair to preserve hearing
  - o Prognosis:
    - 90% heal spontaneously, and
    - 10% require tympanoplasty
- Temporal Bone Fractures (see section on Paralysis of the Facial Nerve)
- Barotrauma
  - o Definition: Refers to injury to the ear following a pressure change in the middle ear compartment. Failure of middle ear ventilation leads to negative pressure relative to the outside environment.
  - o Pathogenesis: TM and mucosa retract toward middle ear space and cause pain. Vacuum results in a change in capillary permeability with transudate and possibly bleeding. Eustachian tube "lock" occurs during airplane or diving descent.
  - o Treatment: Decongestant/antihistamines, Valsalva and insufflation, chew gum and swallow frequently. If no response, myringotomy. Should take prophylactic measures when flying or diving.
- Perilymph Fistula
  - o Vigorous coughing or straining, sneezing, or nose blowing can result in rupture of the round window or subluxation of the footplate. Leakage of

perilymph causes dizziness and hearing loss. Initial management is bed rest. If no improvement or if deterioration, surgical exploration is indicated.

Tumors

- Glomus Tumors
  Glomus tumors (nonchromaffin paragangliomas) are the most common "benign" neoplasms of the ear. Are malignant **by location**, as continued slow growth results in erosion and involvement of surrounding structures
    - Symptoms and signs: Hallmark is unilateral pulsatile tinnitus synchronous with pulse rate. Progressive hearing loss and otalgia. Cranial nerve involvement VII - XII.
    - Physical exam reveals a bluish mass behind the tympanic membrane. **Brown's sign**: Increased EAC pressure with a pneumatic otoscope leads to blanching of mass
    - Diagnosis confirmed with arteriography or jugular venogram. Extent of disease evaluated with polytomography and high-resolution CT scanning
    - Differential diagnosis: Venous hum, high jugular bulb, carotid aneurysm, A-V malformation, and idiopathic hemotympanum
    - Treatment: Surgical removal ranges from transcanal tympanotomy to base of skull resection. Radiotherapy is recommended for tumors extending beyond the boundaries manageable by surgery, for post-operative recurrences, and for non-surgical patients
- Malignant Neoplasia
    - Squamous cell carcinoma is the most common middle ear malignancy. Symptoms include aural discharge, bleeding, pain, decreased hearing, and otic polyps. Can resemble COM! Treatment is temporal bone resection vs palliative radiation depending on extent of disease

Congenital Disorders

- Otospongiosis (Otosclerosis)
    - Definition: A primary bone dyscrasia affecting 4-8% of Caucasian and 1% of Black temporal bones. Involvement of oval window results in footplate fixation and persistent conductive hearing loss (1% Caucasians). Involvement of cochlear endosteum can produce sensorineural hearing loss through release of "toxins" during bone metabolism.
    - Pathogenesis: Autosomal dominant gene with variable penetrance. Role of sodium fluoride in preventing expression of dyscrasia under investigation
    - Symptoms: Hearing loss, tinnitus, dizziness

- o Signs: Usually normal examination. **Schwartze's sign**: red discoloration under drum due to active focus on promontory. Weber lateralizes to involved ear
  - o Treatment:
    - ▪ Medical: Hearing aid. Sodium fluoride 20-30 mg/d with calcium and vitamin D supplementation for sensorineural component
    - ▪ Surgical: Stapedectomy successful in more than 90% of cases
- Lop Ears
  - o Increased angulation of auricle due to a poorly developed antihelix or large concha
  - o Dominant inheritance with variable penetrance
  - o Amenable to surgical correction, preferably before child enters school
- Microtia
  - o Atresia of auricle and/or external canal. Variable in degree
  - o Associated anomalies: preauricular appendages, facial nerve anomalies, hypoplasia of mandible or maxilla
  - o Signs: Absence of meatus or external canal ends in blind sac. Conductive hearing loss
  - o Treatment: Cosmetic reconstruction of auricle at 4-6 years of age. Preferential seating in classroom for unilateral involvement. Hearing aids for bilateral involvement as soon as possible. Surgical reconstruction of external canal, tympanic membrane, ossicular chain often deferred until patient can give own consent--earlier in selected cases

Emergencies in Otolaryngology-Head and Neck Surgery: Head and Neck Infections

Treat head and neck infections immediately and aggressively!

Infection can spread to orbit, brain and mediastinum.

- Extension to orbit from ethmoid sinuses can lead to blindness; time course especially rapid in children
- Ear and sinus infections can spread directly and indirectly to brain; in addition infections in central area of face can extend into cavernous sinus
- Extension in neck along fascial planes can result in mediastinitis; expansion can lead to airway compression
- Infection can spread rapidly due to delayed treatment, virulent pathogen or impaired immune competence or combination of above
  - o With virulent pathogen like fungus in mucormycosis, blindness and death can occur.

- o With strep and staph in necrotizing fasciitis extensive tissue necrosis probable.

Treatment

- With neck abscesses, control airway before I&D
- I&D, remove necrotic tissue
- Culture - aerobic, anaerobic, AFB, fungal, special stains
- Use appropriate antibiotic or antifungal agents
- Control associated problems like diabetes mellitus.

Emergencies in Otolaryngology-Head and Neck Surgery: Laryngeal and Tracheal Injuries

A. General considerations - The respiratory skeleton is suspended from the base of the skull and mandible by the pharynx and strap muscles. Because of its mobility, resilience and relatively shielded anatomy, it usually escapes serious injuries; however, direct anterior blows, strangulation, and penetrating missiles can cause significant damage. Early diagnosis is the key to successful management. Unfortunately, these injuries are often overlooked initially in the multiply injured patient. Prompt diagnosis requires a vigilant approach.

Types of injuries

- Laryngeal fracture
- Tracheal fracture
- Penetrating injuries
- Arytenoid dislocation
- Cricotracheal separation
- Recurrent laryngeal nerve paralysis

Diagnosis

- Symptoms
  - o Pain
  - o Hoarseness
  - o Obstruction (can develop rapidly even if asymptomatic for several hours after the injury)
  - o Hemoptysis
- Signs
  - o Ecchymosis
  - o *Subcutaneous emphysema*

- o Loss of surface landmarks
- o Saliva or air exiting neck wound
- o Crepitus of larynx or trachea
- Indirect laryngoscopy to search for lacerations and/or deformity
- X-rays
    - o Neck (soft tissue)
    - o Chest
    - o CT scan

Treatment

- Maintain airway. Oral or nasal intubation is contraindicated. If intervention is required, proceed with tracheotomy. Try to avoid high tracheotomy in the presence of laryngeal injury.
- Endoscopy evaluation is safe only after tracheotomy. Look for possible associated injuries of the esophagus or bronchi.
- **OPEN** reduction of fractures and careful suturing of lacerations is imperative, as soon as possible after injury.

Late Complications: hoarseness, aspiration, and obstruction.

Emergencies in Otolaryngology-Head and Neck Surgery: Facial Fractures

General Considerations

- Look for other fractures like skull and/or cervical spine fractures
- Test function of cranial nerves
- Indications for reduction
    - o Functional impairment
    - o Cosmetic deformity
- Timing - As soon as is practical, but in general, delay of one week is not harmful. Delay may be necessary due to:
    - o Edema or ecchymosis, which obscures skeletal deformity
    - o Instability of patient due to other injuries

Nose

- Anatomy
    - o Skin very closely related to skeleton

- o Two-thirds cartilaginous, one-third bony
- o Shock absorbing structure
- o Bony bridge extremely strong
- Types of Fracture
  - o Lateral - most common
  - o Depressed - due to dorsal blow
  - o Nasofrontal ethmoidal - unusual and severe, involving displacement of nasal and frontal bones into the ethmoid area
- Diagnosis
  - o Primarily physical exam
    - Pain and tenderness
    - Epistaxis
    - Nasal obstruction
    - Ecchymosis
    - Deformity - may be difficult to assess secondary to swelling or bleeding
  - o X-rays usually not helpful
  - o Look for septal hematoma
- Treatment
  - o Control bleeding and minimize swelling with ice and elevation
  - o DRAIN SEPTAL HEMATOMA IF PRESENT - Failure to diagnose and treat can lead to severe deformity
  - o Prophylactic antibiotics
  - o Swelling usually prohibits early evaluation and reduction. Advise head elevation to facilitate resolution.
  - o Reduce within 5-7 days by closed or open manipulation. Indications for reduction are functional (obstruction) and/or cosmetic.
    - Simple fractures - splint one week
    - Nasofrontal ethmoidal
      - External fixation by lead plates or acrylic bar
      - Internal fixation with rigid fixation plates
   - May need to repair medial canthal ligament or lacrimal sac apparatus \

Orbit

- Anatomy: The orbit is a bony pyramid with the optic foramen at its apex
  - o Floor of orbit is the roof of maxillary sinus
  - o Medial wall - Lamina papyracea of ethmoid bone
  - o Lateral wall Zygoma and sphenoid bone (greater wing)
  - o Superior wall - Frontal bone - floor of frontal sinus and anterior fossa
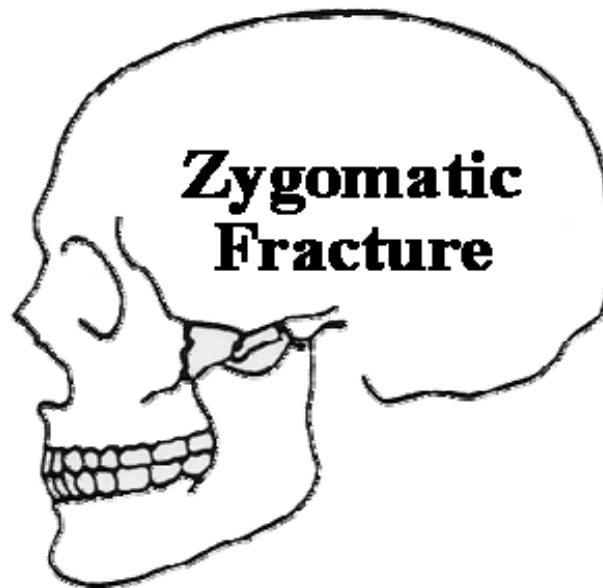
- Types of Fractures
  - Orbital floor blow-out fracture

Orbital Fracture "Blow Out"

  - Orbital rim
  - Trimalar (tripod fracture, avulsion of lateral wall)

Malar Fracture
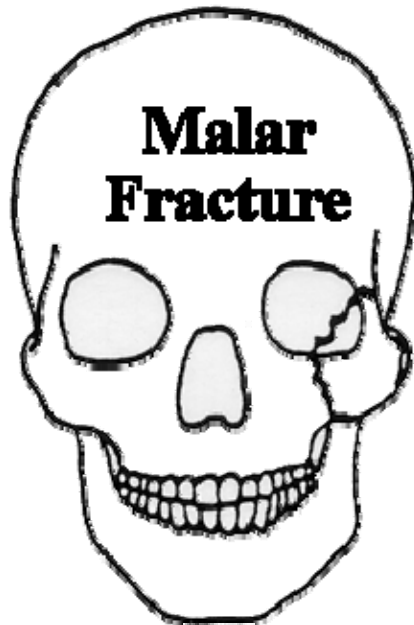
- o Zygomatic arch

- Diagnosis
  - o Clinical
  - o "Black eye" - periorbital ecchymosis and edema
  - o Cheek depression - may be difficult to detect 2o to swelling, indicates involvement of zygoma
  - o Orbital rim step-off
  - o Infraorbital hypesthesia
  - o Diplopia or entrapment of inferior oblique muscle, due to defect in orbital floor
  - o Enophthalmos - orbital floor defect
  - o Trismus - zygomatic arch impinging on coronoid process of mandible
- X-rays
  - o Water's view - orbital rim, maxillary sinus
  - o Submental vertex to visualize zygomatic arch
  - o Frontal (Caldwell) and lateral sometimes helpful
  - o CT scan - coronal cuts helpful in identifying orbital floor fracture
- Treatment
  - o Indications
    - ▪ Functional deficit - trismus or ocular symptoms
    - ▪ Cosmetic defect - wait for swelling to subside prior to reduction
  - o Reduction - usually requires open exploration and manipulation
    - ▪ Blow-out fracture - replace orbital contents and restore floor. May use permanent or absorbable alloplastic implant or autogenous bone graft
    - ▪ Orbital rim - same, plus repair rim

- Trimalar - explore floor if indicated. Fixation by interosseous wiring, external pin, rigid fixation plate or sinus packing
- Isolated zygomatic arch fracture - Gilles or intraoral reduction.

Mandible

- Anatomy
  - Condyle - articulates with skull
  - Coronoid process - under zygomatic arch
  - Angle and ramus - protected by masseter
  - Body - tooth-bearing portion

Illustration demonstrating frequency of fractures by anatomical area:
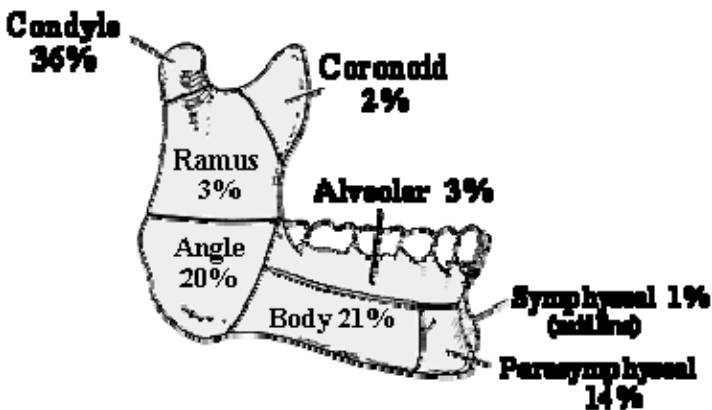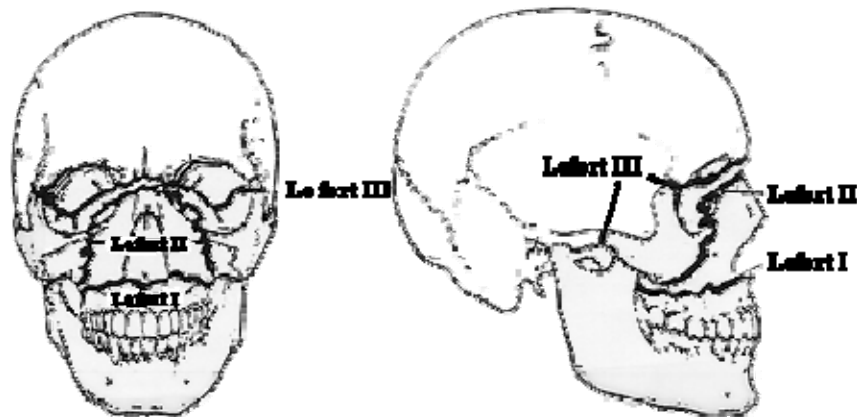

- Diagnosis
  - Clinical
    - Swelling and tenderness
    - Trismus
    - Malocclusion
    - Palpable step-off
    - Intraoral lacerations
    - Mental nerve hypesthesia
  - X-rays
- Treatment
  - Goals of treatment
    - Restore occlusion
    - Avoid nonunion by immobilizing fracture(s) and preventing infection
  - Fixation
    - Interdental wiring
    - Interosseous wiring or plates

- ▪ Intraoral splints
- ▪ External Pins
  - o Length of immobilization - depends on age of patient, site and angulation of fracture. Example: Condylar fracture in children - soft diet only. Example: Body fracture in elderly patient - more extensive treatment.
- • Important considerations
  - o Condyle is the growth center for the mandible. Therefore, injury here in childhood can cause significant deformity.
  - o Interdental wiring is potentially hazardous in the non-alert patient. Wire cutters should be kept at the bedside when the patient is recovering from anesthesia, and used to open jaws immediately in case of vomiting or airway problem. Never rely on nasotracheal intubation to reestablish an airway in the presence of intermaxillary fixation.

Le Fort Fractures (Mid Face Fractures) - Result from severe frontal blows. Frequently associated with intracranial damage, CSF leak.

- • Types of fractures
  - o Le Fort I - tooth bearing portion separated from upper maxilla
  - o Le Fort II - fracture across orbital floor and nasal bridge (pyramidal fracture)
  - o Le Fort III - fracture across frontozygomatic suture line, entire orbit and nasal bridge (craniofacial separation)


  - o Combinations common
- • Diagnosis
  - o "Dishpan Face"
  - o Mobile maxilla
  - o X-rays - CT scan most helpful axial and coronal cuts
- • Treatment

- o Postpone until patient neurologically stable and swelling resolved, usually 7 to 10 days
- o Rigid fixation plates or IMF and wire upper teeth to next higher stable point
- o Splint for palate split

Frontal Sinus Fractures

- Anatomy
  - o Anterior table - part of forehead and supraorbital rim
  - o Posterior table - anterior wall of anterior cranial fossa
  - o Inferiorly, the nasofrontal duct drains the sinus into the nose
- Diagnosis
  - o Clinical
    - Pain
    - Swelling
    - Ecchymosis
    - Epistaxis or CSF rhinorrhea
    - Associated nasal or skull fractures
  - o X-rays
    - Caldwell and lateral skull views
    - Tomograms, CT scan - essential for evaluation of nasofrontal ostia
- Treatment
  - o Indications
    - Posterior table fracture
    - Nasofrontal ostia injury
    - Cosmetic defect from displaced anterior table depression
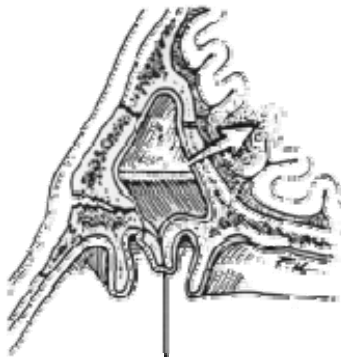
  - o Frontal sinus obliteration
    - Exploration of frontal sinus via osteoplastic flap
    - Examine and repair dura if necessary
    - Remove all mucosa from the sinus

- Fill the sinus with fat to prevent communication with nose and reepithelialization

Basilar Skull Fractures

- Diagnosis
  - Conductive and/or sensorineural hearing loss
  - VII paresis or paralysis
  - Hemotympanum
  - CSF otorrhea
- Treatment
  - Observation in NICU
  - Emergency decompression of VII nerve if nerve was noted to be out immediately after injury
  - Reserve surgery for persistent CSF otorrhea; allow adequate time for CSF flow to stop on its own
  - Repair disrupted ossicular chain later

Facial Lacerations – General Considerations

- Find all lacerations including those "hiding" in scalp
- Test function of cranial nerves
- Note areas of hypesthesia or anesthesia before using local anesthetic
- Clean wounds thoroughly
- Do not discard any tissue initially
- Restore lips, lids and eyebrows precisely
- Stent injured lacrimal duct
- Repair lacerated nerves accurately in OR
- Establish hemostasis
- Minimize wound tension
- Provide for wound drainage
- Administer tetanus prophylaxis

Common Diseases of the External and Middle Ear

The External Ear

Infection

- **External Otitis** ("Swimmer's Ear")
  - Symptoms: pruritus, otalgia varying from sense of fullness to throbbing pain, hearing loss.
  - Signs: Edema and erythema of canal skin, tenderness of tragus, foul-smelling secretions, possible periauricular cellulitis.
  - Treatment: Clean EAC; Topical otic neosporin-polymyxin B (or colistin)-hydrocortisone for gram negative bacilli (most commonly *Pseudomonas aeruginosa*) for 10 days; impregnated wick for severe edema; **adequate** analgesic.
  - Preventive Measures for Recurrent Otitis Externa: Ethyl alcohol drops (70%) or acetic acid - nonaqueous solutions (2%) after swimming or bathing. Avoid self-instrumentation.
- **Necrotizing External Otitis** (Malignant External Otitis)
  - Symptoms & Signs: Progressive pain and drainage from the EAC. Granulation tissue often present. *Pseudomonas aeruginosa* invasion of soft tissue, cartilage and bone. Occasional facial nerve palsy.
  - Treatment: Radical surgical debridement with combination semi-synthetic penicillin and aminoglycoside for 4-6 weeks. Significant mortality in diabetics who acquire disease.
- **Perichondritis**
  - Symptoms: Pain and warmth of the pinna following trauma or infection.
  - Signs: Erythema, induration, and possible fluctuance of part or all of the auricle.
  - Treatment: Most common organism: *Pseudomonas aeruginosa.* Betadine or boric acid wet-to-dry dressings to open wound. If perichondritis progresses to chondritis with abscess, then incision, drainage, and debridement of non-viable cartilage is necessary.
  - Obtain cultures.
- **Otomycosis**
  - Symptoms: Itching or mild otalgia. Secondary bacterial infection may produce intense pain.
  - Signs: *Aspergilla nigrans* produces a grayish membrane with hyphae visible under microscope. Erythema of underlying epithelium.

- o Treatment: Clean EAC. Topical cresyl acetate or 1% gentian violet and/or boric or acetic acid and alcohol drops.
- **Bullous Myringitis**
  - o Symptom: otalgia.
  - o Signs: Hemorrhagic blebs on TM and adjacent canal.
  - o Treatment: Incision of blebs if severe pain. Prophylactic oral antibiotics to prevent otitis media. Anesthetic otic drop.
- **Herpes Zoster Oticus** (Ramsey Hunt Syndrome)
  - o Symptoms: Otalgia, malaise, headache, possible dizziness.
  - o Signs: Vesicular eruption of distal canal and concha. Occasional 7th CN paralysis.
  - o Treatment: Analgesics. Middle cranial fossa decompression of facial nerve if progressive degeneration.

Allergy

- **Contact Dermatitis**
  - o Symptoms: Burning, itching, pain
  - o Signs: Variable. Range from erythema to hyperpigmentation of skin. Fissures with weeping.
  - o Agents incriminated: Shampoos, hair sprays, perfumes, ear plugs, and earrings. Most common: Nickel allergy to earrings.
  - o Treatment: Remove allergen. Topical corticosteroids.
- **Eczema**
  - o Symptoms and signs: Itching, scaling, and fissuring: More aggressive forms will present with weeping, crusting, and secondary bacterial infections.
  - o Predisposing factors: Seborrheic dermatitis, atopic dermatitis, psoriasis, and other skin conditions.
  - o Treatment: Topical steroid lotions and creams.

Trauma

- **Hematoma of Auricle**
  - o Etiology: Blunt trauma results in accumulation of blood between perichondrium and cartilage.
  - o Differential Diagnosis: Perichondritis, cellulitis, and relapsing polychondritis.
  - o Treatment: Repeated aspiration under sterile conditions and mastoid pressure dressings.
  - o Complication: Organization and calcification of clot with necrosis of underlying cartilage leads to "cauliflower ear".
- **Laceration of Auricle**

- o Simple: Thorough cleaning of wound with antiseptic solutions. Conservative debridement of necrotic skin edges and cartilage that cannot be covered with perichondrium. Closure of perichondrium to prevent notching. Cosmetic closure of skin. Prophylactic antibiotics.
  - o Complicated: Same principles. Contaminated or extensive wounds may require staging with use of grafts or reconstructive flaps.
  - o Avulsion, Treatment: Amputated parts should be cleaned and placed in iced physiologic saline until reconstruction. Anticoagulants and prophylactic antibiotics may improve success.
- **Burns**
  Treatment similar to general burn management except:
  - o Prophylactic antibiotics are indicated to prevent suppurative perichondritis; and,
  - o Stenting of a burned meatus necessary to prevent stenosis.
- **Lacerations of External Canal**
  Injury predisposed to stenosis. Canal should be carefully examined, cleaned, and debrided under microscope. Skin of meatus should be reapproximated and denuded areas covered with split thickness skin graft supported in place with rosette of antibiotic impregnated gauze and packing.
- **Foreign Bodies of EAC**
  - o Insects. Immobilize with topical 2% lidocaine or ether and remove with gentle irrigation or alligator forceps under direct vision.
  - o Materials: All shapes and sizes in all age groups! Key to successful removal is use of proper instruments: microscope, alligator forceps, right-angle hook, suction, and local anesthesia. Young children often require general anesthesia to remove impacted objects without further injury. Topical otic antibiotics if localized reaction to foreign body.

Cysts and Tumors

- **Cysts**
  - o Pilar (Sebaceous) cysts arise in hair follicles. Present as discrete, mobile masses frequently with overlying orifice. May become secondarily infected. Treatment is complete excision.
  - o Epidermal cysts derived from layer of epithelium. Filled with keratin debris. Treatment consists of complete excisional biopsy.
  - o Preauricular cyst and fistula
    - ▪ Results from faulty fusion of mesodermal hillocks that form the auricle. Fistula opening located in front of the incisura. Recurrent infection can be troublesome. After injection of methylene blue into the fistulous tract, the tract and cyst are excised.

- **Benign Lesions**
  - Keloids
    - Predisposition among Blacks. Hypertrophy of connective tissue in traumatized areas. Most common area: ear lobe secondary to ear piercing. Treatment is complete excision followed with injections of cortisone.
  - Exostosis
    - Periosteal outgrowths in the osseous canal of cold-water swimmers. On rare occasion will cause a conductive hearing loss or impact cerumen. In those cases, surgical removal is indicated.
- **Malignant Lesions**
  - Precancerous: Actinic Keratosis
    - Flat, scaling lesions on the sun-exposed regions of face, neck, and hands. Tend to occur in those with fair complexion. May give rise to squamous cell carcinoma. Treatment with topical 5-fluorouracil or liquid nitrogen is very effective.
  - Basal Cell Epithelioma
    - Classically presents as discrete nodule with smooth, raised edges and central crater. Superficial telangiectasias occur on edges. Locally invasive. Poor control may result in invasion of EAC, middle ear, TMJ, or parotid. Treatment of choice is wide surgical excision or Mohs chemosurgery. Invasion of EAC requires *en bloc* resection of the canal.
  - Squamous Cell Carcinoma
    - Most commonly presented as raised, ulcerated lesions on helix. Preferred treatment is wide surgical excision or Mohs chemosurgery. Pre- or postoperative radiation therapy is reserved for advanced lesions. Invasion of EAC or temporal bone requires temporal bone resection. Nodal metastasis occurs in extensive lesions. Parotidectomy and radical neck dissection performed to control clinically evident metastasis.

The Middle Ear

The symptoms of middle ear pathology are limited to otalgia, tinnitus, and hearing loss. When proper otologic examination fails to reveal the etiology of otalgia, one should think of **referred pain**. Sensation to the ear is provided by cranial nerves V, VII, IX, X, and the C1-2 plexus; hence, diseases elsewhere in the head and neck may refer pain to the ear. A useful mnemonic is the "10 T's of otalgia":

1. TMJ
2. Tonsils

3. Throat
4. Tube (Eustachian)
5. Teeth
6. Tongue
7. Tics (Glossopharyngeal)
8. Trachea
9. Thyroid
10. Tendons

Inflammation and Infection

- **Serous otitis media** (otitis media with effusion) refers to the accumulation of non-purulent middle ear fluid due primarily to eustachian tube dysfunction and secondarily to metaplasia of mucosa.
    - Etiologies
        - Nasopharyngeal obstruction: adenoid hypertrophy, neoplasia, iatrogenic.
        - Intratubal obstruction: URI, allergy, sinusitis.
        - Middle ear obstruction: chronic otitis media, cholesteatoma, tumor.
        - Failure of physiological opening: cleft palate, submucous cleft, some neurological disorders.
        - Other Contributing Factors: Metaplasia due to recurrent or chronic infection, hypothyroidism, diabetes mellitus, immune deficiency syndromes, connective tissue disorders.
    - Symptoms: Mild otalgia, stuffiness, autophony, hearing loss.
    - Signs: Retracted, discolored TM. Diminished TM mobility.
    - Medical Treatment:
        - Treat nasal congestion or drainage.
        - Treat concurrent infections - adenoids, middle ear, sinuses, pharynx.
        - Antibiotics for OME.
        - Control allergies.
        - Valsalva maneuvers for insufflation.
        - Politzerization.
    - Sequelae of Persistent SOM:
        - Conductive hearing loss (10-30 dB).
        - Recurrent suppurative otitis media.
        - Impaired auditory processing with impaired socialization and delayed speech and language development in young children.
        - Ossicular erosion, tympanosclerosis, cholesteatoma formation.
    - Surgical Treatment of SOM:

- - - Pressure equalization tubes. Recent studies have demonstrated that adenoidectomy may provide additional benefit but there is still some controversy regarding this
  - o When to Recommend Tubes:
    - - SOM for more than 3 months.
    - - Three-four episodes OM/year in an ear with chronic or recurrent SOM.
    - - Hearing handicap.
- **Acute Suppurative Otitis Media**
  Refers to an acute exudative middle ear disease secondary to bacteria.
  - o Clinical Stages of Acute Suppurative Otitis Media
    - - Hyperemia
    - - Exudation
    - - Suppuration
    - - Resolution
    - - Coalescence
    - - Complications:
      - - Acute surgical mastoiditis
      - - Facial nerve paralysis
      - - Acute labyrinthitis
      - - Sigmoid sinus thrombophlebitis
      - - CNS infection
  - o Pathogens:
    - - Infants: gram negative enteric bacilli
    - - Under age 5: pneumococcus, H. influenza, streptococci
    - - Over age 5: pneumococcus, H. influenza (less prevalent), streptococci
  - o Drugs of Choice
    - - According to appropriate cultures
    - - Amoxicillin (30-40 mg/kg/d) in 3 doses-every 8 hours
    - - Cefaclor (20-40 mg/kg/d) in 3 doses-every 8 hours
    - - Trimethoprim (6-12 mg/kg/d) and Sulfamethoxazole (30-60 mg/kg/d) in 2 doses q 12 hrs
    - - Erythromycin (50 mg/kg/d) and Sulfisoxazole (150 mg/kg/d) in 4 doses-q 6 hrs
- **Chronic Suppurative Otitis Media**
  COM refers to a permanent tympanic membrane perforation with associated middle ear and mastoid disease. Intermittent or continuous otorrhea usually exists.
  - o Types of Perforations:
    - - Central
    - - Marginal
    - - Attic - usually association with cholesteatoma

- Perforations are often accompanied by purulent drainage and otic polyps
  - o Evaluation:
    - Pure tone and speech audiology
    - Mastoid films
  - o Treatment:
    - Clean under microscope
    - Topical otic antibiotics
    - Treatment of predisposing conditions: smoking, allergy, chronic sinusitis, chronic tonsillitis, uncontrolled diabetes mellitus, etc.
    - Surgery
  - o Goals of Surgery (Tympanomastoidectomy)
    - Eradicate infection
    - Restore hearing
    - Close middle ear cleft
- **Tympanosclerosis**
  Submucosal hyaline degeneration in the tympanic membrane and middle ear mucosa. Extensive involvement of the TM and ossicles may result in conductive hearing loss. On rare occasion middle ear surgery is advised to restore hearing. Medical therapy and PE tubes do not prevent progression of disease.

Cholesteatoma

- Definition: A confined epithelial sac which expands by collection of desquamated cells and debris
- Classifications:
  - o **Congenital**: Very rare. Cholesteatoma results from entrapment of an epithelial cell rest within the temporal bone during embryological differentiation of the temporal bone. No TM perforation. Usually presents as pearly white mass behind intact TM or as facial weakness.
  - o **Primary acquired**: Perforation or retraction pocket in the pars flaccida. Different theories of pathogenesis.
  - o **Secondary acquired**: Marginal pars tensa perforation allows squamous epithelium to migrate inward.
- Complications: Erosion of ossicles, sensorineural hearing loss, labyrinthitis, facial nerve paralysis, meningitis, brain abscess, sigmoid sinus thrombophlebitis, petrous apicitis, neck abscess (Bezold's).

Trauma

- **Tympanic Membrane Perforations**

- o Etiology

  Sudden alteration of air pressure in the EAC: Compression (slap, hit, skiing), blast, instrumentation (Q-tip), burn, skull fracture, or lightning
- o Danger signs:

  CSF otorrhea implies basilar skull fracture. Vertigo, nausea and vomiting, nystagmus, may be due to oval or round window fistula, labyrinthine or brain concussion.
- o Management:
  - Baseline audiograms
  - Keep ear dry
  - Antibiotics if infection develops. Labyrinthine fistulae may require exploration and repair to preserve hearing
- o Prognosis:
  - 90% heal spontaneously, and
  - 10% require tympanoplasty
- **Temporal Bone Fractures** (see section on Paralysis of the Facial Nerve)
- **Barotrauma**
  - o Definition: Refers to injury to the ear following a pressure change in the middle ear compartment. Failure of middle ear ventilation leads to negative pressure relative to the outside environment.
  - o Pathogenesis: TM and mucosa retract toward middle ear space and cause pain. Vacuum results in a change in capillary permeability with transudate and possibly bleeding. Eustachian tube "lock" occurs during airplane or diving descent.
  - o Treatment: Decongestant/antihistamines, Valsalva and insufflation, chew gum and swallow frequently. If no response, myringotomy. Should take prophylactic measures when flying or diving.
- **Perilymph Fistula**
  - o Vigorous coughing or straining, sneezing, or nose blowing can result in rupture of the round window or subluxation of the footplate. Leakage of perilymph causes dizziness and hearing loss. Initial management is bed rest. If no improvement or if deterioration, surgical exploration is indicated.

Tumors

- **Glomus Tumors**

  Glomus tumors (nonchromaffin paragangliomas) are the most common "benign" neoplasms of the ear. Are malignant **by location**, as continued slow growth results in erosion and involvement of surrounding structures

- o Symptoms and signs: Hallmark is unilateral pulsatile tinnitus synchronous with pulse rate. Progressive hearing loss and otalgia. Cranial nerve involvement VII - XII.
  - o Physical exam reveals a bluish mass behind the tympanic membrane. **Brown's sign**: Increased EAC pressure with a pneumatic otoscope leads to blanching of mass.
  - o Diagnosis confirmed with arteriography or jugular venogram. Extent of disease evaluated with polytomography and high-resolution CT scanning.
  - o Differential diagnosis: Venous hum, high jugular bulb, carotid aneurysm, A-V malformation, and idiopathic hemotympanum.
  - o Treatment: Surgical removal ranges from transcanal tympanotomy to base of skull resection. Radiotherapy is recommended for tumors extending beyond the boundaries manageable by surgery, for post-operative recurrences, and for non-surgical patients.
- **Malignant Neoplasia**
  - o Squamous cell carcinoma is the most common middle ear malignancy. Symptoms include aural discharge, bleeding, pain, decreased hearing, and otic polyps. Can resemble COM! Treatment is temporal bone resection vs palliative radiation depending on extent of disease.

Congenital Disorders

- **Otospongiosis** (Otosclerosis)
  - o Definition: A primary bone dyscrasia affecting 4-8% of Caucasian and 1% of Black temporal bones. Involvement of oval window results in footplate fixation and persistent conductive hearing loss (1% Caucasians). Involvement of cochlear endosteum can produce sensorineural hearing loss through release of "toxins" during bone metabolism.
  - o Pathogenesis: Autosomal dominant gene with variable penetrance. Role of sodium fluoride in preventing expression of dyscrasia under investigation.
  - o Symptoms: Hearing loss, tinnitus, dizziness.
  - o Signs: Usually normal examination. **Schwartze's sign**: red discoloration under drum due to active focus on promontory. Weber lateralizes to involved ear.
  - o Treatment:
    - ▪ Medical: Hearing aid. Sodium fluoride 20-30 mg/d with calcium and vitamin D supplementation for sensorineural component.
    - ▪ Surgical: Stapedectomy successful in more than 90% of cases.
- **Lop Ears**
  - o Increased angulation of auricle due to a poorly developed antihelix or large concha.
 - o Dominant inheritance with variable penetrance.

- o   Amenable to surgical correction, preferably before child enters school.
- **Microtia**
  - o   Atresia of auricle and/or external canal. Variable in degree.
  - o   Associated anomalies: preauricular appendages, facial nerve anomalies, hypoplasia of mandible or maxilla.
  - o   Signs: Absence of meatus or external canal ends in blind sac. Conductive hearing loss.
  - o   Treatment: Cosmetic reconstruction of auricle at 4-6 years of age. Preferential seating in classroom for unilateral involvement. Hearing aids for bilateral involvement as soon as possible. Surgical reconstruction of external canal, tympanic membrane, ossicular chain often deferred until patient can give own consent--earlier in selected cases.

Inner Ear Disease: Hearing Loss

Hearing is the transduction of sound (mechanical energy) into neural impulses and the interpretation of those impulses by the central nervous system. Hearing loss can result from a defect at any level in this system. The proper management of patients with hearing loss requires an understanding of the normal mechanisms.

Nature of Sound: Vibration of Air

- **Loudness** is determined by the **amplitude** of pressure changes in the alternating compression and rarefaction of air,and expressed in units called decibels (dB).
- **Pitch** is determined by the **frequency** of cycles of vibration and is expressed in cycles per second or Hertz (Hz).
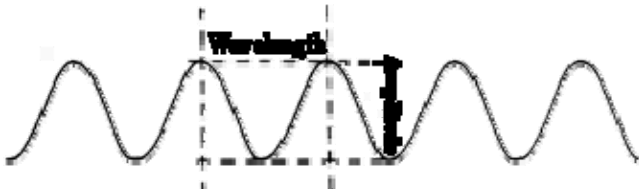
Conversion of Sound into Neural Energy

- The external ear shelters the eardrum and plays a role in localization of sound.
- The middle ear transmits the vibration of air into vibrations of the fluid in the inner ear. The difference in **impedance**(resistance to vibration) of air and water causes much sound energy to be reflected from an air-fluid interface. The middle ear compensates for this impedance mismatch.
    - Transmission of sound
        - Eardrum (tympanic membrane, or TM) vibrates in response to sound
        - Malleus, embedded in the TM, transmits vibrations to incus and stapes.
        - Stapes, in the oval window, transmits vibrations to fluid investibula.
    - Impedance mismatch compensation
        - Area of eardrum is 10 times that of oval window
        - Mechanical advantage of 2 to 1 due to leverage of ossicles.
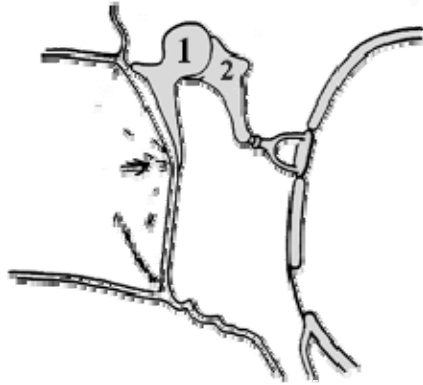
Middle ear transformer system. Note in the diagram above that the handle of the malleus (1) compared to the long process of the incus (2) adds an advantage of 3-to-1, allowing a gain in sound energy of only 2.5 decibels. However, the area ratio of the tympanic membrane footplate is much greater. The effective ratio is 14:1 and corresponds to a 23-decibel gain.

The inner ear **transduces** sound waves of inner ear fluid into afferent impulses in the auditory nerve by stimulation of the hair cells in the cochlea

Anatomy of cochlea

Physiology:

- Motion of stapes sets perilymphatic fluid in vestibule into motion.
- Vibrations travel through Reissner's membrane to endolymphatic fluid, and produce a traveling wave in the basilar membrane.
- As fluid is non-compressible, there must be another mobile wall to permit vibration. Round window serves this function.

Hair cells transform mechanical energy to electrical energy.

- Intensity coding: Perceived "loudness" is a function of the number of auditory nerve fibers firing and their discharge rate
- Frequency coding:
- Place coding - hair cells at maximal displacement of basilar membrane are maximally stimulated.
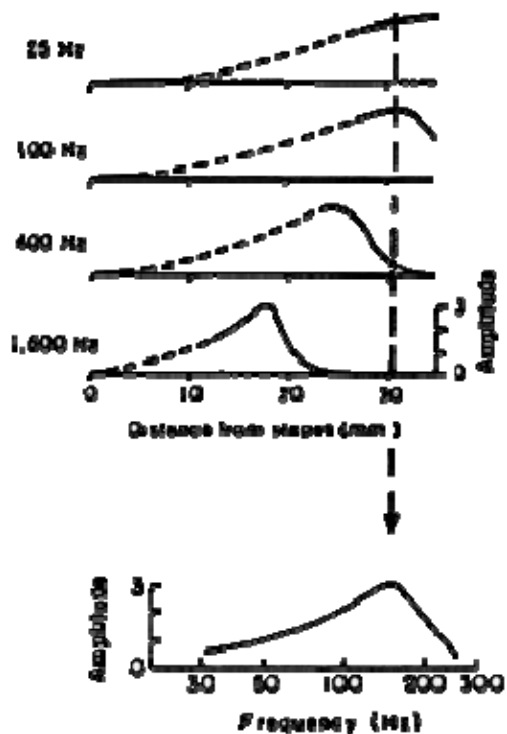
- o Volley coding - hair cells fire at same frequency as sound
- o Telephone place coding - currently most popular theory: Low-frequency sounds are volley coded; high-frequency, place coded; and at mid-frequency, both mechanisms are operative.
- o Impulses transmitted to brain via acoustic nerve with projections to both sides
- o Central perception and interpretation.

Evaluation of Hearing Loss

- History
  - o Age of patient
  - o Severity of loss
  - o Duration
  - o Onset - rapid vs. gradual (sudden hearing loss is an emergency),constant vs. fluctuating.
  - o Precipitating or exacerbating factors: trauma, noise, drugs,prenatal infection, etc.
  - o Associated symptoms: Vertigo, tinnitus, pain or fullness in the ear, headache
  - o Family history
- Physical - emphasize the following:
  - o Otologic exam

- - Systematic otoscopy
    - Tuning forks to grossly assess hearing and to differentiate conductive vs. sensorineural
  - Exam of nasopharynx
  - Neurologic exam
  - Inspection, palpation, and auscultation of neck
  - Look for associated anomalies
- Tests
  - Basic audiogram - all patients
  - Diagnostic audio, ENG, internal auditory canal, x-rays, and/or CT scan if vertigo present or neural lesion suspected
  - Electrocochleography if Meniere's suspected
  - Appropriate blood tests. **All patients with sensorineural hearing loss should have VDRL and FTA-ABS.**

Differential Diagnosis

- **External ear**:
  - Cerumen impaction
    - One of commonest causes of sudden hearing loss
    - Treat by removing wax
  - External otitis - inflammation and swelling of canal skin
  - Tumors of external canal
  - Congenital aural atresia
- **Middle ear** - some further discussion in chapter on external and middle ear disorders
  - Otitis media
    - Acute - infectious or serous
    - Chronic - serous
    - Must always rule out possibility of nasopharyngeal carcinoma
  - Tympanic membrane perforation or cholesteatoma
  - Normal tympanic membrane with conductive hearing loss - suspect ossicular abnormality: otosclerosis, ossicular dislocation, etc.
- **Sensorineural hearing loss** - often associated with poor discrimination out of proportion to degree of pure tone sensitivity loss - this is due to distortion of sound by cochlea or nerve
  - Congenital
    - Hereditary
      - Isolated sensorineural hearing loss
        - Normal inner ear
        - Abnormal inner ear (Scheibe, Mondini-Michelle, etc.)

- - - Hearing loss with associated anomalies
  - - Acquired
    - - Prenatal infection, especially syphilis, rubella, CMV
      - Prenatal drugs
      - Birth trauma
      - Developmental anomaly
  - - Hereditary but delayed onset
    - - Dominant or recessive
      - Numerous syndromes, some with associated anomalies (example: Waardenburg's syndrome with white forelock, hypertelorism, etc.)
- o Acquired
  - - Noise induced - very common
    - - Due to single blast or repeated or prolonged exposure to loud noise (hunting, rock music)
      - Affects high frequencies first (4 kHz); often progressive
      - Frequently associated with tinnitus
      - No known treatment. Counsel patient to avoid noise in future
      - PREVENTION is key to reducing incidence
  - - Presbycusis - hearing loss of old age
    - - Not universal, etiology not known
      - Central interpretation deficit complicates peripheral sensitivity loss
      - No known cure
      - Amplification can help, but hearing aids must be carefully fitted Cochlear distortion and central processing may preclude us
  - - Head trauma - temporal bone fracture, labyrinthine concussion, central damage
  - - Meniere's disease or syndrome
    - - **Fluctuating** hearing loss
      - Characteristically associated with bouts of vertigo
      - Anatomically correlated with endolymphatic hydrops
      - Electrocochleograph (ECOG) frequently shows elevated summating potential
      -) In active phase, glycerol may improve hearing
      - Treatment
        - - Medical: low-salt diet, diuretics, avoidance of caffeine, anti-vertigo medication, psychological support
          - Surgical: for selected patients with progressive disease
  - - Luetic hearing loss (syphilis)
    - - Usually a fluctuating hearing loss - may mimic Meniere's

- Treponemas may remain in endolymph after eradicated from other sites in the body.
- Treatment - steroids and antibiotics (penicillin)
- Ototoxic drugs
  - Reversible: aspirin - associated with tinnitus
  - Permanent: aminoglycosides, anti-neoplastic drugs, etc.
  - Treat by prevention:
    - Careful monitoring of blood levels of toxic drugs
    - Monitor hearing and vestibular function
- Oval or round window rupture
  - Sudden onset of hearing loss, usually fluctuating, often accompanied by vertigo. Definitive diagnosis can only be made by surgical exploration.
  - Usually associated with sudden pressure change: flying, Valsalva, scuba diving, sneeze, etc.; but may be idiopathic
  - Treatment - initially, bed rest for suspected patients. If no recovery, explore and repair leak if found
- Idiopathic sudden sensorineural hearing loss
  - Sudden hearing loss with no apparent cause
  - Etiology obscure, could be viral, autoimmune, vascular, or allergic, to name a few suspected causes
  - Diagnostic evaluation - should be extensive to rule out other causes
  - Treatment - many therapies suggested - few are statistically proven except for bed rest and possibly 95% O_2:5% CO_2 inhalation and steroid therapies. Patient is usually admitted to the hospital for treatment.
- Acoustic nerve tumor
  - Uncommon tumor. Usually arises in vestibular nerve and is schwannoma, or less often, neurilemmoma
  - Usually present with hearing loss. Progression of vestibular nerve involvement is so slow that it is not noticed by patient.
  - Characteristic audiometric results with abnormal acoustic reflex, poor discrimination, and/or abnormal ABR.
  - X-rays or CT show flaring of IAC in large tumors. Small tumors are seen with air contrast CT
  -) Treatment - surgical excision
  - Infections
    - Viral infection
    - Bacterial infection - labyrinthitis, meningitis, etc.
  - Otosclerosis

- - Sensorineural hearing loss often seen in association with otosclerosis of foot plate, but occurrence of pure sensorineural hearing loss is controversial
    - Treatment with fluoride may be helpful
    - Surgical trauma
  - Central hearing loss - normal basic tone audiogram and impedance, impaired understanding and processing

Significance of Hearing Loss

- Acquired in adulthood
  - Social and occupational handicap
  - Loss of monitoring of environmental warning sounds
  - Loss of pleasure of music, etc.
- Congenital
  - Severe language development handicap
  - Early recognition, prompt amplification, and/or special early management vital for normal development. Therefore, high risk infants should be screened.
- Acquired in childhood
  - Can cause language delay or learning problems
  - Audiometric evaluation is mandatory in all children with speech delay and/or learning problems

Frequent screening of school children is advised.

Inner Ear Disease - Vertigo

Dizziness is a common complaint and too often the symptom is attributed to an "inner ear problem." Numerous cochleovestibular, neurologic, cardiovascular, metabolic, ocular, and systemic diseases are capable of eliciting the sensation of dizziness; the ear, however, is responsible for only 50-60 percent of the known causes of dizziness.

Anatomy and Physiology of the Labyrinth

- The **semicircular canals**
  - Anatomy: the semicircular canals (lateral, posterior, and superior) lie at right angles to one another and are encased within the otic capsule of the temporal bone.
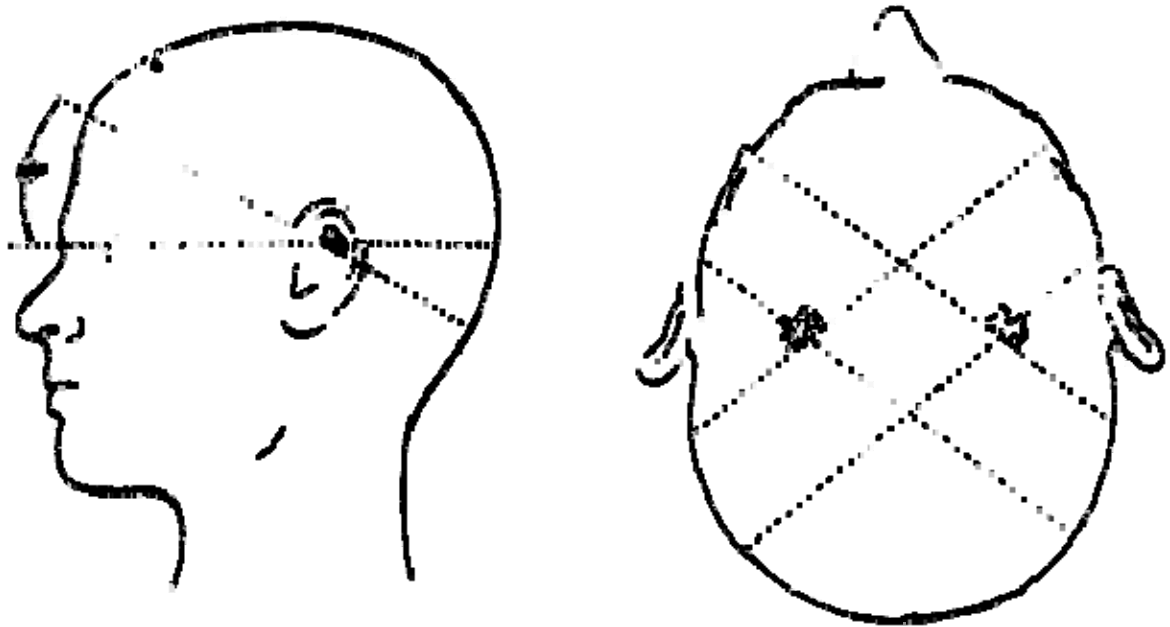
Each canal contains perilymph which bathes the membranous ducts within the canal. Each canal has an ampulla or a widening of the canal at the point it communicates with the vestibula. The crista ampullaris is located in each respective ampulla. The crista contains specialized neuroepithelium with hair cells imbedded in a gelatinous material to form the cupula.
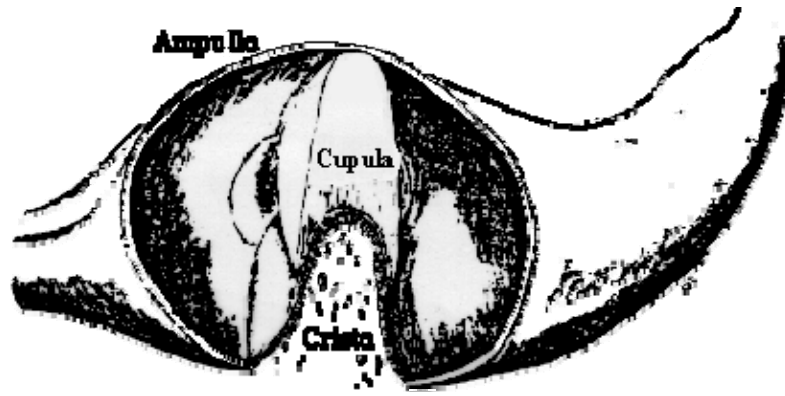
Physiology: the cupula extends into the ampulla to detect rotational movement of the endolymph.
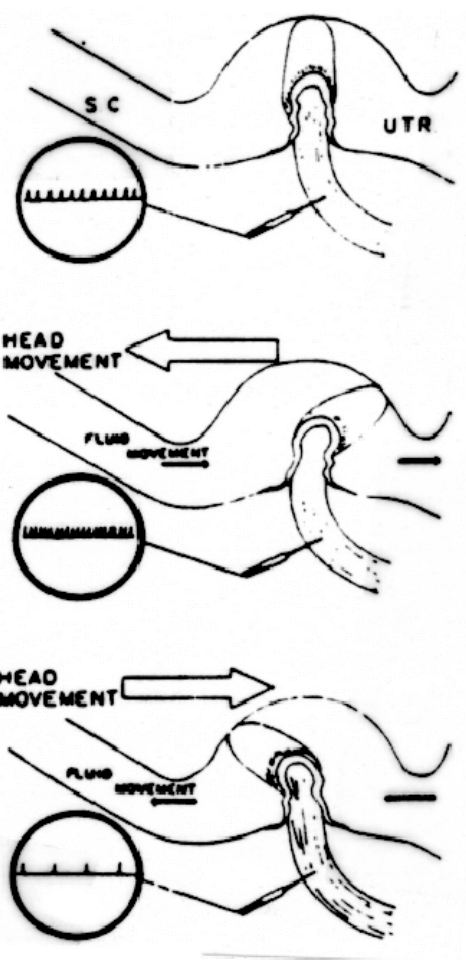
- The maculae of the utricle and saccule
  - Anatomy: the utricle and saccule are located in the bony vestibula. The endolymph contained within the utricle and saccule is continuous with the

cochlear duct and the membranous duct of the semicircular canals. Both the saccule and utricle have maculae which contain hair cells embedded in a gelatinous material covered with calcium carbonate crystals (otoconia).
  - o Physiology: the maculae are responsive to the effect of gravity and linear movement.
- Posture and movement
  - o The labyrinth acts as a bilateral frequency modulator. Acceleration,deceleration, or rotational movement of the head leads to excitation of one system and inhibition of the opposite. Sensory output is relayed to the vestibular nuclei and pathways for central interpretation.
  - o The manifestation of disease: in order to maintain posture and move through the environment in an orderly and safe fashion,appropriate information from three sensory modalities is important: the visual axis, proprioception in the joints and muscles, and the labyrinths. This input is integrated in the brain stem and cerebellum to adjust posture and motor activity and to maintain orientation. A failure in sensory input, poor integration in the central nervous system, or diseased support systems (cardiovascular and metabolic), can provoke the feeling of disorientation or dizziness. The interdependence of so many organ systems accounts for the large differential diagnosis of dizziness.

Differential Diagnosis of Dizziness:

The cochleovestibular system

- Infection
  - o Acute otitis media
  - o Chronic otitis media
  - o Serous otitis media
  - o Bacterial labyrinthitis
  - o Viral labyrinthitis
  - o Vestibular neuronitis
  - o Syphilis
  - o Herpes zoster oticus
- Trauma
  - o Perilymph fistula
  - o Temporal bone fracture
  - o Labyrinthine concussion
  - o Iatrogenic injury
  - o Barotrauma
  - o Cervical vertigo

- Tumor
  - Cholesteatoma
  - Acoustic neurinoma
  - Glomus tumors
  - Primary or metastatic carcinoma
- Vascular
  - Infarction of labyrinthine artery
  - Intralabyrinthine hemorrhage
- Degenerative
  - Benign positional vertigo (cupulolithiasis)
  - Aging
- Developmental
  - Congenital anomalies of the inner ear
- Idiopathic
  - Meniere's disease (Endolymphatic hydrops)
  - Bell's palsy
- Disorders of bone metabolism
  - Otospongiosis
  - Osteopetrosis
- Ototoxins
  - Aminoglycosides
  - Salicylates
  - Alcohol
  - Loop diuretics: ethacrynic acid and furosemide
  - Heavy metals: mercury, gold, lead, arsenic drugs
  - Antineoplastics: nitrogen mustard, bleomycin, cis-platinum

Nervous system

- Infection
  - Meningitis
  - Encephalitis
  - Brain abscess
- Demyelinating disorders
  - Multiple sclerosis
  - Other demyelinating processes
- Tumor
  - Cerebellopontine angle tumors
  - Benign and malignant neoplasia
  - Metastatic carcinoma
- Developmental

- o Malformations of the base of skull
- Peripheral neuropathy
  - o Diabetes mellitus
  - o Ethanol
  - o Pellagra
  - o Tabes dorsalis
- Vascular
  - o Hyperventilation
  - o Vertebrobasilar insufficiency
  - o Migraine variants
  - o Brain stem infarction or hemorrhage
  - o Cerebellar infarction or hemorrhage
  - o Vascular loop syndrome
- Seizure disorders
  - o Temporal lobe
  - o Petit mal

Cardiovascular system

- Circulatory
  - o Hypovolemia
  - o Anemia
  - o Polycythemia
  - o Orthostatic hypotension
  - o Hypotension
- Cardiac
  - o Arrhythmias
  - o Valvular disease: AS/AI
  - o Stokes-Adams attacks
- Great vessels
  - o Subclavian steal
  - o Hypersensitive carotid sinus reflex

Other Systems

- Ocular/Oculomotor
  - o Changes in refraction
  - o Cataracts
  - o Glaucoma
  - o EOM neuropathy
  - o Muscle imbalance

- Endocrine or metabolic
  - Diabetes mellitus
  - Hyperlipidemia
  - Hyperthyroidism
  - Carcinoid syndrome
  - Menstruation-pregnancy-menopause
  - Pheochromocytoma
- Allergy/autoimmune
  - Inhalant
  - Food
  - Drug
  - Collagen vascular disorders
- Psychiatric
  - Chronic anxiety
 - Hysteria
- "Old age syndrome"
  - Multisensory deficit

The Evaluation of Dizziness

- History
  - Characterizing exactly what the patient means by **"dizzy"** is the most important step in the evaluation.
  - **Vertigo** is an illusion of movement and is specific for a lesion in the inner ear, vestibular nuclei, or vestibular pathways. Momentary vertigo associated with rapid head movements typifies benign paroxysmal positional vertigo. Vertigo lasting for several hours tends to occur with inner ear disorders. Persistent vertigo of greater than three weeks' duration is due to a problem within the central nervous system!
  - **Imbalance or incoordination** connotes disease in the cerebellum, brain stem, or vestibulospinal tracts.
  - **Light-headedness** or the feeling of faintness, although often benign, can implicate a problem in any of the systems listed in the differential diagnosis.
  - Peripheral vestibular disorders do not produce a loss of consciousness! Loss of consciousness associated with dizziness is most frequently due to vertebrobasilar insufficiency, cardiac arrhythmias, or seizures.
- Examination
  - Resting pulse and blood pressure should be measured in the supine and standing positions to document presence or absence of orthostatic hypotension.

- o Complete head and neck exam
  - **Otologic inspection** is necessary to rule out disease of the external and middle ear.
  - The Weber and Rinne test are used to document sensorineural or conductive hearing losses.
  - A fistula test is performed with a pneumatic otoscope in order to ascertain the presence or absence of a perilymph fistula.
  - The patient is examined for the presence of spontaneous gaze and positional nystagmus.
  - Nasopharyngoscopy and indirect laryngoscopy are considered a part of the neurotologic examination.
  - Cranial nerve assessment is essential.
  - Vestibular and cerebellar assessment is made through rapid repetitive motion, past pointing, Romberg, tandem walk, and cold water caloric testing.
- o Auscultation of the precordium and the neck is necessary to detect carotid bruits, AV malformations, and valvular heart disease.

Laboratory Studies

- Cochleovestibular
  - o Standard audiometry
    - Pure tone studies
    - Speech studies
    - Recruitment
    - Tone decay
  - o Impedance audiometry
    - Tympanometry
    - Acoustic reflex
  - o Auditory brainstem evoked response
  - o Electronystagmography
    - Oculomotor testing
    - Bithermal calorics
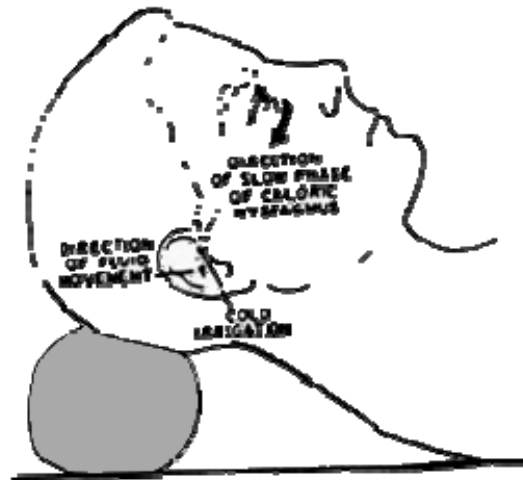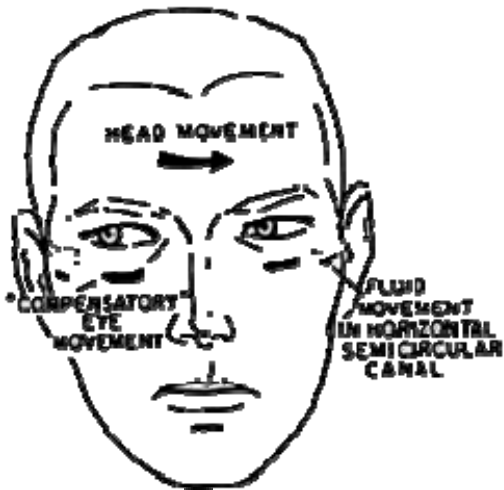
- Positional tests
- Rotary testing
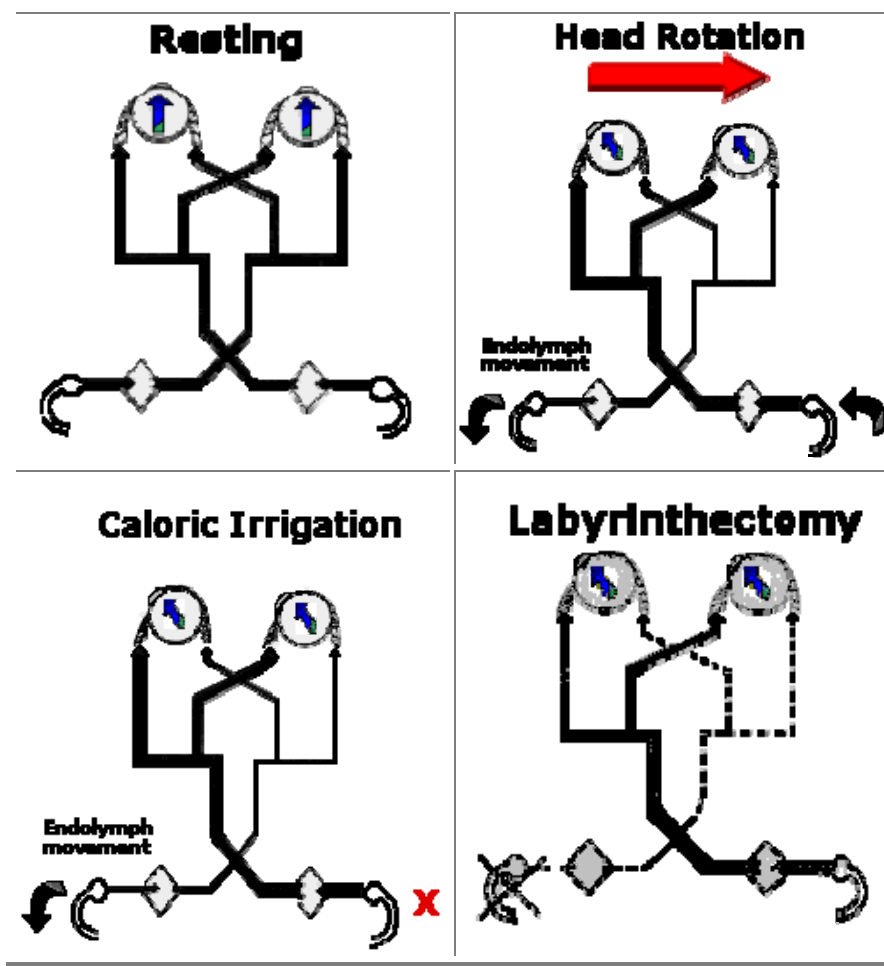
Generation of the vestibular (**slow**) phase of different kinds of nystagmus. The thickness of the lines connecting the semicircular canal to the eye muscles is proportional to the intensity of nervous discharge along the nerve pathways.

- Roentgenographic views of the internal auditory canal: plain or polytomography
- CT scanning
    - Contrast
    - High resolution
    - Air-contrast
- Arteriography
- Nervous system
    - Lumbar puncture/CSF studies
    - EEG
    - CT scanning with contrast
    - NMR scanning
    - Arteriography
- Cardiovascular system
    - CXR
    - EKG
    - Holtor monitor
    - Stress testing
    - Carotid doppler
    - Echocardiogram
    - Arteriography
- Other systems
    - CBC with differential
    - Fasting blood glucose
    - Five-hour glucose tolerance test
    - Lipid profile
    - Thyroid function studies
    - Rheumatoid factor and antinuclear antibody
    - RPR, VDRL, or FTA-ABS
    - Psychiatric testing

Common Causes of Dizziness

- **Cochleovestibular system**
    - Benign paroxysmal positional vertigo.
        - Symptoms: a 15-30 second episode of vertigo induced byposition chang

- - Signs: the positional nystagmus may be observed by purposefullyinducing the position change and observing the eyes. Nystagmustends to be toward the involved ear and exhibits latency and fatiguability.
    - Laboratory: ENG documents the presence of positional nystagmus.
    - Treatment: reassurance and vestibular exercises. Singular nerve section for the recalcitrant and disabled patient.
  - Meniere's disease (See previous section on Hearing Loss).
  - Viral labyrinthitis
    - Symptoms: acute onset of vertigo usually associated with nausea and vomiting
    - Hearing loss may or may not be present.
    - Signs: unilateral hearing loss, spontaneous nystagmus with the slow component toward the involved ear. Pass pointing and falling to the side of the lesion in the acute stages.
    - Laboratory: audiograms may show sensorineural hearing loss. ENG reveals nystagmus and often a caloric weakness.
    - Treatment: the condition is self-limited and the most effectivetherapy includes rest and sedation. Meclizine or diazepam often beneficial.
  - Vestibular neuritis
    - Symptoms and signs: presentation and physical findings can be identical to those of viral labyrinthitis except that hearing loss is not present.
    - Laboratory: ENG will show a unilateral weakness in theinvolved ear.
    - Treatment: same as for viral labyrinthitis. Vestibular neuronitis can be recurrent. A vestibular nerve section willcure the vertigo and preserve hearing.
  - Acoustic neurinoma. Patients rarely present with true vertigo secondary to acoustic neurinoma but more frequently complain ofunsteadiness, tinnitus, or hearing loss. See previous section on Hearing Loss.
  - Labyrinthine concussion
    - Symptoms: vertigo or dizziness with or without hearing loss following severe head injury.
    - Signs: spontaneous nystagmus with the slow component toward the involved ear may be present along with a sensorineural hearing loss.
    - Laboratory: a basic audiogram will document the presenc eof sensorineural hearing loss. The ENG may document the presenceof a caloric weakness or a positional nystagmus. Polytomography of the skull base or CT scanning is indicated when skull fractures are suspected.

- Treatment includes the use of antivertiginous medications in the initial stages. Labyrinthectomy or vestibular nerve sectionare indicated for a patient with symptoms persistent beyond six months.
  - o Otosyphilis. See section on Hearing Loss.

- **Cardiovascular**

  - o Orthostatic hypotension.
    - Symptoms: the patient complains of light-headedness or thesensation of faintness upon sitting upright or standing.
    - Signs include an increased pulse rate or a fall of systolicpressure with the change in position.
    - Laboratory: none.
    - Treatment: reassurance and a change in medication whenindicate
  - o Hyperventilation
    - Symptoms: light-headedness, fullness in the throat, perioral paresthesias, chest tightness, anxiety.
    - Physical examination: normal.
    - Laboratory: if the patient is symptomatic, an arterial blood gas may reveal the presence of hypocarbia.
    - Treatment: reassurance along with methods to increase the pCO_2 (paper bag).

- **Neurological systems**

  - o Vertebrobasilar insufficiency.
    - Symptoms: these patients can experience true vertigo but this is usually associated with visual disturbances, dysarthria, disorientation, and ataxia.
    - Signs: physical examination may be normal between attacks.
    - Laboratory: CT scan is usually normal. Findings on arteriography can be variable
    - Treatment: ASA, Persantine, anticoagulation in severe cases.
  - o "Old age syndrome"
    - Symptoms: complaints of dizziness and disequilibrium withfrequent falls in the elderly population.
    - Signs: include orthostatic hypotension, diminished visual acuity, presbycusis, etc.
    - Laboratory: findings tend to be nonspecific.
    - Treatment: ambulation with assistance and adjustment of any medications implicated in the production of orthostatic hypotension.

Facial Paralysis

Anatomy of the 7th Cranial Nerve

- Anatomy of the facial nerve and fallopian canal
  - **Intracranial** nerve arises near pons and courses 12mm to porus acousticus.
  - **Meatal portion** (10 mm) is anterior to the superior vestibular nerve and superior to the cochlear nerve.
  - **Intratemporal portion**
    - **Labyrinthine segment** (3-4 mm) passes through narrowest part of the fallopian canal. Common site of pathology: temporal bone fractures and Bell's palsy.
    - **Tympanic segment** runs from geniculate ganglion to pyramidal turn (11 mm).
    - **Mastoid segment** descends 13 mm to exit the stylomastoid foramen.
  - **Extracranial portion**
    - Nerve extends 15-20 mm from stylomastoid foramen to pes anserinus.
    - Variable branching patterns.
  - Clinical comment: The course of the facial nerve through the posterior fossa, temporal bone, and parotid gland renders this cranial nerve vulnerable to many neoplastic, traumatic, and infectious events. Disorders of the nerve provoke some interest in other medical specialties, but because of his background in head and neck anatomy and pathology and skill in temporal bone surgery, the otolaryngologist is most qualified to diagnose and manage paralysis of the facial nerve. Nevertheless, all clinicians should be able to recognize a peripheral paralysis and initiate proper evaluation.
- Anomalous Courses
  - Most common anomaly: dehiscence of facial canal.
    - Common sites: oval window and geniculate ganglion.
    - Exposed nerve is more susceptible to injury during otologic surgery.
  - Most course anomalies are within temporal bone:
    - Prolapse of nerve against stapes
    - Bifurcation around stapes
    - Deviation across promontory
    - Knuckle at the pyramidal (second) turn
    - Duplication variants
  - Anomalies are more common in malformations of the ear.

Pathophysiology of the Facial Nerve

- Mixed Motor-Sensory Nerve
  - **Efferent** fibers from the motor nucleus innervate muscles of facial expression, post-auricular, stylohyoid, posterior digastric, and stapedius muscles.
  - Superior salivary nucleus projects **efferent** (parasympathetic preganglionic) fibers to sphenopalatine ganglion where postganglionic fibers then innervate lacrimal glands and mucinous glands of the nose. Another set of parasympathetic fibers synapse at the submandibular ganglion. Postganglionic fibers connect the submandibular and sublingual glands.
  - **Afferent** fibers convey taste from anterior two-thirds of tongue to nucleus tractus solitarius via lingual nerve, chorda tympani, and nervus intermedius.
  - **Afferent fibers** mediate sensation from posterior external auditory canal, concha, ear lobe, and deep parts of face. Projections unknown.
- Nerve Injury and Regeneration
  - Sunderland classification of nerve injury:
    - **Neuropraxia:** reversible conduction block (1° damage).
    - **Axonotmesis:** loss of structural continuity of axon with intact endoneurial sheath (2° damage).
    - **Neurotmesis:**
      3°: loss of continuity of axons and endoneurial sheaths;
      4°: loss of continuity of axons, sheaths, funiculus;
      5°: complete loss of nerve continuity.
  - Degeneration
    - Interruption of the continuity of the axon separates the distal axon from its metabolic source, the neuron or cell body. **Wallerian degeneration** of the distal axon and myelin sheath begins within 24 hours.
    - Macrophages phagocytose degraded myelin and axons.
  - Regeneration
    - Neuron metabolism leads to increases in mRNA, enzymes, and structural proteins.
    - Axonal stumps swell with axoplasm and proliferation of neurofilaments.
    - Conditions at the site of injury govern the fate and organization of the sprouts.
    - **Simple misdirection:** the entry of one axon into a tubule destined for a muscle other than the one previously innervated. Clinical expression: **synkinesis or associated movement**.

- **Complex misdirection:** a single axon through branching innervates tubules to different muscles. Clinical expression: **mass movement**.
- Other sequelae of faulty regeneration: tics, spasms, contractures, weakness, and gustatory lacrimation.

Differential Diagnosis of Peripheral Facial Paralysis

- Extracranial

  - Traumatic
    - Facial lacerations
    - Blunt forces
    - Penetrating wounds
    - Mandible fractures
    - Iatrogenic injuries
    - Newborn paralysis
  - Neoplastic
    - Parotid tumors
    - Tumors of the external canal and middle ear
    - Facial nerve neurinomas
    - Metastatic lesions
  - Congenital absence of facial musculature

- Intratemporal

  - Traumatic
    - Fractures of petrous pyramid
    - Penetrating injuries
    - Iatrogenic injuries
  - Neoplastic
    - Glomus tumors
    - Cholesteatoma
    - Facial neurinomas
    - Hemangiomas
    - Meningiomas
    - Acoustic neurinomas
    - Squamous cell carcinomas
    - Rhabdomyosarcoma
    - Arachnoidal cysts

- - - Metastatic
  - o Infectious
    - ▪ Herpes zoster oticus
    - ▪ Acute otitis media
    - ▪ Chronic otitis media
    - ▪ Malignant otitis externa
  - o Idiopathic
    - ▪ Bell's palsy
    - ▪ Melkersson-Rosenthal syndrome
  - o Congenital: osteopetroses

- Intracranial

  - o Iatrogenic injury
  - o Neoplastic
  - o Congenital
    - ▪ Mobius syndrome
    - ▪ Absence of motor units

Evaluation of Facial Paralysis

- Examination
  - o The presence of a peripheral facial paralysis demands a complete head and neck examination with otoscopy and cranial nerve evaluation.
  - o Characteristics of a peripheral paralysis:
    - ▪ At rest: less prominent wrinkles on forehead of affected side, eyebrow droop, flattened nasolabial fold, corner of mouth turned down.
    - ▪ Unable to wrinkle forehead, raise eyebrow, wrinkle nasolabial fold, purse lips, show teeth, or **completely** close eye.
    - ▪ Bell phenomenon: visible vertical rotation of globe on closing affected eye.
  - o Characteristics of a central facial paralysis:
    - ▪ Because of uncrossed contributions from ipsilateral supranuclear areas, movements of the frontal and upper orbicularis oculi mm. tend to be spared.
    - ▪ Facial movement may be present on affected side during emotional expression.
    - ▪ Involvement of tongue.
    - ▪ Presence of lacrimation and salivation.

- Electrodiagnostic Testing
  Expediency of management of acute paralysis may prevent conversion of minor injury into a more severe form with resulting sequelae.
 - o Nerve Excitability Test
    - Technique: Using a stimulating electrode (square pulse of 0.3 msec duration) over the terminal ramifications of the facial nerve, one increases the current (milliamperes) until movement in the appropriate muscle group is just visible. Normal values (unaffected side of face) are compared to the side of paralysis.
    - Interpretation: A difference of 3.5 mamp or more indicates an unfavorable prognosis.
  - o Electroneurography (Evoked Electromyography)

    Technique: Square wave impulses of 0.2 msec duration and 50-100 volt amplitude with a frequency of 1/sec are delivered with a bipolar electrode in front of the tragus while a second bipolar electrode captures the compound action potentials of underlying facial muscles in the nasolabial fold.

    - Interpretation: The difference in amplitude of the potentials of the intact and involved side of the face correlate with the percentage of degenerated motor fibers (denervation).
    - Advantage: Quantitative analysis of amount of degeneration.
    - Disadvantage: Amplitudes are a 24-48 hour delayed representation of actual events occurring at site of lesion.
    - Clinical applications: Facial nerves subjected to traumatic injuries of a magnitude requiring surgical repair undergo 90% degeneration within six days of injury. In cases of Bell's Palsy, a poor prognosis can be anticipated in patients reaching 95% or more degeneration within 14 days of onset of the palsy.
- **Topographic Diagnosis** - Topographic testing to determine the anatomical level of a peripheral lesion is possible because of the mixed function of the nerve and the branching pattern within the temporal bone.
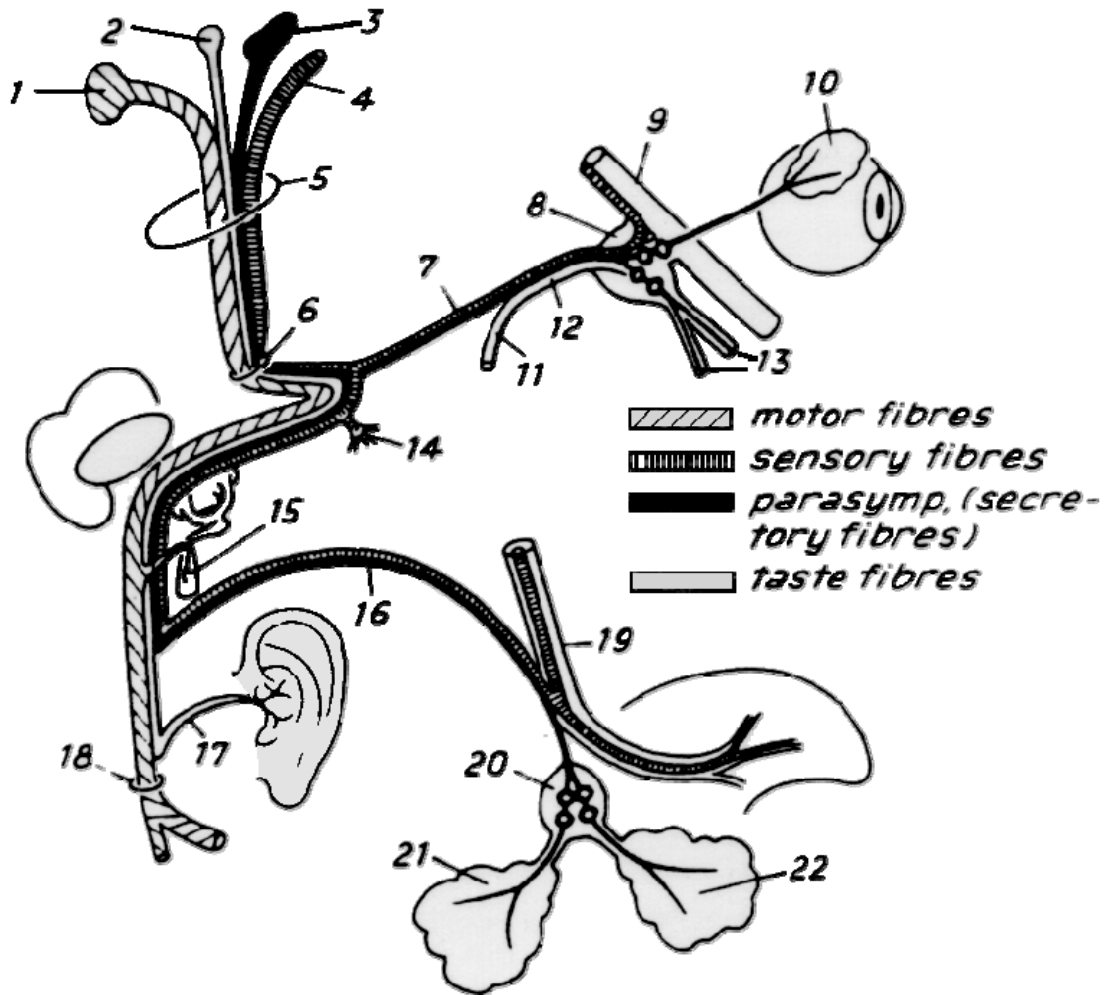
1. nucleus of facial nerve

2. spinal nucleus of trigeminal nerve

3. superior sailvary nucleus

4. solitary tract

5. porus acusticus internus

6. meatal foramen

7. greater petrosal nerve

8. sphenopalatine ganglion

9. maxillary nerve

10. lacrimal gland

11. deep petrosal nerve

12. vidian nerve

13. innervation of glands of nose and palate (motor fibers for levator palati muscles)

14. anastamosis with minor petrosal nerve

15. stapedial nerve

16. chorda tympani

17. auricular branch

18. stylomastoid foramen

19. lingual nerve

20. submandibular ganglion

21. submandibular gland

22. sublingual gland

Tests of clinical value include:

- Petrosal nerve
    - Schirmer test: quantitative evaluation of tear production
    - Interpretation: When unilateral wetness is reduced by more than 30% of the total amount of both eyes after 5 minutes or when bilateral tearing is reduced to less than 25 mm after a 5-minute period, the Schirmer test is considered clinically significant and implies a lesion at or proximal to the geniculate ganglion.
- Stapedius nerve
    - Impedance audiometry can record the presence or absence of stapedius muscle contraction to sound stimuli 70 to 100 dB above hearing threshold.
    - Interpretation: Absence of the reflex is due to a lesion proximal to stapedius nerve (vertical segment of facial nerve). (Caution: The Schirmer's test can give false negative results.)

Diagnostic Studies

- Audiometry
    - Pure tone audiometry records cochlear nerve function.
    - Stapedial reflex is part of topographic testing.
    - Speech discrimination, tone decay, auditory evoked potentials are used to screen for retrocochlear lesions, e.g., tumors of the cerebellopontine angle.
- X-ray
    - Computed tomography with and without contrast (radiopaque and air) is preferred for lesions of IAC, posterior fossa, and brain stem. High resolution scans needed for base of skull lesions.
    - MRI is best for soft tissue assessment and tumors of the facial nerve.

Management of Facial Paralysis

- Extracranial Etiologies
    - Traumatic injuries: lacerations, gunshot wounds, iatrogenic.
        - Most important areas to repair: main trunk, temporofacial and cervicofacial divisions.
        - When immediate repair in contaminated or extensive wounds is not feasible, proximal and distal stumps should be tagged. The transected ends lose response to electrical stimulation within 72 hours. If not

properly identified, these endings may become involved in scar tissue. Anastomosis or grafting in such cases may be impossible.

- Methods of repair: direct end-to-end anastomosis and interpositional grafting. Do not approximate ends under tension!

- Iatrogenic injury
  - Complication of parotid surgery. Tumors are best managed by the experienced otolaryngologist-head and neck surgeon.
  - Integrity of nerve should be ascertained prior to closure. Immediate repair indicated.
- Neoplasia
  - A mass in the parotid associated with facial paralysis is a sign of malignancy. Two most common cell types: adenoid cystic and undifferentiated.
  - Sacrifice of involved nerve and nerve adjacent to tumor indicated in high-grade malignancies: adenoid cystic, high-grade mucoepidermoid carcinoma, ex-pleomorphic adenoma, etc.
  - Reconstruction: interpositional grafting and 7-12 cranial nerve crossover.

- Intratemporal Etiologies
  - Temporal bone fractures
    - Signs: bleeding from the external canal, hemotympanum, step-deformity of the osseous canal, conductive hearing loss (longitudinal fracture), sensorineural hearing loss (transverse fracture), CSF otorrhea, and facial nerve involvement (20% of longitudinal fractures and 50% of transverse fractures).
    - In general, paralysis of immediate onset carries a poor prognosis and paralysis of delayed onset has a more favorable recovery. **All** paralysis should be followed with electrical testing, as exceptions to the maxim exist. Timely exploration and repair ensure better quality of return of function.
    - Types of pathology: intraneural hematoma, impingement of bone and transection of nerve. Most common site of injury: adjacent to geniculate ganglion.
    - Surgical approaches: Longitudinal fractures are explored through the middle fossa, and mastoid, if necessary. Facial nerve is examined via transmastoid, translabyrinthine approach in transverse fractures.
  - Iatrogenic injury
    - Incidence 0.6-3.7%
    - Most common areas: pyramidal turn and the tympanic segment over the oval window.
  - Neoplasia

- - The primary tumor of the facial nerve **per se** is the facial neurinoma. Weakness of the face is the most common symptom. Treatment is surgical removal with grafting of the involved segment of nerve.
    - Many benign and malignant masses may involve the facial nerve in its course through the temporal bone: glomus tumors, meningiomas, cholesteatomas, squamous cell carcinoma, rhabdomyosarcoma, etc. Surgical removal is necessary in most cases. Radiation therapy may be palliative depending on cell type, size, and location. If the nerve cannot be spared at the time of resection, interpositional grafting is warranted.
  - Idiopathic facial palsy (Bell's Palsy)
    - Bell's Palsy is the most common cause of facial paralysis (greater than 50% of cases of acute palsy). Unfortunately, this leads to over-diagnosis of the condition and a false sense of security. Every patient with a facial paralysis needs a complete evaluation. When the diagnosis of Bell's palsy is made (by exclusion), the patient must be followed 6 - 9 months or until recovery of facial movement. Failure of **any** return of function implies an etiology other than Bell's palsy. Re-evaluation is mandatory in such cases, as the most commonly overlooked diagnosis is one of neoplasia.
    - Etiology is still unknown.
    - Entrapment theory: an inflammatory response leads to compression and ischemia of the nerve in the narrowest part of the fallopian canal, the meatal foramen and labyrinthine segment.
    - Electrical testing follows the degeneration of the motor fibers. Decompression of the nerve is indicated when 90-94% degeneration occurs **within** 2 weeks of onset.
    - Steroids are indicated early in the course of the disease. The use of acyclovir is under investigation.
    - Surgical decompression is accomplished via the middle fossa by an otologist-neurotologist. Transmastoid decompression is no more efficacious than steroid therapy.
  - Infection
    - **Acute suppurative otitis media** is caused by gram-positive cocci and Hemophilus influenza. Invasion into the facial canal through a dehiscence may evoke an inflammatory response with edema, compression, and ischemia resulting in facial weakness. Treatment includes myringotomy, appropriate antibiotics, and transmastoid decompression if degeneration progresses.
    - Facial paralysis due to **chronic otitis media** requires tympanomastoidectomy for eradication of infection or cholesteatoma.

- - Otalgia, facial weakness and a vesicular eruption on the concha or external canal (sensory distribution of 7th cranial nerve) characterize **herpes zoster oticus** (Ramsay-Hunt Syndrome). Site of pathology: labyrinthine segment of nerve. Acyclovir is treatment of choice.
  - **Malignant otitis externa** is due to **Pseudomonas** invasion of soft tissue, cartilage, and bone. Treatment includes debridement of infected tissue, decompression of facial nerve when involved, and six weeks of semi-synthetic penicillin in combination with an aminoglycoside. Cipro may have a role in long-term therapy.
- Other Etiologies
  - Congenital
    - Mobius syndrome: hypoplasia of 6th and 7th cranial nerve nuclei.
    - Birth trauma: due to forceps compression or compression of side of face against sacrum during labor.
    - Osteopetroses: hereditary bone diseases. May result in bony obliteration of foramina with compression of cranial nerves. Decompression is indicated on rare occasion.
    - Intracranial: Most common causes are **neoplastic** and **iatrogenic**.

Nose and Paranasal Sinuses, Olfaction and Taste

## The Nose and Paranasal Sinuses

Exam

- Open speculum up-and-down to avoid pressure on septum
- Co-axial lighting (head mirror) is ideal, use otoscope in a pinch
- The first turbinate you see is the inferior turbinate
- Red mucosa = inflammation; blue color = irrelevant
- Polyps found above and medial to inferior turbinate polyps in children: think cystic fibrosis
- Airflow is primarily along the nasal floor
- Septal deviations, C-shaped deformities, spurs

Septal perforations (Wegener's, midline granuloma previous septal surgery, cocaine abuse?)

Anatomy

Mucosal Landmarks of the Nasal Cavity
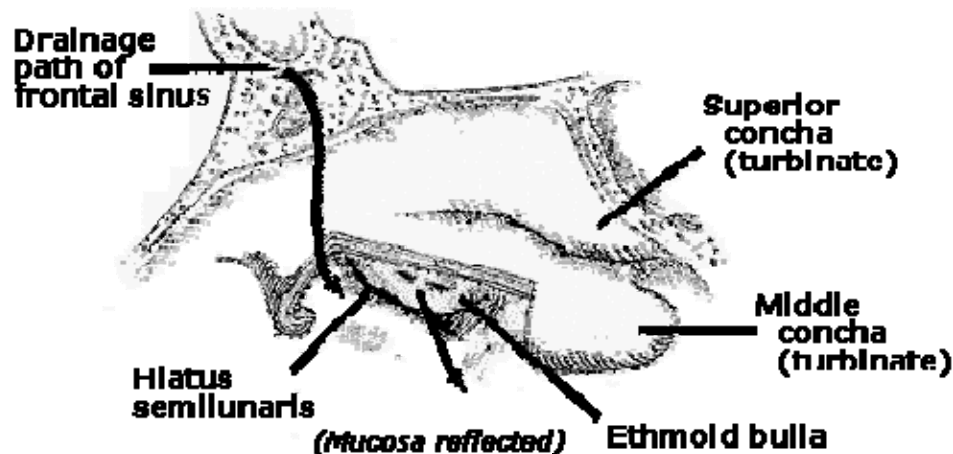
A: Frontal sinus
B: Sphenoid sinus
C: Superior concha (turbinate
D: Middle concha (turbinate)
E: Inferior concha (turbinate)
F: Auditory tube opening

Everything drains under the middle turbinate except:

- tears - nasolacrimal under inferior turbinate
- posterior ethmoids and sphenoid drain more postero-superior

Embryology:

Developmental stages of maxillary and frontal sinuses
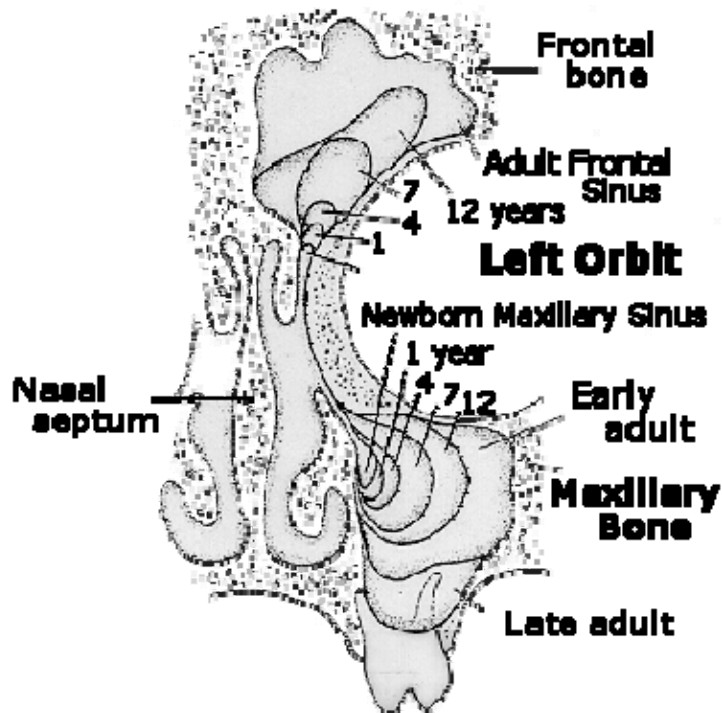
Sinus Films:

- Of questionable usefulness in patient with obvious symptoms
- Not needed for diagnosis of nasal fracture:
  - "If it looks broken - it is,
  - if it doesn't - it isn't,
  - if you're not sure - wait"
- **Common radiologic abnormalities:**
  - **Air-fluid levels** suggest an acute process
  - **Opacification** = secretions, polyps, etc.
  - (Ethmoids should be slightly darker than orbits)
  - **Thickened mucosa** (check lateral maxillary wall): Suggests chronic inflammation

- o **Maxillary sinus retention cysts**
  - ▪ Very frequent finding
  - ▪ Harmless unless symptomatic
- o **Frontal sinus mucocele**
  - ▪ Nasofrontal duct obstruction (head injury?)
  - ▪ Potentially serious problem
  - ▪ Look for loss of scalloped edge
- **Standard views:**

  The goal is to place sinuses close to the film and at an angle that temporal bone shadows are not superimposed

  - o **Water's** - best for maxillary sinus (Ethmoids and frontals too far from film
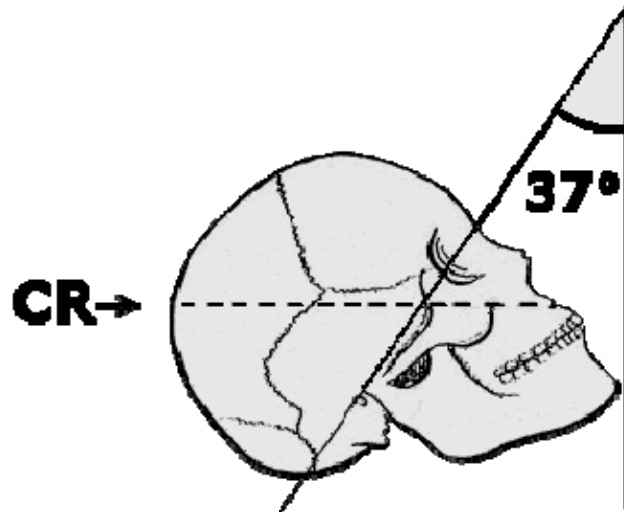
  - o **Caldwell** - best for ethmoids and frontal sinus (Temporal bones overlie maxillary)

Caldwell
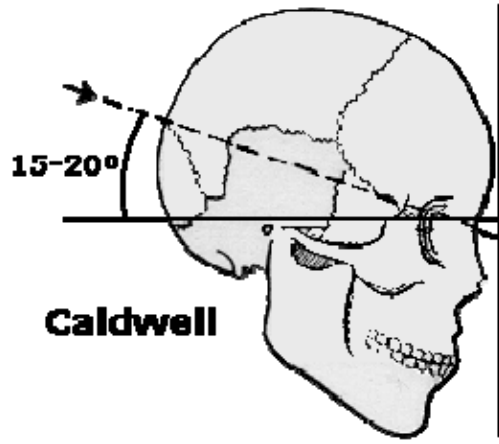
- o **Lateral** - sphenoid, frontal(?), maxillary (?)

Lateral

- o **Submentovertical** ("bucket-handle") - ethmoids; Fluid in maxillary sinus will also layer out

Submentovertical

Acute Sinusitis:

- **Diagnosis:**
- Pain from paranasal sinusitis is often referred in a predictable distribution.

- **Symptoms:**
  - Purulent rhinorrhea
  - Pain, increase with palpation/percussion
  - Periorbital edema
  - Sensitive teeth or gums (irritation dental roots)
- **Treatment:**
  - **Antibiotics:**
    - Amoxicillin Erythromycin-sulfisoxazole
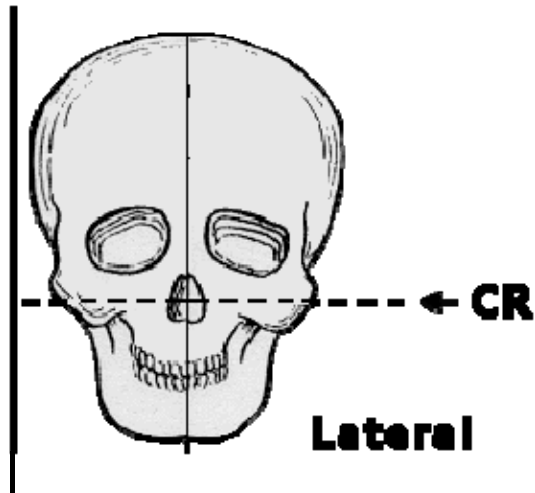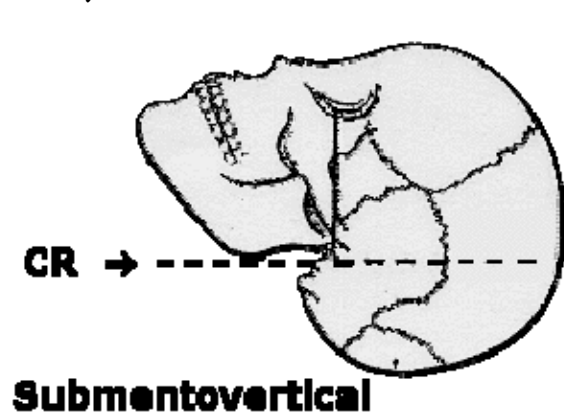   - Cefaclor Trimethoprim-sulfamethoxazole
      - To cover: *Streptococcus pneumonia*
      - *Hemophilus*
      - *Moraxella catarrhalis*
  - **Steam inhalation/humidifier** - Mainly for liquification of secretions
  - **Decongestants:**
    - Topical (e.g. Afrin) for short-term
    - Systemic
      Pseudoephedrine (e.g. Sudafed, 30-60 mg Q6H)
      Phenylpropanolamine
      Phenylephrine
  - **Antihistamines:** (see allergy section below)
    Most "cold remedies" are a combination of decongestants and sedating antihistamines with the idea that the side effects of jitteriness and sleepiness will cancel each other out.
  - **Nasal irrigation** (The Proetz Maneuver)

- **Surgical drainage** (rarely used): for pain relief or unresponsive infection. Options for maxillary sinus include:
  - cannulate ostia
  - puncture anterior wall (under lip)
  - puncture nasal wall under turbinate

Chronic Sinusitis:

- **Diagnosis:**

- o Is it really sinusitis? vs. tension or migraine headaches or temporomandibular joint arthritis etc.
  - o Is allergy a component? (see allergy section below)
  - o Is it vasomotor rhinitis?
    - ▪ Profuse rhinorrhea,
    - ▪ Often precipitated by cold air or eating
    - ▪ Treatment: ipatromium bromide (Atrovent®)
  - o Is it post-nasal drip causing sore throat, hoarseness
- **Treatment, medical:** (see allergy section below)
- **Treatment, surgical:**

Caldwell-Luc: Approach maxillary sinus via sublabial incision, open anterior bony wall

Frontal section through the maxillary sinus after a Caldwell-Luc procedure

- **Nasoantral window:** Make communication between maxillary sinus and nasal cavity under the inferior turbinate; this is outside of the normal ciliary flow pattern and they usually close within 1-2 years
- **Ethmoidectomy:** Break down the partitions between the many air cells; external and intranasal approaches
- **Frontal sinus obliteration:**

A bicoronal or brow incision may be used.

Scalp reflected, showing frontal periosteum.

Elevating periosteum to open the frontal sinus cavity.

- **Endoscopic sinus surgery:** Relieve obstruction at the osteomeatal complex, an area where flow from the frontal, maxillary and ethmoid sinuses can be obstructed
- **Septoplasty** (all incisions inside the nose)
- **Polypectomy:** Polyps will usually recur unless followed by medical therapy

Allergic Rhinitis:

- **Symptoms:**
  - o Sneezing (very characteristic symptom for allergies)
  - o Itchy ears, eyes, and palate
  - o Congested ears
  - o Runny nose, nasal congestion
  - o Post-nasal drip (sore throat)

- **Pathophysiology:**
  - The mechanisms of inflammation are similar whether the etiology is allergic or infectious.

  - Mast cells can be degranulated by:
    - Crosslinking of IgE on their surface by an allergen
    - Anaphylatoxins (C3a and C5a) from complement activation
    - Some drugs, e.g. morphine and codeine

- **Treatment:**
  - **Allergen avoidance** - mandates a detailed history
    - The biggest offenders are dust, pets, pollens, molds
    - **Pollens:** Is it seasonal? In south Texas, something is pollinating all the time. Need to know the local plants. Don't garden, keep car windows closed. Ragweed season is late August - October
    - **Dust:** "Does the vacuum cleaner (closets, attic, etc.) bother you. Dust mite feeds on human dander and grows whenever humidity is over 30% (seasonal in north USA). Carpeting is the major problem. Focus on cleaning the bedroom (8 hours sleep in a low allergen room helps). Wash bedding every 2 weeks in hot water. Polyester, not foam or feather pillows. Plastic cases on mattresses and pillow to keep dander out. No upholstered chairs, throw rugs, etc. Clear out bookcases and shelves. Blinds are preferable to curtains or drapes. Change air conditioning filters often (in-line electrostatic filters are good, "bug zapper-type" filters release ozone - bad for asthmatics). No feather dusters; damp dust cloth. Face masks during housecleaning. Avoid oscillating or ceiling fans that stir up dust.
    - Exposure to house dust during childhood potentiates development of dust allergy - New Engl J Med 1990, 322:502
    - **Molds:** "Do mildewy carpets bother you?" Cold fronts coming in over rice paddies north of Houston bring spores. Rain may clean air, but growth surges in the humidity which follows.
    - Pets: "outside dogs" still "count"
  - People are "more allergic" during their allergy season - i.e. they respond more strongly to any of the allergens during times when the nasal mucosa is inflamed and full of mast cells.
  - It may take 2 years to "acquire" new allergies to local allergen when people move

- Children might outgrow their allergies, adults rarely do and may even develop sensitivity to things which did not bother them in the past
- Skin tests or RAST tests must be correlated with symptoms history. Food allergies should diagnosed by history and diet challenge in adults
- **Anti-histamines** - for the sneezing, scratchy throat, itchy eyes. Will have little effect on nasal congestion but may have drying effect.
  - **Sedating** (available without prescription)
    All cause sedation, some drying, and possible urinary retention. There are several chemical groups; Benadryl is more sedating, for an equivalent amount of "anti-allergy" effect than some of the others. Chlorpheniramine 4 mg PO Q 6 hours is an economical choice. Patients will overcome the sedating side effects with 2-3 weeks of REGULAR use.
  - **Non-sedating (prescription only)**
    Astemizole (Hismanal) 1 PO Q AM has a longer half life (blocks cutaneous reactivity to histamine for 3 weeks) than Terfenadine (Seldane) 1 PO BID. Price per day is the same for the two and they are more expensive than over-the-counter sedating antihistamines. Both are pregnancy Category C "no teratogenic effects..but use only if potential benefit outweighs potential risk..". Not approved for use in children under 12 years
  - **Topical** - available abroad, U.S. clinical trials underway, shows great promise as nasal spray and eyedrops
- **Decongestants** - for congestion and rhinorrhea
  Histamine, leukotrienes and prostaglandins are released causing vasodilation, tissue edema, and increased mucus secretion. Anti-histamines will not block leukotriene and prostaglandin effects so that decongestants must be included in therapy.
  - **Topical decongestants**: vasoconstriction; tissue ischemia; release vasodilators; rebound vasodilation; persistent turbinate edema = rhinitis medicamentosa
  - **Systemic** - no rebound congestion
    All are adrenaline-type drugs and can exacerbate hypertension. Pseudoephedrine, 30-60 mg PO Q 6 hours is an economical choice. Cause "jitteriness" with excessive use
- Highly allergic patients should carry and "Epi-pen" and use it promptly
- **Topical nasal steroids** - "Best allergy medicine going"
  - Make the nasal mucosa an inhospitable site for mast cells. Blocks synthesis of both leukotrienes and prostaglandins, prevents influx of neutrophils
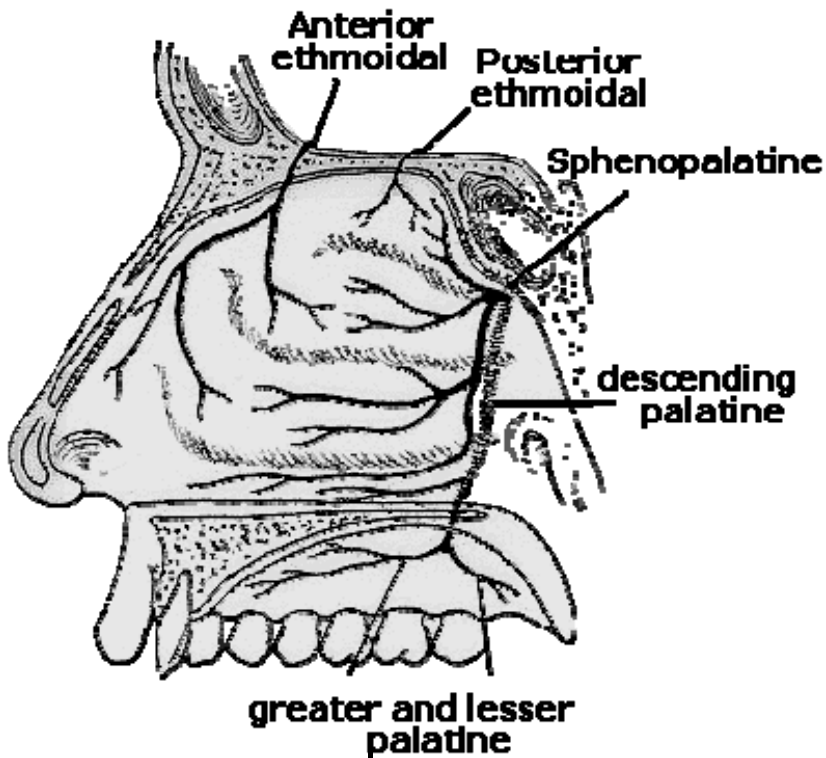 - Brands:

- Beconase and Vancenase = beclomethasone
- Nasalide = flunisolide (fluorinated, more potent)
- Decadron Turbinaire = dexamethasone (systemic effects)
- Aerosol and aqueous preparations = same medicine; AQ more expensive, rarely needed
  - Are topical nasal steroids safe?
    - Systemic absorption is negligible
    - No hypothalamic-pituitary axis suppression except with Decadron
    - No mucosal abnormalities seen on biopsy after years of use
    - Approved for children above age of 6
    - No evidence of growth suppression in children
  - Place tip just inside nostril and sniff; 2 puffs each nostril BID
  - Warn patients:
    - No "instant decongestant"
    - May sting for first week
    - Takes 1-2 weeks for optimum effect
    - Discard when aerosol "sizzles"
- Indications for systemic steroids = nasal polyps 30-40 mg daily 2 weeks
- **Cromolyn**
  - As a single agent, less effective than steroids, but it is a good second drug to combine with steroid sprays. Two puffs each nostril BID or TID. Opticrom were good eyedrops but are off the market
- **Immunotherapy**
  Weekly desensitization therapy to limited # allergens. Mechanism (?) - elevated IgG and suppress IgE antibodies. Can have potentially lethal reactions and should be administered under medical supervision

Epistaxis

- Usually located on anterior septum
- Try 15 minutes of pressure. Get hypertension under control
- Topical epinephrine/neosynephrine on pledgets as vasoconstrictor
- Pull pledgets out and look fast for the bleeding site
- Suction away blood and cauterize with silver nitrate
- Try packing nose lightly with Surgicel or gelfoam sponges soaked with topical thrombin
- Vigorous bleeds must be packed with antibiotic ointment-soaked gauze strips. Need good lighting and instruments for an adequate job. Avoid packing

patients with coagulopathies who will invariably re-bleed when the pack is removed

- Intranasal balloons (e.g. Epistat) are easier to use but less consistently effective
- Persistent bleeding is then treated with posterior and anterior packs
- Leave packs in three days. Cover with antibiotics to prevent sinusitis
- If packing fails vessels must be ligated. If the responsible vessel cannot be identified then both maxillary artery and ethmoid arteries are ligated
- Blood supply of the lateral nasal wall.

Blood supply of the nasal septum.

Anterior ethmoidal

Posterior ethmoidal

Septal branch of superior labial

Septal branches of sphenopalatine

Branch of greater palatine
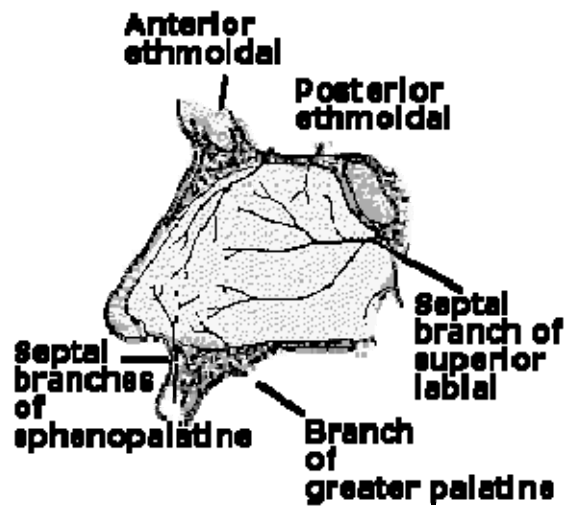
Tumors:

- **Juvenile nasoangiofibroma** - epistaxis in boys
- **Nasopharyngeal carcinoma** -
    - early symptoms = serous otitis media, neck metastases
    - Chinese at higher risk
    - EBV genome in undifferentiated carcinoma
        - **Squamous cell carcinomas**
        - **Inverting papillomas** (occupational exposure?)

Olfaction

- **Anosmia**
    - Head injury, especially antero-posterior can shear off nerves as they cross the cribiform plate
    - Viral (influenza) infection can kill off nerves
    - Obstruction such as nasal polyps or septal deviation
- **Hyposmia** Advanced age
- **Hyperosmia** Addison's, pregnancy
- **Cacosmia** Infection (sinus, dental), hysteria

Taste

- Innervation anterior 2/3rds of tongue CN VII
- posterior tongue, pharynx CN IX
- 4 basic tastes - sweet, sour, bitter, and salt
- Altered taste is usually olfactory loss. Ask patient whether they can still taste sweet or salt. Check oral mucosal for lesions and adequacy of salivation. Medications such as sulfa drugs and anti-arthritics can cause altered taste sensations

Inflammatory Disorders of the Pharynx

Inflammatory disorders of the pharynx most commonly present as throat or neck pain. Dysphagia, odynophagia, and airway obstruction are other frequent complaints. The pharynx is a dynamic conduit for inspired air and ingested matter, responsible for diverting each into the trachea or esophagus, respectively. This process may be impaired by anything which obstructs or restricts the mobility of the pharynx. The following outline is directed toward a systematic approach to the evaluation of the patient with sore throat, odynophagia or dysphagia.

Evaluation

- Key historical considerations
  - Age of patient
  - Onset and duration
  - History of recent trauma (including possible foreign body)
  - Inflammatory symptoms - fever, pain, malaise, malodorous breath
  - Status of nasal airway: congestion, obstruction, rhinorrhea, purulent discharge, allergic history, snoring
  - Reflux symptoms such as heartburn or water brash
  - Associated ear pain
  - Dysphagia or odynophagia
  - Dyspnea or stridor
  - Other associated symptoms
  - Recent exposure to infectious discharge
  - Cancer risk factors: smoking history, ETOH abuse
- Key considerations of physical examination for patients with throat pain:
  - Ears - The patient's ears need to be examined for primary ear pathology, as acute otitis media and serous otitis media are often preceded by pharyngitis and nasal congestion. Conversely many patients with pharyngeal inflammation or tumor will have referred ear pain in which case otoscopy will be normal.
  - Nose - The nose should be examined for any evidence of obstruction, purulence, or excessive secretions. Mouth breathing leads to drying of pharyngeal mucosa; this is a very common cause of chronic sore throat. Excessive secretion may cause the patient to clear his throat frequently, which traumatizes the larynx; and infected drainage from sinusitis may cause irritation in the pharynx.

- Pharynx - Examination of the throat for asymmetry, injection, erythema, exudate, swelling, or pooling of secretions. Also, careful inspection and palpation of any ulcerations, lesions, mucosal or submucosal masses.
- Neck - Careful palpation and inspection of the neck for lymphadenopathy, swelling, tenderness, induration or fluctuance. Large, firm, non-tender masses suggest neoplasia, while multiple small nodes are often seen in chronic recurrent infections.

Differential Diagnosis of Throat Pain

- Trauma
  - Ingested foreign bodies may cause acute or chronic throat pain. Fish bones or chicken bones often lodge in the tonsil, the vallecula, pyriform sinuses, while such objects as coins are often wedged in the cricopharyngeal area. A careful history will elicit the probable type of foreign body, and the patient can often help localize the foreign body by indicating the site of the pain.
    - Diagnosis - Careful examination will usually reveal the foreign body if it is still present in the pharynx. Foreign bodies at the level of the cricopharyngeus or upper esophagus may be seen on soft tissue lateral x-ray of the neck. However, many objects are not radiopaque.
    - Treatment - Appropriate treatment involves either office removal, admission for endoscopy under general anesthesia, or reassurance. Patients who have swallowed a sharp object causing irritation may complain of a "foreign body sensation" for 3-5 days after the episode even if the foreign body has passed. If no object is seen on physical or radiologic exam, and the patient is able to swallow, he should be assured that the symptoms will probably subside. If symptoms persist beyond five days, or if there is drooling or inability to swallow liquids, endoscopy is indicated.
  - Chronic exposure to cigarette smoke, especially in conjunction with alcohol intake, can cause intermittent or persistent pharyngeal irritation.
  - Penetrating injuries of the pharynx and mouth may result from assault, or from falling with sharp objects in the mouth (especially pencil injuries in children). These can be complicated by vascular injuries or may lead to parapharyngeal or retropharyngeal abscess. Close observation, prophylactic antibiotics, and in some cases, arteriography, may be indicated.
  - Iatrogenic injury can result from nasogastric tubes or endotracheal intubation
  - Patients on anticoagulants may develop pharyngeal hematomas from seemingly insignificant trauma.

- Infection: Most infectious conditions are characterized by acute onset of symptoms. The following list includes some of the more common conditions.
  - **Viral or Bacterial Pharyngitis**
    - Symptoms - This condition affects all ages, and is characterized by diffuse sore throat and other symptoms of upper respiratory infection.
    - Signs - Diffuse erythema and edema of the oral and nasopharyngeal mucosa. Cervical lymph nodes may be slightly enlarged. Viral infection cannot be reliably differentiated from bacterial infection on physical exam.
    - Treatment - In general, supportive care consists of good oral hygiene, hydration, saline gargles, rest, and analgesics such as aspirin or acetaminophen. If bacterial infection is present, antibiotics will hasten resolution and prevent rheumatic complications. Empiric prescription of antibiotics is controversial.
  - **Infectious Mononucleosis (Epstein-Barr Virus)**
    - Symptoms - Primarily affects young adults, who present with non-specific malaise, fatigue, and low-grade fever. They commonly complain of sore throat and tender cervical adenopathy.
    - Signs - Diffuse erythema of the oropharynx and tonsils often mimicking bacterial tonsillitis. The tonsils may appear almost necrotic. Diffuse cervical adenopathy is present bilaterally. CBC and mono spot are useful in diagnosis.
    - Treatment - Treatment of the sore throat in infectious mononucleosis generally consists of the supportive measures as outlined above for any viral pharyngitis. In severe cases adenotonsilles involvement can lead to upper airway obstruction, which may require treatment with steroids and antibiotics. Patients with infectious mononucleosis should also be followed by an internist or family physician to monitor for hepatitis and other complications of mono.
  - **Acute Tonsillitis -** The most common organism is beta hemolytic *streptococcus*, but viral organisms can also cause exudative tonsillitis. Other causative organisms include *staphylococcus aureus*, *streptococcus viridans*, and various hemophilus species.
    - Symptoms - Rapid onset of throat pain with pain on swallowing associated with fever, often 102° - 103° F with malaise and fatigue being common.
    - Signs - Swollen erythematous mucosa of the oropharynx and hypopharynx, often with edema of the uvula and soft palate. The tonsils are red, enlarged and covered with an exudate or studded with white follicles. Tender, firm cervical adenopathy is often present.
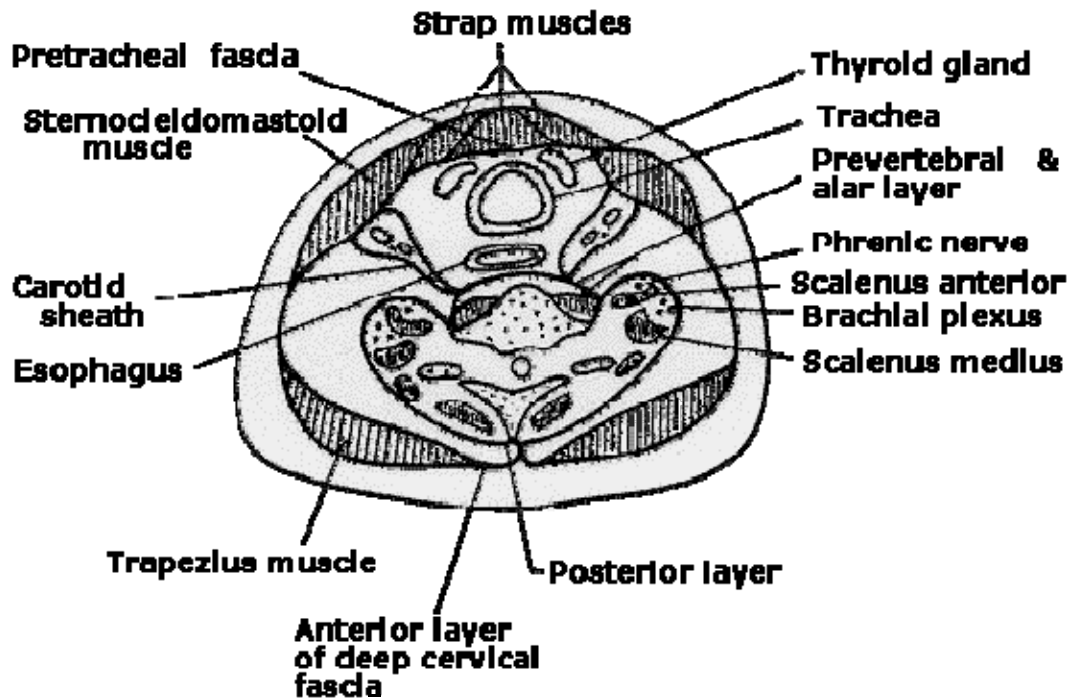
- Treatment - A 10-day course of penicillin is indicated. Erythromycin may be used in patients with a penicillin allergy. In resistant cases clindamycin may be helpful. Supportive measures such as hydration, humidification of inspired air and analgesics.
  - o **Peritonsillar Abscess (Quinsy)** - This develops by a spread of bacterial tonsillitis to the peritonsillar space which lies between the tonsillar capsule and the superior constrictor muscle.
    - Symptoms - Progressively increasing pharyngeal pain, often unilateral with radiation to the ear on the affected side, and increasing dysphagia with eventual difficulty in handling secretions and opening the mouth (trismus).
    - Signs - Unilateral erythema and swelling of the anterior tonsillar pillar and soft palate with deviation of the uvula to the opposite side. Bilateral cervical adenopathy is common. Trismus is often severe and may preclude a complete examination unless a sphenopalatine block is employed.
    - Treatment -
      - Needle aspiration or incision and drainage of the peritonsillar space.
      - Antibiotic coverage (penicillin) parenterally followed by p.o. administration for at least ten days.
      - Rehydration, analgesics, and good oral hygiene are important adjunctive measures in patient care.
      - If the patient has a prior history of tonsillitis the abscess is likely to recur, and tonsillectomy is recommended. Whether this should be done acutely or after an interval of recovery is controversial.
  - o **Vincent's Angina** - This condition, also termed ulcerative tonsillitis, pseudomembranous angina, and trench mouth, is characterized by acute inflammation and ulceration of the pharyngeal tonsils usually due to a fusiform bacillus.
    - Symptoms - Severe throat pain often radiating to the ears.
    - Signs - Tonsil is covered by a pseudomembrane (formed by the necrosis of the superficial layer of the mucous membrane and the tonsil). Removal of the pseudomembrane reveals ulceration.
    - Treatment - Oral or parenteral penicillin and vigorous oral hygiene
  - o **Lingual Tonsillitis**
    - Symptoms - Pain in the upper throat. Voice is often garbled and odynophagia is a prominent symptom
    - Signs - Examination of the posterior tongue with a mirror reveals enlarged lingual tonsils usually with exudate

- Treatment - 10-day course of penicillin and supportive therapy
- **Candidiasis** - (Also known as thrush or moniliasis). A fungal infection most commonly seen in very young, elderly, or immunosuppressed patients. Long-term antibiotic therapy and radiation treatment also predispose patients to candidiasis.
    - Symptoms - Oral and pharyngeal pain
    - Signs - Diffuse pharyngeal erythema and edema with multiple white patches over the inflamed mucosa. Removal of the whitish material reveals superficially ulcerated mucosa. The diagnosis is made on a KOH prep which reveals budding yeast forms.
    - Treatment - Clotrimazole lozenges or Nystatin oral suspension.

(The following entities are commonly associated with respiratory obstruction in addition to sore throat.)

- **Epiglottitis** - An acute inflammatory condition of the supraglottic larynx. This is most common in children aged three to five years but also occurs in adults. The usual organism is *Hemophilus influenzae*. **This condition is an otolaryngologic emergency.**
    - Symptoms - *Rapid* onset of sore throat and fever with increasing pain on swallowing. Dysphagia causes salivary pooling and progresses rapidly to difficulty in breathing and airway obstruction. Complete respiratory obstruction can occur within hours of the onset of symptoms.
    - Signs - The patient usually appears quite ill, often with fever of 102°-104° F and has a characteristic muffled voice. Examination with a tongue blade or indirect laryngoscopy may cause coughing or gagging which can precipitate sudden total airway obstruction, and should only be attempted by an experienced examiner with tracheotomy instruments immediately at hand. Examination reveals excessive secretions with erythema of the pharynx; the epiglottis is edematous and often "cherry" red.
    - Treatment - Prompt attention is mandatory, and management of the airway is of paramount importance when epiglottitis is diagnosed. The patient should be taken to the operating room for examination and an airway established either by endotracheal intubation or tracheotomy. Once the airway is secured, the larynx can be examined more carefully. Blood cultures are the most reliable means of obtaining a culture of the offending organism. The patient should be promptly started on appropriate antibiotics, (ceftriaxone, cefotaxime, or cefuroxime), humidified air and aggressive respiratory support as indicated.

- o **Croup** - Epiglottitis must be differentiated from croup (acute laryngotracheitis). This is a subglottic and tracheobronchial inflammatory process most commonly caused by parainfluenza, respiratory syncytial and other viruses, with circumferential subglottic erythema and edema.
    - Symptoms - Upper airway obstruction with a barking cough. The disease most commonly occurs in children between six months and two years of age. Viral croup is preceded by an upper respiratory infection with sore throat. "Nocturnal croup" or "spasmodic croup" is an idiopathic, recurrent upper airway obstruction which is usually benign and self-limited.
    - Signs - A characteristic croupy cough, stridor, hoarse voice and tracheobronchial secretions. The child is most often tachypneic and breathing is labored.
    - Treatment - Mild to moderate respiratory distress: humidified air and a mist tent, intravenous fluids, steroids, and epinephrine may be sufficient to reverse the acute inflammatory response. In patients with more significant respiratory distress, endotracheal intubation or even tracheotomy may be necessary. If bacterial infection supervenes, repeated bronchoscopy may be required to remove purulence and necrotic debris.
- o **Deep neck infection** - To understand deep neck infections, a brief review of the cervical fascia and fascial spaces of the neck will be useful.

Strap muscles
Pretracheal fascia
Sternocleidomastoid muscle
Thyroid gland
Trachea
Prevertebral & alar layer
Phrenic nerve
Carotid sheath
Scalenus anterior
Brachial plexus
Scalenus medius
Esophagus
Trapezius muscle
Posterior layer
Anterior layer of deep cervical fascia

- Anatomy
  - Fascial Layers
    - Superficial cervical fascia beneath the skin and superficial to the platysma muscle of the neck.
    - Deep cervical fascia has three subdivisions:
      - Anterior layer (superficial) - surrounds the sternocleidomastoid, trapezius muscles and strap muscles.
      - Pretracheal (visceral) - envelopes the trachea, larynx and hypopharynx.
      - Prevertebral fascia - runs posterior to the esophagus and great vessels, and ensheathes the prevertebral musculature.
  - Fascial spaces -
    - The visceral space - contains the lower pharynx, larynx, trachea and cervical esophagus, thyroid gland and great vessels
    - The prevertebral or retropharyngeal space - between the prevertebral musculature and prevertebral fascia. It is continuous with the mediastinum
    - Carotid sheath
    - Submental space
    - Submaxillary space
    - Sublingual space.
- Neck spaces are interconnected with each other and also communicate with the mediastinum so that infections can spread easily to a variety of areas. Common clinical conditions which can occur in these spaces are retropharyngeal abscess, parapharyngeal abscess, as well as infection of sublingual and submental space including Ludwig's angina.
  - Parapharyngeal space infections
    - Etiology: suppuration of deep cervical lymph nodes, direct contamination by needle sticks or as the result of vascular inflammation such as phlebitis or thrombosis of the deep neck veins. Infections extending into the deep neck structures frequently begin with a bacterial pharyngitis, acute tonsillitis, or dental abscess. It may also follow surgical manipulation of the tonsils or dental extraction.
    - Symptoms - Sore throat, neck pain, dysphagia and swelling.
    - Signs - Patient is frequently toxic with a high fever. Trismus due to splinting of the pterygoid muscles is a prominent symptom. Displacement of the lateral pharyngeal wall without swelling or enlargement of the tonsil is characteristic. Tender swelling of the neck.
    - Treatment - Blood cultures and intravenous antibiotics. If the patient does not respond to this therapy, then incision and drainage through the neck is indicated.

- o Retropharyngeal abscess can occur at any age but most commonly is seen in young children.
    - Etiology - suppuration of the retropharyngeal lymph nodes, injuries to the posterior pharyngeal wall
    - Symptoms - Severe sore throat, difficulty swallowing, possible airway obstruction.
    - Signs - Erythema and edema of the oropharynx, bulging of the posterior pharyngeal wall. A lateral soft tissue xray of the neck demonstrates widening of retropharyngeal space.
    - Treatment - Incision and drainage under general endotracheal anesthesia followed by vigorous oral hygiene and appropriate antibiotic coverage
  - o **Ludwig's Angina** - An unusual inflammatory condition of the floor of the mouth, with pronounced edema and often abscess formation in the sublingual space. It can lead to fatal airway obstruction.
    - Etiology - usually trauma to the floor of the mouth, severe dental caries, tonsillitis, peritonsillitis, or recent dental extraction
    - Symptoms - Pain in the floor of mouth and submental area
    - Signs - Severe swelling and induration of the floor of the mouth, gums and tongue with displacement of the tongue posteriorly and superiorly, oropharyngeal airway obstruction, and drooling
    - Treatment - Intravenous antibiotic (penicillin) following blood cultures, close observation and often tracheostomy. If cellulitis progresses to abscess formation then incision and drainage is indicated.
- Neoplasia - Cancer of the upper aerodigestive tract frequently will present as a chronic sore throat. The possibility of cancer must be considered in any patient over the age of 30 who has persistent sore throat, especially with a strong smoking or drinking history. Careful evaluation and attention to other factors and findings as mentioned above may reveal a benign etiology for the persistent throat pain. However, when no other simple explanation can be made, it is important for the physician to rule out the presence of carcinoma. The systematic evaluation for malignancy is covered in a separate section (see chapter on Head and Neck Tumors).

Tonsillectomy and Adenoidectomy - These two procedures are among the most commonly performed operations accounting for nearly 1/2 of all childhood surgical procedures. Although the literature concerning these procedures is vast, most published papers are based on opinion rather than scientific fact. This is due to the difficulties inherent in maintaining a large controlled series. Patients randomized for non-operative management frequently drop out to seek surgery elsewhere. However, most otolaryngologists agree on general guidelines for tonsil and adenoid surgery as presented below.

- Tonsillectomy
  - Indications
    - Strong
      - Cor pulmonale secondary to hypertrophied tonsils
      - Upper airway obstruction
      - Obstructive sleep apnea
      - Complications of streptococcal infection, such as rheumatic fever or nephritis
      - Dysphagia secondary to hypertrophied tonsils
      - Peritonsillar abscess
      - Unilateral tonsillar hypertrophy
    - Relative
      - Recurrent tonsillitis, 5-6 episodes/year or 3-4 episodes in successive years
      - Chronic tonsillitis with halitosis or sore throat
      - Tonsillary hypertrophy with speech distortion or snoring
  - Contraindications - abnormal clotting
  - Complications
    - Hemorrhage -
      - Early - within 24 hours
      - Late - 7-10 days
    - Dehydration secondary to odynophagia and trismus - low-grade fever
    - Infection of tonsillar bed - high fever
- Adenoidectomy
  - Indications
    - Urgent - severe nasal obstruction
    - Relative
      - Persistent nasal obstruction
      - Chronic or recurrent otitis media
      - Chronic or recurrent adenoiditis
      - Chronic or recurrent sinusitis
  - Contraindications
    - Clotting disorder
    - Submucosal cleft palate (bifid uvula, is "red flag")
    - Short soft palate
  - Complications
    - Bleeding - rarely serious
    - Infection
    - Velopharyngeal insufficiency with speech defect and or nasal regurgitation
    - Scarring of eustachian tube orifice

Salivary Gland Disorders

Inflammatory Diseases

Viral - Mumps

- Etiology: Contagious systemic myxovirus. Incubation period of 14 to 21 days.
- Signs and symptoms
  - Prodrome of fever, malaise, and headache may occur
  - Painful swelling of one or both parotid glands with erythema of Stenson's duct orifice. Ingestion of sour liquids increases pain.
  - Complications may occur due to involvement of other organs
    - Sensorineural deafness
    - Encephalitis
    - Orchitis or oophoritis can lead to sterility
    - Pancreatitis
- Treatment - supportive and symptomatic. No specific treatment currently available.
- Prevention by mumps vaccine

Acute Bacterial Infection

- Etiology
  - Stasis - secondary to obstruction, decreased flow or dehydration
  - **Staphylococcus aureus** is the most common pathogen in the parotid. Staph aureus and oral flora are seen in submandibular gland.
- Signs and Symptoms - pain, tenderness and swelling with increased pain on eating. Orifice of duct is red and swollen, and massage of the gland may express pus.
- Treatment
  - Antibiotics
  - Warm compresses
  - Promote drainage by
    - Massage
    - Sialogogues
    - Dilatation of duct
  - If condition unresponsive or progressive after above, surgical drainage is indicated.
    - In the parotid gland, care must be taken to avoid the facial nerve. A parotidectomy incision is made and skin over the gland is elevated. The gland is drained bluntly by inserting a clamp and spreading in the direction of the nerve.

- In draining the submandibular gland, the marginal mandibular nerve must be avoided.

Chronic or Recurrent Infections

- Etiology -
  - Usually related to scarring and inflammation of the duct and/or parenchyma from prior infections
  - May also be due to stones
- Signs and Symptoms - as in acute infection
- Treatment
  - Conservative treatment as for acute infection
  - In refractory disease, surgical excision is indicated

Autoimmune Diseases - Sjogren's Syndrome

- Etiology - collagen vascular disease
- Signs and Symptoms -keratoconjunctivitis sicca, xerostomia, and a connective tissue disorder, such as rheumatoid arthritis. Enlargement of salivary and lacrimal glands, often with recurrent sialoadenitis
- Diagnosis - biopsy of salivary glands, usually the lower lip, shows lymphoreticular hyperplasia
- Treatment
  - Treat recurrent infection
  - May develop a superimposed malignancy. Therefore, if a mass appears, surgical excision is needed.

Degenerative Diseases

Fatty Infiltration

IHypertrophy

- Alcoholism
- Kwashiorkor
- Metabolic diseases

Obstructive Disease

Sialolithiasis (Salivary Duct Stones) - Common in submandibular gland, uncommon in the parotid

- Etiology - Inspirated secretions, ductal debris, and calcium phosphate coalesce, due to inflammation or stasis.
- Signs and symptoms
  - Submandibular stone may be palpable in the floor of the mouth.
  - Partial obstruction causes enlargement and pain on eating, with return to normal as saliva drains
  - Total obstruction leads to chronic enlargement and often infection
- Treatment
  - Stones near the orifice may be removed intraorally
  - Deeper stones require excision of the gland

Ductal Stenosis

- Etiology-Trauma, neoplasm or chronic inflammatory process
- Signs and symptoms-Painful swollen gland-Neoplasm usually palpable
- Treatment-Dilatation or glandular excision

Cystic Disease

Ranula - A sialocele of the floor of the mouth

- Types
  - Circumscribed - obstruction and cystic dilatation of sublingual gland or submandibular duct.
  - Plunging - extravasation of saliva into tissues of the floor of the mouth. May extend deep into floor of the mouth
- Signs and Symptoms - cystic submucosal mass in the floor of the mouth; may periodically shrink with discharge of contents into mouth
- Treatment
  - Circumscribed cyst may be excised, along with involved gland or glands
  - Plunging ranulas cannot be excised and should be marsupialized

Congenital Cysts

Developmental Diseases

Agenesis

Branchial Cleft Cysts

- First branchial cleft cysts present as cysts or draining sinuses in preauricular area
  - Type I cysts track deep into parotid along EAC

- o Type II cysts track deep into parotid and are intimately involved with facial nerve
- Treatment-surgical excision

Salivary Gland Masses

Etiology

- Inflammatory scarring or focal obstruction,
- Inflammatory lymph node enlargement, secondary to cat scratch disease, scalp or external ear infection, etc.
- Metastatic involvement of nodes
- Neoplasm
  - o Benign-75-80% of all parotid tumors are benign
    - ▪ Benign mixed tumor
      - ▪ 65% of parotid neoplasms
    - ▪ Warthin's tumor
    - ▪ Lymphangioma, hemangioma
  - o Malignant - 20% of all parotid tumors are malignant. Submandibular and minor salivary gland tumors have increasing percentage of malignancy, i.e., the smaller the gland, the greater the likelihood of malignancy.
    1. Mucoepidermoid carcinoma
    2. Adenoid cystic carcinoma - associated with high propensity for nerve invasion
    3. Squamous cell carcinoma

Diagnosis

- Careful examination of scalp, ear and face for infection or malignant lesion
- Palpation of other lymph nodes
- Persistent salivary gland mass should be assumed to be neoplastic unless proven otherwise
- Minimum biopsy of parotid mass is a superficial parotidectomy
- Submandibular masses require excision of gland
- Minor salivary gland masses require excision with a margin of surrounding normal tissue

Treatment - Most salivary gland tumors require surgical excision of involved gland with or without post operative radiotherapy depending on the histology of the tumor and extent of disease. (See section on Head and Neck Tumors for management principles)

Disorders of Speech and Swallowing

Speech

- **Normal Mechanisms**
  - Phonation-the production of sound by the larynx
    - Requirements
      - Approximation of vocal folds
      - Forced expiration (adequate breath support)
      - **Passive** vibration of free mucosal edge of vocal fold
    - Pitch determined by the fundamental frequency of vocal fold vibration
      - Dependent on vocal fold length and tension
      - Controlled by "pre-phonatory tuning" and auditory feedback
    - Intensity is dependent on subglottic pressure, which is related to:
      - Expiratory flow
      - Glottic aperture area
  - Resonance-the modulation of sound by passage through body tissues. This can be voluntarily modified by movements of the tongue, palate and pharynx, as well as by changing the position and shape of the larynx. It may also be altered by pathology.
  - Articulation-the formation of words is accomplished by voluntary movements of the upper aerodigestive tract (lips, teeth, tongue, palate, etc.) to produce:
    - Unvoiced consonants
    - The "shaping" of phonation into vocalizations
- **Speech Disorders**
  Speech disorders may result from disruption of phonation (hoarseness), articulation (dysarthria), resonance, or prosody. A speech disorder is a symptom or sign - **not a diagnosis**. It cannot be properly treated if the etiology is unknown. Further, it can be a manifestation of a serious underlying disorder. Hence a thorough diagnostic evaluation is always indicated for persistent speech disorders.
  - Hoarseness-abnormal vocal fold vibration-coarseness or raspiness of the voice. Most commonly, hoarseness is due to either infectious laryngitis or vocal abuse and will resolve with voice rest. However, a patient with hoarseness which persists more than two weeks should be referred for laryngeal exam.
    - Structural changes in larynx
      - Laryngitis
        - Diffuse edema of the larynx
        - Etiology: infection, allergy, acute or chronic gastroesophageal reflux, trauma, or vocal abuse.
        - Therapy

- Voice rest!
- Specific management of causative factors
- Reinke's edema
  - Isolated edema of the mucosal edge of the vocal fold
  - Etiology
    - Usually due to hormonal changes (menopause, hypothyroidism, etc.) but may also be seen in allergy, vocal abuse, or secondary to URI
  - Therapy
    - Voice rest, speech therapy, medical management of endocrine problems. If persistent, stripping of vocal fold mucosa may be indicated.
- Vocal nodules
  - Thickened area on vocal cord, usually bilateral, at junction of anterior and middle thirds.
  - Etiology
    - Analogous to a callus. Develops with vocal abuse.
  - Therapy
    - Voice therapy in adults and older children. Mature nodules in adults are excised. Nodules in children frequently regress in puberty.
- Vocal polyps
  - Sessile or pedunculated, on vocal fold
  - Etiology - most commonly results from traumatic hemorrhage into vocal fold with stretching of mucosa and loss of elasticity.
  - Therapy
    - Excision
- Contact granuloma
  - Hyperplasia and granulation of mucosa overlying the vocal process of the arytenoid, seen more commonly in males.
  - Etiology
    - Traumatic irritation (intubation)
    - GE reflux, chronic throat clearing or cough, vocal abuse may also be implicated.
  - Therapy
    - Voice rest, voice therapy, anti-reflux regimen and cough suppression.
    - May need biopsy to rule out cancer or surgical removal.

- Hyperkeratosis
  - White plaques on vocal fold
  - Etiology - smoking, other chemical agents
  - Biopsy to rule out carcinoma, discontinue smoking, stripping of mucosa
- Papillomas
  - Warts on vocal folds. Most often in children. Airway obstruction can be life threatening.
  - Etiology
    - Human papilloma virus subtype HPV6, HPV11.
    - Relationship with maternal condylomas has been suggested
  - Therapy
    - Surgical removal by cup forceps or CO2 laser. Usually requires multiple repeat excisions because of recurrence.
    - May spontaneously resolve
- Carcinoma of the larynx
  - See section on Head and Neck Cancer. Laryngeal lesion requires direct laryngoscopy and biopsy for diagnosis and staging
  - Etiology - patient almost invariably smokes heavily and may drink
  - Therapy
    - Radiation, surgery, or combination
- Laryngeal paralysis
  - Unilateral vocal fold paralysis
    - Symptoms are determined by position of the cord, which correlates to specific neural lesion.

Head and Neck Tumors

Introduction

The management of cancers of the head and neck has conventionally been the province of surgeons and radiotherapists. In the past fifteen years, medical oncologists have been increasingly involved in patients with these neoplasms. Multimodality management of head and neck cancer patients is now the modus operandi in most medical centers. Head and neck tumors should not only be the concern of head and neck surgeons, radiotherapists and oncologists, but also all primary care physicians and dentists. Practitioners familiar with these tumors can often recognize the symptoms and signs of early disease. The establishment of a diagnosis of head and neck cancer at an early stage significantly improves the prospect of curative therapy.

Mucosal Tumors

- **Incidence and Epidemiology**
  - Squamous cancers of the upper aerodigestive tract constitute approximately 6% of new cancer cases in men and 2% of women. At all sites except the salivary glands there is a significant preponderance of cases in men. Oral and pharyngeal cancer is more common in white males at every site, but the incidence of laryngeal cancer is somewhat higher in black males.
  - The geographic distribution pattern for head and neck cancer shows considerable variation and is site-dependent. For example, cancers of the nasal cavity and paranasal sinuses are slightly more common in the South than in the rest of the United States. Nasopharyngeal cancer is a very common disease in the Chinese, with age-specific incidence rates in males from Kwangtung Province (Cantonese) 40 times that of U.S. Caucasian males.
- **Etiology and Pathogenesis**
  - The overwhelming majority of head and neck cancers have been related to prolonged exposure to environmental factors. While many associations between risk factors and various head and neck cancers are firm, others remain questionable.
    - **Sunlight** - Lip cancer, skin cancer
    - **Tobacco** - Tobacco contains many carcinogens
  - Risk is a function of the degree of exposure and the inherent susceptibility of the site. Tobacco chewing is uncommon in the United States. However, it is common practice in some parts of the world, such as Ceylon, Bombay, other parts of India and portions of Southeast Asia, which have some of the highest

incidence rates in the world of oral and pharyngeal cancer. Oral cavity cancer is the commonest form of cancer in Bombay. A mixture called pan (betel, nut and leaf, lime, catechu, tobacco and other additives) is very popular in India. It is chewed into a quid and buccal mucosa cancer usually develops at the site where the quid is kept and has most frequent contact.

- o Further evidence of the importance of type of exposure and site of cancer is the high incidence of cancer of the hard palate in populations that practice reverse smoking, i.e., where the burning end of the cigarette is kept in the mouth during smoking, in parts of India, Sardinia, Venezuela and Panama. Hard palate cancer is otherwise uncommon in most of the world.
    - Cancer of the lip associated with pipe smoking.
    - Cigarette smoking, the most popular form of tobacco use in this country clearly plays a causative role in tongue, pharyngeal, laryngeal, esophageal and lung cancer.
- o **Alcohol**
    - Synergistic with tobacco
    - Ethanol per se, not a carcinogen, other factors implicated
- o **Nutritional Deficiencies** - Specific role not established, but an area of increasing study and investigation
- o **Occupational Factors** - e.g., nickel workers, wood workers implicated in paranasal sinus cancer
- o **Epstein-Barr Virus (EBV)** - Possible etiological role in nasopharyngeal carcinoma
- o **Genetic Factors** - An area of increasing study and interest. Certainly, some families have high incidence of cancer but genetic link not completely understood. However, some head and neck neoplasms have had recent chromosomal identification, e.g., retinoblastoma linked to q14 band of chromosome 13, medullary carcinoma of thyroid to chromosome 10, neurofibromatosis to chromosome 22.
- o **Poor Oral Hygiene** - Oral cavity, especially floor of mouth cancer, tongue, and alveolar ridge neoplasms.
- o **Radiation** - Ionizing radiation which was used in past to treat such benign conditions as acne, tonsillar and adenoid hypertrophy, enlarged thymus in newborn and chronic sialoadenitis has led to increased risk of thyroid cancer, parotid neoplasms, malignant degeneration of papillomas and possibly other upper aerodigestive tract neoplasms.
- **Pathology Ulcerative or Exophytic**
    - o **Histology**
        - Majority are squamous cell carcinoma (> 90%)
        - Adenocarcinoma
        - Verrucous carcinoma

- Others
  - **Modes of Spread**
    - Epidermoid carcinomas of the head and neck usually remain localized and tend to progressively invade adjacent tissues.
    - Extension into regional lymph nodes are more likely in lesions with:
      - Large size
      - Sites with abundant lymphatic drainage
    - Hematogenous metastases-less common-seen in more aggressive tumors, and tumors present for some time
  - **Symptoms and Signs -** Reflect the anatomic location, the degree of advancement and growth characteristics
    - An obvious lesion
    - Bleeding
    - Malodorous breath
    - Odynophagia
    - Otalgia - local or referred
    - Trismus to muscles of mastication
    - Nasal stuffiness, unilateral nasal obstruction, postnasal drip, headache and epistaxis should not be attributed to sinusitis without careful investigation
    - Nasal speech
    - "Hot potato" voice
    - Poorly fitting dentures
    - Loosening of teeth
    - Dysphagia
    - Hoarseness
    - Cranial nerve palsies
    - Cervical adenopathy - in patient with known head and neck primary malignancy, approximately 85% are metastatic
- **Diagnosis -** Most head and neck cancers are treatable and curable when discovered early. However, many cancers of the head and neck are large and extensive when diagnosed.
  - History
  - Occupational risks and social habits
  - Symptoms and signs
  - Physical Examination
    - Head and Neck Examination - both inspection and palpation especially oral cavity, base of the tongue, and palate
    - General Physical Examination - distant metastases, coexisting medical problems
  - Radiographic and Laboratory Studies

- Chest roentgenogram, complete blood count and platelet count, prothrombin time, partial thromboplastin time, SMA15, urinalysis and electrocardiogram
- Radionuclide scanning utility is dependent upon the likelihood of metastatic disease

o Biopsy - histologic confirmation of the diagnosis is mandatory before proceeding with any definite therapy
- Superficial lesions - punch biopsy - ideal for readily accessible lesions of the skin or mucosa
- Deeper lesions
  - Needle biopsy
  - Fine needle aspiration with cytology
  - Large bore needle
  - Incisional biopsy - violates capsule and potentially seeds tumor. Useful when all diagnostic modalities have failed to establish a diagnosis and excisional biopsy of the mass is not technically feasible.
  - Excisional biopsy - removal of a suspected tumor mass in its entirety. Rarely indicated in squamous cell carcinomas of the upper aerodigestive tract.

o Evaluation of the Neck Mass - any neck mass in an adult that persists more than four to six weeks should be considered potentially malignant until proven otherwise, especially in patient with a history of smoking, drinking or neck radiation. The proper evaluation of this particular patient does not consist of immediate open neck biopsy, but begins with a complete physical examination with an emphasis on the head and neck. Appropriate blood studies and radiographs should be carried out. If complete examination of the head and neck does not reveal a primary lesion, then the patient should undergo endoscopy under general anesthesia. He should have nasopharyngoscopy, direct laryngoscopy, bronchoscopy, and esophagoscopy performed. In most instances, a primary lesion will be identified at the time of endoscopy and appropriate biopsies can be taken. A treatment plan can then be outlined based on the information obtained at endoscopy. In a small percentage of patients, no primary lesion will be grossly evident. Selected random biopsies should be performed of the nasopharynx, pyriform sinus, base of tongue, and tonsillar fossa, as these areas have been identified in previous studies as the most common sites for occult head and neck primaries. With this careful systematic evaluation, the primary tumor will be identified in almost all cases. However, in a small percentage of cases, no primary lesion will be found. If this is the case, then exploration of the neck with biopsy of the mass is indicated. The patient should be prepared for a neck dissection which is indicated if frozen

section analysis reveals squamous carcinoma. In the case of adenocarcinoma or lymphoma, then a neck dissection is not performed and further diagnostic work-up and definitive therapy should be pursued.

- **Staging**
  The most commonly accepted staging in the United States is that of the American Joint Committee for Cancer Staging and End Results Reporting.
- **Specific and Supportive Management**
  - **General Consideration of Specific Therapy for Various Stages of Disease -** Choice of treatment should be based on the histopathology of the tumor, the staging classification of the tumor, the general physical status of the patient and the psychosocial condition of the patient at the time of diagnosis. These considerations will determine whether treatment should be directed at cure or palliation or simply support. Any treatment employed may affect respiration, deglutition, phonation and aesthetic appearance. It is important that the patient be an informed and active participant in treatment decisions throughout the course of therapy. The patient's ultimate decision should be respected at all times. By the same token, the patient should be made aware of the consequences of failing to pursue active treatment.
  - The principles of therapy of head and neck cancer directed at cure of the disease should try to meet three objectives:
    - To eradicate the neoplasm completely
    - To give the patient the best functional result by careful planning of the radiation fields or appropriate reconstructive techniques for surgical defects
    - To leave the patient with as good a cosmetic result as possible
  - Principles of Palliation Therapy. In cancers which are deemed unresectable because of local extension or deemed incurable because of diffuse metastatic spread, treatment can be directed toward palliation.
    - Palliative treatment may be employed to:
      - Control local advancement of tumor
      - Provide relief from pain, e.g., the use of radiotherapy for bone metastasis can be quite helpful in relieving the extreme pain incurred from such metastases
      - Provide relief from obstruction, e.g., a patient with a far advanced laryngeal tumor may benefit greatly from a tracheostomy to prevent suffocation
      - To control bleeding
  - Concern for the patient's quality of life should guide the treatment decisions. The choice of treatment modalities will depend on:
    - The size of the tumor and the location of the lesion
    - The gross characteristics of the tumors, i.e., exophytic or infiltrative

- Histopathologic differentiation of the tumor
- Presence of local bone and muscle involvement
- Presence or absence of nodal disease
- The general medical condition of the patient
- Socio-economic condition and occupation of the patient
- The experience of the surgeon, radiotherapist and oncologist in treating head and neck tumors

The tools at the disposal of the radiotherapist, the surgeon, and the medical oncologist differ greatly. Only a thorough understanding of the nature of the biologic process as well as the capabilities and limitations of each treatment modality will allow selection of the most appropriate therapy for any individual patient.

- **Radiation Therapy**
  - Megavoltage therapy. Despite the tremendous advance in technological equipment available to the radiation therapist, including computerized dosimeters, the proper treatment of lesions with minimal side effects requires an experienced and sophisticated therapist who understands both the nature of these tumors as well as the capabilities and limitations of his equipment.
  - External Beam
  - Interstitial
- **Surgery**
  - Gross removal of the primary tumor in its entirety
  - Removal of all involved lymph nodes dependent on the histopathology of the tumor, the location of the tumor, the propensity for the tumor to metastasize, and general status of the patient
    - Classical radical neck dissection-En bloc resection of lymphatics and soft tissue contained in superficial layer of deep cervical fascia to deep layer of deep cervical facia from the trapezius to the clavicle to the midline to mandible. Weakness of the shoulder because of the sacrifice of cranial nerve XI. The carotid artery and remaining cranial nerves are spared.
    - Modified (conservation) neck dissection-resection of lymphatics and soft tissue within the limits defined above but with preservation of the sternocleidomastoid muscle, strap muscles, internal jugular vein, and cranial nerve XI. This is a technically difficult procedure and should be attempted only by experienced head and neck surgeons.
  - Restoration of physiologic function and reconstruction of all significant physiological and cosmetic defects dependent on:
    - Location of the tumor
    - Extent of resection

- ▪ Reconstructive methods employed
- ▪ Patient's motivation and ability to adapt
- **Chemotherapy** - Head and neck tumors frequently respond to chemotherapeutic agents. However, these drugs are used primarily for palliation or as adjuvant therapy in conjunction with surgery and radiation and have not replaced other modalities. Some drugs with proven activity in head and neck cancers:
    - o Methotrexate
    - o Bleomycin
    - o Hydroxyurea
    - o Cisplatin
    - o 5-Fluorouracil
- **Supportive Measures**
    - o Treat underlying medical condition
    - o Supplemental nutrition
- **Rehabilitation**
    It often involves relearning such basic skills as swallowing and talking.
    - o Laryngectomy
    - o Esophageal speech
    - o Electrical vibratory device
    - o Pharyngotracheal fistula
    - o Palatal and Orbital Resection Prostheses
    - o Allow swallowing and normal sounding speech
    - o Camouflage of large nasal and orbital defects
    - o Radical Neck Dissection-may need a physical therapist for shoulder weakness
- **Follow-up**
    - o Monitor the patient's response to therapy
    - o To detect recurrence or second primary
    - o Every two months in the first year
    - o Every three months the second and third year
    - o At least every six months in the fourth and fifth years
    - o Yearly thereafter

Salivary Gland Tumors

The salivary glands are divided into the major glands (parotid, submandibular and sublingual) and minor glands (found in the submucosa of the nose, sinuses, mouth and upper aerodigestive tract). Tumors arise in both the major and minor glands, but are more frequent in the former. The most common site for a salivary tumor is the parotid gland and fortunately 70-80% are benign. Occurring less frequently than parotid lesions,

submandibular and sublingual tumors are malignant in approximately 50% of cases. Minor salivary gland tumors are unusual and approximately 60% are malignant.

- **Types of Tumors**
  - **Benign**
    - **Benign Mixed Tumor** (Pleomorphic adenoma) - The most common tumor of the parotid gland
    - **Warthin's Tumor** (papillary cystadenoma lymphomatosum) - Occurs most frequently in the "tail" of the parotid gland of white, middle aged males. Appear "hot" on Tc99 scan. Bilateral lesions not uncommon.
  - **Malignant**
    - **Adenoid Cystic Carcinoma** - Very lethal even when treated early. Although five-year survivals are quite good, 20 year survival is very poor-15% or less depending on site of origin. Most patients die of pulmonary metastases. This tumor also has a proclivity for perineural spread.
    - **Mucoepidermoid Carcinoma** - Graded into high grade (very malignant and lethal) to low grade (very curable with surgery alone). The most common parotid tumor seen in childhood. Generally metastatic to lymph nodes.
    - **Acinic Cell Carcinoma** - Low grade malignancy
    - **Squamous Cell Carcinoma** - Very aggressive tumor. Must rule out metastasis from a skin lesion to parotid lymph nodes. Primary parotid lesions tend to metastasize to cervical lymph nodes.
- **Diagnosis**
  - It is generally difficult to reliably differentiate benign from malignant lesions on the basis of history and physical examination. Facial paralysis and pain are almost exclusively associated with malignant lesions. A several year history of a slowly enlarging, lobulated mass is suggestive of a benign mixed tumor.
  - Computerized axial tomography may be helpful, but is unreliable in accurately differentiating benign from malignant lesions.
  - Thin needle aspiration is frequently accurate in diagnosing the lesions, but generally does not change the therapy which is surgical removal. Except for readily accessible, minor salivary gland lesions, open, incisional biopsy is to be condemned as this may lead to "seeding" or spread of the tumor, particularly the benign mixed tumor.
- **Treatment**
  - **Parotid Lesion** - Complete excision of the tumor with a margin of surrounding normal salivary gland. Since the vast majority of lesions occur in the

superficial lobe (lateral to the facial nerve) then the primary operation is a superficial parotidectomy with facial nerve dissection. This is potentially curative for all benign lesions and is generally the only surgery necessary for many malignant lesions. If a branch of the facial nerve is involved by a malignancy (particularly the adenoid cystic carcinoma) then that branch and perhaps all of the parotid gland and the facial nerve may need to be removed. A neck dissection is frequently indicated in squamous and high grade mucoepidermoid carcinomas.

- o **Submandibular and Sublingual Glands** - Complete excisions of the gland and tumor. If a malignancy is discovered, then a neck dissection and perhaps excision of the floor of mouth may be indicated depending on the tumor type.
- o **Minor Salivary Glands** - The operation depends on the location of the involved gland, but complete excision with a margin of normal tissue is essential. In the case of adenoidcystic carcinomas, surrounding nerves must be sampled for possible invasion and excised if involved.
- **Radiation Therapy** - Although not curative, most malignant salivary gland tumors respond to radiation therapy and it is usually incorporated into the treatment plan of the more ominous lesions (adenoid cystic carcinoma, adenocarcinoma, high grade mucoepidermoid carcinomas and squamous cell carcinomas). Radiation is used as the primary treatment for malignancies in patients who are poor surgical candidates. Radiation of benign lesions is not the accepted therapy in most circumstances in this country.

Core Curriculum Syllabus: Recommended Reading

General texts for medical students:

1. Ballenger JJ. *Diseases of the nose, throat and ear*, 14th edition. Philadelphia: Lea & Febiger, 1991.

2. DeWeese EE, et al. *Otolaryngology - head and neck surgery*, 8th edition. St Louis: Mosby, 1994.

More detailed textbooks to assist students in patient evaluation and prepare for operating room cases:

1. Cummings CW, et al. *Otolaryngology - head and neck surgery*. St Louis: Mosby, 1993.

2. Bailey BJ, et al. *Head and Neck Surgery -- Otolaryngology*. Philadelphia: Lippincott, 1993.

3. Glasscock ME. *Shambaugh's surgery of the ear*, 4th edition. Philadelphia: Saunders, 1990.

4. Schuknecht HF. *Pathology of the ear*. Cambridge: Harvard University Press, 1993.

5. Montgomery WW. *Surgery of the upper respiratory tract*, 2nd edition. Philadelphia: Lea & Febiger, 1979.

6. Batsakis JG. *Tumors of the head and neck*, 2nd edition. Baltimore: Williams & Wilkins, 1979.

Major journals to seek specifically for articles regarding selected topics:

1. Archives of Otolaryngology-Head and Neck Surgery (American Medical Association)

2. Laryngoscope (The Triological Foundation)

3. Annals of Otology, Rhinology, and Laryngology Annals of Otology, Rhinology, Laryngology (Annals Publishing Company)

4. Head & Neck Surgery (John Wiley & Sons)

5. Otolaryngology - Head and Neck Surgery (formerly Transactions of the American Academy of Ophthalmology & Otolaryngology, C.V. Mosby)