Applied Anatomy and Physiology of Ear, Nose and Throat

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Outline

- Introduction/Objective
- Anatomy and Physiology of the Ear
- Anatomy and Physiology of the Nose and Paranasal Sinuses
- Anatomy and Physiology of the Throat
- Conclusion
- Summary

Objectives

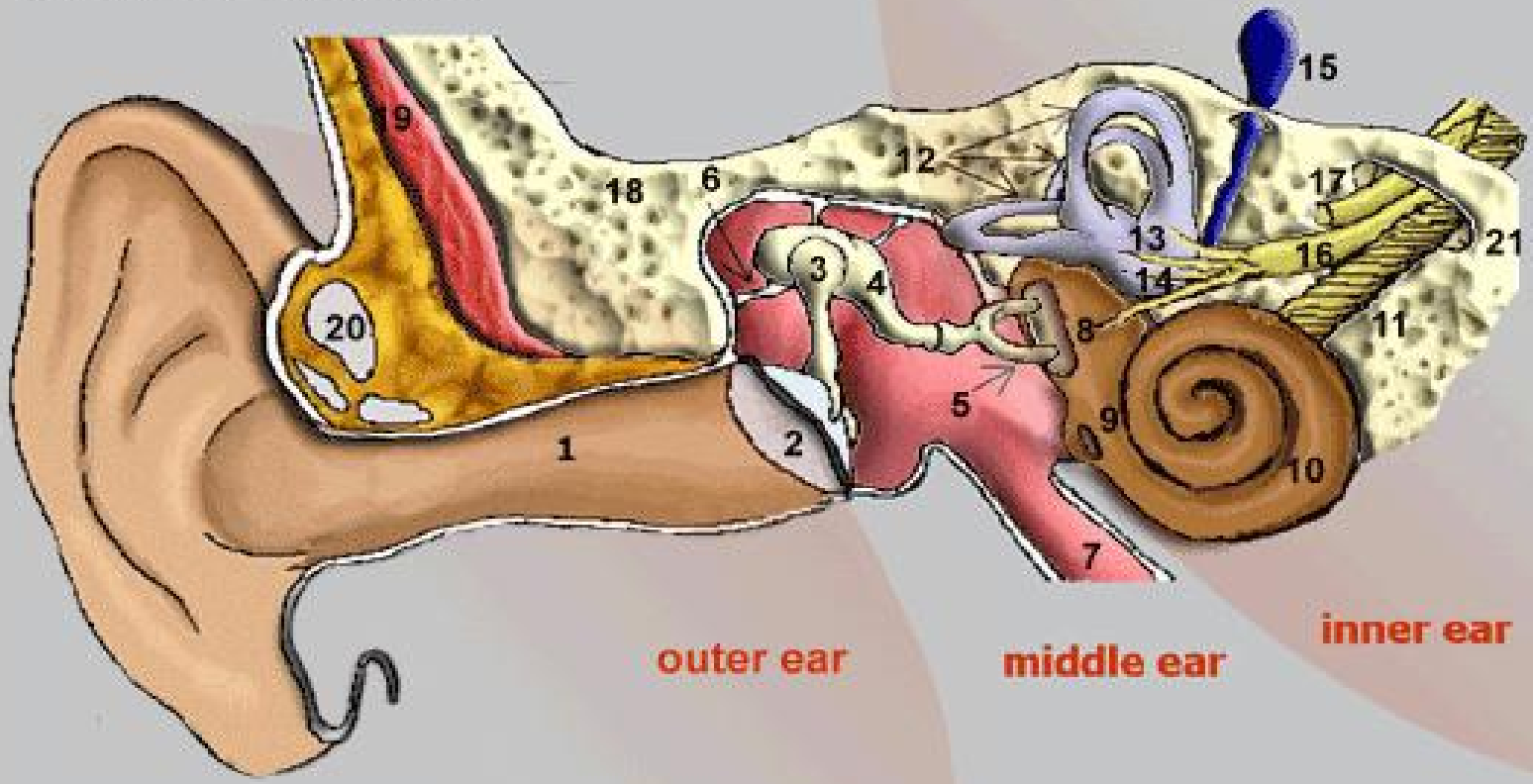
- To know the Anatomy and Physiology of
- the Ear, Nose and Throat as it will relate to basic primary care.
- To be able to identify the problems of patients with ear, nose and throat care
- To be able to link the patho-physiology of symptoms of ear, nose and throat diseases

Introduction

- Ear start its development during 3rd-6th week of Intra Uterine Life and by the end of the 7th month foetal life the ear has been fully formed.
- **Timing of development of the ear and week of gestation.**

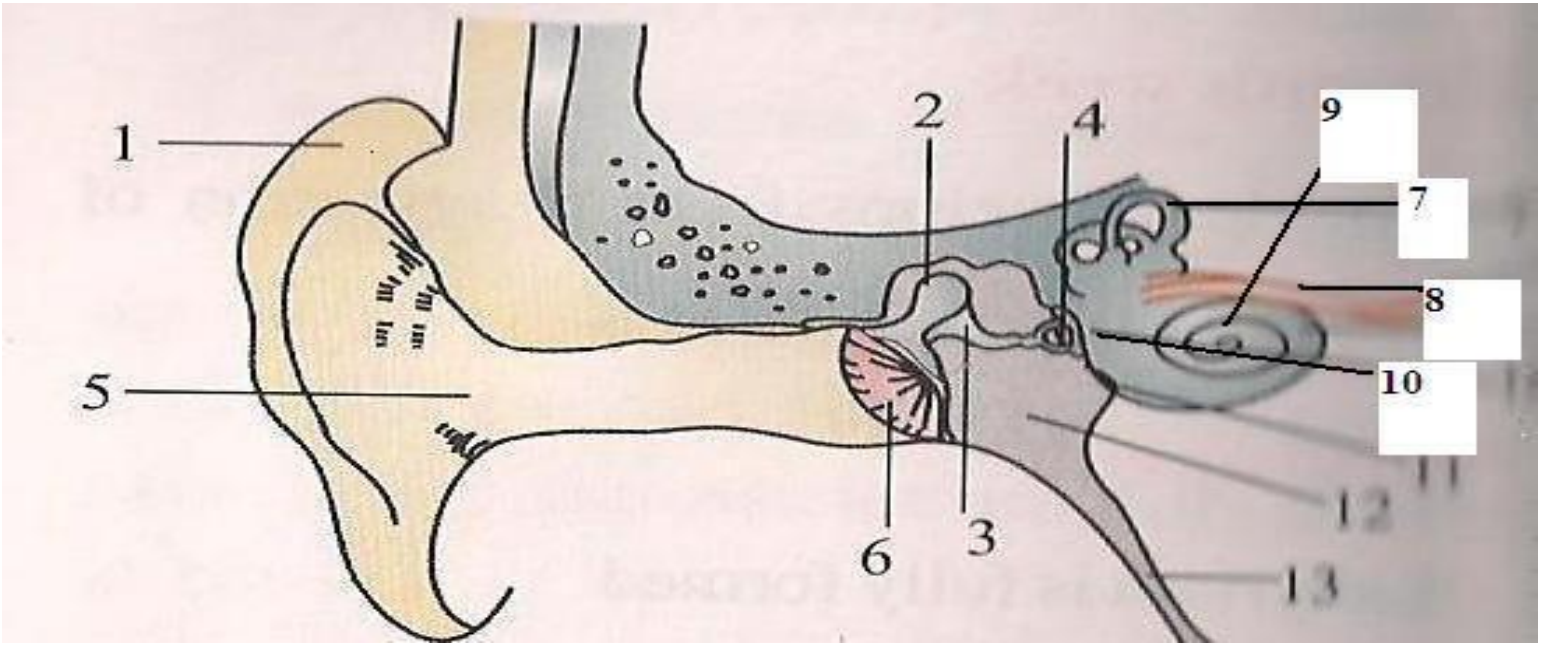
Devept	Pinn	Meatus	Middle Ear	Vesti Labyrt & Coch
Begins	6th	8th	3rd	3rd
Compl	20th	28th	30th	20th

Ear diagram



1. external auditory canal
2. tympanic membrane (eardrum)
3. malleus
4. incus
5. stapes
6. ligament
7. Eustachian tube
8. oval window
9. round window
10. cochlea
11. cochlear nerve
12. semicircular canals
13. utricle
14. saccule
15. endolymphatic sac
16. vestibular nerve
17. facial nerve
18. temporal bone
19. muscle
20. cartilage
21. internal auditory canal to brain

Anatomy of the Ear



1. Pinna
2. Malleus
3. Incus
4. Stapes
5. External auditory canal
6. Tympanic membrane
7. Superior semicircular canal
8. Vestibulo-cochlear nerve
9. cochlea
10. oval window
11. round window
12. promontory
13. Eustachian tube

Main Components of the Hearing Mechanism:

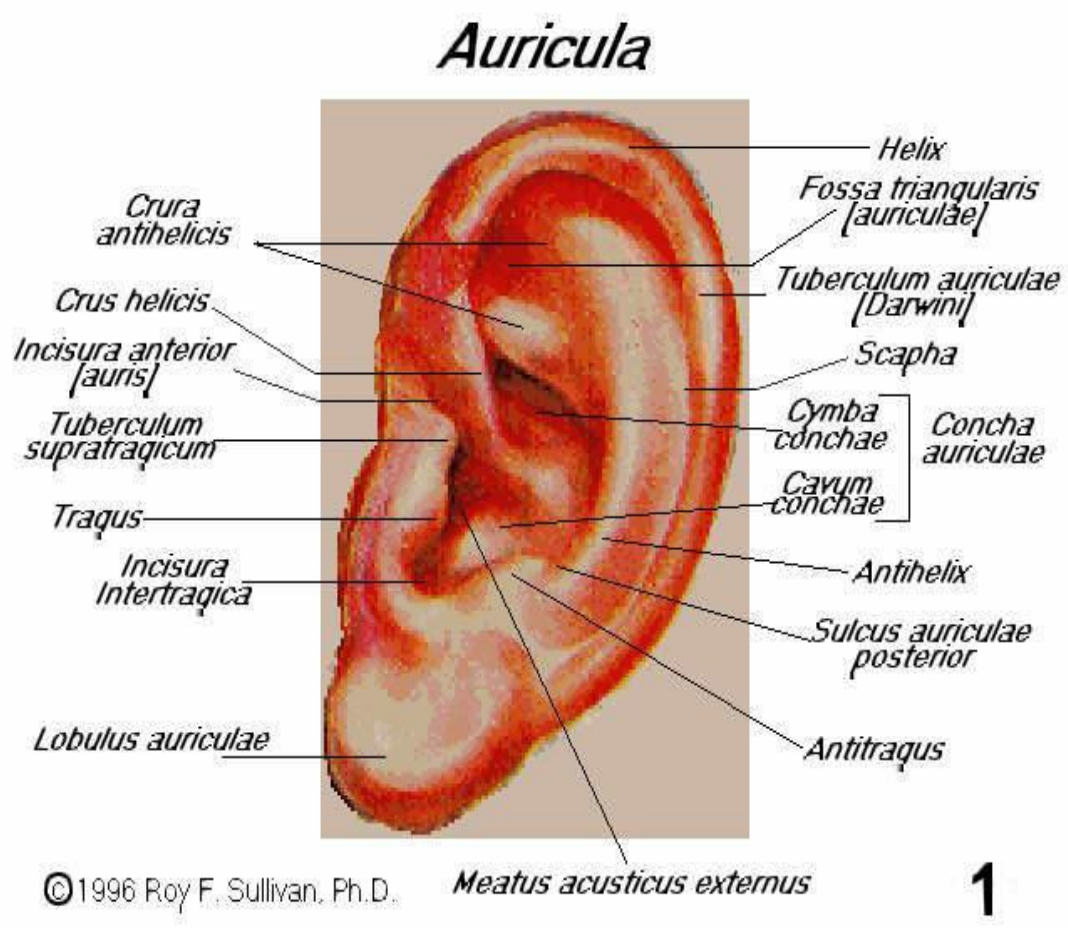
Divided into 4 parts (by function):

- **Outer Ear**
- **Middle Ear**
- **Inner Ear**
- **Central Auditory Nervous System**

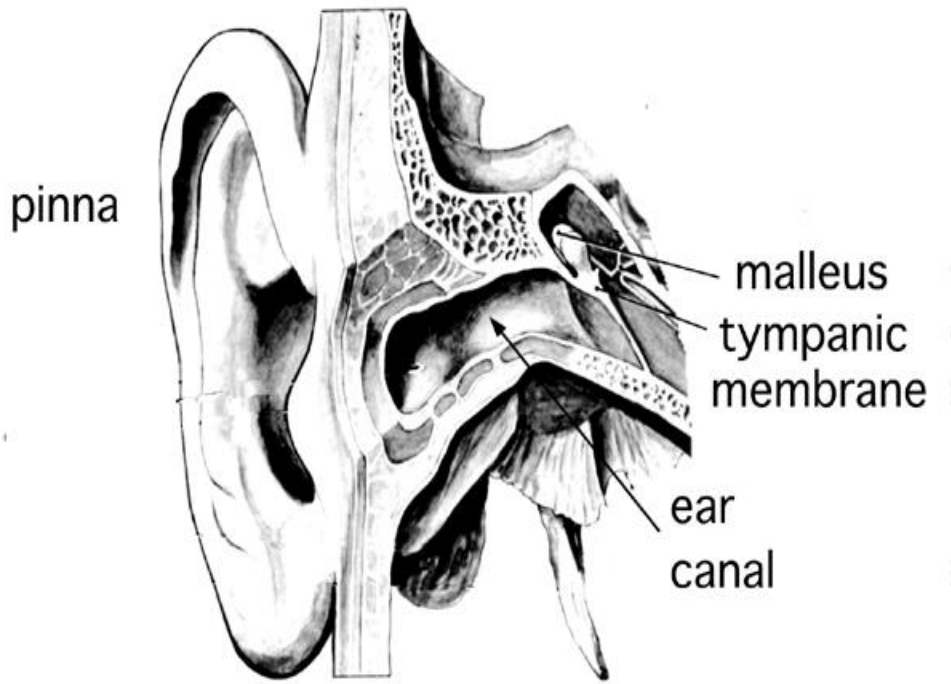
Structures of the Outer Ear

Auricle (Pinna)

- **Gathers sound waves**
- **Aids in localization**
- **Amplifies sound approx. 5-6 dB**



External Auditory Canal:



- **Approx. 1 inch long**
- **“S” shaped**
- **Outer 1/3 surrounded by cartilage; inner 2/3 by mastoid bone**
- **Allows air to warm before reaching TM**
- **Isolates TM from physical damage**
- **Cerumen glands moisten/soften skin**
- **Presence of some cerumen is normal**

Blood supply of the external ear/Lymphatic drainage

Auriculo-temporal branch of superficial temporal artery.

Posterior auricular branch of the external carotid artery.

- * Pre auricular Lymph Node Anteriorly
- * Post auricular Lymph Node Posteriorly
- * Infra auricular Lymph Node Inferiorly

Nerve supply

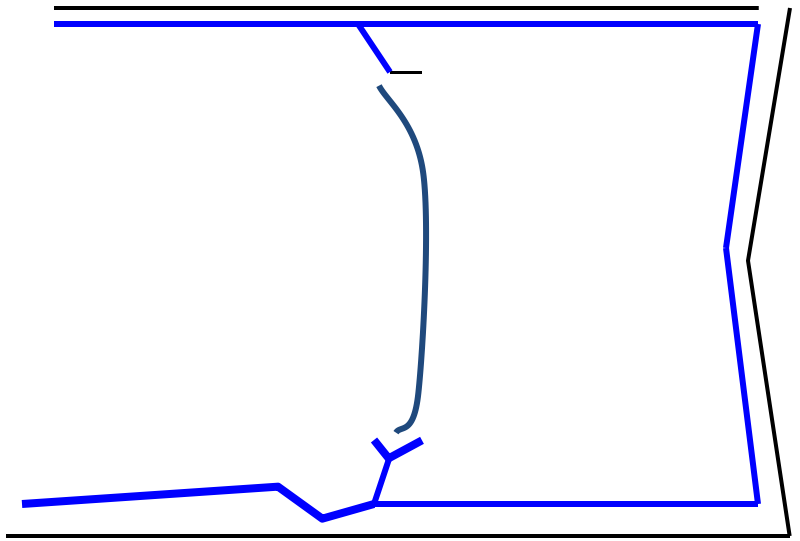
Auricle is- the auriculo-temporal branch of the trigeminal nerve, greater auricular (C2-C3), lesser occipital (C3)
EAC - auricular branch of the vagus nerve (Arnold's nerve).

MIDDLE EAR CLEFT

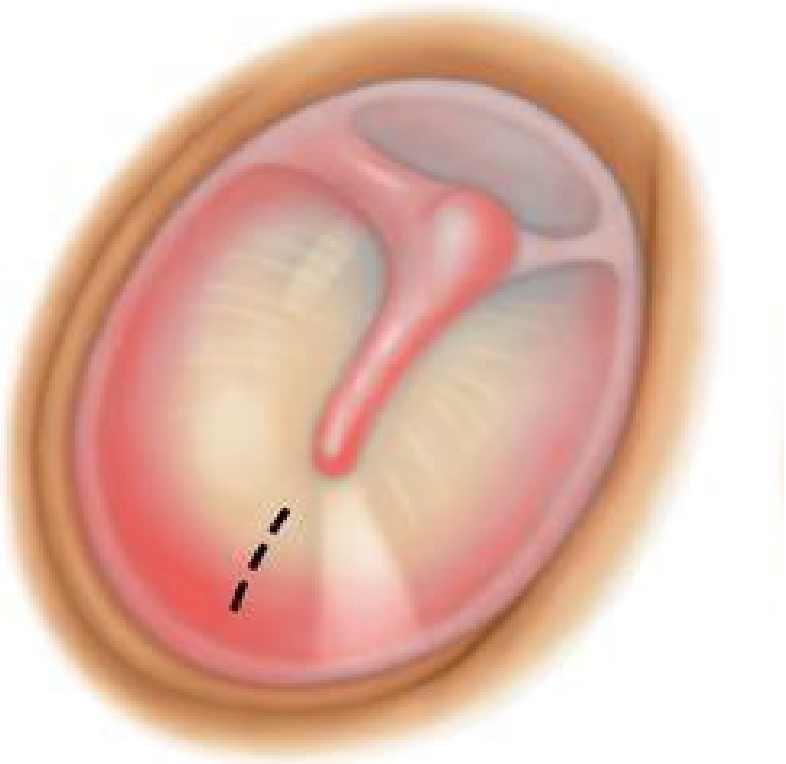
- Middle ear cavity
- Additus
- Antrum
- Mastoid air cells
- Eustachian tube

MIDDLE EAR CAVITY

- 6 sided box
- Lateral wall
- Medial wall
- Anterior wall
- Posterior wall
- Roof
- Floor

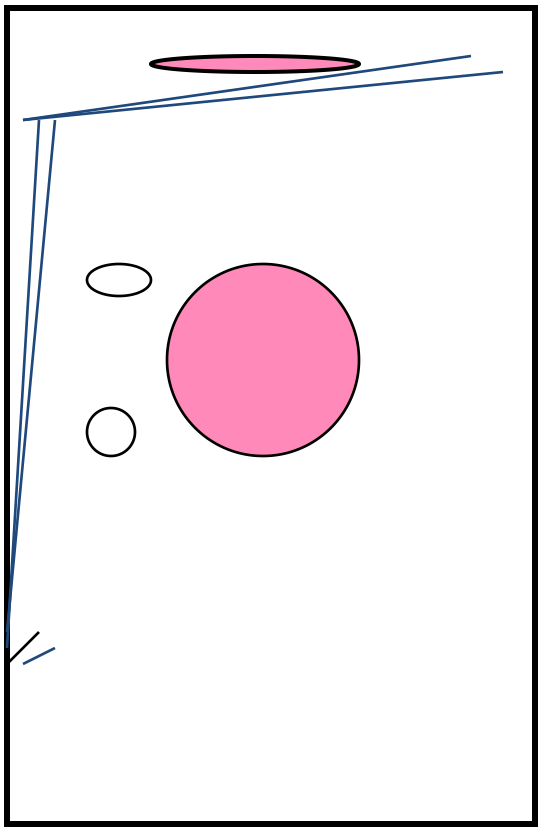


Lateral wall
Tympanic Membrane



- Thin membrane
- Forms boundary between outer and middle ear
- Vibrates in response to sound waves
- Changes acoustical energy into mechanical energy

MEDIAL WALL

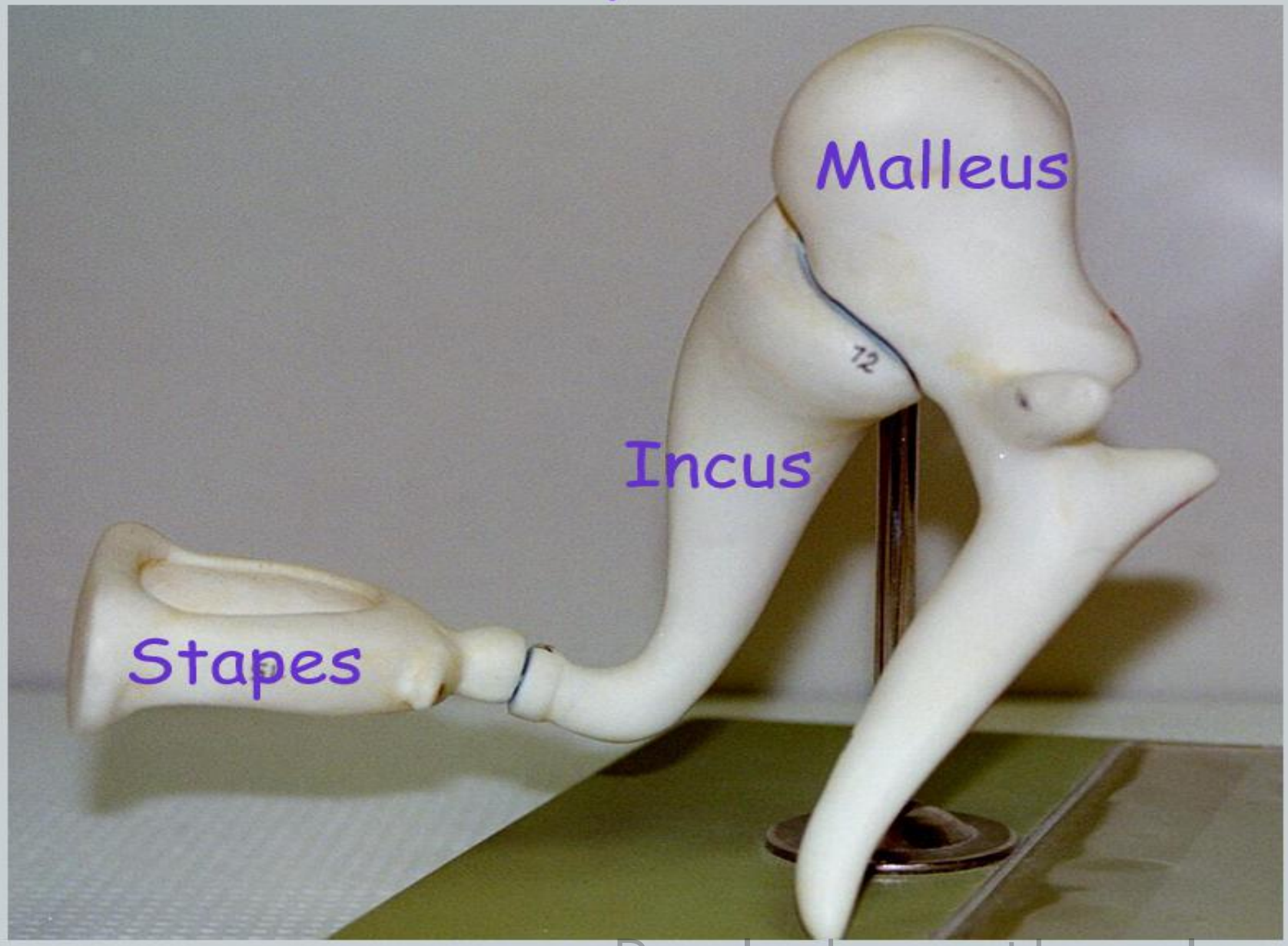


- Separates the Inner ear from ME via round window –closed by 2^0 TM
- Oval window –Stapes footplate
- Promontory -1st turn of cochlea

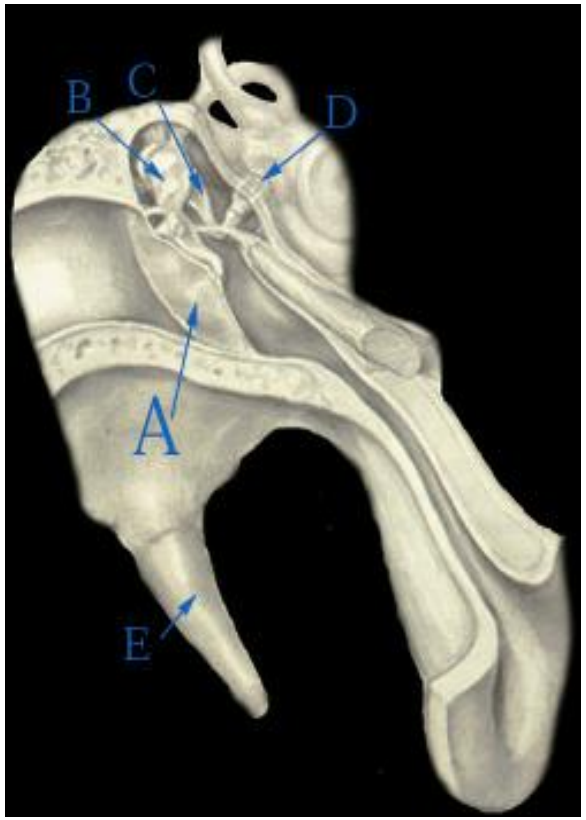
ME Cavity
Stapedius Muscle/Tensor tympani

- Attaches to stapes neck
- Contracts in response to loud sounds; (the Acoustic Reflex) - Built-in earplugs!
- Absent acoustic reflex could signal conductive loss or marked sensorineural loss
- Supplied by facial nerve
- TT- attached to handle of Malleus –supplied by mandibular branch of CN 5
- Changes stapes mode of vibration; makes it less efficient and reduce loudness perceived
-

Auditory Ossicles



Anterior wall
Eustachian Tube (AKA: “The Equalizer”)



- 37mm long – Inner 1/3 bony
- Mucous-lined, connects middle ear cavity to nasopharynx
- “Equalizes” air pressure in middle ear
- Normally closed, opens under certain conditions –swallowing, yawning
- Infection spread from Nasopharynx adult and children
- Short and wide - Childrenabnormal fxn leads to absorption of residual air in ME..there is retraction and dec TM vibration with THL

Floor and Roof

- Thin plate of bone separating the cavity from bulb of Jugular vein
- Dehiscent

- Thin plate of bone separating the cavity from middle cranial fossa and Temporal lobe of brain – Tegmen tympani

Posterior wall

communicate with mastoid antrum and air cell through a narrow aditus – infection spread.OsteomyelitisOsteomyelitis

Inner Ear

Consist of bony Labryinth

- Central Vestibule – Communicate posteriorly with the three SCC and Anteriorly withSpiral cochlear
- Cavity contain fluid called Perilymph – Encloses membranous Labyrinth

Membranous labyrinth (ML) consist of

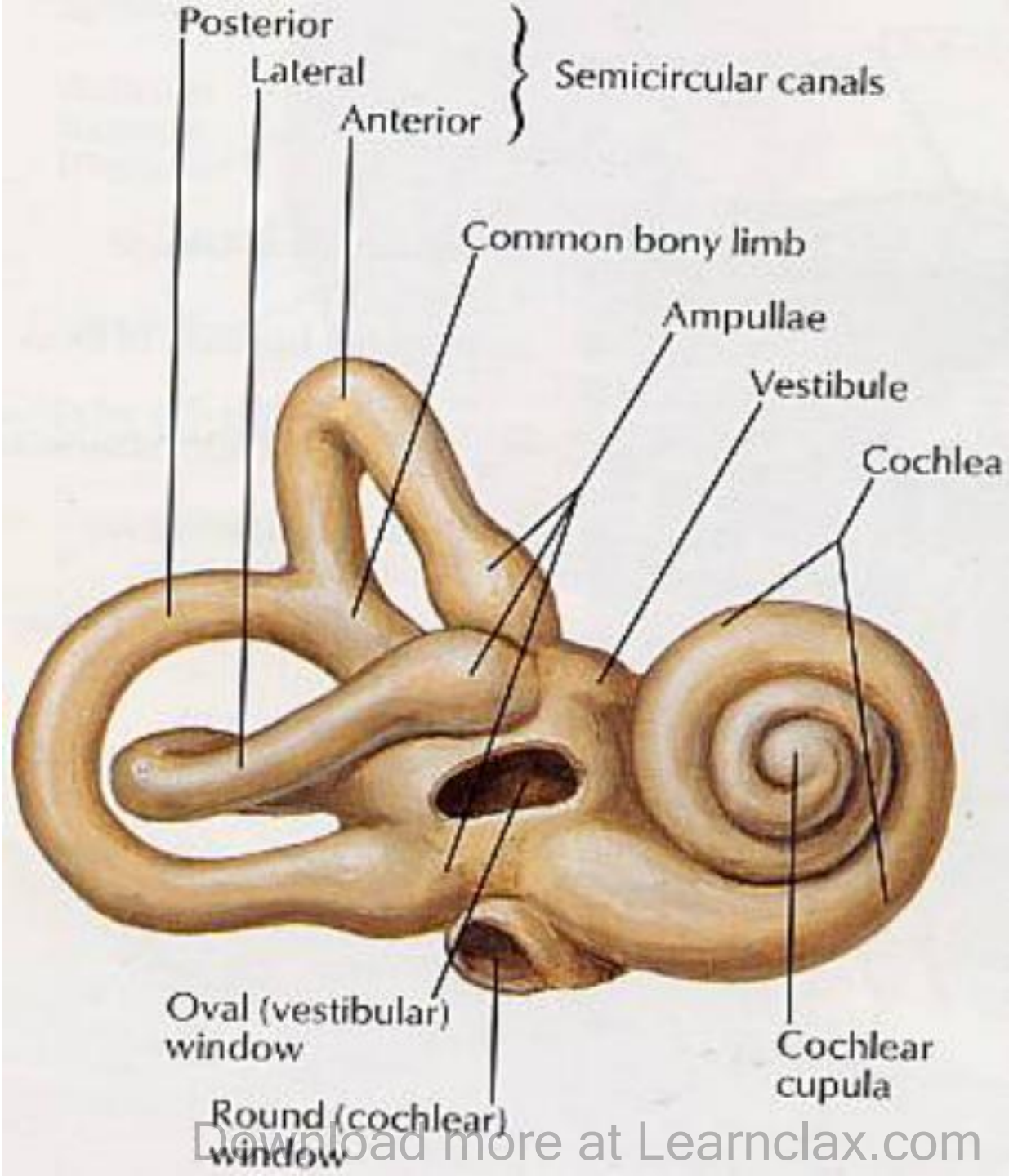
- Utricle/Saccule

Which communicate with the SCC and cochlear canal – Endolymph

Within the ML – Specialised sensory receptor –maculae of utricle/saccule/spiral organ of corti – hearing

Position of SCC-signal changes in position

Structures of the Inner Ear: The Cochlea



Physiology of the Ear

The main functions of the ear are for (1) Hearing (2) Balancing (Equilibrium)

Hearing

- The auditory functions of the ear consist of conduction of sound waves through the

  External ear, Middle ear and Cranial bones with perception of these sounds by

  cochlear nerve to the brain.

- **Equilibrium function**
- The equilibrium of the body is maintained by co-ordination of three systems:
- (1) Vestibular apparatus
- (2) Proprioceptors; and
- (3) Vision (eye)
- Loss of functions of two leads to severe problems with posture and balance.

Nose

- The nose can be divided into the external nose and the nasal cavity.
- **External nose:**

The external nose is a triangular pyramid projecting from the face with its roof above and the base directed downwards.

- Bony and cartilaginous framework. The

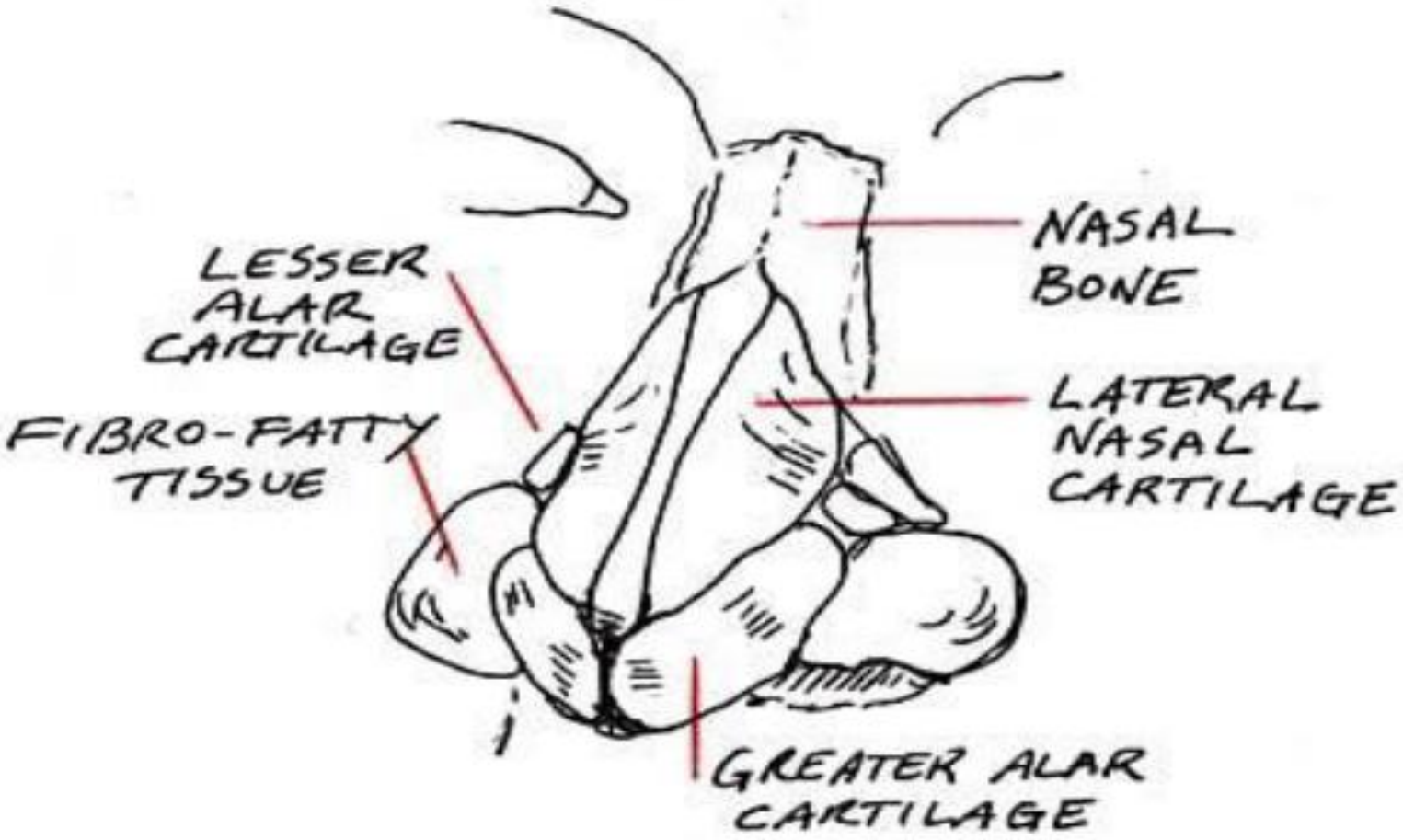
EXTERNAL NOSE

- Upper bony part of the dorsum of the nose is called the bridge.
- The rounded lower borders are called alae nasi.
- Anterior Nares are situated in the base of the nose and face downwards.
- They are separated by the columella.

EXTERNAL NOSE

- Bony framework is formed by the following bones:
- (1) The nasal bones.
- (2) The nasal processes of the frontal bone
- (3) The frontal processes of the maxilla.

Anatomy of the Nose



ANATOMY OF THE NOSE

- Cartilaginous Framework
- Small cartilages and the quadrilateral septal
- cartilage.
- Blood supply is by Facial and Ophthalmic arteries and the veins.
- Lymphatic Drainage passes to the pre-auricular and sub-mandibular lymph nodes.

NASAL CAVITIES

- The nasal Septum divides the nose into 2 nasal cavities. These two nasal cavities lie below the cranial cavity, above the oral cavity and between the orbits
- Each nasal cavity communicates with

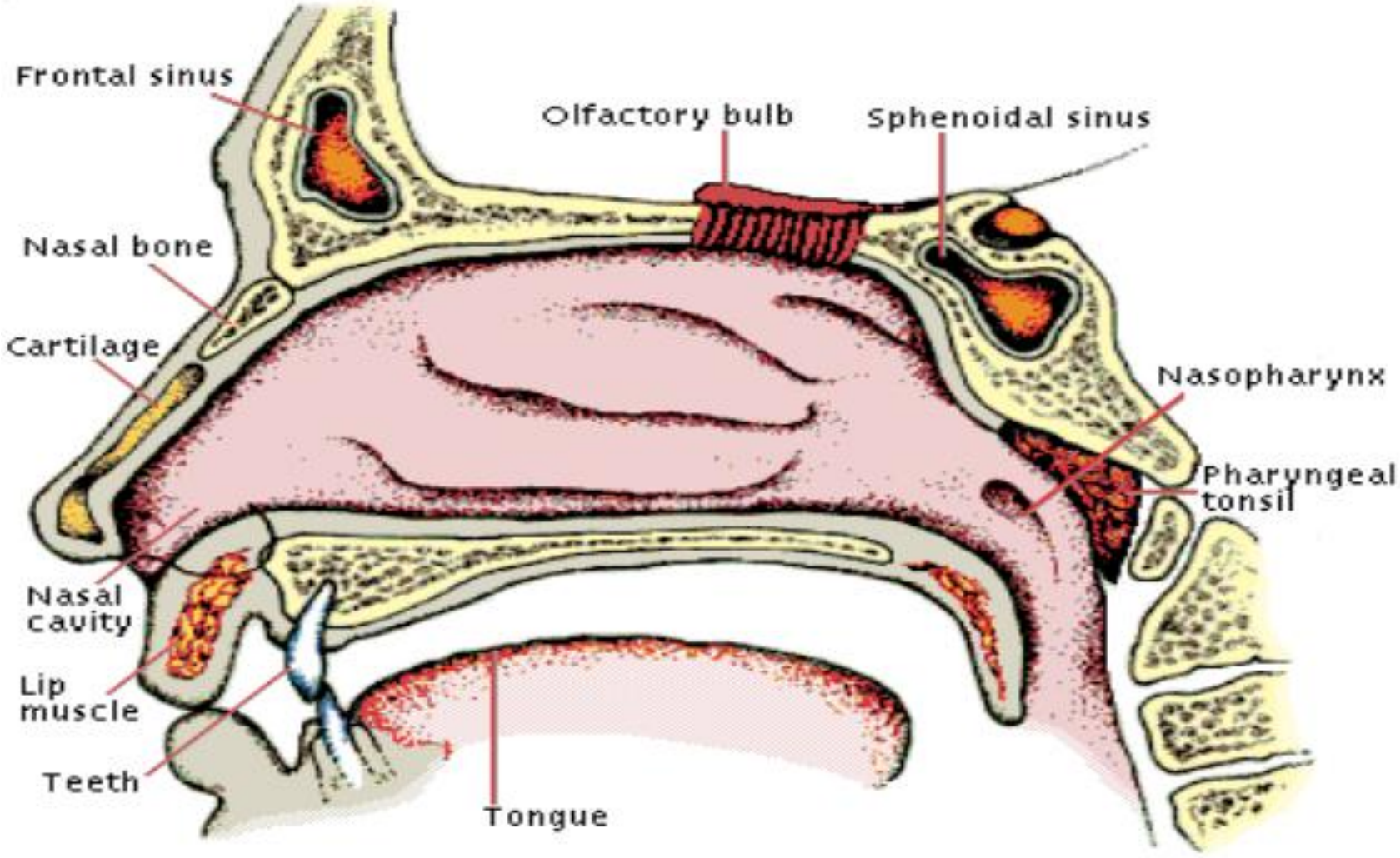
(1) Exterior through the anterior nares

(2) Nasopharynx through the posterior nares (choana)

(3) Paranasal sinuses through the Ostia.

(4) Middle ear through Eustachian tube

Nasal Cavity



Parts of the Nasal Cavity

- The nasal cavity extends from the anterior nares to the choanae posteriorly – Continous with nasopharynx.
- Vertically - from cribriform plate - Palate.
- Narrower anteriorly than posteriorly, broader at the base than superiorly.
- A median septum divides - two nasal fossae. Each half thus has a floor, a roof, a lateral wall and medial wall.

Nasal Cavity

The nasal cavity consists of 4 parts:

(1) Vestibule (2) Atrium (3) Olfactory region

(4) Respiratory region

The vestibule - anterior and inferior portion of the nasal cavity lined by skin in contrast to the rest of the nasal cavity. Has sebaceous glands and hair follicles called vibrissae.

Nasal Cavity

Atrium is the part in front of the middle turbinate.

3) Olfactory region

- The roof of the nasal cavity, above the superior turbinate and the septum. Lined by the yellow olfactory neuro-epithelium having bipolar sensory cells.

(4) The respiratory region

- The lower 2/3 of the nasal cavity is lined by pseudo stratified ciliated columnar epithelium rich in goblet cells.

Nasal Cavity

Has well vascularised mucosa with erectile muscle

It is pink in colour. It is continuous with the mucosa of the sinuses, nasopharynx and Eustachian tubes.

The ciliary movement propels the nasal secretions backwards towards the posterior choanae. The sub-epithelial tissue is also loose, very vascular and erectile. There are many mucous and serous glands.

Boundaries

- The nasal cavity
- Floor; Roof; Medial wall and Lateral wall.
- The floor –Hard palate
- Roof - Cribiform plate with olfactory nerves
- Medial wall –Septum
- The lateral wall - 3 turbinates: inferior, middle, and superior turbinates.

Lateral wall of the nose

Superior turbinates -Posterior ethmoidal sinuses.

- Middle turbinates –

i) Bulla ethmoidalis ii) Hiatus semilunaris

iii) Infudibulum iv) Opening of frontal, maxillary, anterior ethmoidal and middle ethmoidal.

- Inferior turbinate - nasolacrimal duct.
- Spheno-ethmoidal recess is above the superior meatus, the sphenoidal sinus is in this recess.

Blood supply

(1) Spheno-palatine artery

(2) Greater palatine artery

(3) Superior labial artery

(4) Anterior and posterior ethmoidal artery

Anastomose - anterio-inferior part - Kiesselbach's plexus - common site for epistaxis in children - trauma or picking the nose.

All vessels except posterior ethmoidal – Little's Area

Nerve supply

- Sensory, Olfactory and Autonomic nerves.

(1) Sensory: The sensations from the nose are through the following branches:

Ophthalmic division: anterior ethmoidal nerve.

Maxillary division – i) Anterior superior dental nerve branches of the Spheno-palatine ganglion

ii) Greater palatine nerve, iii) Short palatine nerve and iv) Long spheno-palatine nerve.

(2) Olfactory nerve - the sense of smell.

(3) Autonomic nerve supply is for sympathetic Funct.

Autonomic supply/lymphatic drainage

- Sympathetic supply - Vasoconstriction and hypo secretion
- Para-Sympathetic supply - Vasodilatation and hyper secretion
- Sub-mandibular node drains the external nose and the anterior part of the nose
- while the upper deep cervical nodes drain the rest of the nasal cavity directly or via
- the retropharyngeal nodes.

Applied Anatomy

(1) Dangerous area of the face.

- The lower part of the external nose and the upper lip - Infection may spread to the cavernous sinus via the inferior ophthalmic veins.

(2) Dangerous area of the nose.

- The olfactory area of the nose may infect the meninges along the pia and arachnoid sheaths of the olfactory nerve passing through the cribriform plate of the ethmoid.

Applied Anatomy

(3) Nasal Infection may spread to the paranasal sinuses, Eustachian tube and the respiratory tract by direct continuity.

Paranasal Sinuses

- Air filled spaces in certain bones of the skull - in direct communication with the nasal cavity through their openings called ostia.

They can be divided into 2 groups:

(1) Anterior group – frontal, anterior ethmoidal and maxillary air sinuses.

(2) Posterior group – posterior ethmoidal and sphenoidal air sinuses.

Functions of the Nose

(1) Respiration: The nose is for breathing. Mouth breathing occurs when the nose is blocked.

(2) Air conditioning: The air inhaled through the nose is warmed and moistened before the lungs

(3) Protection: Inhaled air is purified in the FF ways

(a) Vibrissae filter coarse particles.

(b) Cilia remove smaller particles which stick to the mucosa in the nose and are passed backwards into the pharynx by the ciliary's movements.

The mucous which reaches the pharynx is swallowed.

Functions of the nose

(c) Lysozymes can kill the bacteria.

(d) Sneezing throws out irritating particles or fumes from the nose.

(4) Olfaction is an important function of the nose and it has a protective value against dangers.

(5) Resonance is added to voice by the nasal cavity.

(6) Eustachian Tube functioning: The nose permits equalization of pressure of air between the external atmosphere and the middle ear cavity through the Eustachian tube.

Functions of the nose

- (7) Drainage: The paranasal sinuses and nasolacrimal duct drain into the nasal
- cavity.
- (8) Reflexes: Sneezing is a reflex action that has a protective function. When the
- individual is exposed to irritants, the respiration may be stopped temporarily.
- Olfactory sense may also reflexly stimulate salivary and gastric secretions

Functions of the Paranasal Sinuses

- The functions of the paranasal sinuses include the following:
- (1) Reduction of the weight of the skull
- (2) Vocal resonance
- (3) Rapid growth of the face due to formation of the sinuses
- (4) Protection of the orbit
- (5) Air conditioning

Anatomy and Physiology of the Throat (Pharynx)

Funnel shaped fibro-muscular tube that forms the upper part of the digestive and respiratory tracts - lined by mucous membrane.

It extends from the base of the skull - body of the C6

Nasal cavity, Oral cavity,Laryngeal inlet - Open into it

Corresponding part of the pharynx is named as

- (1) Nasopharynx: opening into the nasal cavity.
- (2) Oro-pharynx: opening into the oral cavity.
- (3) Laryngopharynx (Hypopharynx)

Anatomy and Physiology of the Throat (Pharynx)

The lower end of the pharynx is continuous with the Oesophagus. This is the narrowest part of the gastro-intestinal tract called cricopharynx behind the cricoid cartilage.

- It is about 10-15 cm long in adult; it is shaped like a funnel with the broad end at the top.

Structure of the Pharynx

The pharynx has 5 layers

(1) mucous membrane (2) Waldeyer's ring in the sub mucosa (3) pharyngeal aponeurosis

(4) muscular coat (5) buccopharyngeal fascia

The mucous membrane

(a) Ciliated columnar epithelium and (b) Transitional epithelium upper & lower half of the nasopharynx.

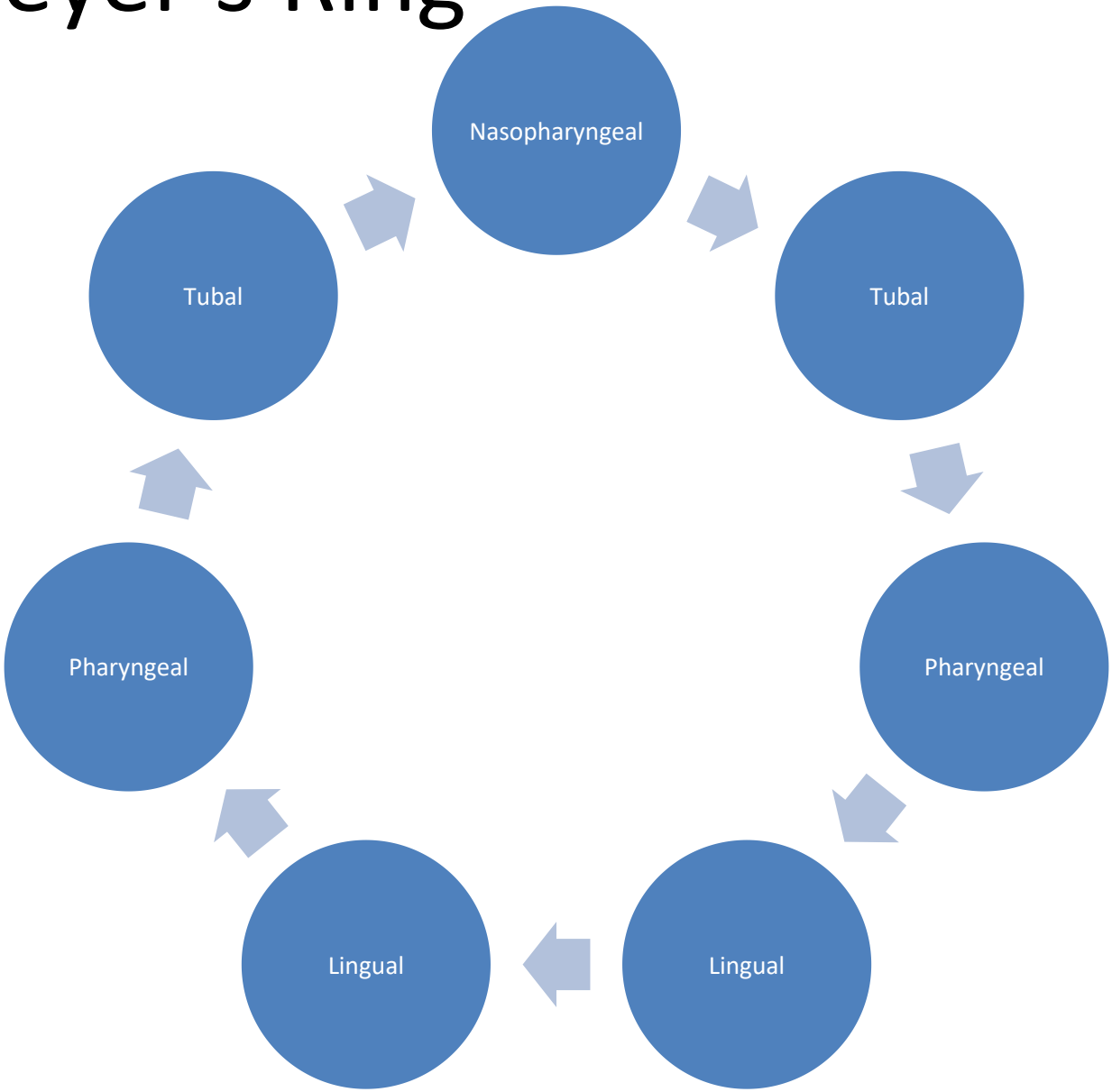
(c) Stratified squamous epithelium – Oropharynx and laryngopharynx.

Waldeyer's ring in the sub mucosa

Collection of lymphoid tissue scattered in the pharynx. The lymphoid ring has efferent vessels, but no afferent vessels.

The Waldeyer's ring consists of: **(a)** Palatine tonsils (The Tonsil) **(b)** Nasopharyngeal tonsil (Adenoid) **(c)** Tubal tonsils in the fossa of Rosen Muller behind the opening of the E.T. **(d)** Lingual tonsils spread on the posterior – third of the tongue. **(e)** Lateral pharyngeal bands behinds the posterior faucial pillars **(f)** Pharyngeal nodules in the posterior pharyngeal wall

Waldeyer’s Ring



Structure of the Pharynx

The lymphoid tissue is small at birth; it increases in size till age 8 – 10 years & by 15yr -regresses

(3) **Pharyngeal Aponeurosis -** an incomplete coat of connecting tissue between the sub mucosal and muscular layers.

Pharyngobasilar fascia - thickest upper part of the aponeurosis.

Structure of the Pharynx

(4) **Muscular Coat**

There are External Layer and Internal Layer of muscles.

(a) The external Layer: The superior, middle and inferior constrictor muscles –overlapp each other

All the muscles arise from anterior structures, and pass backwards to be inserted into median raphe. Function- The constrictors narrow the pharynx

Structure of the Pharynx

- (b) Internal Layer: The stylopharyngeus, palatopharyngeus and salpingo-
- Pharyngeus muscles constitute this layer. Function -These muscles shorten the pharynx.

(5) **Buccopharyngeal fascia**

- Is a thin layer covering the outer surface of the external muscles.

Blood Supply/Venous drainage

The pharynx is supplied by facial artery, given off the tonsillar branch. There is also twinge from:

i) Ascending pharyngeal artery

ii) Descending palatine artery

iii) Dorsalis lingua artery

iv) Greater palatine artery

- The veins form the pharyngeal plexus
- common facial vein and
- internal jugular vein

Nerve supply/Lymphatics

The pharynx is supplied

i) pharyngeal plexus formed by the 9th, 10th and 11th CN

The 5th CN - supplies innervations to the nasopharynx.

- The pharynx drains to the deep cervical lymph nodes directly or indirectly through

  the retropharyngeal and jugulodigastric nodes

APPLIED ANATOMY

(a) Killian's Dehiscence: Is a potential gap between the two part of the Inferior

Constriction muscle, namely the oblique thyropharyngeus and transverse

- cricopharyngeus. - pharyngeal pouch -a prolapse of the mucous membrane This may be due to neuromuscular in-coordination

APPLIED ANATOMY

(b) Capsule of the tonsil, which is a part of the pharyngeal aponeurosis, form the plane of dissection in tonsillectomy.

(c) Paratonsillar vein may lead to severe haemorrhage during or after tonsillectomy.

(d) Referred pain in the ear after tonsillectomy commonly occurs, because the ears & tonsils are supplied by the glossopharyngeal nerve.

APPLIED ANATOMY

(e) Blood clot in the tonsillar fossa prevents retraction and contraction of the blood vessels. As a result, the bleeding continues like uterine bleeding until the clot is removed.

(f) Intratonsillar cleft is the usual source of peritonsillar abscess. Recurrent quinsy may render the dissection of the tonsils during tonsillectomy difficult due to adhesion.

Physiology of the Pharynx

- **(A) Functions of the Tonsils**

(1) Tonsils play an important role in acquiring immunity against infections especially in the first 5 years of life.

(2) Tonsils along with other lymphoid tissues in the body also form lymphocytes.

(3) Tonsils also produce Antibodies Ig A.

(4) Tonsils produce barrier to infection spread to the body through the Waldeyer's ring.

(B) Functions of the Nasopharynx

1. Is a conduit for humidified air to pass from the nasal cavity to the lower respiratory tract.
2. Ventilates the middle ear through the eustachian tube and helps maintain middle ear pressure.
3. It acts as a resonating chamber for voice production
4. It acts as a drainage channel for mucous secreted by nasal and paranasal sinus mucosa.
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(C) Functions of the Oro-pharynx

1. Conduit for food and air.
2. Is involved in the pharyngeal phase of deglutition, prevents food from regurgitating into the Nasophx.
3. Aids in production speech.
4. A few taste buds are present at the base of tongue and soft palate.
5. The mucous membrane produces secretions which lubricates the pharynx.

(D) **Functions of the Laryngopharynx**

1. It is a common passage for both air and food.
2. It is a resonance chamber during the production of speech.
3. It is also involved in the pharyngeal phase of deglutition.

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