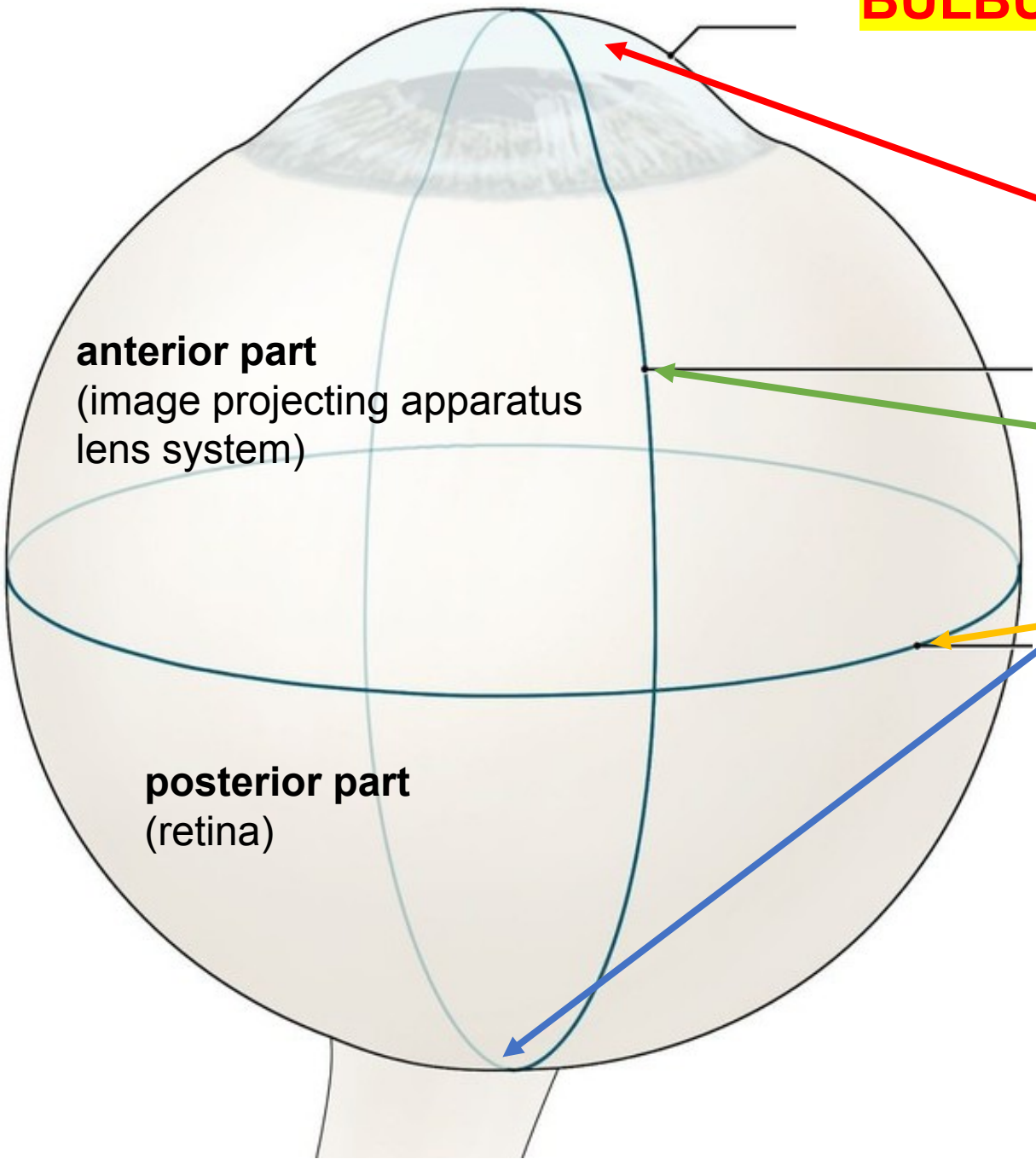
THE VISUAL SYSTEM

BULBUS OCULI



anterior part
(image projecting apparatus
lens system)

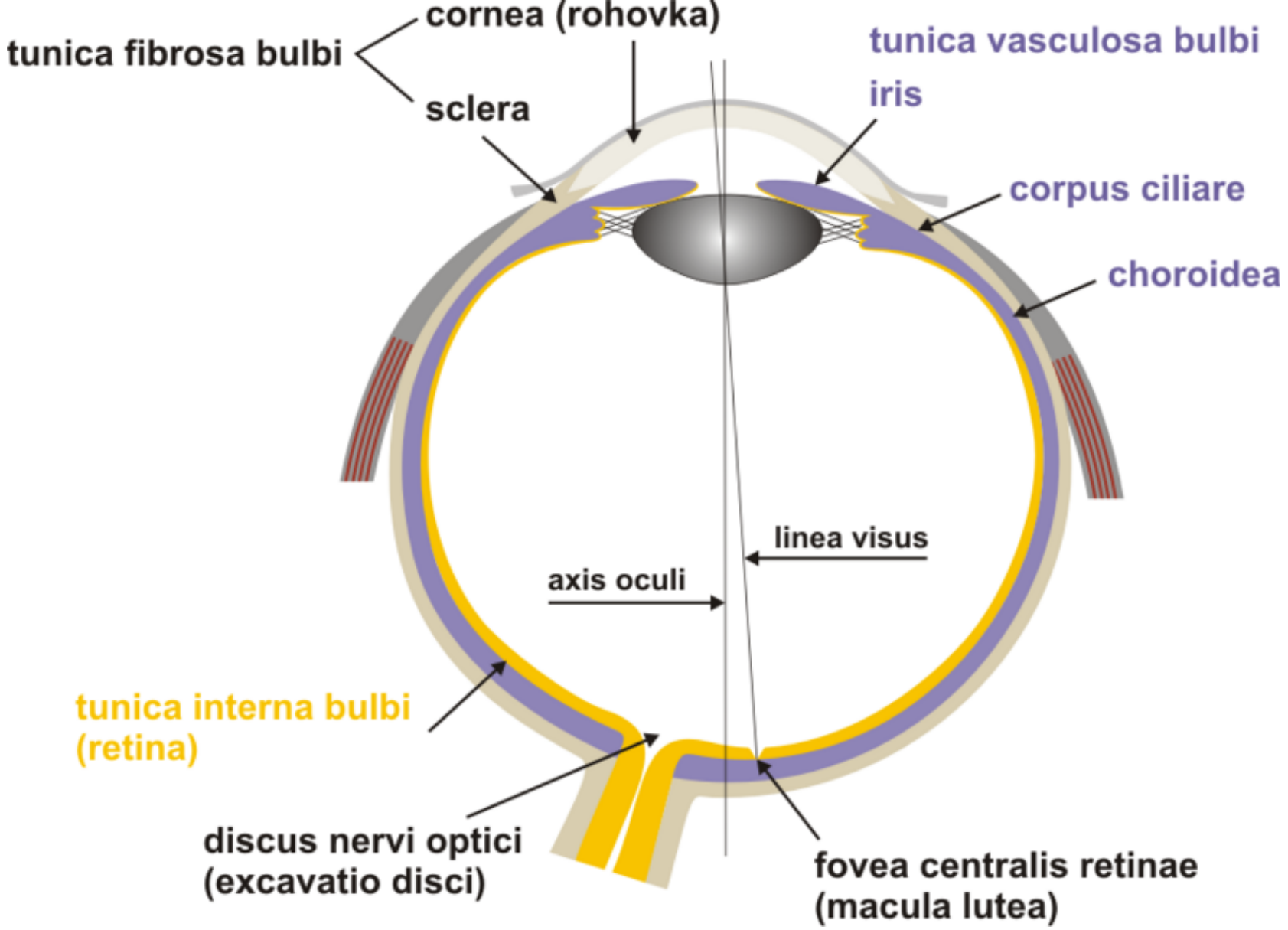
posterior part
(retina)

polus anterior et
posterior

meridiani

equator

BULBUS OCULI
EYEBALL



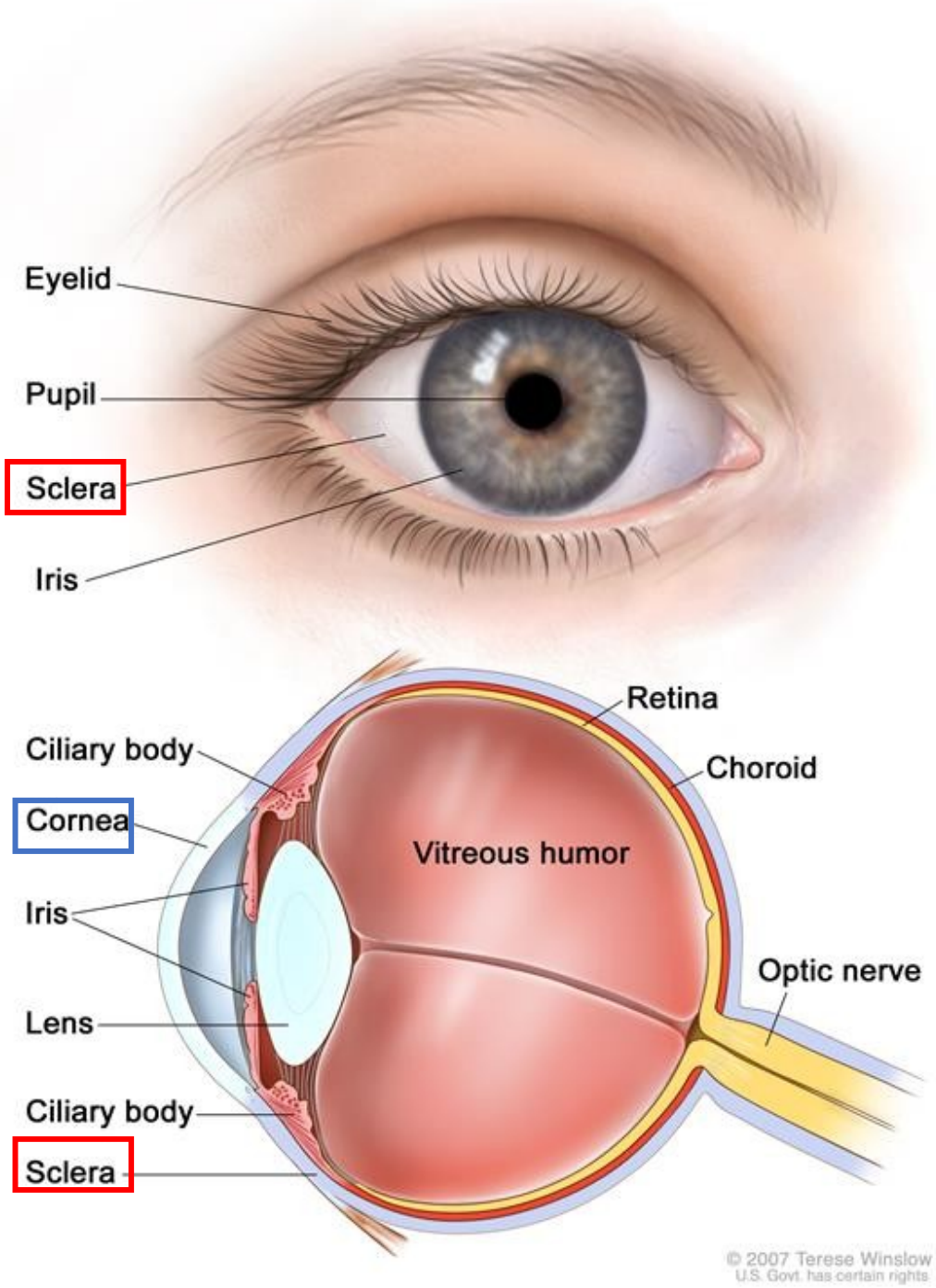
axis bulbi externus
X
linea visus

1. **Tunica fibrosa**
2. **Tunica vasculosa**
3. **Tunica interna (nervous tunic)**

1. Tunica fibrosa

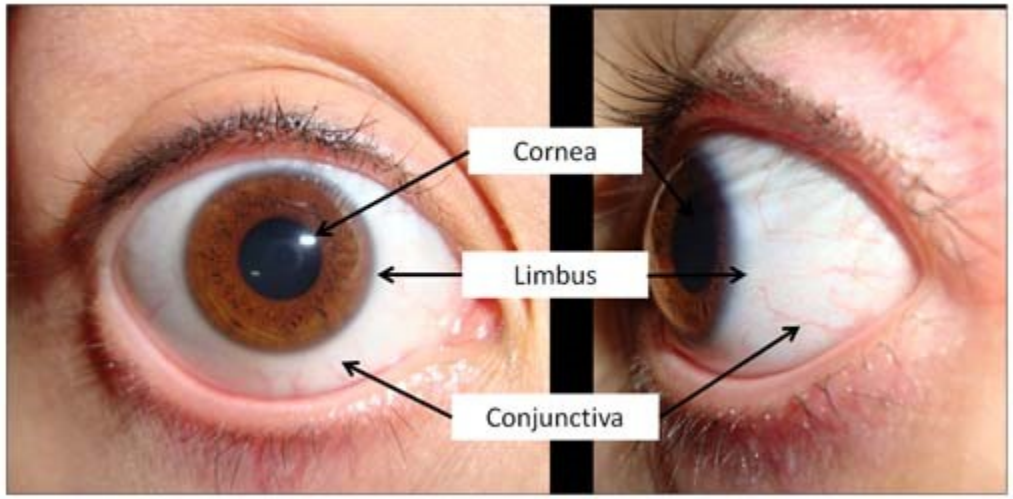
a) cornea – anterior, transparent

a) sclera – posterior, white



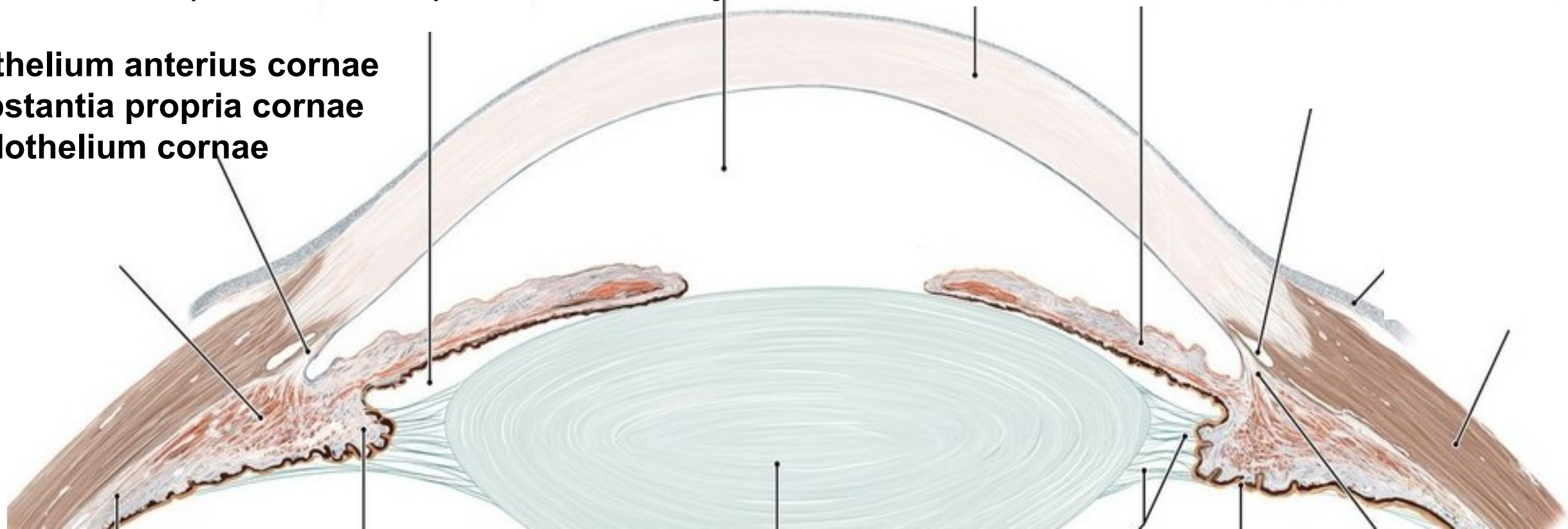
CORNEA

nonvascular, transparent fibrous coat, like a watch glass
it is a part of refractive media of eye



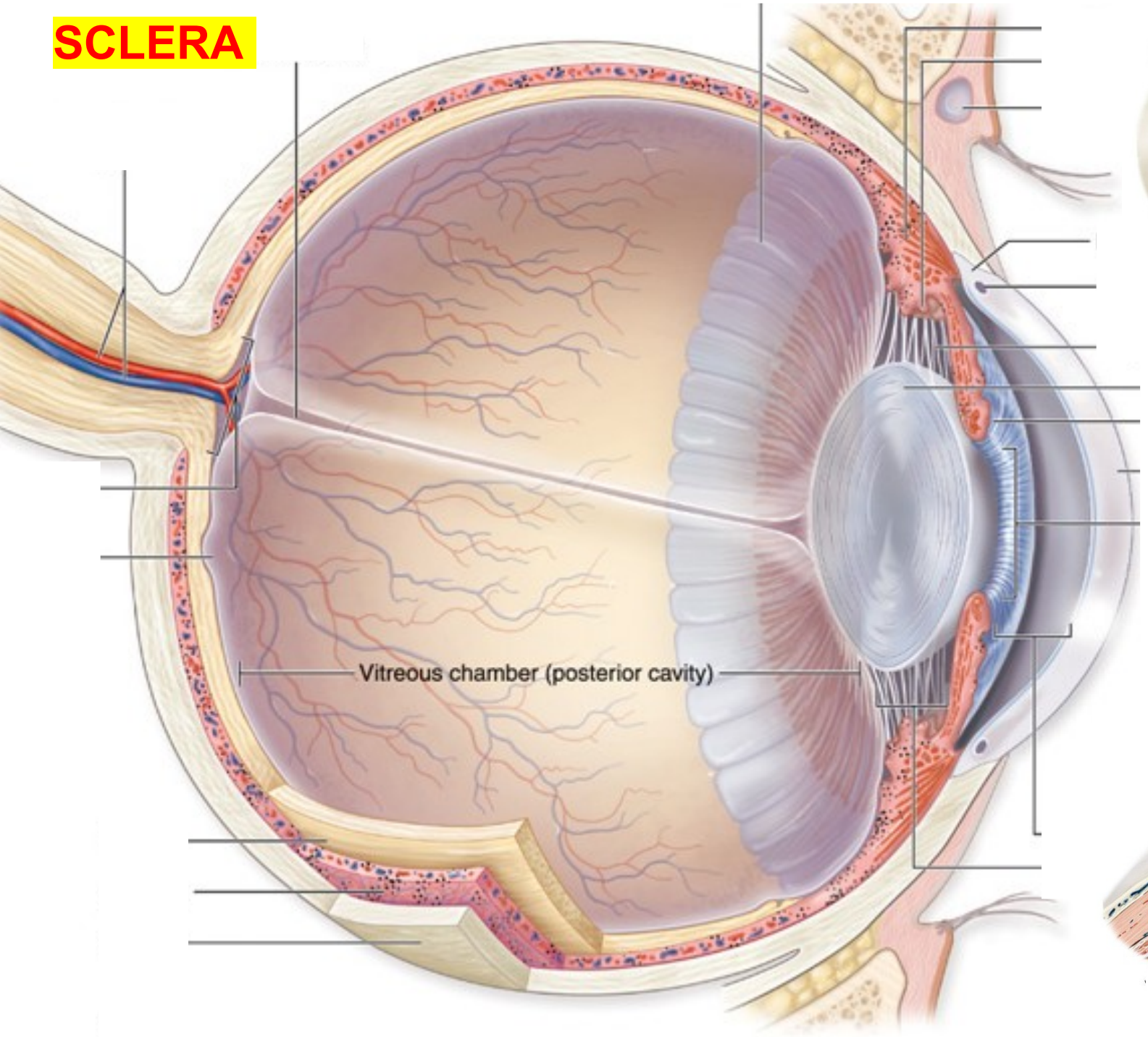
facies anterior (vertex cornae) et posterior
limbus cornae (sulcus sclerae) – sclerocorneal junction

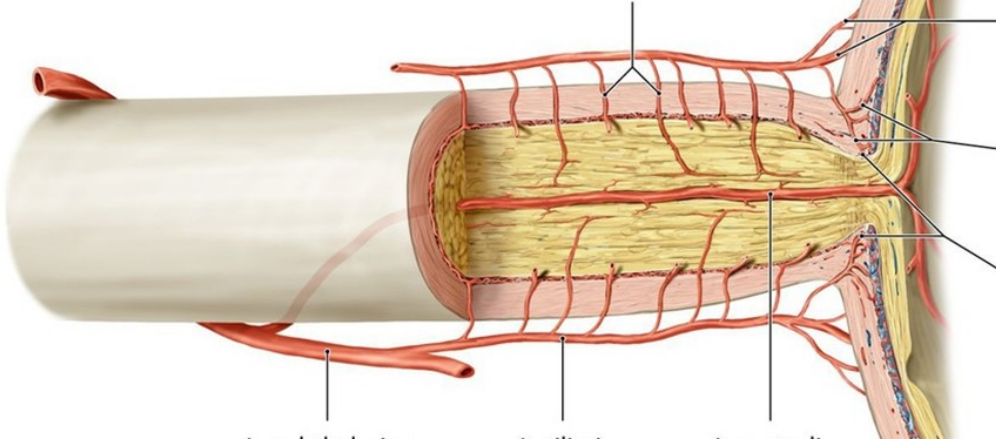
epithelium anterius cornae
substantia propria cornae
endothelium cornae



KERATITIS

SCLERA



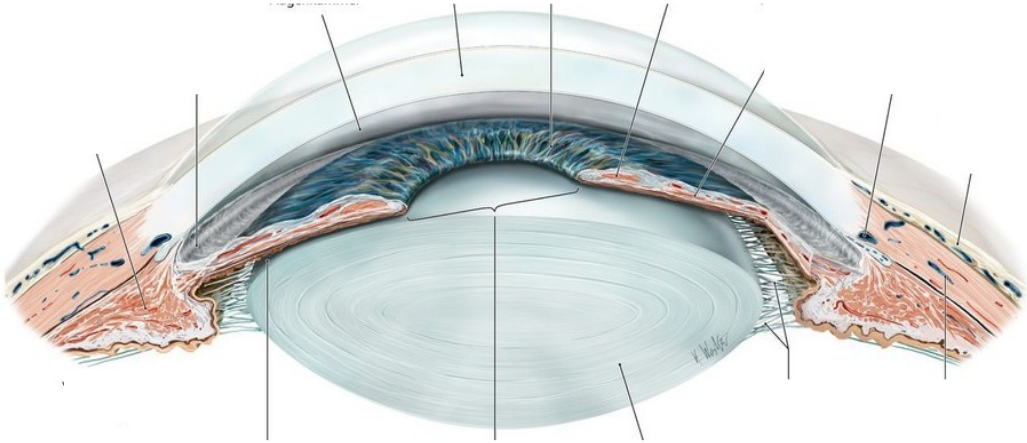


dense, connective tissue capsule gives the shape of the eyeball

limbus sclerae

sinus venosus sclerae

lamina cribosa sclerae

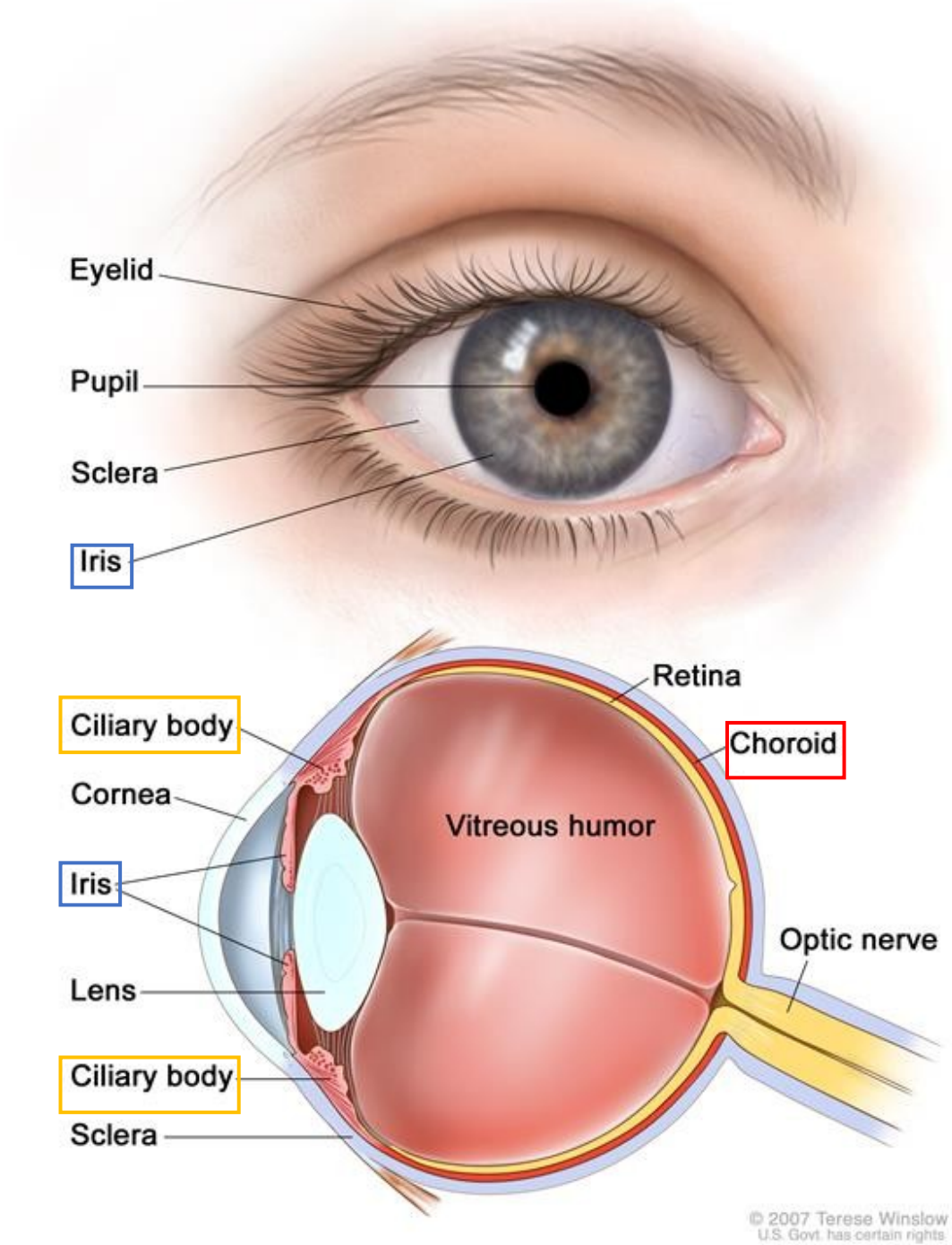


2. Tunica vasculosa

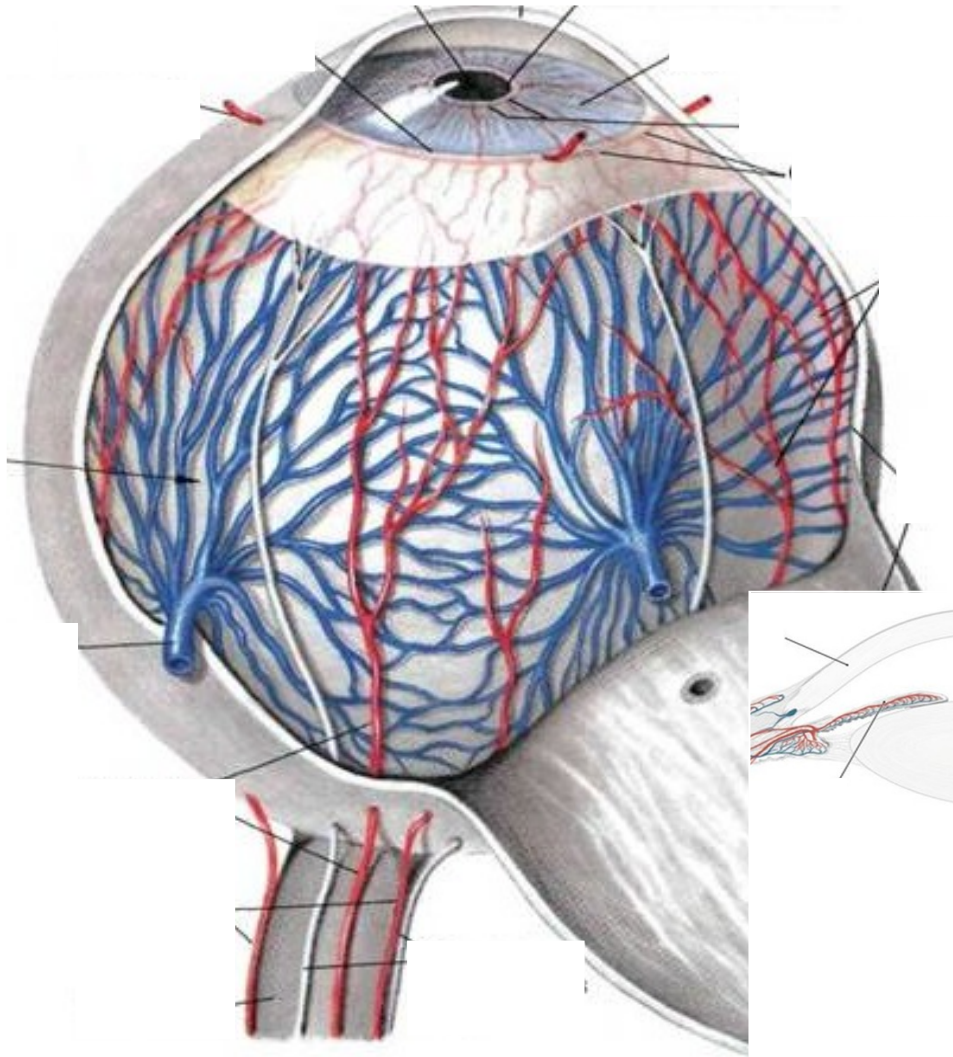
a) choroidea

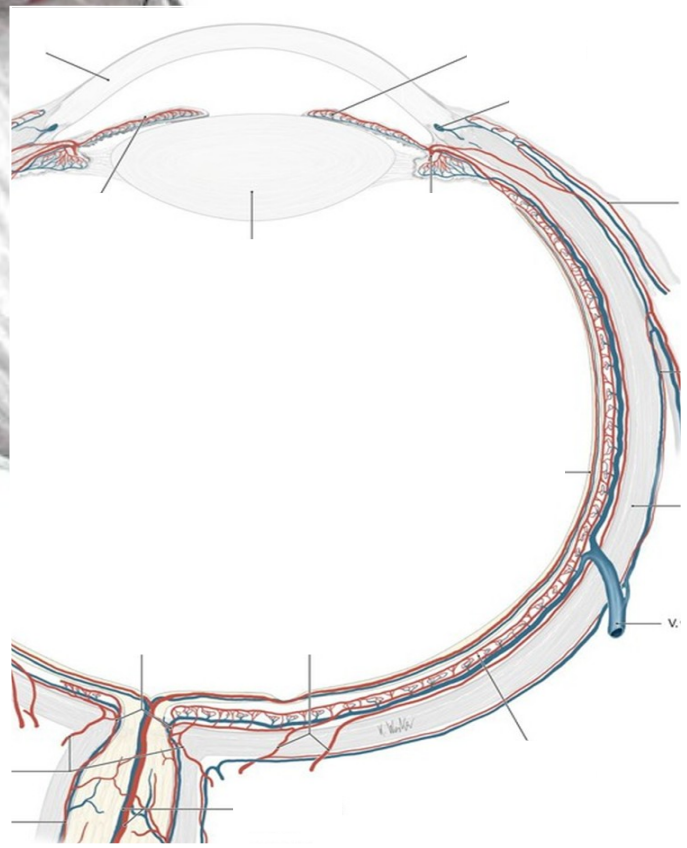
b) corpus ciliare

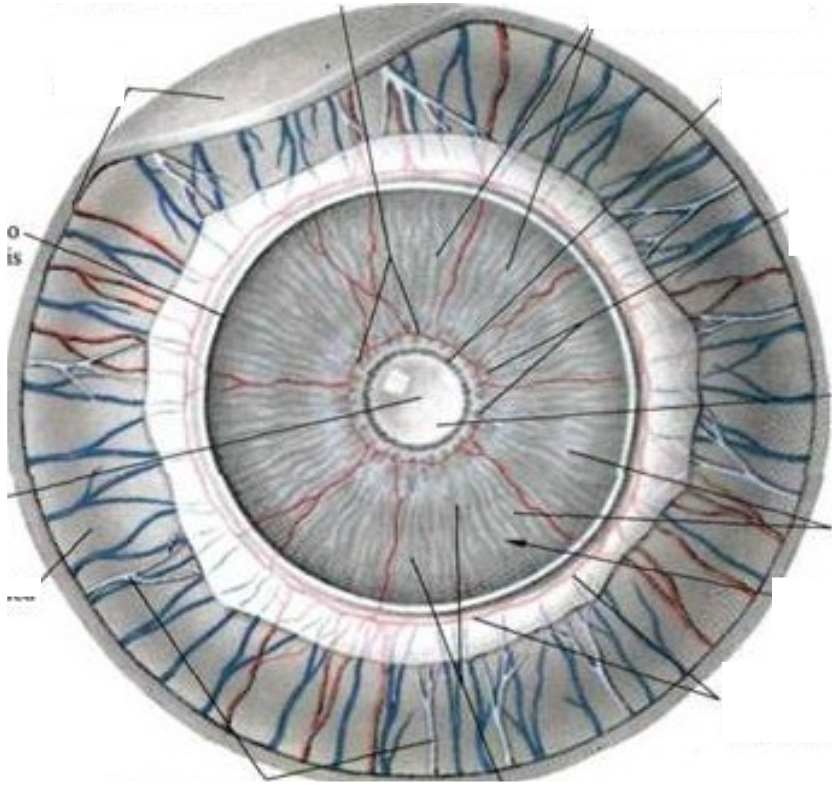
c) iris



CHOROIDEA



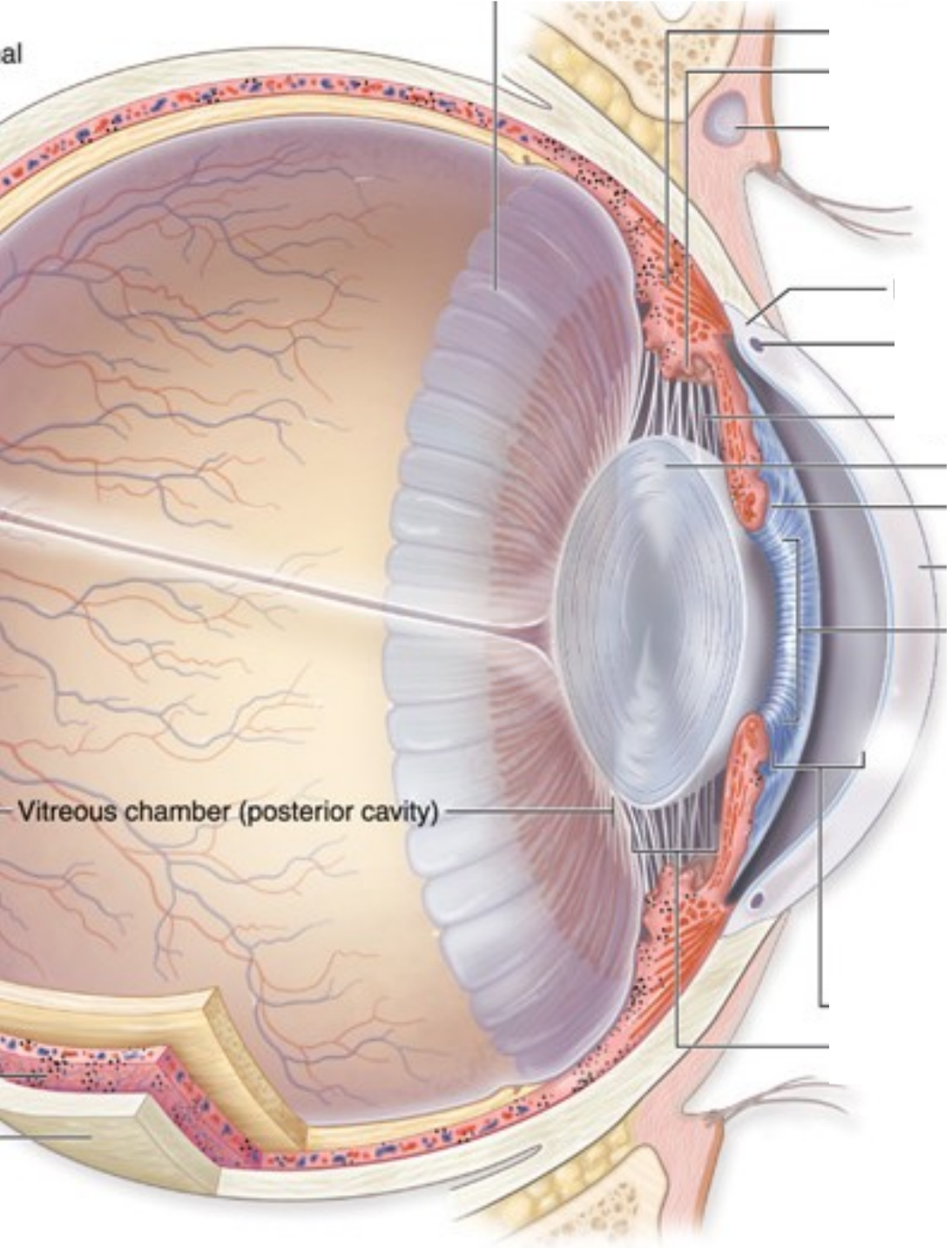


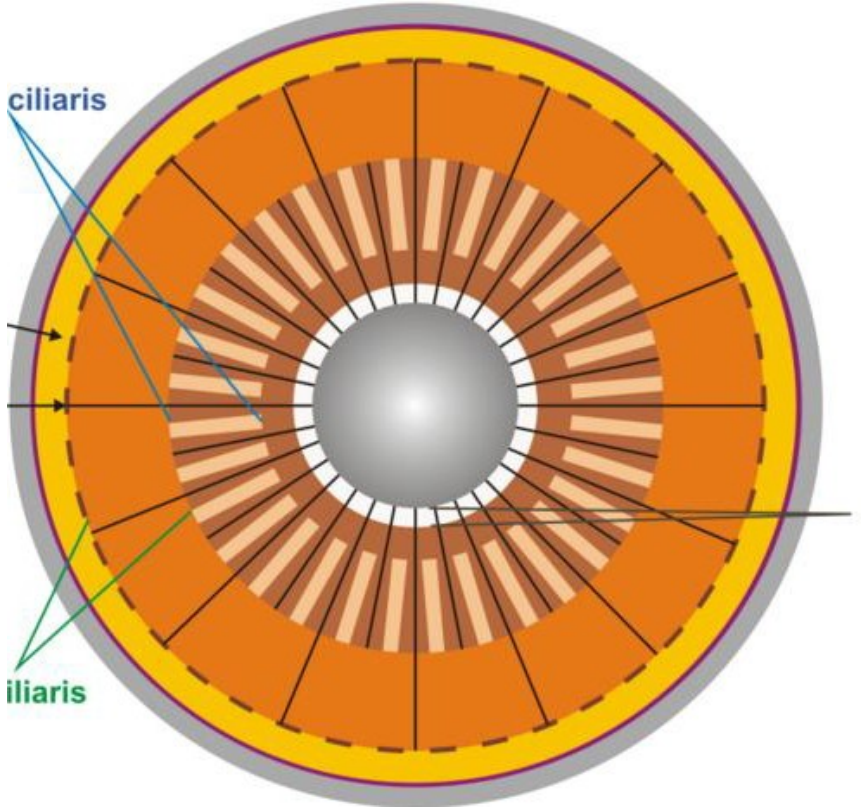


posteriorly,
highly vascularized – nutrition of retina
brownblack appearance– melanocytes (melanin)
venous plexuses and layers of capilaries

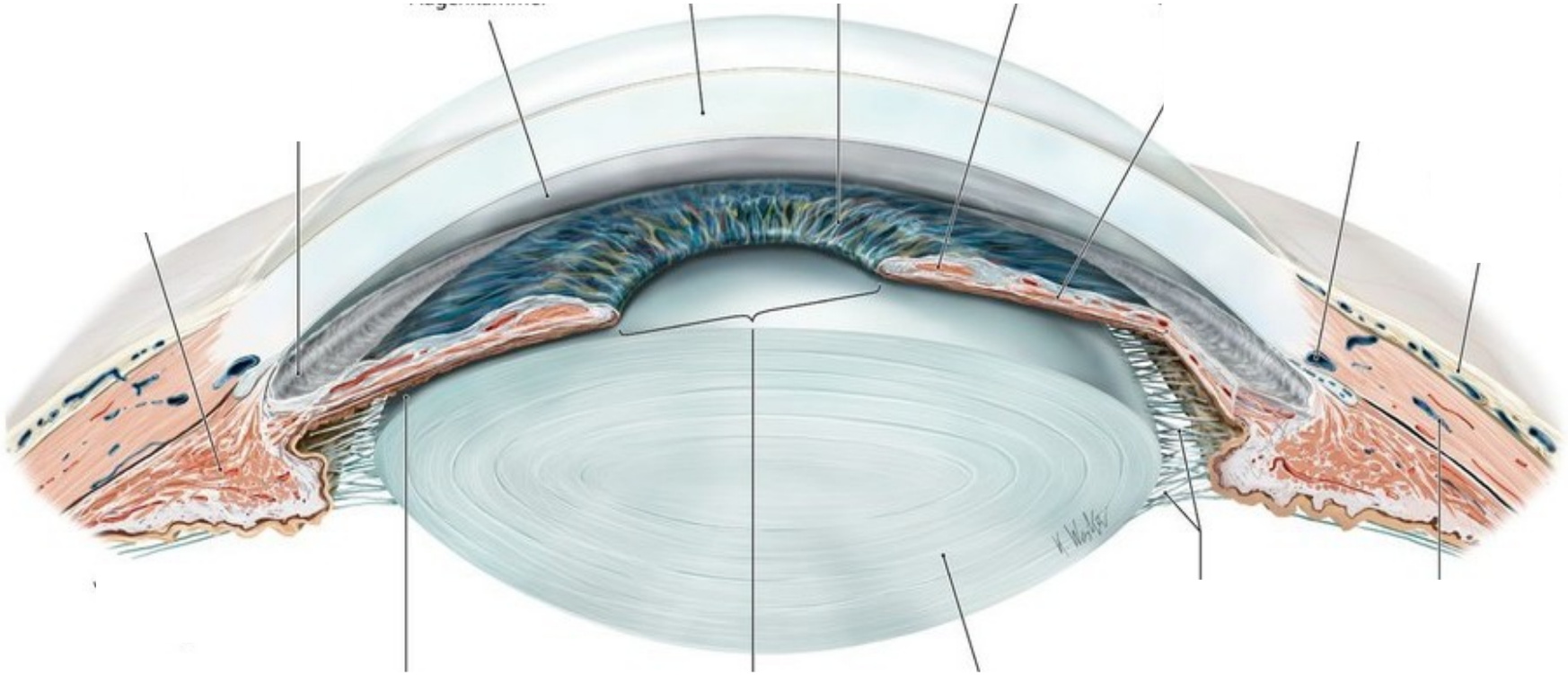
CORPUS CILIARE

Anteriorly, containing ciliary muscles, place of attachement of suspensory ligaments of lens
Between ora serrata and sclerocorneal junction
1) orbiculus ciliaris (L)
2) corona ciliaris (M) (processus et plicae ciliares)
humor aquosus

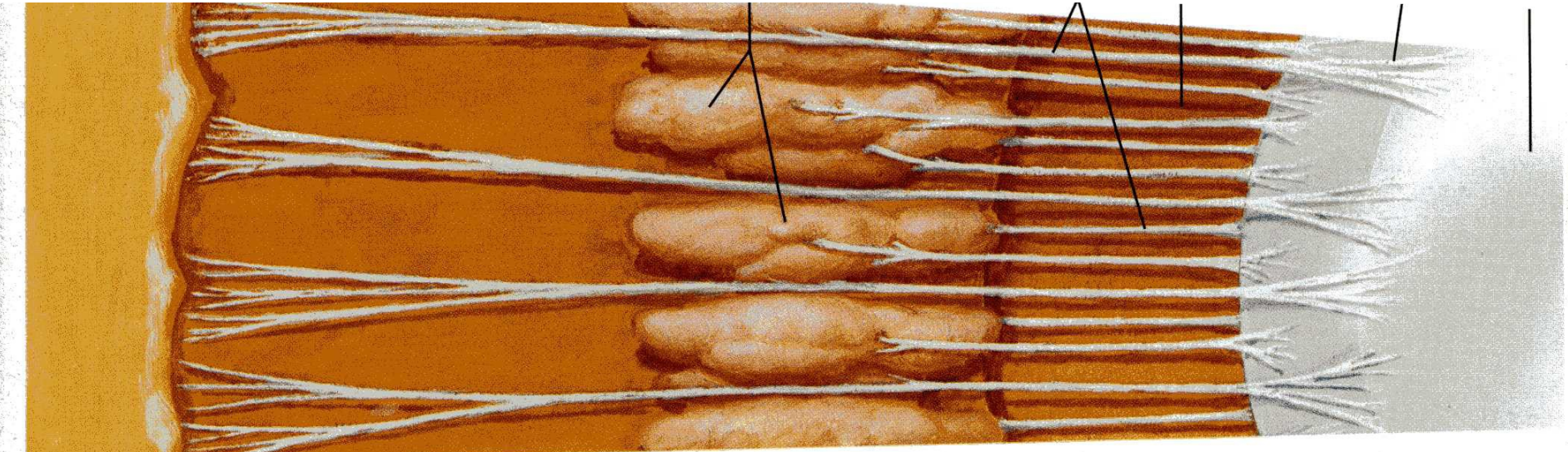


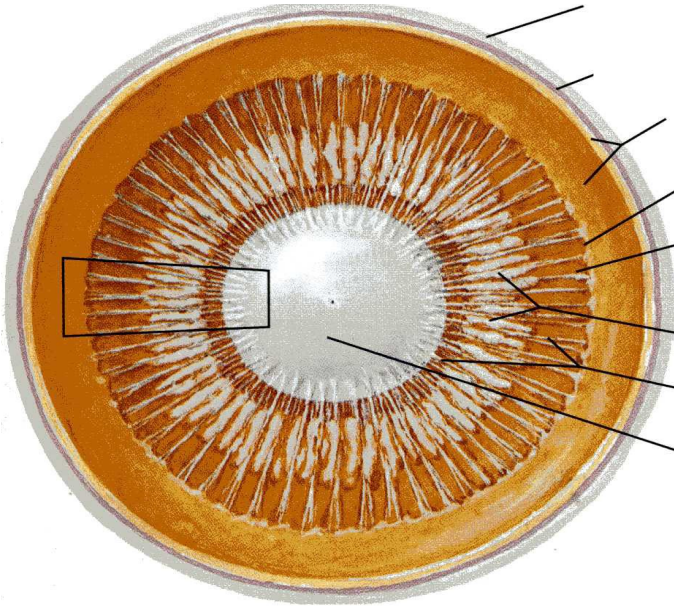


SUSPENSORY APPARATUS OF LENS

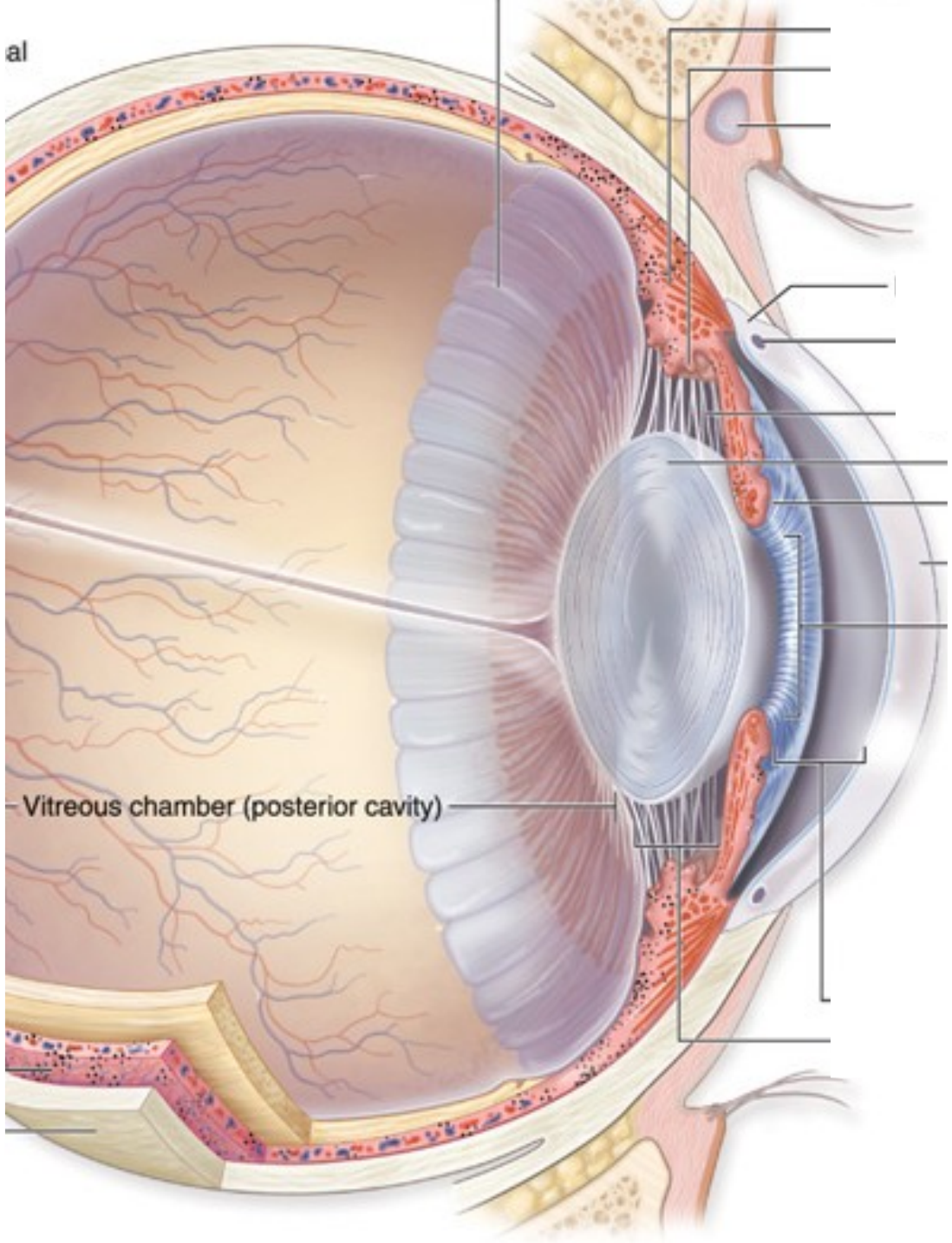


zonula ciliaris
(fibrae zonulares)
m.ciliaris





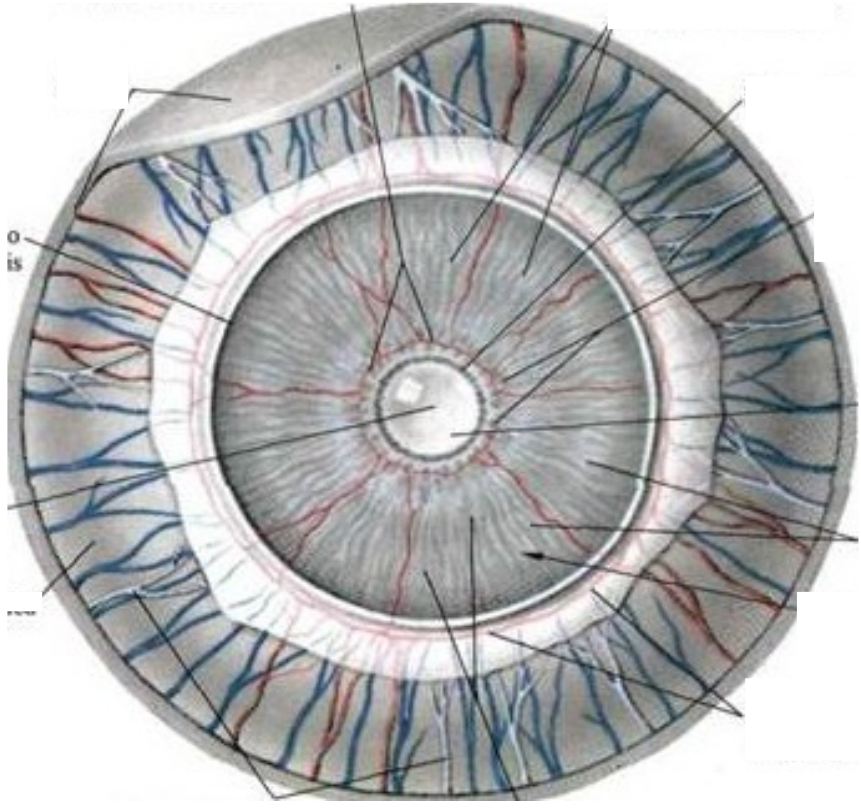
IRIS



Colored disc with hole - pupil
margo ciliaris et pupilaris(pupilla)

facies anterior iridis **et posterior** iridis
stroma iridis

fce světelné clony

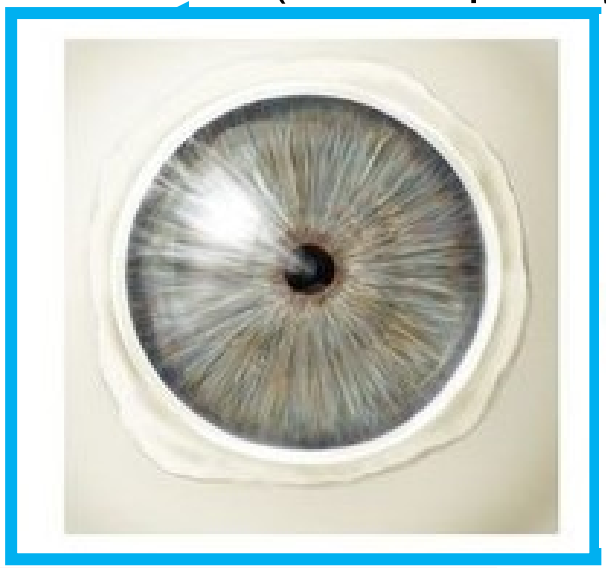


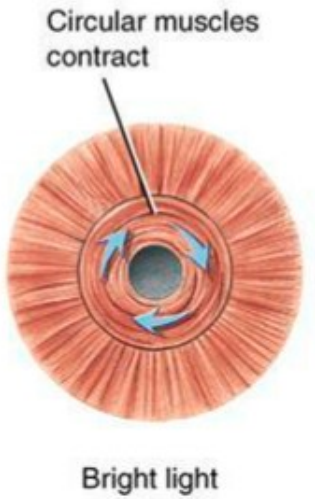
between anterior et posterior chambre

Regulates the amount of light entering through the pupil

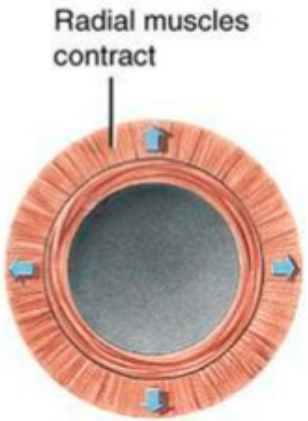
Circular and radial smooth muscle fibers:

m.sphincter pupillae
(miosis, parasympaticus)



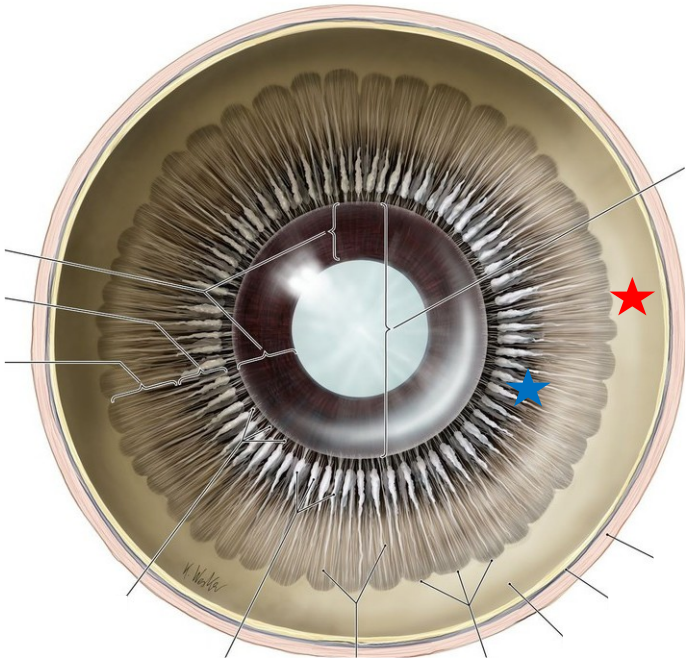


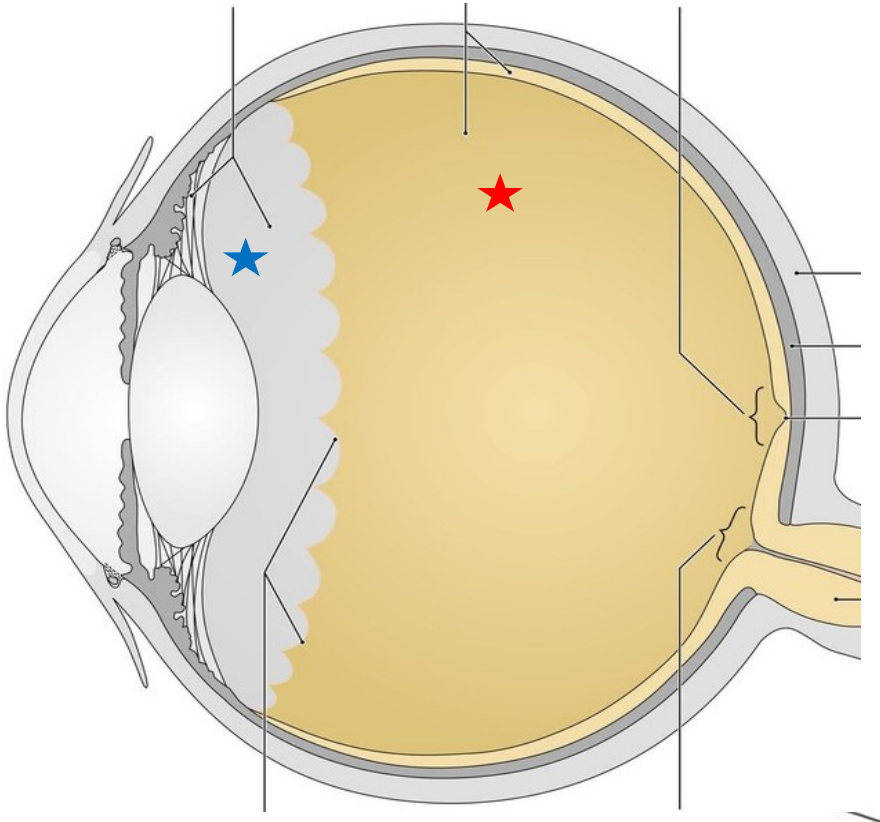
m. dilatator pupilae
(mydriasis, sympaticus)

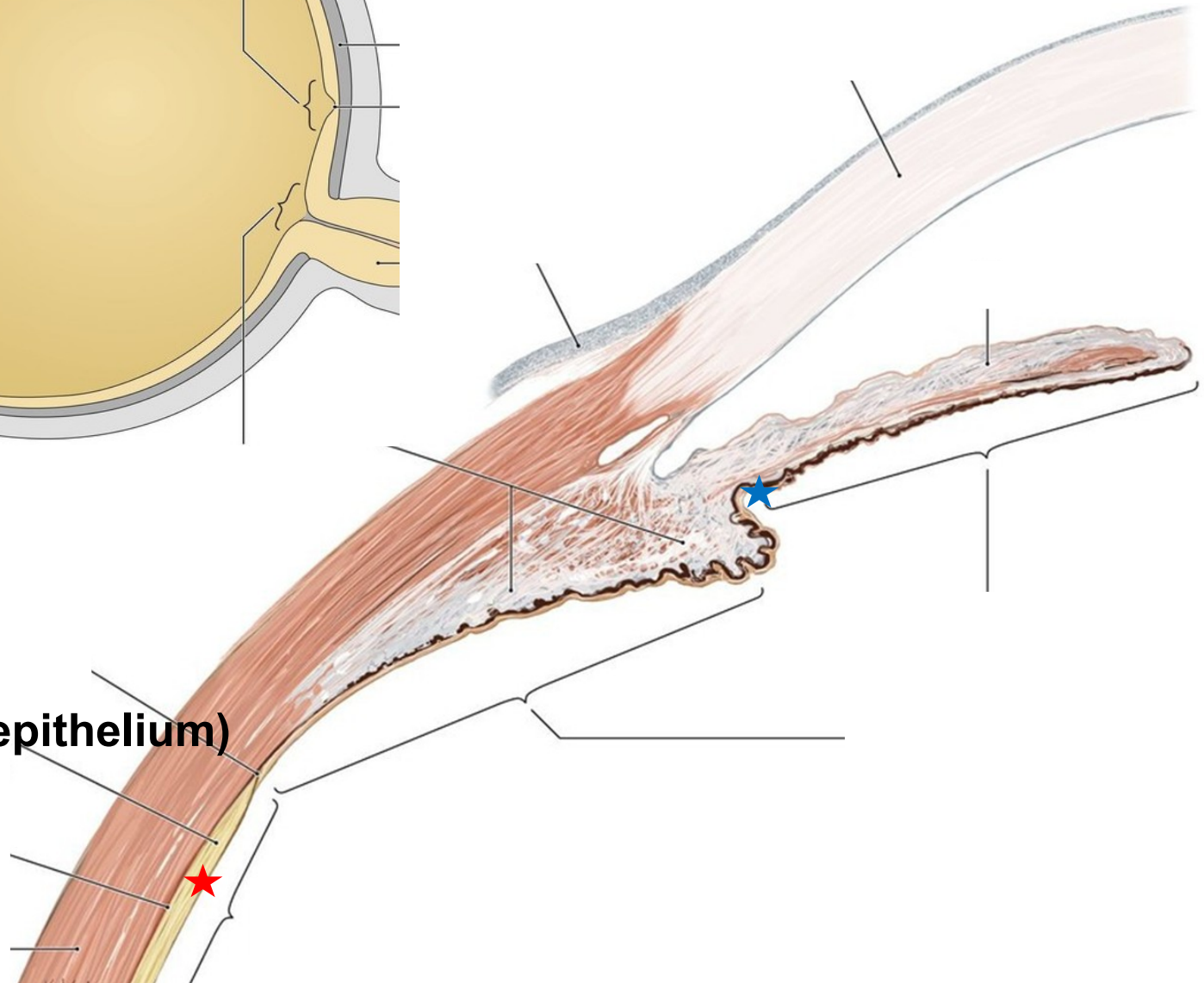


pigment (eye color)

RETINA





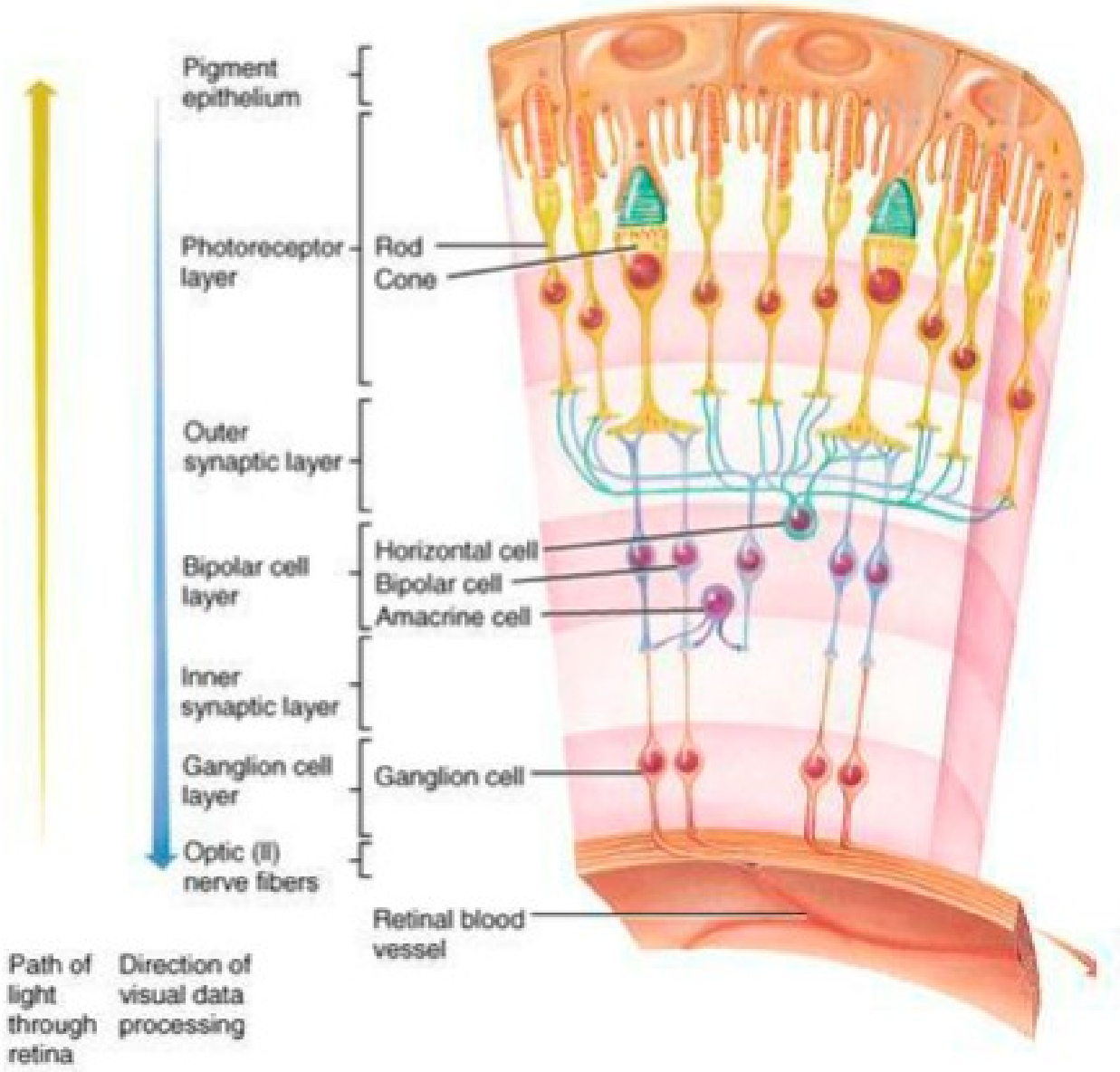


Stratum pigmenti retinae - outer
Neuronal layer - inner

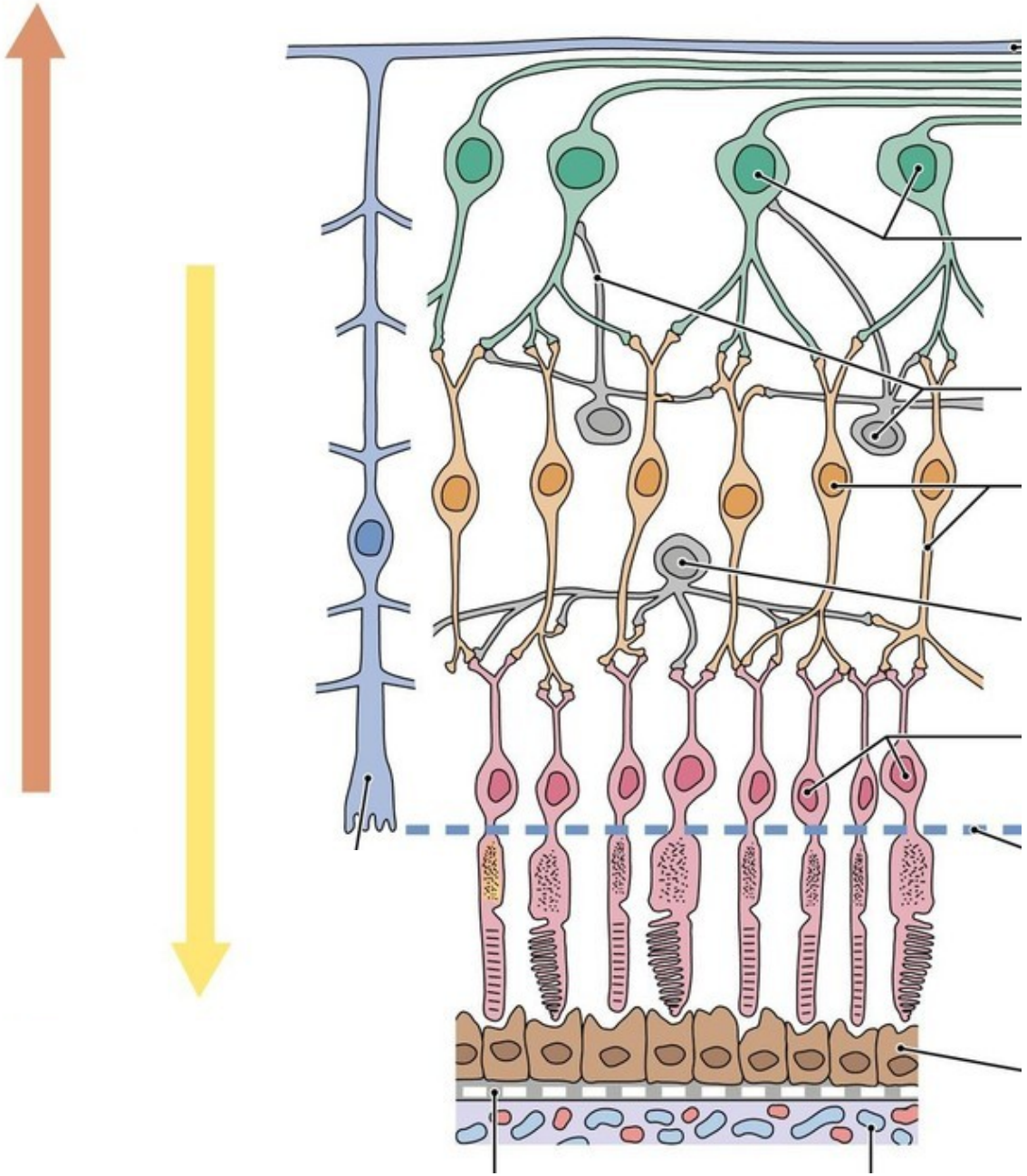
pars optica retinae (with sensory cells)
pars ciliaris et iridica retinae (with pigment epithelium)
(pars caeca retinae)

between is ora serrata

PARS OPTICA RETINAE



- ***Pigmented epithelium***
  - nonvisual portion
  - absorbs stray light & helps keep image clear
- 3 layers of neurons (outgrowth of brain)
  - photoreceptor layer
  - bipolar neuron layer
  - ganglion neuron layer
- 2 other cell types (modify the signal)
  - horizontal cells
  - amacrine cells



4. neuron – ncl.corporis geniculati lateralis – radiatio optica (area 17)

3. Multipolar neurons Stratum ganglionare n. optici – n. opticus

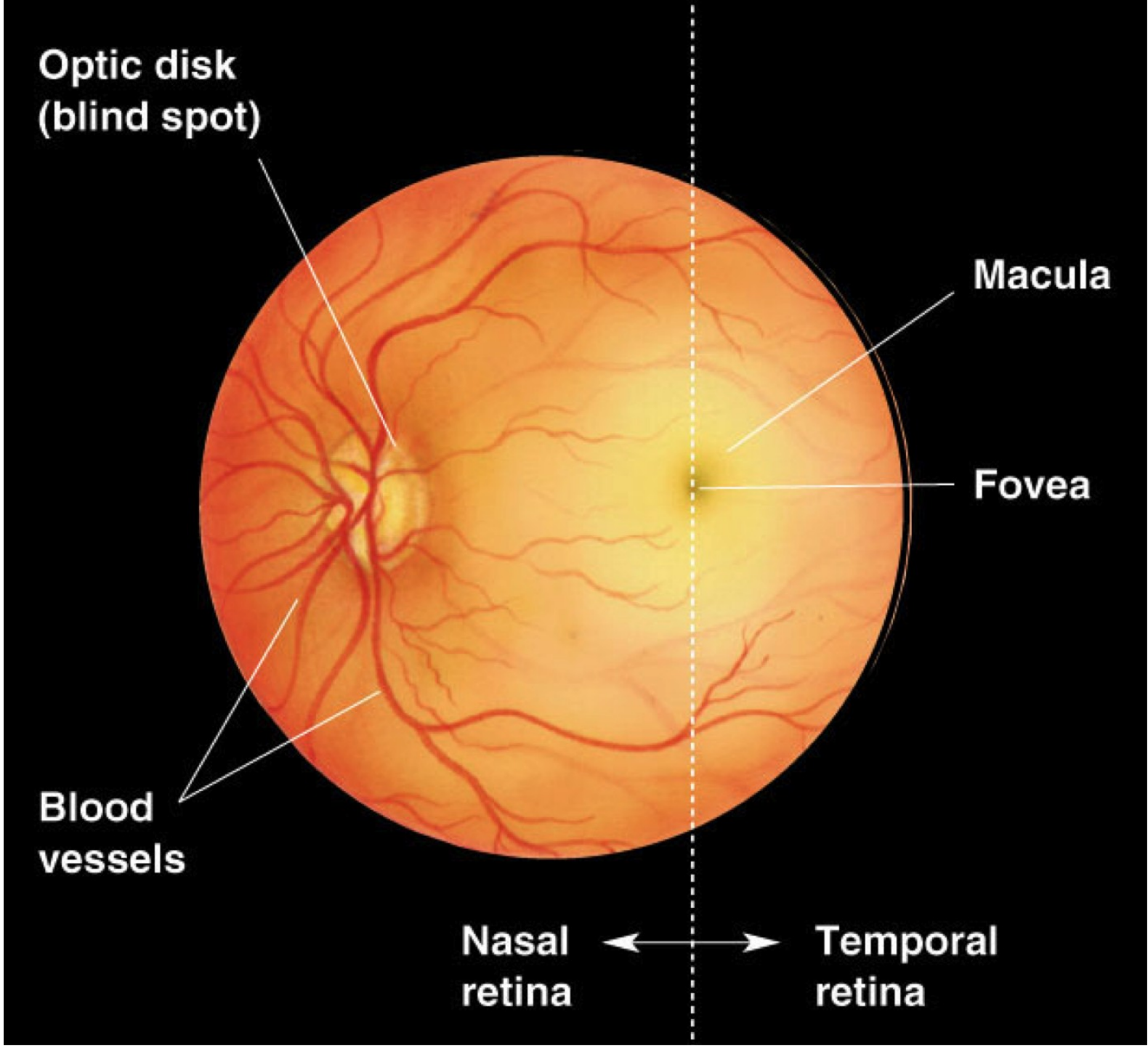
2. Bipolar neurons (Stratum ganglionare retinae)

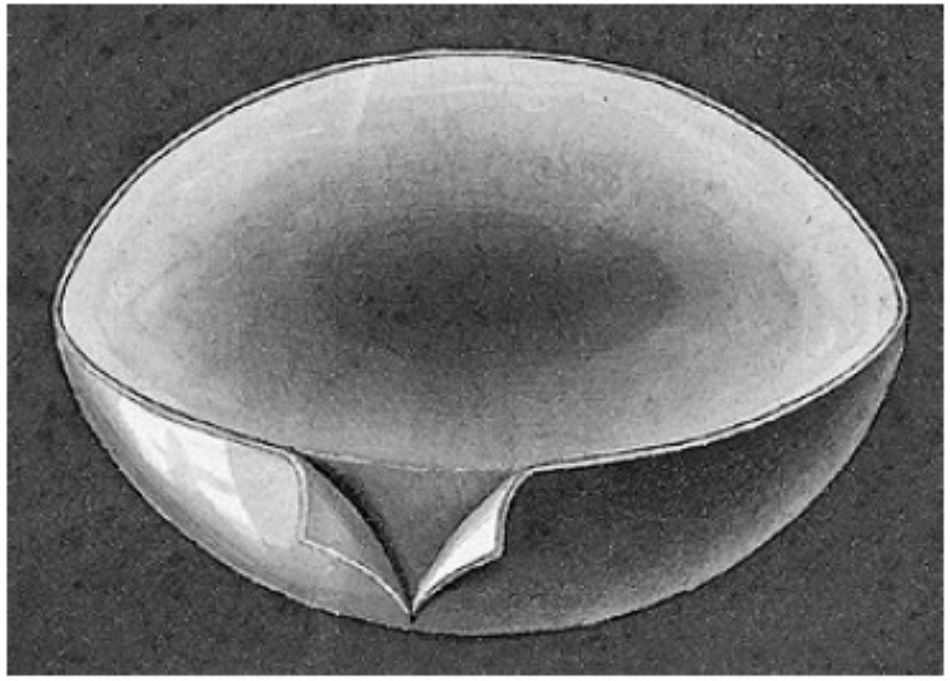
1. Stratum neuroepitheliale
Rod (130 million)
Cones (6-7 million, macula lutea)

FUNDUS OCULI

= posterior part of the eye – examination with ophtalmoscope through pupil

macula lutea – fovea centralis – linea visus (cones)
discus n.optici – blind spot – macula caeca (no rods and cones)





Transparent
Biconvex body

facies anterior
facies posterior

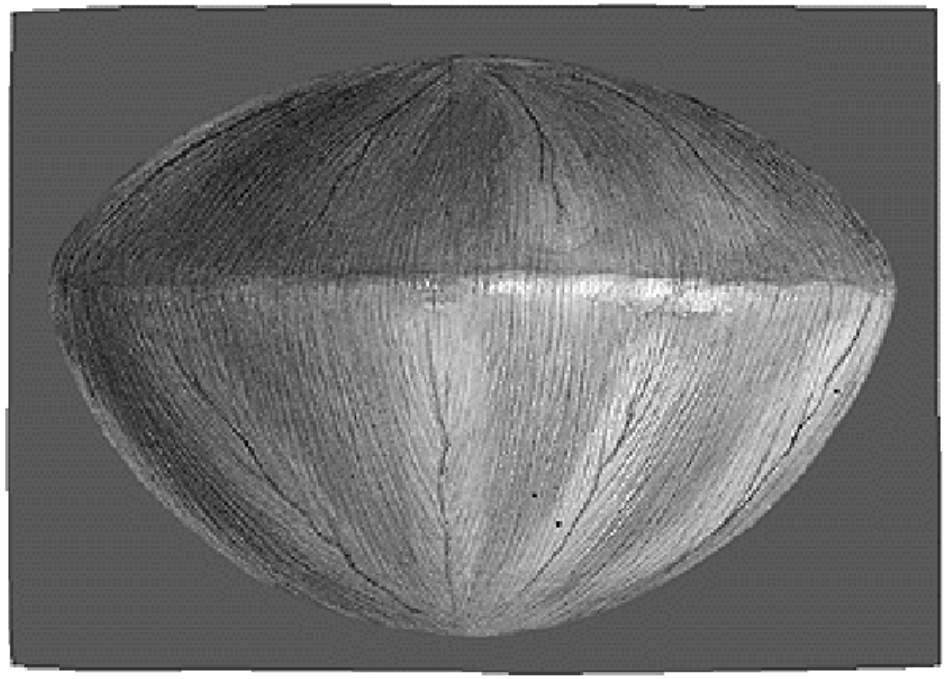
polus anterior
polus posterior

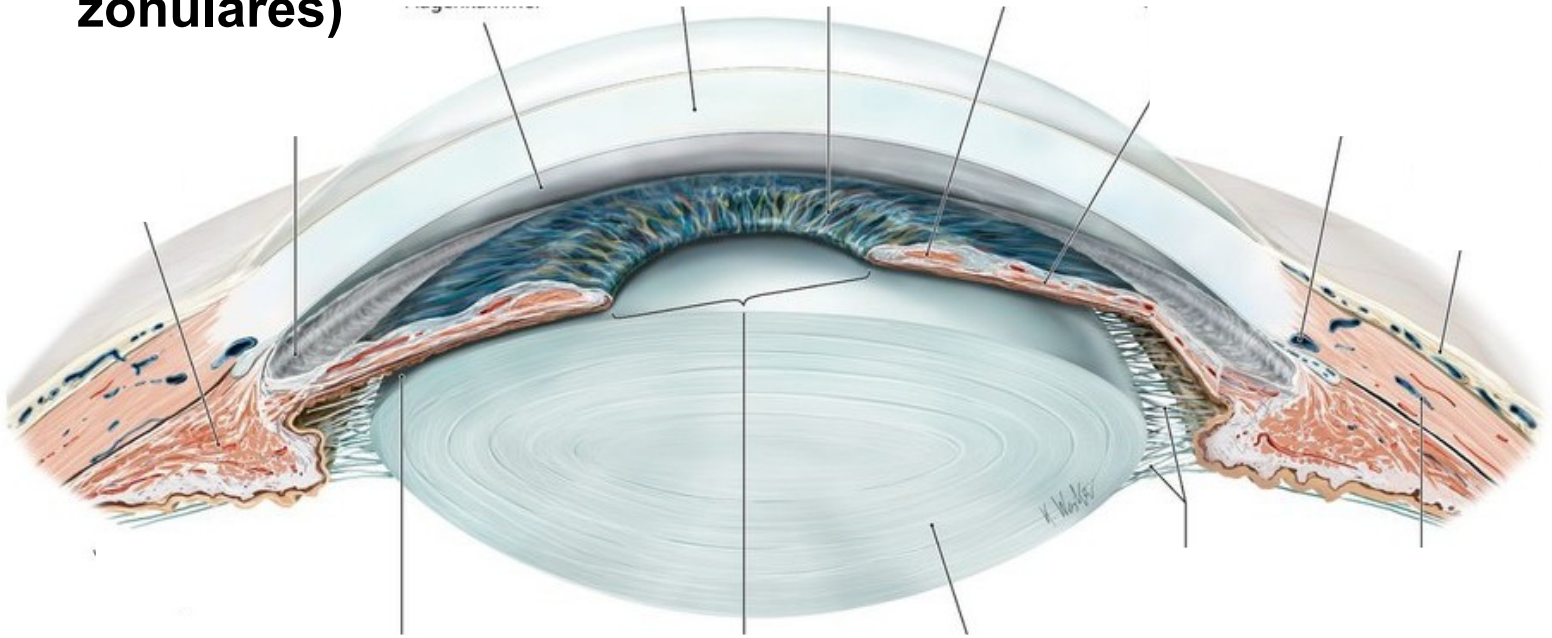
equator lentis
(fibrae
zonulares)

LENS

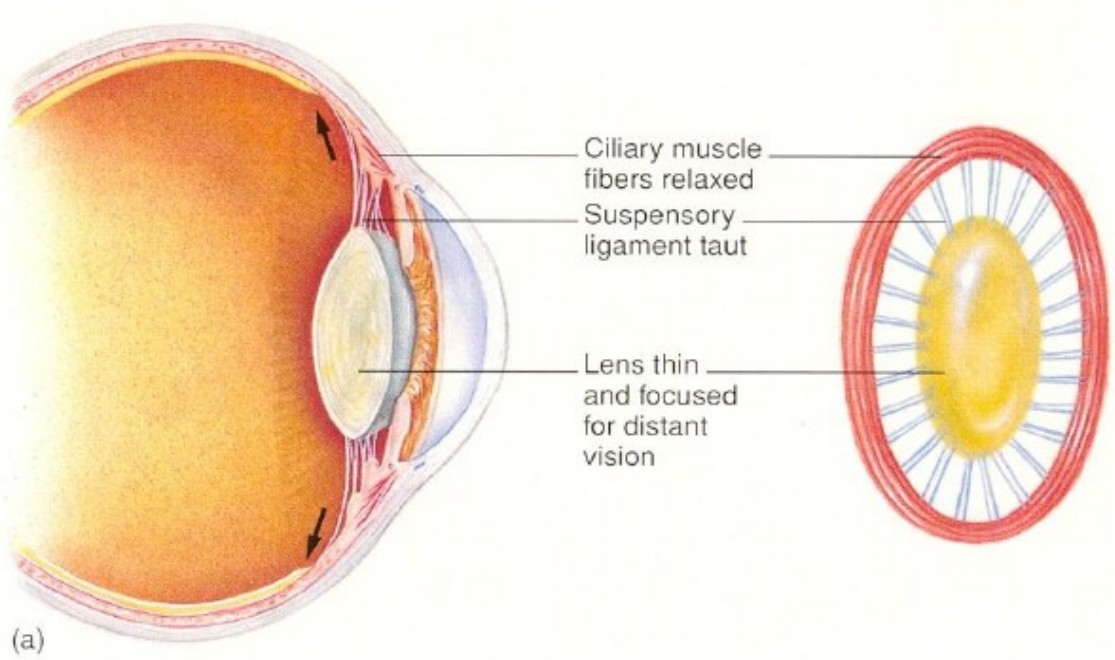
capsula lentis
epithelium lentis (fibrae lentis)

cortex lentis
nucleus lentis

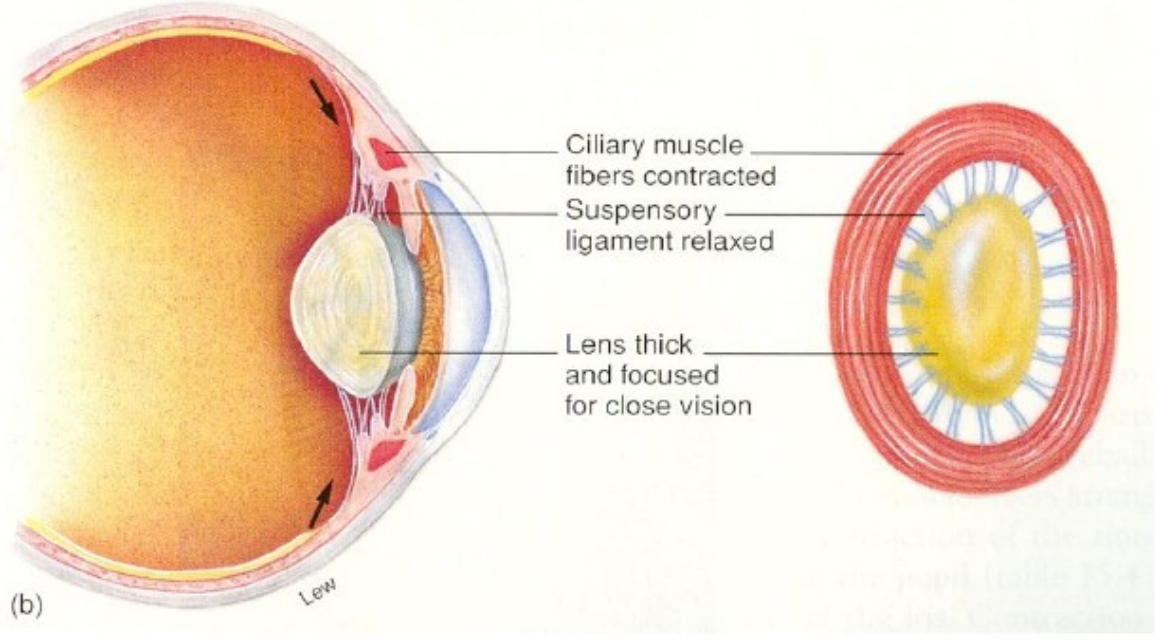




AKOMODACE



pohled do dálky,
sval je povolený

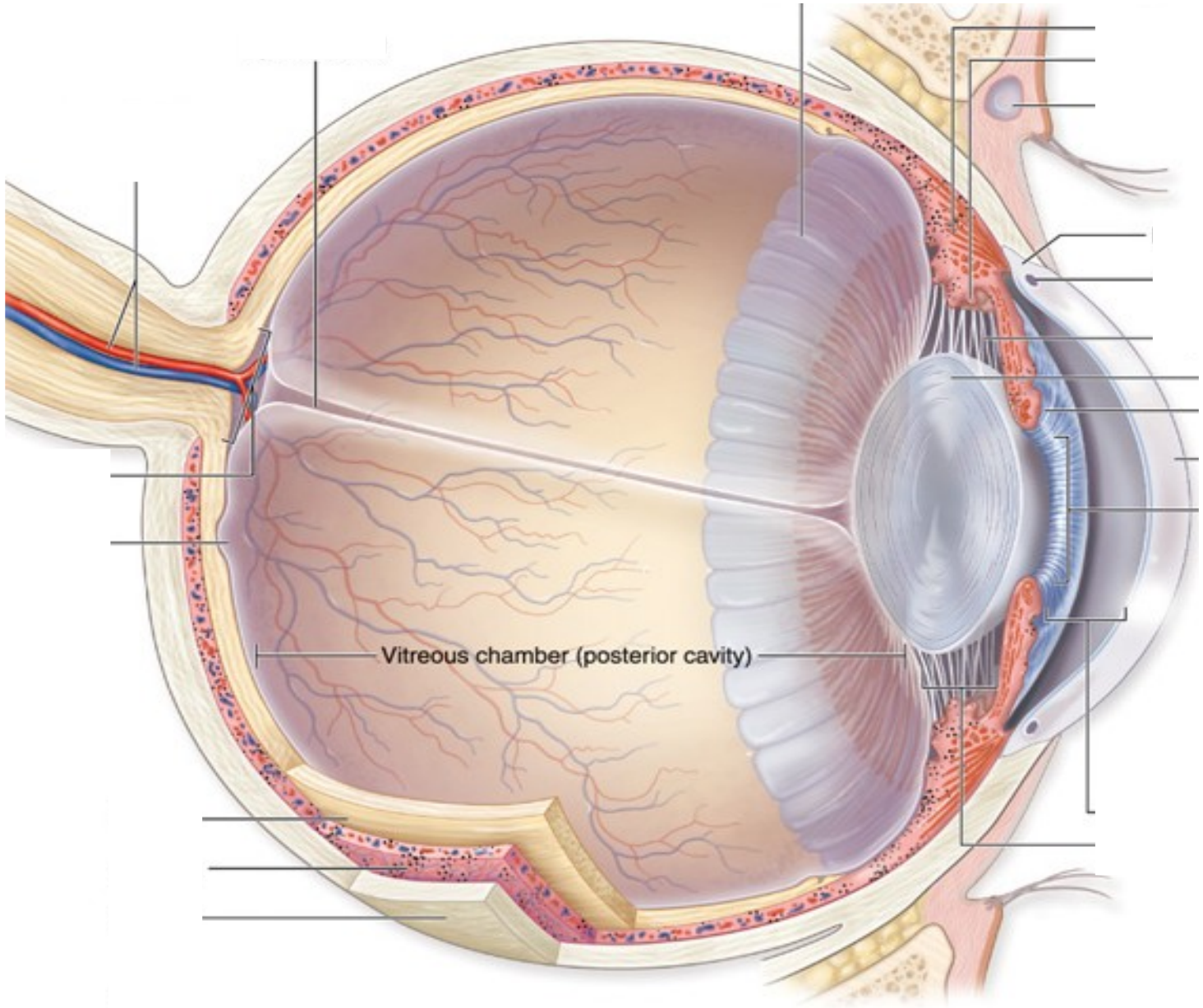


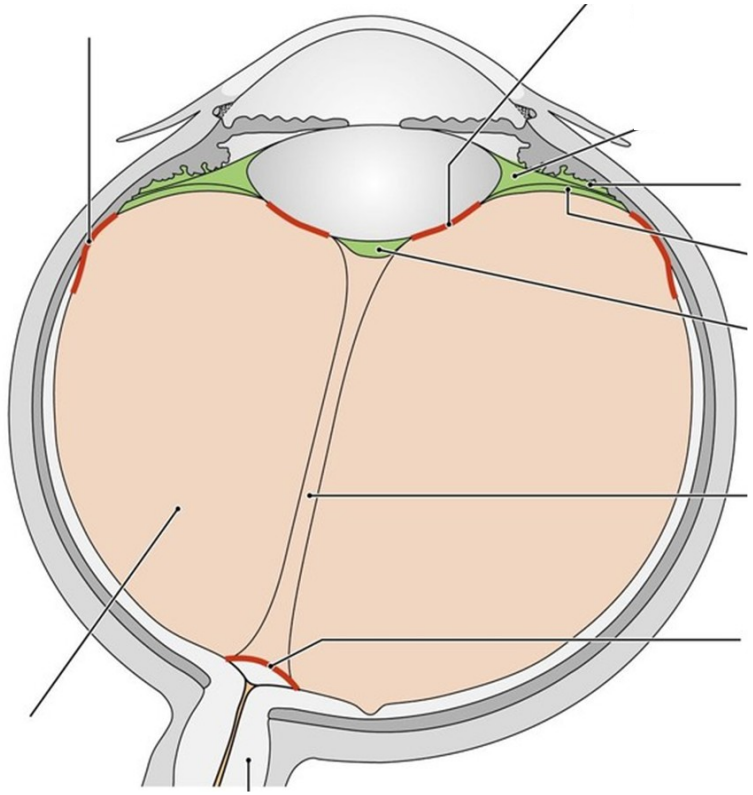
pohled do blízka,
sval je smrštěný

CORPUS VITREUM

= transparent gel occupies the space between the lens and the retina = camera vitrea

jelly- like substance called humor vitreus





CAMERAE BULBI

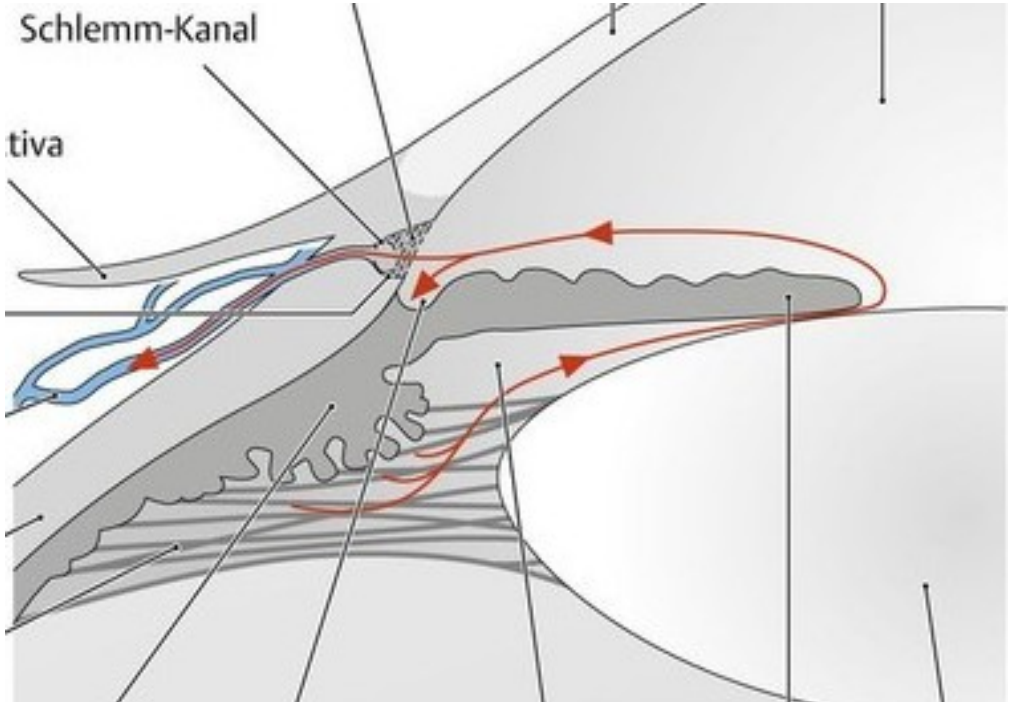
humor aquosus
(is produced by vessels of the iris and epithelial cells of ciliary body

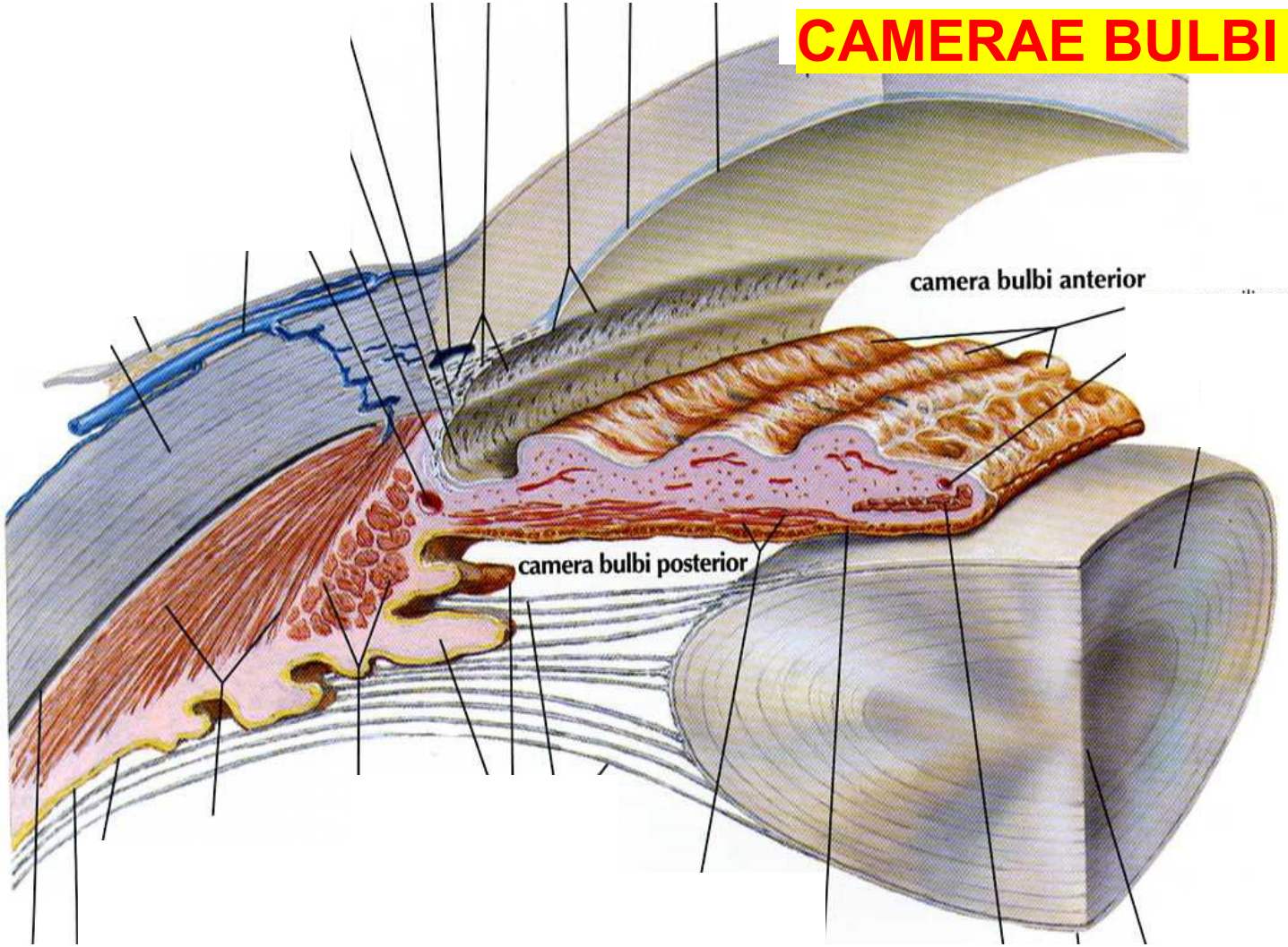
posterior chamber

anterior chamber

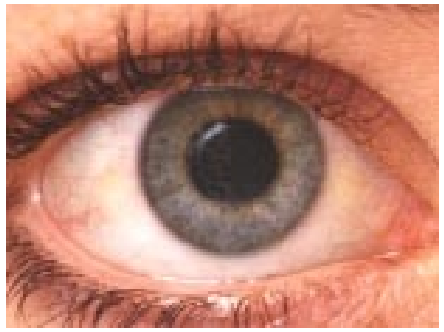
iridocorneal angle

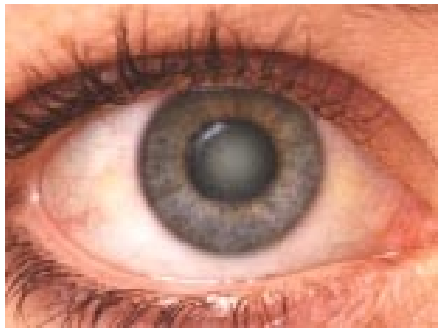
sinus venosus sclerae



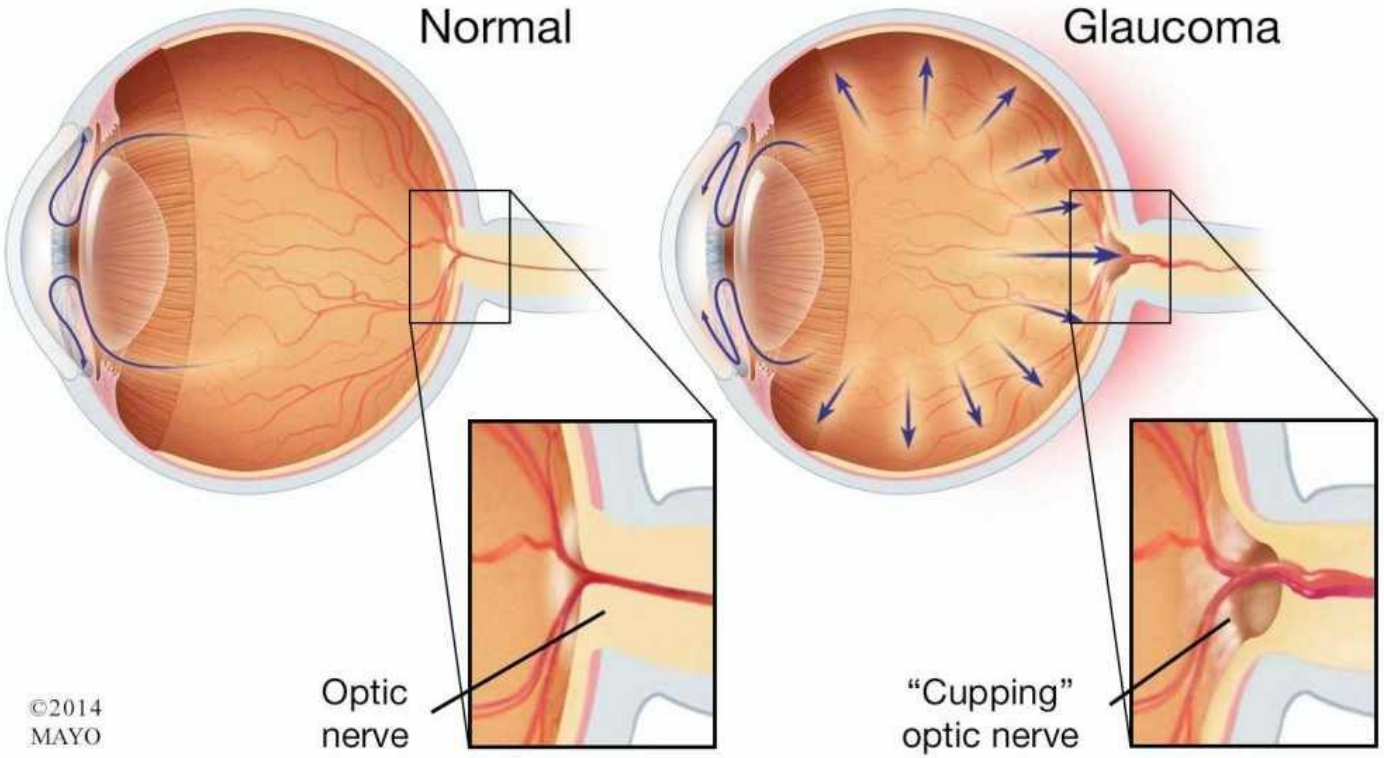


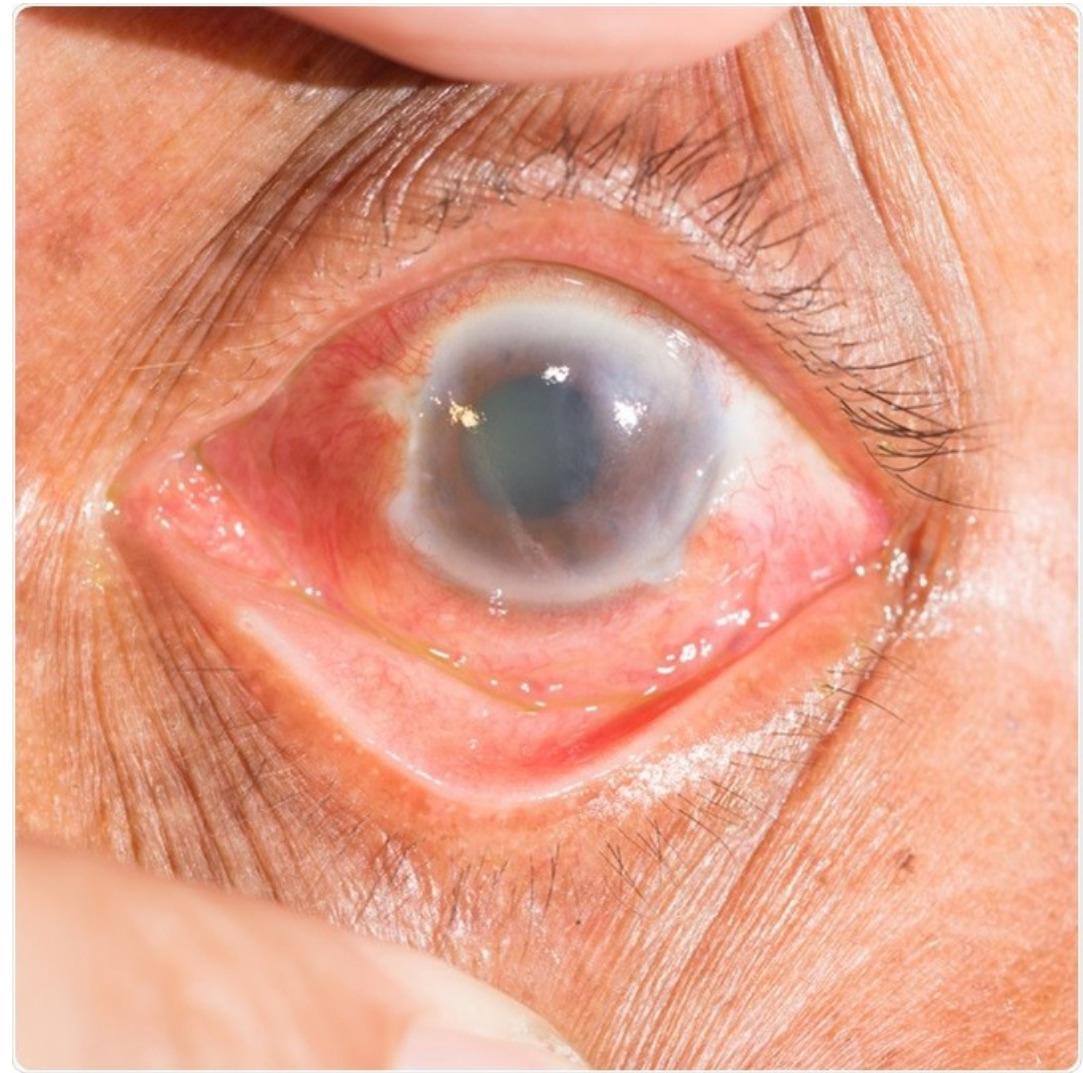
cataracta



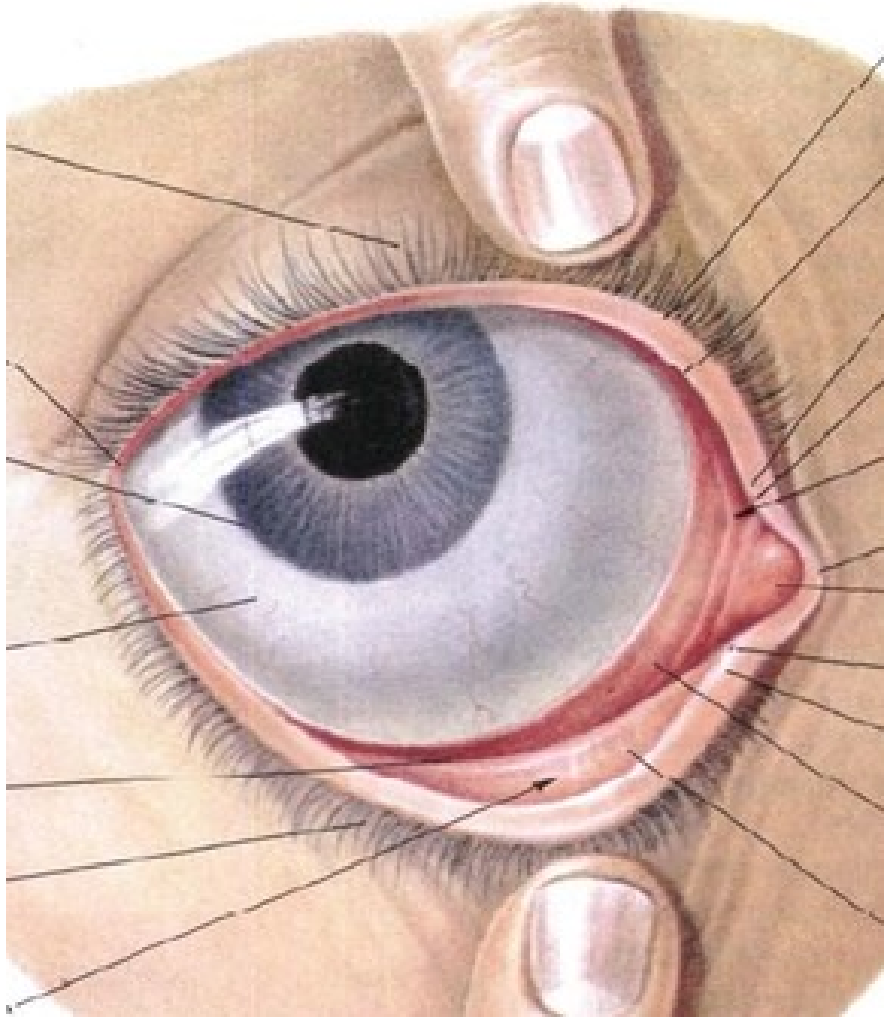


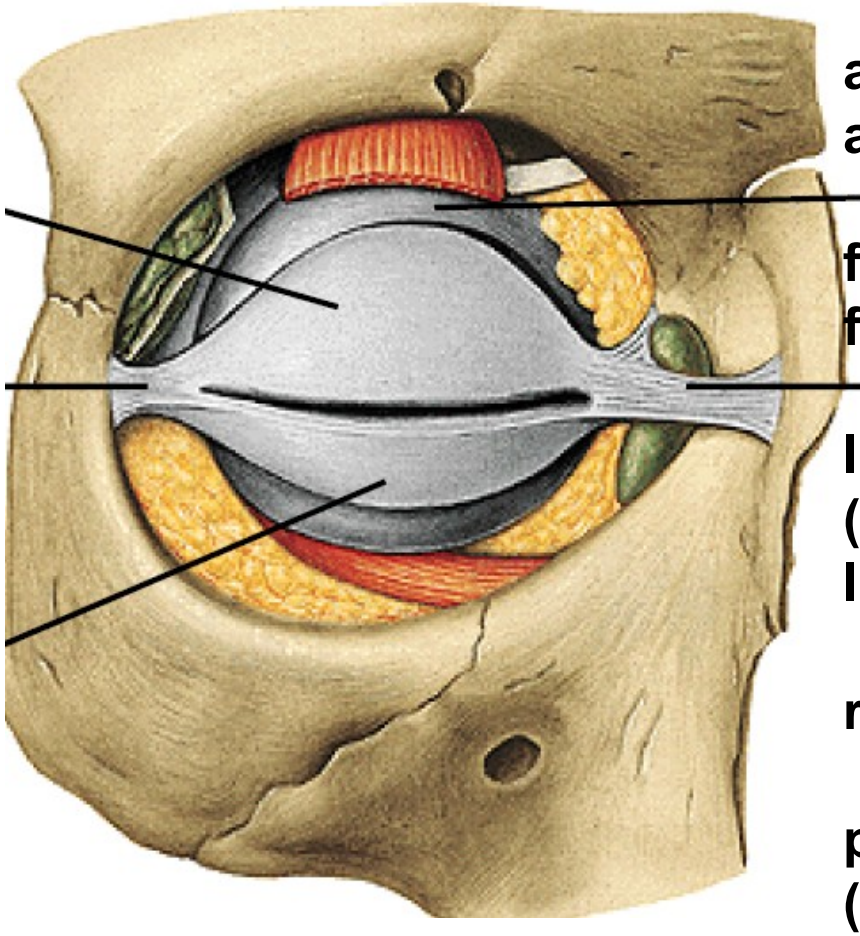
- ✓ ztráta průhlednosti čočky
- ✓ vidění neostré a zamlžené
- ✓ v každém věku, nejčastěji následek přirozeného stárnutí oka


Normal
Glaucoma
Optic nerve
"Cupping" optic nerve
©2014 MAYO



PAPEBREA (eyelids)





palpebra superior
palpebra inferior

rima palpebrarum

angulus oculi medialis
angulus oculi lateralis

facies anterior
facies posterior

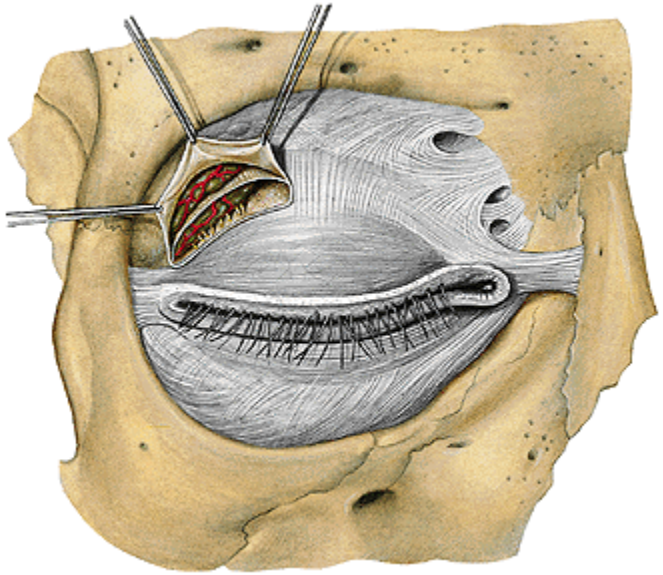
limbus palpebralis anterior
(cilia, gll. sebacae, gll. ciliares)
limbus palpebralis posterior

rivus lacrimalis

papilla lacrimalis
(punctum lacrimale)

tarsal plates

EYELID MORPHOLOGY



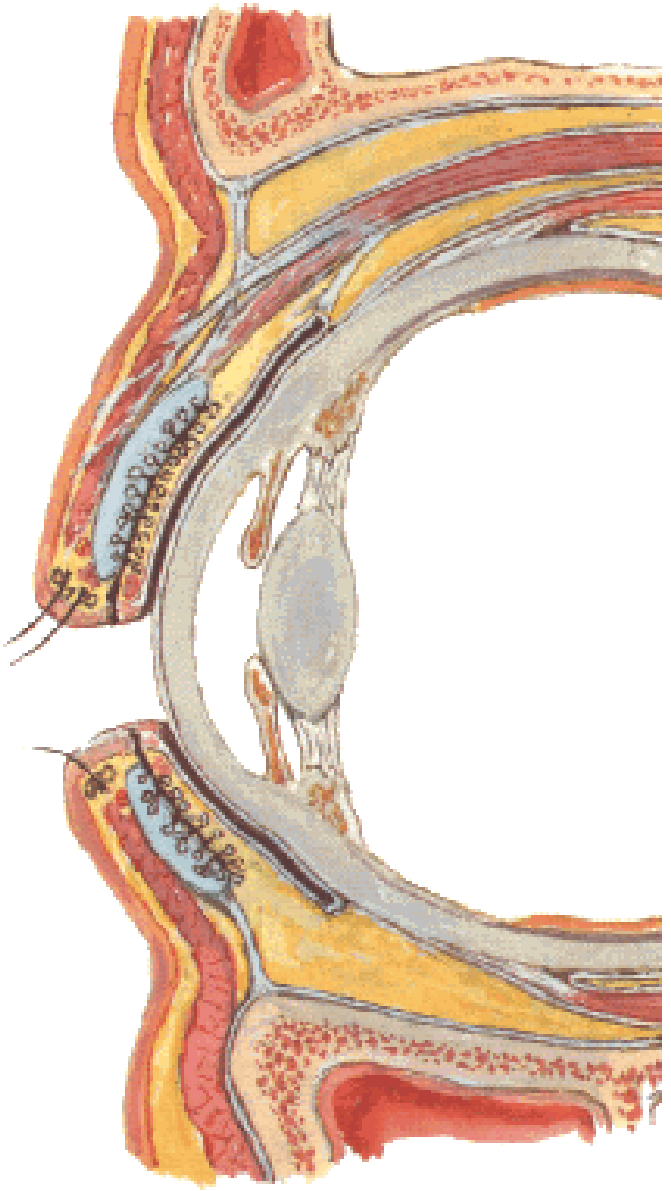
septum orbitale

tarsus superior, inferior
gl. tarsales (Meibomi)

lig. palpebrale med., lat.

m. tarsalis sup., inf.

m. orbicularis oculi



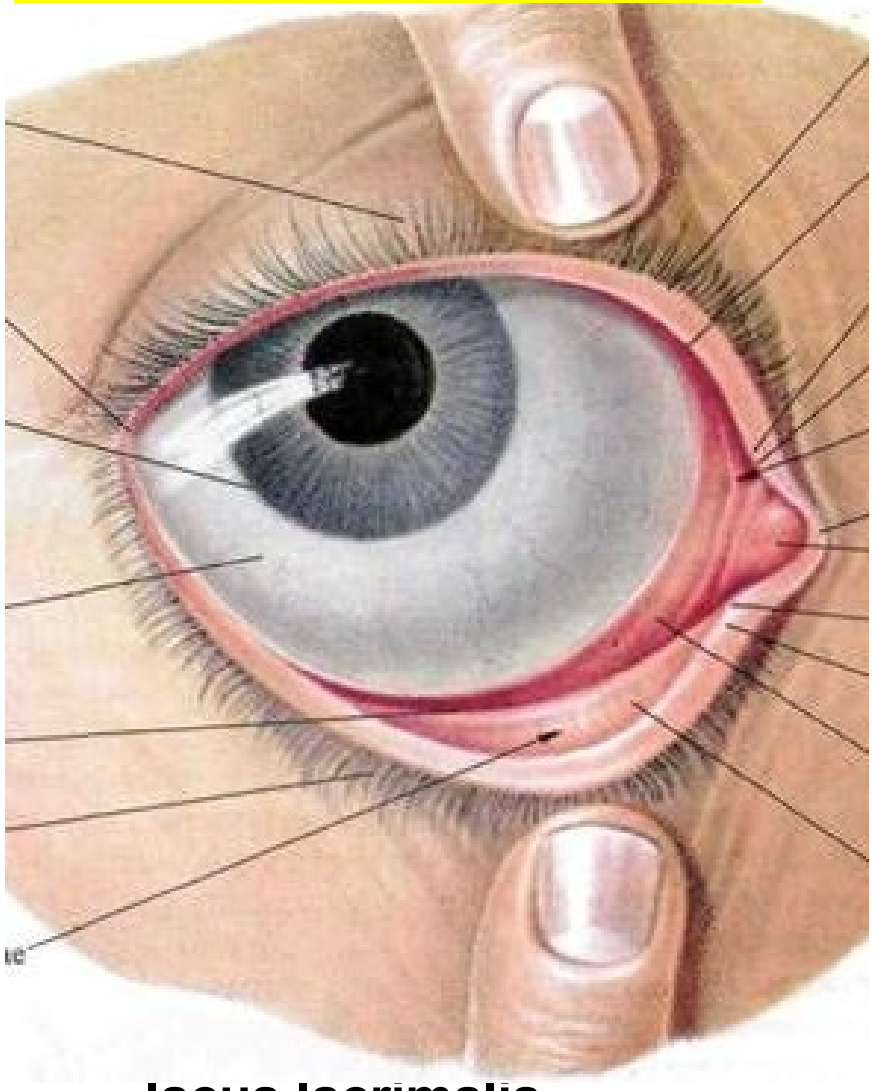
Chalazion

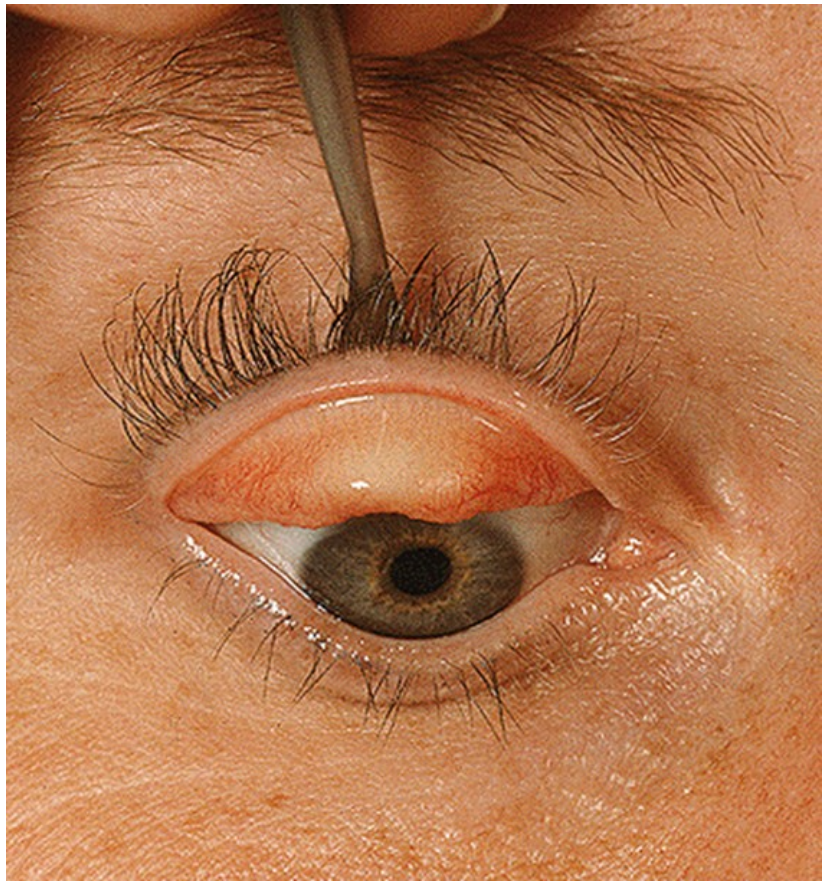
(inflammation of gl. tarsalis)

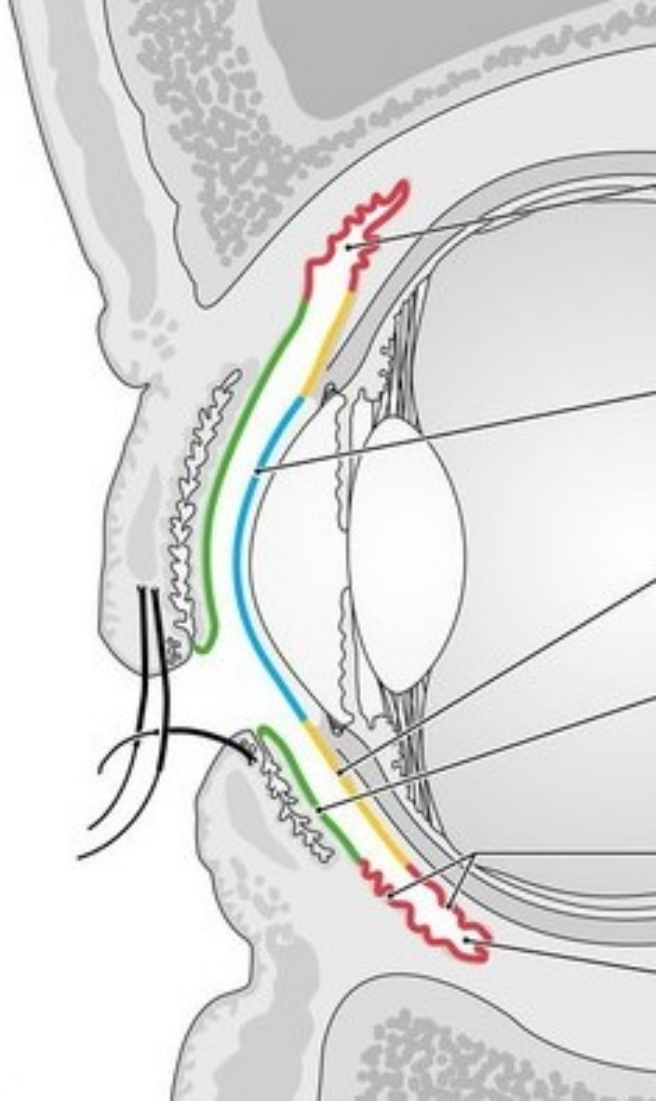
Hordeolum

(inflammation of gl. ciliaris)

TUNICA CONJUNCTIVA



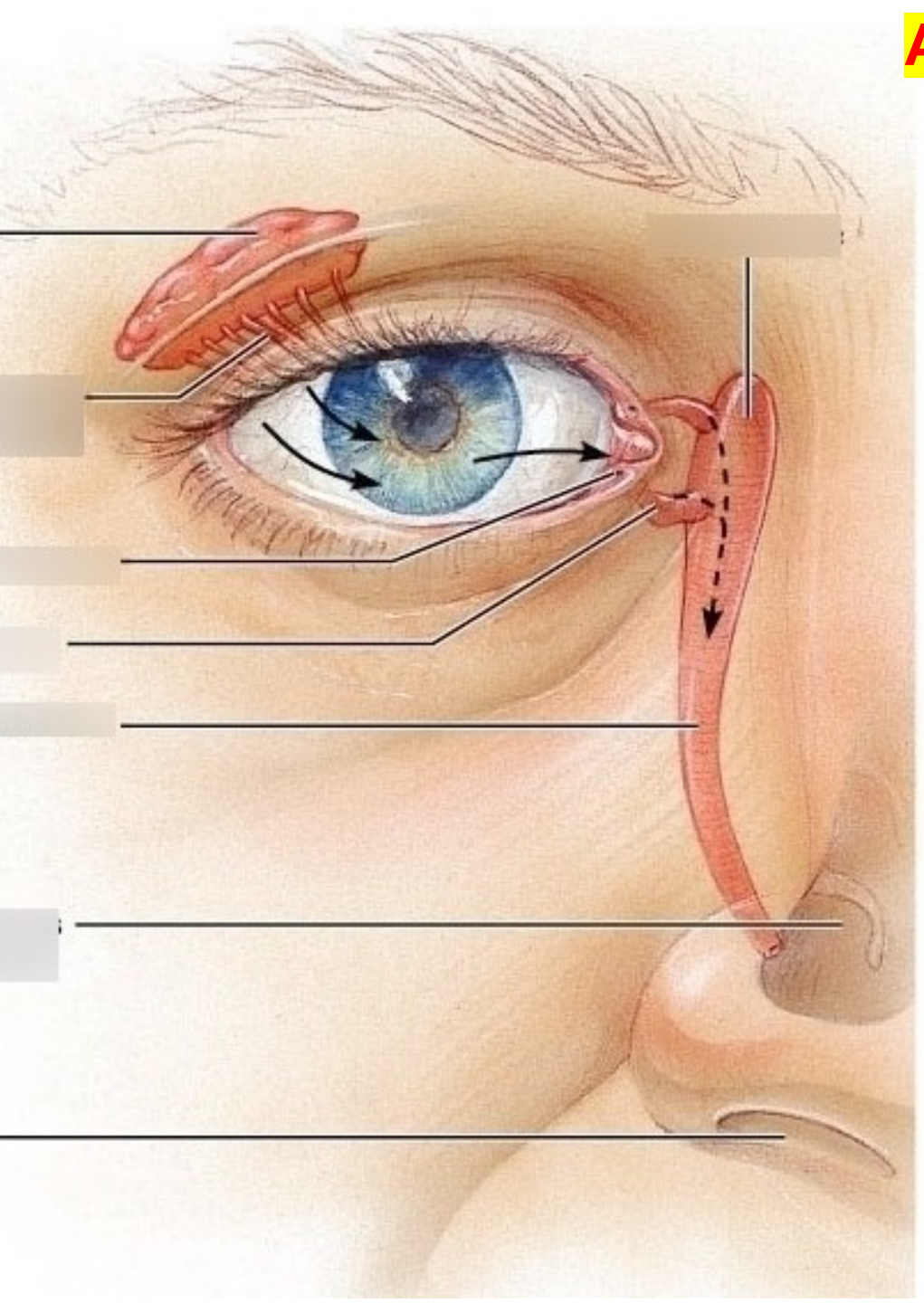




lacus lacrimalis
caruncula lacrimalis
papilla lacrimalis
punctum lacrimale

tunica conjunctiva palpebrarum
tunica conjunctiva bulbi
fornix conjuntivae super. et infer.
saccus conjunctivae
plica semilunaris

APARATUS LACRIMALIS



Gl. lacrimalis (pars orbitalis a palpebralis)

Ductuli exretorii (fornix conjunctivae sup.)

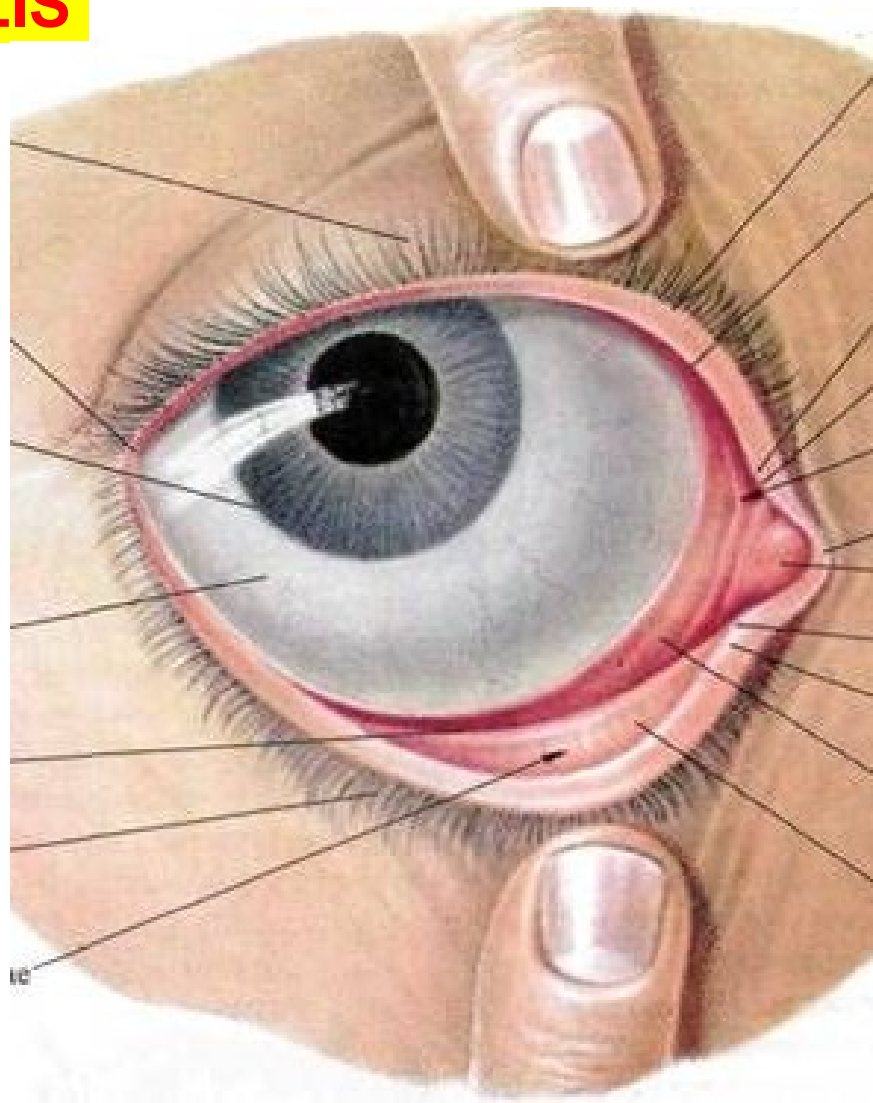
Lacrimae

Punta lacrimalis

Canaliculi lacrimales

Saccus lacrimalis

Ductus nasolacrimalis (meatus nasi inferior)



lacus lacrimalis
caruncula lacrimalis
papilla lacrimalis
punctum lacrimale

MM. BULBI

7 STRIATED MUSCLES

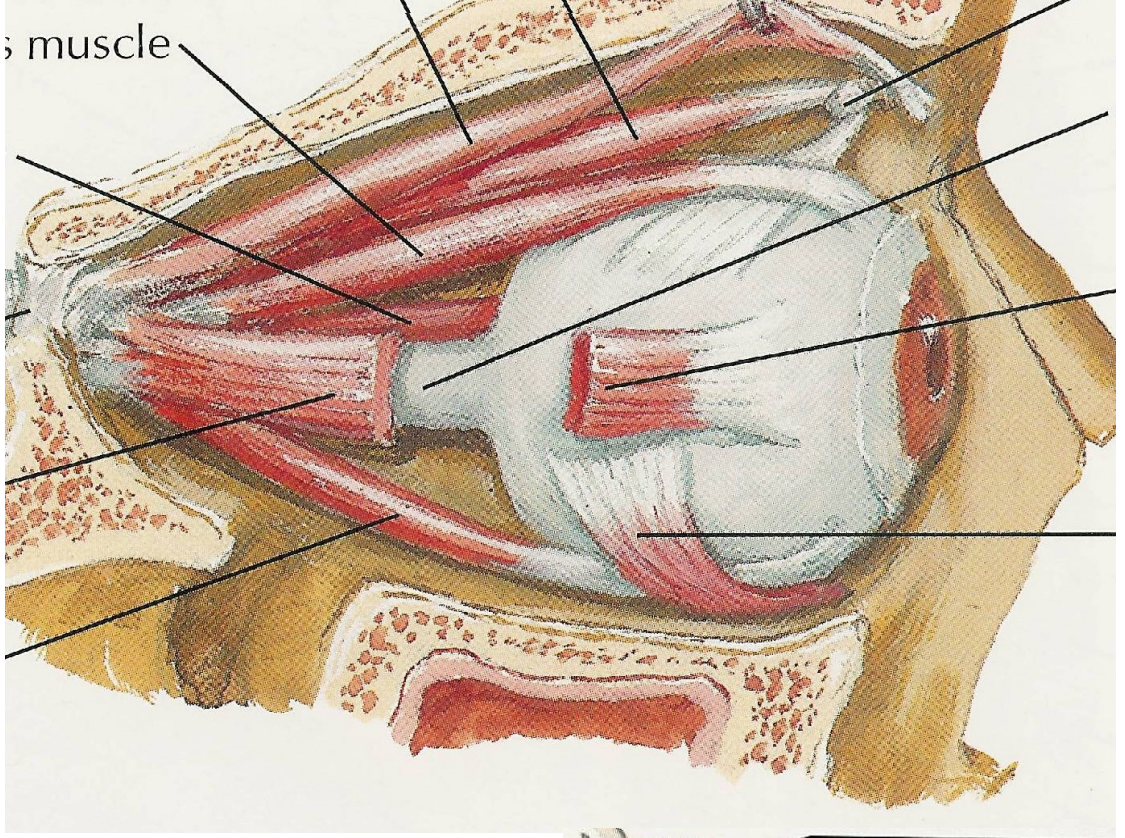
Innervation: n. III,IV,VI

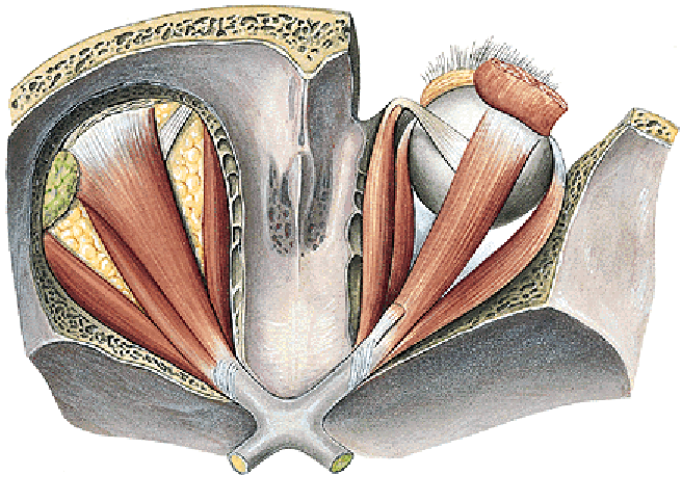
origin: **anulus tendineus communis**,

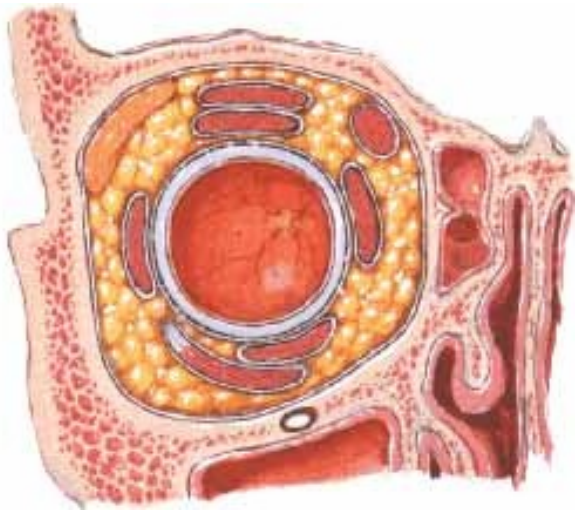
m. obliquus inferior: **inferior wall of the orbit**

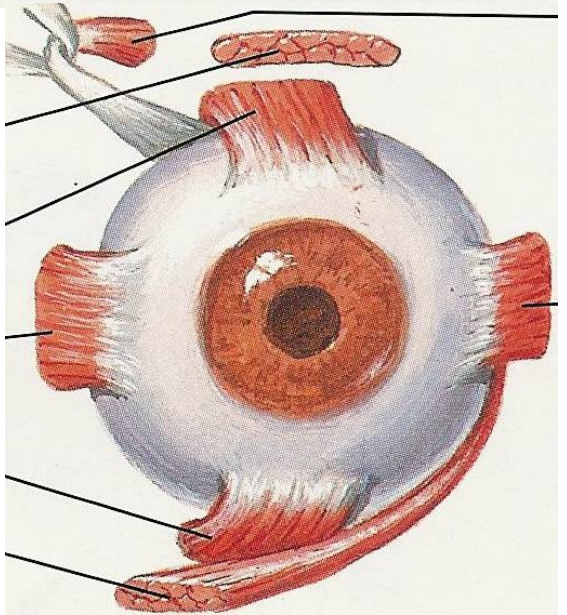
insertion: bulbus oculi

1. **M. LEVATOR PALPEBRAE SUPERIORIS** (N. III)
2. **M. RECTUS SUPERIOR** (N. III)
3. **M. RECTUS INFERIOR** (N. III)
4. **M. RECTUS MEDIALIS** (N. III)
5. **M. RECTUS LATERALIS** (N. VI)
6. **M. OBLIQUUS SUPERIOR** (N. IV)
7. **M. OBLIQUUS INFERIOR** (N. III)





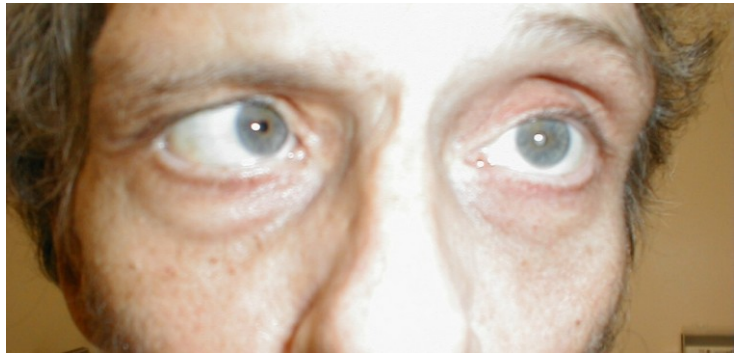




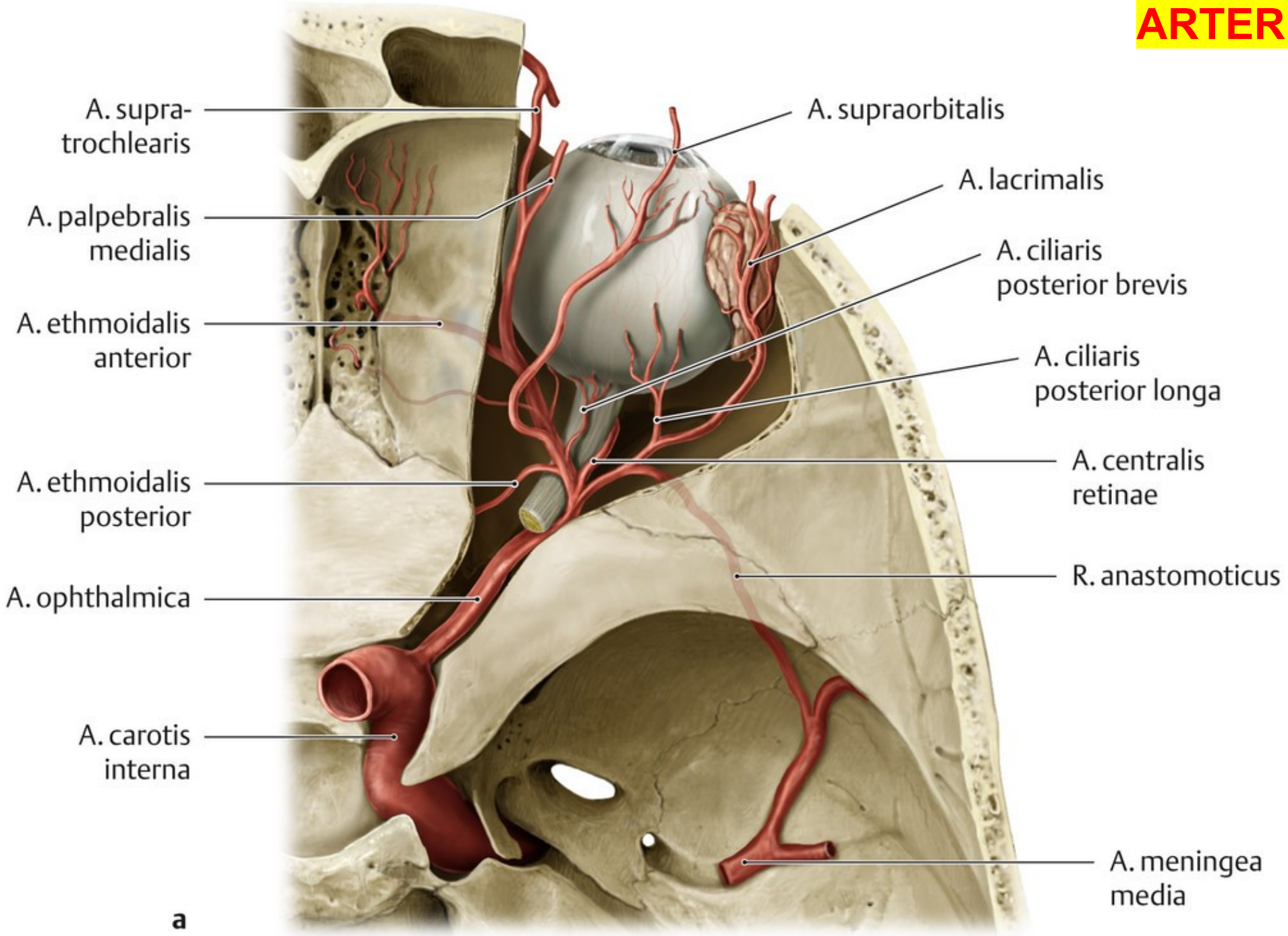
diplopie

Discoordination of extraocular muscles

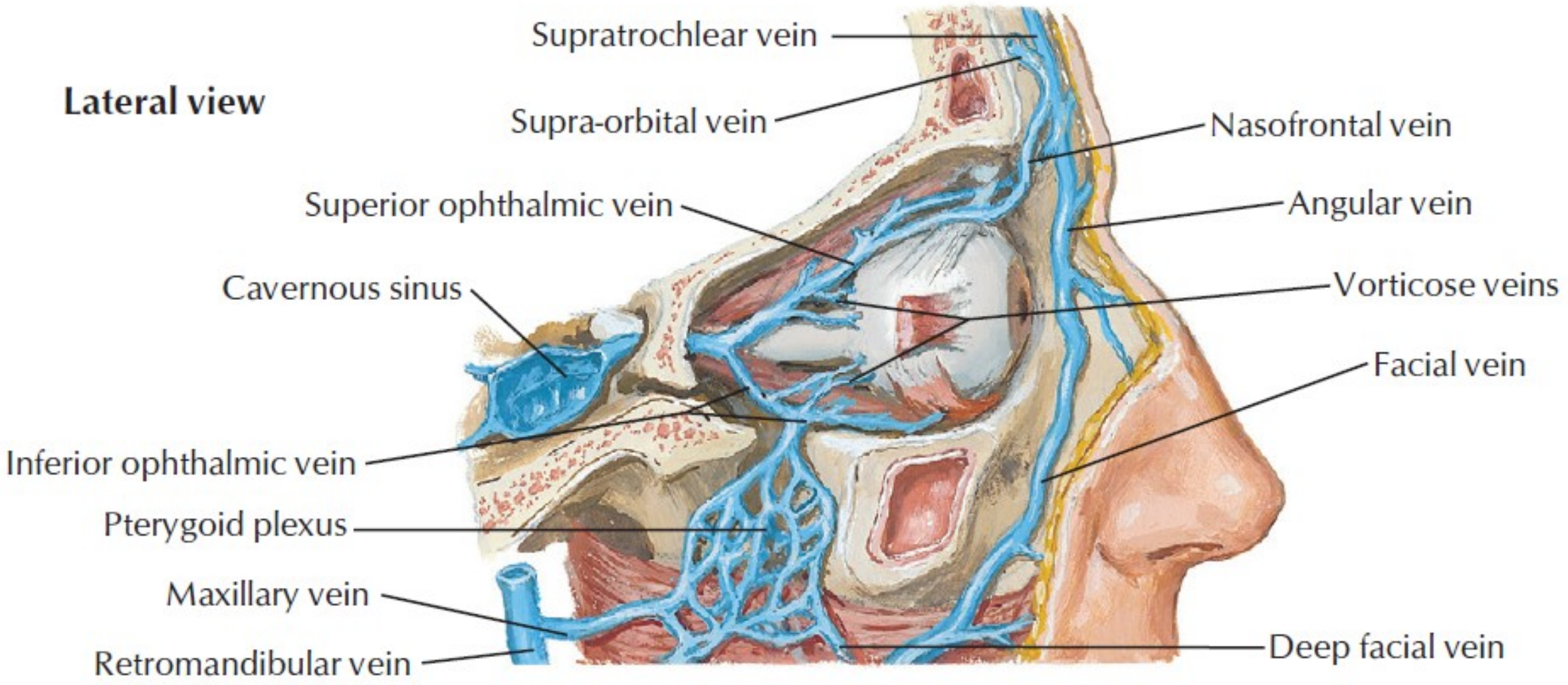
Strabismus



ARTERIA OPHTHALMICA

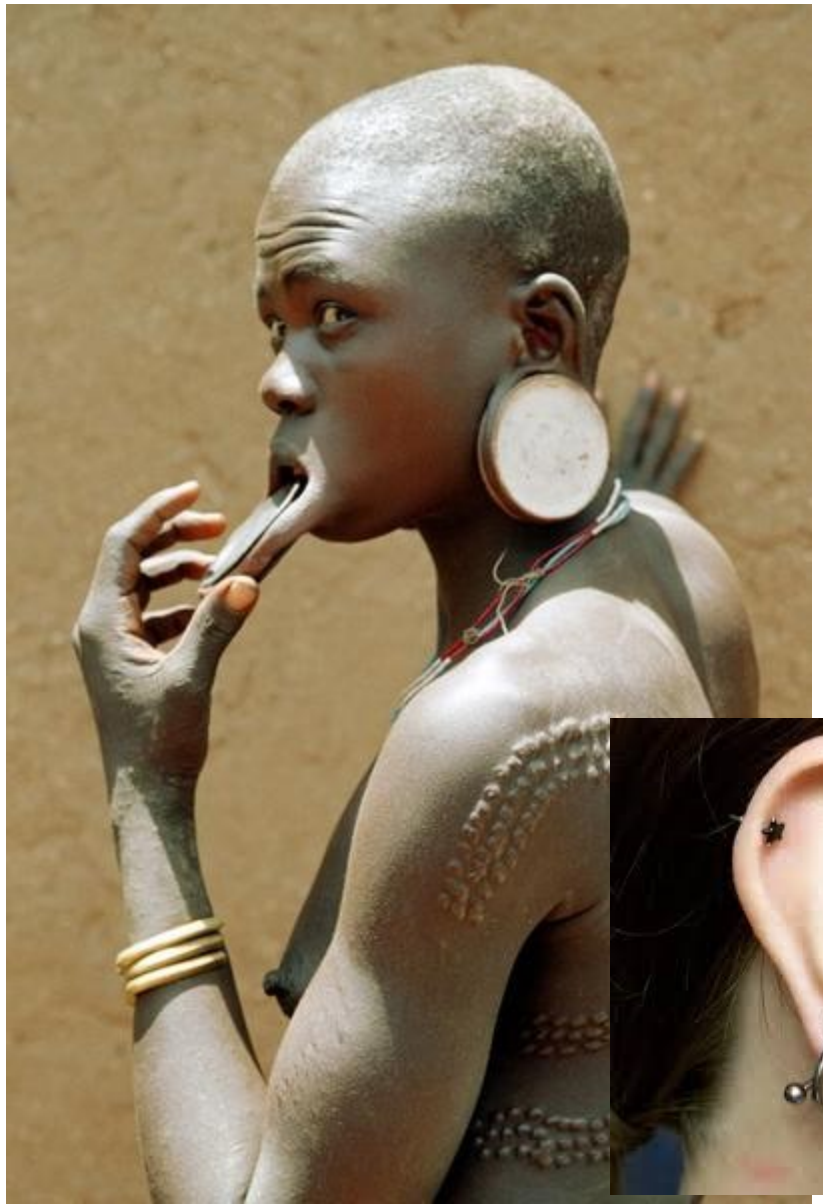


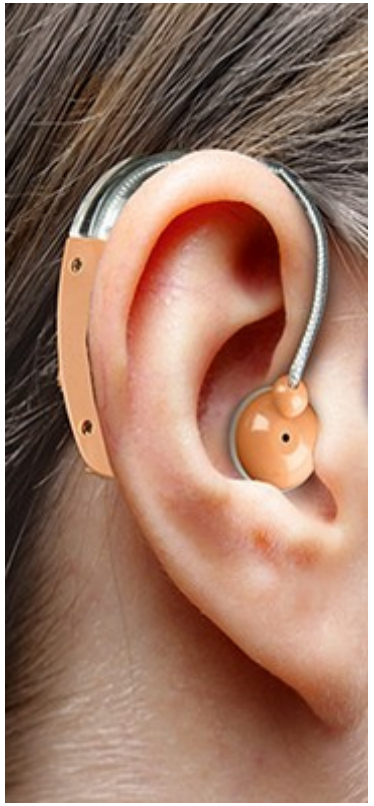
VENAE OPHTHALMICAE



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

Organum vestibulocochleare





Auris ext.

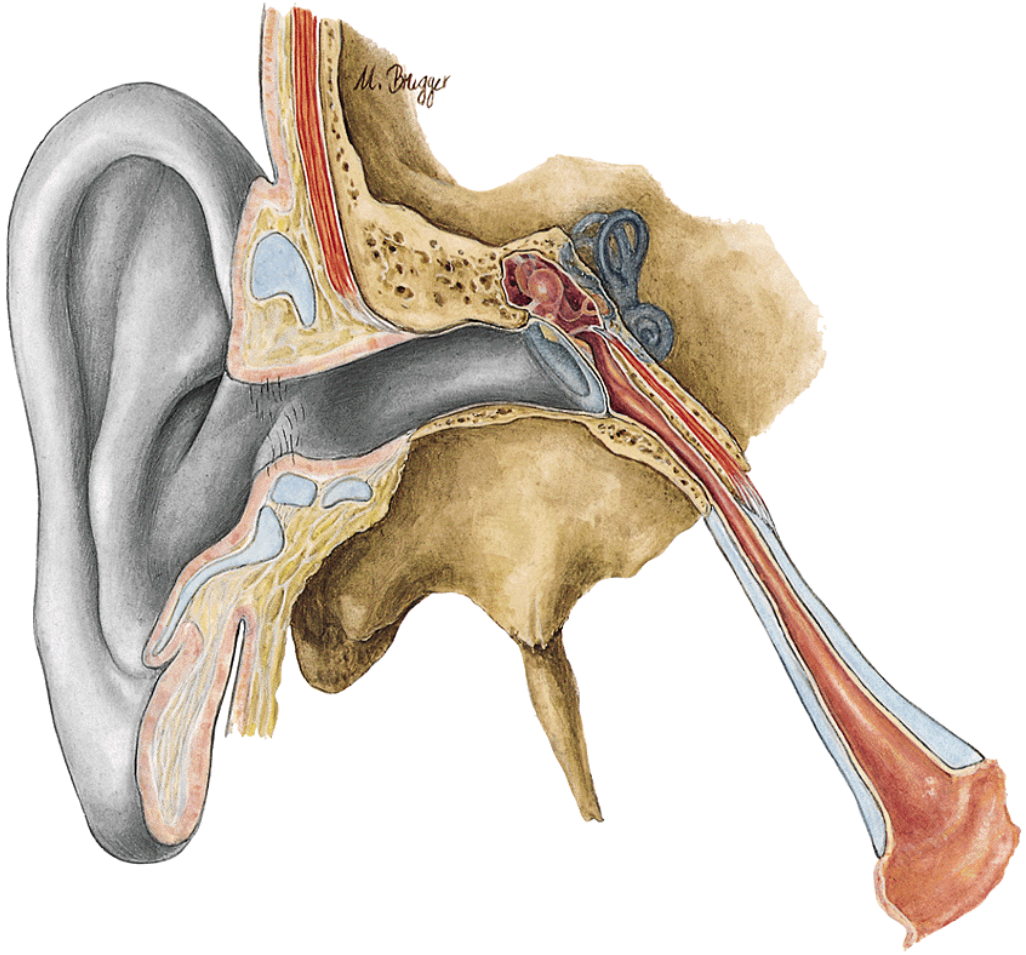
Auricula
Meatus acusticus ext.
Membrana tymp.

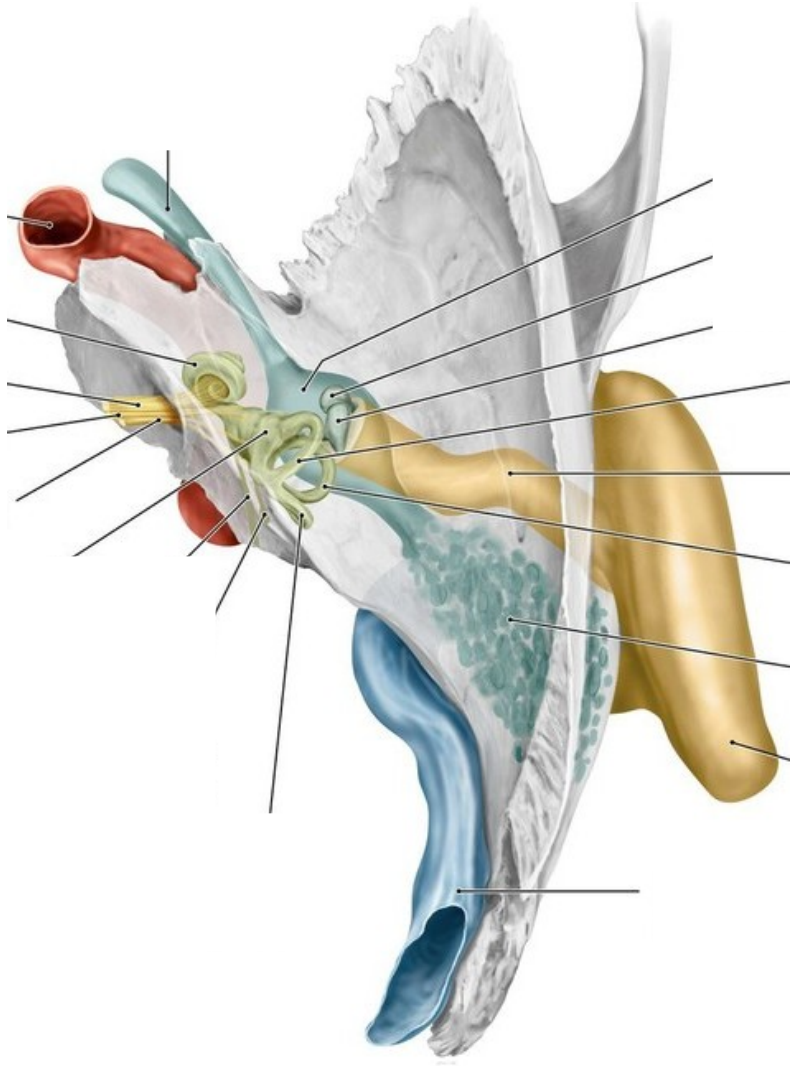
Auris med.

Cavum tympani
Tuba auditiva
Cellulae mastoideae

Auris int.

Labyrinthus osseus et membranaceus





A. AURIS EXTERNA

1. Auricula

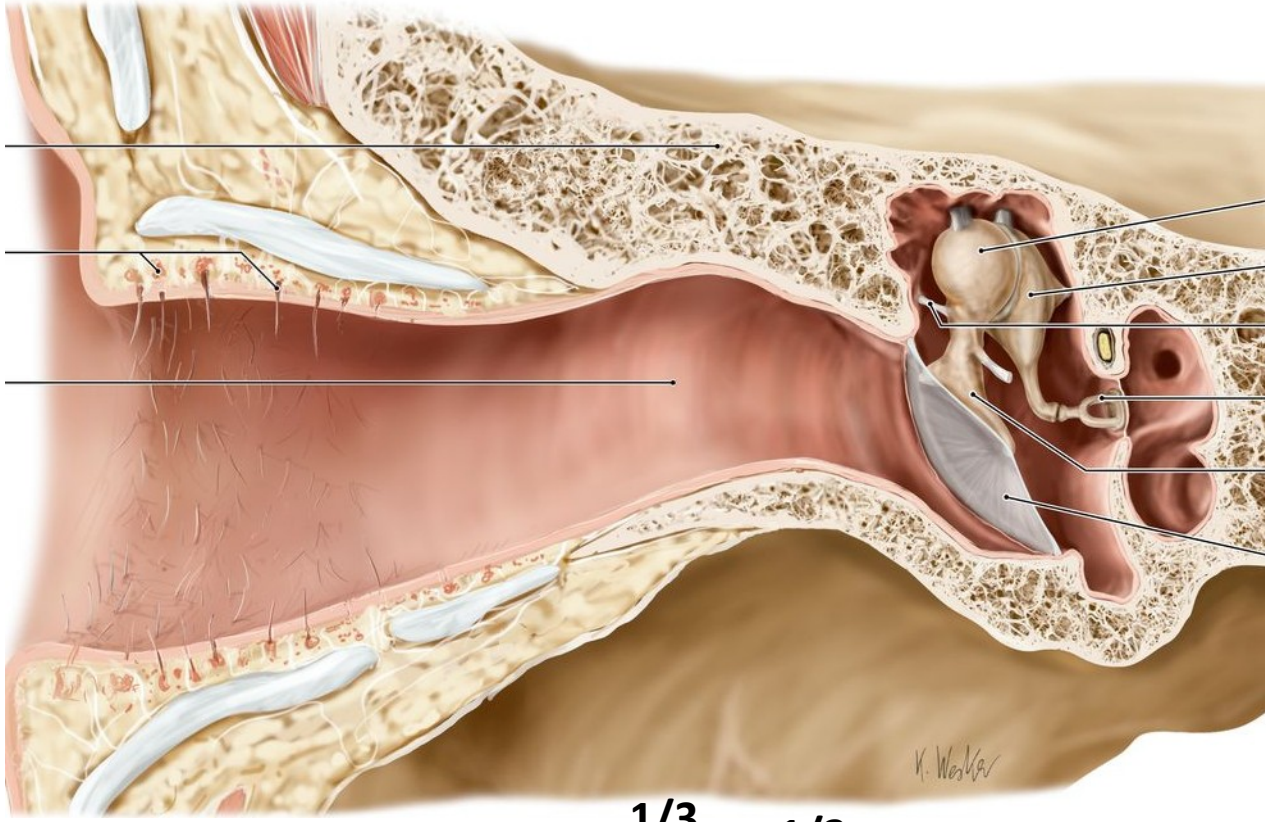
2. Meatus acusticus ext.

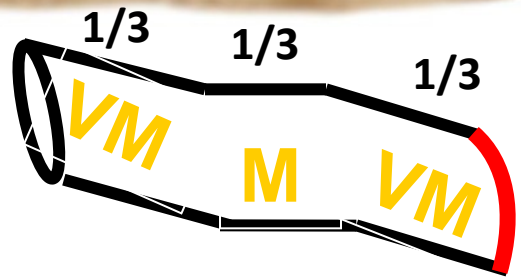
2/3

Meatus acusticus externus cartilagineus

1/3

meatus acusticus externus osseus (pars tympanica)





Porus ac. ext.

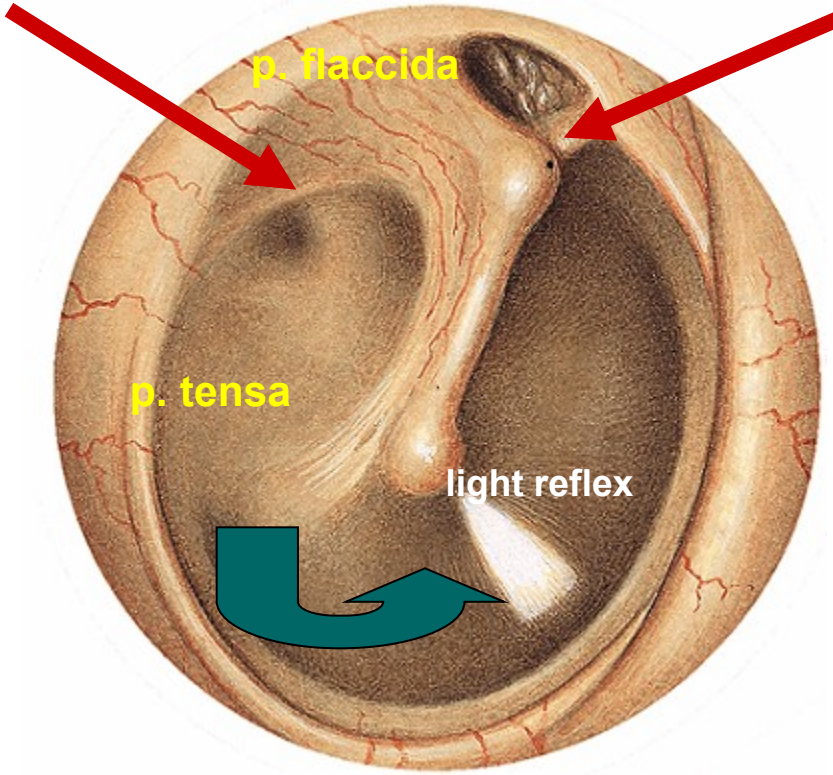
Membr. tymp.

Skin with glandulae ceruminosae (cerumen), tragi

3. Membrana tympani

Plica mallearis post.

Plica mallearis ant.



Prominentia mallearis

(proc. lat. mallei)

Stria mallearis

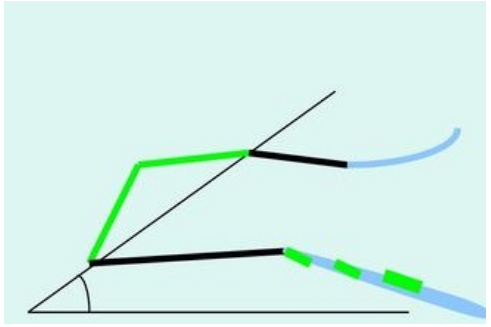
(manubrium m.)

Umbo membranae tympani

(místo vtažení)

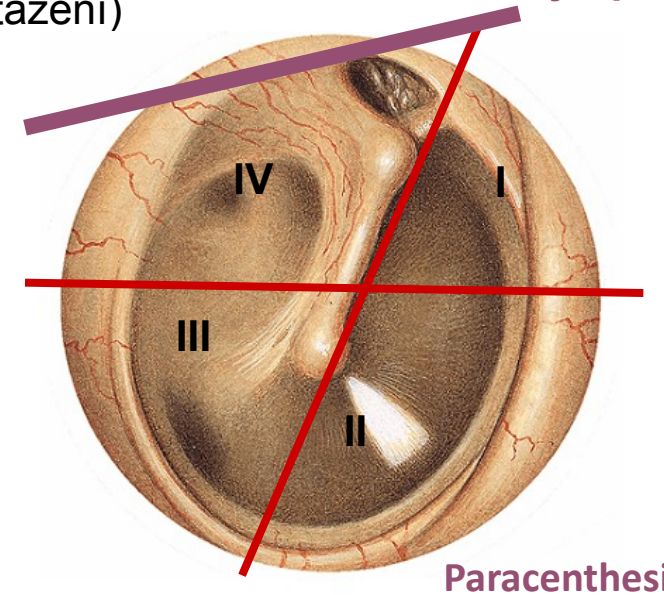
Limbus membranae tympani,
anulus fibrocartilagineus
in sulcus tympanicus

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



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

Chorda tympani

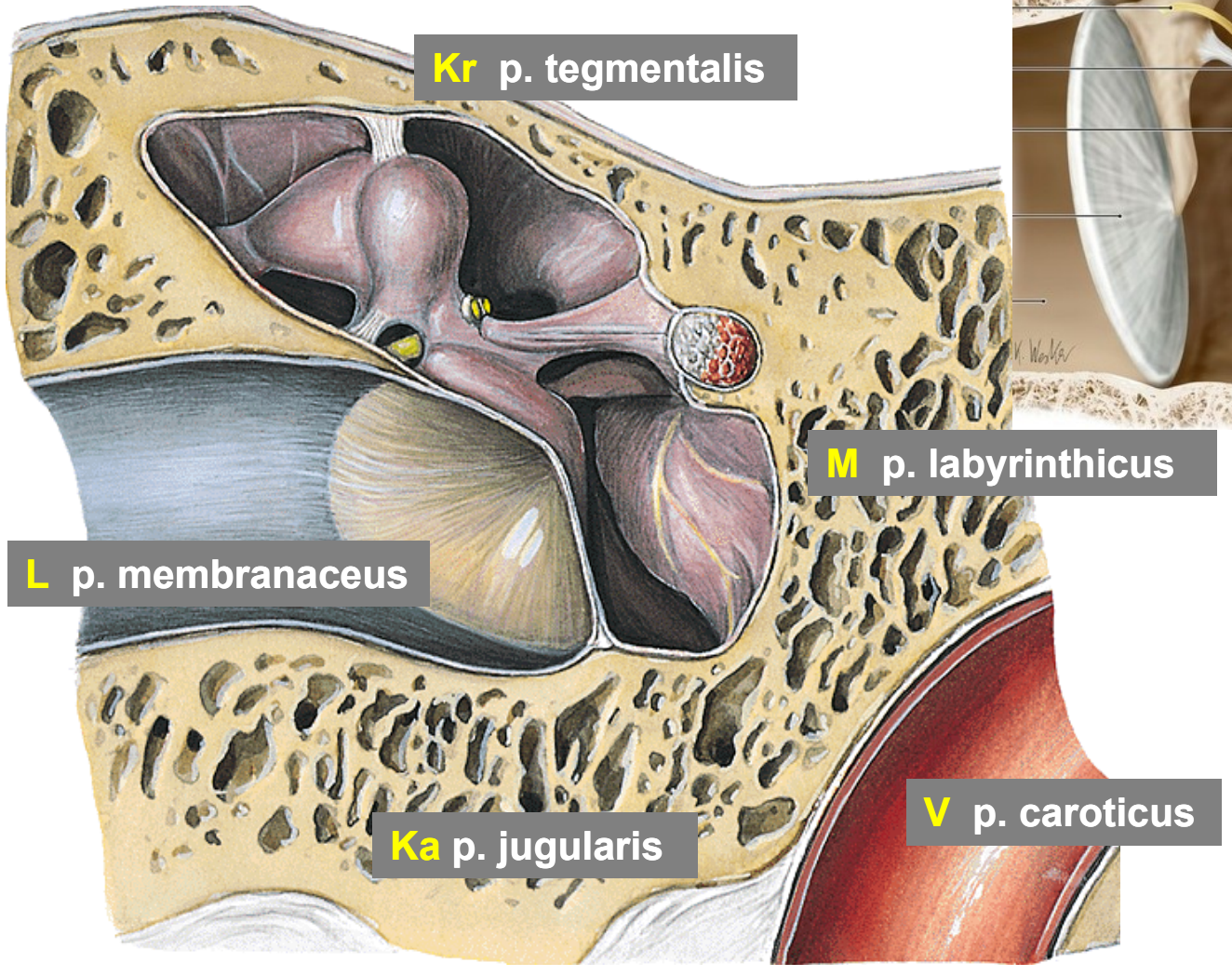


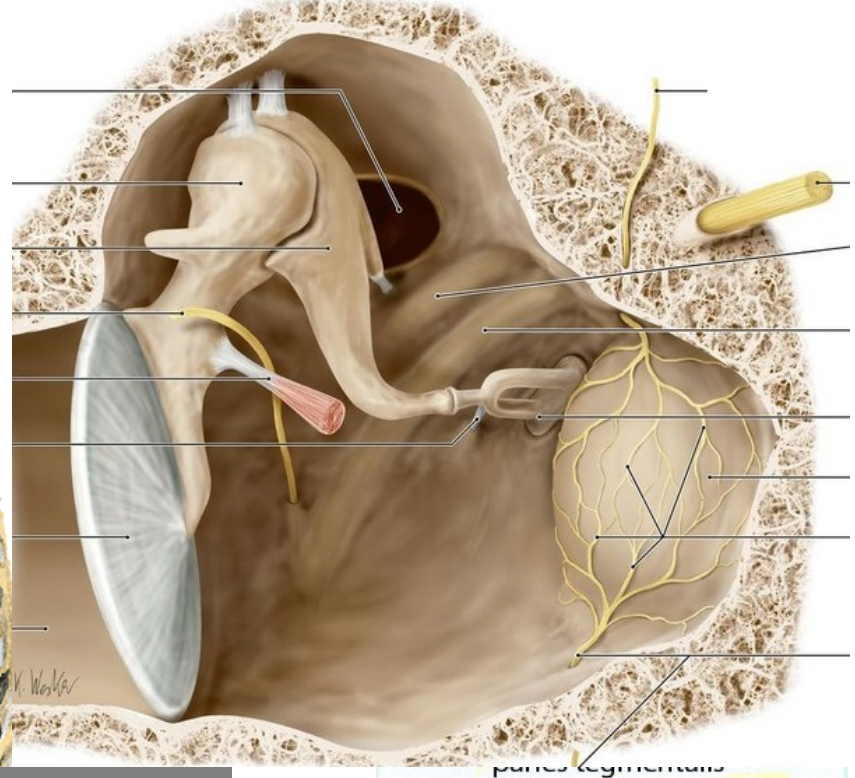
Paracenthesis !

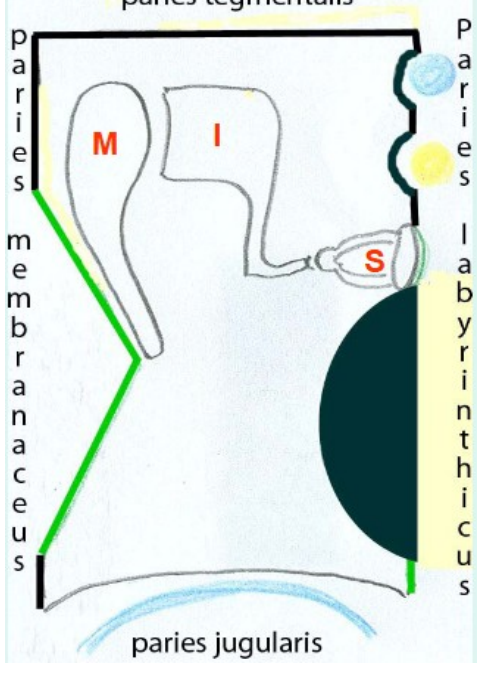
B. AURIS MEDIA

1. Cavum tympani

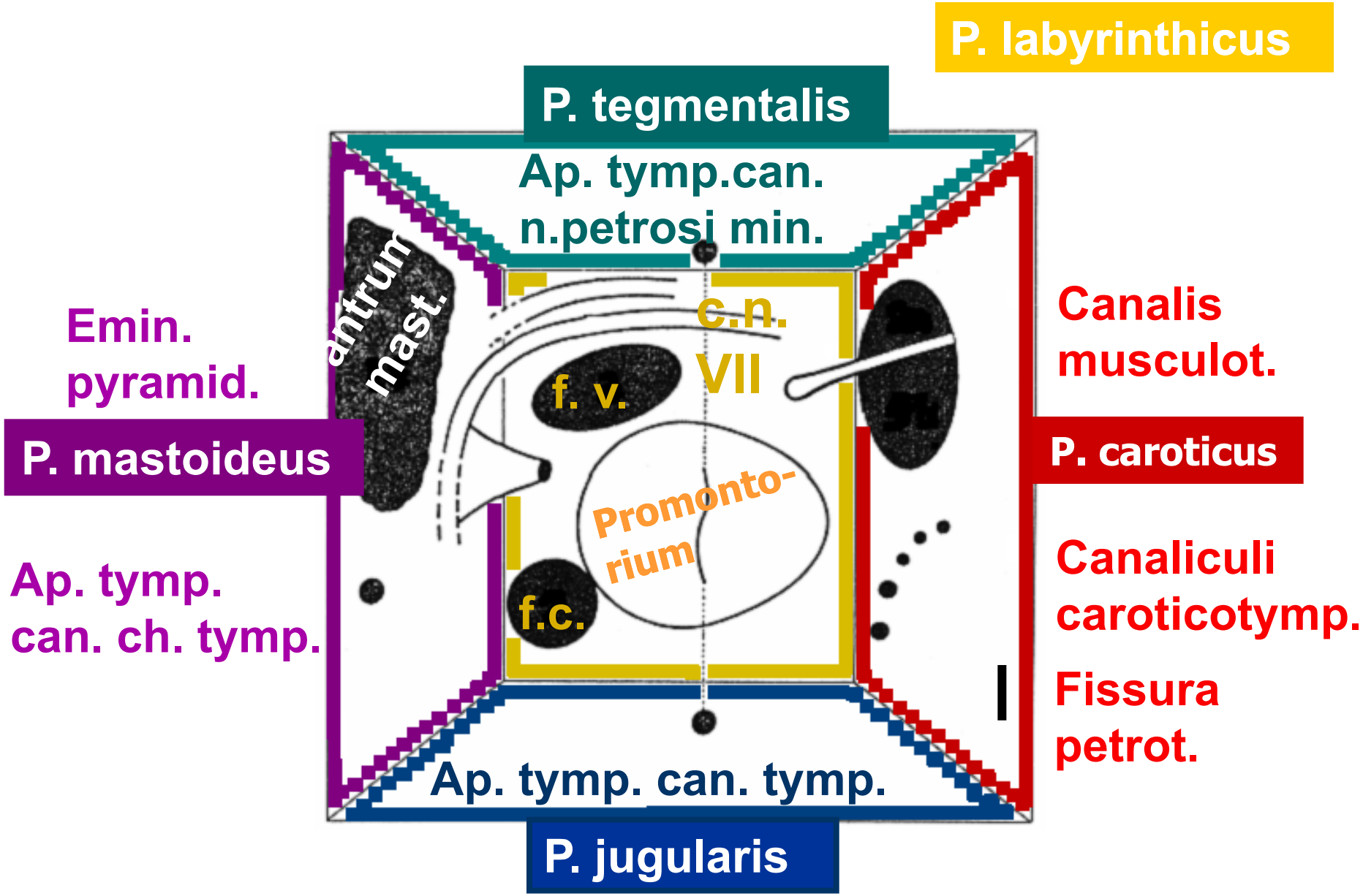
D p. mastoideus





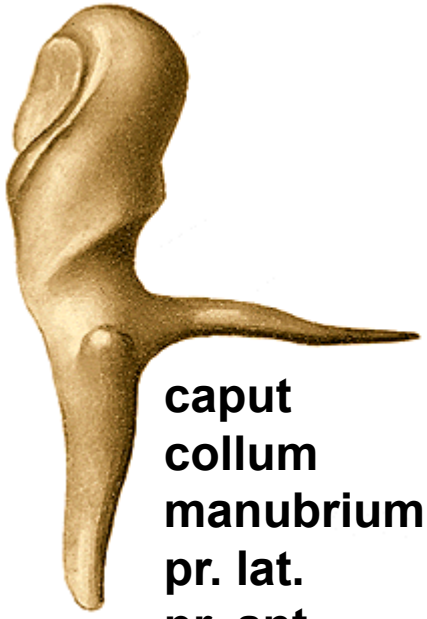


Shape as a biconcave lens


P. labyrinthicus
P. tegmentalis
Ap. tymp.can.
n.petrosi min.
antrum mast.
c.n. VII
f. v.
Promonto-rium
f.c.
Emin. pyramid.
P. mastoideus
Ap. tymp. can. ch. tymp.
Canalis musculot.
P. caroticus
Canaliculi caroticotymp.
Fissura petrot.
Ap. tymp. can. tymp.
P. jugularis

Ossicula auditus

Malleus

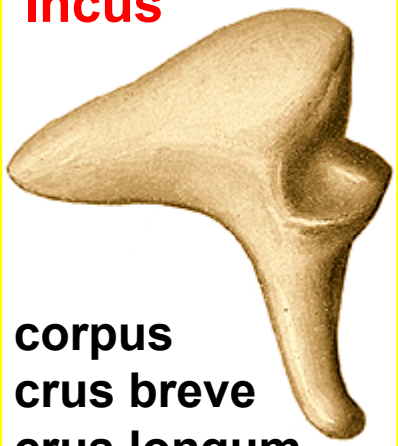


caput
collum
manubrium
pr. lat.
pr. ant.

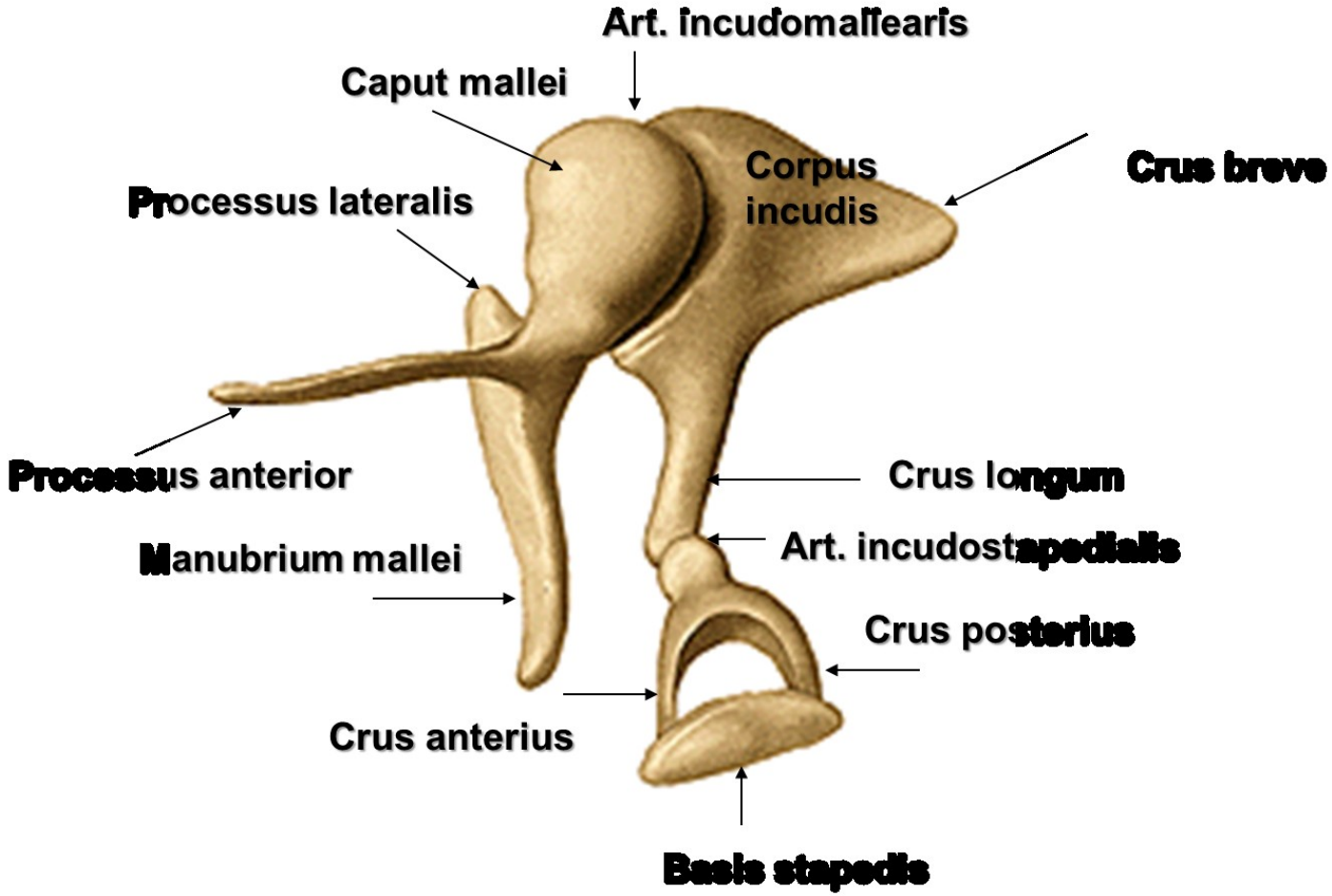
Stapes

caput
crus ant.
crus post.
basis

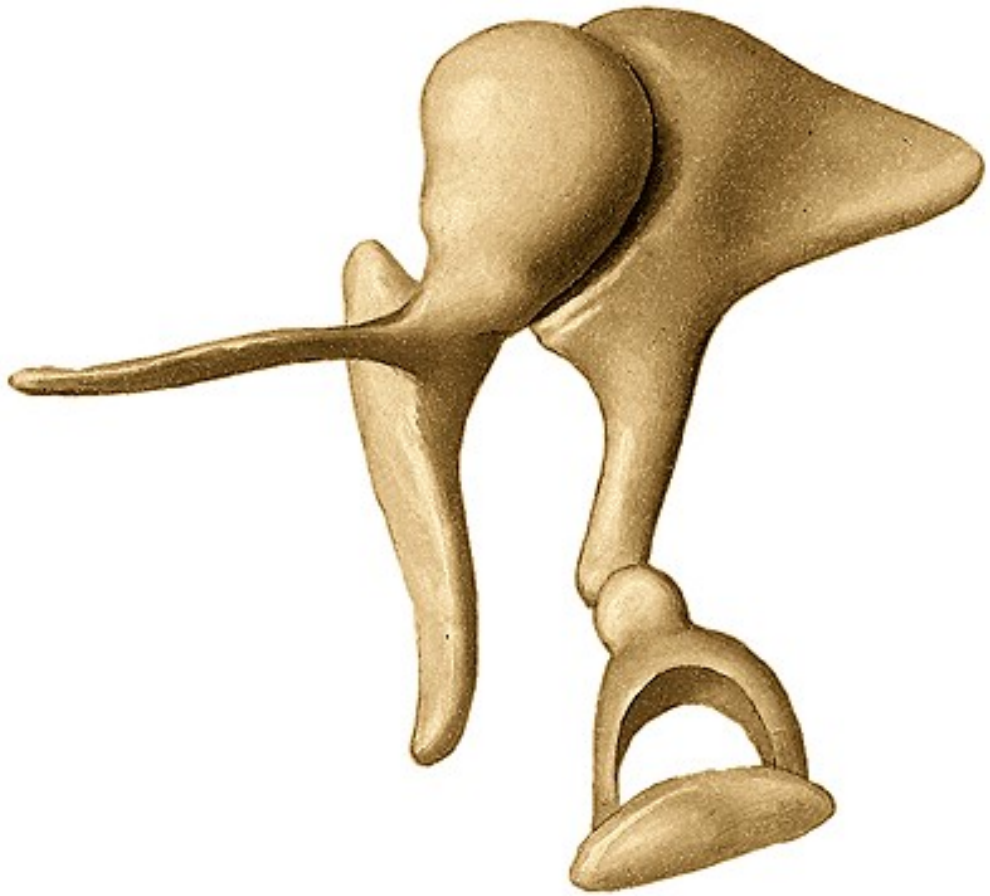
Incus

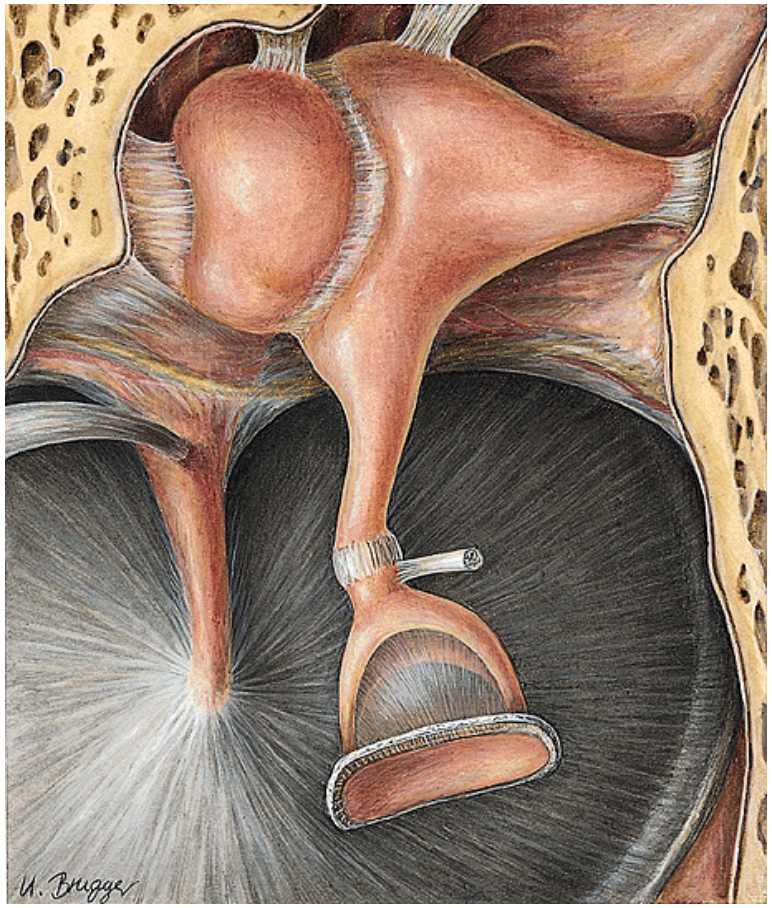


corpus
crus breve
crus longum
pr. lenticularis



Connections of ossicula auditus





1.joints

Art. incudomallearis

Art. incudostapedia

2. bands

lig. mallei sup., lat., ant.

lig. incudis sup., post.

membrana stapedis

lig. anulare stapedis

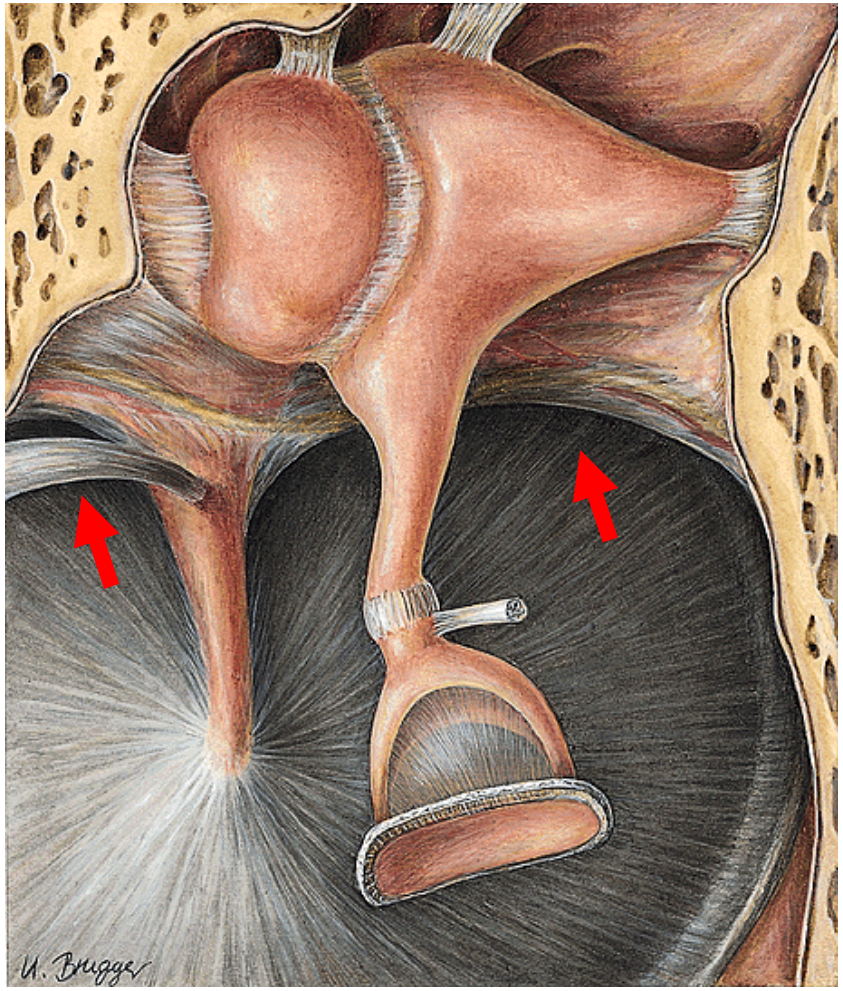
3. muscles

M. stapedius

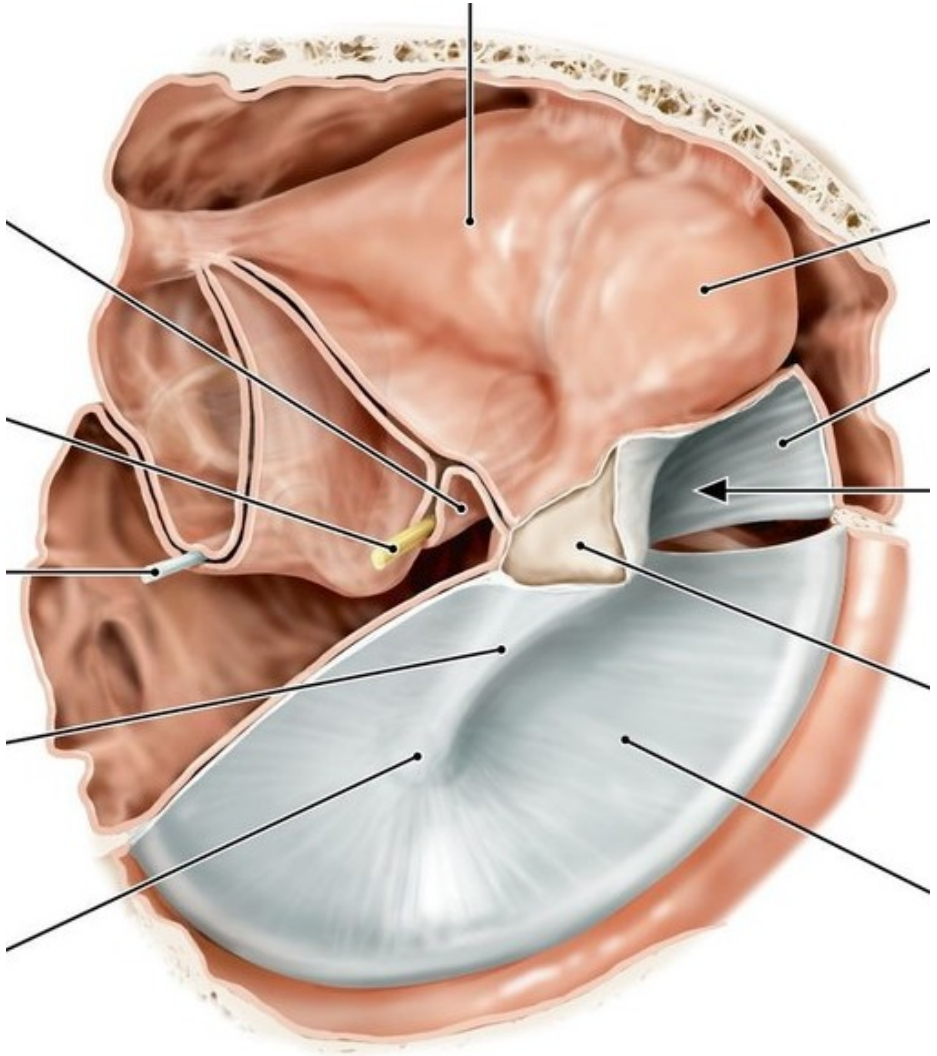
M. tensor tympani

Mucose of middle ear

Plica chordae tymp.



Plica chordae tymp.



Recessus membranae tympani ant.

Recessus membranae tympani post.

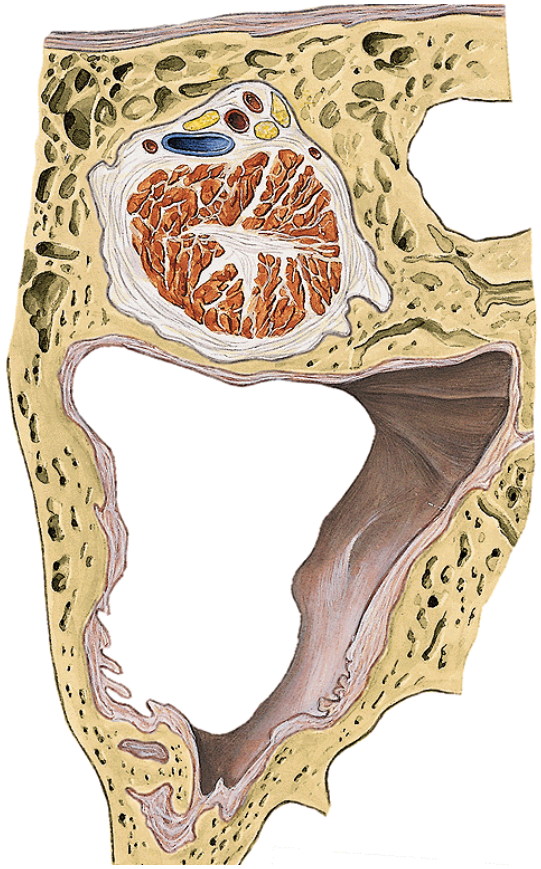
2. Tuba auditiva

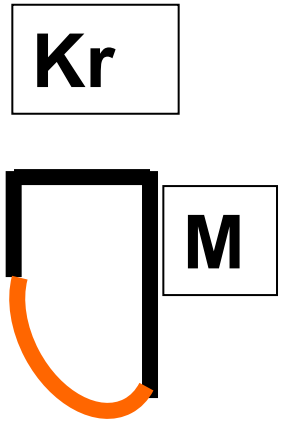
joins tympanic cavity with pharynx (baroperception)

ostium pharyngeum TA – lat. + dors. + up and opens in TC to anterior wall as ostium tympanicum of TA.

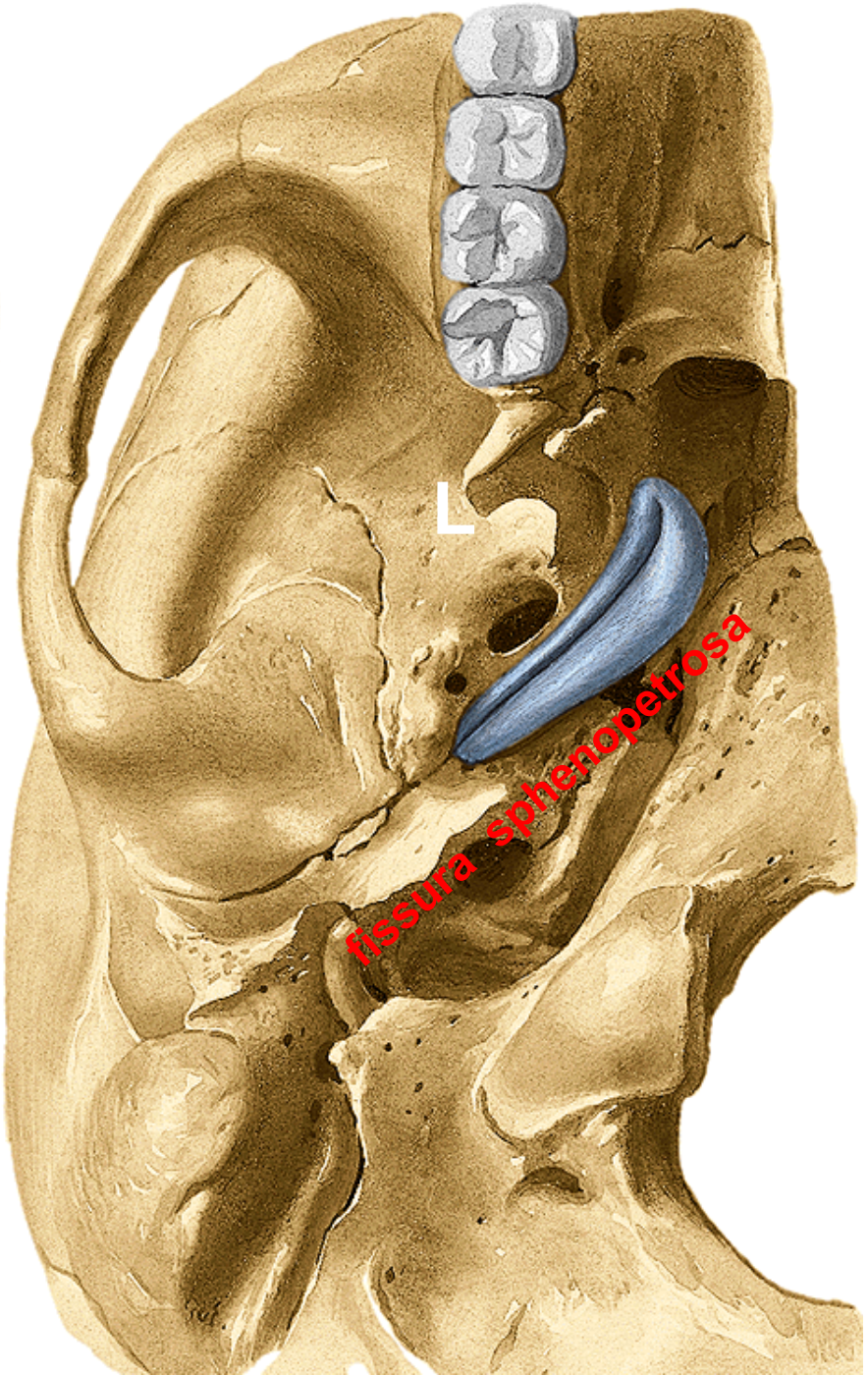
Lateral 1/3 is located in semicanalis TA = pars ossea TA,

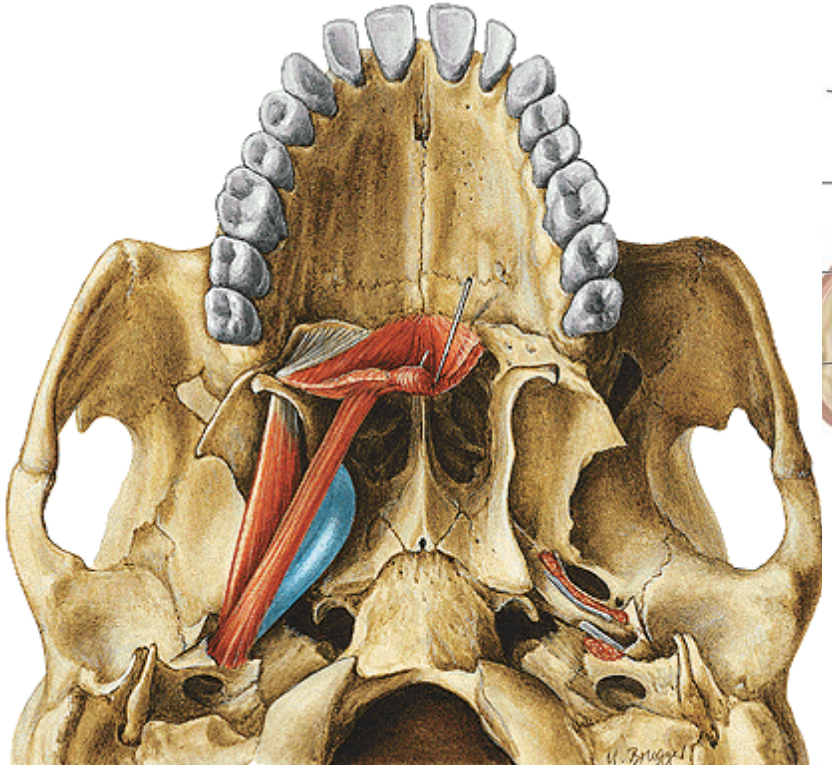
medial 2/3 = pars cartilaginea TA – is opened caudally (with lamina membranacea), between bone and cartilaginous part is isthmus TA;

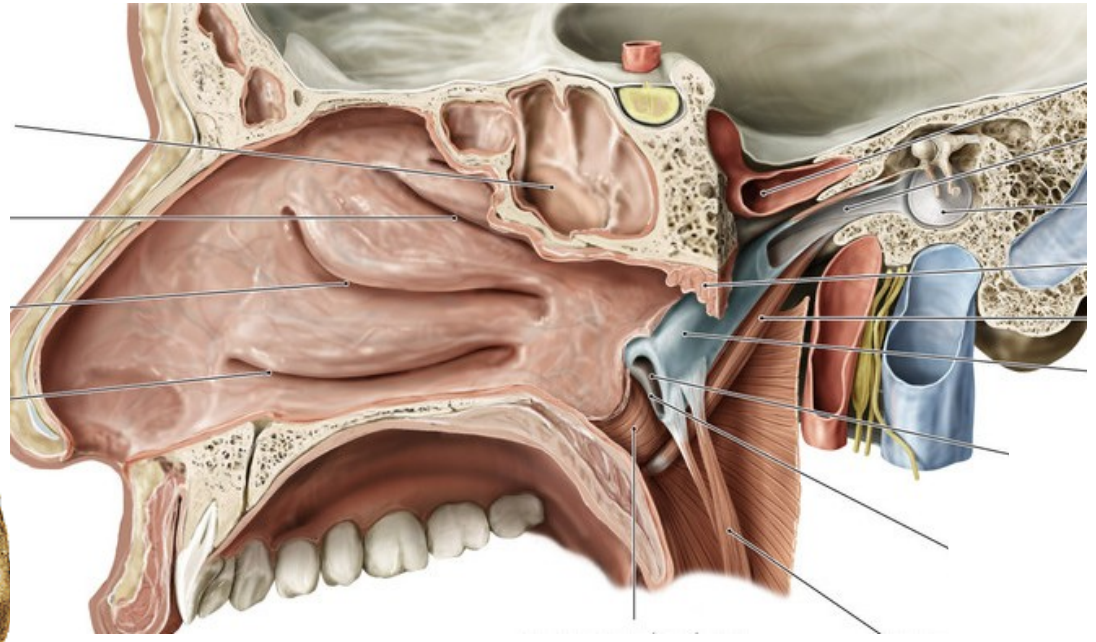


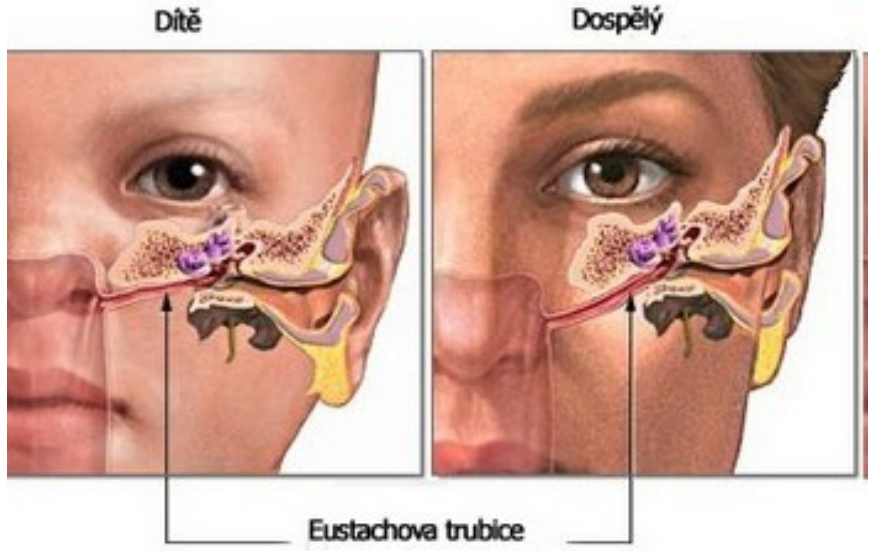


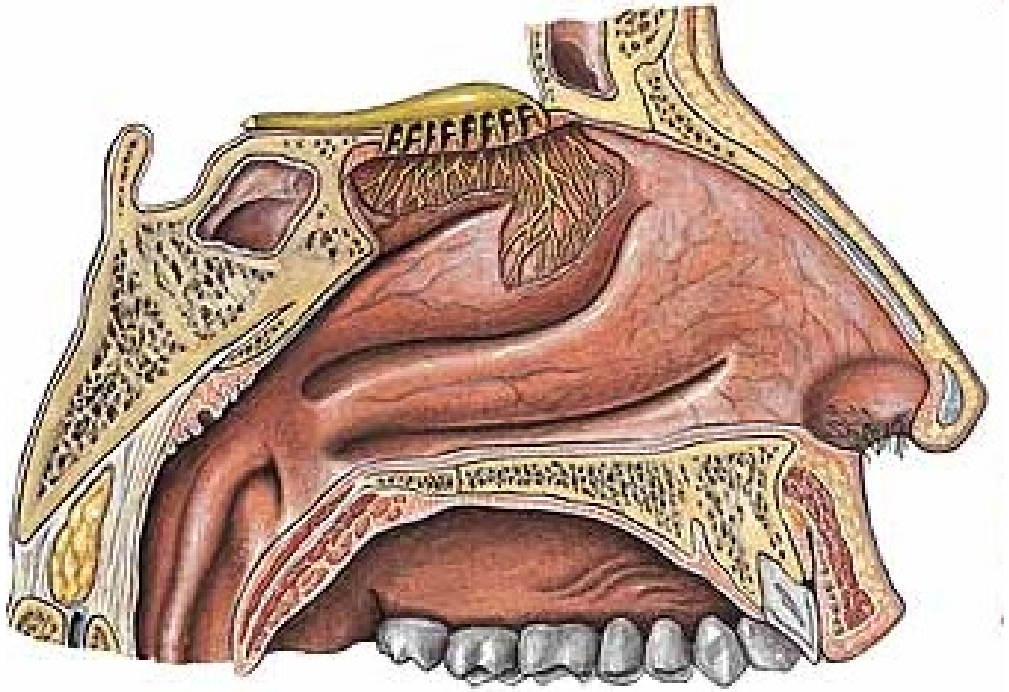
lamina membranacea



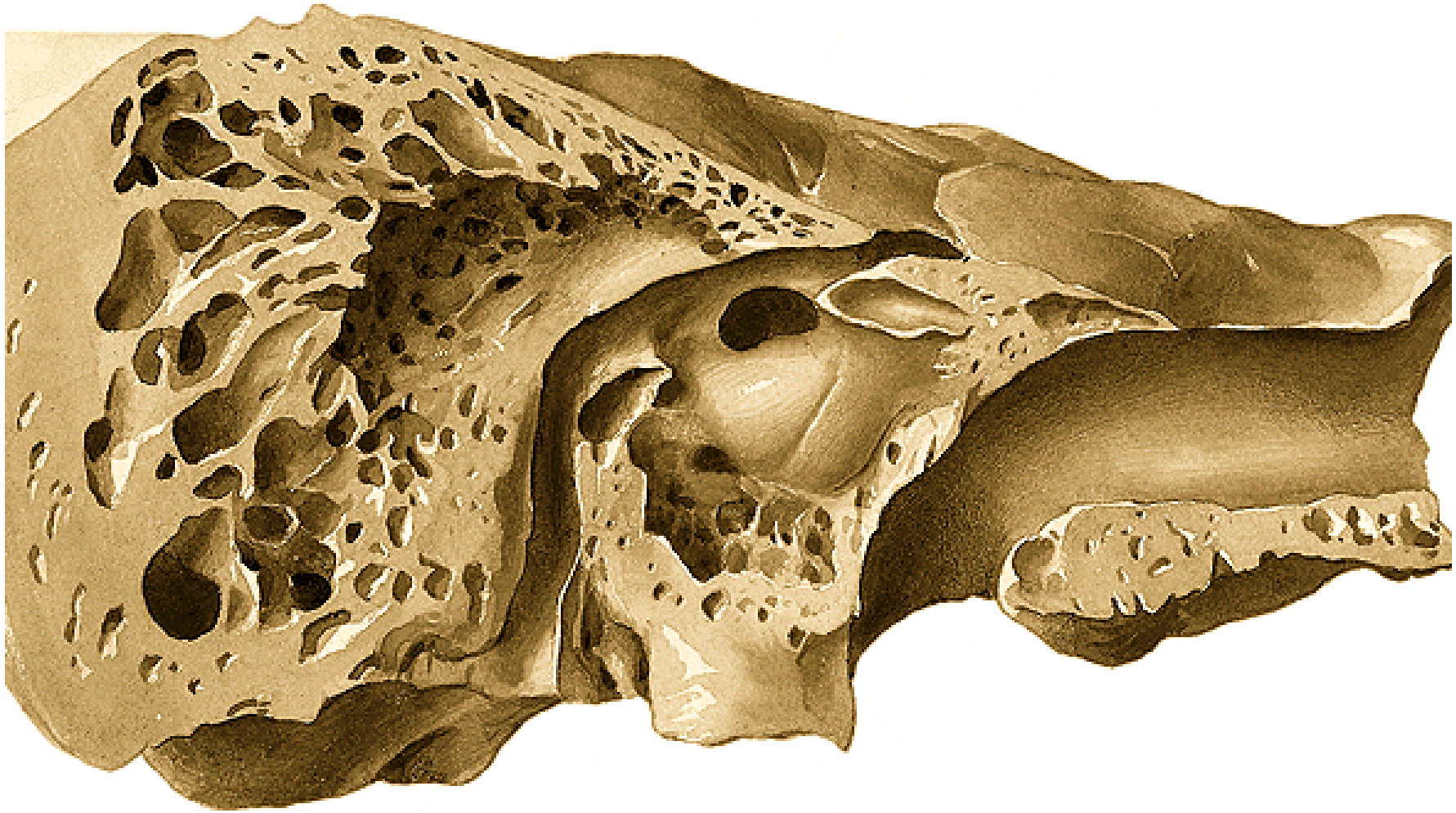





Dítě
Dospělý
Eustachova trubice

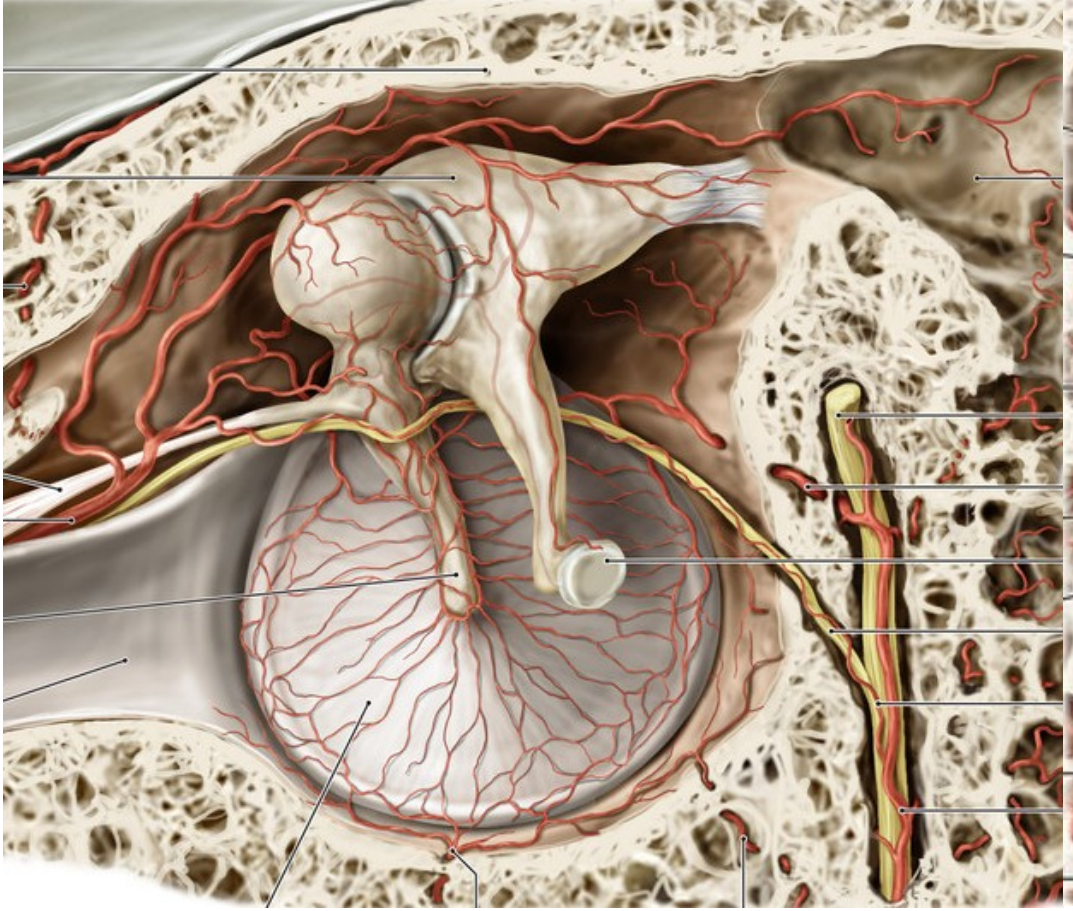


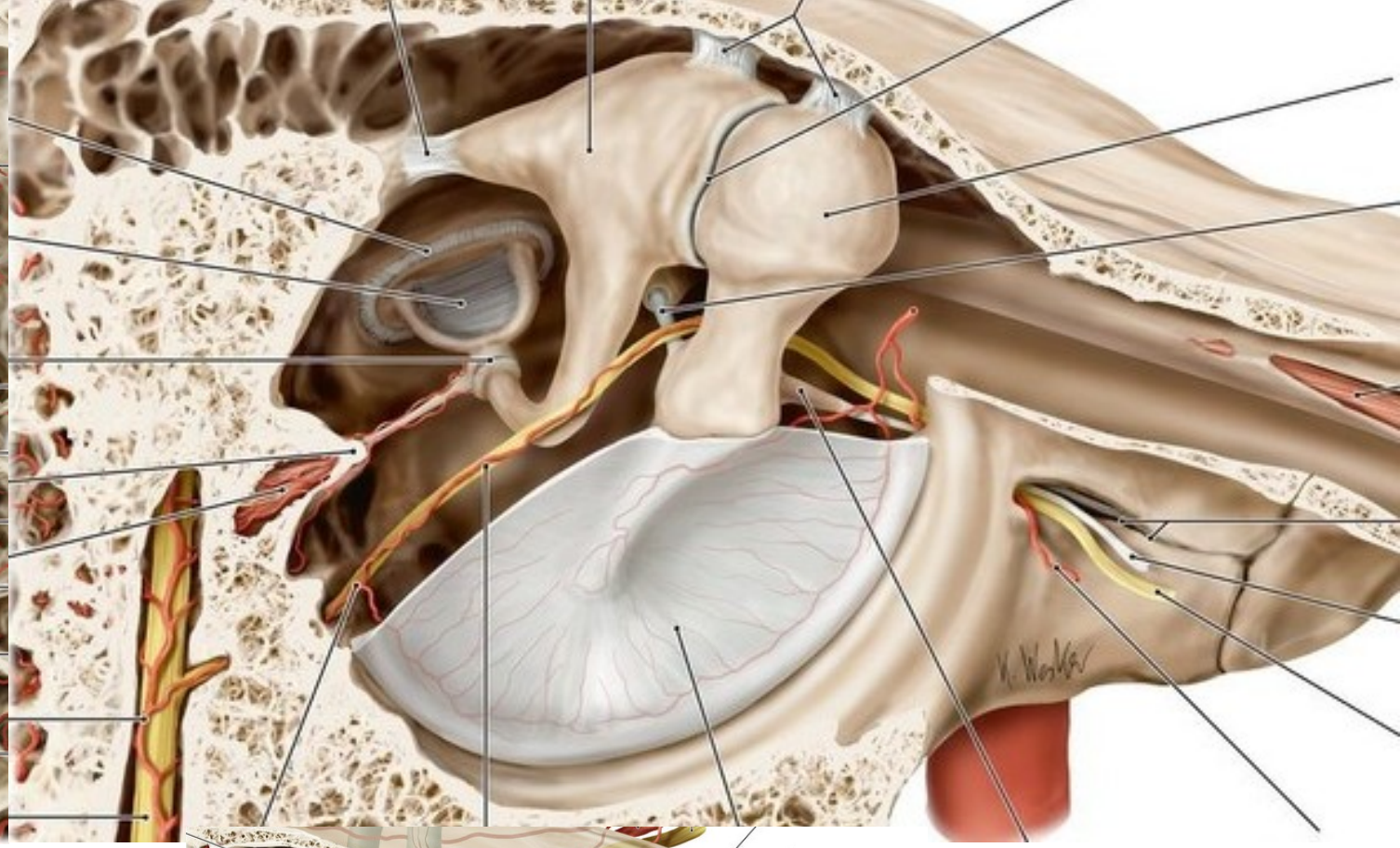
3. Cellulae mastoideae

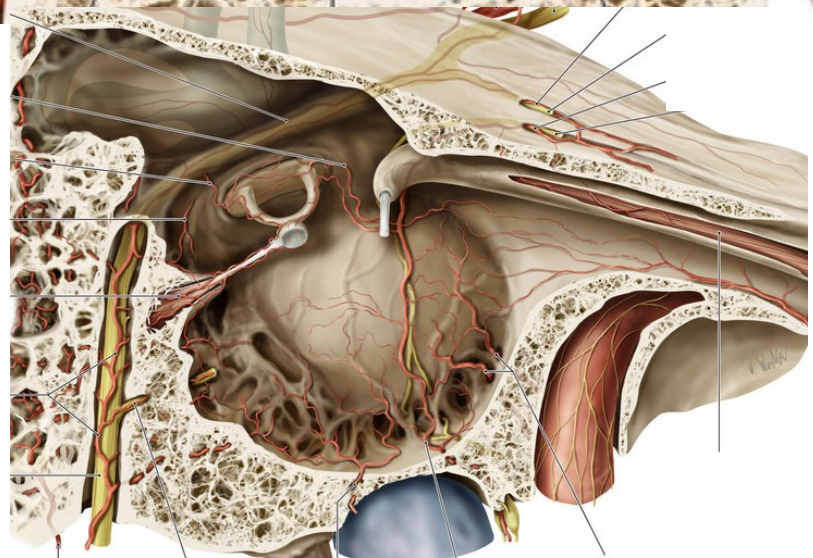


Antrum mastoideum

Relationship with sinus sigmoideus







C. AURIS INTERNA

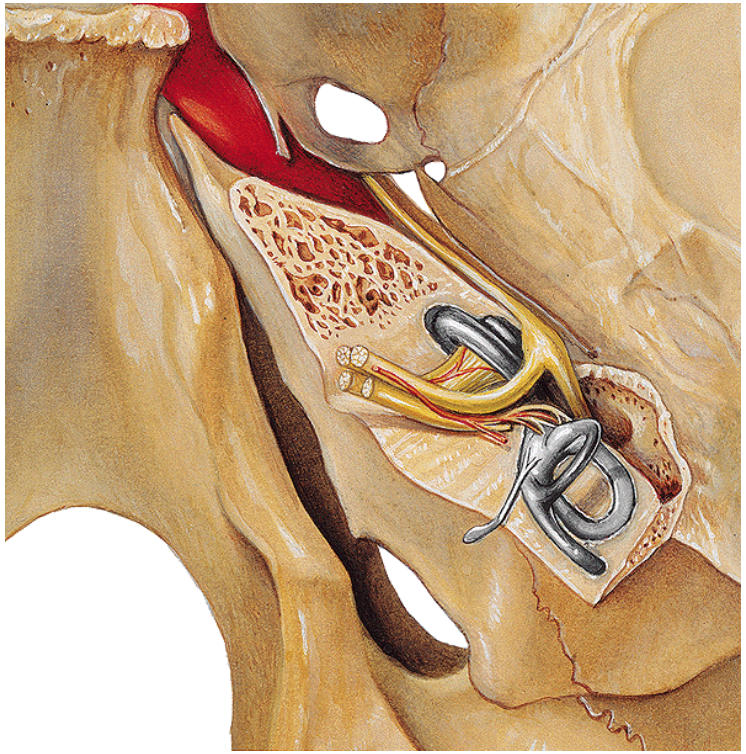
Labyrinthus osseus

Vestibulum

Canales semicirculares ossei

Cochlea

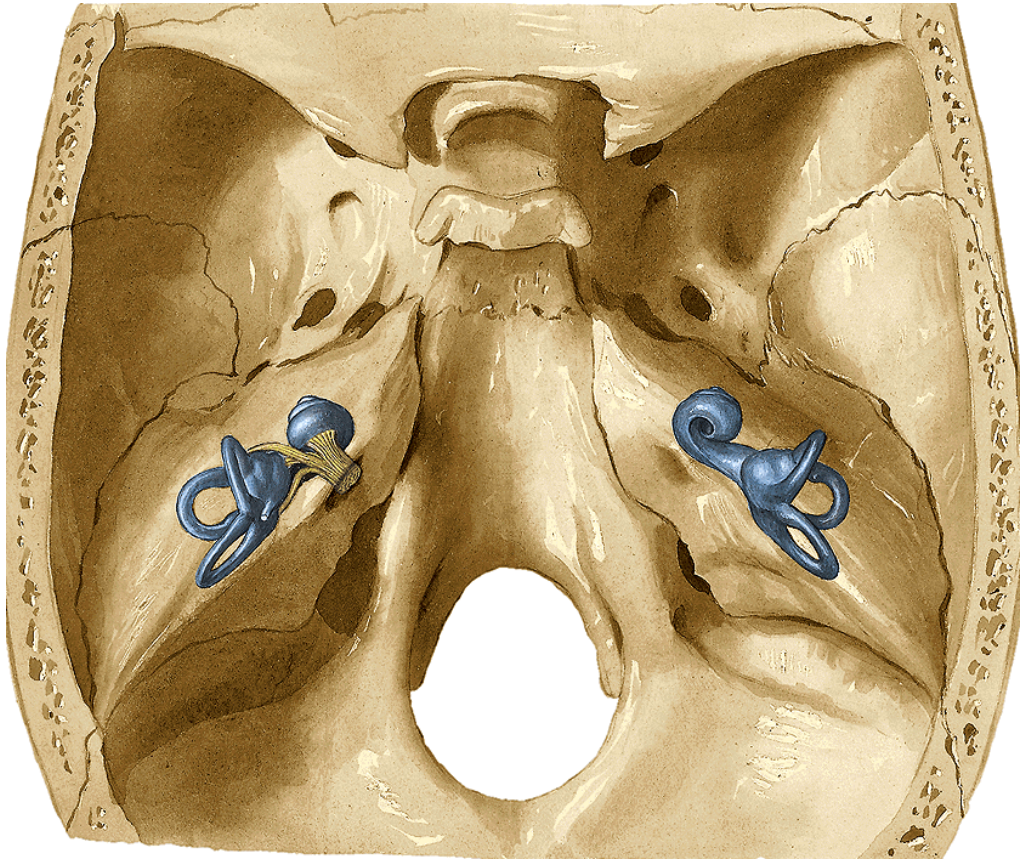
Labyrinthus membranaceus



Labyrinthus vestibuli (utriculus, sacculus, ductus semicirculares)

Labyrinthus cochlae (ductus cochlearis)

Labyrintus osseus



- pars cochlearis

cochlea

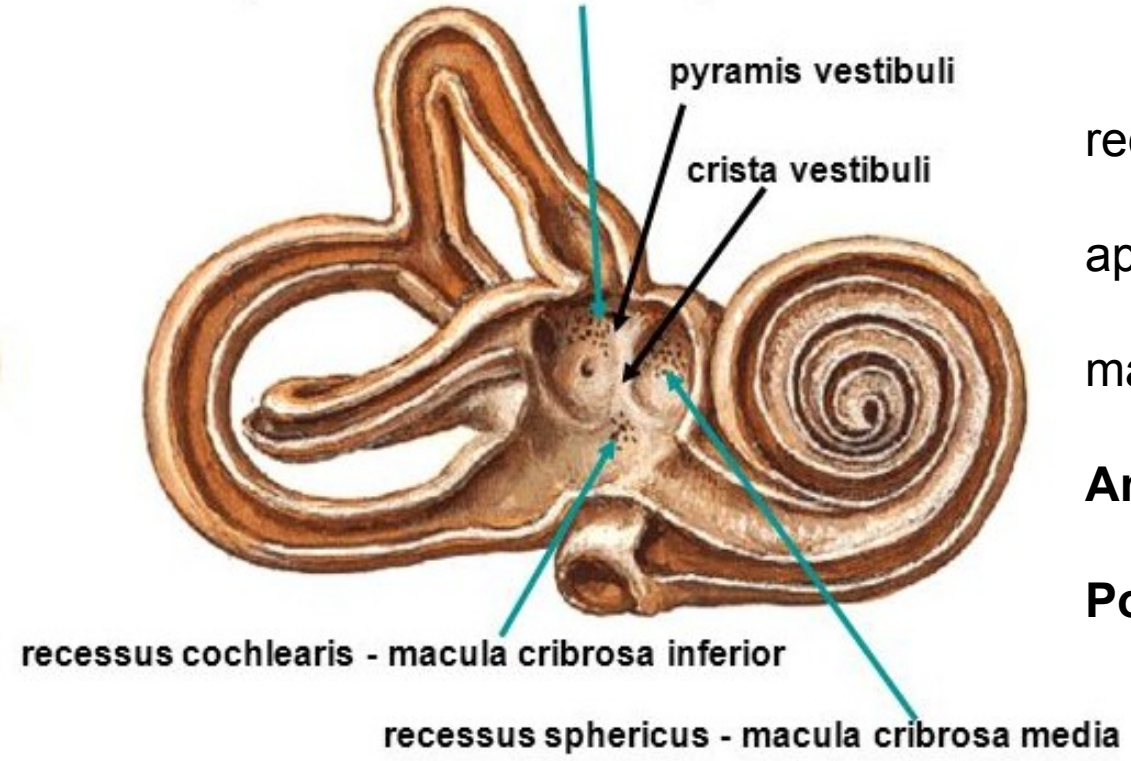
- pars vestibularis

vestibulum

canalis semicircularis ossei

Perilymfa

recessus ellipticus - macula cribrosa superior



Vestibulum

Lateral wall (tympanic):
fenestra vestibuli (for basis stapedis)

Medial wall:
crista vestibuli with pyramis vestibuli

recessus utriculi=ellipticus with macula cribrosa superior (for n. utriculoampullaris) and utricle

recessus sacculi=sphericus with macula cribrosa media (for n. saccularis) and saccule

recessus cochlearis with macula cribrosa inferior (for acoustic nerve)

apertura interna aquaeductus vestibuli (ductus endolymphaticus)

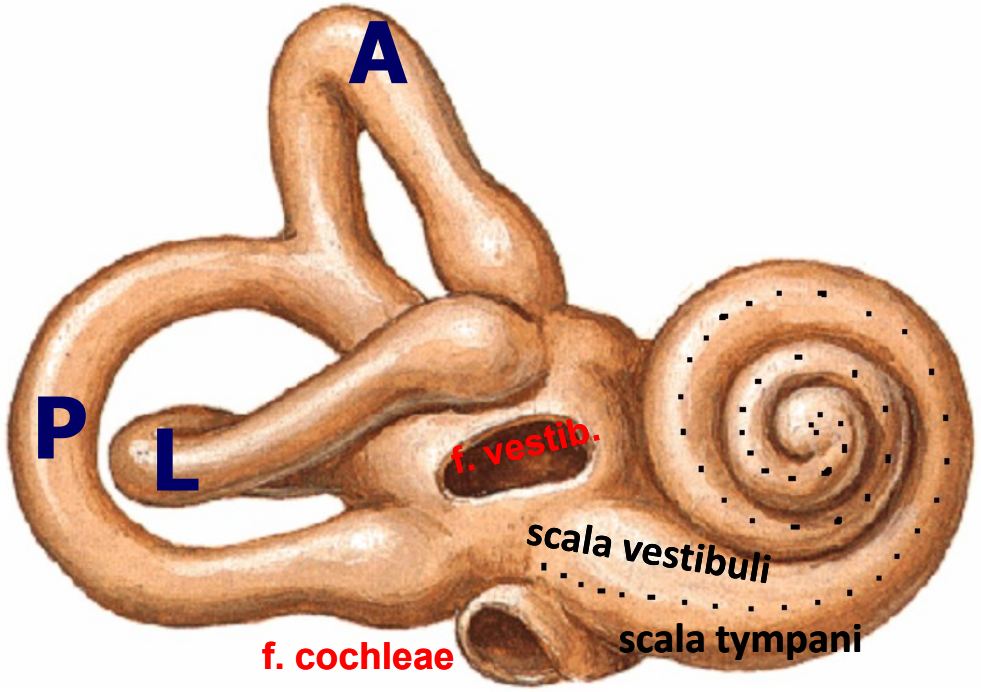
macula cribrosa posterior (n. ampullaris posterior)

Anteroior wall – communication with scala vestubuli

Posterior wall – openings of semicircular canals

Canales semicirculares ossei

Canales semicirculares ossei
lateralis, anterior, posterior
crus osseum simplex and commune,
crus osseum ampullare

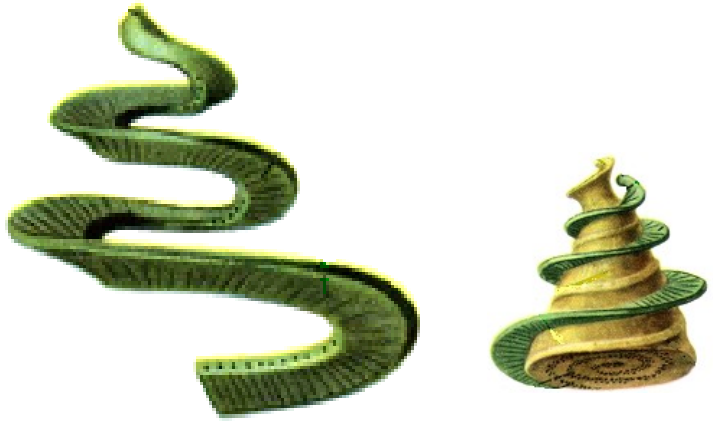


Cochlea

Anterior part of labyrinth,
Lying anterior to the vestible

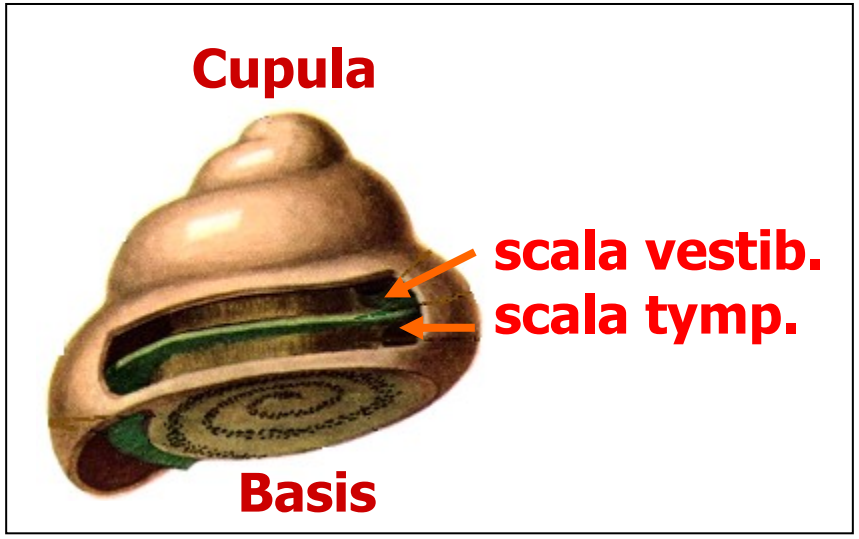
Modiolus

= central conical axis
basis modioli
(tractus spiralis foraminosus),



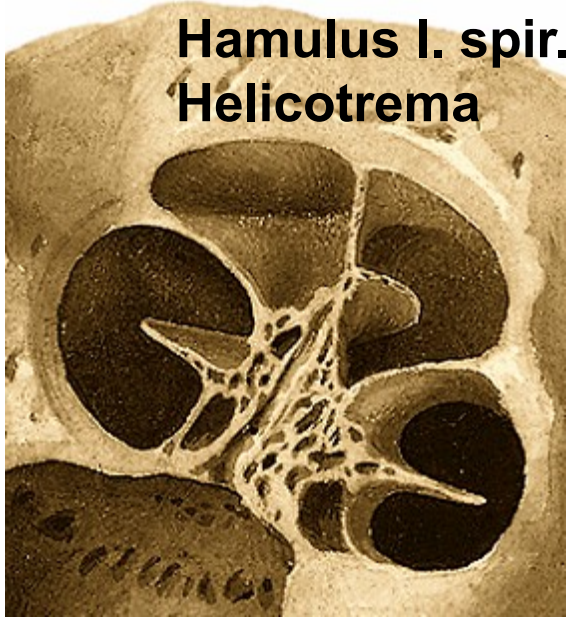
Lamina spiralis ossea

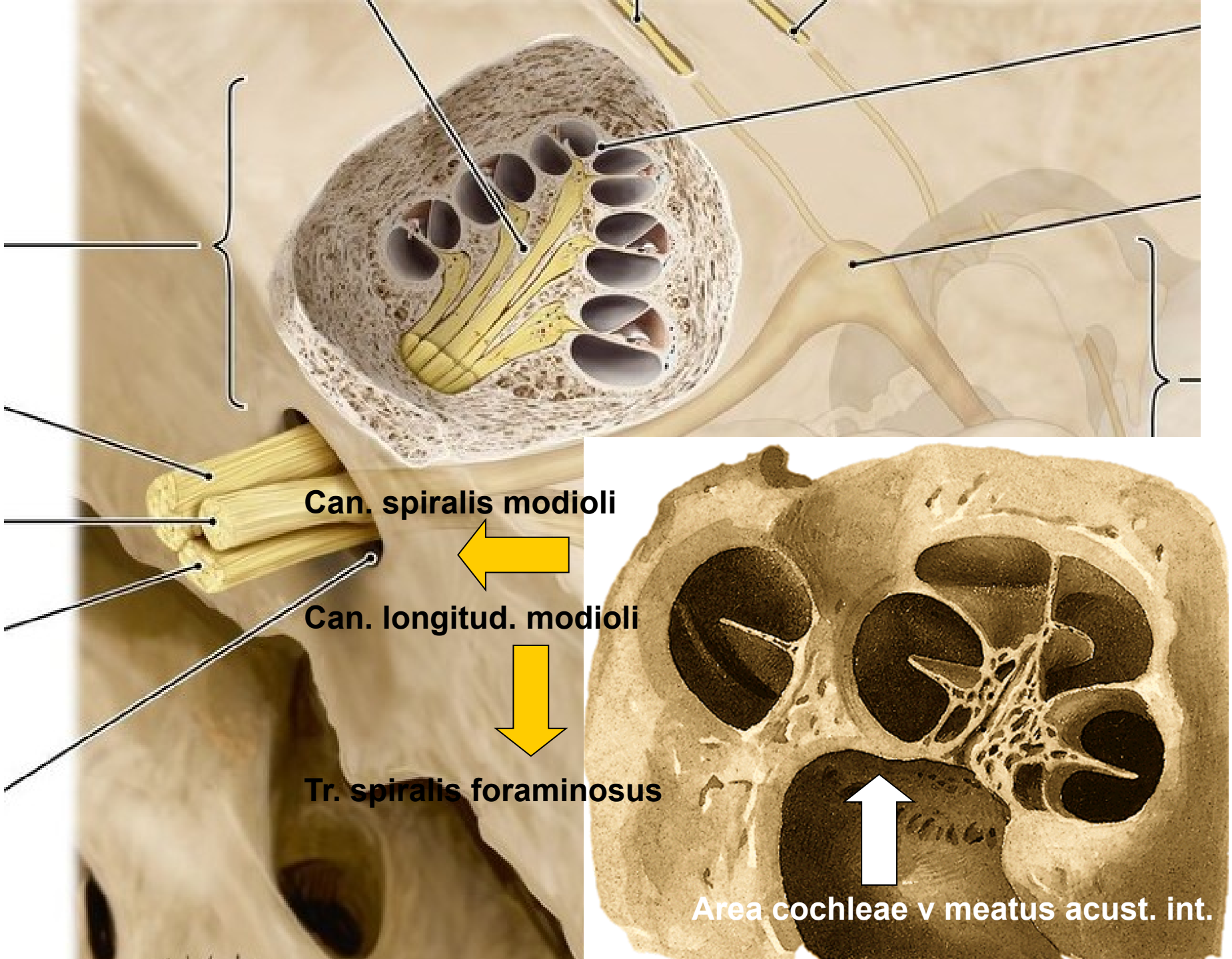
Scala vestibuli (opens to vestibulum),
scala tympani (opens to CT – membrana tympani secundaria),
hamulus laminae spiralis,
helicotrema



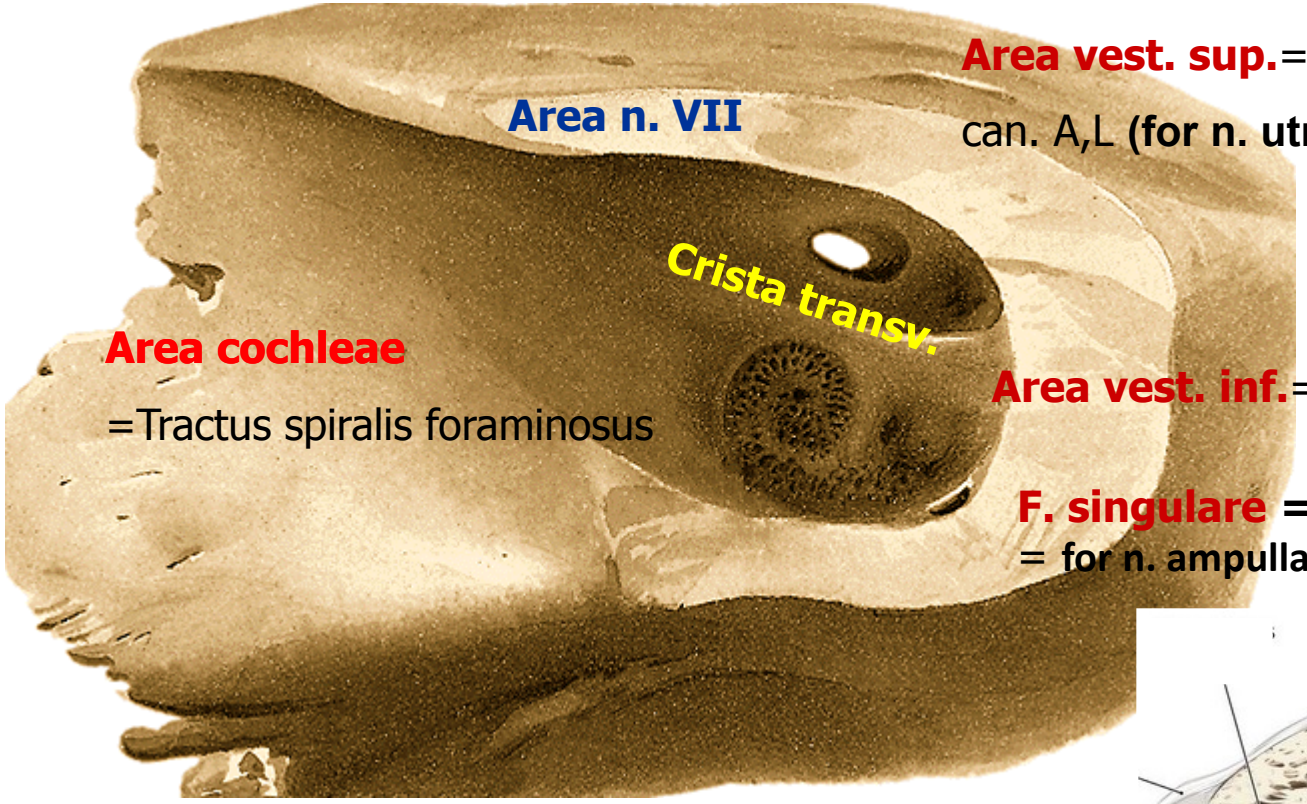
Canalis spiralis cochlae

by scala vestibuli is joined with vestibulum,
scala tympani passes under vestibulum,
by fenestra cochleae opens to CT,
ductus perilymphaticus




Can. spiralis modioli
Can. longitud. modioli
Tr. spiralis foraminosus
Area cochleae v meatus acust. int.

Meatus acusticus internus

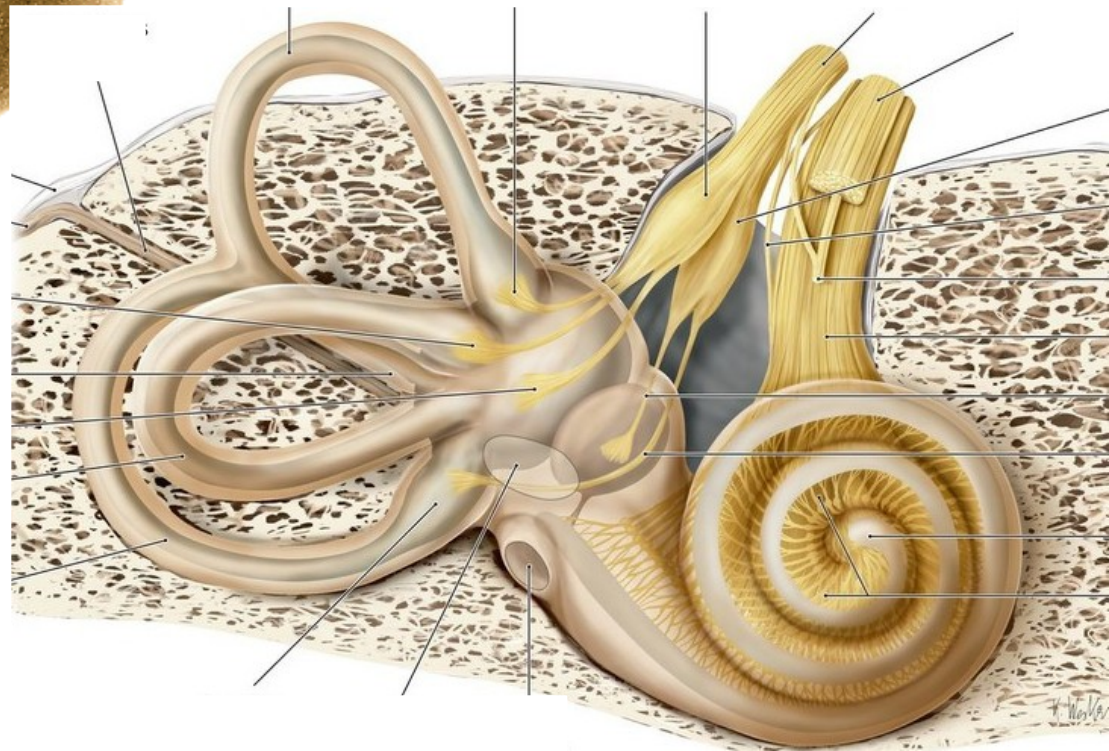


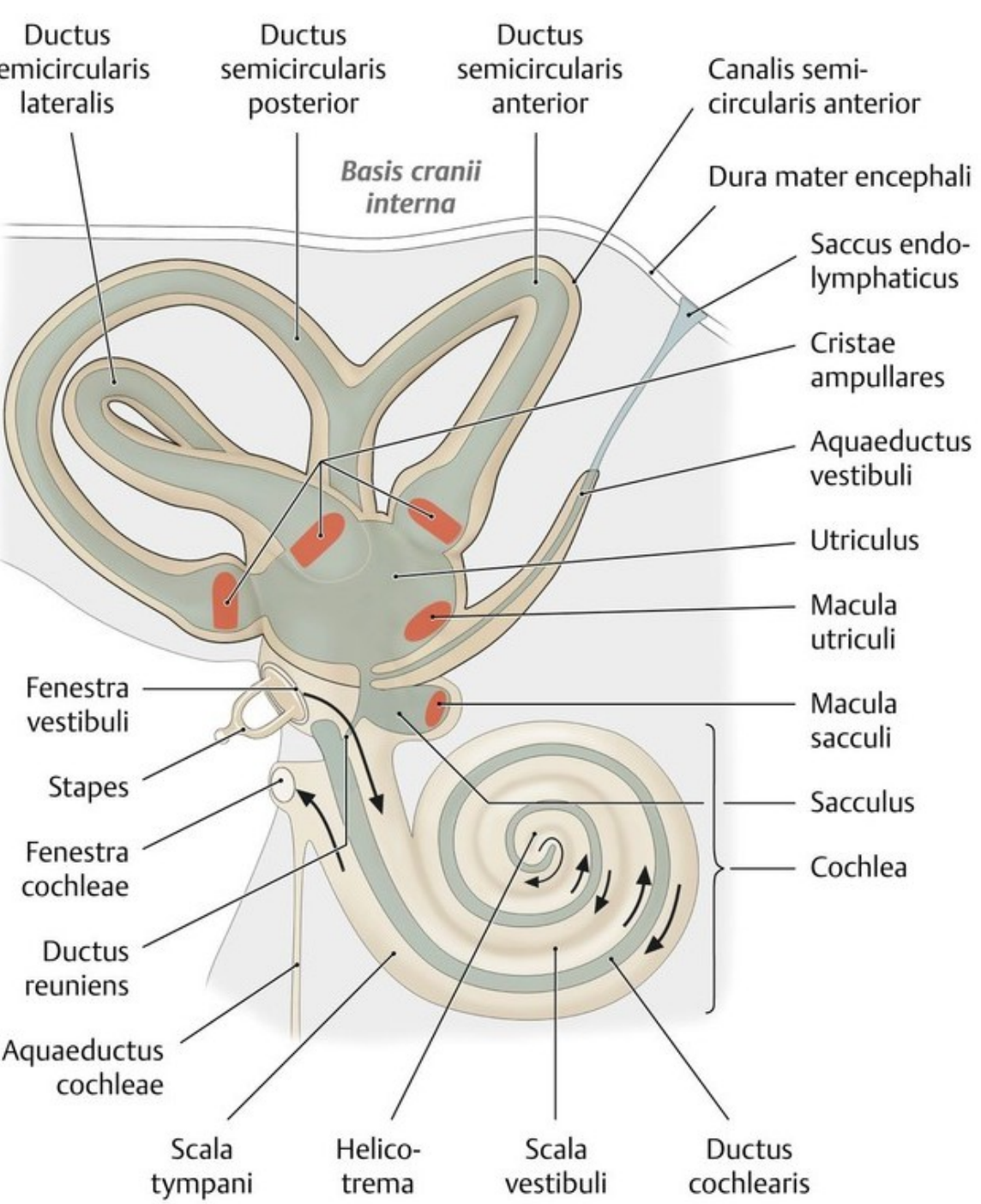
Area vest. sup.= **macula cribrosa sup.**

can. A,L **(for n. utriculoampullaris)**

Area vest. inf.= **macula cribrosa med. (n. saccularis)**

F. singulare = macula cribrosa inf.
= for n. ampullaris posterior)





Labyrinthus membranaceus

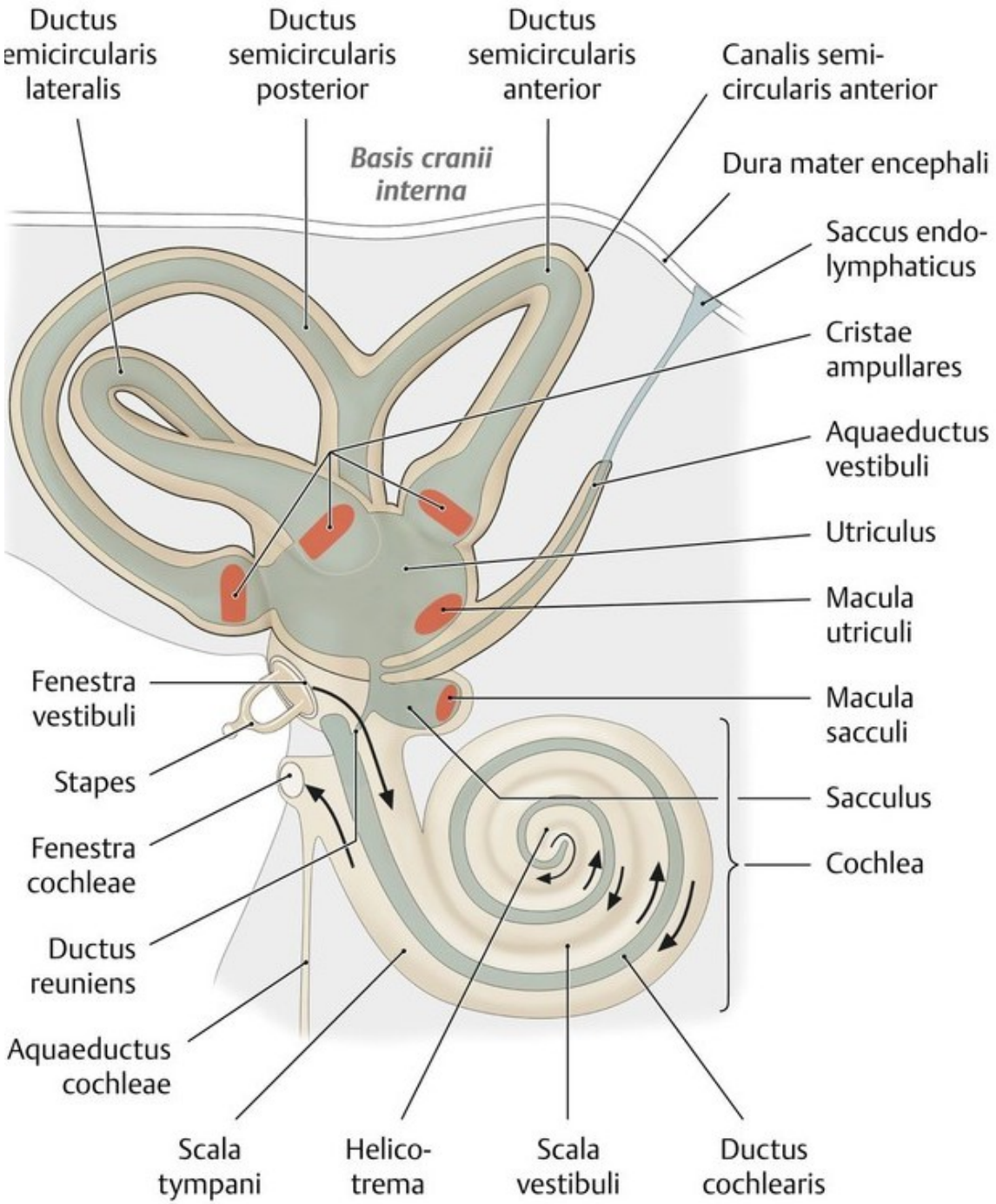
Labyrinthus vestibularis

Utriculus - on medial wall of vestibulum in recessus utriculi (ellipticus), utricular macula is located horizontally, by ductus utriculosaccularis is joined with ductus endolymphaticus)

Sacculus - on medial wall of vestibulum in recessus sacculi (sphericus), macula sacculi is in the vertical possition

endolympha

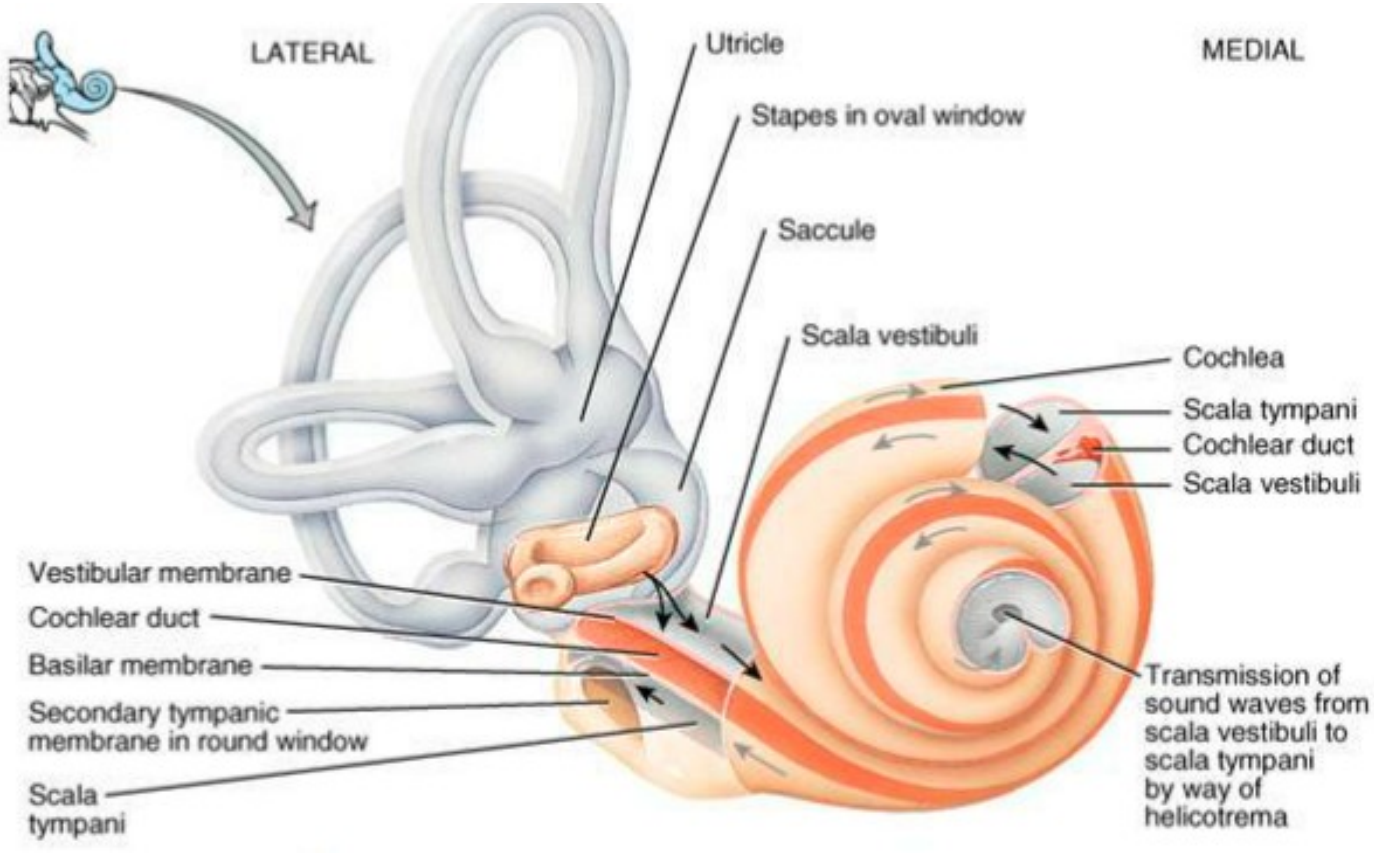
Epithelium – sensory hair - membrana statoconiorum with statoconia, ganglion vestibulare



Ductus semicirculares –
Similar with osseous canals,
open into the utricle
crista ampullaris, cupula ampullaris –
movement of endolymph, register movements of the head

Ductus endolymphaticus is joined with ductus utriculosaccularis, and passes along aquaeductus vestibuli, and ends in the saccus endolymphaticus under the dura mater

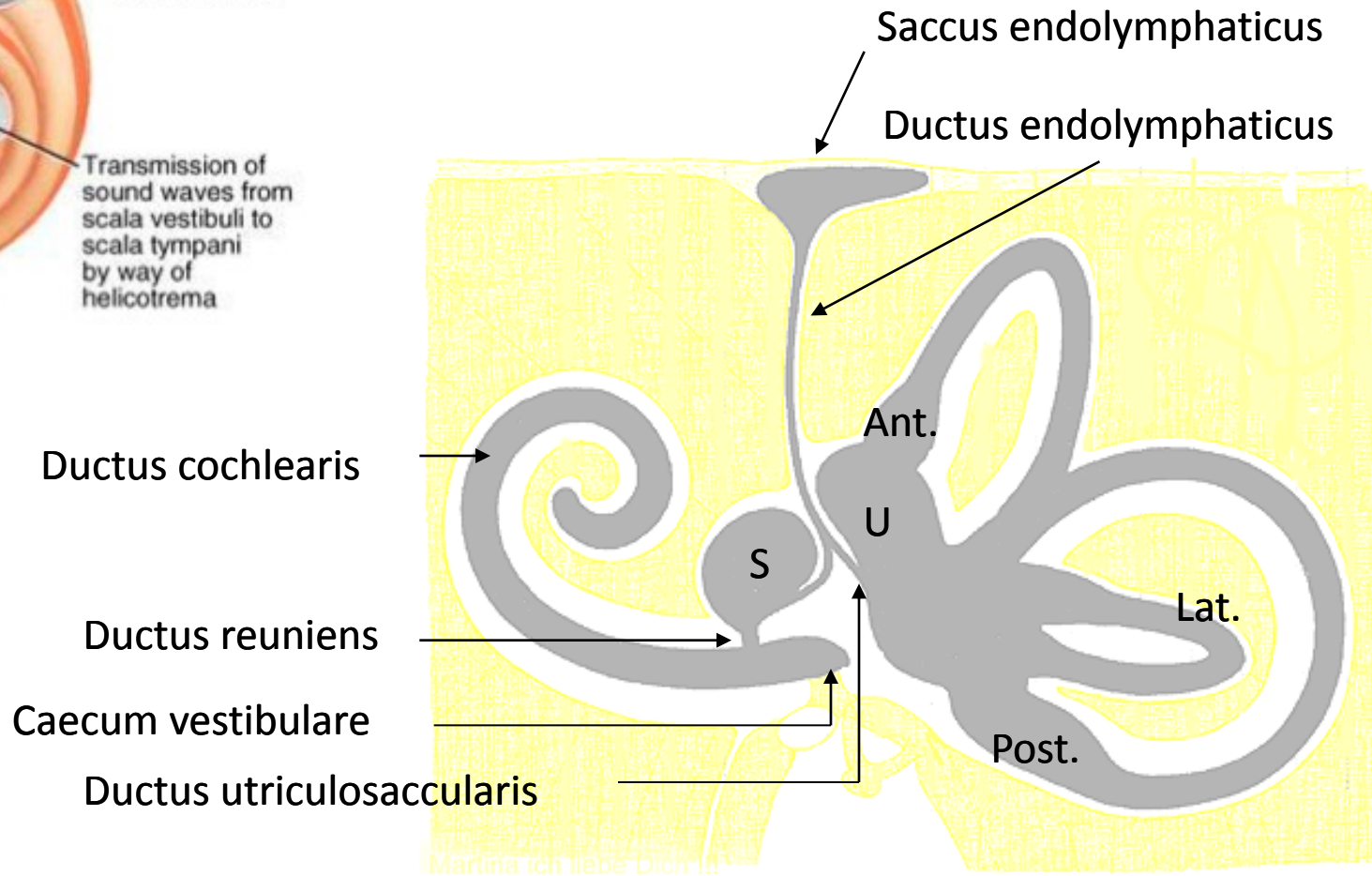
Organ of balance
- utriculus, sacculus, semicircular ducts
= vestibular apparatus
- register acceleration and changes of possition
– orientation in space

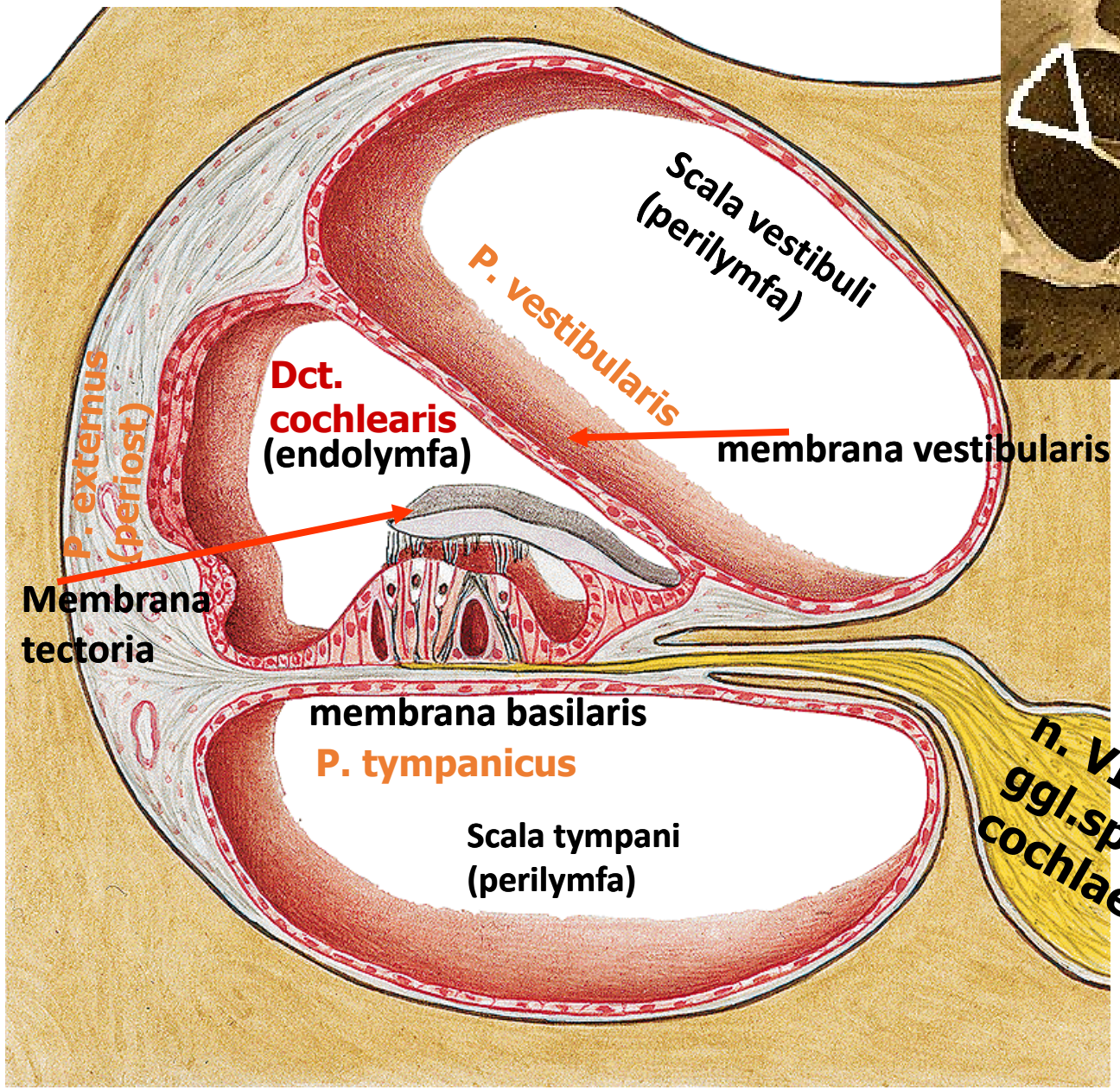


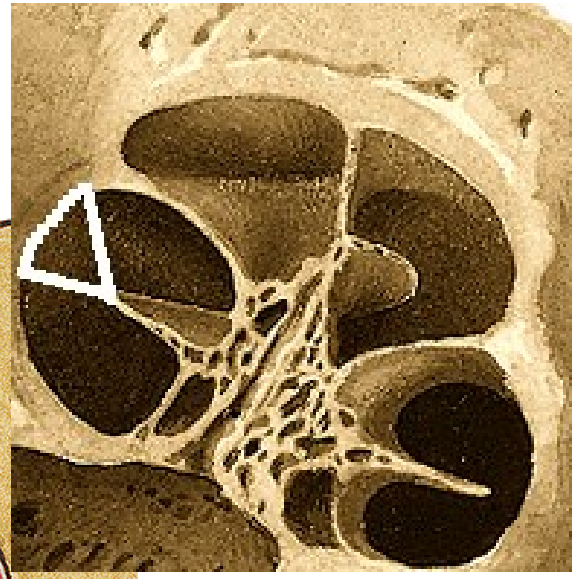
Labyrinthus cochlearis

Ductus cochlearis with ceacum vestibulare and caecum cupulare, ductus reuniens (joins ductus cochlearis with sacculus). Is filled with endolymph.

Ductus cochlearis divides bone cochlea into scala tympani and scala vestibuli (with perilymph)





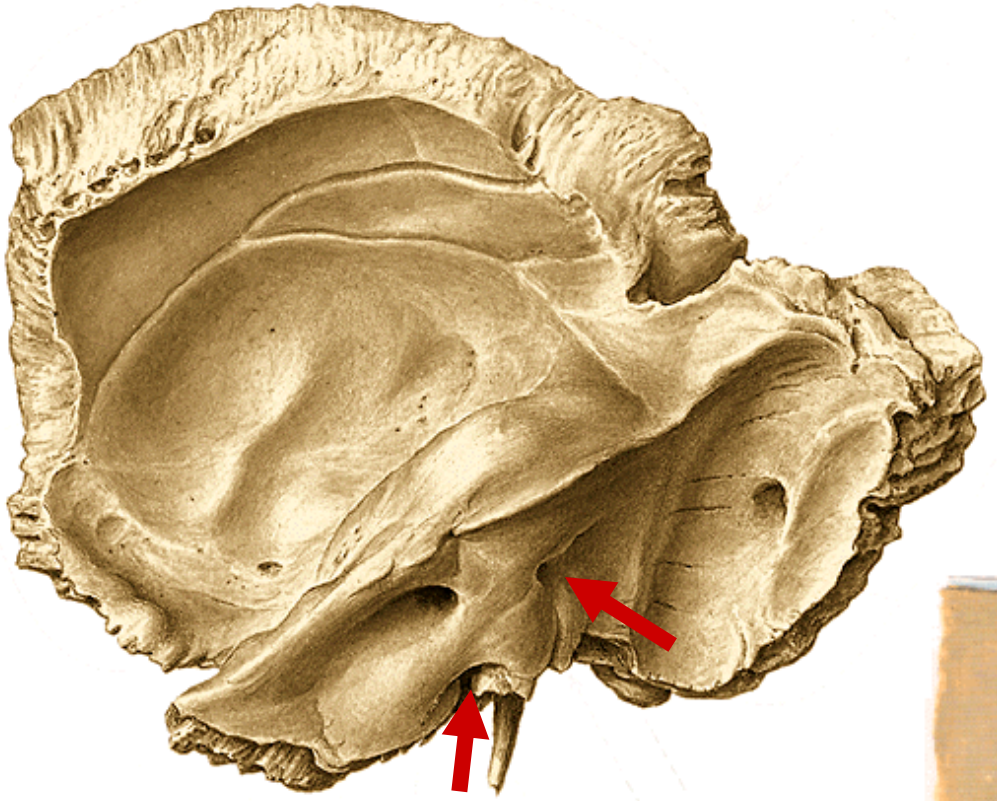


Ductus cochlearis

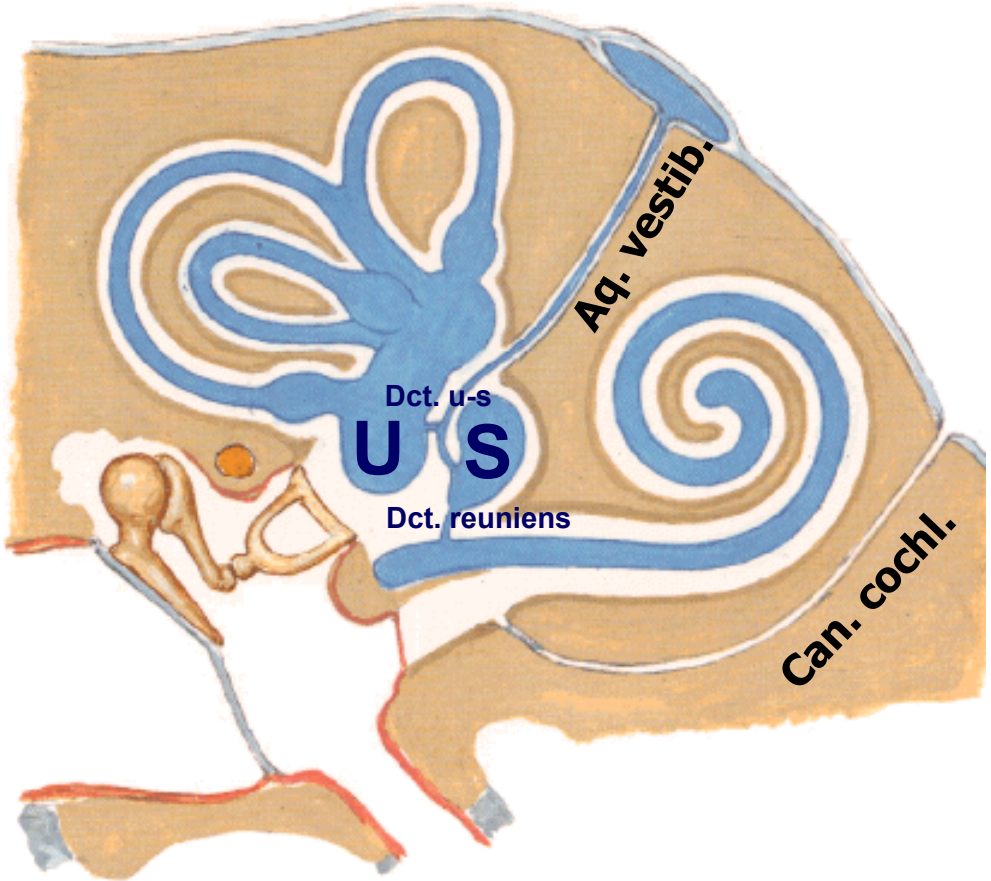
Lateral wall – joins with periosteum of canalis spiralis cochleae

Tympanic wall – forms bottom of DC and separates it from scala tympani,
membrana basilaris
Organum spirale Corti located on the membrana basilaris ,above this is membrana tectoria
ganglion spirale cochleae (bipolar cells)

Vestibular wall – is formed by thin membrana vestibularis.

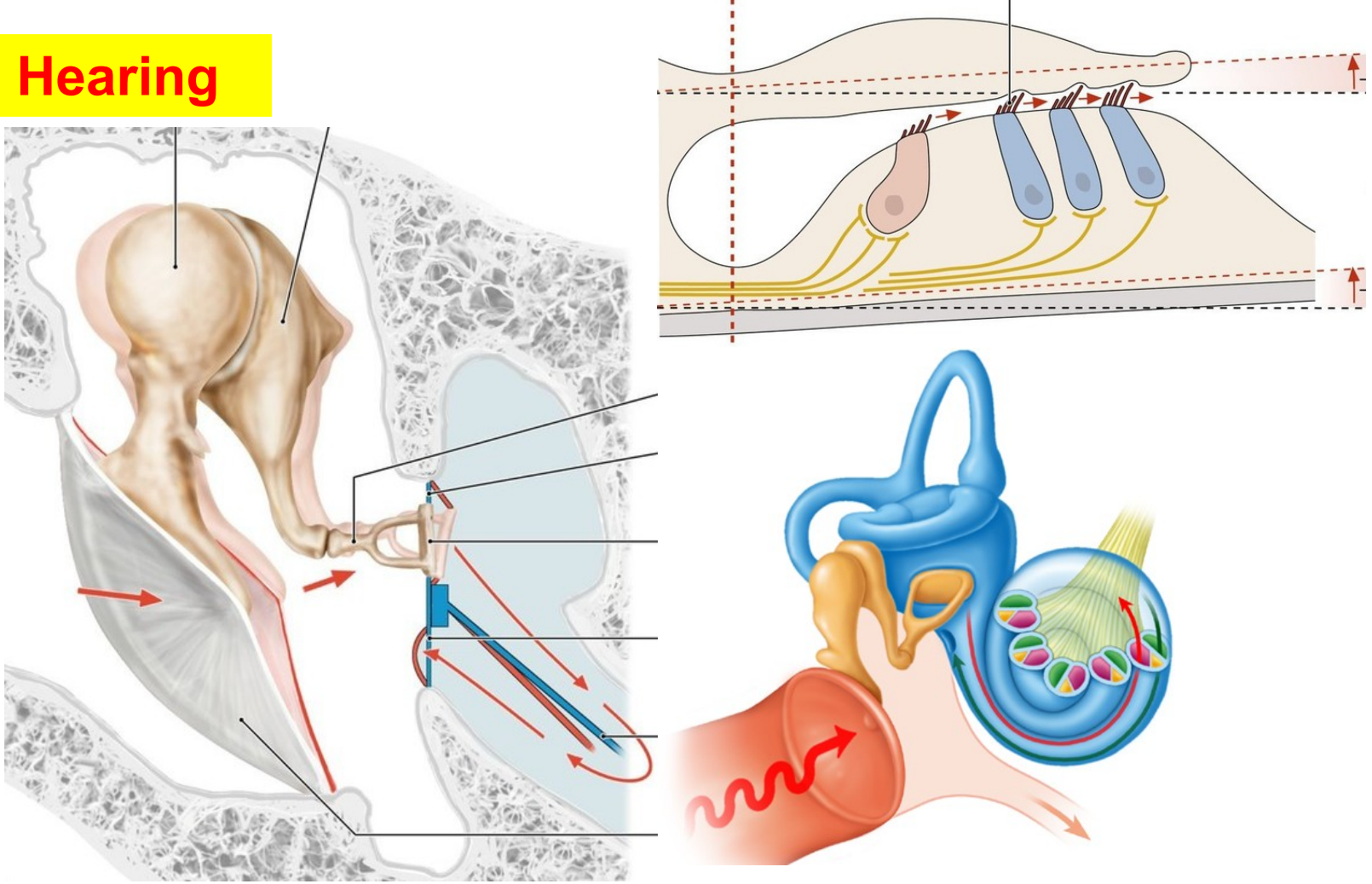


Endolymph – from plasma, ductus endolymphaticus to saccus and apertura externa aquaeductus vestibuli to subarachnoideal space.



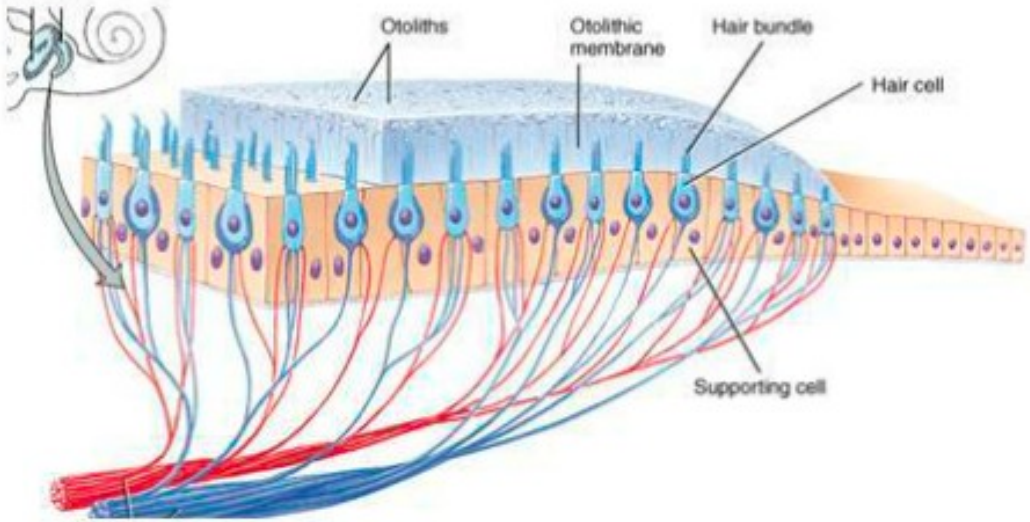
Perilymph – in spatium perilymphaticum (between bone and membranaceous labytinth) – through canaliculus cochleae to subarachnoideal space.

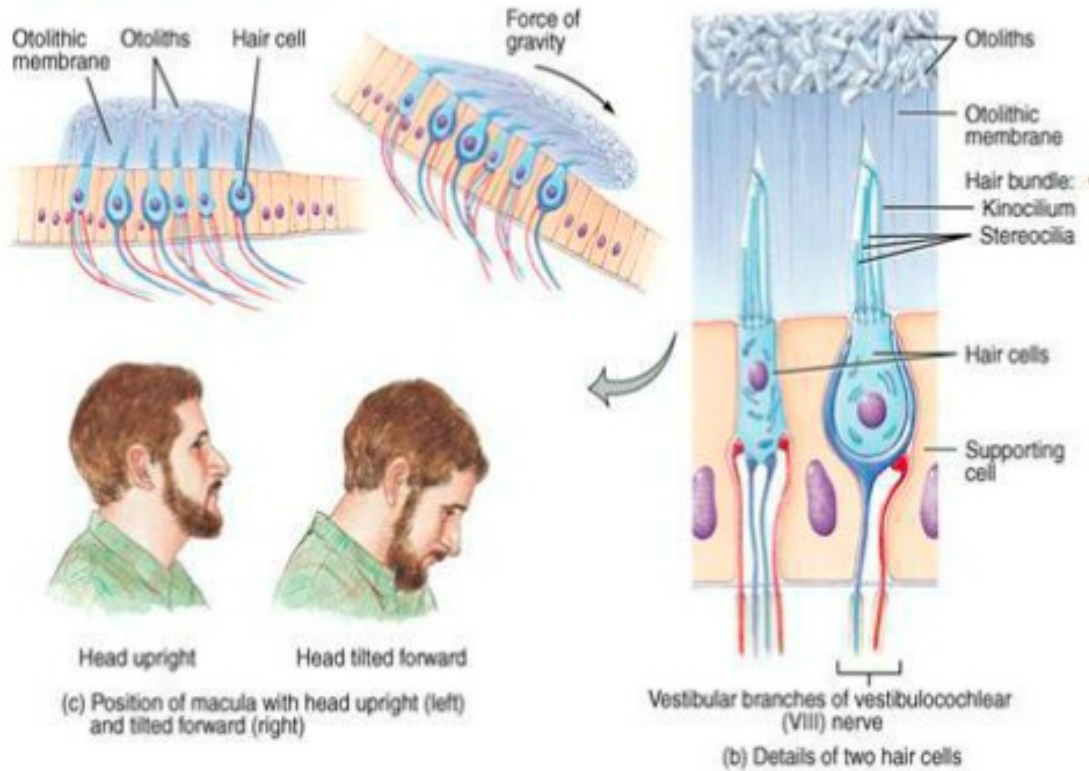
Hearing



Sound waves are catched by auricula, to the meatus acusticus externus, to membrana tympani,
by movement of ossicula auditis 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.

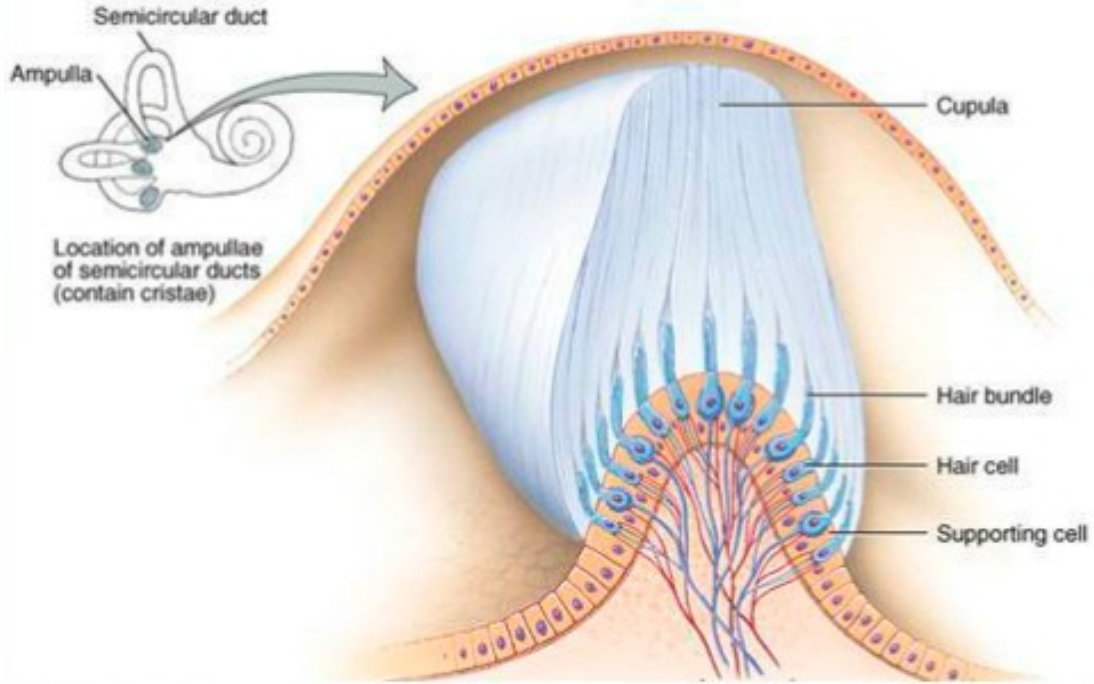
Static equilibrium: Saccule & Utricle



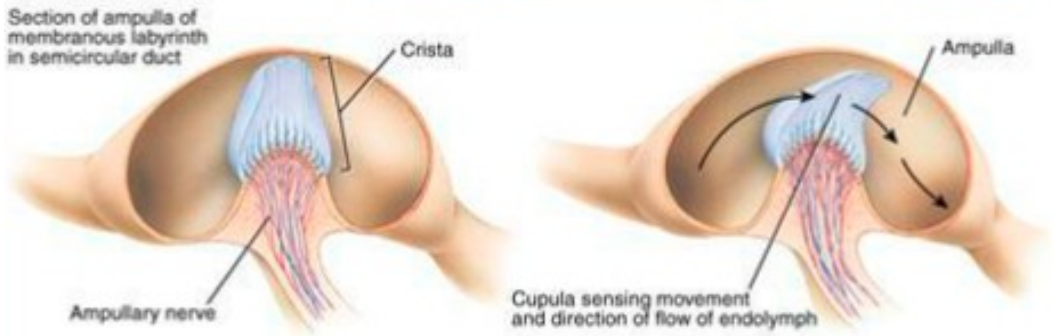


- Thickened regions called ***macula*** within the saccule & utricle
- Cell types in the macula region
  - hair cells
  - supporting cells that secrete gelatinous layer
- Gelatinous ***otolithic membrane*** contains calcium carbonate crystals called otoliths that move when you tip your head
- head movement and otolith movement bends the hair cells and results in receptor potentials

Dynamic equilibrium: Semicircular Ducts



- Small elevation within each of three semicircular ducts
  - anterior, posterior & horizontal ducts detect different movements
- Hair cells covered with cupula of gelatinous material
- When you move, fluid in canal bends cupula stimulating hair cells that release neurotransmitter



- Fibers from vestibulocochlear nerve (VIII) end in ***vestibular nuclei*** and the cerebellum
- Fibers from these areas connect to:
  - cranial nerves that control eye and head and neck movements (III,IV,VI & XI)
  - vestibulospinal tract that adjusts postural skeletal muscle contractions in response to head movements
  - motor cortex can adjust its signals to maintain balance

The part of tunica vasculosa bulbi is:
 :r1 sclera
 :r2 pupilla
 :r3 lens
 :r4 no statement is correct
:r4 ok

Choose correct statement about humor aquosus :
 :r1 is part of lens
 :r2 is part of corpus vitreum
 :r3 fills the cameras bulbi
 :r4 all statements are correct
:r3 ok
--

Choose correct statement about conjunctiva :
 :r1 covers both sides of palpebrae
 :r2 it is accessory structure of the eye
 :r3 fills camerae bulbi
 :r4 no statement is correct
:r2 ok
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Into the fenestra vestibuli is inserted:
 :r1 cochlea
 :r2 nervus vestibularis
 :r3 maleus
 :r4 no statement is correct
 :r4 ok

What is the part of labyrinthus membranaceus:
 :r1 vláskové buňky
 :r2 rosolovitá hmota s krystalky
 :r3 endolymfa
 :r4 všechny odpovědi jsou správné
:r4 ok