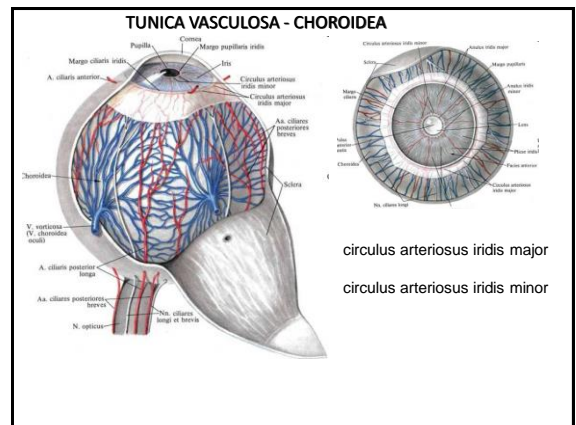
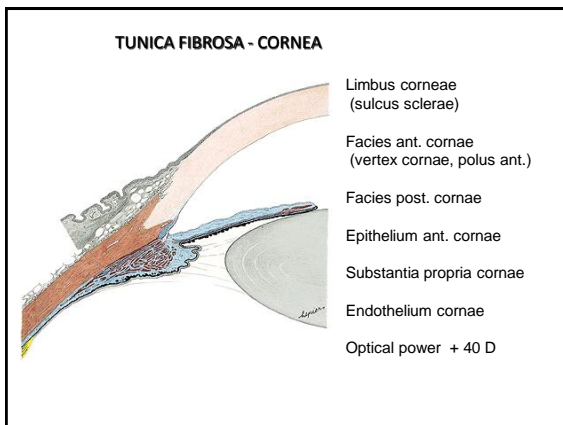
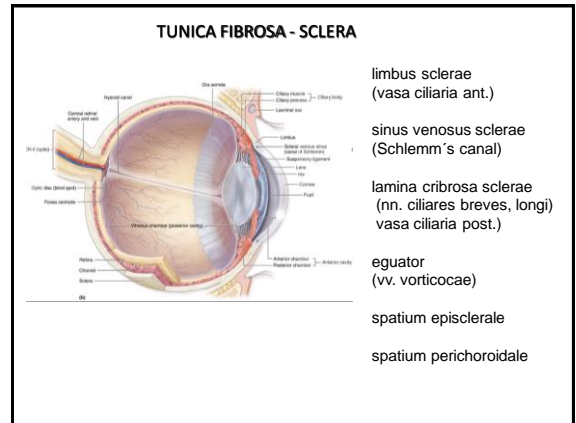
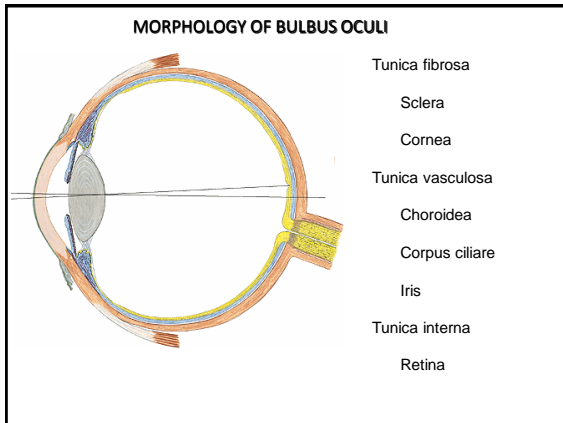
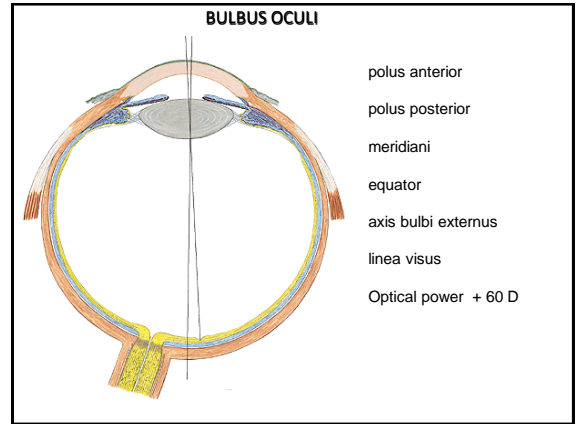
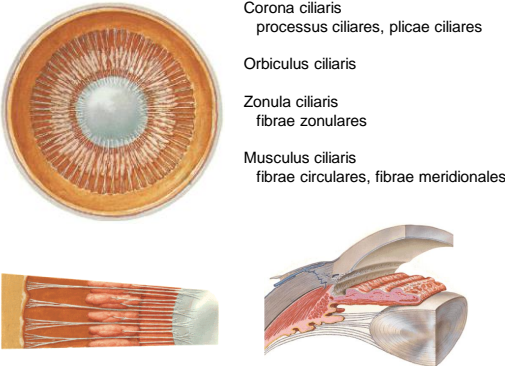


Visual system, vestibular and auditory system

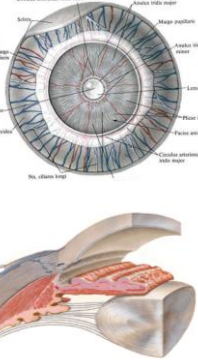


TUNICA VASCULOSA – CORPUS CILIARE



- Corona ciliaris
processus ciliares, plicae ciliares
- Orbiculus ciliaris
- Zonula ciliaris
fibrae zonulares
- Musculus ciliaris
fibrae circulares, fibrae meridionales

TUNICA VASCULOSA – IRIS

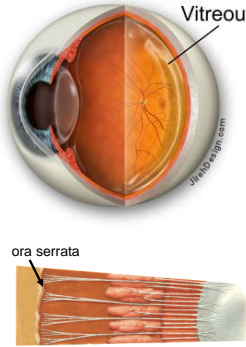


- margo ciliaris
- margo pupillaris (pupilla)
- facies ant. iridis
(anulus iridis major, minor)
- facies post. iridis

STROMA IRIDIS

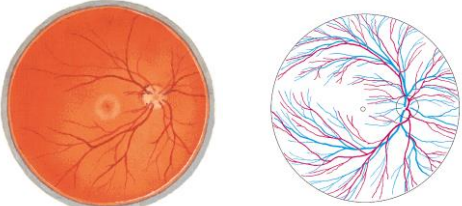
- m. sphincter pupillae
(miosis, parasympaticus)
- m. dilatator pupillae
(mydriasis, sympaticus)
- pigment (eye color)

TUNICA INTERNA – RETINA



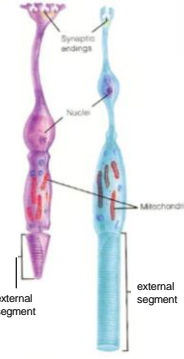
- Vitreous
- Pars caeca retinae
- pars ciliaris retinae
- pars iridica retinae
- Ora serrata
- Pars optica
- fotoreceptors (coni, bacilli)

FUNDUS OCULI



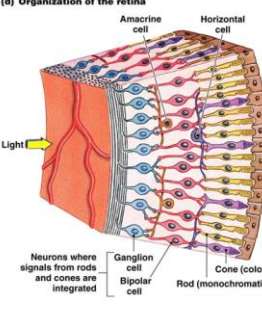
- Macula lutea
- fovea centralis (linea visus)
- Macula caeca
- discus n. optici, papilla n. optici, excavatio disci
- Vasa centralia retinae
(arteriolae et venulae maculares)

MORPHOLOGY OF RETINA



- Stratum pigmentosum
- Stratum neuroepitheliale
coni (6-7 million, macula lutea)
bacilli (130 million)
- Stratum ganglionare retinae
bipolar neurons
- Stratum ganglionare n. optici
multipolar neurons

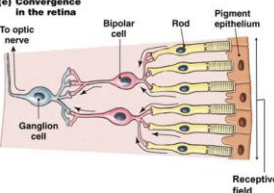
(d) Organization of the retina



Neurons where signals from rods and cones are integrated

- Amacrine cell
- Horizontal cell
- Ganglion cell
- Bipolar cell
- Cone (color vision)
- Rod (monochromatic vision)

(e) Convergence in the retina



- To optic nerve
- Ganglion cell
- Bipolar cell
- Rod
- Pigment epithelium
- Receptive field

OPTIC TRACT

1. neuron
coni, bacilli
2. neuron
bipolar cells
3. neuron
multipolar cells
4. neuron
corpus geniculatum laterale

Area 17, 18, 19

LENS CRYSTALLINA

Facies anterior lentis (polus anterior lentis)
Facies posterior lentis (polus posterior lentis)
Equator lentis (fibrae zonulares)

MORPHOLOGY

Capsula lentis
Substantia lentis (fibrae lentis)
Epithelium lentis
Cortex lentis
Nucleus lentis

ACCOMMODATION-LENS

a) Looking into the distance
b) Near vision (m. ciliaris)

CORPUS VITREUM

Camera vitrea bulbi
Membrana vitrea
Stroma vitreum
Humor vitreus
Fossa hyaloidea
Canalis hyaloideus a. hyaloidea

CAMERAE BULBI

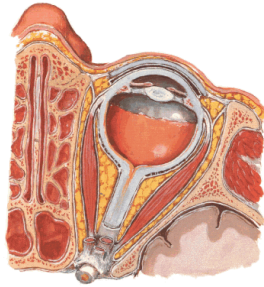
Camera oculi anterior
Camera oculi posterior
Camera vitrea
Humor aquosus
Angulus iridocornealis
Lig. pectinatum anguli iridocornealis
Spatia iridocornealia
Sinus venosus sclerae
Venulae aquosae

MUSCULI BULBI

m. rectus superior, inferior, medialis, lateralis
m. obliquus superior, inferior
m. levator palpebrae superioris

FASCIAE ORBITALES

- Periorbit (m. orbitalis)
- Vagina bulbi
- Spatium episclerale
- Corpus adiposum orbitae



PALPEBRAE

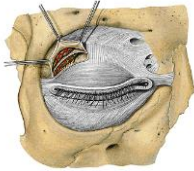


- palpebra superior, inferior
- rima palpebrarum
- angulus oculi medialis, lateralis
- facies anterior, posterior palpebrae
- limbus palpebralis anterior (cilia, gl. sebaciae, gl. ciliares)

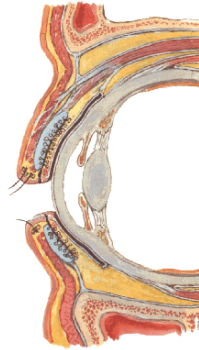


- limbus palpebralis posterior
- rivus lacrimalis
- papilla lacrimalis (punctum lacrimale)

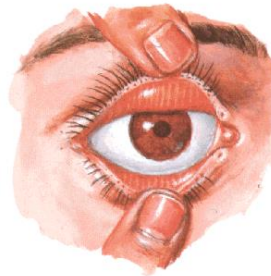
EYELID MORPHOLOGY



- septum orbitale
- tarsus superior, inferior
gl. tarsales (Meibomi)
- lig. palpebrale med., lat.
- m. tarsalis sup., inf.
- m. orbicularis oculi



CONJUNCTIVA

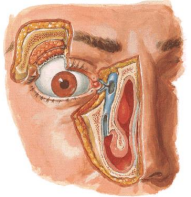


- tunica conjunctiva palpebrarum
- tunica conjunctiva bulbi
- fornix conjunctivae sup., inf.,
- saccus conjunctivae
- plica semilunaris conjunctivae
- lacus lacrimalis
- caruncula lacrimalis
- papilla lacrimalis
- punctum lacrimale

APPARATUS LACRIMALIS



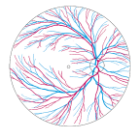
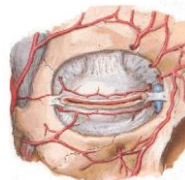
- Gl. lacrimalis (pars orbitalis a palpebralis)
- Ductuli excretorii (fornix conjunctivae sup.)
- Lacrimae
- Punta lacrimalis
- Canaliculi lacrimales (ampulla canaliculli lacrimalis)
- Saccus lacrimalis (fornix sacci lacrimalis)
- Ductus nasolacrimalis (meatus nasi inferior)
- Plica lacrimalis



ARTERIA OPHTHALMICA



- a. centralis retinae
- a. lacrimalis (aa. palpebrales lat.)
- rr. musculares (a. ciliares ant.)
- a. ciliares posteriores breves et longi (circulus art. iridis major, minor)
- a. supraorbitalis
- a. ethmoidalis post. et ant. (a. meningea ant.)
- aa. palpebrales med.
- a. supratrochlearis
- a. dorsalis nasi




VENAE OPHTHALMICAE
v. ophthalmica sup.

- v. nasofrontalis
- vv. palpebrales
- vv. ethmoidales ant., post.,
- v. lacrimalis
- vv. vorticosae
- vv. ciliares
- v. centralis retinae

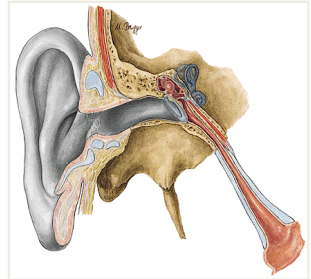
(fissura orbitalis sup., sinus cavernosus)

v. ophthalmica inferior
 venous net on the bottom of orbit
 (fissura orbitalis inf., plexus pterygoideus)

Anastomosis with v. facialis (v. faciei profunda, v. angularis),

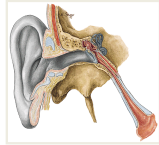


ORGANUM VESTIBULOCOCHLEARE
 Cochlear apparatus – perception of sound
 Vestibular apparatus – perception of position and movement of the head in space



Division of the organum vestibulocochleare

- I. Auris externa (external ear) – catches sound waves and transport them to the tympanic cavity
 - 1) Auricula
 - 2) Meatus acusticus externus
 - 3) Membrana tympani
- II. Auris media (middle ear)
 - 1) Cavum tympani
 - 2) Ossicula auditus and their ligg. and articulationes
 - 3) Musculi ossiculorum auditus
 - 4) Tunica mucosa cavi tympani
 - 5) Tuba auditiva (auditory tube - Eustachian tube)
 - 6) Cellulae mastoideae
- III. Auris interna (internal ear)
 - 1) Labyrinthus osseus (bone labyrinth)
 - 2) Labyrinthus membranaceus (membranous labyrinth)

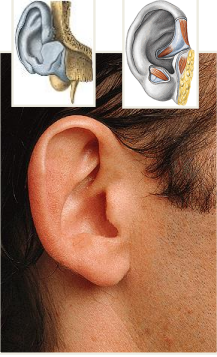


I. Auris externa (external ear)

1) Auricula

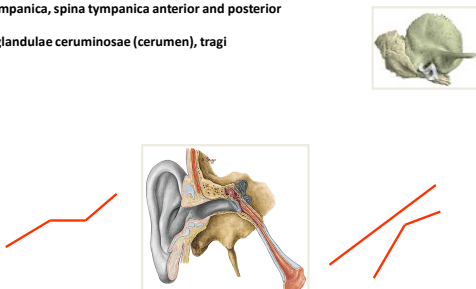
lateral surface - cartilago auriculae, lobulus auriculae helix, crus helicis, scapha, anthelix, crura anthellicis, fossa triangularis, concha auriculae with cymba conchae, cavum conchae, porus acusticus externus, tragus, antitragus, incisura intertragica

medial surface - eminentia scaphae, eminentia conchae, eminentia triangularis, fossa anthellicis



2) Meatus acusticus externus (about 3.5 cm long)
 Porus acusticus externus (med. 1/3 VM, middle 1/3 T, lat 1/3 VM)
 isthmus between bone and cartilagineous part
 lat. 2/3 – cartilago meatus acustici externi (groove opened up and dorsally),
 med. 1/3 meatus acusticus externus osseus (pars tympanica, sulcus tympanicus, incisura tympanica, spina tympanica anterior and posterior)

Skin with glandulae ceruminosae (cerumen), tragi

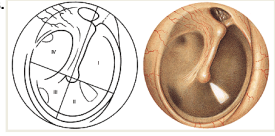


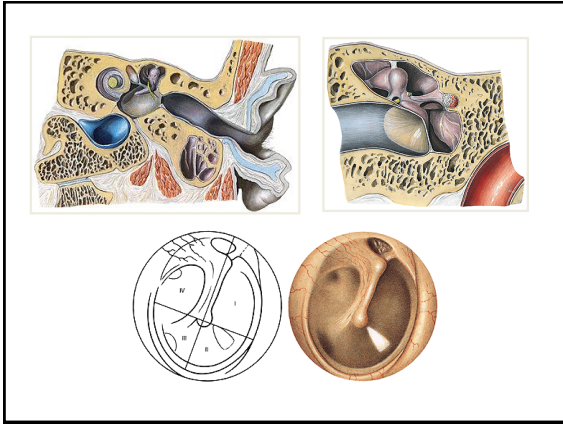
3. Membrana tympani = (TM) (ear drum) (about 11x9 mm)

Limbus membranae tympani, anulus fibrocartilagineus in sulcus tympanicus, umbo, stria mallearis, prominentia mallearis, plica mallearis anterior and posterior and between them pars flaccida (Schrapnell's membrane), rest of (TM) - pars tensa membranae tympani, light reflex

Position:
 horizontal plane - 45° (inclination of TM)

Structure of (TM)
 Stratum fibrosum + anulus fibrocartilagineus, externally skin, internally mucosus.





CAVUM TYMPANI (TYMPANIC CAVITY=TC)
 Shape as a biconcave lens

Lateral wall (paries membranaceus): membrana tympani, recessus epitympanicus and hypotympanicus

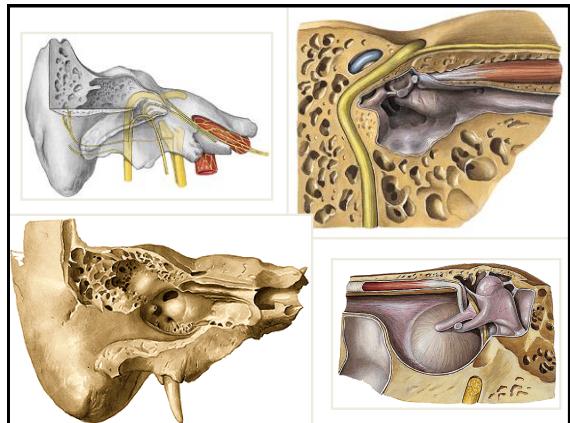
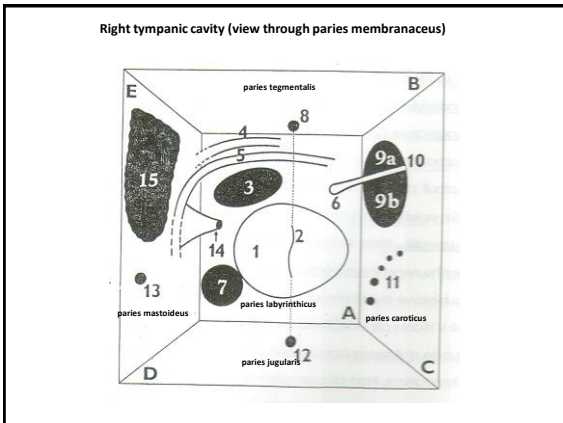
Medial wall (paries labyrinthicus): promontorium (1st whorl of cochlea), fenestra cochleae (with membrana tympani secundaria), fenestra vestibuli (with basis of stapes), prominentia canalis semicircularis lateralis and prominentia canalis facialis, sulcus promontorii (for n. tympanicus), processus cochleariformis (turns here tendo of m. tensor tympani)

Upper wall (paries tegmentalis): tegmen tympani, apertura tympanica canalis nervi petrosi minoris (=lesser petrosal nerve)

Caudal wall (paries jugularis): apertura tympanica canaliculi tympanici

Anterior wall (paries caroticus): canalis musculotubarius (semicanalis m. tensoris tympani and semicanalis tubae auditivae), canaliculi caroticotympanici, fissura petrotympanica (for chorda tympani)

Posterior wall (paries mastoideus): antrum mastoideum, cellulae mastoideae, eminentia pyramidalis (for m. stapedius), apertura tympanica canaliculi chordae tympani



Ossicula auditus (malleus, incus, stapes)

Malleus – caput mallei, collum mallei, manubrium mallei (fuses with membrana tympani and forms stria mallearis), processus anterior (to the fissura petrotympanica), processus lateralis (fuses with membrana tympani and forms prominentia mallearis)

Incus – corpus incudis, crus breve, crus longum with processus lenticularis (joins with head of stapes)

Stapes – caput stapedis, basis stapedis (located in fenestra vestibuli), crus anterior (straight) and crus posterior (curved)

Ligaments:

Lig. mallei anterior (through fissura petrotympanica to spina sphenoidalis)

Lig. mallei superius (joins head of malleus to the tegmen of TC (= tympanic cavity))

Lig. mallei laterale (to the edge of incisura tympanica)

Lig. incudis superius (joins corpus incudis with tegmen of TC)

Lig. incudis posterius (between crus breve incudis and dorsal wall of TC)

Lig. anulare stapedis (joins basis stapedis and fenestra vestibuli)

Membrana stapedis (between crura and basis stapedis)

Joints:

Articulatio incudomallearis (caput mallei + corpus incudis, sellar joint)

Articulatio incudostapedia (processus lenticularis incudis + caput stapedis, spheroid joint but with minimal movements)

Muscles:
M. tensor tympani (wall of upper part of musculotubar canal – tendon around of processus cochleariformis – manubrium mallei, V)
M. stapedius (eminentia pyramidalis – crus posterior stapedis, VII., takes off stapes from the fenestra vestibuli)

Mucosis:
Plica mallearis anterior (covers processus anterior of malleus)
Plica mallearis posterior (from collum mallei dorsally – up and laterally – recessus membranae tympani superior = Prusack's cavity /lat. pars flaccida MT, med. collum mallei, cran. lig. mall. lat, caud. continues to recessus MT posterior)

BOTH MALLEAR PLICAE form **PLICA CHORDAE TYMPANI** (chorda passes between manubrium mallei and crus longum incudis)

Plica incudis (from crus longum incudis to dorsal wall of TC)
Plica stapedis (covers stapes and tendon of m. stapedis)

Tuba auditiva (auditory tube, Eustachian tube)
joins tympanic cavity with pharynx (baroperception)

3.5-4 cm, ostium pharyngeum TA – from here lat. + dors. + up and opens in TC to anterior wall as ostium tympanicum of TA.
Lateral 1/3 is located in semicanalis TA = pars ossea TA, medial 2/3 = pars cartilaginea TA – is opened caudally (with lamina membranacea), between bone and cartilaginous part is isthmus TA;
mucosis – continuation of nasopharynx mucosis and mucosis of TC, tonsilla tubaria

Muscles:
m. tensor veli palatini and **m. levator veli palatini**.
Cellulae mastoideae (antrum mastoideum, mucosis continues from CT)

Vessels and nerves of CT

Arteries:
A. tympanica inferior (from a. pharyngea ascendens - a. car. ext., canaliculus tympanicus)
A. tympanica posterior (from a. stylomastoidea – a. car. ext. – to CT through canaliculus chordae tympani)
A. tympanica superior (a. meningea media – a. car. ext. – through can. n. petrosi minoris)
A. tympanica anterior (a. maxillaris – a. car. ext. – through fissura petrotympanica)
Rr. carotici – (a. car. int.)

Veins:
to the v. meningea media, sinus petrosus superior and plexus pterygoideus

Nerves:
Sensory:
Plexus tympanicus (n. tympanicus IX., nn. caroticotympanici – sympathetic, + VII.)
Motor:
n. tensor tympani and n. stapedius

AURIS INTERNA

I. Labyrinth osseus
1) Vestibulum and canales semicirculares ossei
2) Cochlea
3) Perilympha

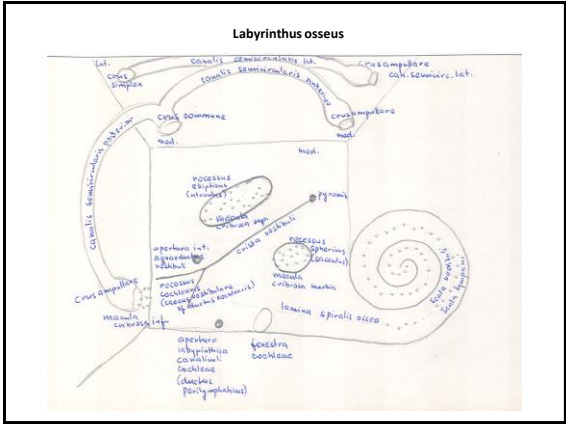
II. Labyrinth membranaceus
1) Labyrinth vestibularis
2) Labyrinth cochlearis
3) Endolympha

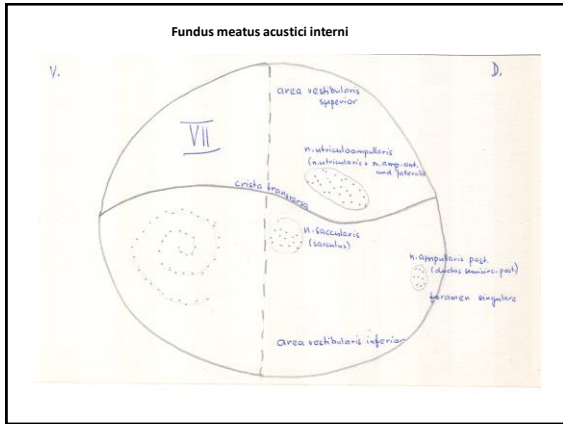
I. Labyrinth osseus

- Vestibulum
- Canales semicirculares ossei
- Cochlea
- Meatus acusticus internus

1. Vestibulum – fenestra vestibuli (for basis stapedis)
recessus utriculi=ellipticus with macula cribrosa superior (for n. utriculoampullaris)
recessus sacculi=sphericus with macula cribrosa media (for n. saccularis)
crista vestibuli with pyramid vestibuli
recessus cochlearis for caecum vestibulare
apertura interna aquaeductus vestibuli
macula cribrosa posterior (n. ampullaris posterior)
scala vestibuli cochleae

2. Canales semicirculares ossei
Lateralis, anterior, posterior – crus osseum simplex and commune, crus osseum ampullare


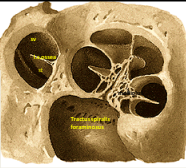




3. Cochlea

Basis cochleae, cupula cochleae

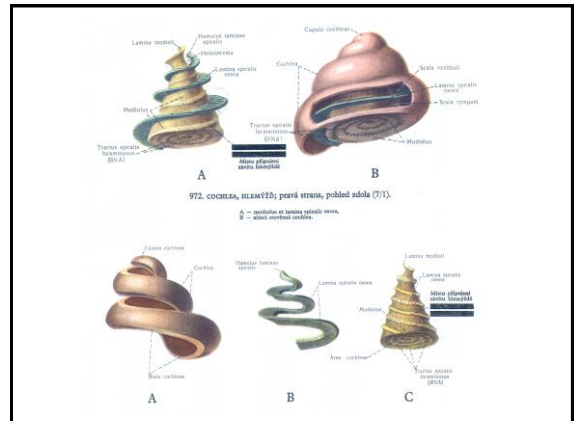
- Canalis spiralis cochleae
- Modiolus
- Lamina spiralis ossea

Ad a) Canalis spiralis cochleae – by scala vestibuli is joined with vestibulum, scala tympani passes under vestibulum, by fenestra cochleae opens to CT, ductus perilymphaticus

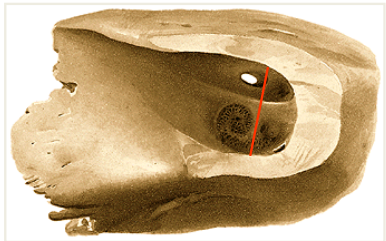
Ad b) Modiolus – basis modioli (tractus spiralis foraminosus), canales longitudinales modioli, canalis spiralis modioli (contents bodies of bipolar neurons – ganglion spirale cochleae

Ad c) Lamina spiralis ossea
Scala vestibuli (opens to vestibulum), scala tympani (opens to CT – membrana tympani secundaria), hamulus laminae spiralis, helicotrema



Meatus acusticus internus

Porus acusticus internus, fundus meatus acustici interni, crista transversa, area nervi facialis, area vestibularis superior (for n. utriculoampullaris), area vestibularis inferior (n. saccularis and foramen singulare for n. ampullaris posterior), area cochlearis with tractus spiralis foraminosus
Vestibular ganglia



II. Labyrinthus membranaceus

Spatium perilymphaticum with perilymph, inside endolymph

- Labyrinthus vestibularis
- Labyrinthus cochlearis

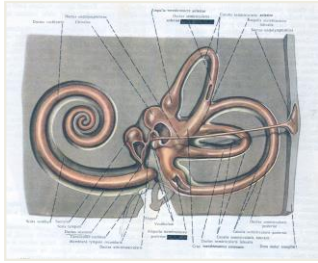
Ad II a) Labyrinthus vestibularis

- Utriculus
(on medial wall of vestibulum in recessus utriculi, from it pass 3 ductus semicirculares, by ductus utriculosaccularis is joined with sacculus)
- Sacculus
(on medial wall of vestibulum in recessus sacculi)

Epithelium – maculae staticae (macula utriculi is horizontal, macula sacculi is vertical, membrana statoconiorum with statoconia, ganglion vestibulare

Ductus utriculosaccularis, ductus endolymphaticus – aquaeductus vestibuli

3) Ductus semicirculares – crus membraceum ampullare, crus membraceum simplex (lat. canal), crus membraceum commune (ant. and post. canal), crista ampullaris, cupula ampullaris – movement of endolymph, register movements of the head



Ad II. B

Labyrinthus cochlearis

Ductus cochlearis with caecum vestibulare and caecum cupulare, ductus reuniens (joins ductus cochlearis with sacculus).

Ductus cochlearis divides bone cochlea into scala tympani and scala vestibuli helicotrema (for perilymph), membrana tympani secundaria in the fenestra cochleae – end of scala tympani.

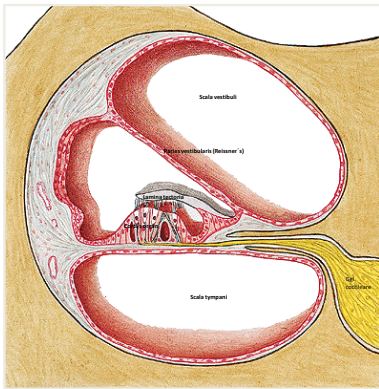
Ductus cochlearis

Lateral wall – joins with periosteum of canalis spiralis cochleae, lig. spirale cochleae, lamina basilaris, prominentia spiralis with vas prominens.

Tympanic wall – forms bottom of DC and separates it from scala tympani, labium limbi vestibulare and tympanicum, foramina nervosa, lat. part of tympanic wall is formed by membrana basilaris (between labium limbi tympanicum and lig. spirale cochleae).

Organum spirale Corti located on the membrana basilaris (two Corti's columnae – cells with hairs), above this is membrana tectoria (medially is joined to labium limbi vestibulare, laterally is free), ganglion spirale cochleae (bipolar cells) .

Vestibular wall – is formed by thin membrana vestibularis.



Endolymph – from plasma, ductus endolymphaticus to saccus and apertura externa aquaeductus vestibuli to subarachnoideal space.

Perilymph – in spatium perilymphaticum (between bone and membranaceous labyinth) – through canaliculus cochleae to subarachnoideal space.

Arteries of the inner ear:

- a. labyrinthi (from a. basilaris – aa. vertebrales)
- a. stylomastoidea (a. auricularis posterior)
- a. tympanica superior (a. meningea media)

- b. Vv. labyrinthi to the sinus transversus and sinus petrosus superior and inferior
- c. No lymph (only perilymph and endolymph)
- d. N. vestibulocochlearis VIII.

Hearing

Sound waves are caught by auricula, to the meatus acusticus externus, to MT, by movement of ossicula auditus to fenestra vestibuli of inner ear – to perilymph of scala vestibuli/tympani – oscillation of endolymph – basilar membrane and Corti's organ – 1. neuron of auditory tract.