Strongly recommanded study literature:

Hans Behrbohm, Oliver Kaschke, Tadeus Nawka,Andrew Swift: **Ear, Nose, and Throat Diseases**: Founding Authors W. Becker, H.H. Naumann, C.R. Pfaltz (Paperback) Publisher: Thieme Publishing Group; 3rd Revised edition edition (12 Aug 2009). 471 pages , Language English. ISBN-10: 313671203X, ISBN-13: 978-3136712030.

Ear I

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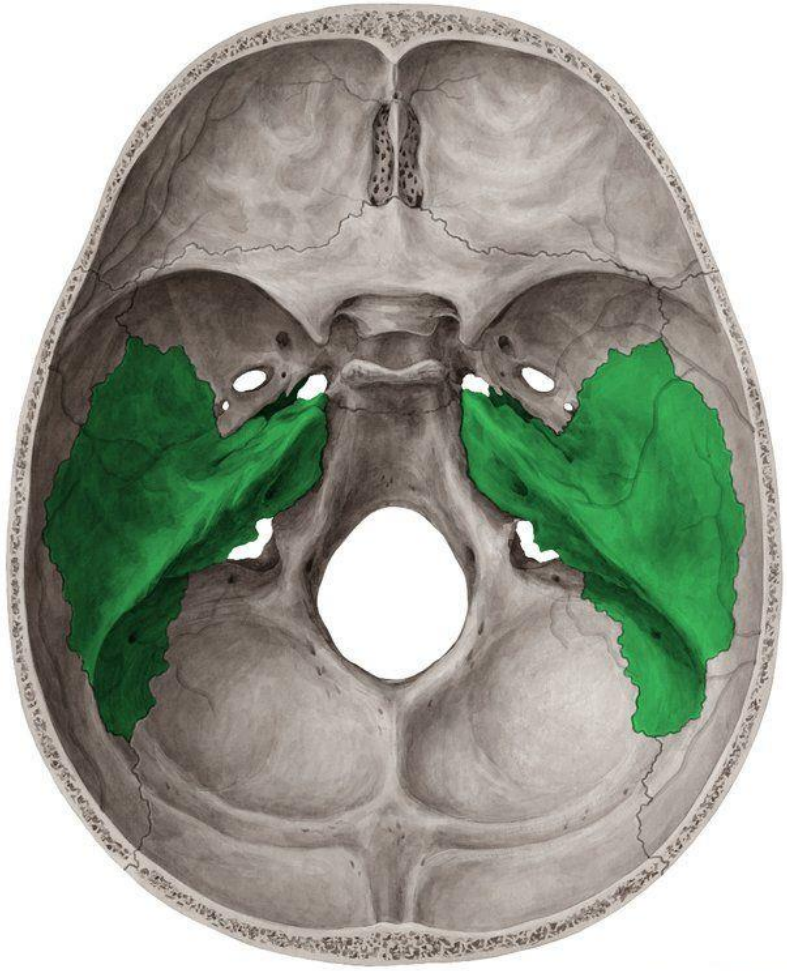
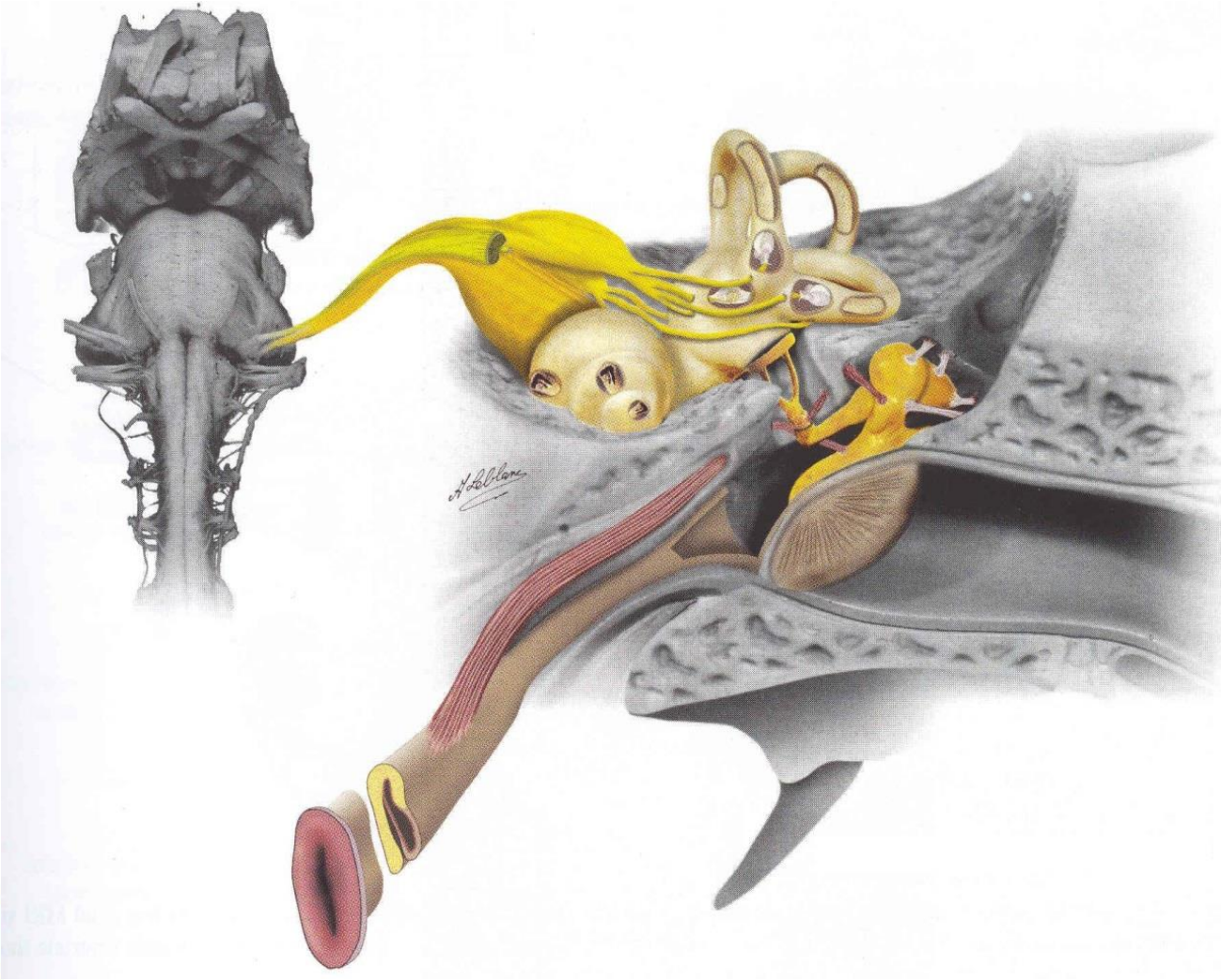
FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ

The hearing and balance system

The hearing and balance system localized in temporal bone





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The hearing system

Two main subdivisions:

Peripheral Part

- external, middle and inner ear
- auditory nerve

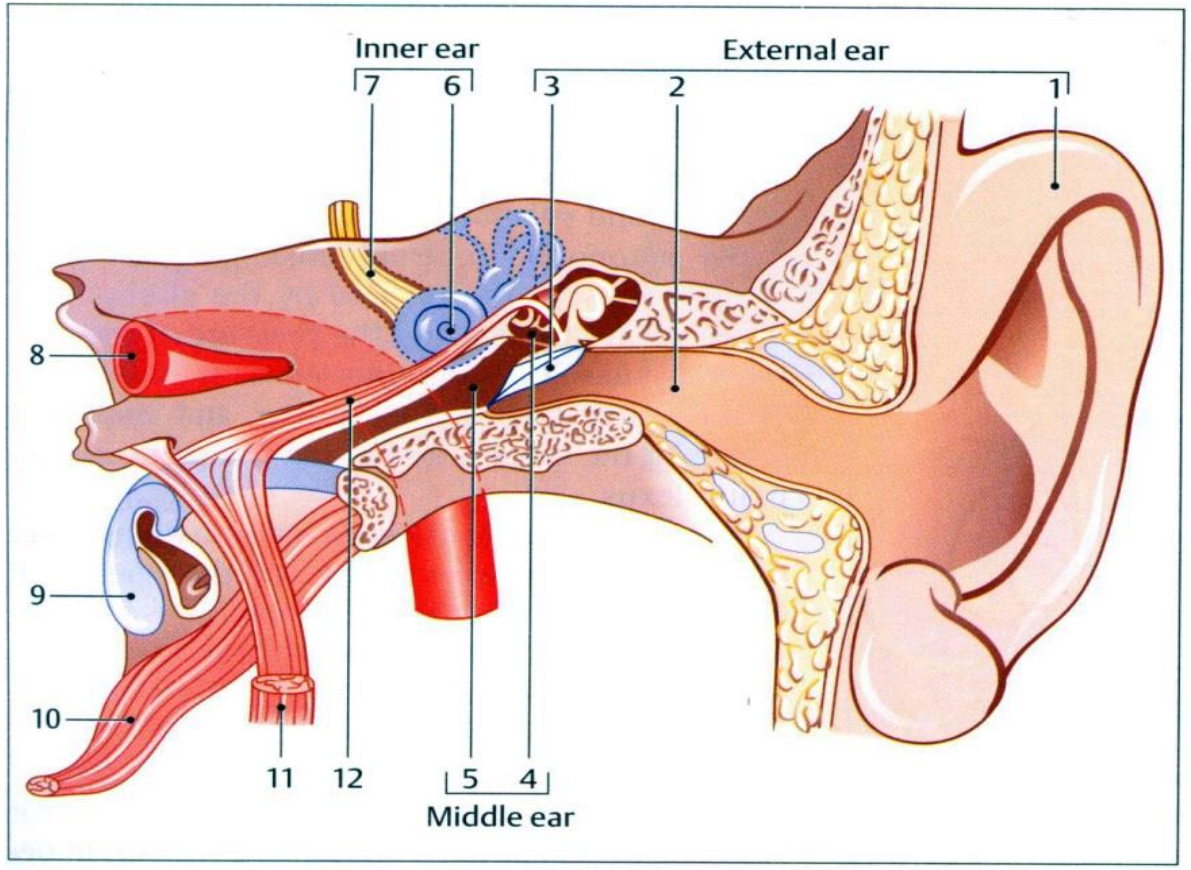
Central Part

- central hearing pathways
- subcortical and cortical auditory centers

Anatomic boundary - entry the VIIIth nerve into brainstem.

Function of hearing system

- The external and middle ear *transport* the stimulus
- cochlea *distributes* the stimulus
- the sensory cells *transform* the stimulus



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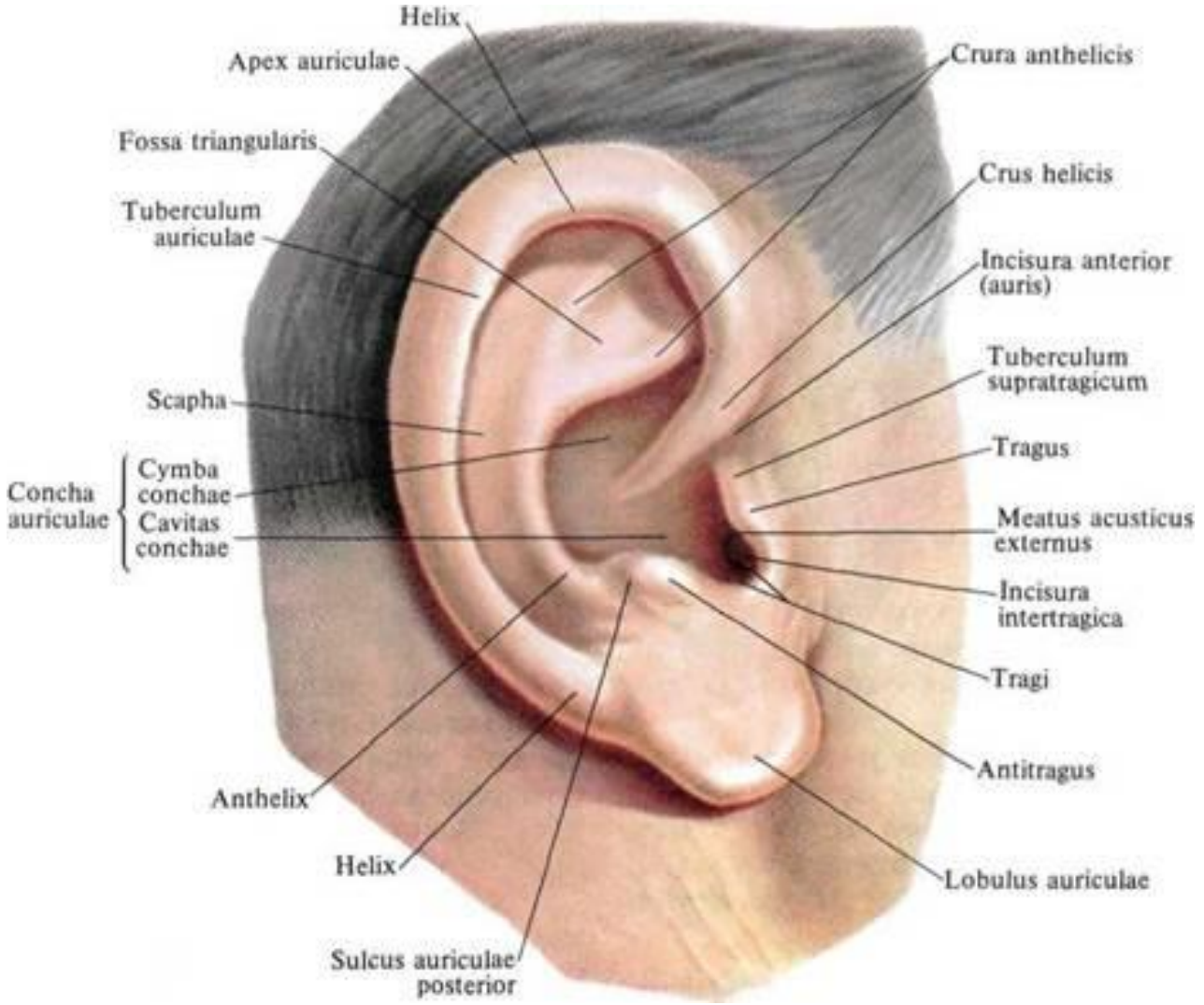
External ear

Auricle – abundantly formatted cartilage (localization, protection)



External meatus (meatus acusticus externus)

External part

- cartilage
- Lined with skin and down (tragi) and sebaceous gland – cerumen

Internal part

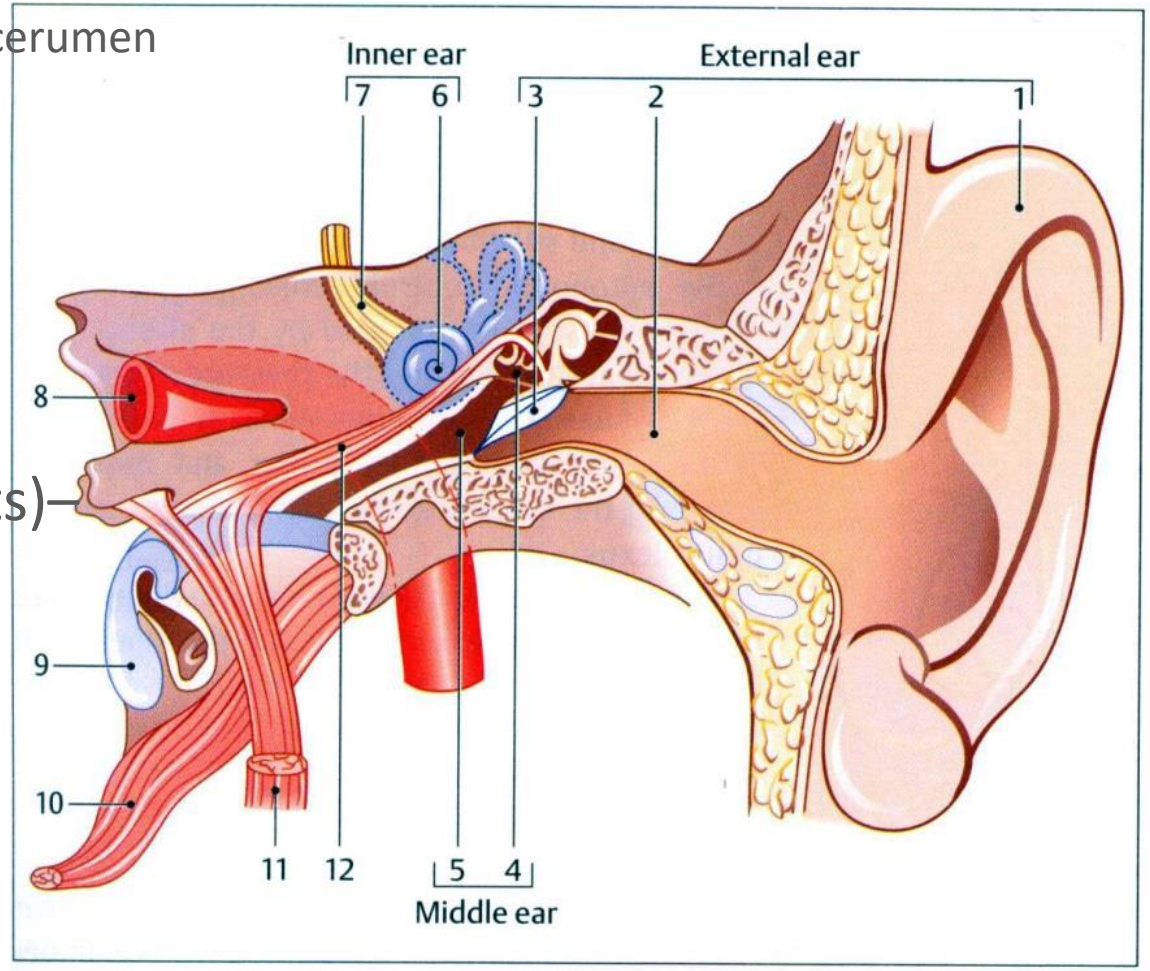
- Temporal bone
- Lined with thinned epidermis (skin)

– curved cartilaginous mobile part –

must be drawn upward and posteriorly (in adults)–

to bring the same axis

External meatus skin has 10x higher growth potential than middle ear mucose membrane – theory of development of acquired cholesteatoma



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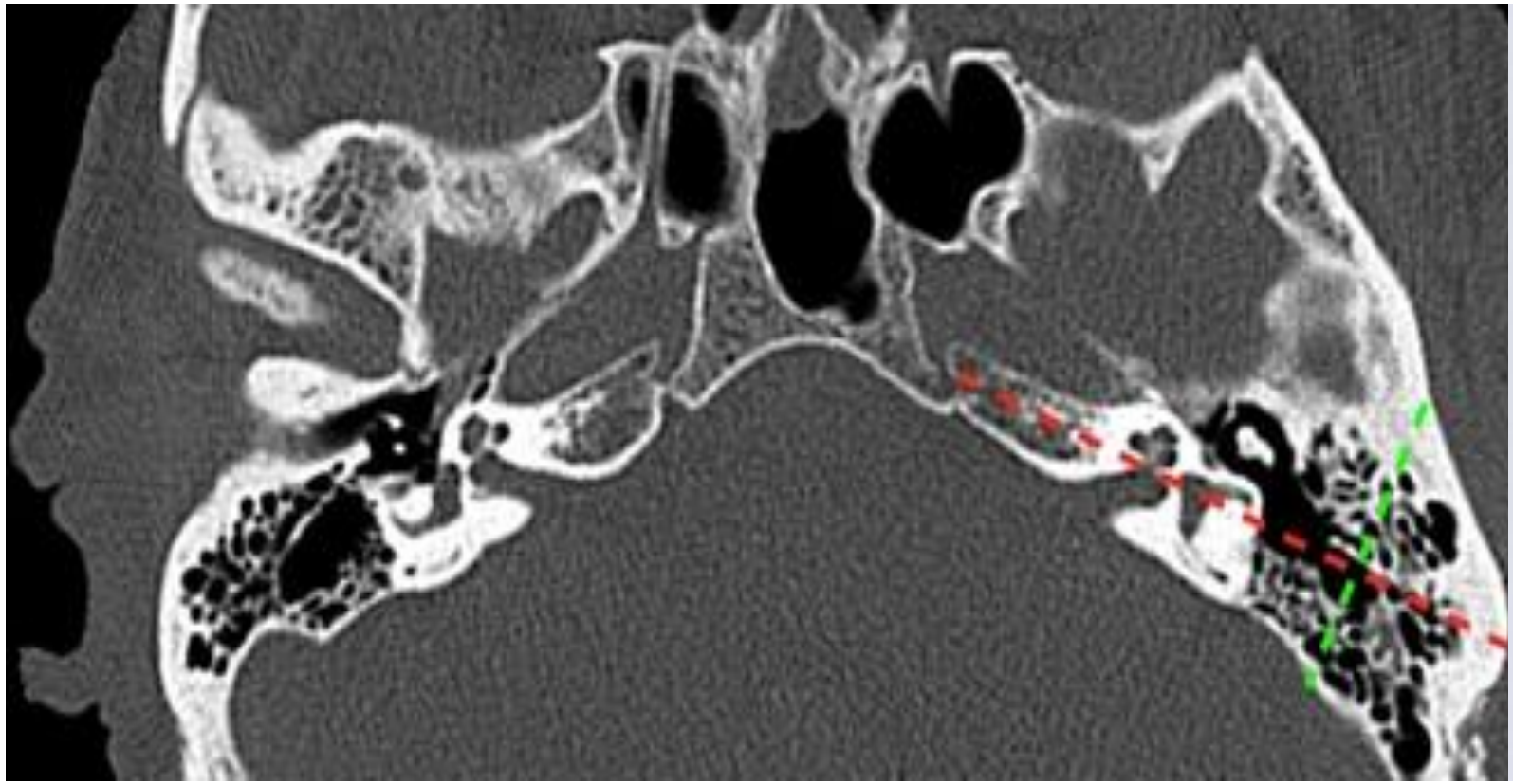
Middle Ear

Middle Ear cavity

- summary name for **the whole pneumatic system of temporal bone**: tympanic cavity, cells of proc. mastoideus and Eustachian tube (tubotympanal and tympanomastoideal segment)



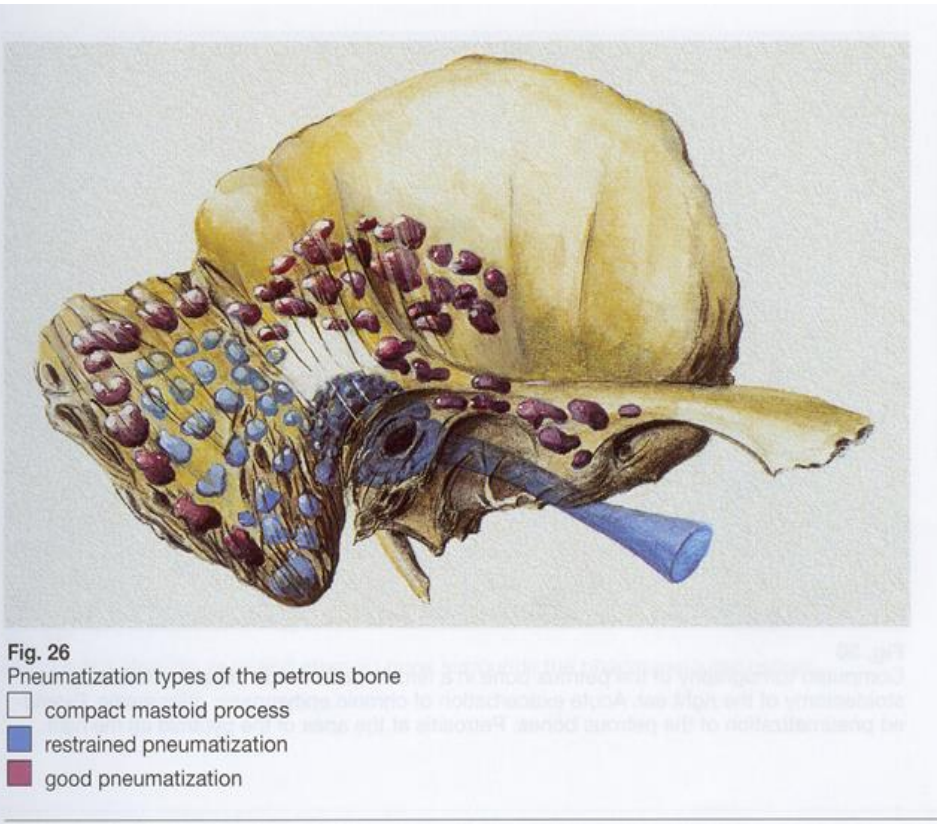


Fig. 26
Pneumatization types of the petrous bone
compact mastoid process
restrained pneumatization
good pneumatization

Middle Ear

Tympanic membrane (membrana tympani) - a sound pressure receptor and transformer

Inclination and declination angle to meatus axis, surface 55 mm^2

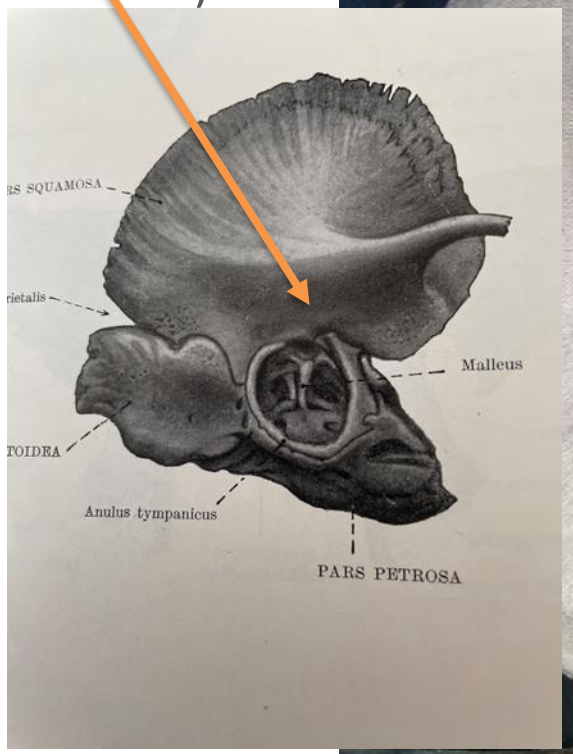
- sulcus tympanicus; incissura tympanica Rivini
- anulus fibrocartilagineus (fixing of tymp.membrane)

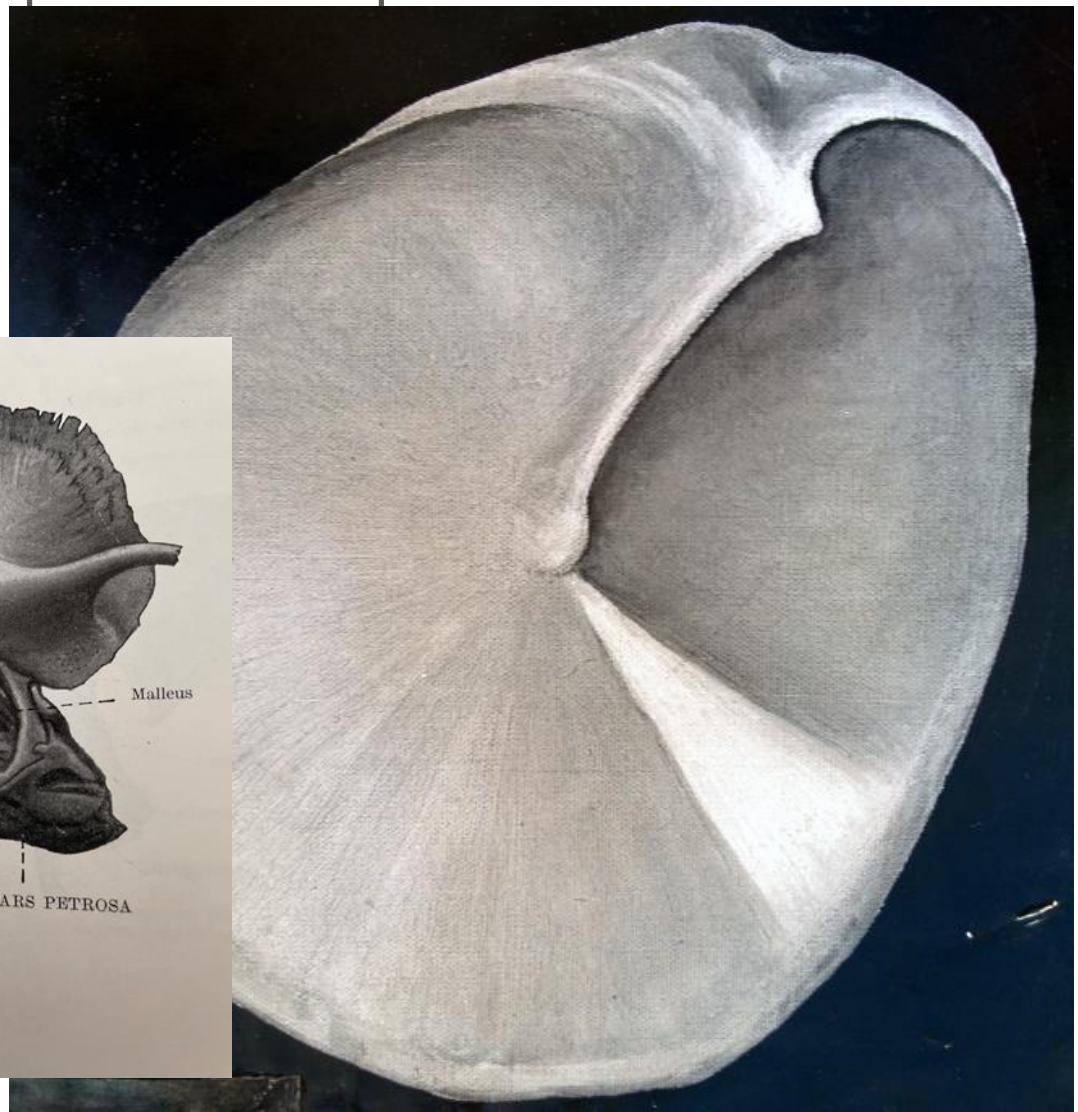
pars tensa

- *Three layers:*
  - external- epidermis (stratum cutaneum)
  - middle– fibrous layer (str. fibrosum)
  - internal– epithelium (str. mucosum)

pars flaccida (membrana Shrapnelli)

- Surface 5 mm^2 in superior part of ear drum
- Fibrous layer is almost missing (lower strength)





Tympanic cavity (Cavum tympani; shape of biconcave lens) 6 walls

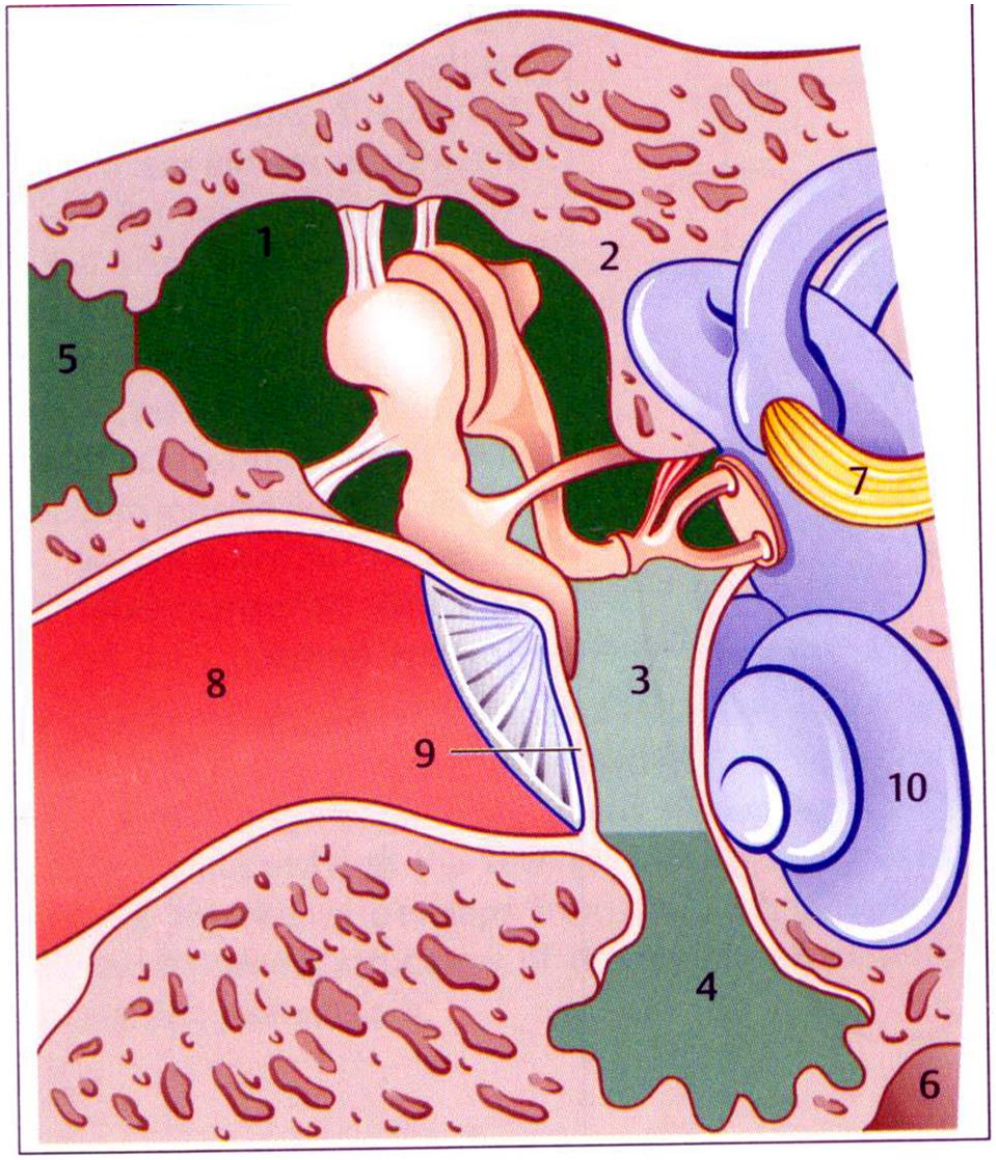
Paries:

- membranaceus
- labyrinthicus
- tegmentalis
- jugularis
- mastoidea
- caroticus

Lateral projection of Ear drum divides tympanic cavity

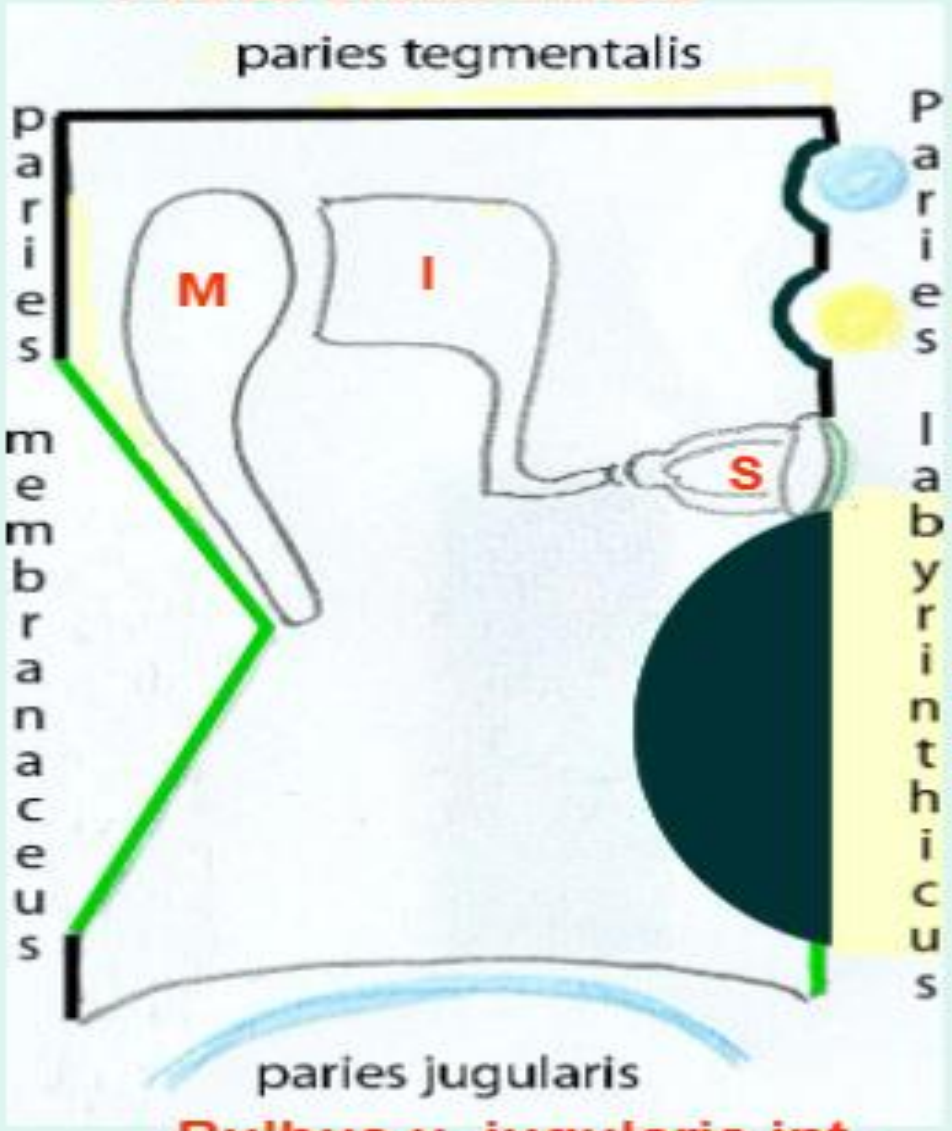
Into:

1,2 epitympanic recess
3 mesotympanum
4 hypotympanic recess



Cavum tympani schema

Fossa cranii media



Recessus epitympanicus

Membrana tympani

L

Canalis semicircularis lateralis

N. facialis

Fenestra ovalis - vestbuli

Promontorium – 1. závit hlemýždě

M

Fenestra rotunda - cochleae

Bulbus v. jugularis int.

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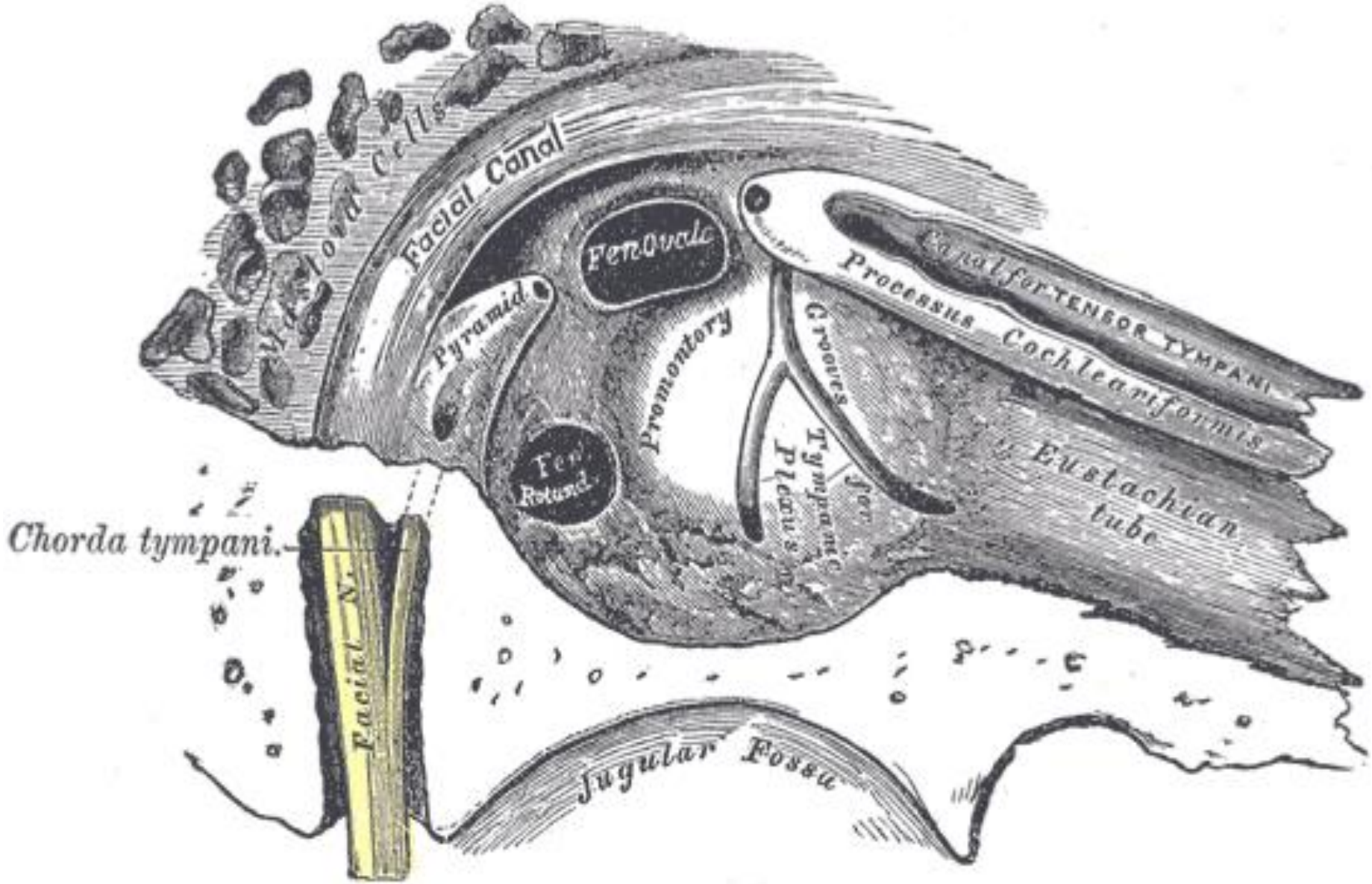
Tympanic cavity – medial wall



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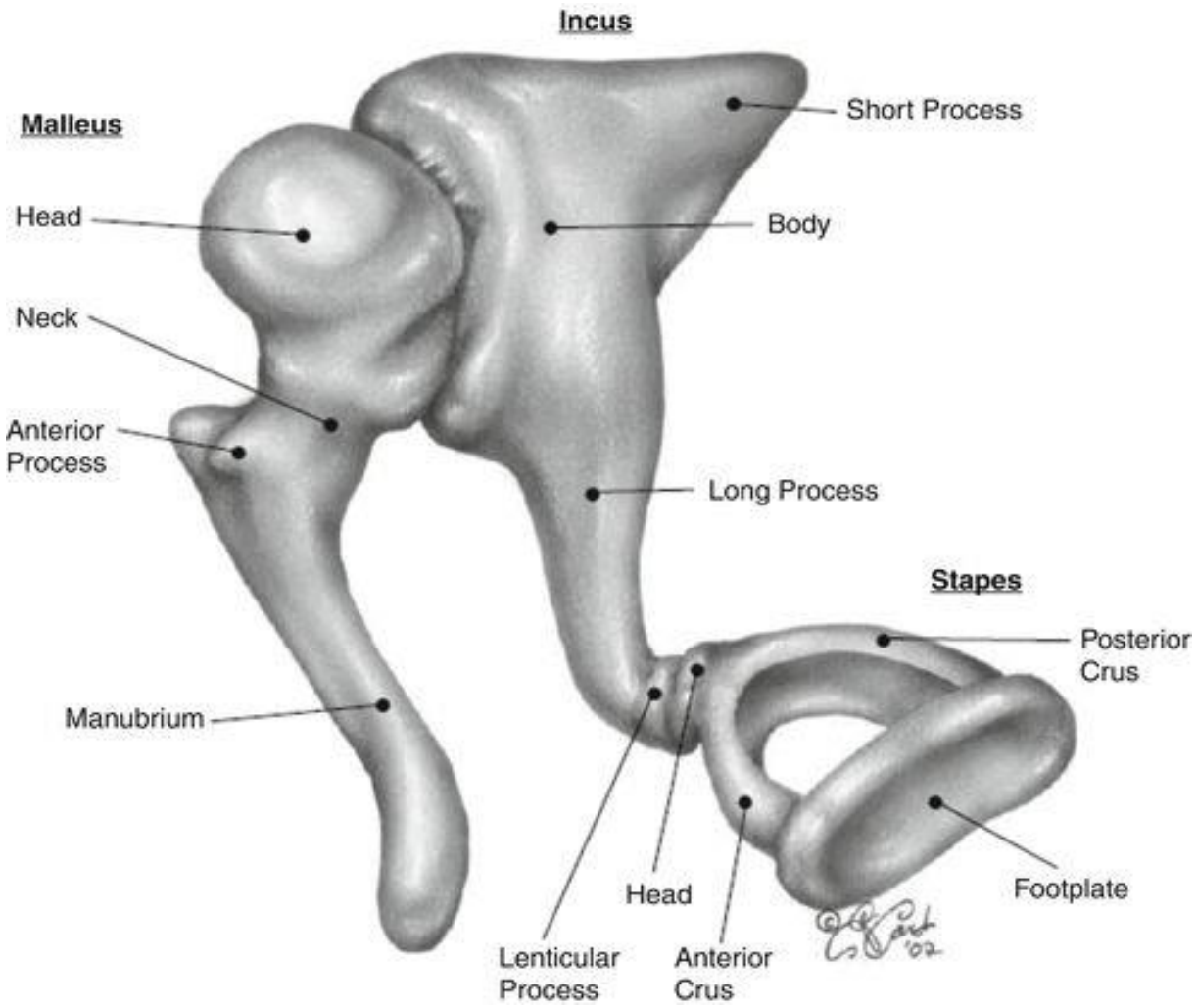
Middle ear

Tympanic cavity (cavum tympani)

ossicular chain:

- *malleus*
- *incus*
- *stapes*



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Hearing function of tympanic cavity (transfer system)

1. Compensation of loss of acoustic energy (ear- liquid):

   a/ tympanic membrane - oval window 14x

   b/ lever-action system of ossicles 1,3x

   c/ lever-action system due to uneven incurvation of ear drum, all together amplification is 30-35dB

2. Mutual change of deviation and pressure acoustic vibration .

Gas = great deviation, low pressure.

Liquid = low deviation, great pressure .

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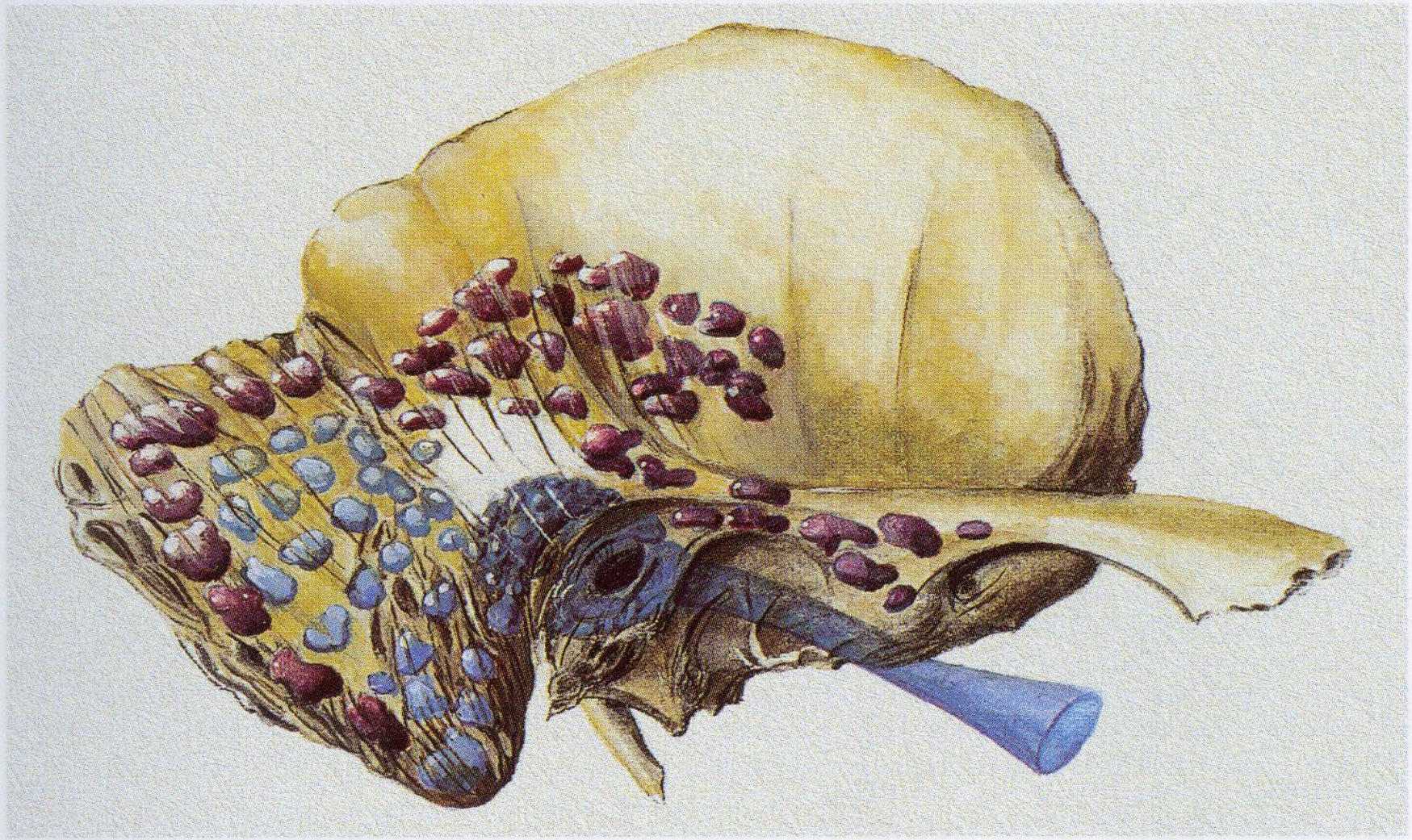

Pneumatization types of the petrous bone

- compact mastoid process
- restrained pneumatization
- good pneumatization

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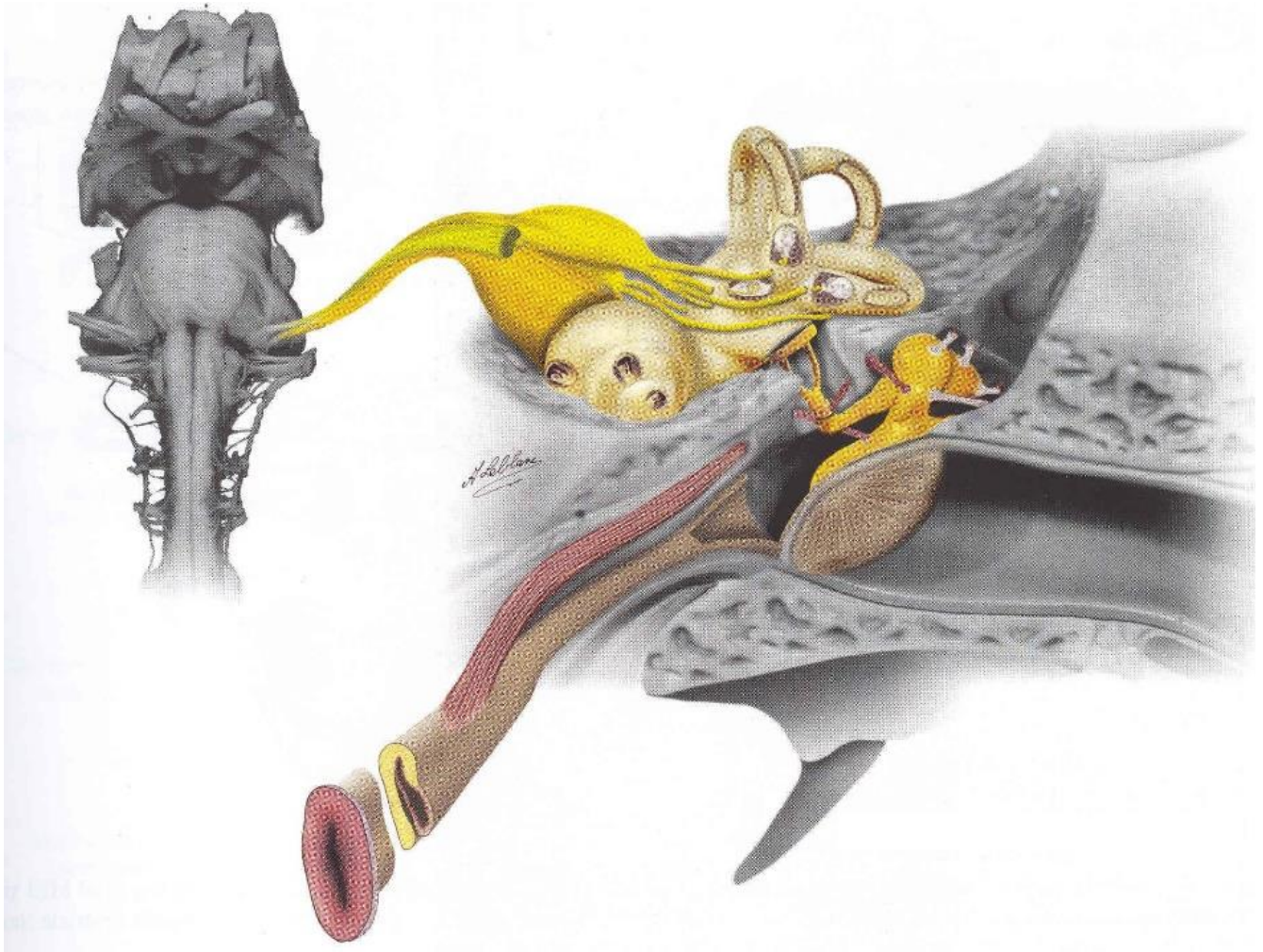
Eustachian tube

- **Ventilation function** - it serves to equalize the pressure between middle ear and the nasopharynx
- **Drainage function** – removal of secretion from middle ear cavity
- **Protective function** - before secretion penetration into middle ear cavity (microbial barrier guard system in epipharynx vs sterile tympanic cavity)



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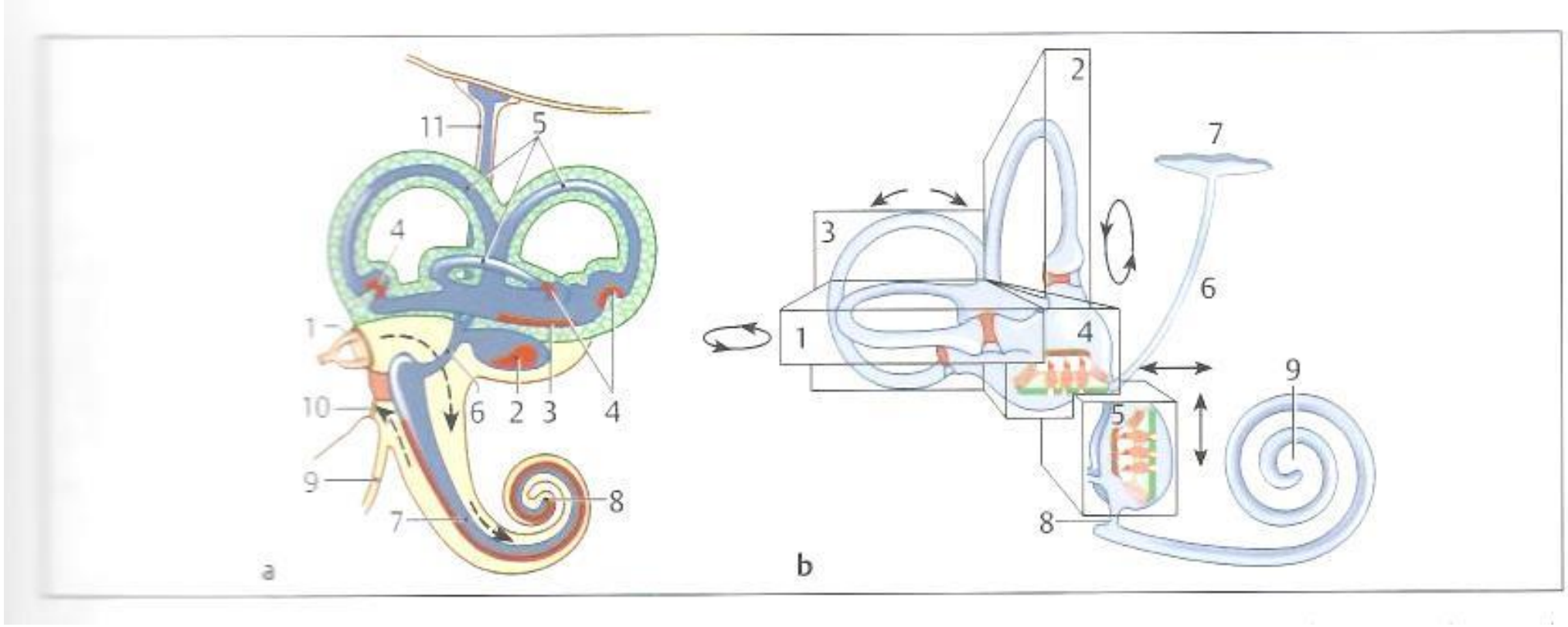
Membranous labyrinth (hearing and balance)

- Cochlear Duct (ductus cochlearis)
- Saccule and Utricle (saculus et utriculus)
- Membraneus semicircular Ducts (canales semicirculares)



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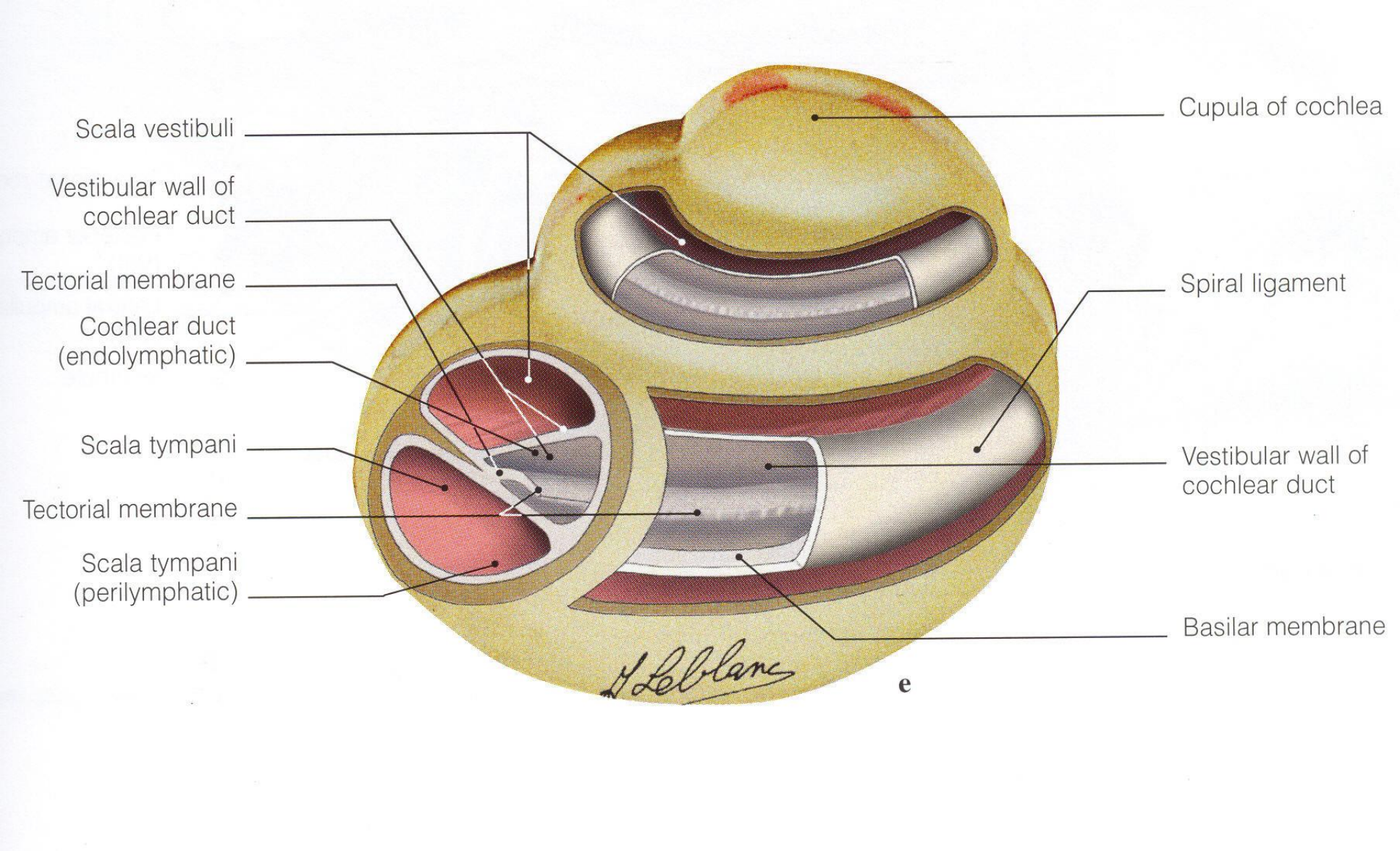
Cross-section of Cochlear Duct (dct. Cochlearis)

A snail shell in shape,

two and half turns



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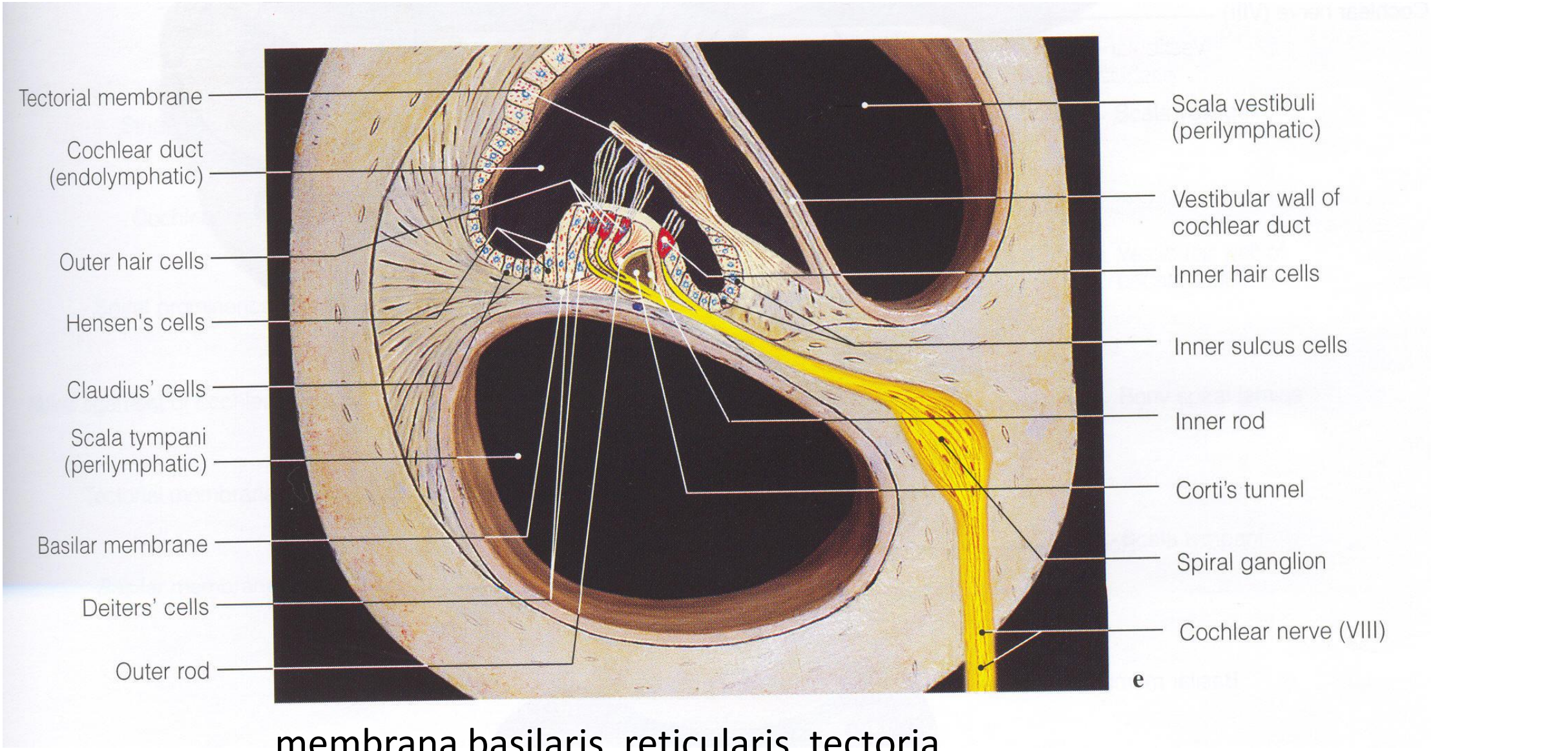
Cochlear duct cross-section, organon spirale Corti



membrana basilaris, reticularis, tectoria

Cochlear function:

- Change of mechanic vibration on neural excitation
- Basic frequency analysis

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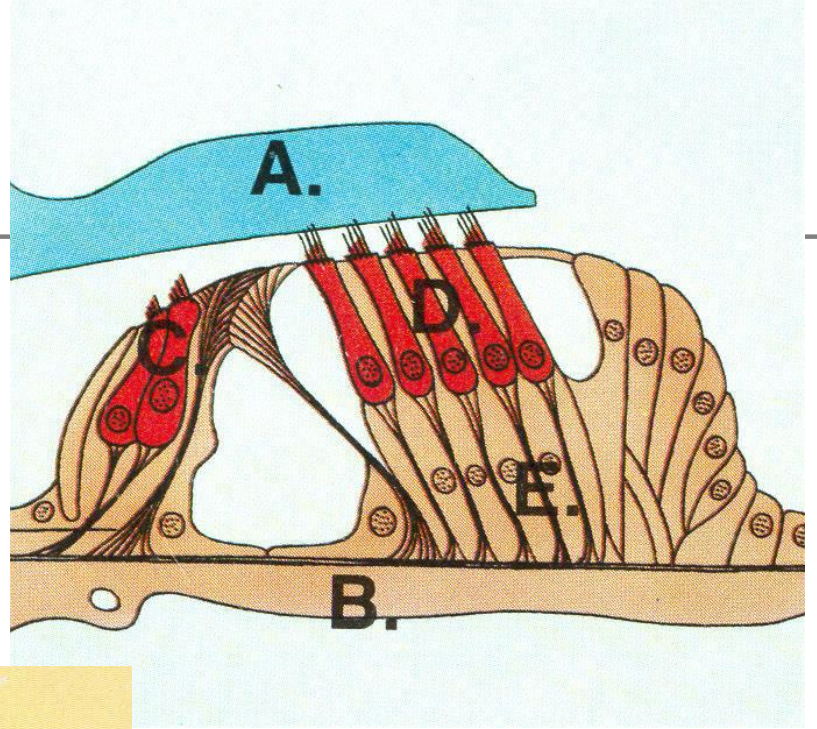
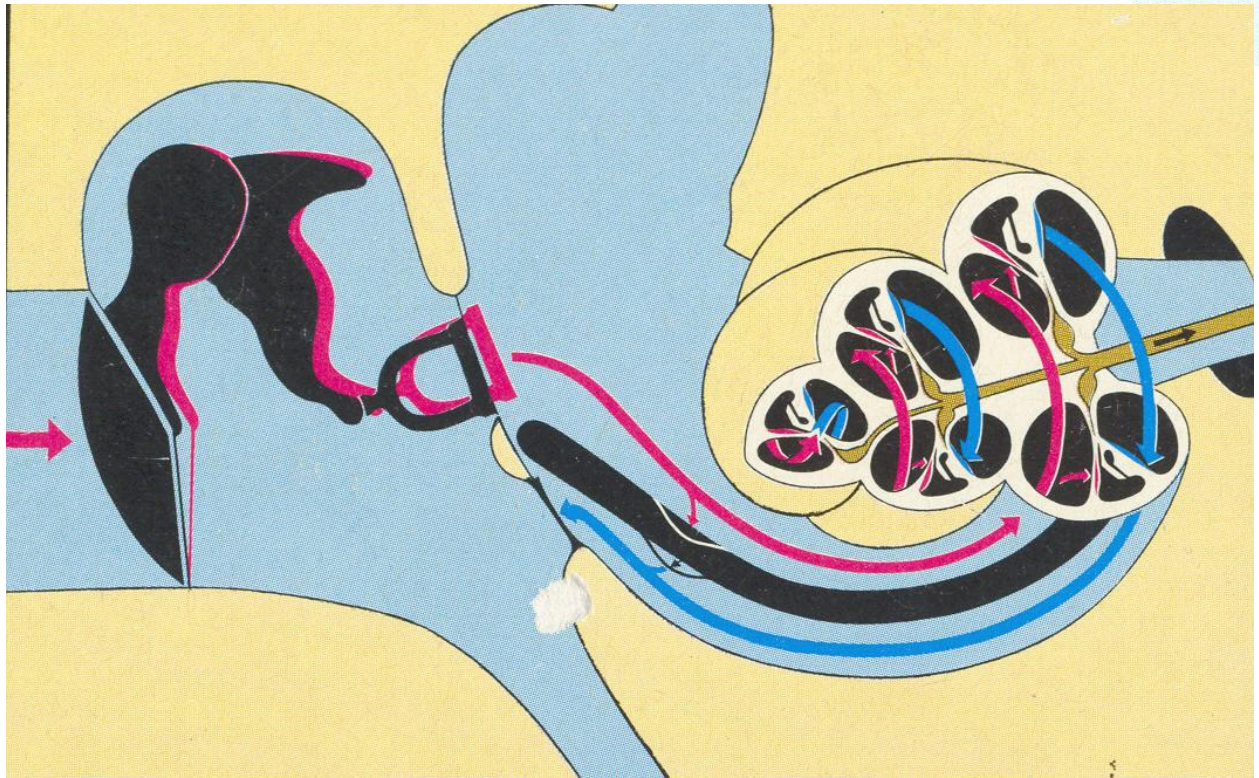
Vibration conduction from the ear drum through cochlea, Organon Corti





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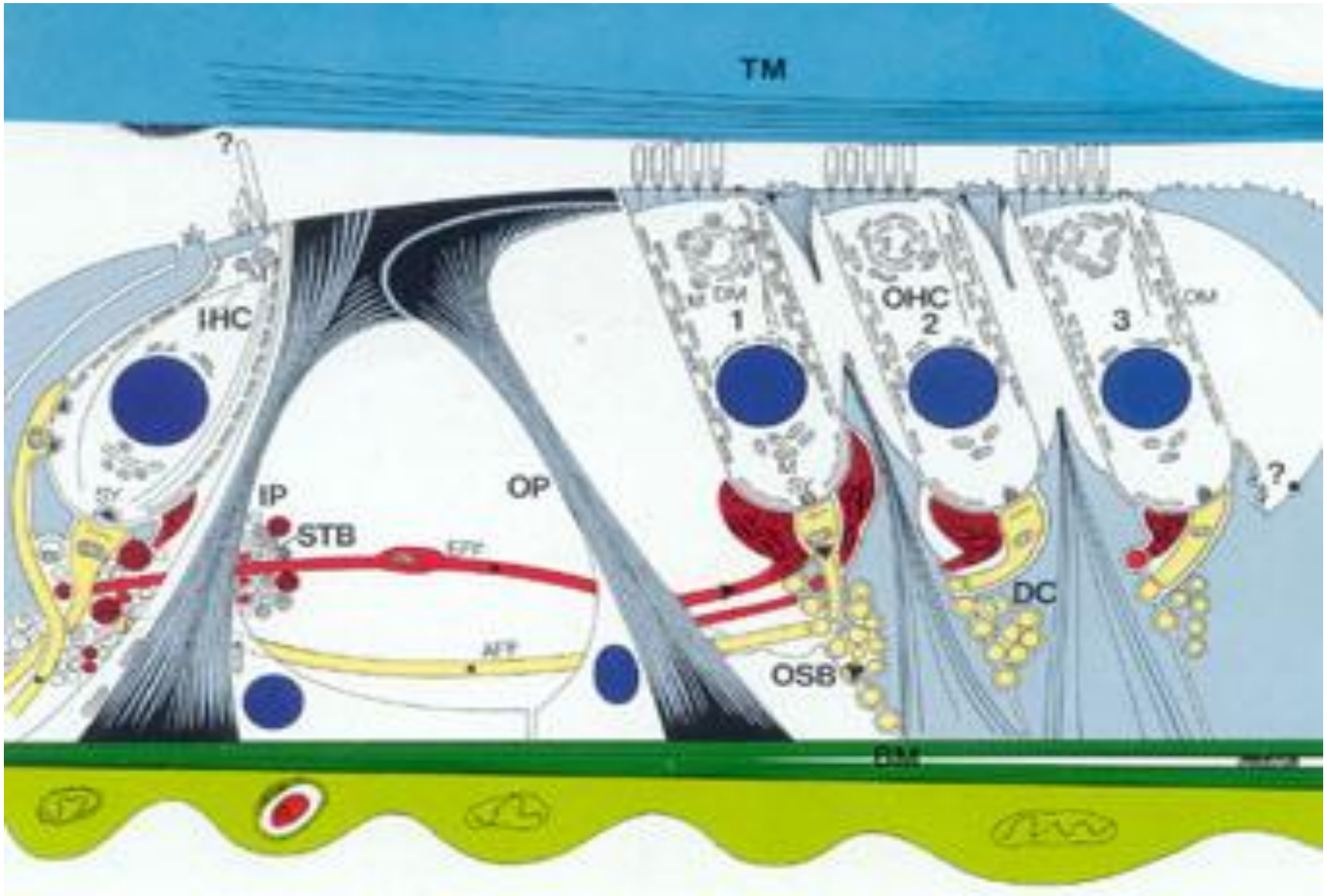
Outer hair cells (OHC) = servomechanism for inner hair cells (IHC)



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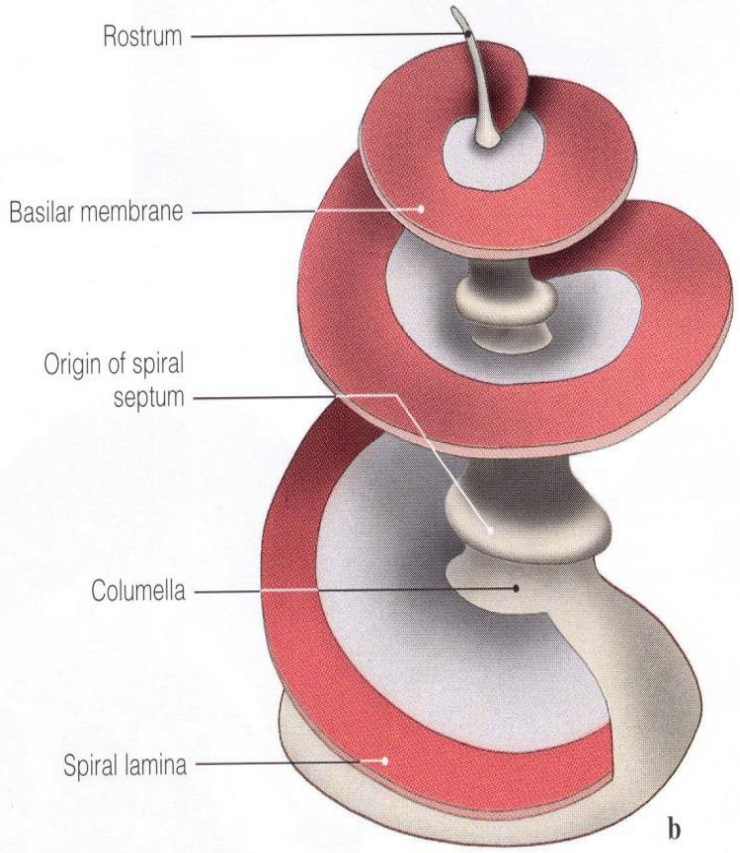
Cochlear septum

System of 3 membranes – membrana basilaris, reticularis, tectoria

Principle of tonotopy

– as higher frequency, the acustic pressure balanced near to stapes. High frequency are perceived in basal thread, low frequencies in apical thread.



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Wave hydrodynamic theory of hearing (von Bekesy theory of „traveling wave“; still valid ☺)

- Acoustic tension is led from ear drum through ossicles into oval window.
- Liquid is je not compressible, pressure changes are equalized on round window membrane, which vibrate in anti phase to stapes.
- Acoustic pressure is **equalized on cochlear septum** and it create wave.
- a sound impulse sends a wave sweeping along the basilar membrane. ... And as Helmholtz had postulated, **Bekesy** found that the high-frequency tones were perceived near the base of the cochlea and the lower frequencies toward the apex." (principle of tonotopy).
- „ traveling wave“ leads to **shift of tectorial membrane of Organon Corti in relation to basilar membrane and deflection of hairs** of sensory cells (opening of iont channels)
- Thus the mechanic energy is **changed into electric potential** in VIII cranial nerve.

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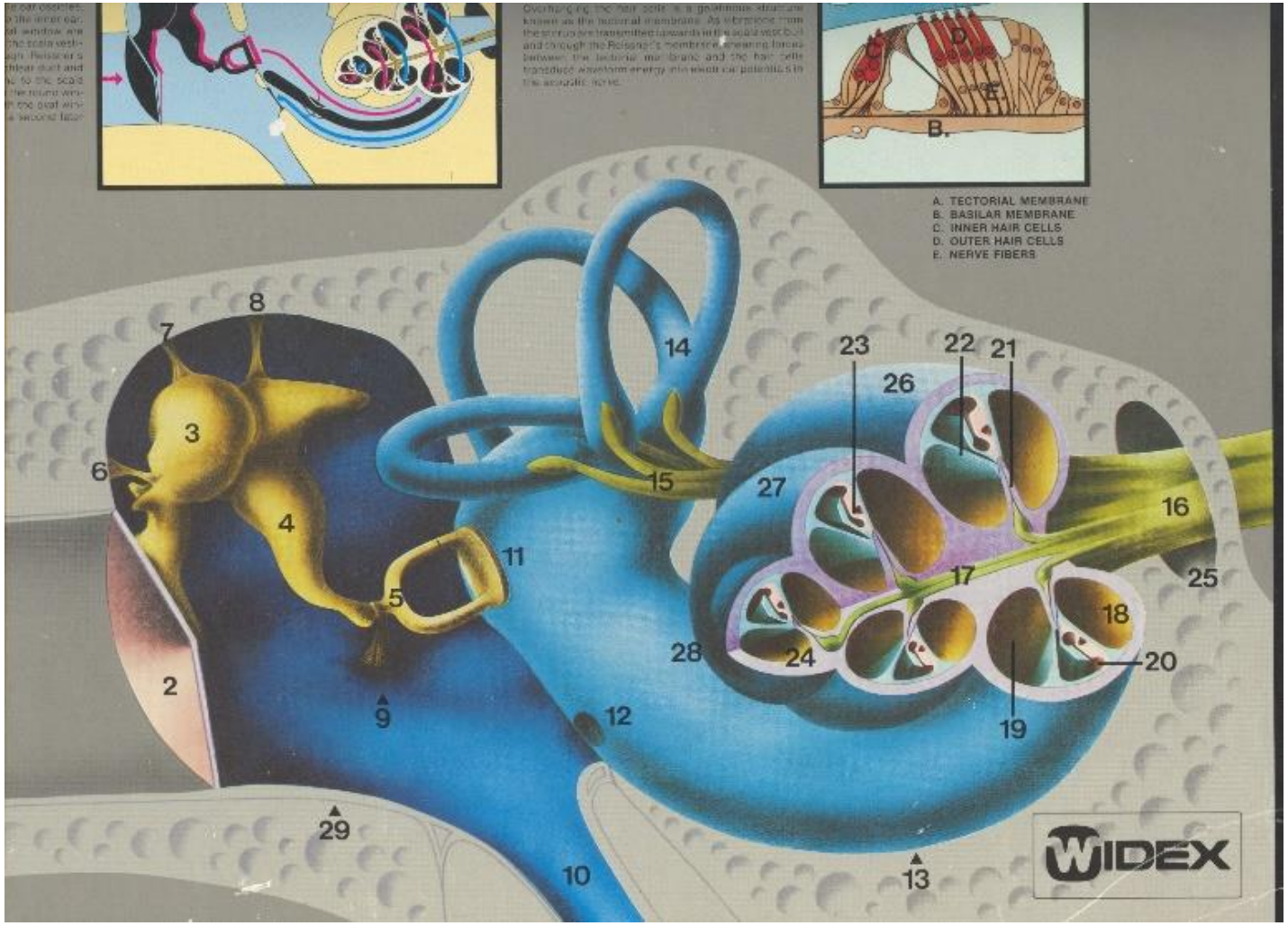
Vestibular system

Basic function

1. Equilibrium of human body in stand and in walking
2. Stabilization of retinal picture and keeping visual sharpness in movement



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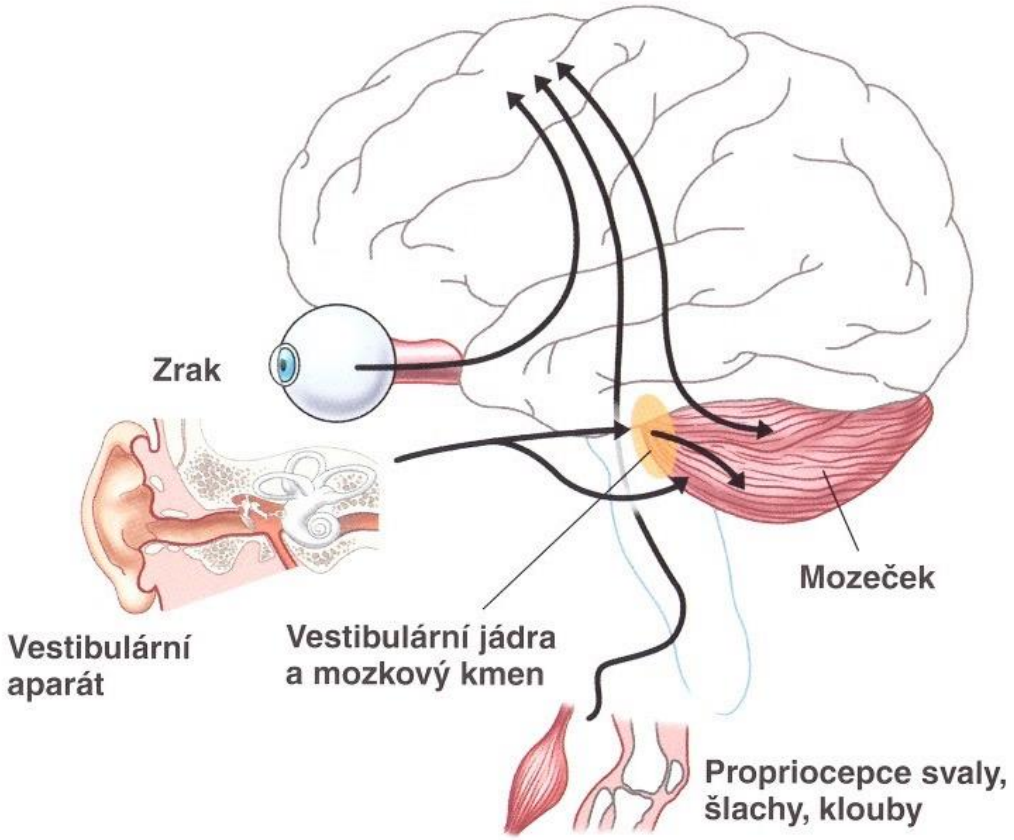
Equilibrium

On keeping balance : Interaction of eye, vestibular-semicircular system, proprioception X vestibular nuclei and cerebellum

Three afferent sources of equilibrium: eye, proprioception and vestibular-semicircular system.

Basic reflex circles

- vestibulo-ocular reflex (VOR)
- Vestibulo-spinal reflex (VSR) - help keep head and body in upright position due to vestibulospinal system.



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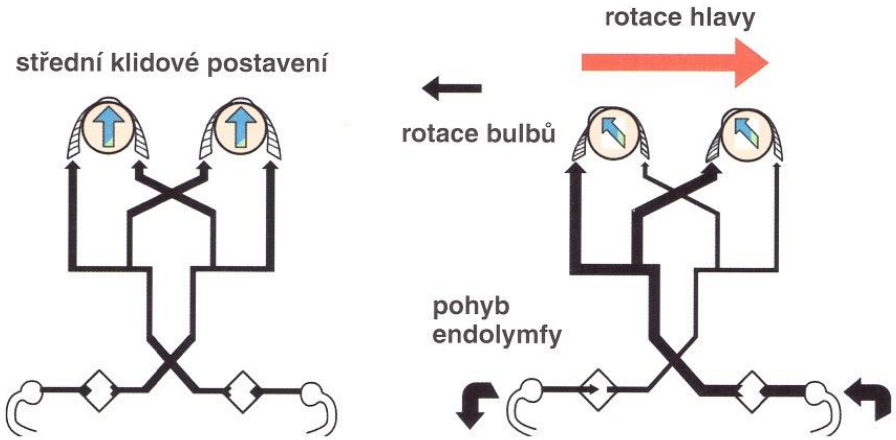
Vestibulo-occular reflex

Stabilisation of retinal picture. Create movement of eye, which are opposite to movement of head in some plains.

Nystagmus – conjugated, coordinated eye movement around a specific axis. **The movement consists of rhythmically alternating slow – and fast beating phases.** The direction of the fast components determines the laterality of the nystagmus.



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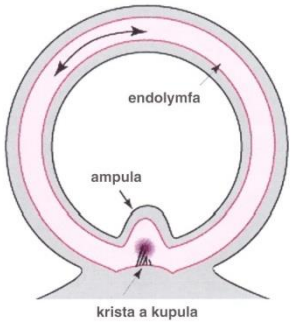
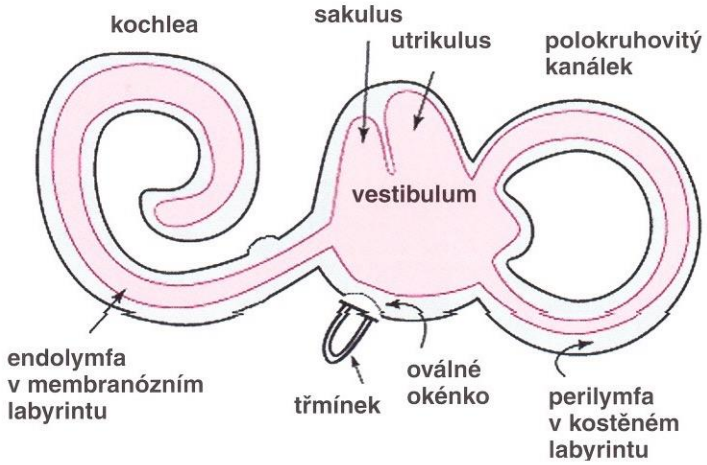
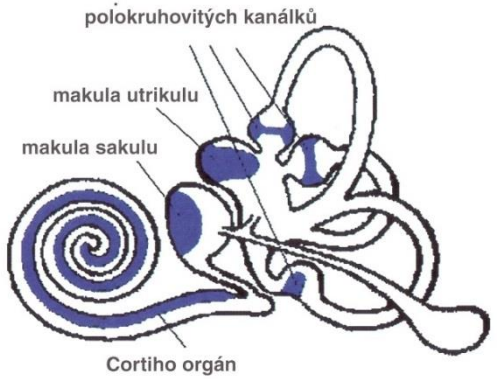
Membranous labyrinth

- Vestibular apparatus localized in pyramis ossis temporalis; membranous labyrinth: saccule, utricle and three semicircular canal; filled with endolymph.
- Every semicircular canal begins with **pars ampullaris** with **ampullary crest**, sense organ is **static macula (macula statica utriculi et saculi).**







Section of semicircular canal, schema of membranous labyrinth (with one canal), sensory organs.

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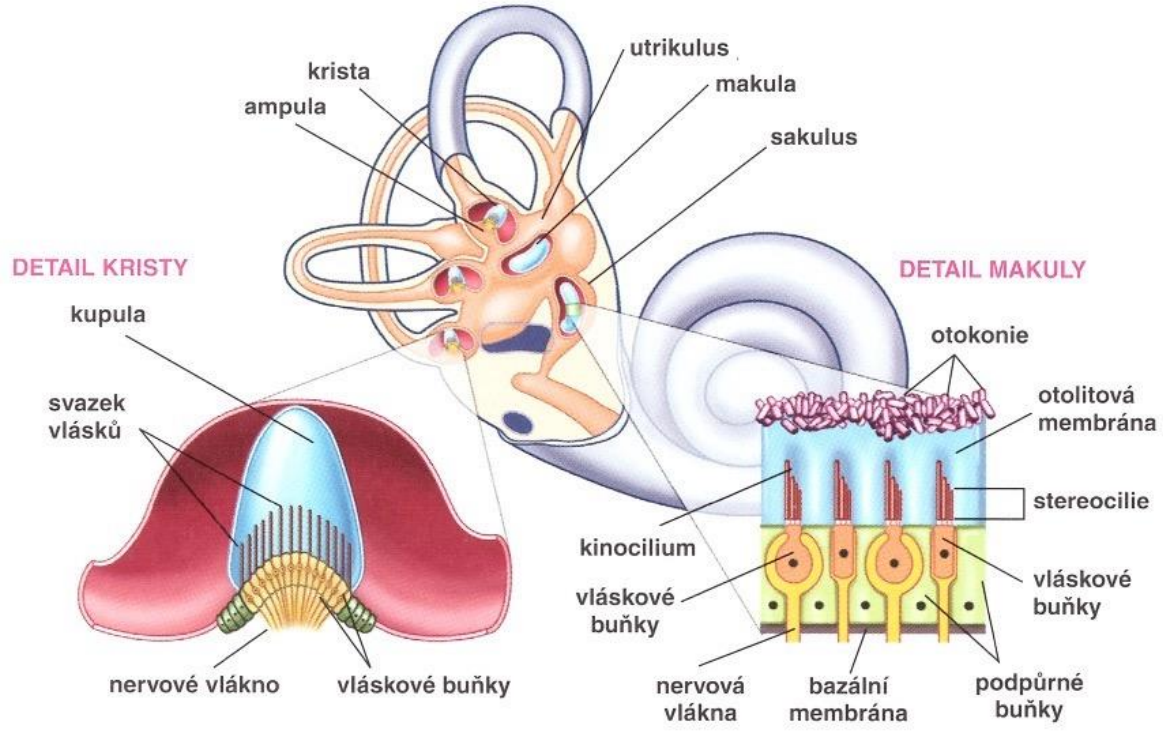
Genesis of receptor potential

Ampullary crests (cristae ampulares) and **maculae utricle and saccule** are created by **supporting cells and hair cells**. On their surface lie the **otoliths** (statoconia) – calcium carbonate crystal.

Linear acceleration changes the otolith pressure, **deflecting the sensory hairs**. This stimulates the sensory cell by altering the resting **potential**.



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Diagnosis, vestibular function tests

History – subjective feeling of dizziness, time of start and duration…

Evaluation of reflexes – **spontaneous** vs. **experimentally provoked** (calorisation, rotation)

- **Nystagmus** (vestibulo-ocular reflex) Detail evaluation of eye movement - electronystagmography, video oculography (preferred)
- **Vestibule-spinal reflexes**:
  - Hautant test (spontaneous deviation test),
  - Romberg test (patient is asked to stand in basic position/wide stance, and to close eyes. A check is to see whether there is unsteadiness or a tendency to fall.)
- **Vestibule-cerebellar reflex**
  - Barany test (finger-nose pointing test) ; posturography

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Vestibular function Tests

- **Head shaking nystagmus** – spontaneous Nystagmus can be provoked by gentle, passive, horizontal shaking of the patients head
- **Unterberger test**, walk „on the rope“
- **Stabilometric plain** - static and dynamic (vestibule-spinal reflexes)
- **Head impulse test**: – in long lasting dizzines. From mild eccentric head position we provide passive quick rotation movement from side to side, patient fixis our tip of nose….

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Vertigo (dizziness)

the outcome of the functional tests is to determine whether it is peripheral or central vertigo. Peripheral vertigo is troublesome but not life-threatening, while central vertigo can be life-threatening.

- ***Periferal type*** – feeling of rotation of itself body or surroundings, direction of rotation is usually into healthy part, loss of stability or feeling of swimming
- ***Central type*** – ineptitude by walk, inability of walk, vertigines with aura (EPI), disorder of vision *"black outs"* – diplopia is seen by disorder of oculomotory.

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Differential diagnosis peripheral vs. central vestibular syndrome

Symptom	Peripheral (harmonic) VS	Central VS
Nystagmus	**Horizontal rotatory** on side of most reactive labyrinth	Other then horizontal rotatoric: vertical, „gaze“ nystagmus, rebound nystagmus etc)
Tonic deviation	**On side of weak labyrinth** (to affected ear) in relation to position of head	Without to relation to head position
Eye fixation	In absence of eye fixation nystagmus is **growing**	In absence of eye fixation nystagmus not changed
Cranial nerves	**Without lesions** (excl.: n. VII)	Laesion of cranial nerves present
Cerebellar symptoms	Not present	Could be present
Disturbance of occulomotoric function	Not present	Could be present
Hearing disorder	Usually Could be **present**	Usually Not present
Central compensation	**Gradually compensation**, harmonic symptoms: intensity of vertigo correlates with nystagmus intensity and tonic deviations	Not present, disharmonic symptoms

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History of ear disease

Physician itself is a „remedy“. (Michael Balint)

Hearing disorder

Otorhoea

Ear discharge

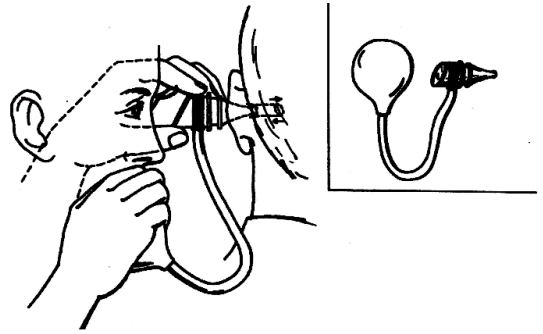
Tinnitus

Pain

Dizzines

Ear evaluation, oto(mikro)scopy

- **Aspection and palpation**
  - Auricle shape, deformities
  - Skin lesions, scars (also retroauriculars)
  - Discharge from external meatus
  - Pain in pressure on tragus (by otitis externa)
  - Pain in pressure on processus mastoideus (by mastoiditis acuta)
- **Otoscopy and oto(micro)scopy evaluation**
  - Ear speculum
  - Illuminated otoscope, pneumo-otoscopy
  - Otomicroscope, endoscope



Vyšetřování Sieglovým zrcátkem

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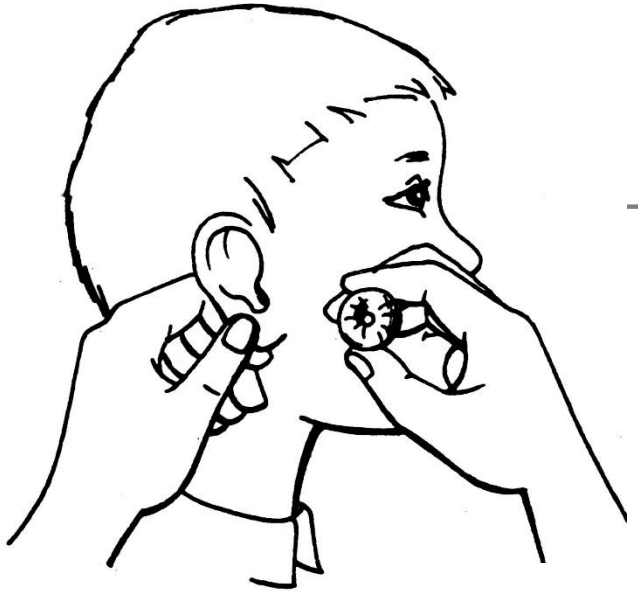
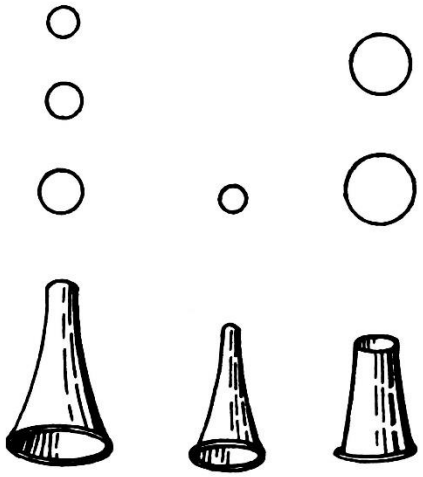


Obr. 13: Zavádění ušního zrcátka u dítěte

Obr. 12: Zavádění ušního zrcátka u dospělého

Otoscopy

eye evaluation of deeper parts of external meatus and ear drum



Obr. 11: Ušní zrcátka

The cartilaginous part of ext. meatus is stretched by pulling the auricle upward and backward

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„Normal“ ear drum

- Grey colour
- Without perforation
- Bezold´s trias
  Prominentia mallearis
  Stria mallearis
  Light reflex

Otoscopy – tympanic membrane quadrants and zones

p - prominenz malleární
s - stria malleární
u - umbo
r - světelný reflex

Kvadranty:
pd - přední dolní
ph - " horní
zd - zadní dolní
zh - " horní

zony: c - centrální, i - intermediální, p - periferní

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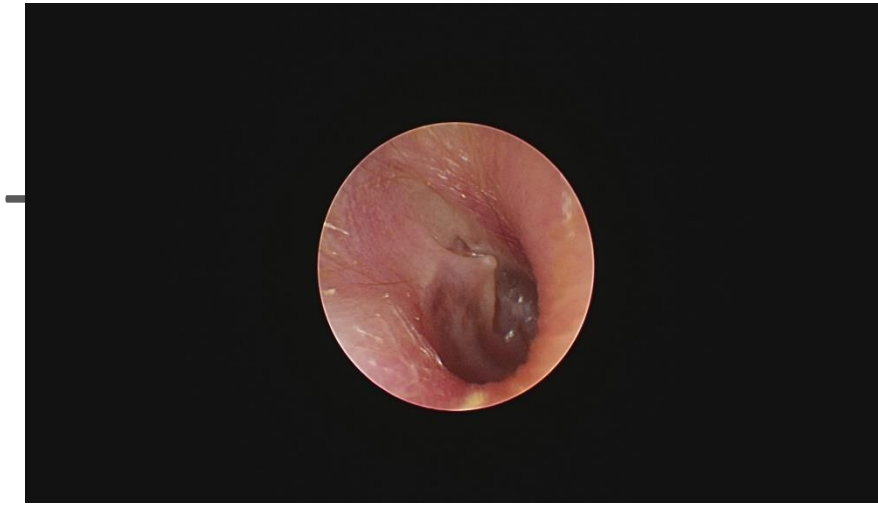
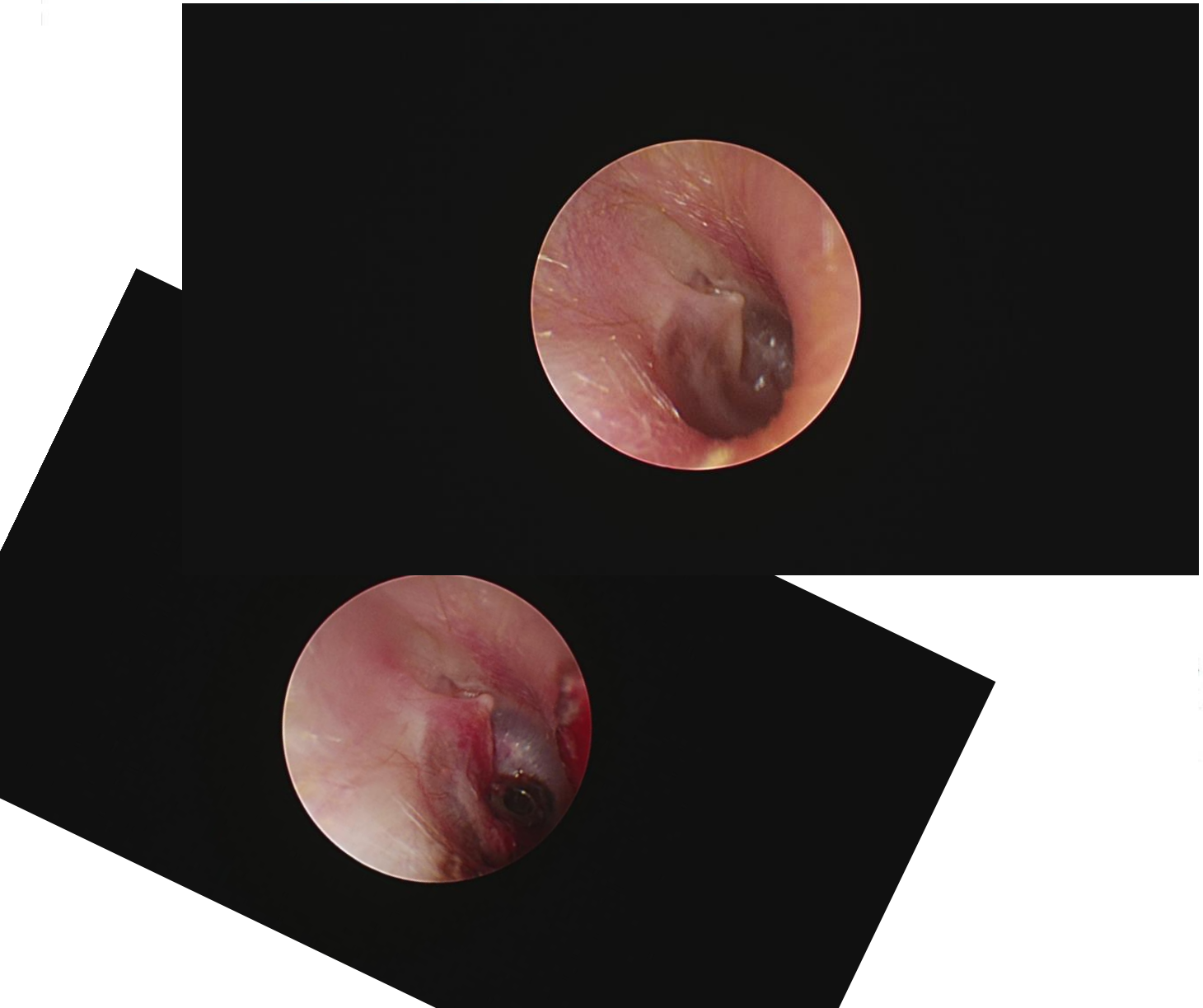
Basic pathologic finding on tympanic membrane

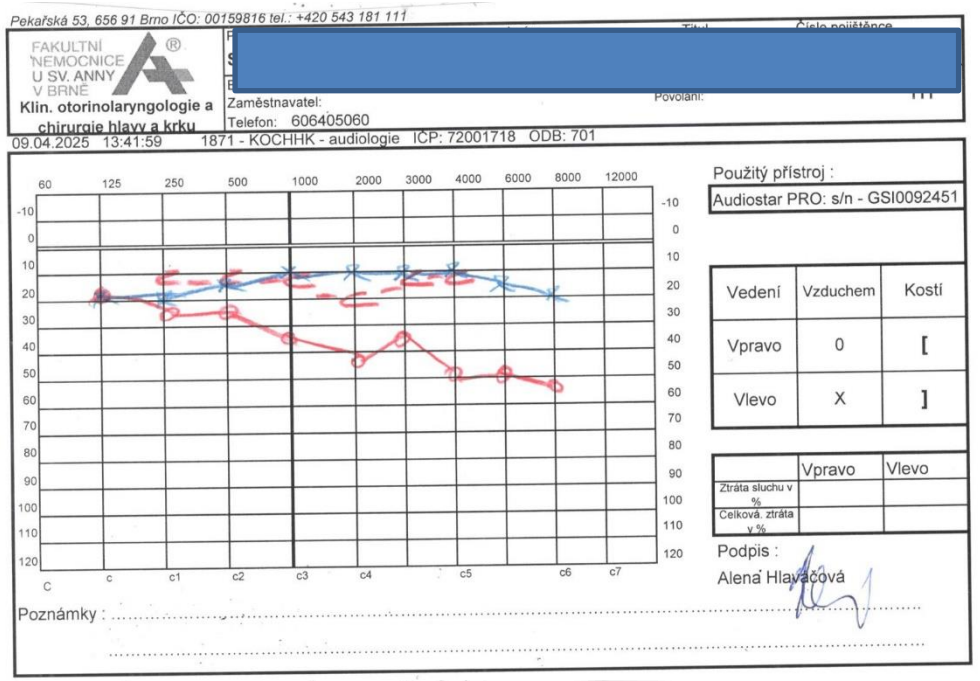
- Changes on the tympanic membrane: Injection of the vessels
- **Position of the tympanic membrane**
  - **bulgging due to exudate** - hyperemia, moist infiltration and opacity of the surface, the contours of the handle of malleus and short process disappear
  - **retraction** - injection of blood vessels
- **integrity of the tympanic membrane perforations –**
  - **after injury**
  - **inflammatory - acute**
    - chronic - central (mesotympanic)
    - marginal (peripheral)



- **changes after inflammation: thickening of the tympanic membrane, scars**
- changes **behind** the ear-drum: middle ear effusion, fluid level, air bubbles

Retraction of the ear drum, pressure equalizing tube





Pekařská 53, 656 91 Brno IČO: 00159816 tel.: +420 543 181 111

FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ

Klin. otorinolaryngologie a chirurgie hlavy a krku

[redacted]

Zaměstnavatel:

Telefon: 606405060

09.04.2025 13:41:59 1871 - KOCHHK - audiologie IČP: 72001718 ODB: 701

Použitý přístroj :

Audiostar PRO: s/n - GSI0092451

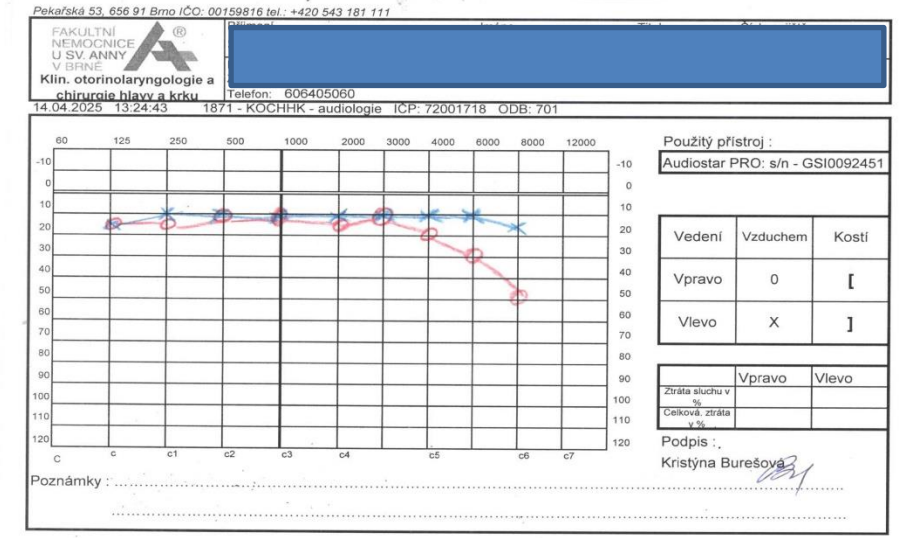
Vedení	Vzduchem	Kostí
Vpravo	0	[
Vlevo	X	]

	Vpravo	Vlevo
Ztráta sluchu v %		
Celková. ztráta v %		

Podpis :

Alena Hlaváčová

Poznámky :



Pekařská 53, 656 91 Brno IČO: 00159816 tel.: +420 543 181 111

FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ

Klin. otorinolaryngologie a chirurgie hlavy a krku

[redacted]

Telefon: 606405060

14.04.2025 13:24:43 1871 - KOCHHK - audiologie IČP: 72001718 ODB: 701

Použitý přístroj :

Audiostar PRO: s/n - GSI0092451

Vedení	Vzduchem	Kostí
Vpravo	0	[
Vlevo	X	]

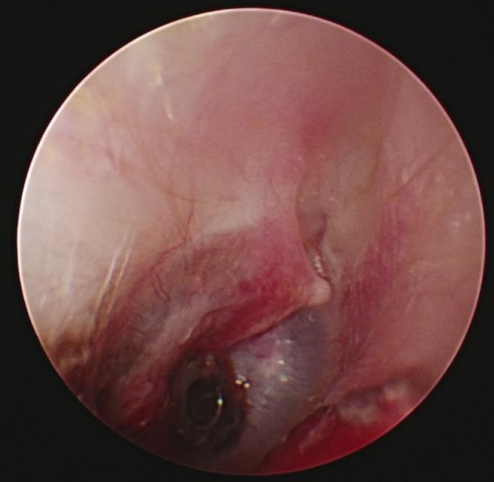
	Vpravo	Vlevo
Ztráta sluchu v %		
Celková. ztráta v %		

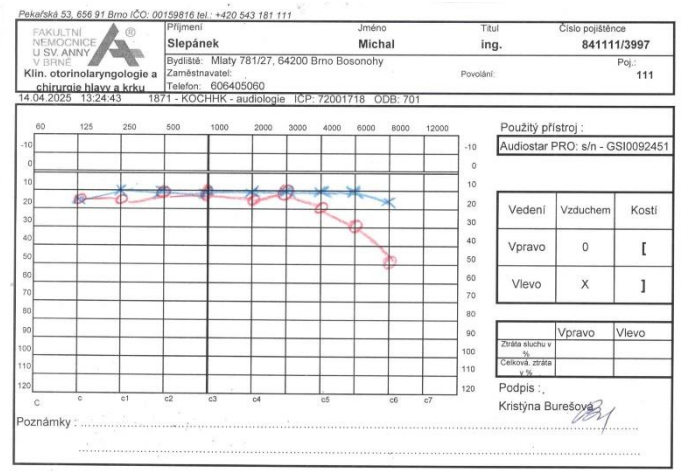
Podpis :

Kristýna Burešová

Poznámky :

FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ





Pekařská 53, 656 91 Brno IČO: 00159816 tel.: +420 543 181 111

FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ
Klin. otorinolaryngologie a chirurgie hlavy a krku

Příjmení	Jméno	Titul	Číslo pojištěnce
Slepánek	Michal	ing.	841111/3997

Bydliště: Mlaty 781/27, 64200 Brno Bosonohy
Zaměstnavatel:
Telefon: 606405060
Povolání:
Poj.: 111

14.04.2025 13:24:43 1871 - KOCHHK - audiologie IČP: 72001718 ODB: 701

Použitý přístroj :
Audiostar PRO: s/n - GSI0092451

Vedení	Vzduchem	Kostí
Vpravo	0	[
Vlevo	X	]

	Vpravo	Vlevo
Ztráta sluchu v %		
Celková ztráta v %		

Podpis :
Kristýna Burešová

Poznámky :

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Retrakční kapsa ve Schrapnel. blance, perforace v zad. hor. kv. s cholest. hmotami

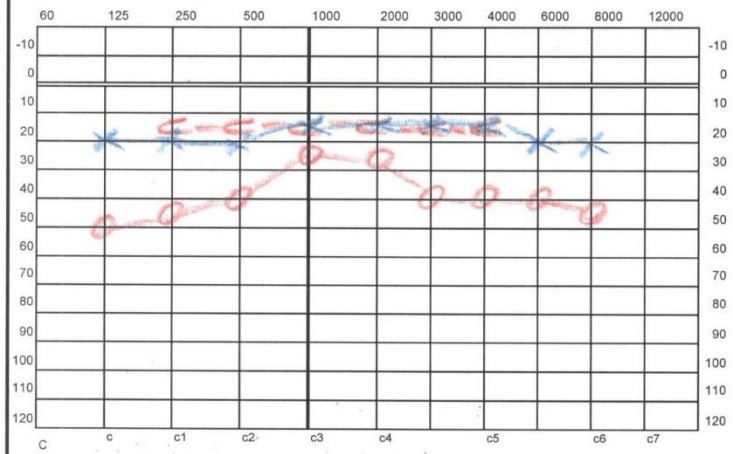
Pekařská 53, 656 91 Brno IČO: 00159816 tel.: +420 543 181 111

FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ
Klin. otorinolaryngologie a chirurgie hlavy a krku

Příjmení	Jméno	Titul	Číslo pojištěnce
Šafář	Jiří		920103/5305

Bydliště: Lišejníky 3, 64100 Poj.: 211
Zaměstnavatel: Povolání:
Telefon: 601326164

21.03.2025 08:47:38 1871 - KOCHHK - audiologie IČP: 72001718 ODB: 701



Použitý přístroj :
Audiostar PRO: s/n - GSI0092451

Vedení	Vzduchem	Kostí
Vpravo	0	[
Vlevo	X	]

	Vpravo	Vlevo
Ztráta sluchu v %		
Celková. ztráta v %		

Podpis :
Kristína Janáčková

Poznámky : .....

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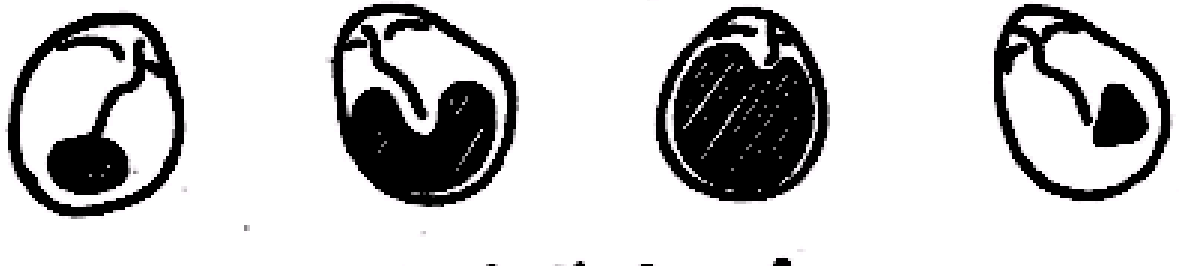
Various types of ear drum perforations



Central perforation

Ear drum injury

Peripheral perforation

Periopheral and central perforation

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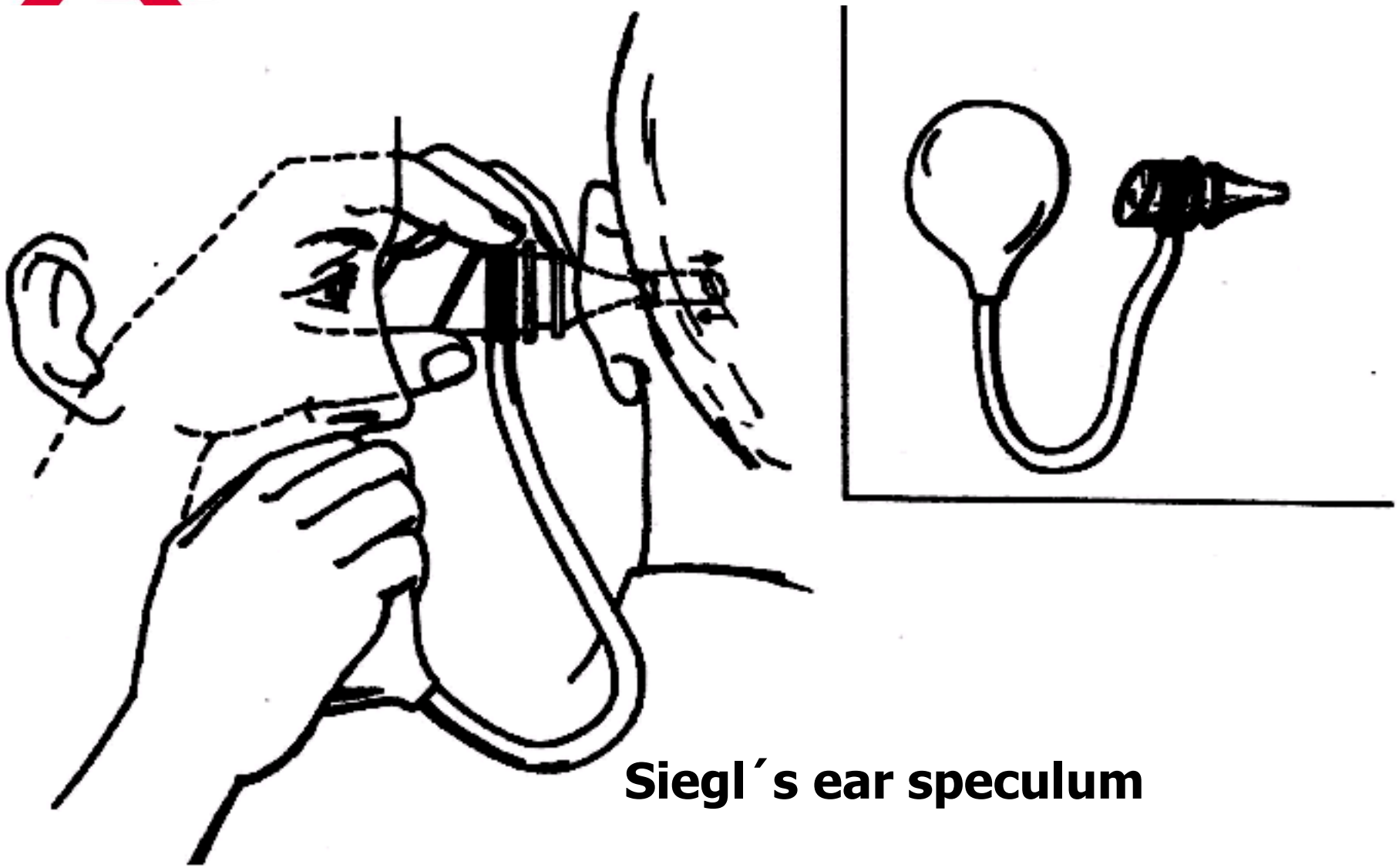
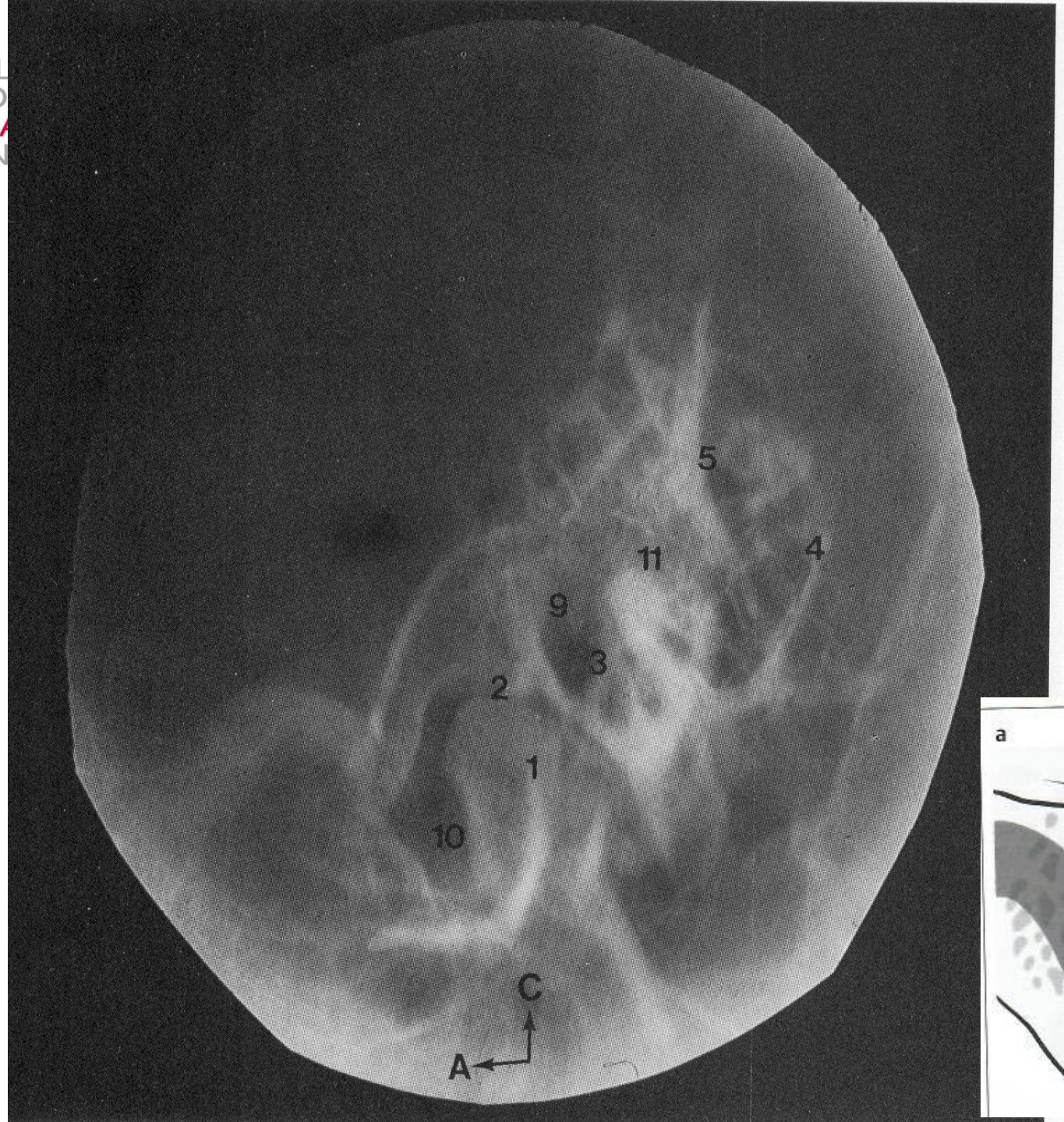
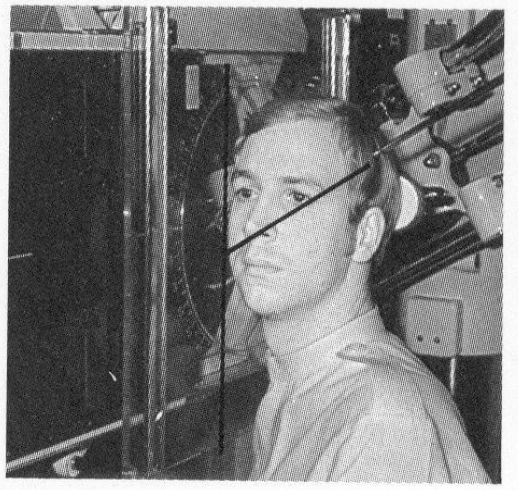
Siegl´s ear speculum

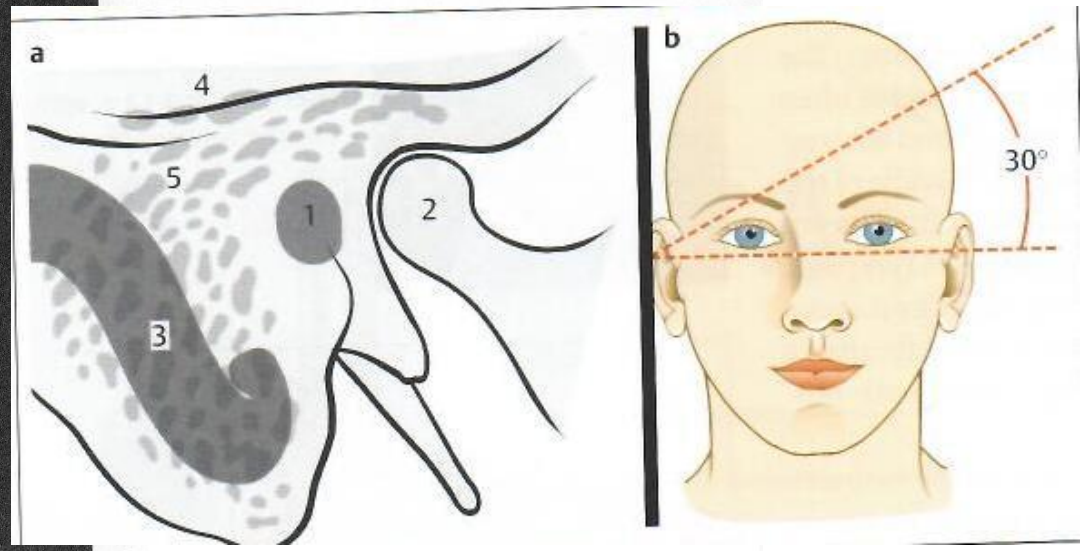


Siegl´s ear speculum



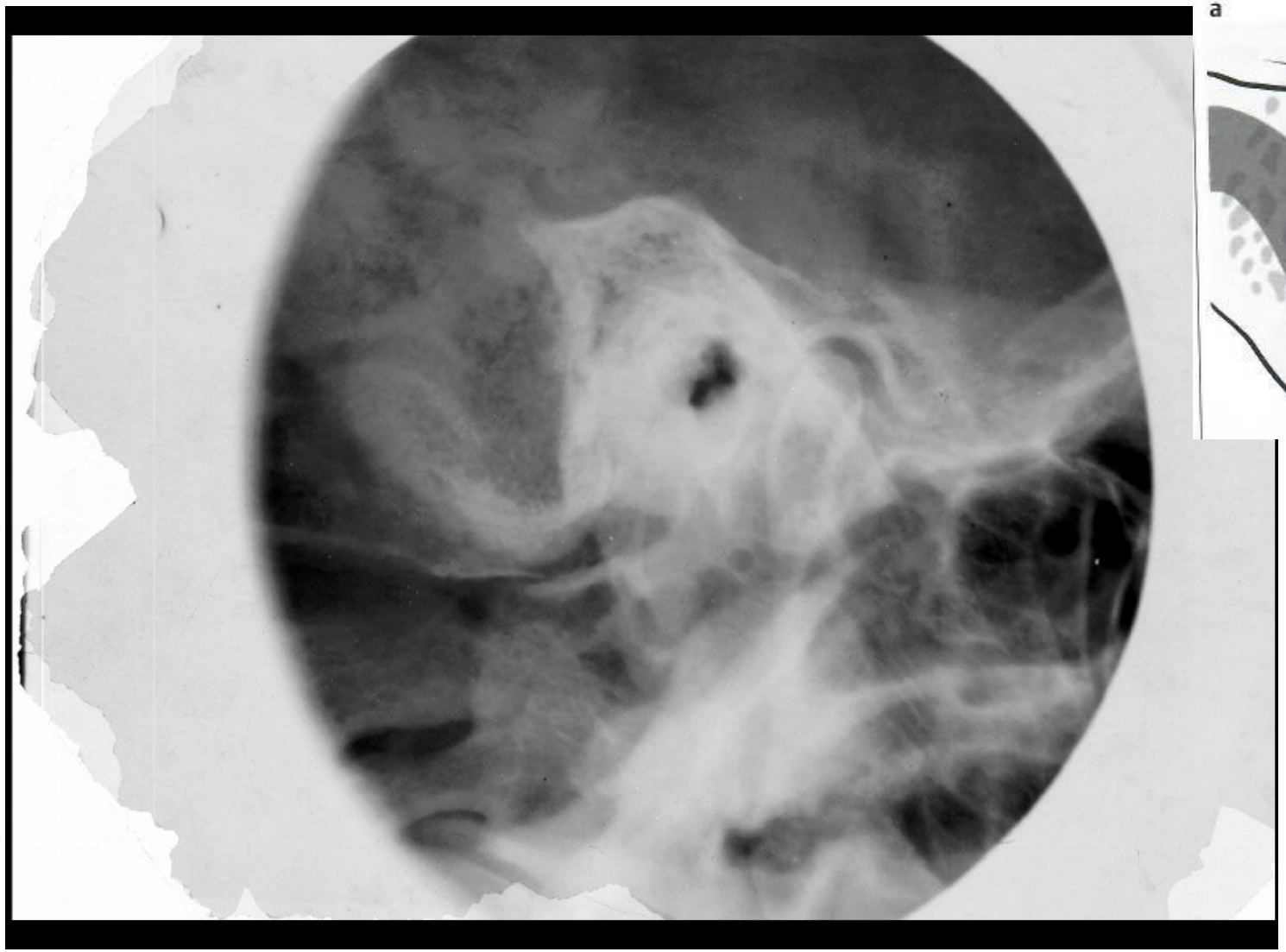


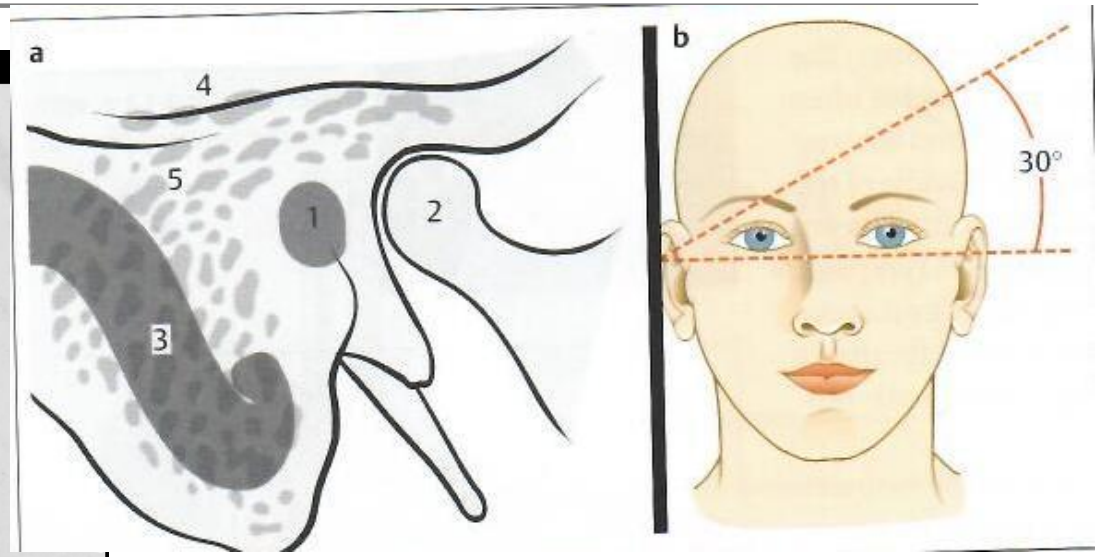
Radiographs in Schüller wiev



FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ

Radiographs in Schüller wiev





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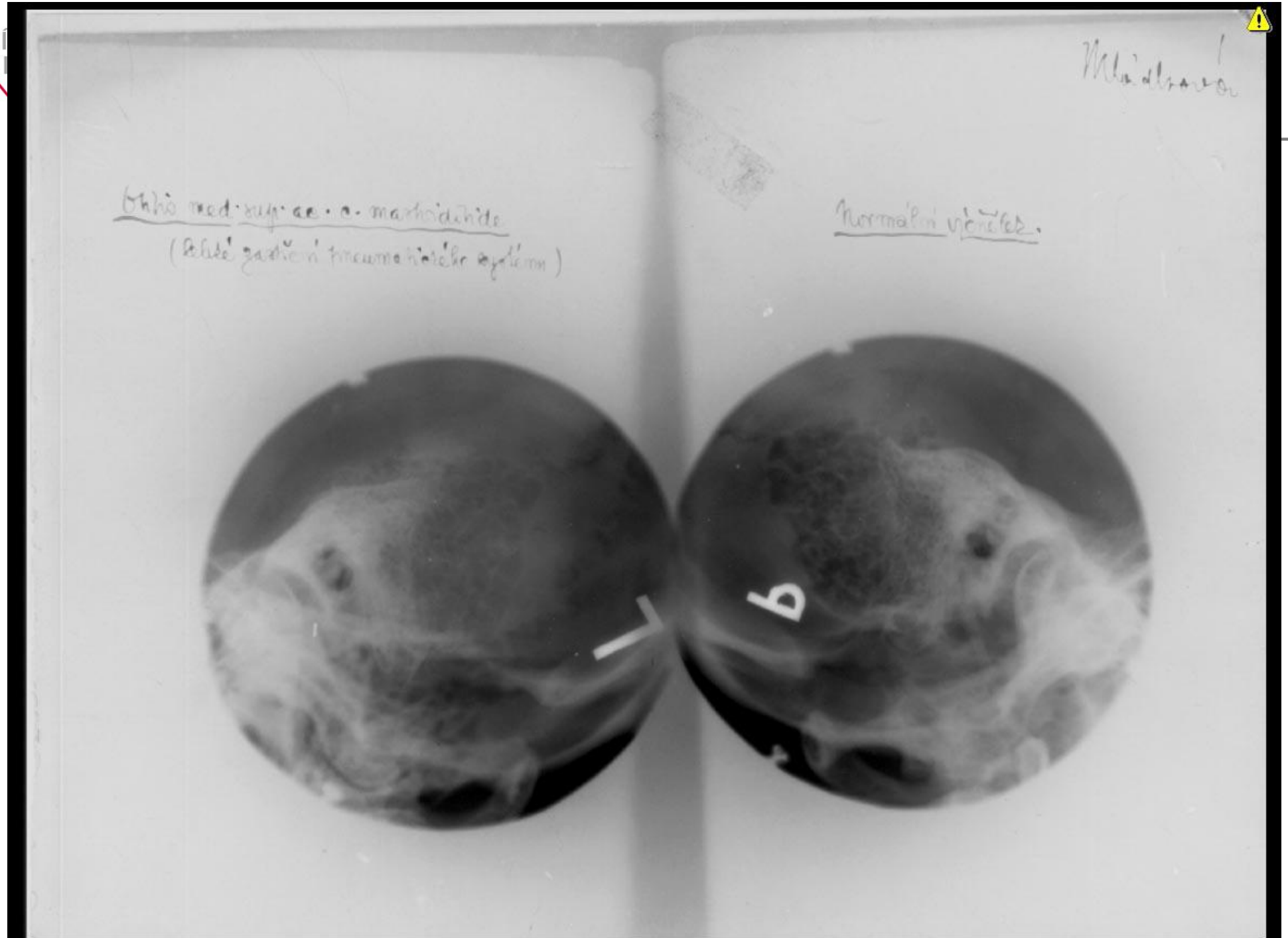

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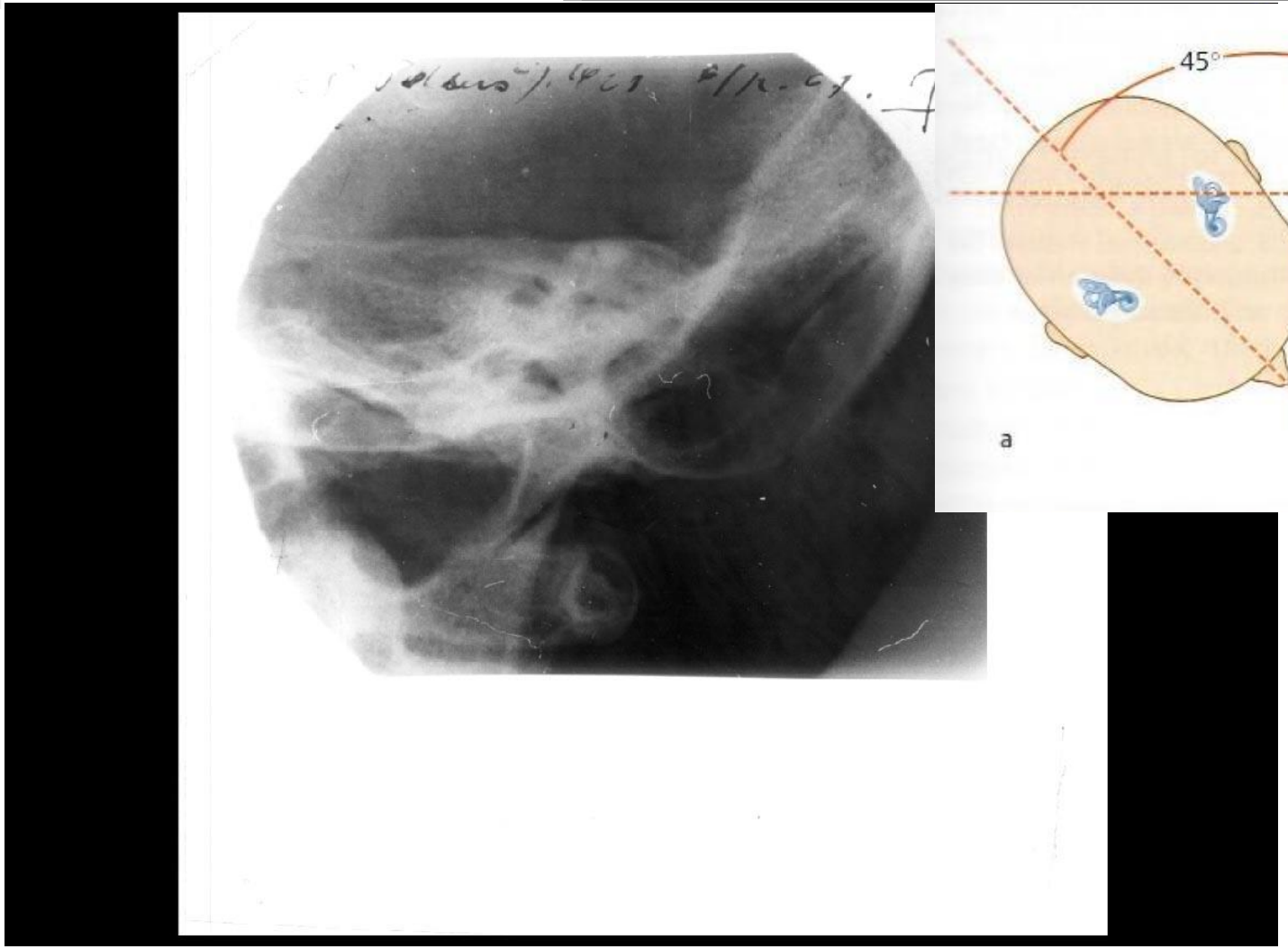
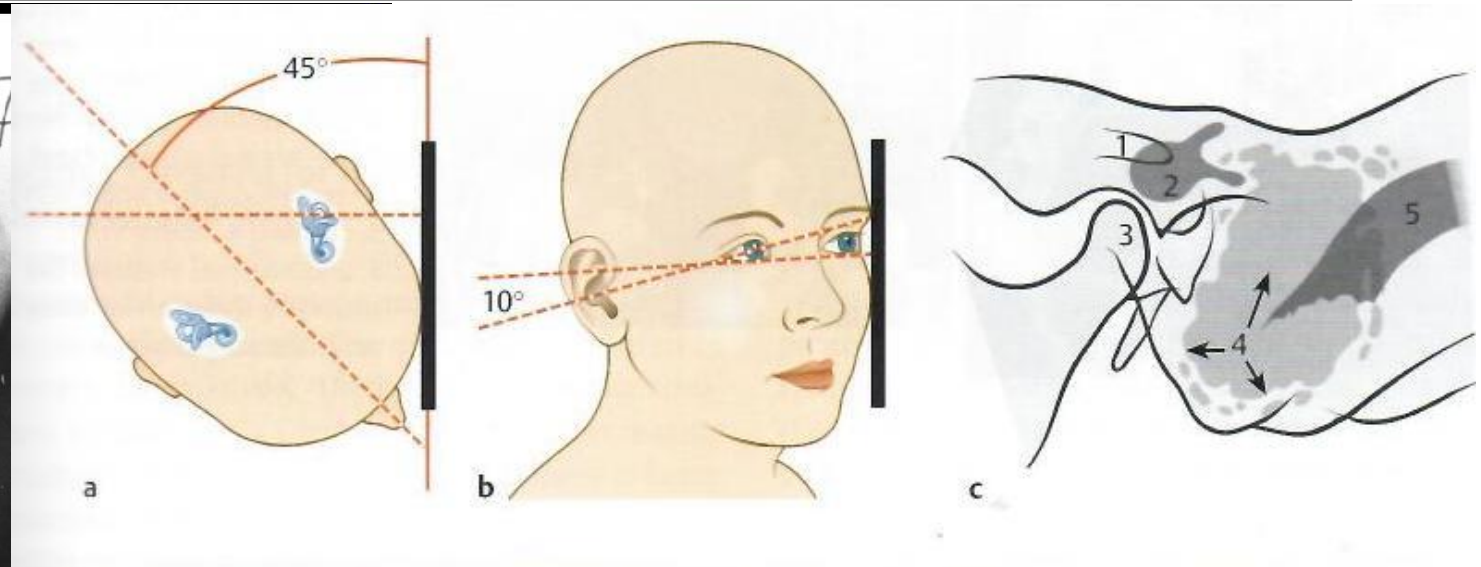
Radiographs in the Stenver view





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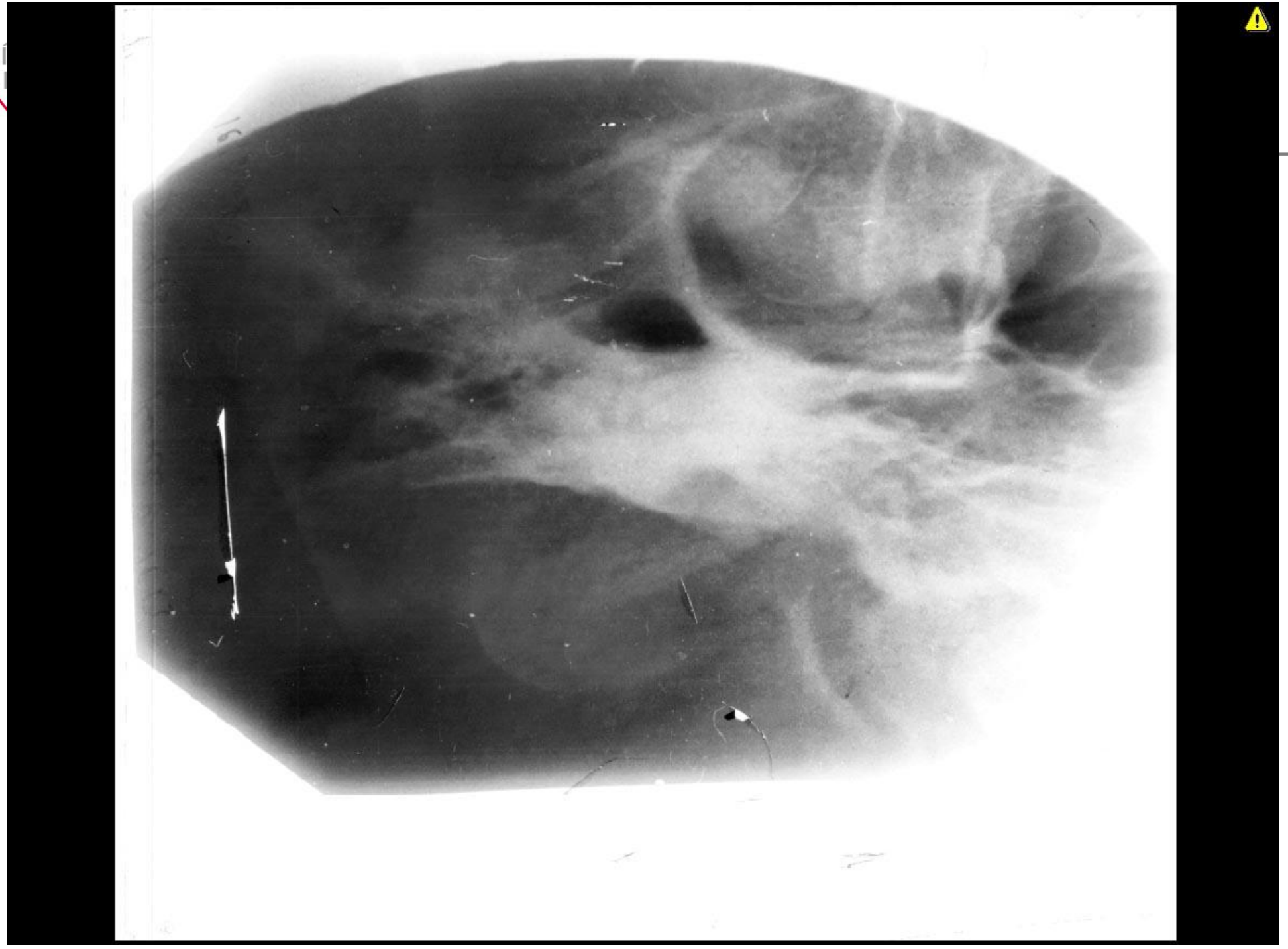
V BRNĚ



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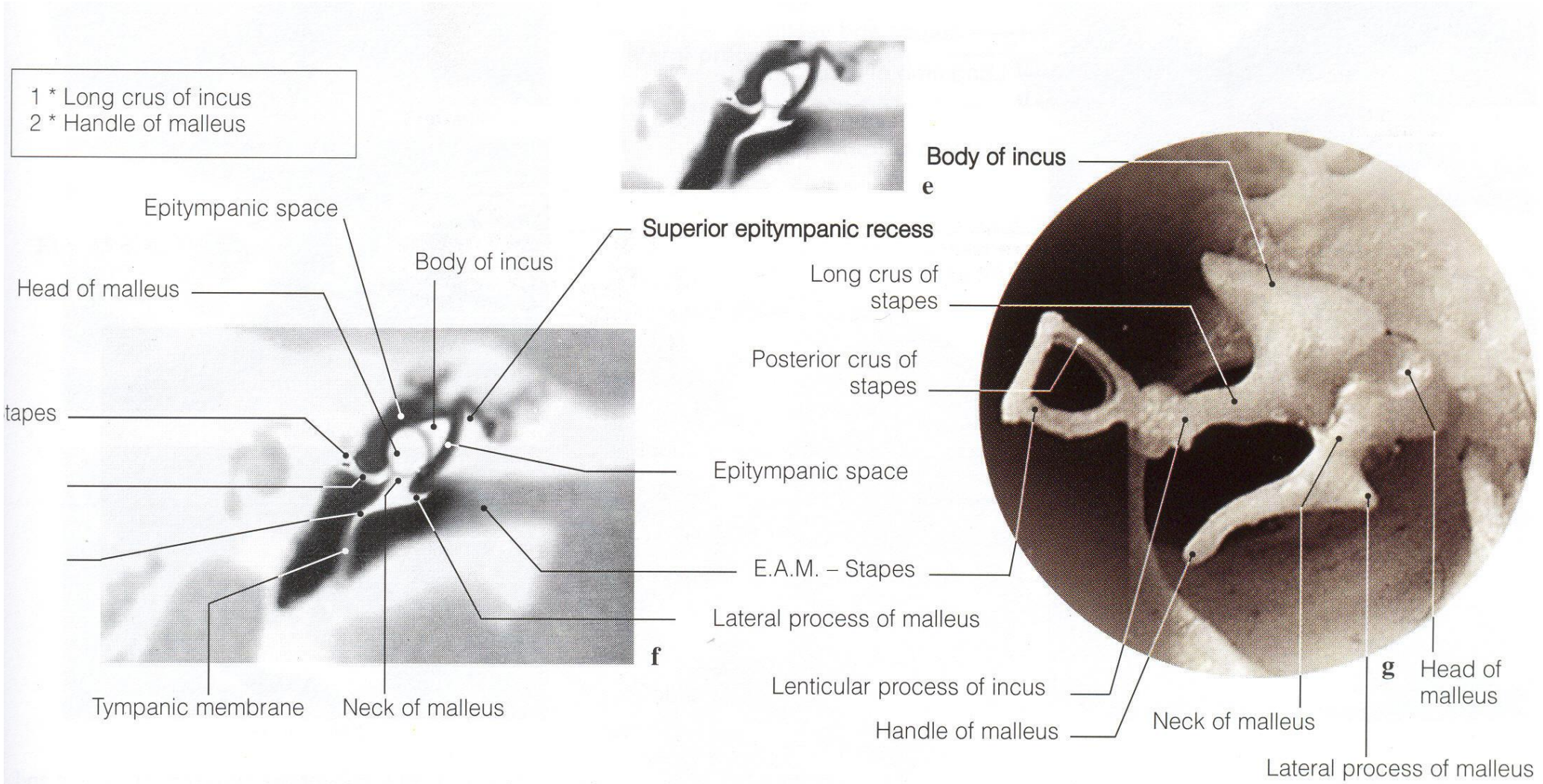
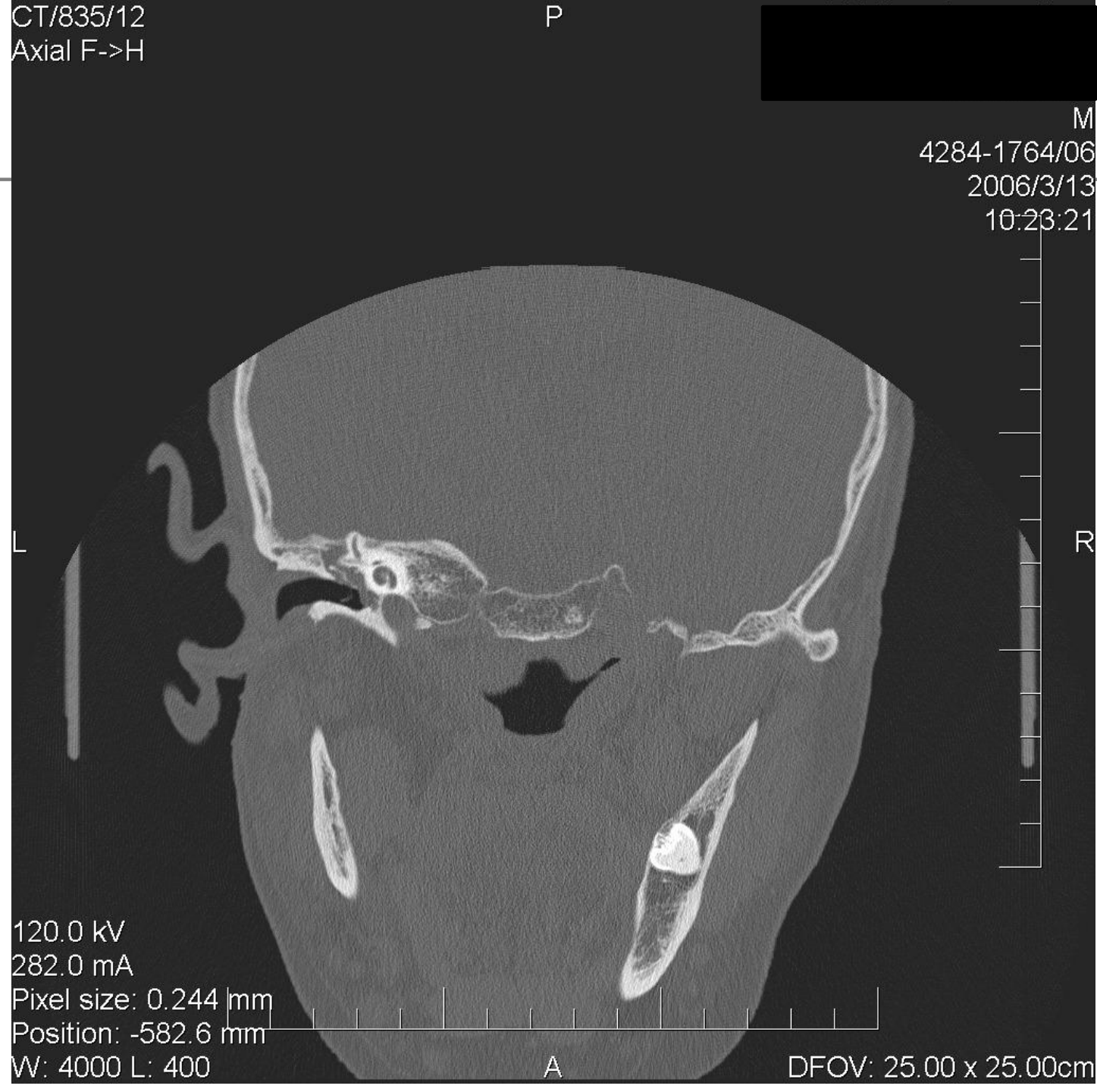
Schema of CT of ossicular chain and middle ear cavity



FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ



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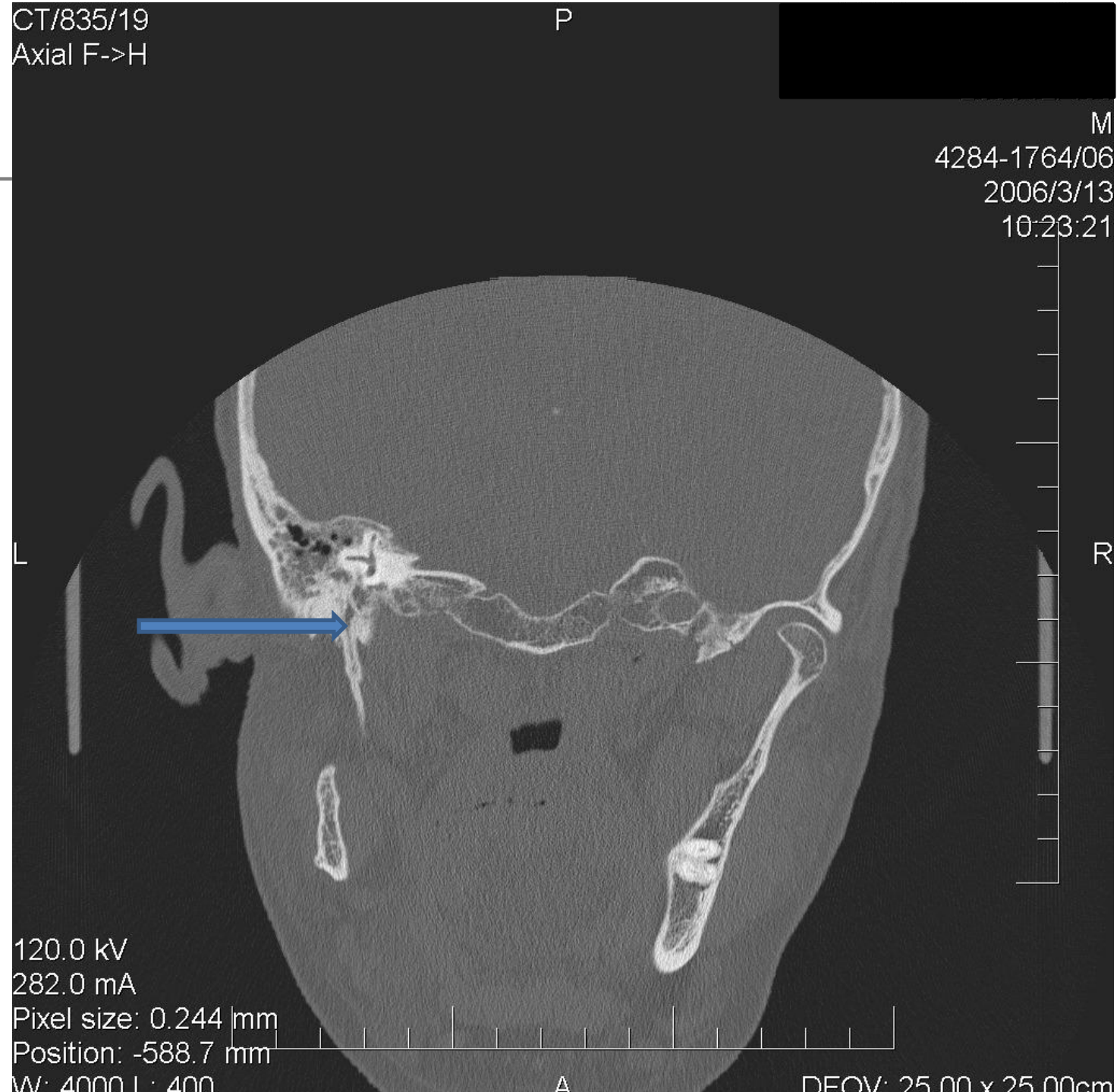
Canalis Fallopi



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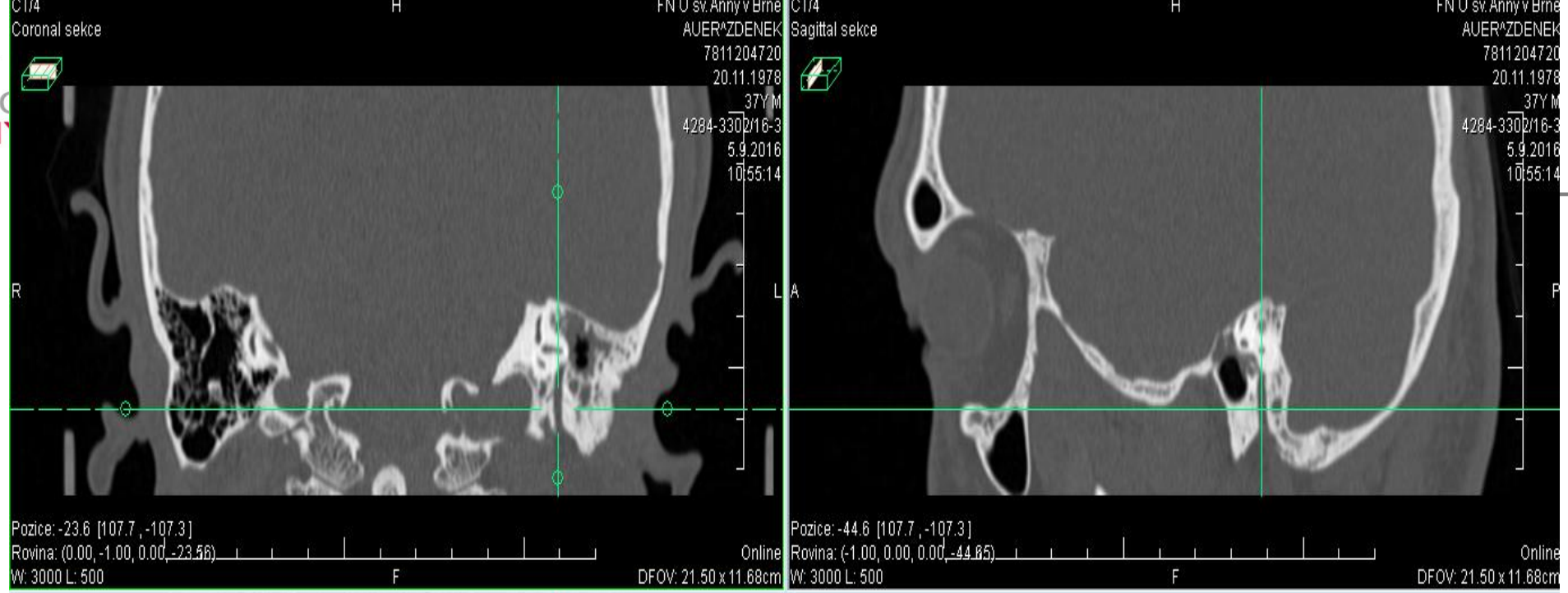

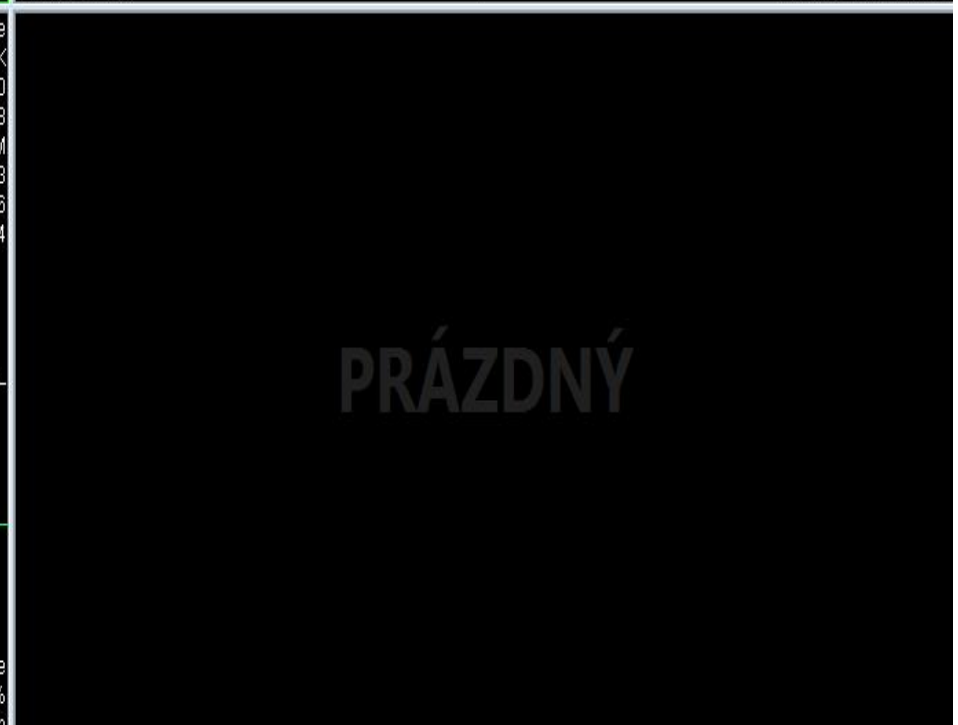

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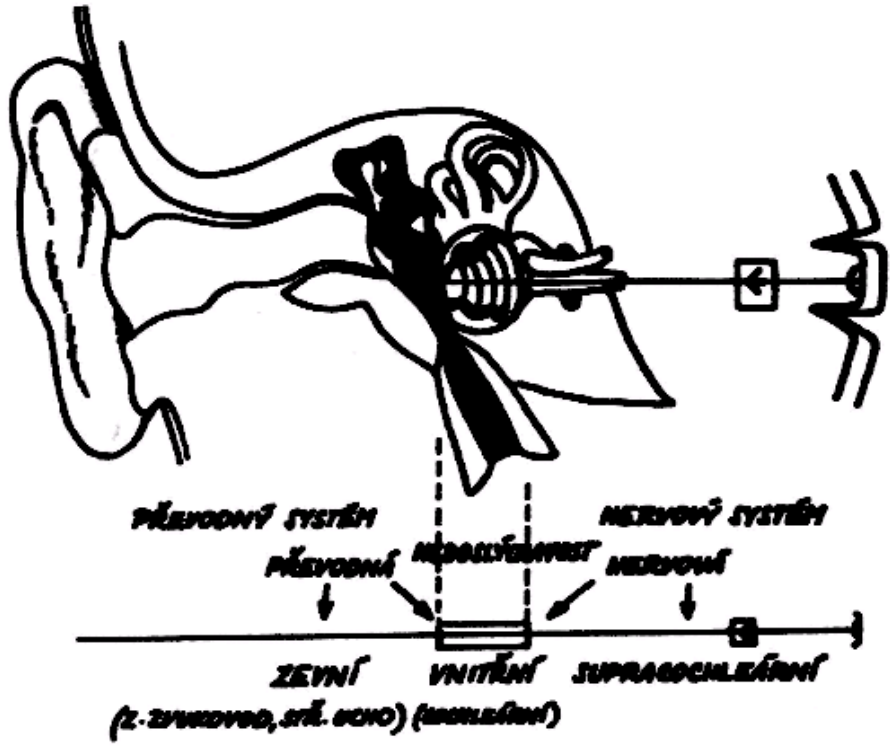
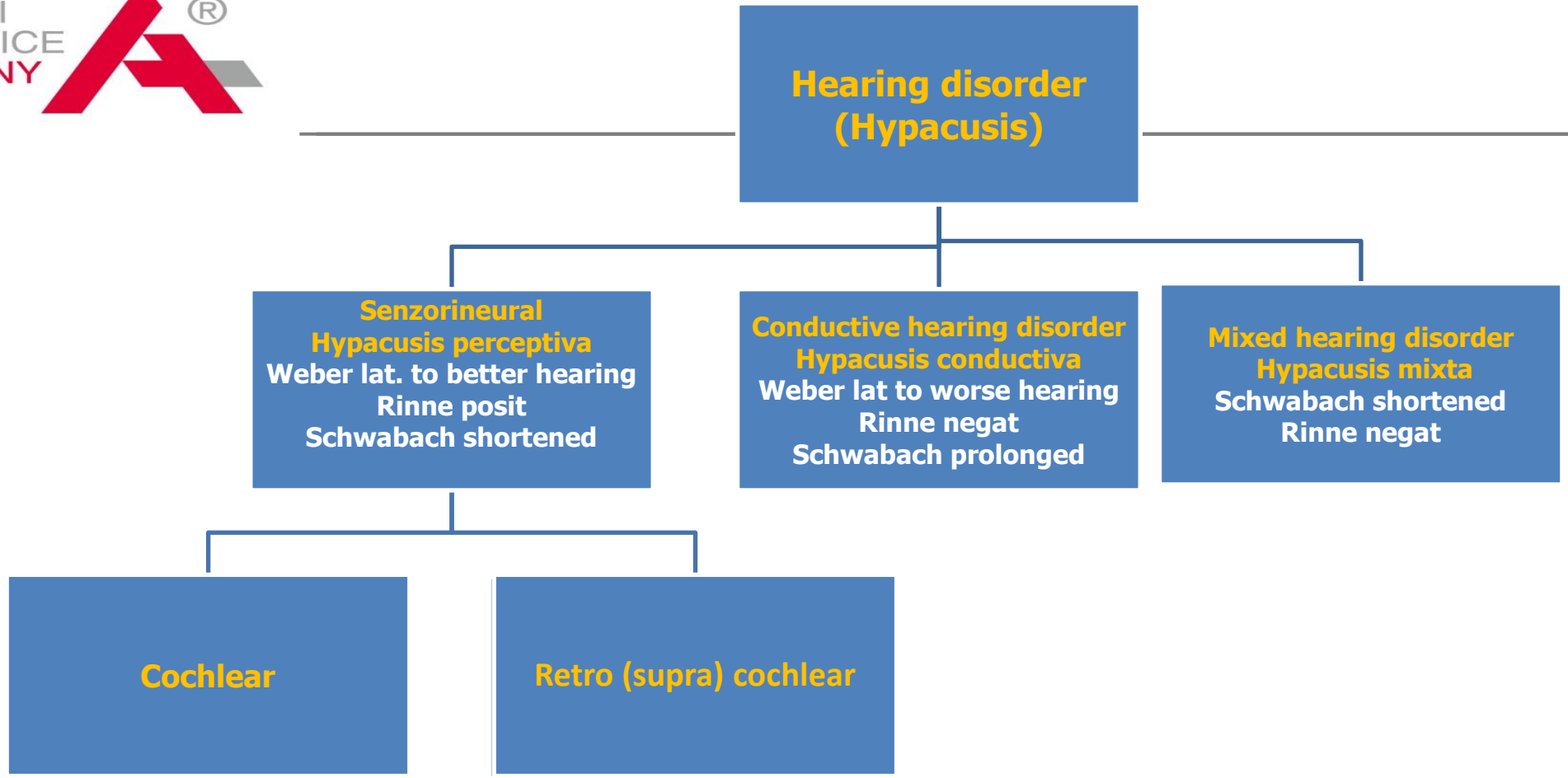
Hearing disorder according to place of lesion

- External ear – conductive hearing loss
- Inner ear sensorineural intracochlear hearing disorder
- Central pathways – retro cochlear hearing disorder



FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ



Classification of basic type of hearing dysfunction according to place of lesion

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Evaluation of hearing function

We evaluate on growing level of objectivity:

- „Classical“ hearing test
- Audiometry
- Objective evaluating methods
  - tympanometry
  - evoked potentials
  - otoacoustic emissions

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Classical hearing test (speech test, tuning fork tests)

Important part of hearing tests:

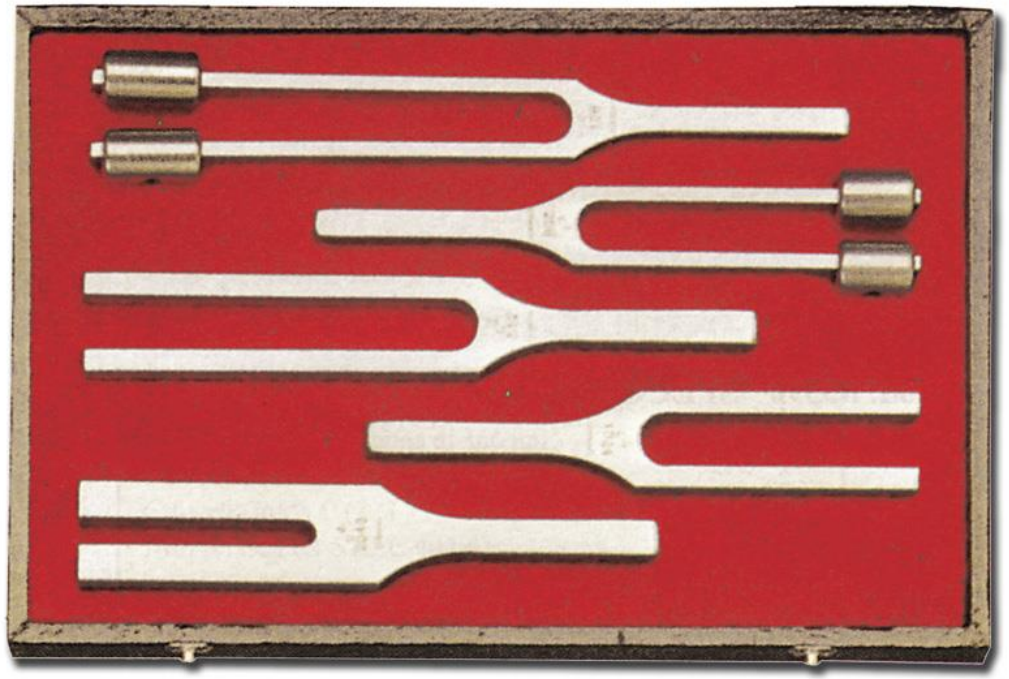
+ quick, easy, cheap, information about understanding speech

– only for orientation

Tuning fork tests:

- **Rinne**
- **Weber**
- Schwabach,

  Gellé, …



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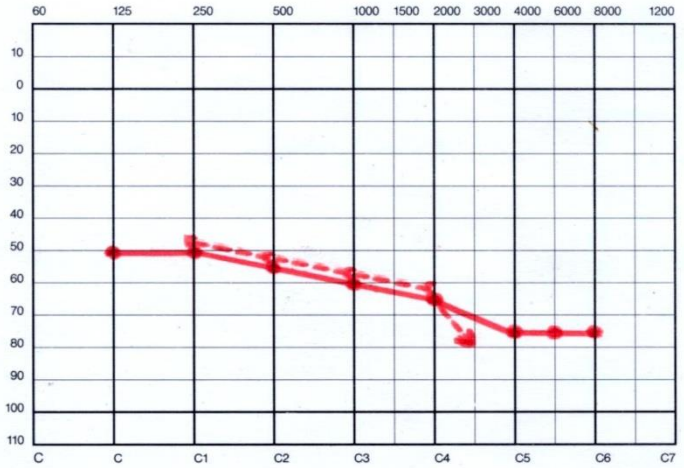
Basic types of hearing disorder

P		L
4	V	10
O,5	Vs	10
	W	
+	R +	
zkr.	Sch	norm



Hypacusis perceptiva (Sensorineural deafness)

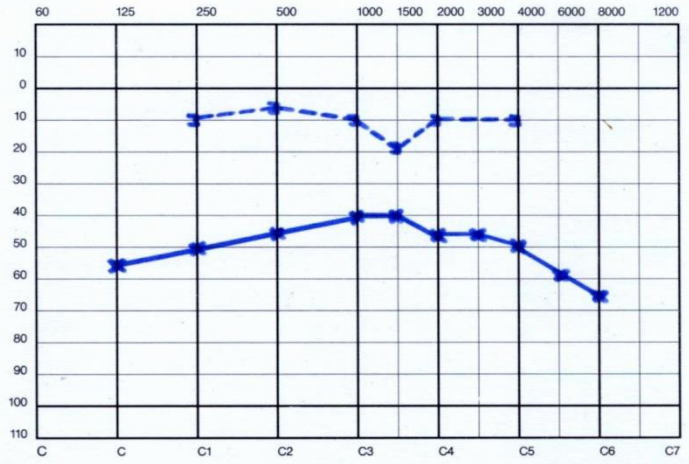
Weber unto better hearing ear

Rinne posit

Schwabach shorter

Retrocochlear

P		L
4	V	10
3	Vs	10
	W	
—	R +	
prod.	Sch	norm.



Hypacusis conductiva (Conductive hearing loss)

Weber unto worse hearing ear

Rinne negat

Schwabach longer

Hypacusis mixta (Mixed hearing loss)

Schwabach shorter

Rinne negat.

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Pure-tone audiometry

An audiometer is an electric tone generator used to determine the **hearing threshold** for pure tones; generates tones of specific frequency (Hz) and intensity (dB).

- audiometric room
- Air conduction:

  → headphones
- Bone conduction:

  →bone vibrator

Normal range – until 20 dB loss

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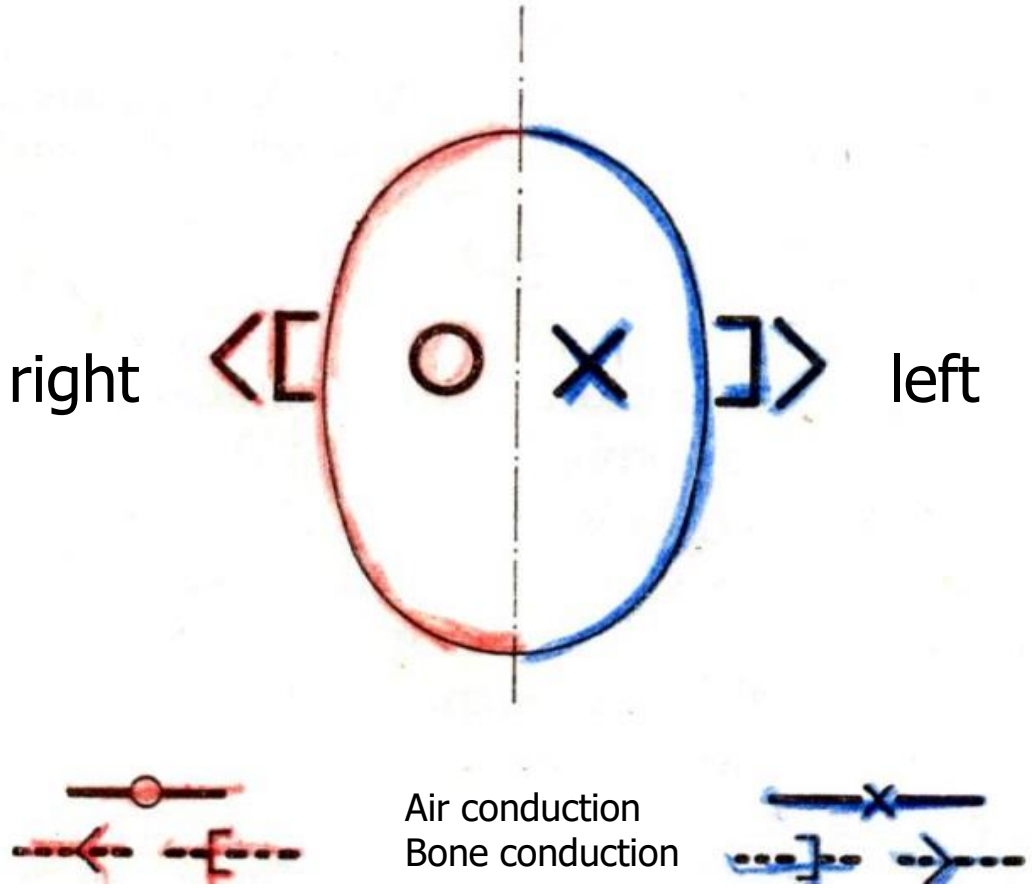
Symbols for record of audiometric evaluation



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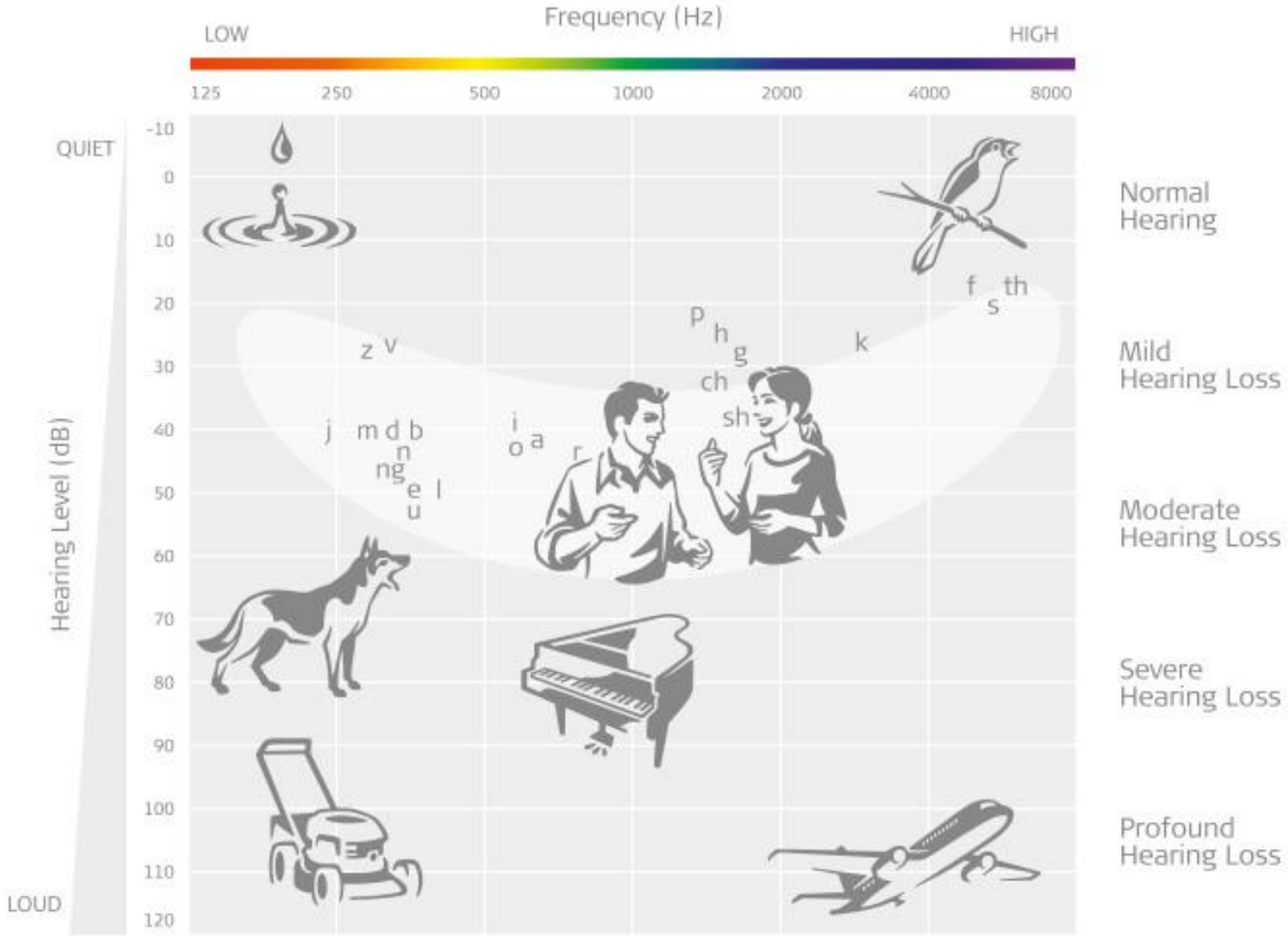
The speech field

Region of the best sensitivity for hearing



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Razítko ústavu:

AUDIOGRAM

Číslo 1– 5. dubna 2004

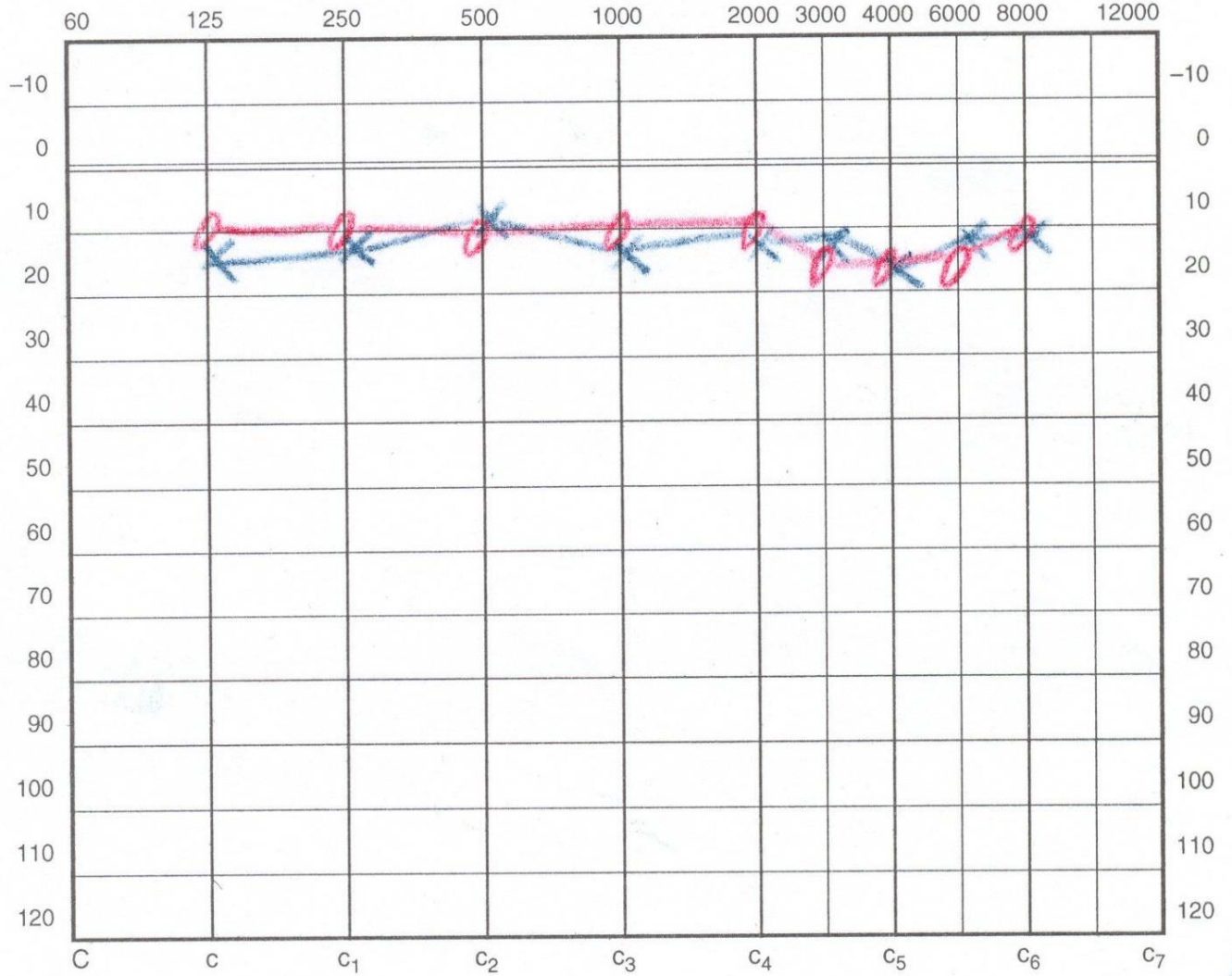
111

Jméno: ..... Dne ... / ... 20 ...

Bydliště: Adamov rodné č.: .....

Srovnání hlasitosti

Ztráta sluchu v decibelech



Audiometr

AL-40

Č. ambulant. protokolu

.....

Vedení	vzduchem	kostí
Vpravo	– o –	[
Vlevo	– x –	]

	Vpravo	Vlevo
Ztráta sluchu v %		
Celk. ztráta v %		

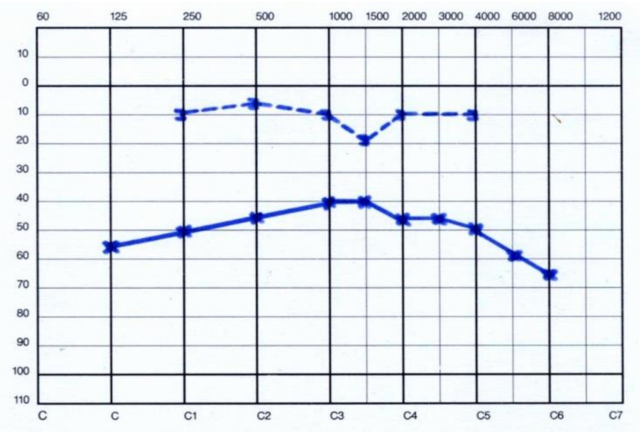
Poznámky: .....

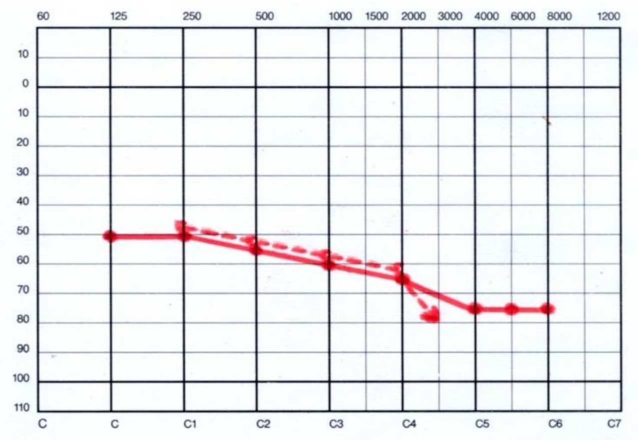
Jan I

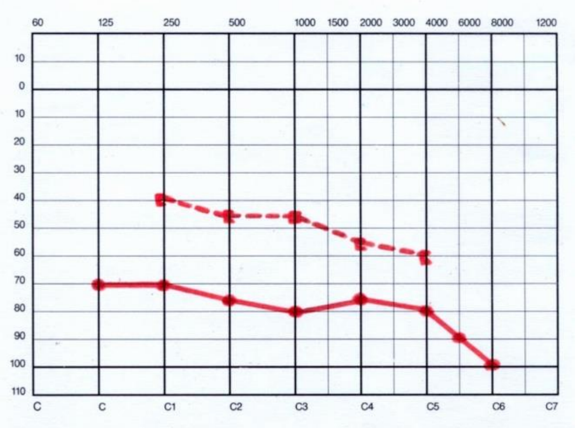
podpis

Hearing loss (Hypacusis)

Conductive Sensorineural Mixed







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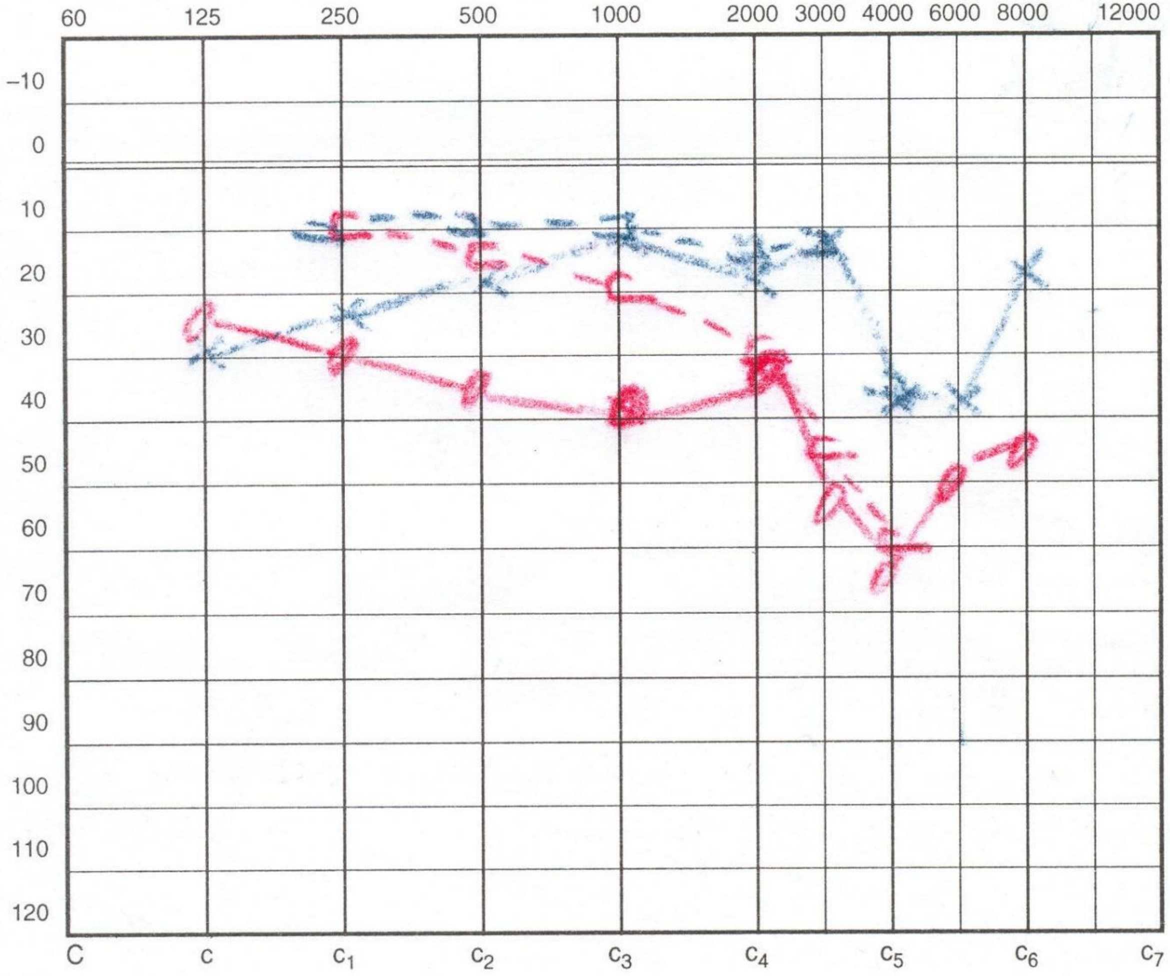

AUDIOGRAM

Číslo – 6. dubna 2004

Razítko ústavu: (111)

Jméno: ...

Dne / / 20..

Bydliště: IVANČICE

rodné č.: ...

Audiometr AC-40

Č. ambulant. protoko

Srovnání hlasitosti

Ztráta sluchu v decibelech

Vedení	vzdu-chem	kost
Vpravo	– o –	[
Vlevo	– x –	]

	Vpravo	Vlev
Ztráta sluchu v %		
Celk. ztráta v %		

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Poznámky: ...

podpis

FAKULTNÍ NEMOCNICE U SV. ANNY V BRNĚ

Razítko ústavu:

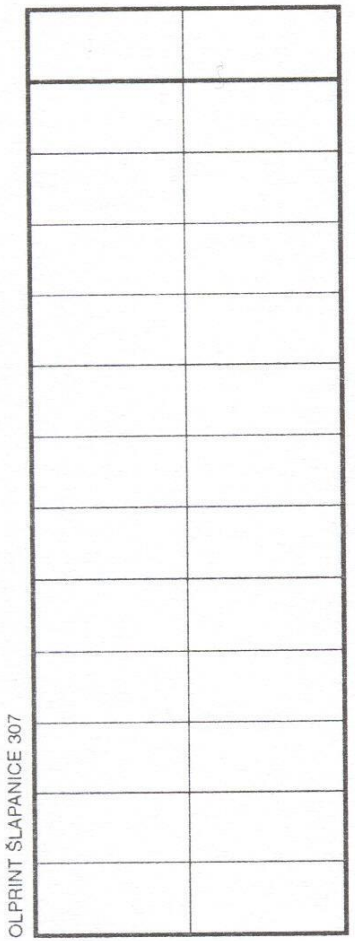
AUDIOGRAM

Číslo

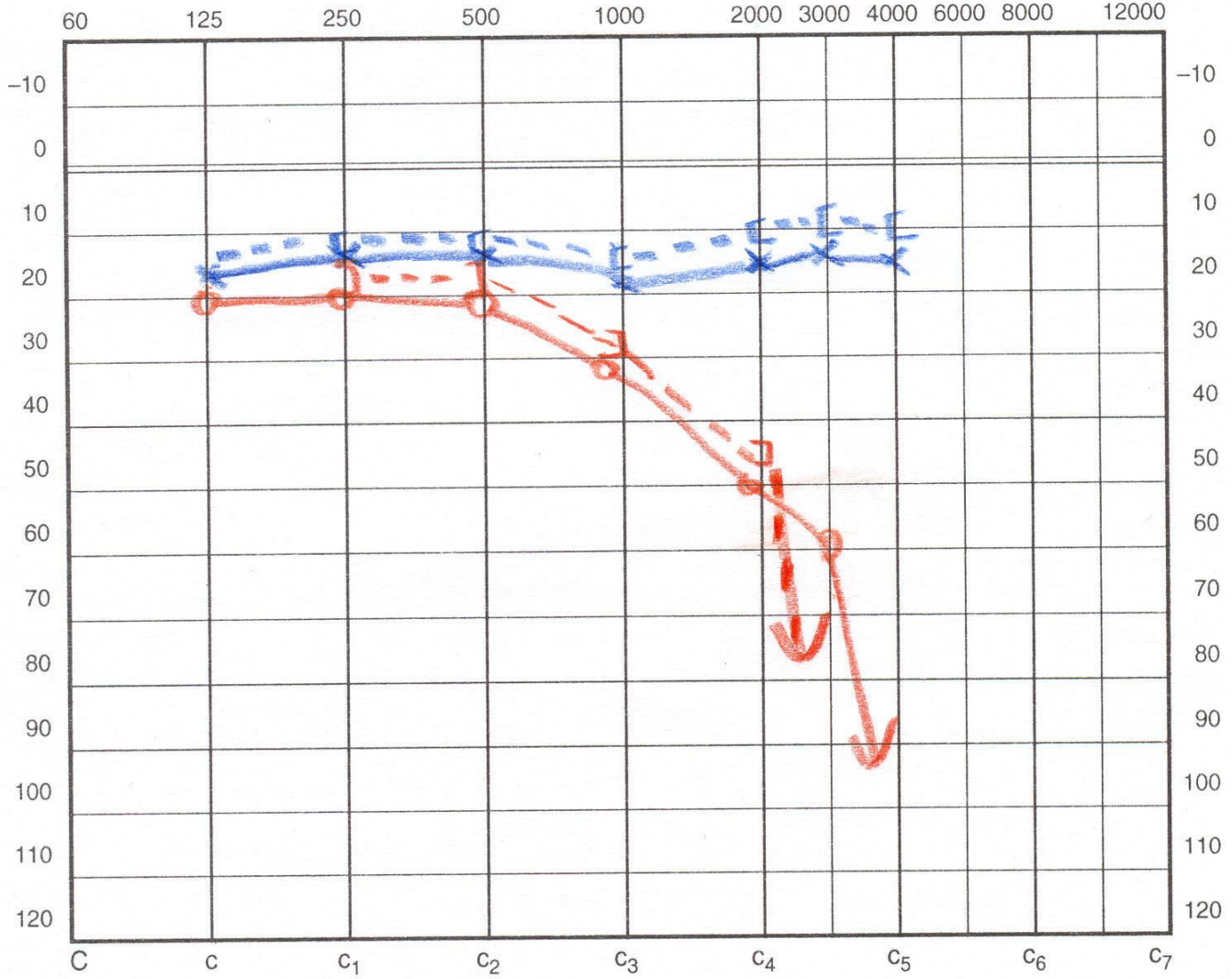
Jméno: ..... Dne ... / ... 20 ...

Bydliště: ..... rodné č.: .....

Srovnání hlasitosti



Ztráta sluchu v decibelech



Audiometr .....

Č. ambulant. protoko .....

Vedení	vzdu-chem	kost
Vpravo	– o –	[
Vlevo	– x –	]

	Vpravo	Vlev
Ztráta sluchu v %		
Celk. ztráta v %		

Poznámky: .....

..... podpis

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FAKULTNÍ NEMOCNI U SV. ANN V BRNĚ

Razítko ústavu:

111

AUDIOGRAM

KILAN

Číslo 2 8. března 2004

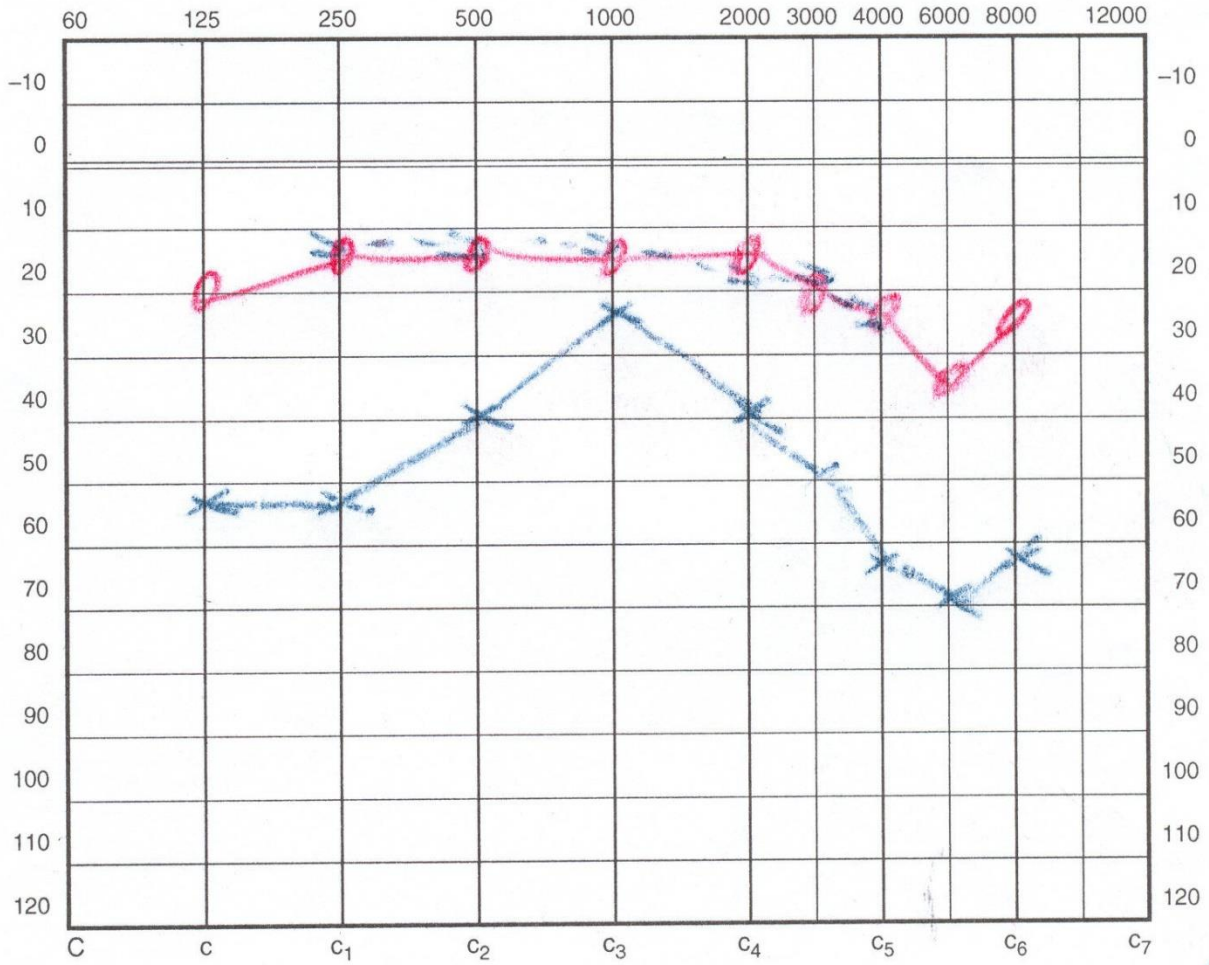
Jméno:

Dne / 20

Bydliště: BRNO rodné č.:

Srovnání hlasitosti

Ztráta sluchu v decibelech



Audiometr AC-40

Č. ambulant. protokolu

Vedení	vzdu-chem	kostí
Vpravo	– o –	[
Vlevo	– x –	]

	Vpravo	Vlevo
Ztráta sluchu v %		
Celk. ztráta v %		

Poznámky:

Kilián

podpis

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FAKULTNÍ NEMOCNI U SV. ANN V BRNĚ

Razítko ústavu:

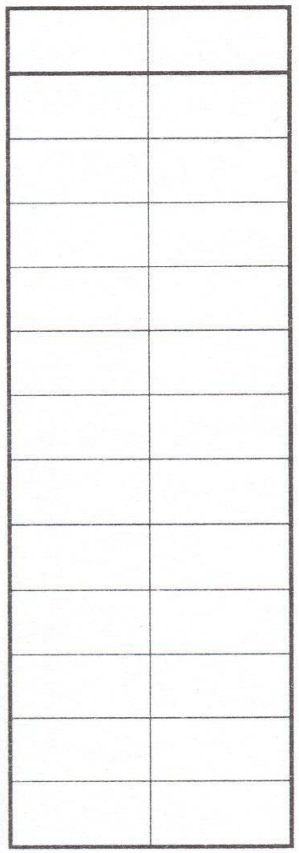
AUDIOGRAM

Číslo

Jméno: ..... Dne ... / ... 20 ...

Bydliště: ..... rodné č.: .....

Srovnání hlasitosti



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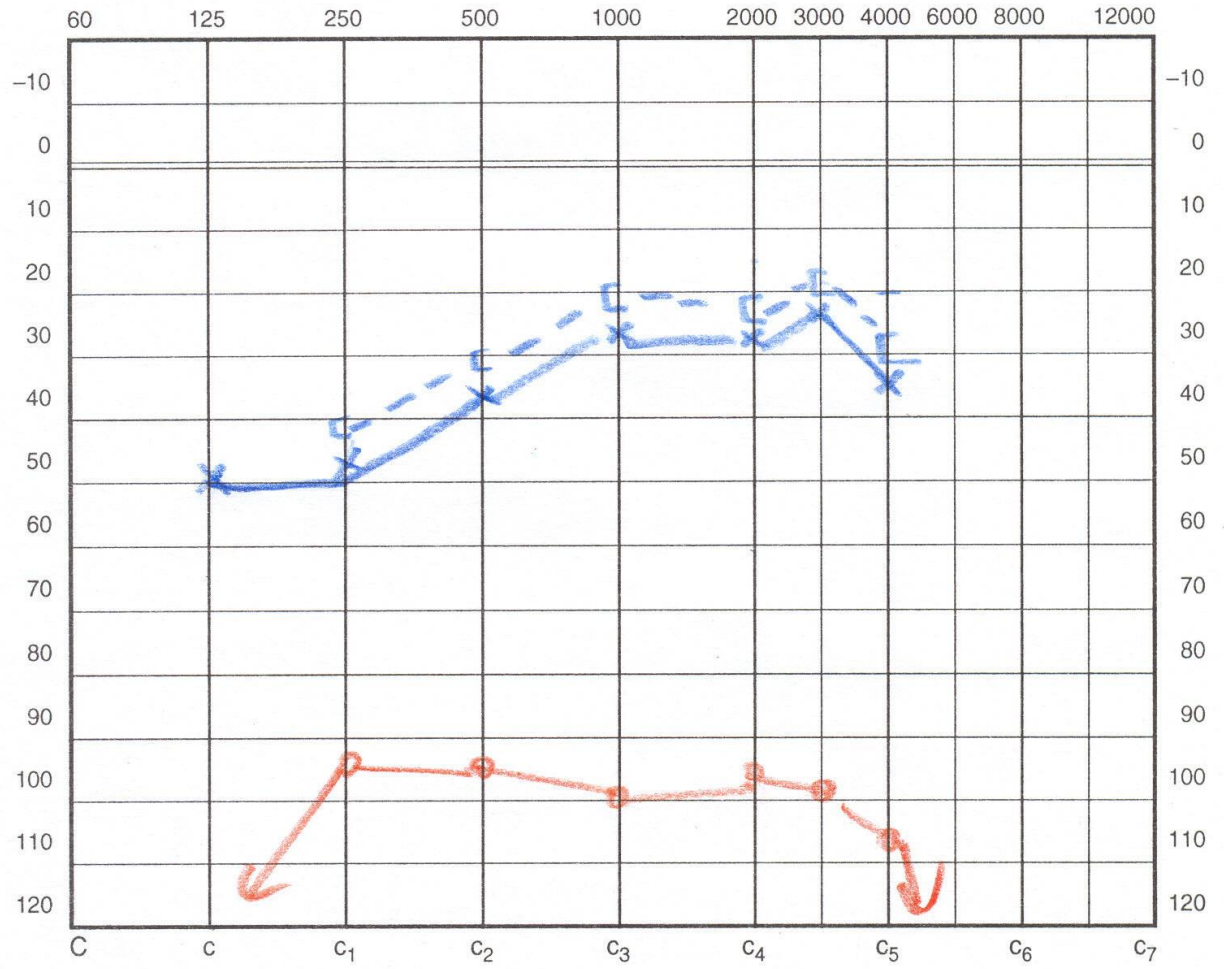

Audiometr

..... Č. ambulant. protokolu .....

Vedení	vzdu-chem	kostí
Vpravo	– o –	[
Vlevo	– x –	]

	Vpravo	Vlevo
Ztráta sluchu v %		
Celk. ztráta v %		

Poznámky: .....

.....

..... podpis

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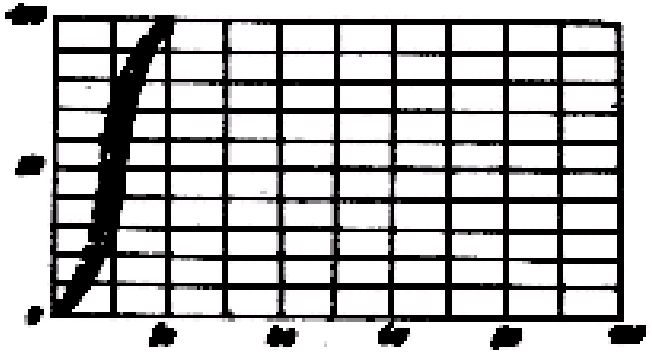
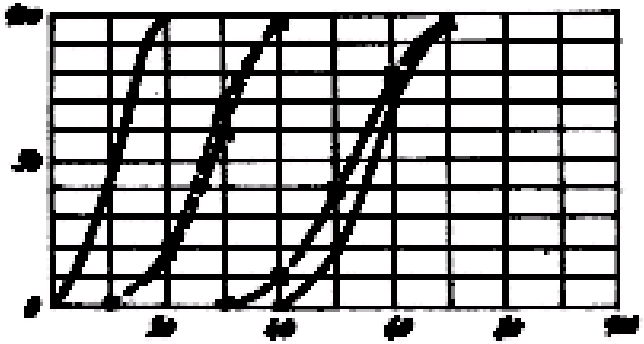
Speech audiometry

Patient repeats words which are reproduced. One correctly repeated word means 10% of comprehension from one set. It is evaluated on increasing levels of intensity till 100% of comprehension or maximally possible per cent of comprehension.

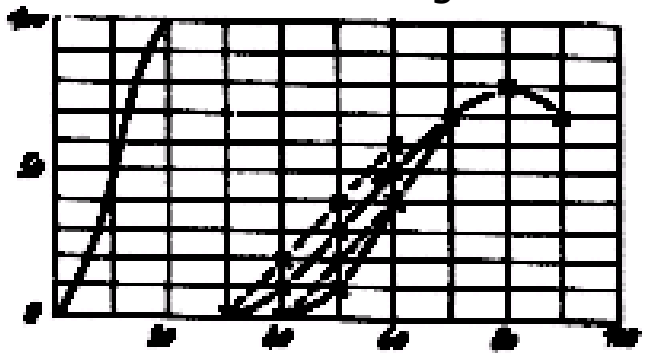
Normal hearing



Conductive hearing loss



Sensorineural hearing loss



Comprehension in %

Speech sound level in %

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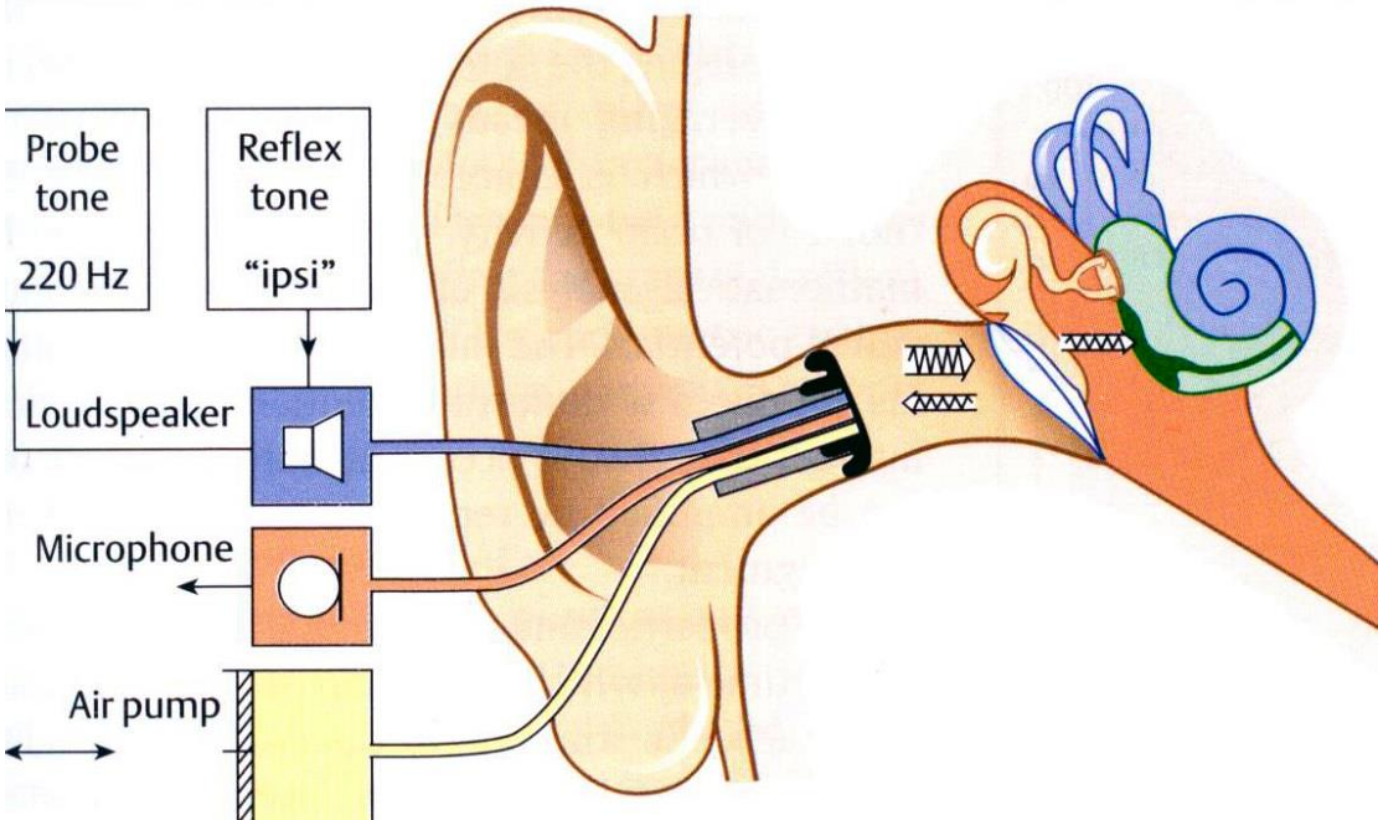
Tympanometry

The greater the pressure differential (before and behind ear drum), the greater is the impedance of tympanic membrane and **more acoustic energy is reflected back** into external meatus. The level of testing tone in meatus is measured by sensitive microphone .



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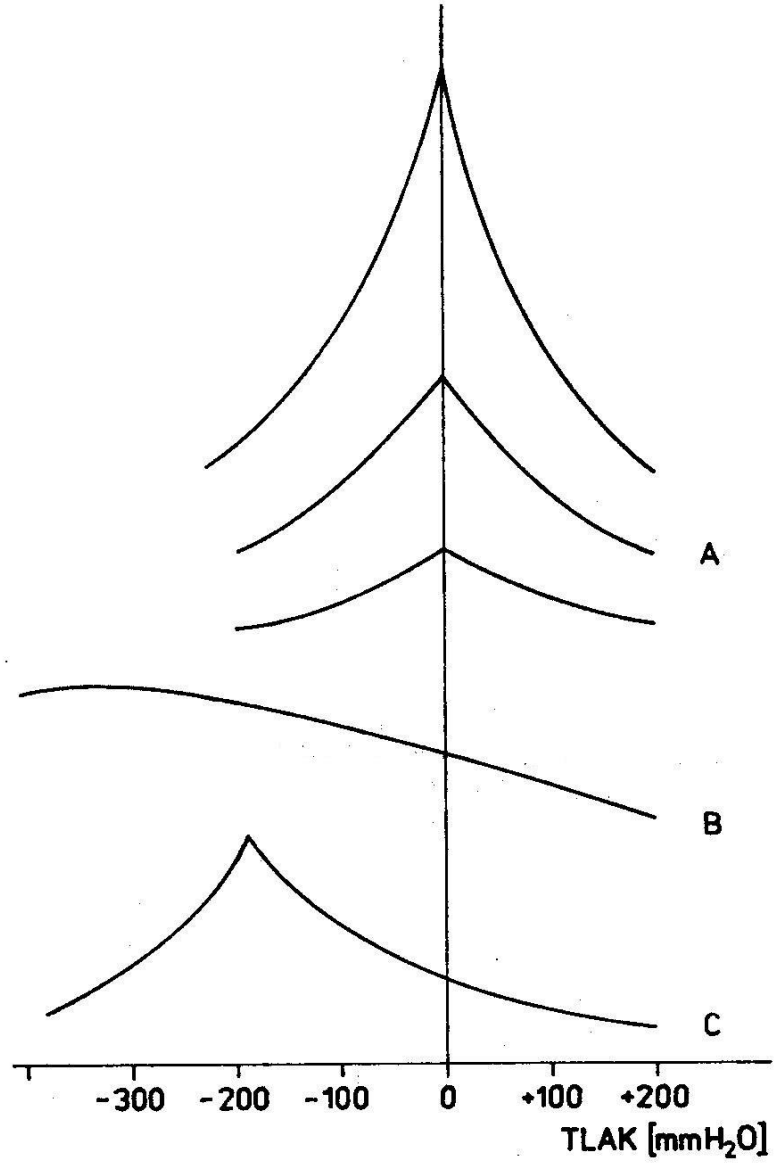
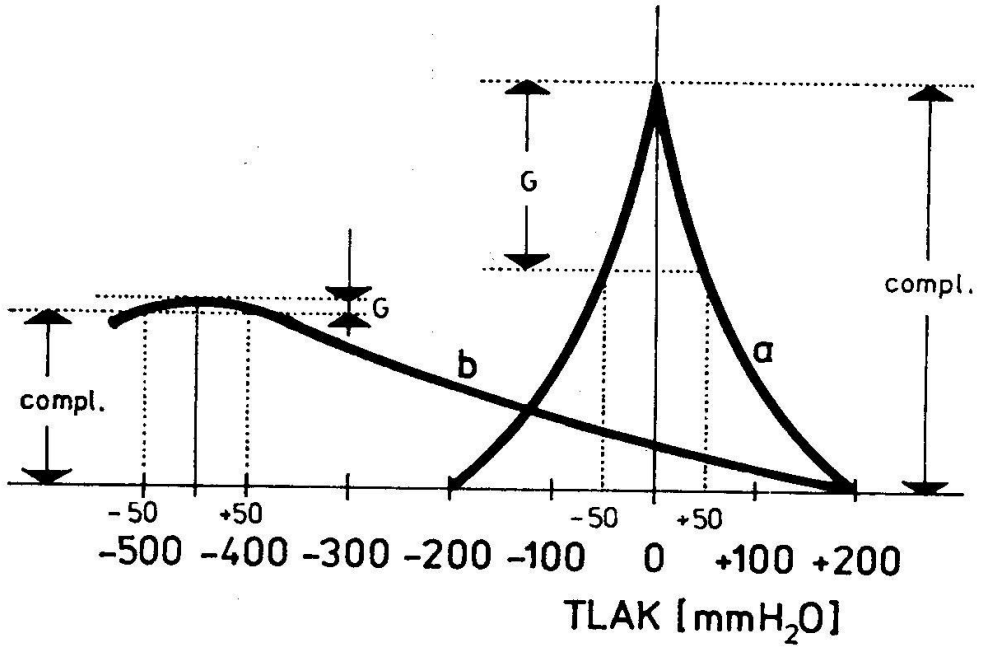
Tympanometry





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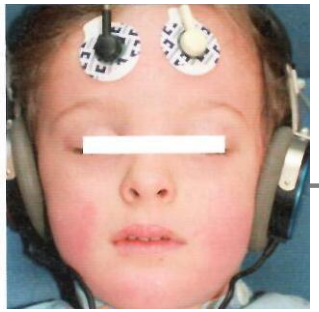
Evoked response audiometry (ERA)



- Human brain works with bioelectric impulses, not sound.
- bioelectric impulses could be measured as an electric potential
- conditions: motoric and psychic rest of patient, camera silent, electric interference suppression of the room
- Patient repeatedly exposed to an acoustic stimulus, an EEG is recorded. **Averaging** – the individual response can be distinguished by mathematical analysis of numerous individual evoked potentials

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Evoked response audiometry (ERA)

- Cochlear potentials, electrocochleography (Ecochg): latency window 0-4 ms. Probe – in externeal meatus or on promontorium)
- Early potentials (brain stem, BERA): 10-12 ms.
- Middle potentials MERA (middle latency evoked response audiometry : 40-60 ms – suitable for processing (steady-state evoked potentials)
- Late potentials (cortical, CERA-cortical evoked response audiometry): to 200 ms. Before application CI or hearing aids.

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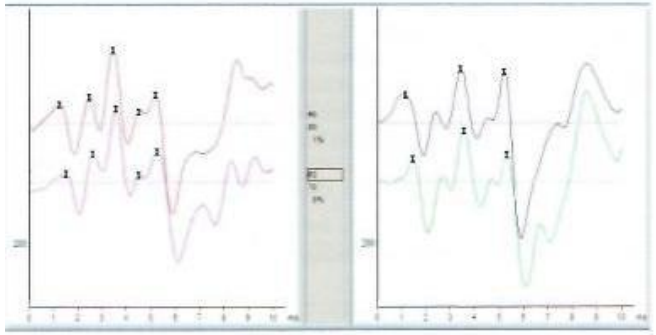
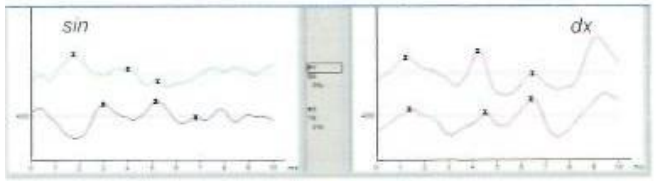
BERA, BAEP (brainstem auditory evoked potentials)

- Early potentials (brain stem, BERA): 10-12 ms.
- Complex 7 peaks, so called Jewett waves, most important I-III.
- Fixed elektrods temporal, occipital and referent forhead, given earphone
- Susp. rektrocochlear laesion – dysmorphy of Jewett complex, missing or shift of latency V wave.
- Senzitivity and specifity for dg vestib schwanoma 70-80 %



Sluchové kmenové potenciály (BERA). Normální nález. Označeny vlny I, III, V.



Sluchové kmenové potenciály (BERA). Retrokochleární léze vlevo (vestibulární schwannom). Dysmorfie Jewettových vln, posun latenci V5. V levém poli záznam z vyšetřovaného ucha, v pravém poli kontralaterální záznam.

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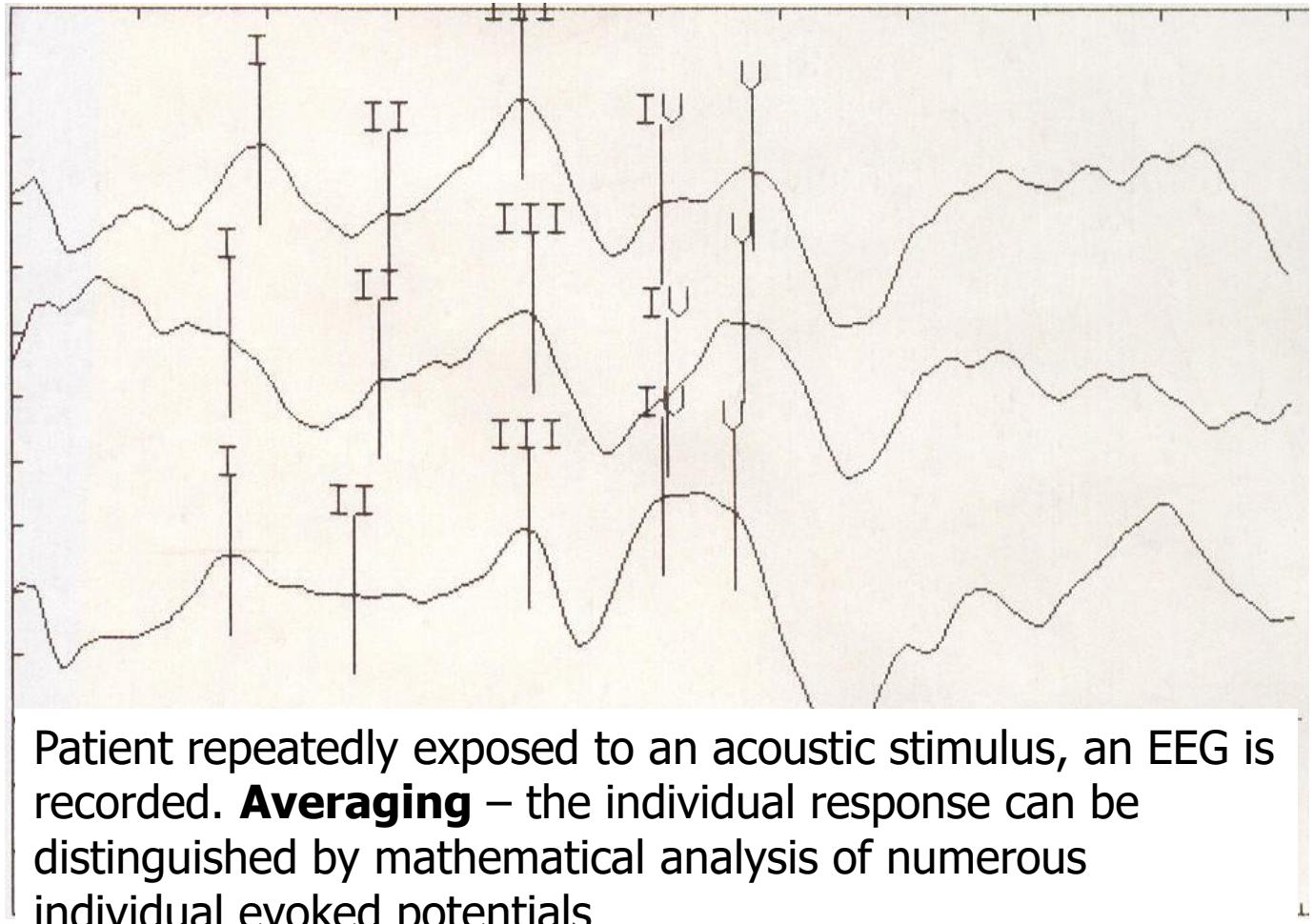
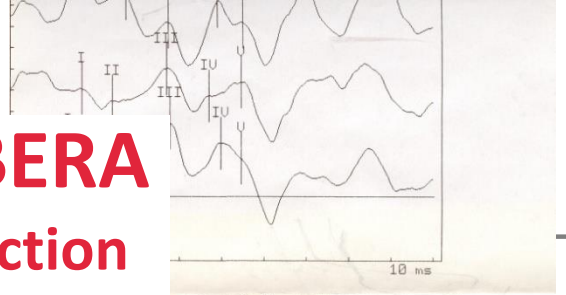
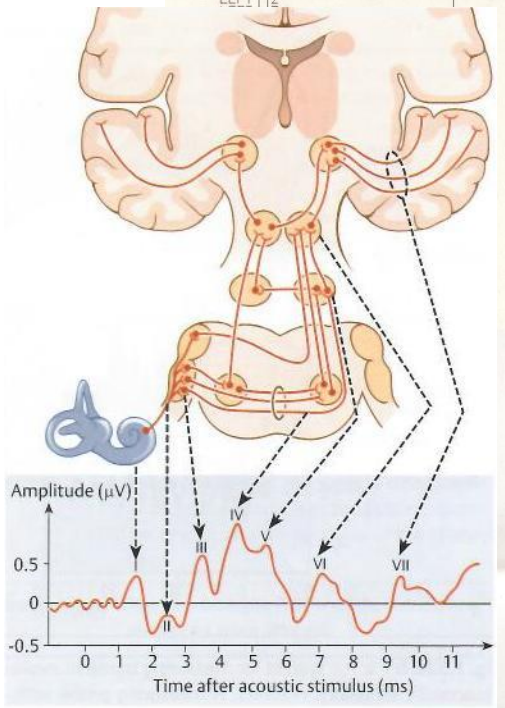
Auditory evoked potentials BERA

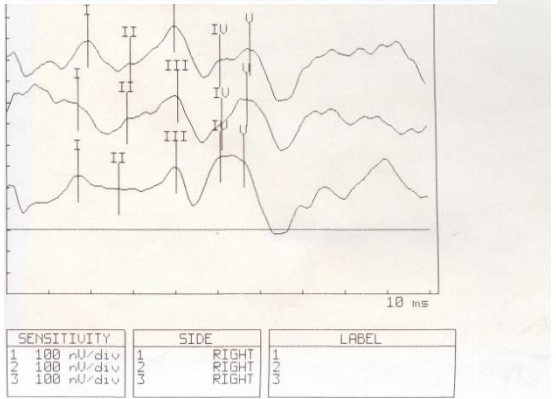
– prolonged latency of 0,2 ms – suspection on small schwanoma n. VIII



Patient repeatedly exposed to an acoustic stimulus, an EEG is recorded. **Averaging** – the individual response can be distinguished by mathematical analysis of numerous individual evoked potentials







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Middle potentials MERA

Steady-state evoked potentials (SSEP)

- Other names: ASSR (auditory steady-state responses), AMFR (amplitude modulated frequency responses) – processing of signals of middle electric response.
- Fully automatized
- Good correlation with pure tone audiometry
- Outcome of measurement – objective frequency – specified threshold audiometry, estimation audiogram

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Otoacustic emision (OAE)

- Sound result from spontaneous or provoked activity of outer hair sells organon Corti.
- Spontaneus OAE arise itself, sign of normal function of Corti organ, present in childhood
- Evoked OAE
  - **Tranziently evoked otoacustic emision** (TEOAE)- as response on acoustic stimulus
  - **Distors products** (DPOAE) – emission response on 2 simultaneous perceived tons of nearby freqency and intensity
- Usage newborn screening of hearing function and frequency specified determination of hearing threshold

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Sensorineural hearing loss

According to type of audiometry curve:

- Basocochlear
- Pankochlear
- Apicocochlear
- Mediocochlear

According to lesion localisation:

- Cochlear
- Retrocochlear

Cochlear lesion

- bothering, but not life threating

Retrocochlear lesion

- bothering, but also they could life threaten

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Sensorineural hearing loss (intra) cochlear

= damage of cochlear structures

Etiology:

- Presbyacusis
- Heredo-degenerative
- Nois damage
- Toxic damage
- Menier´s disease
- Acute sensorineural hearing loss

… etc.

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Sensorineural hearing loss
retro- (supra-) cochlear

= damage of structures proximal from cochlea

Etiology:

Demyelization	- atherosclerosis - sclerosis multiplex
Inflammation	- borreliosis - neuro-viruses - meningitis - meningoencephalitis
Tumors	-vestibular schwannoma - meningioma - other tumors of cerebellar angle
Trauma	- commotion, contusion - scull base fractures

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Differencial diagnosis cochlear/retrocochlear

1. **Subjective tests:**
   - time demanding
   - active cooperation of pt
   - complicated for understanding
   - relatively low validity

2. **Objective tests :**
   - time usually not so demanding
   - demand only passive patient cooperation
   - expansive technical equipment
   - high validity

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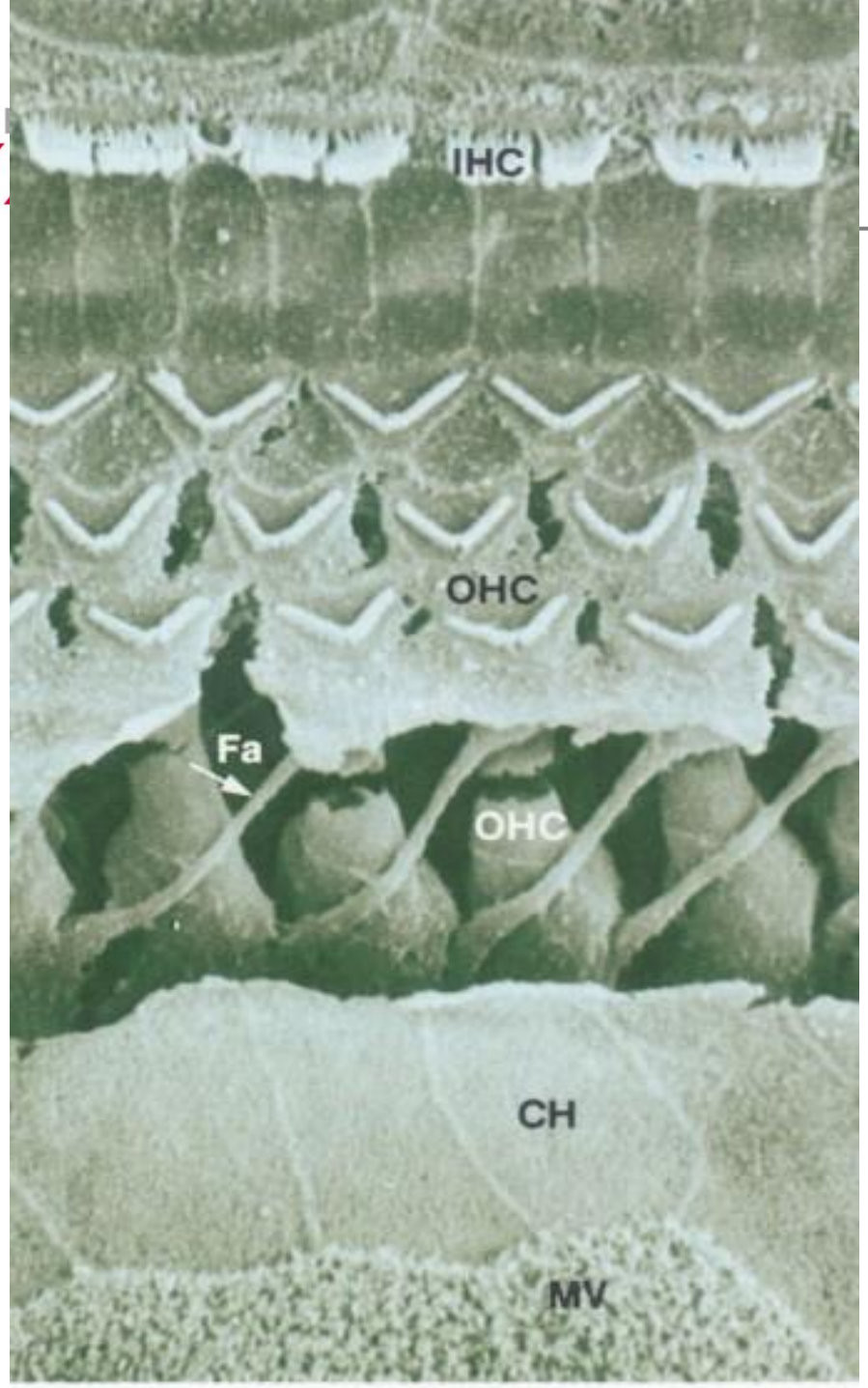
Subjective tests

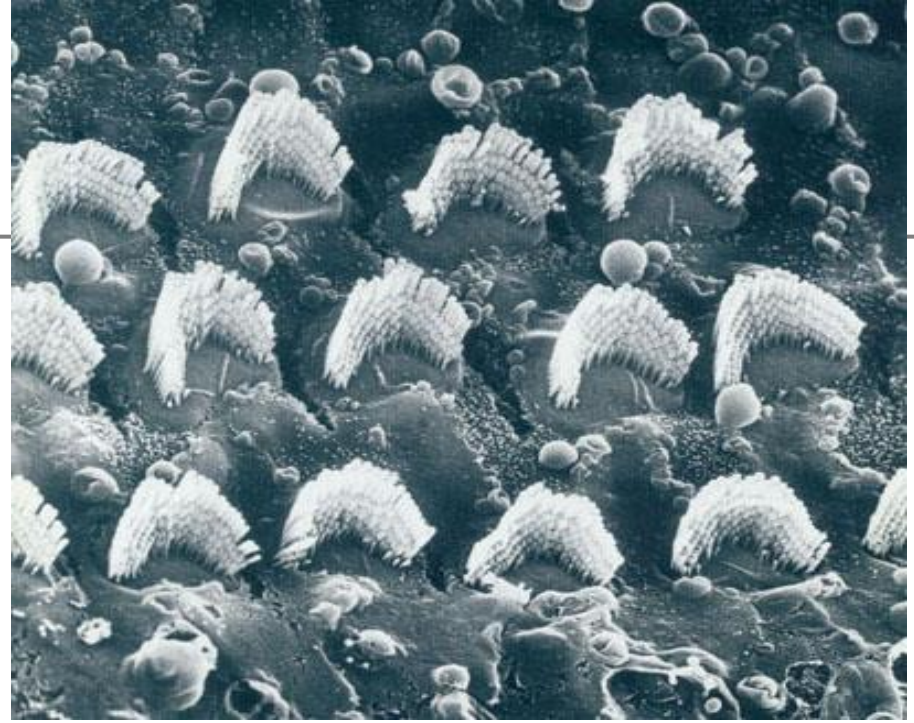
Based on proof of:

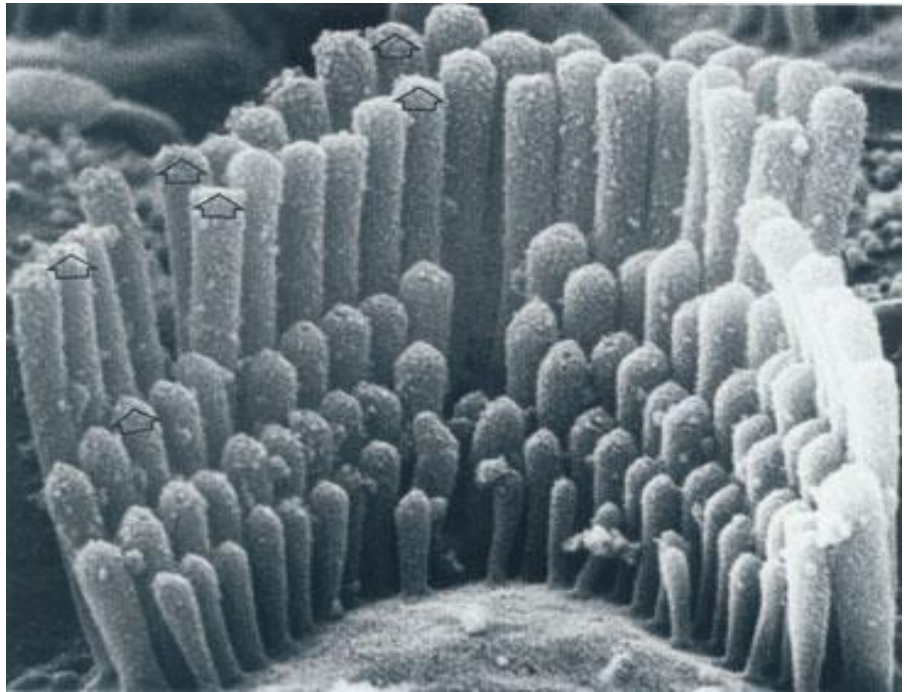
mask effect of noise

recruitment phenomena

wearisomeness of hearing organ


IHC
OHC
Fa
OHC
CH
MV





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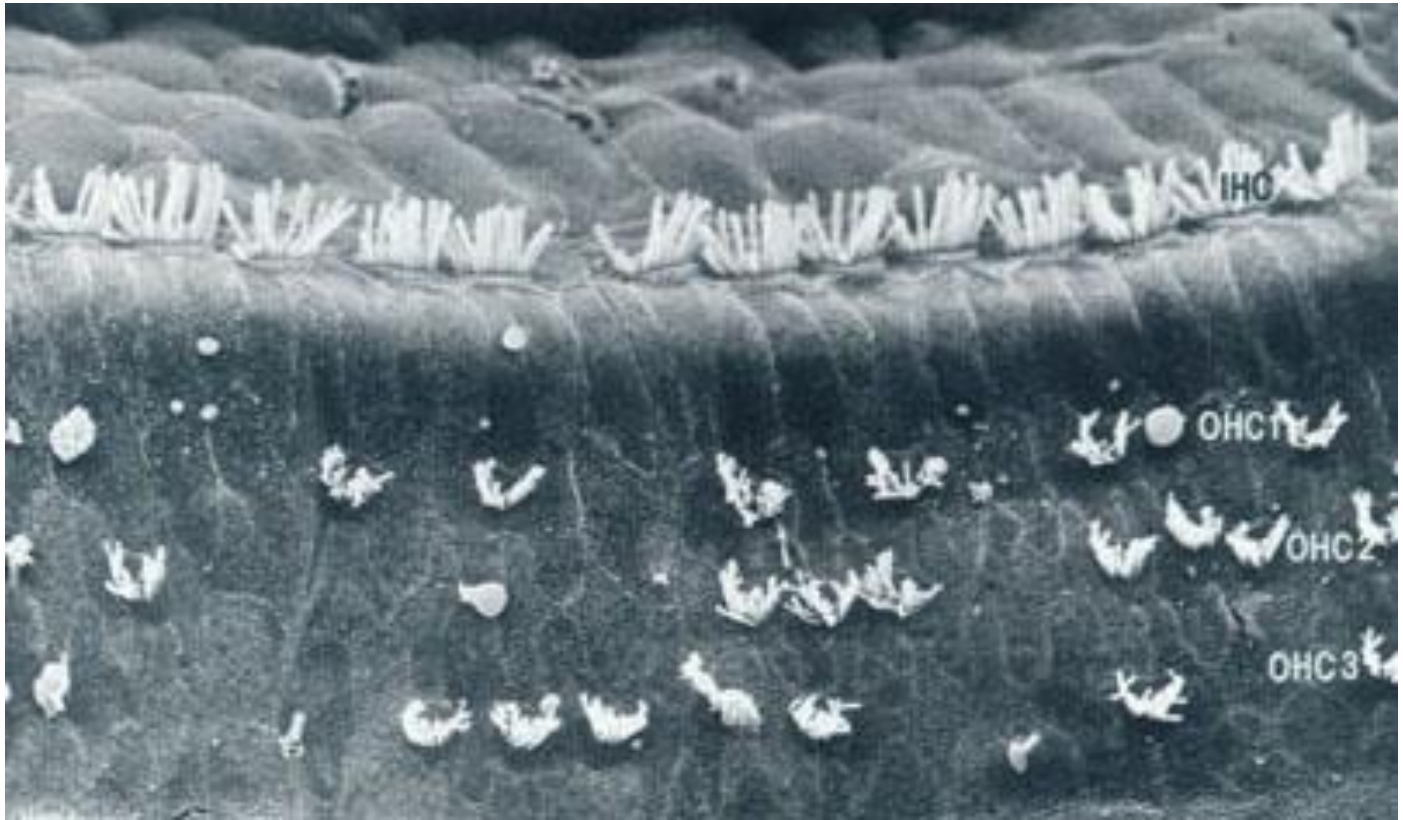
Recruitment phenomena

= abnormal increase of loudness in above-threshold in damage of OHC and normal function IHC.

Fowler test; convergence of perceptions



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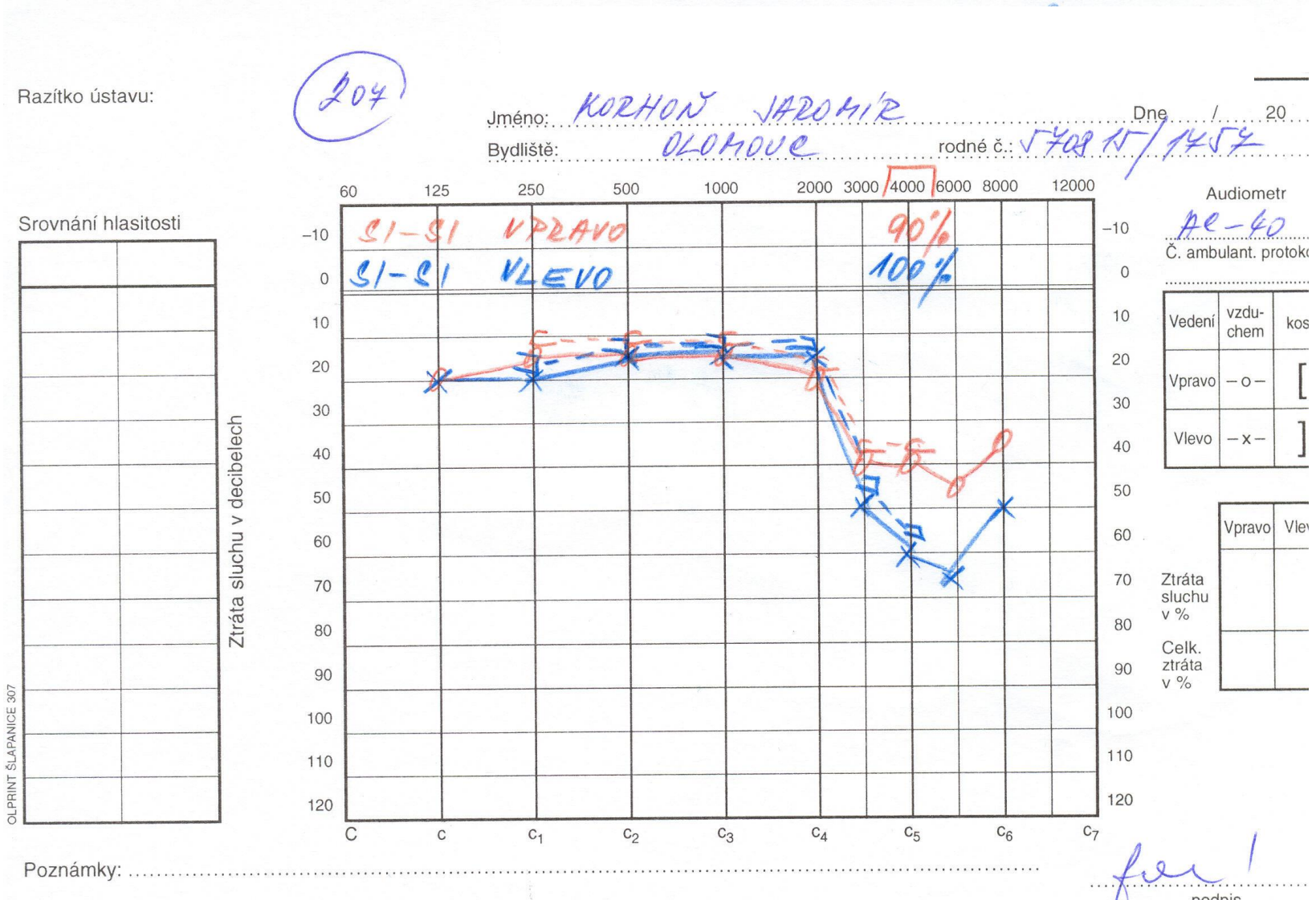
SI-SI Short Increament Sensitivity Index

short time 1 dB increase of intensity 20 dB above treshold (20x)

assuredly recognize



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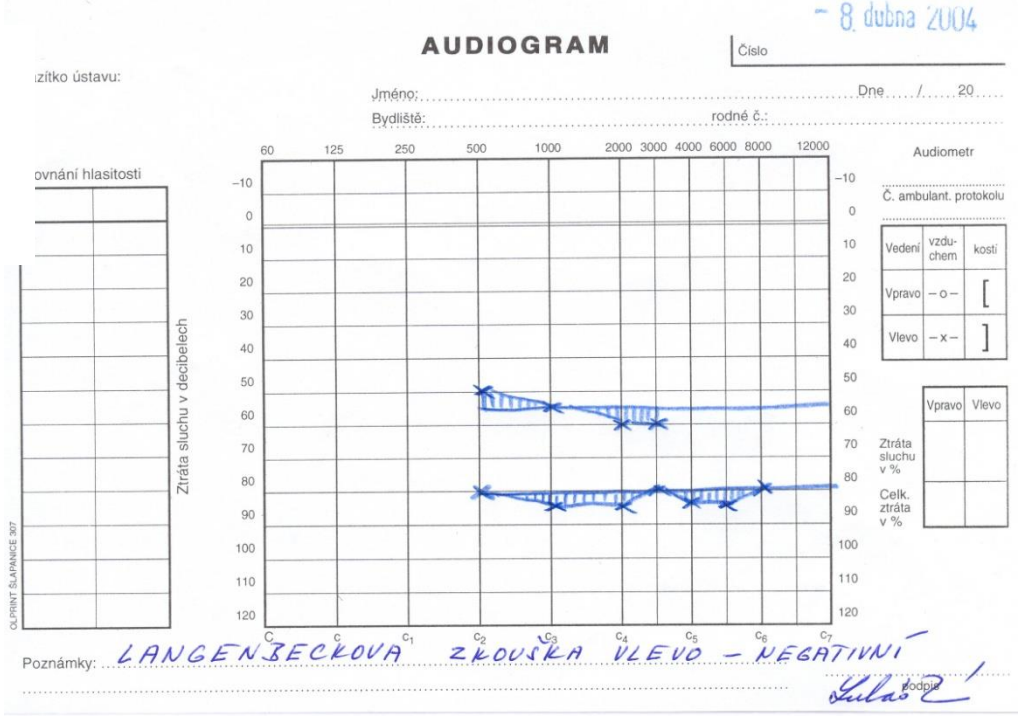
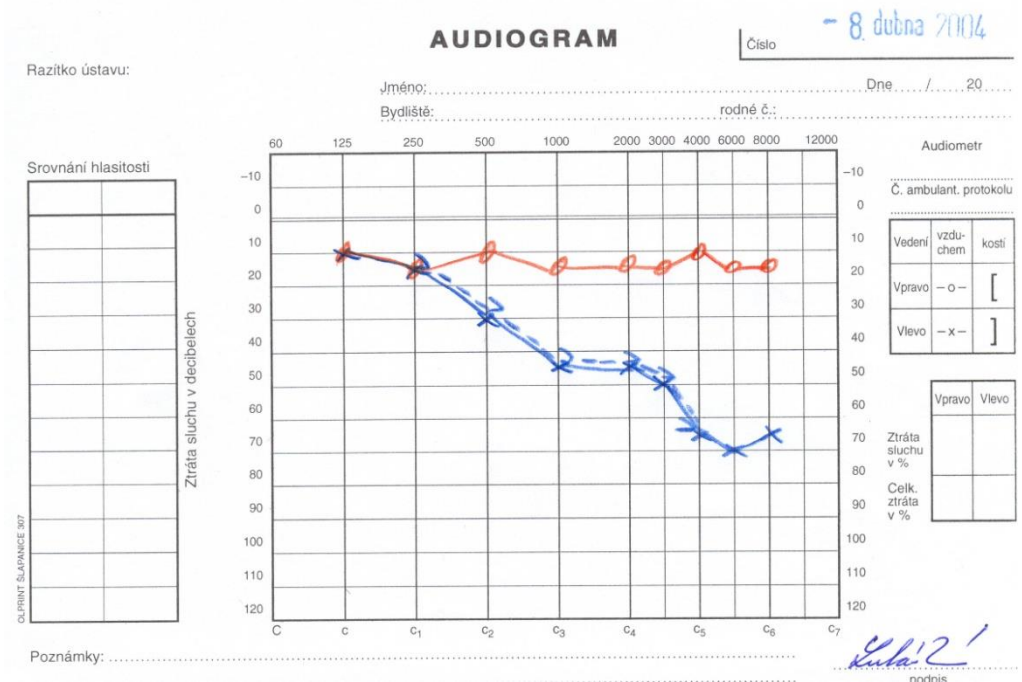
Noise audiometry

Langebeck test

= increase ability to mask tons by hum in supracochlear hearing loss. Thresholds are higher about more than 10 dB as level of ripple.





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Langebeck test

Supracochlear hearing loss