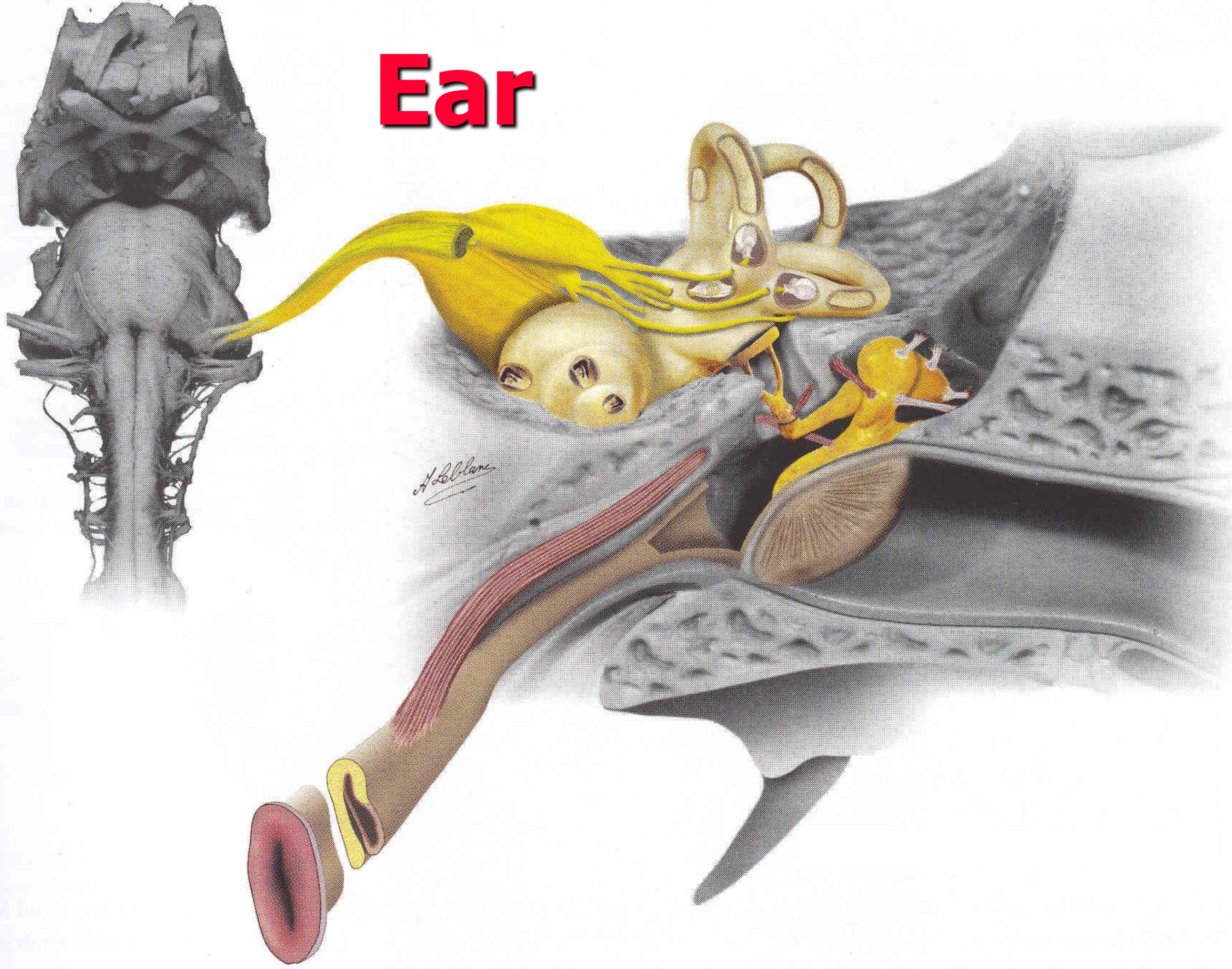


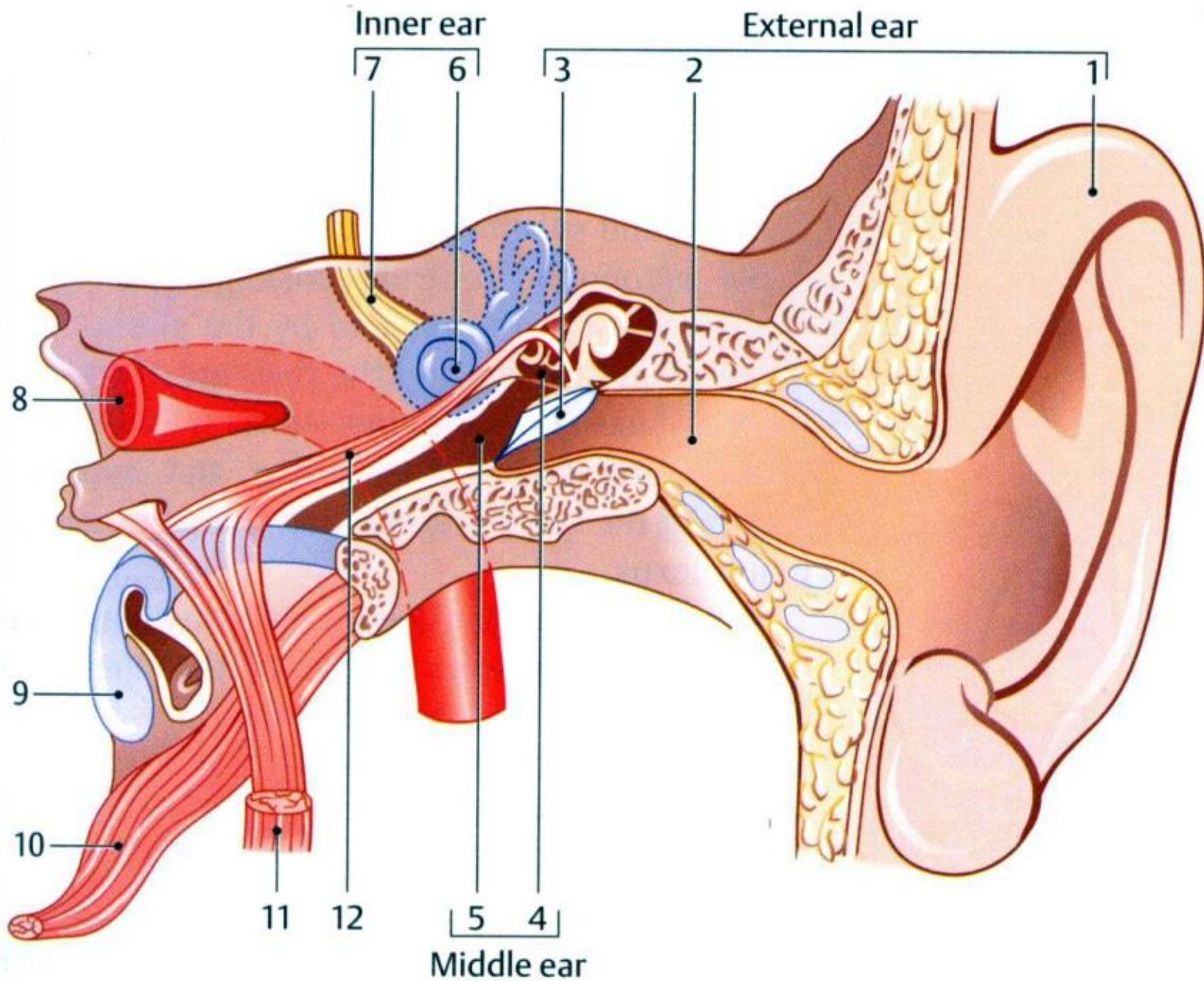
Literature:

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.

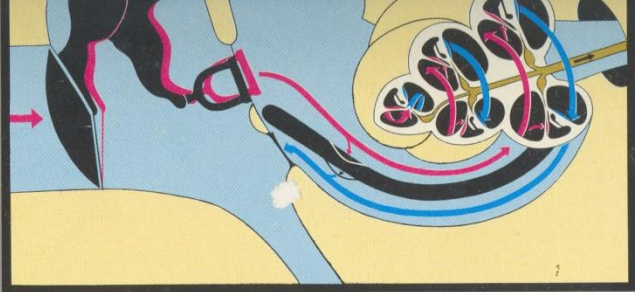
Med Servis Mgr. Jaroslava Wilhelmová, Všetičkova 29,
602 00 Brno. Tel./fax. 05/43241146 .

Ear

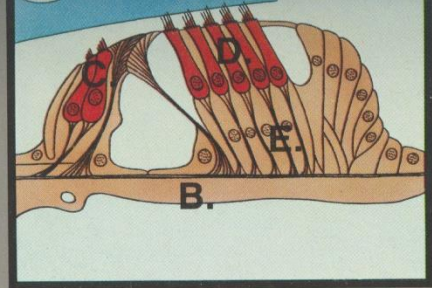




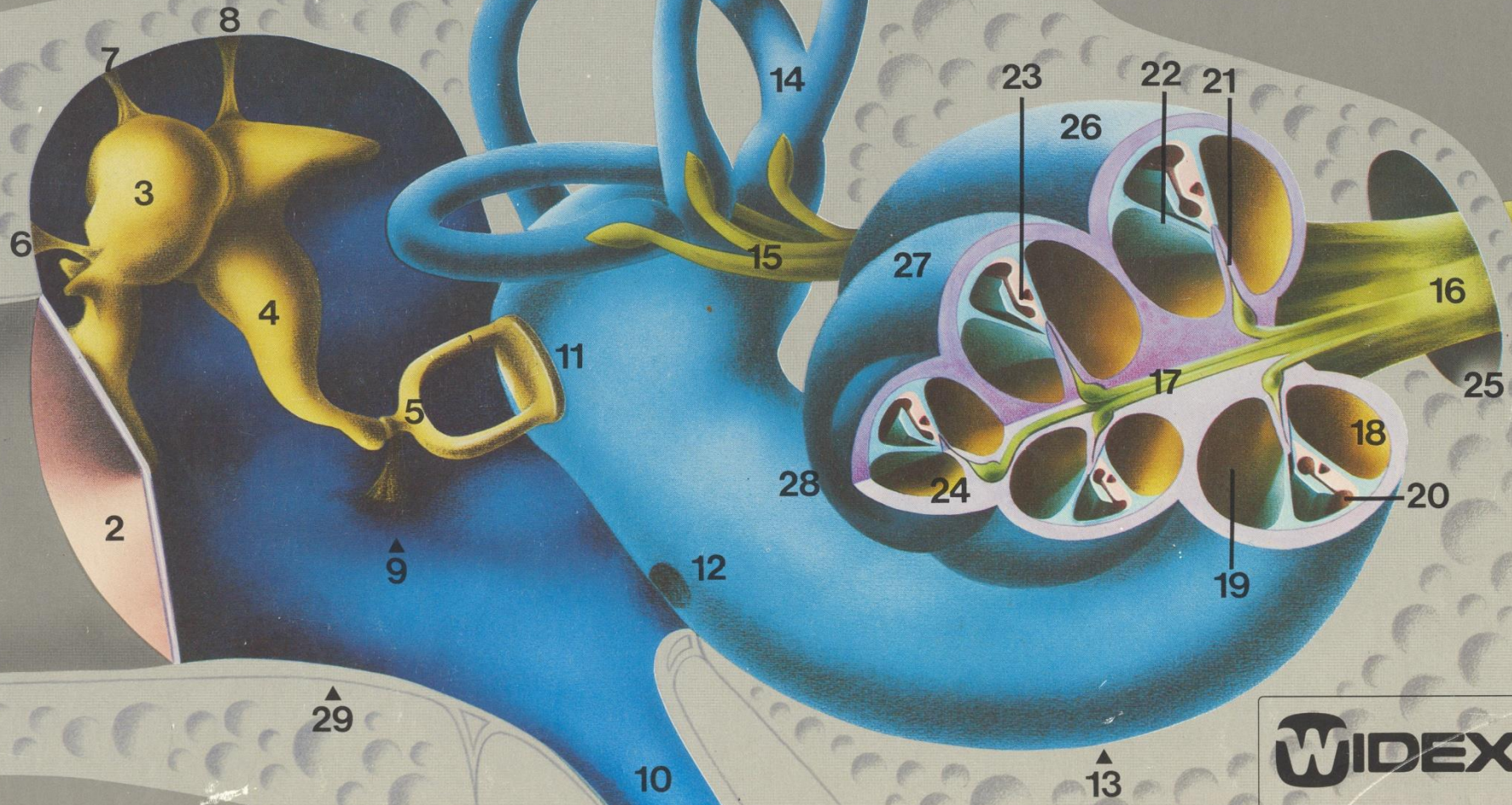
ossicles.
to the inner ear.
oval window are
the scala vesti-
ugh Reissner's
chlear duct and
ne to the scala
the round win-
with the oval win-
a second later

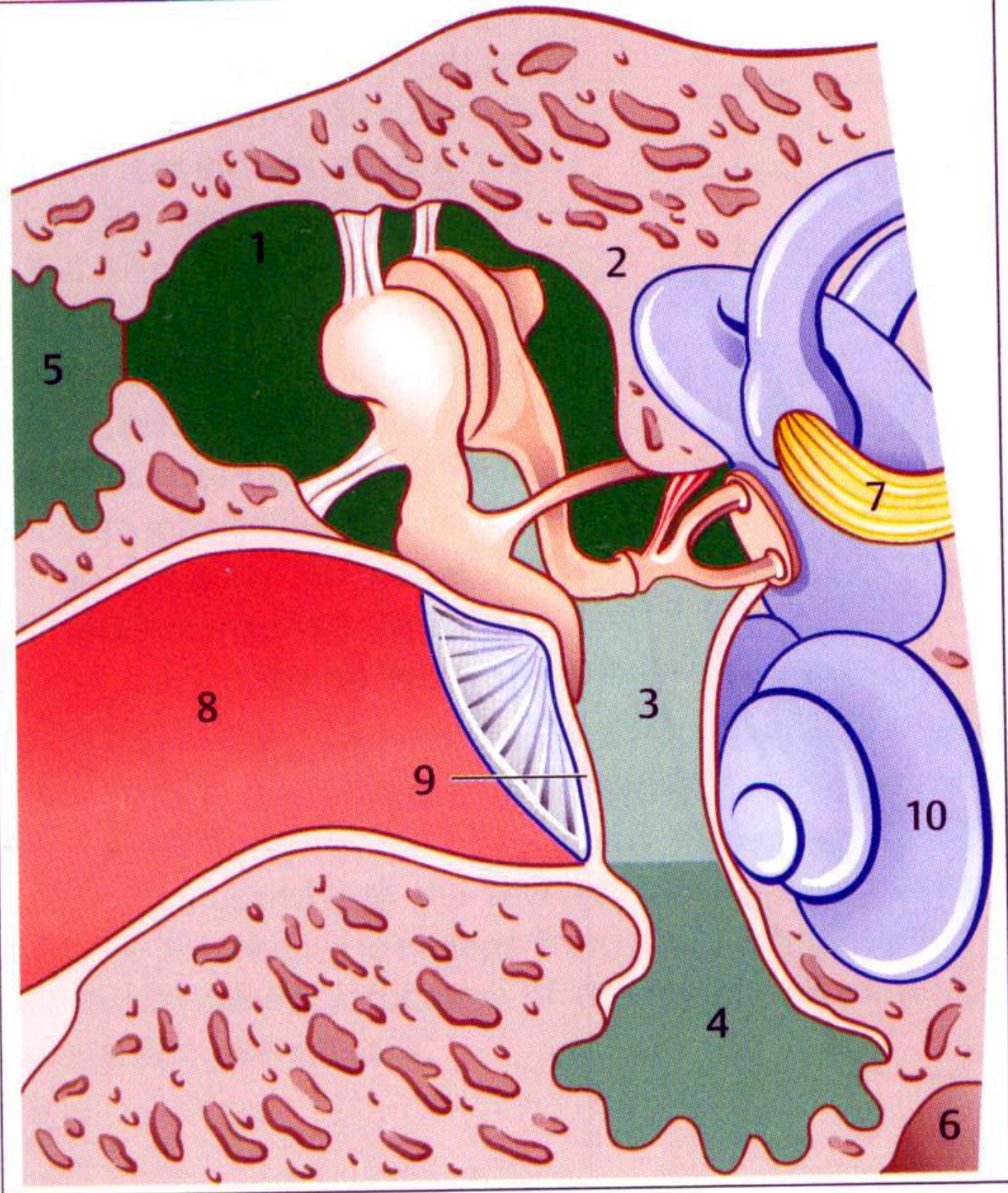


Overhanging the hair cells is a gelatinous structure known as the tectorial membrane. As vibrations from the stirrup are transmitted upwards in the scala vestibuli and through the Reissner's membrane, shearing forces between the tectorial membrane and the hair cells transduce waveform energy into electrical potentials in the acoustic nerve.

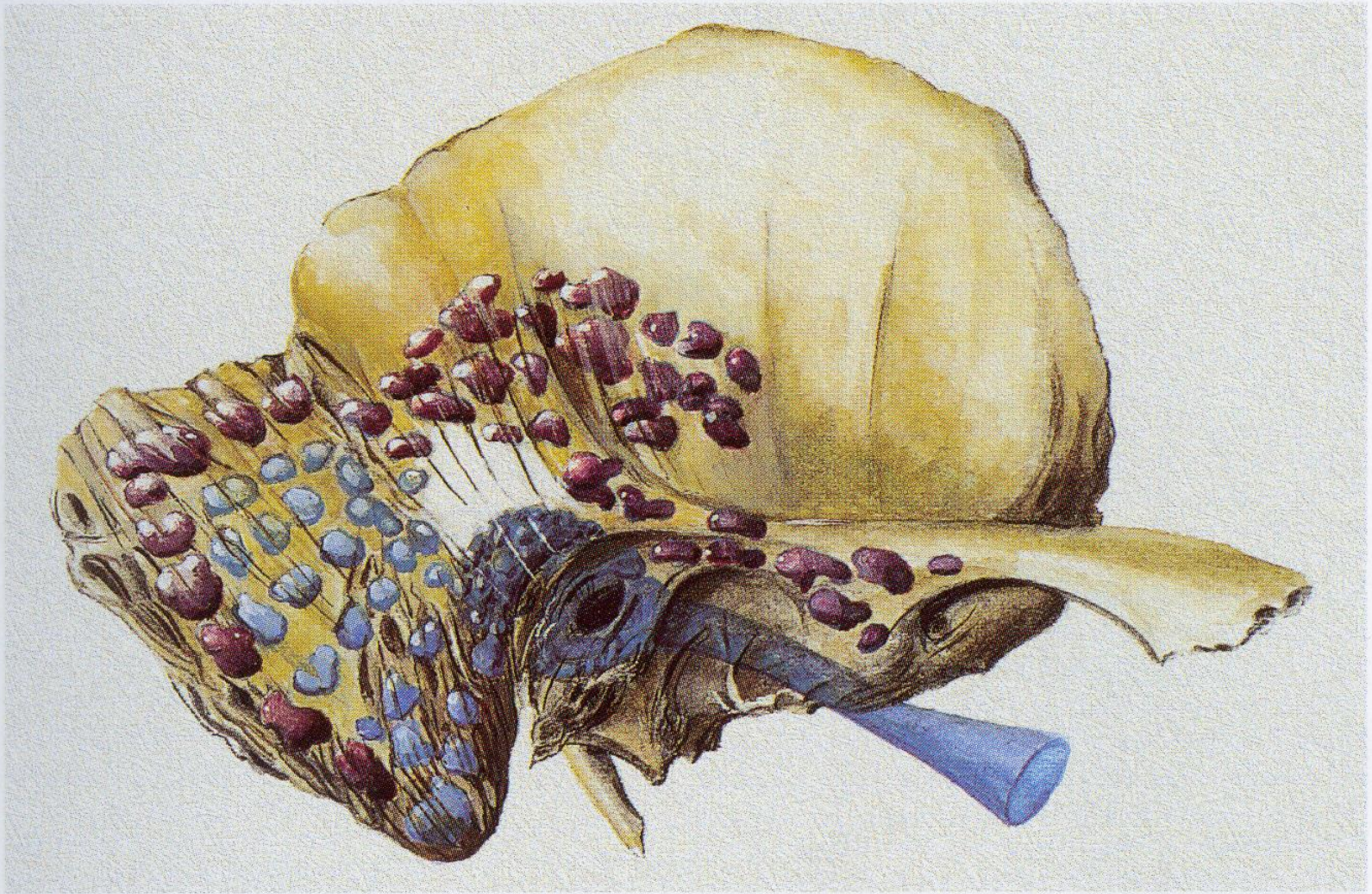


A. TECTORIAL MEMBRANE
B. BASILAR MEMBRANE
C. INNER HAIR CELLS
D. OUTER HAIR CELLS
E. NERVE FIBERS





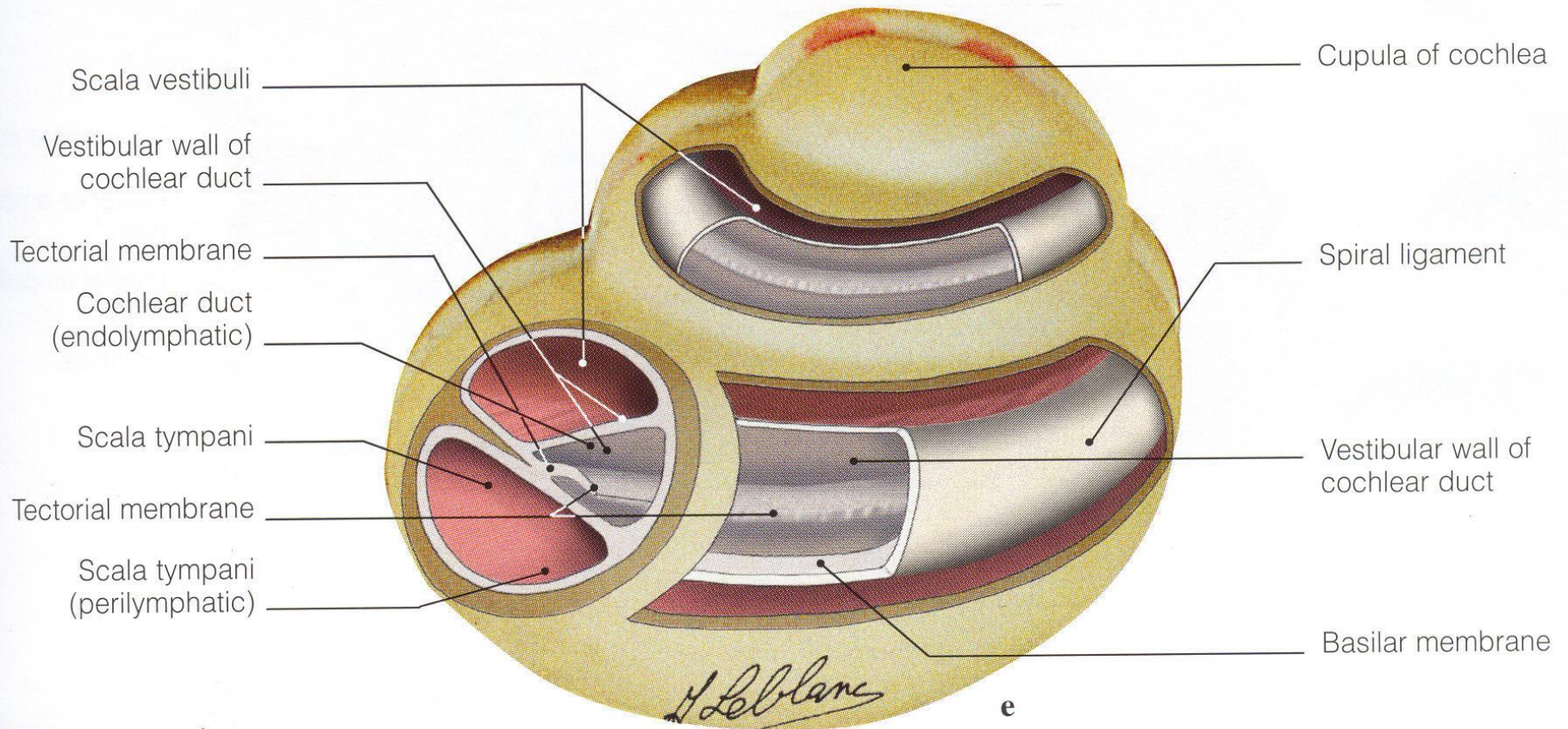




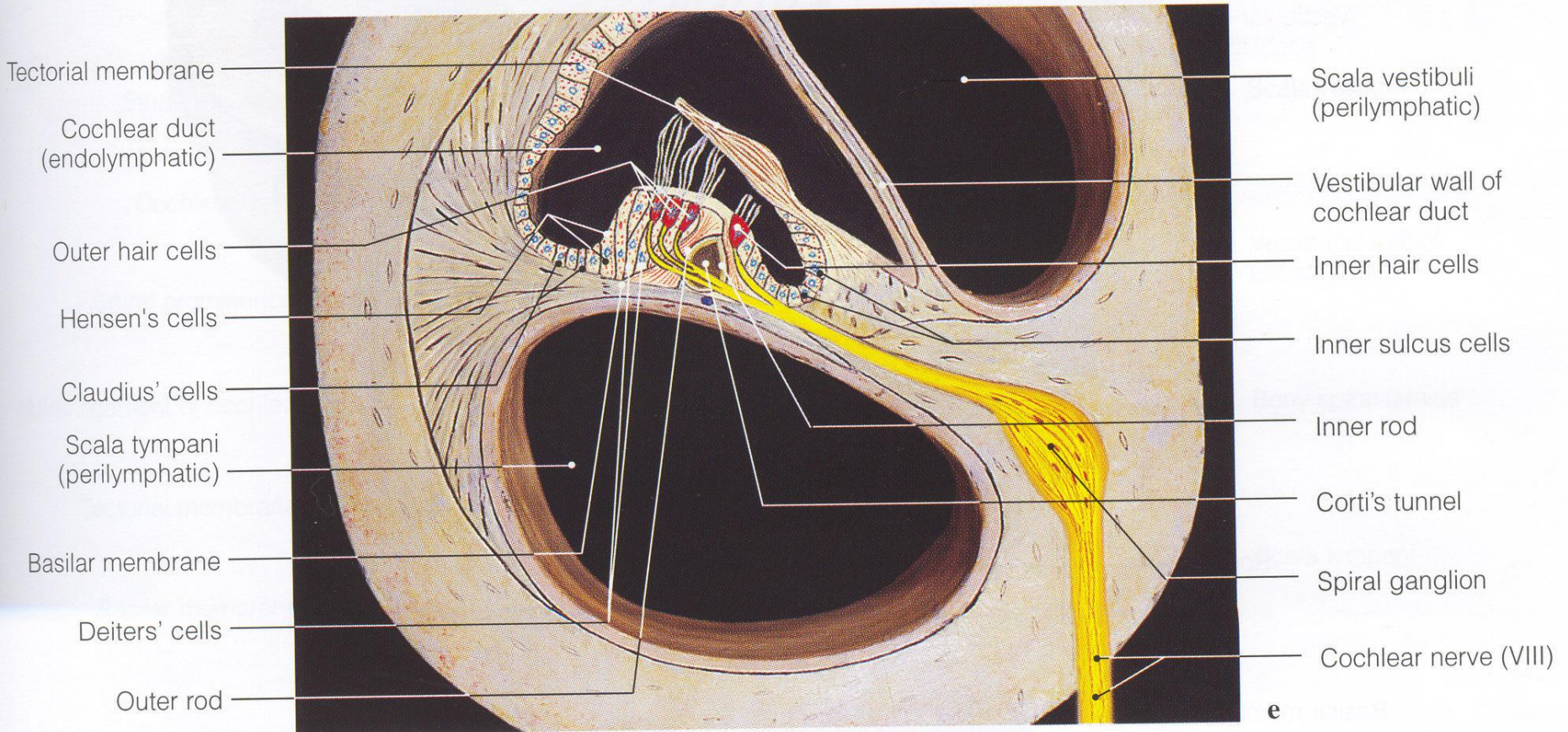
Pneumatization types of the petrous bone

- compact mastoid process
- restrained pneumatization
- good pneumatization

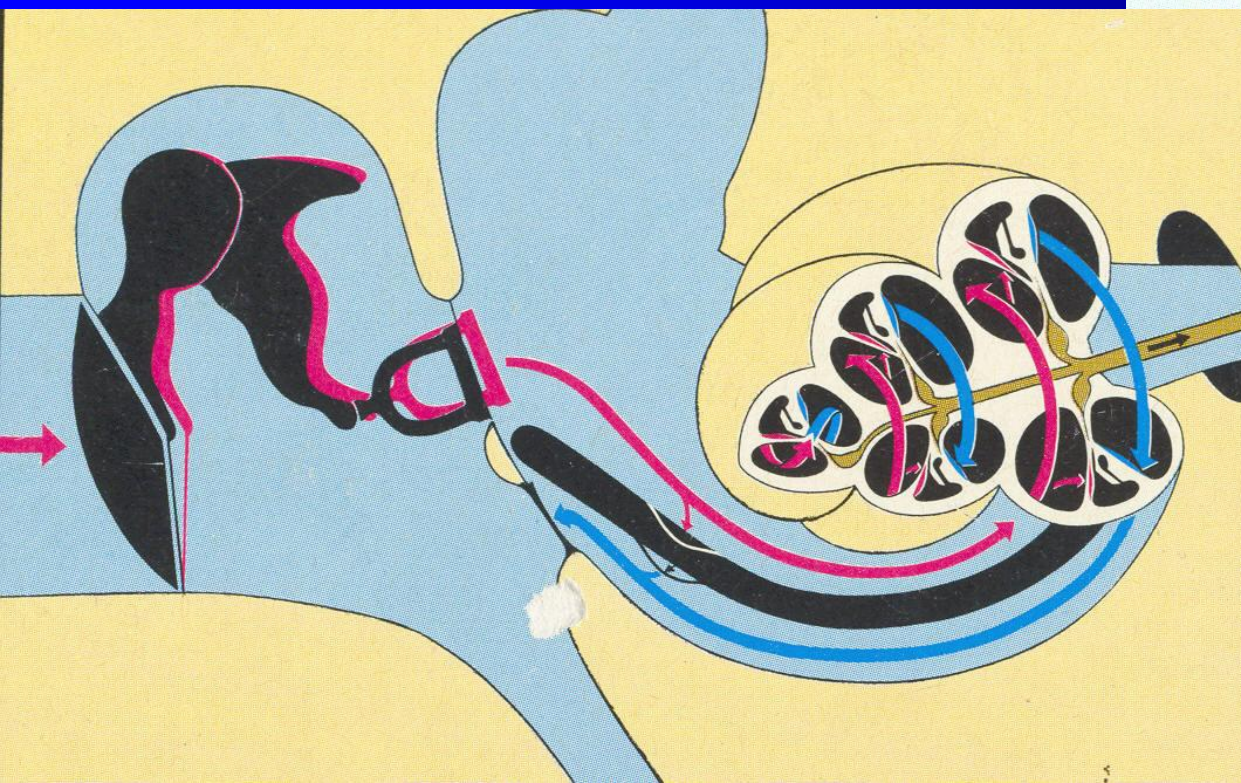
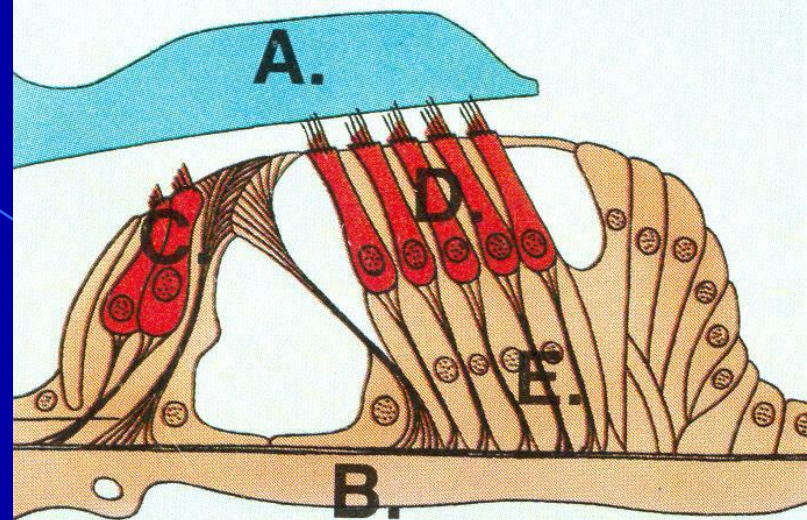
Cochlear cross-section



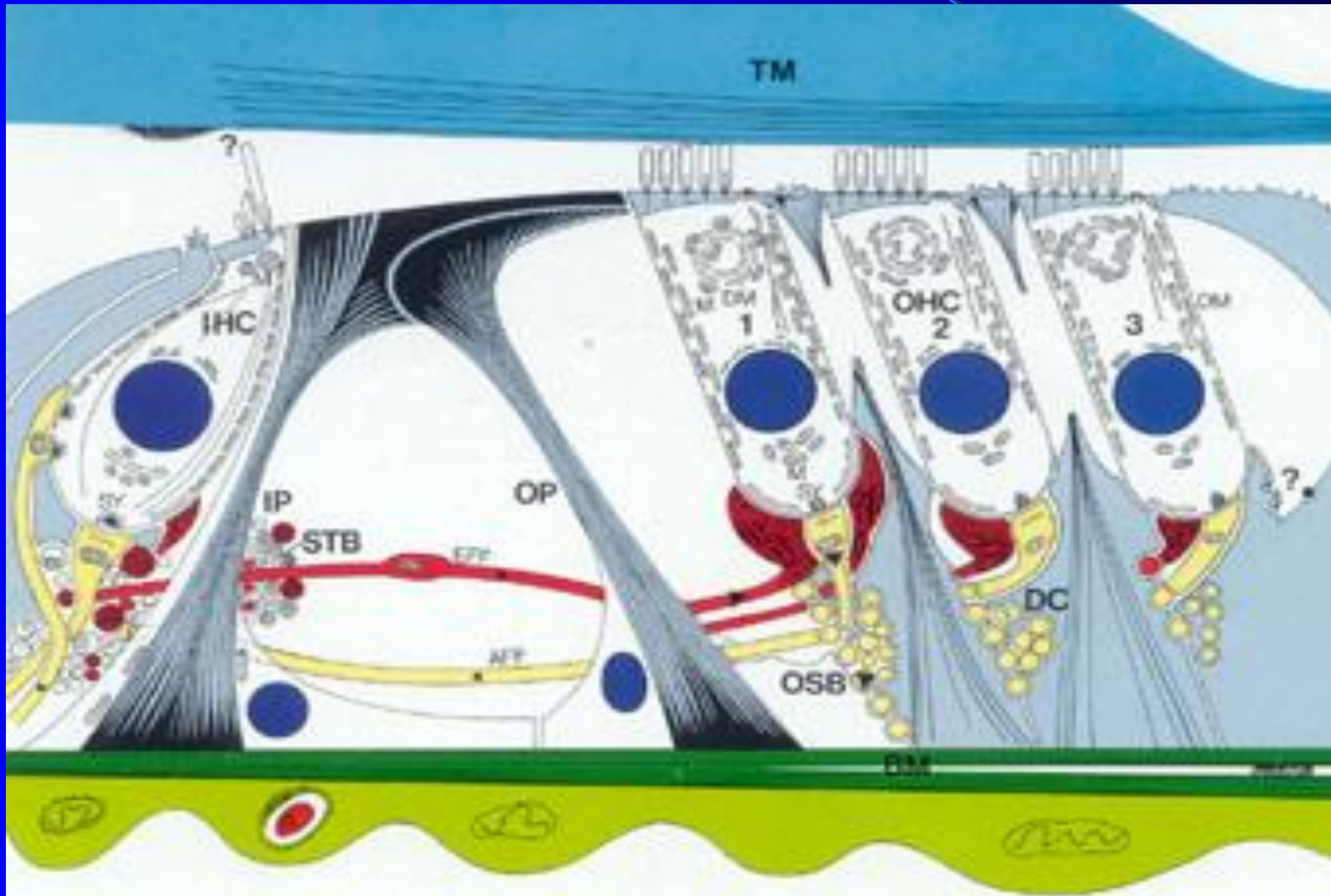
Cochlear duct cross-section



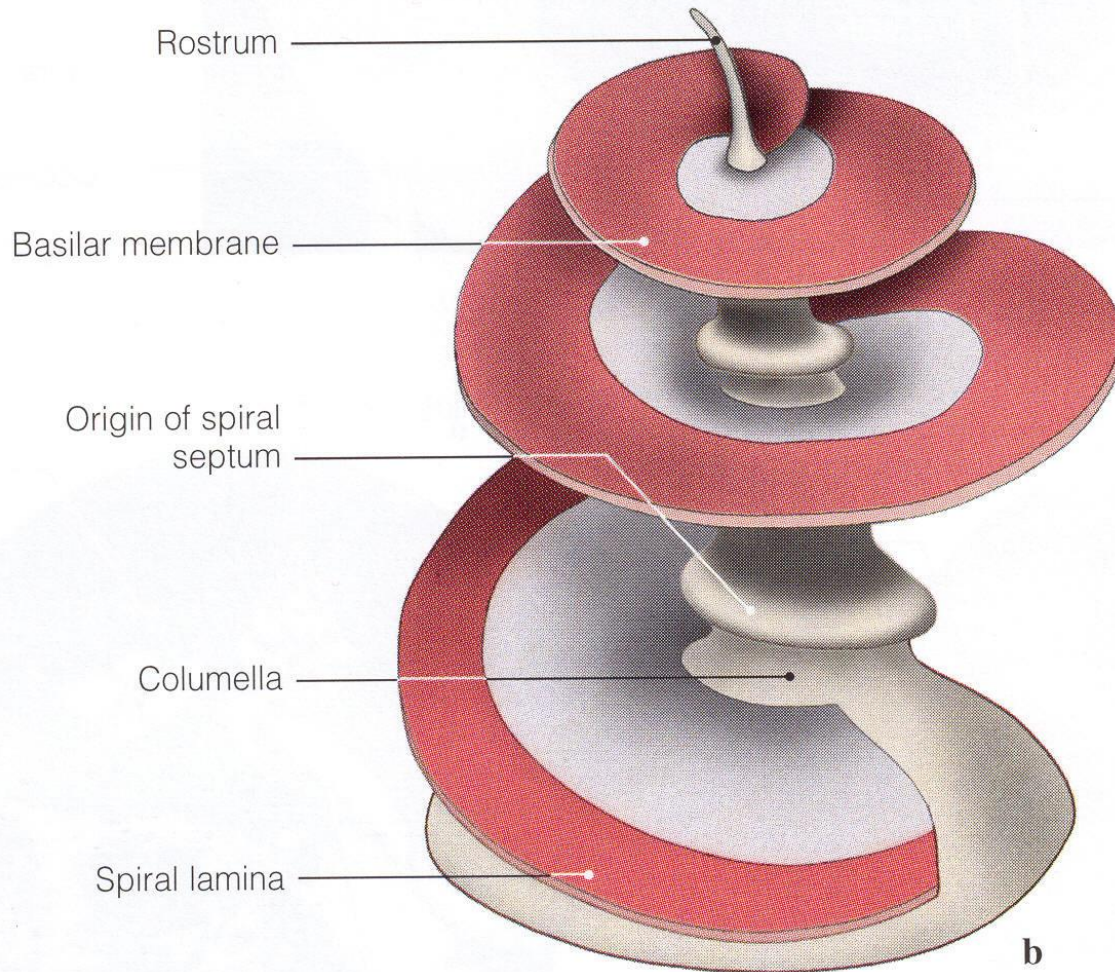
**Conductio of vibration
from tymp.membr.
through cochlea,
Organon Corti**



OHC = servomechanism for IHC



Cochlear septum



ENT investigation

- **history of disorder, in otology: hearing, tinnitus, dizziness, otorrhea (discharge), pain...**
- **inspection, palpation and using investigation instrumentarium (otoscopy, otomicroscopy)**
- **Radiography, ultrasound**
 - **Sumation x-ray: Schüller, Stenvers, Meyer**
 - **CT : axial and coronar sections**
- **functional investigation „classical hearing test“, audiometry, tympanometry, brain-stem electric response audiometry (BERA), spontaneous otoacoustic emission**
- **endoscopic investigation**
- **otoneurology**
- **other: laboratory...**

History of disorder

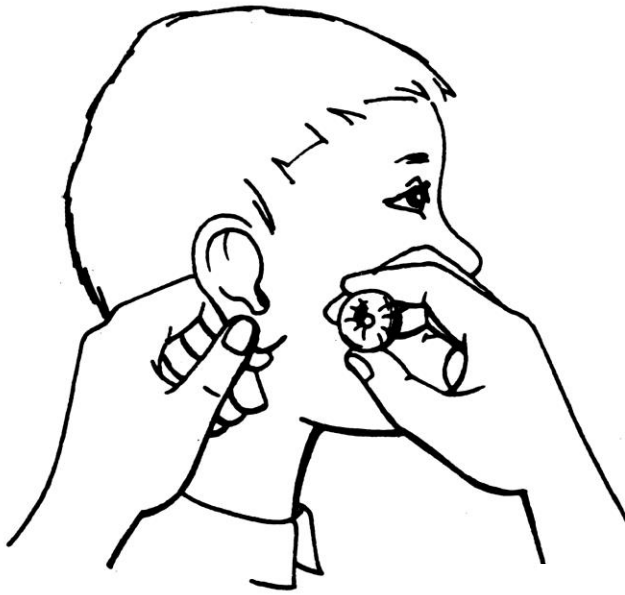
**Physician itself is a „remedy“
(Michael Balint)**

History of disorder – ear disease symptomatology

- **Hearing**
- **Tinnitus**
- **Dizzines**
- **Otorrhea (discharge)**
- **Pain**

Vertigo (dizziness)

- ***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.

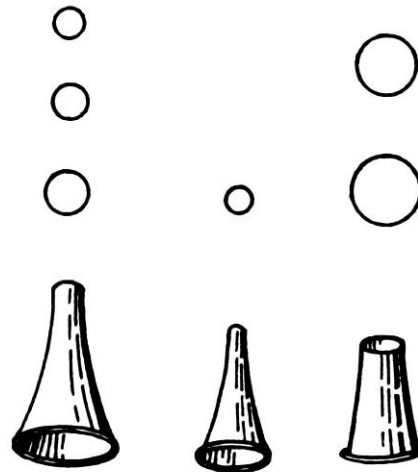


Obr. 13: Zavádění ušního zrcátka u dítěte



Obr. 12: Zavádění ušního zrcátka u dospělého

Otoscopy
eye evaluation of
deeper parts of
external meatus
and ear drum



Obr. 11: Ušní zrcátka

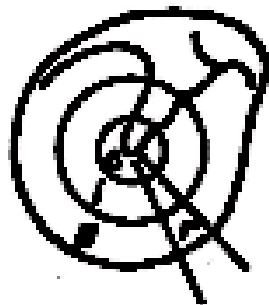
Normal otoscopy:

Bezold's trias:

1. Prominentia mallearis
2. Stria mallearis
3. Light reflex



Otoscopy – tympanic membrane quadrants and zones



p - prominencí malleolusů

i - ústí malleolusů

e - umbo

r - reflexní reflex

Kvadranty:

pl - přední dolní

ph - " horní

zl - zadní dolní

zk - " horní

zóny: e - centrální, i - intermediální, p - periferní

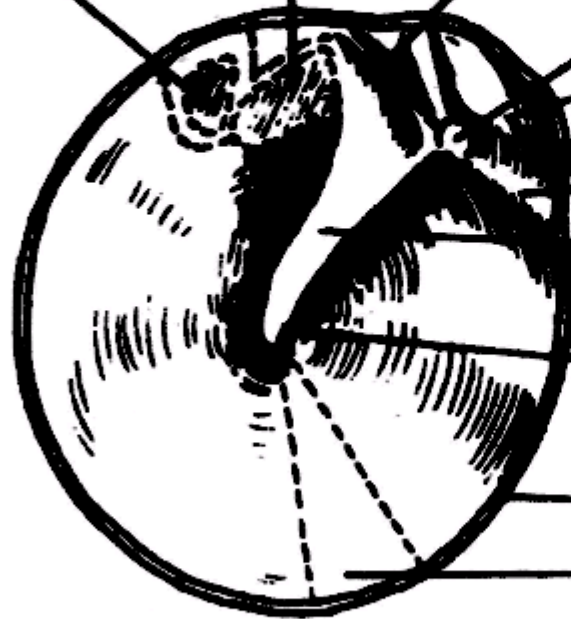
Rozdělení bubínku na kvadranty a zóny

Normal ear drum

(Někdy může
prosvítat)

třmínek

kovadlinka



plica malleol. post.

proc. later. mallei

pars flaccida membr.
tympani

plica malleol. ant.

manubrium mallei
(stria malleolaris)

umbo membr. tympani

anulus tympanicus
reflex

Basic pathologic finding on tympanic membrane

- Injection of the vessels of the tympanic membrane
- **(position) bulging 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) perforations** –
 - after injury
 - inflammatory - acute
 - chronic - central (mesotympanic)
 - marginal (peripheral)
- **(changes after infamm.) thickening of the tympanic membrane, scars**
- changes **behind** the ear-drum: middle ear effusion, fluid level, air bubbles

Various types of perforations of ear drum



Centrální perforace



ruptura bubínku

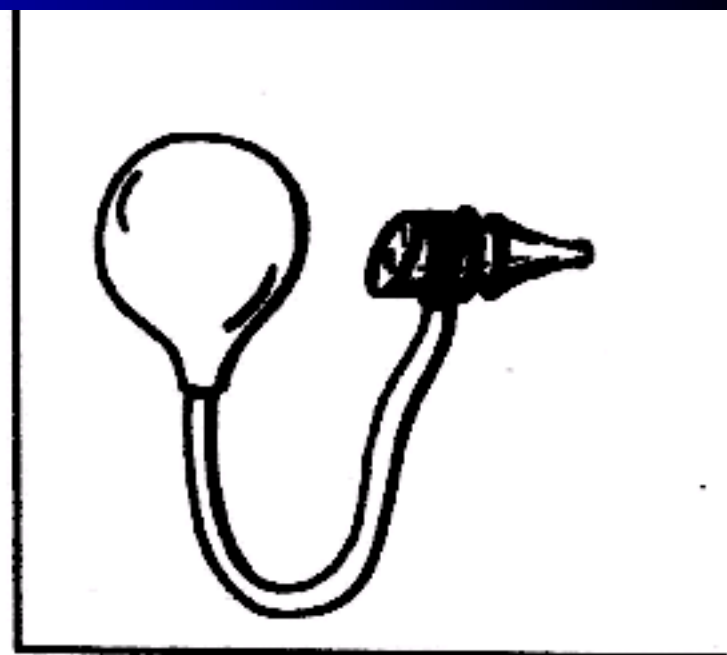
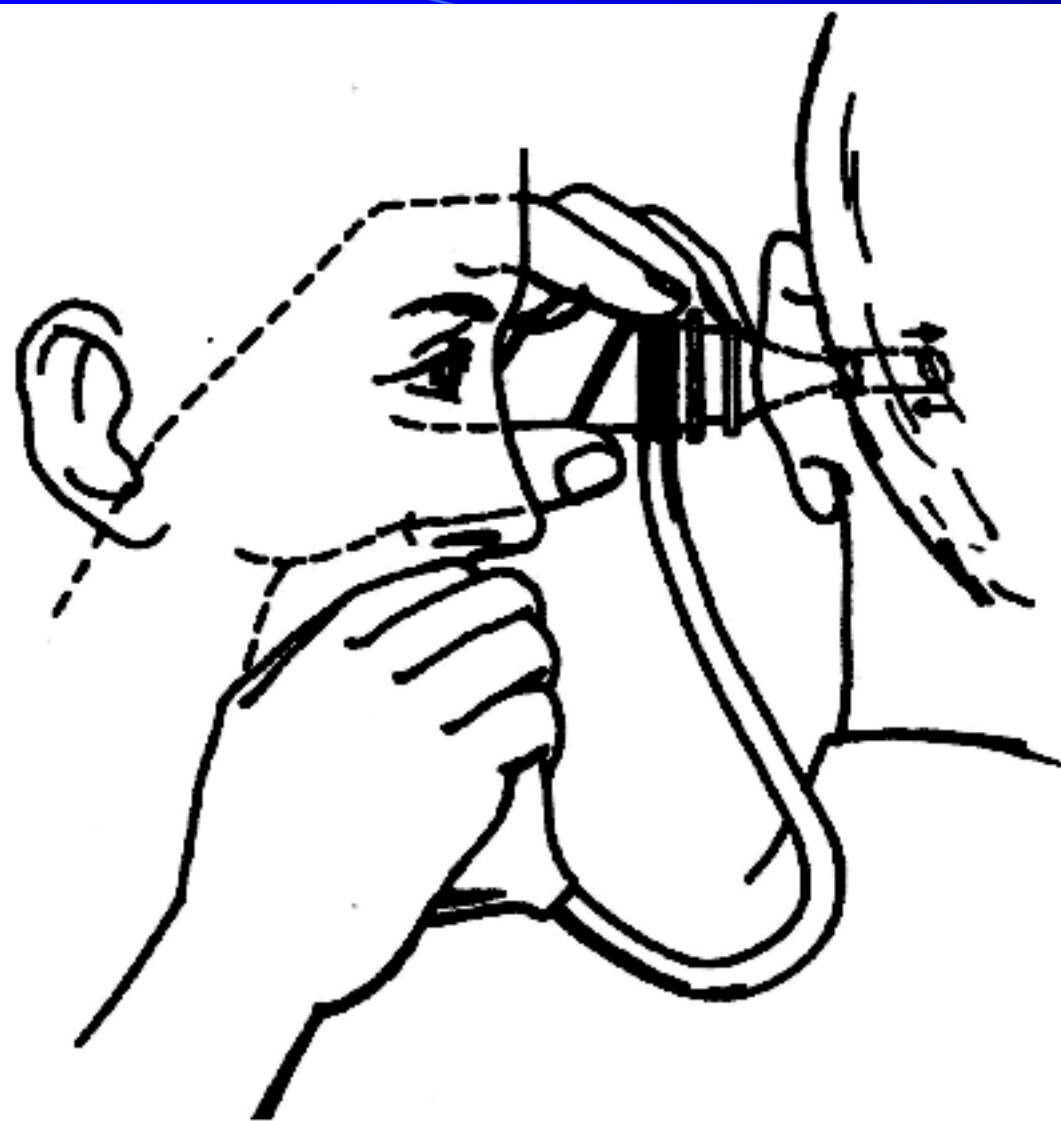


okrajově perforace

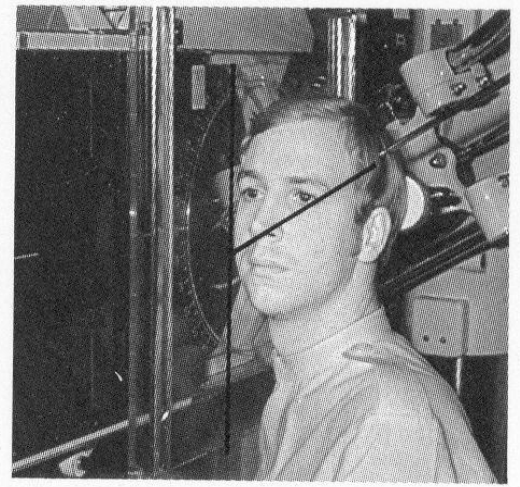


okrajově a centrální perforace

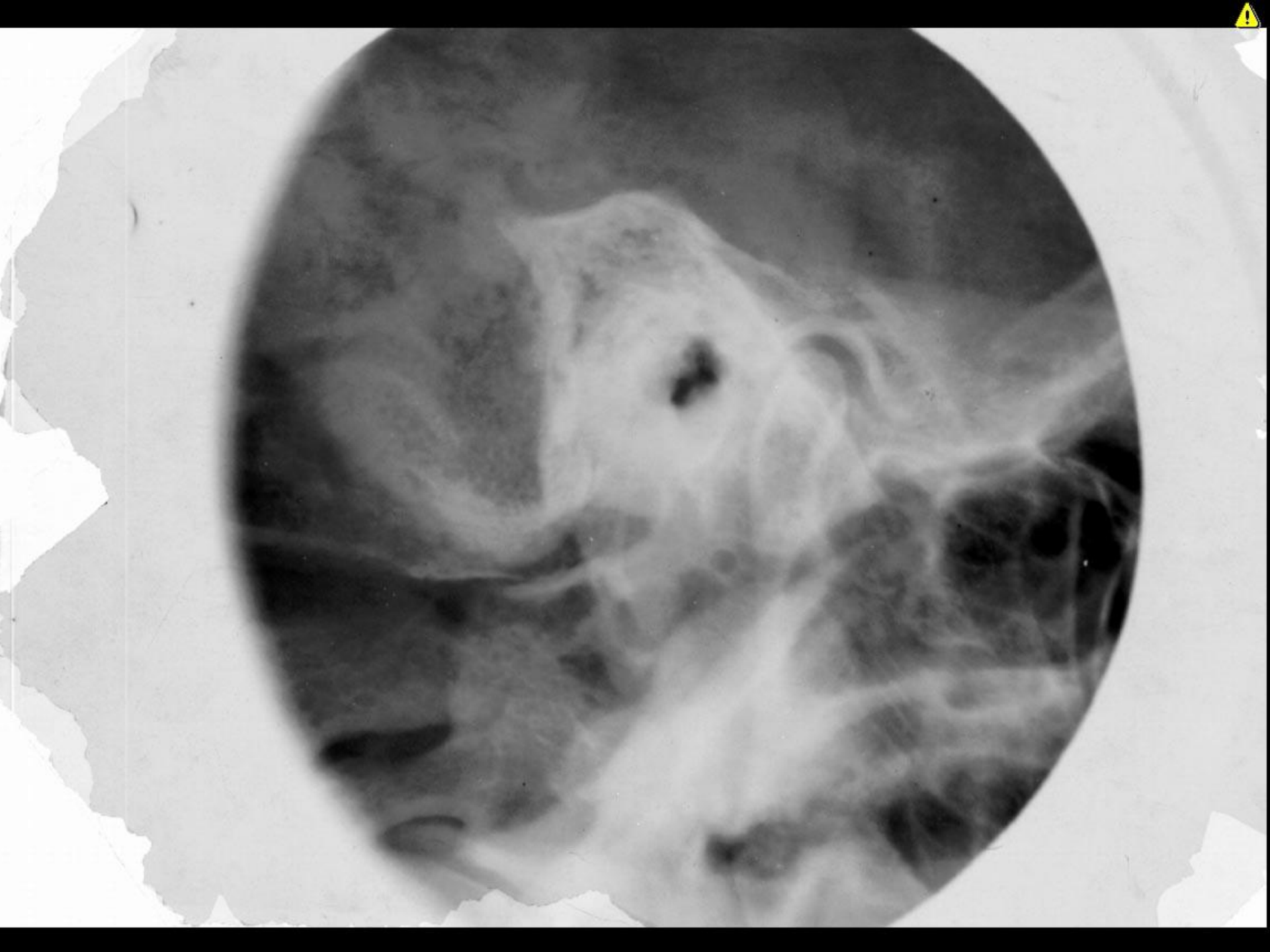




Vyšetřování Sieglovým zrcátkem



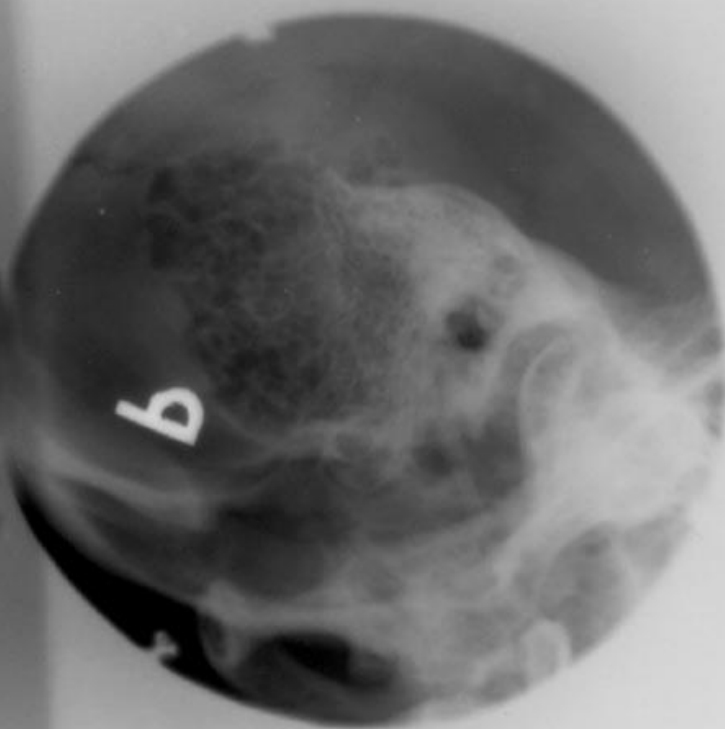
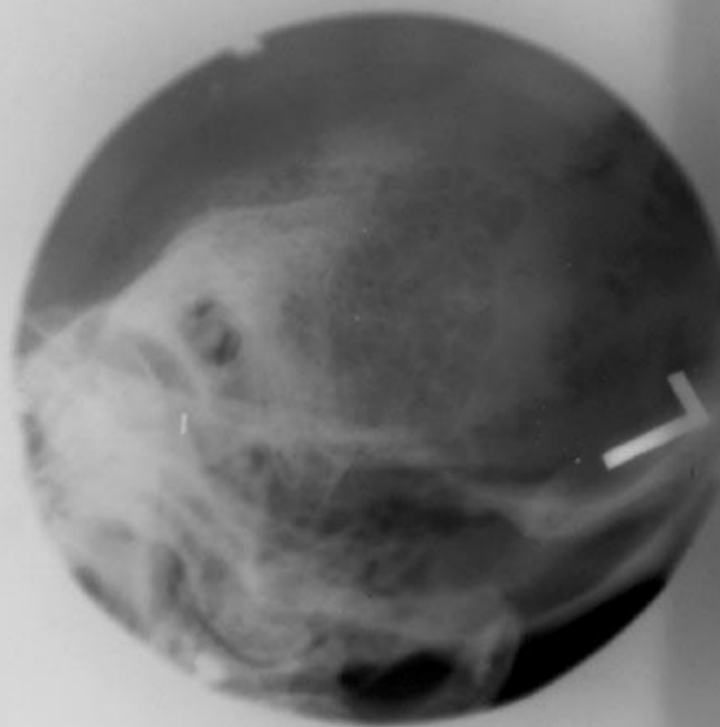
Projekce die Schüllera



Mladtrava

Ohňo med sup. ac. o. mastoidní
(křídle gastrocnemio-pneumotického systému)

Normální vnitřek.





PHOTOGRAPHED BY THE RADIOLOGICAL DEPARTMENT, UNIVERSITY OF CHICAGO, OCTOBER 1937.

7



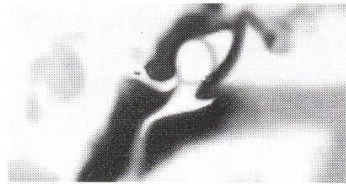
D. 11. 67. 1865

D



Schema of CT of ossicular chain and middle ear cavity

- 1 * Long crus of incus
- 2 * Handle of malleus



Body of incus
e

Superior epitympanic recess

Long crus of stapes

Posterior crus of stapes

Epitympanic space

E.A.M. – Stapes

Lateral process of malleus

Lenticular process of incus

Handle of malleus

Neck of malleus

g
Head of malleus

Lateral process of malleus

Epitympanic space

Body of incus

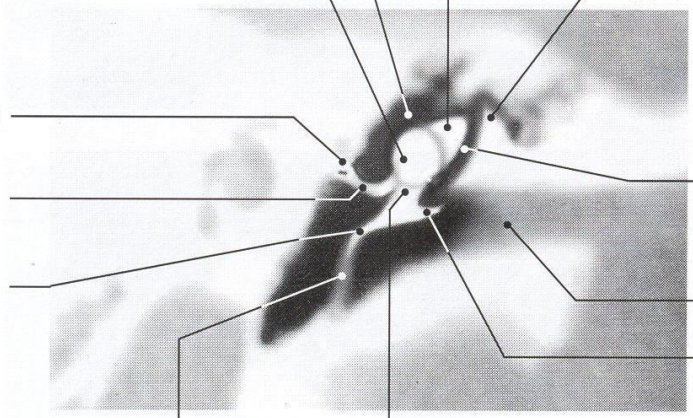
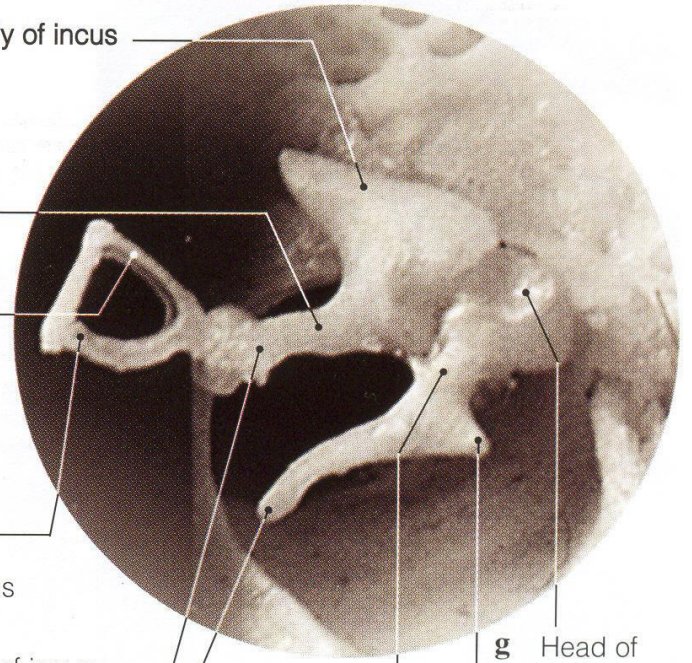
Head of malleus

stapes

f

Tympanic membrane

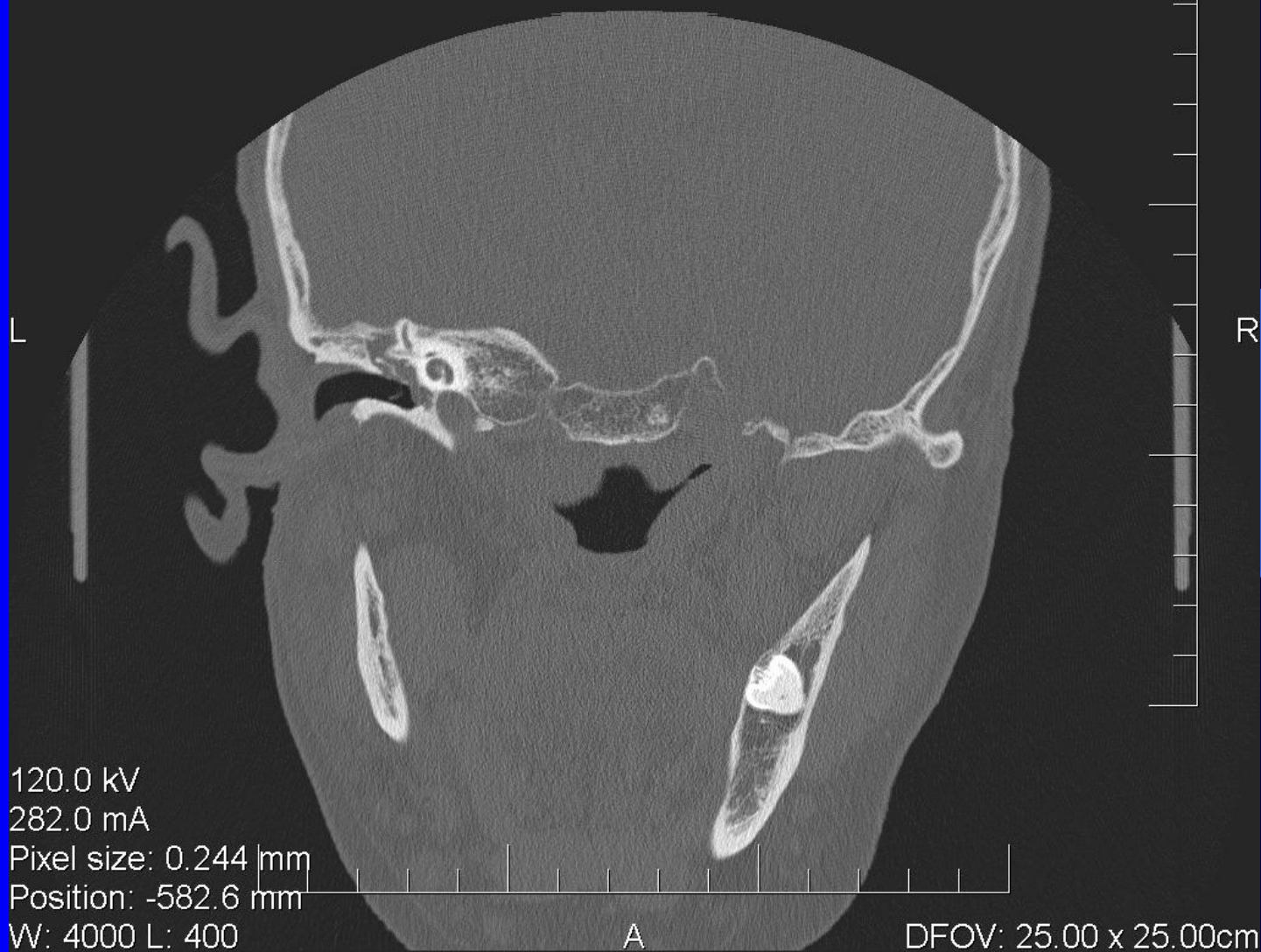
Neck of malleus



CT/835/12
Axial F->H

P

FN U sv.Anny v Brne
JANECEK^DRAHOSLAV
280912/403
M
4284-1764/06
2006/3/13
10:23:21



120.0 kV
282.0 mA
Pixel size: 0.244 mm
Position: -582.6 mm
W: 4000 L: 400

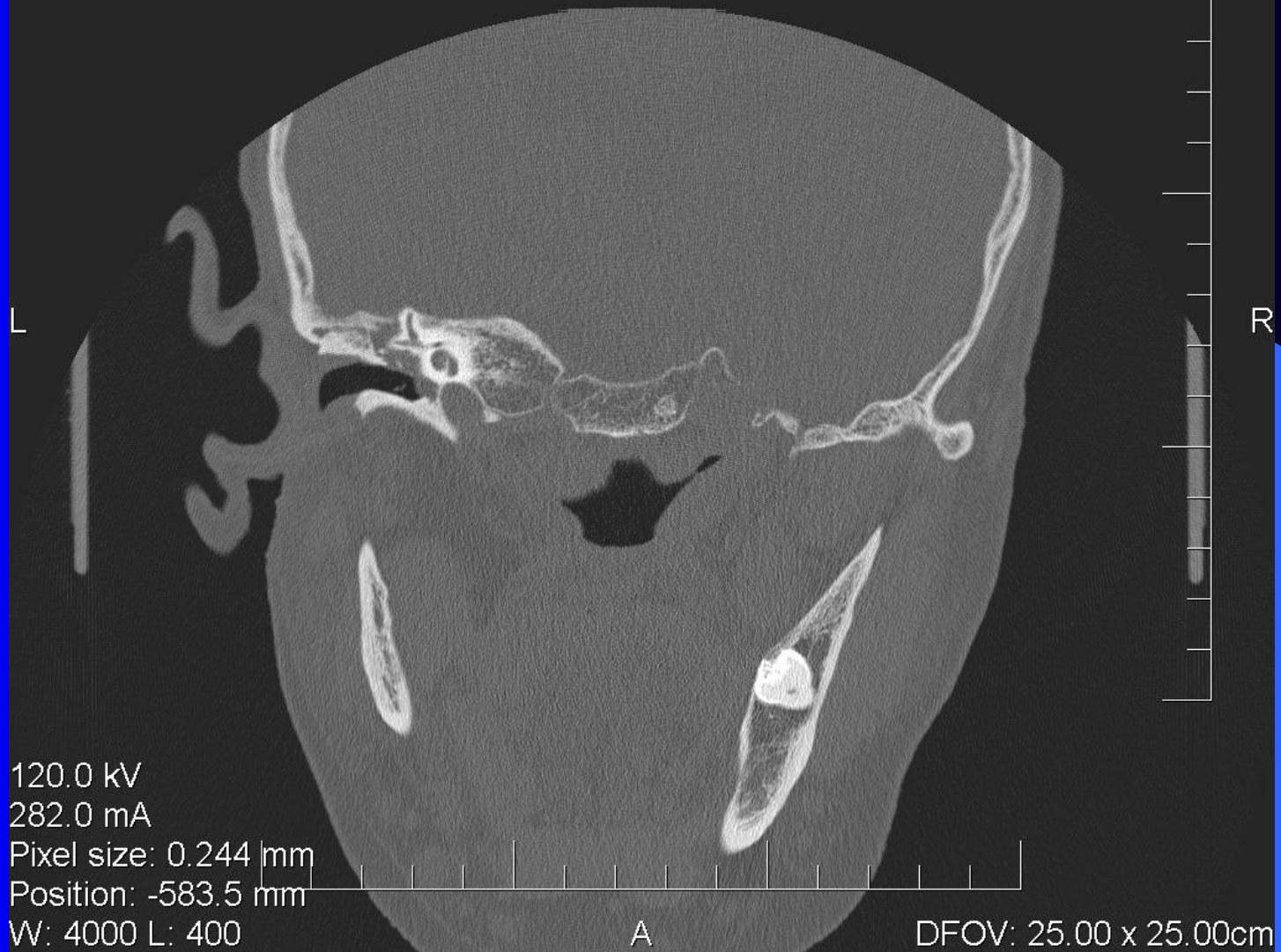
A

DFOV: 25.00 x 25.00cm

CT/835/13
Axial F->H

P

FN U sv. Anny v Brne
JANECEK^DRAHOSLAV
280912/403
M
4284-1764/06
2006/3/13
10:23:21



120.0 kV
282.0 mA
Pixel size: 0.244 mm
Position: -583.5 mm
W: 4000 L: 400

A

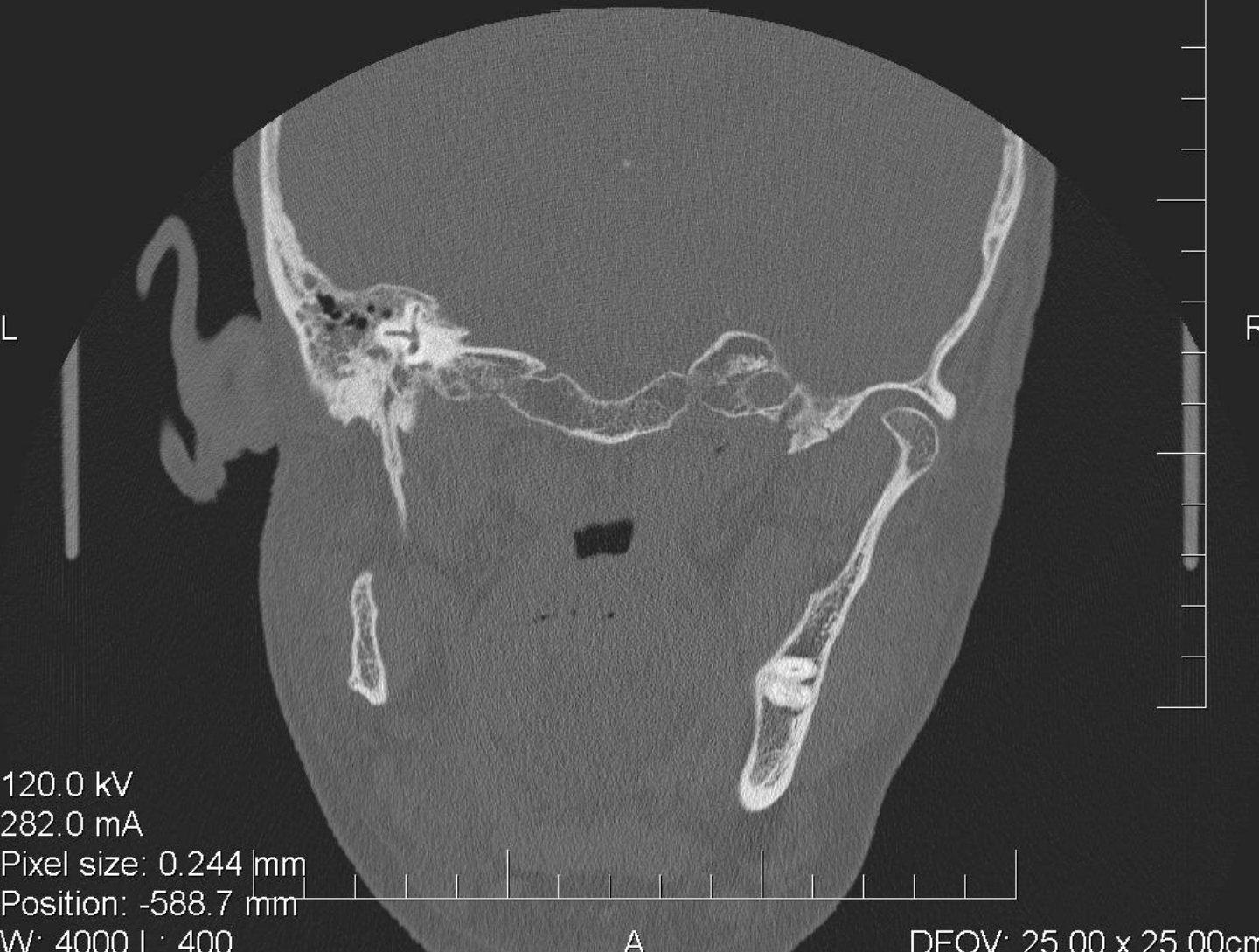
DFOV: 25.00 x 25.00cm

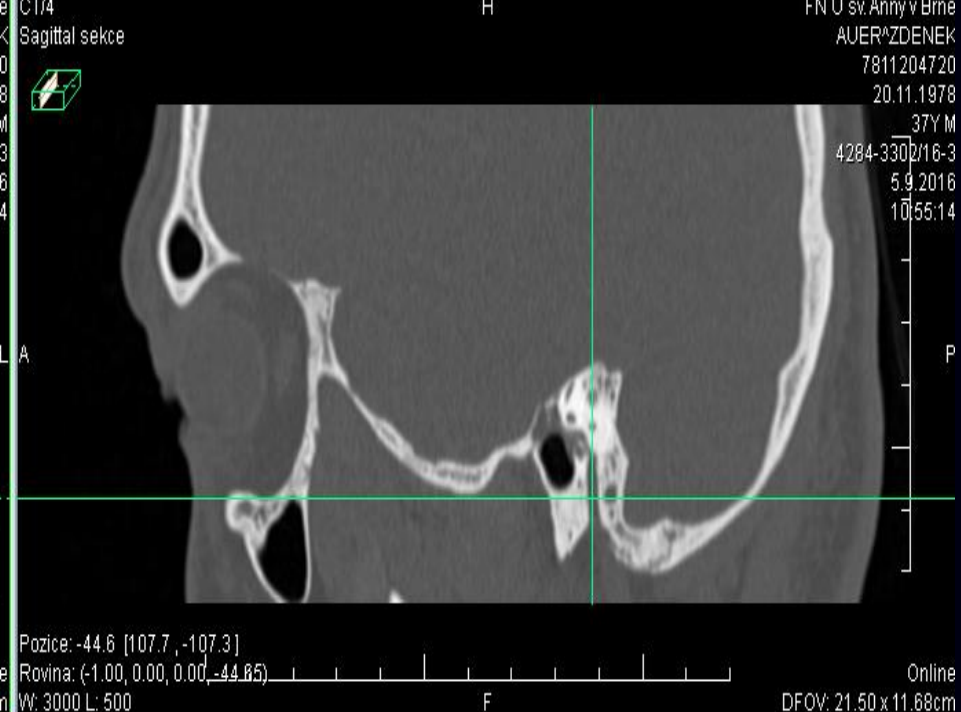
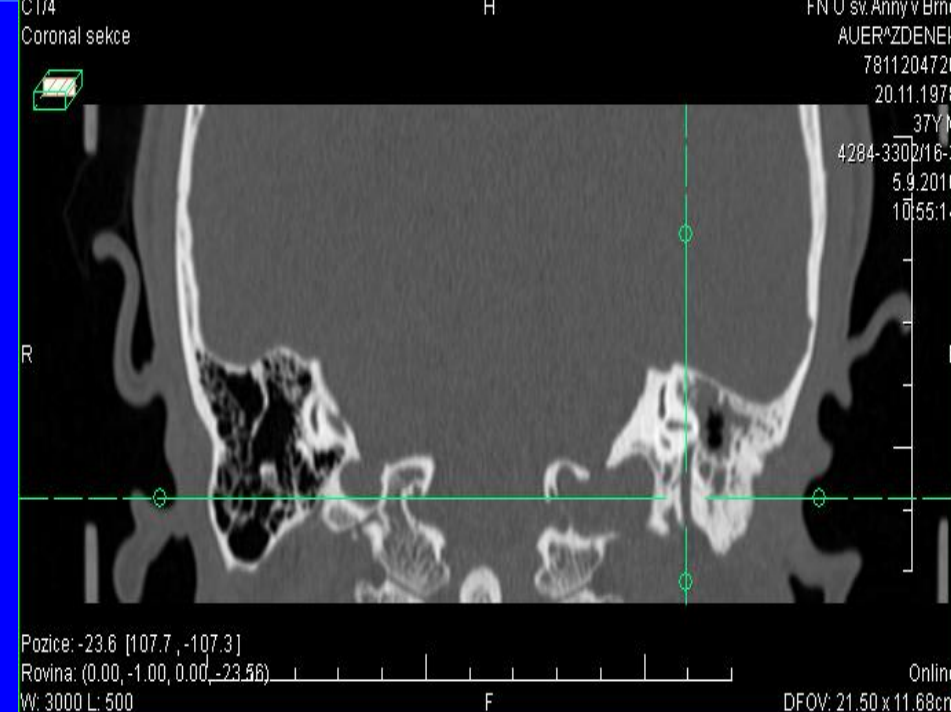
CT/835/19
Axial F->H

P

FN U sv.Anny v Brne
JANECEK^DRAHOSLAV
280912/403
M
4284-1764/06
2006/3/13
10:23:21

Canalis
Fallopi





Disorder of the ear

congenital anomalies
inflammations
tumors
injuries

Microotia III. St.



Microotia

Treacher-Collins syndrome

Most affected individuals have underdeveloped facial bones, particularly the cheek bones, and a very small jaw and chin (micrognathia).

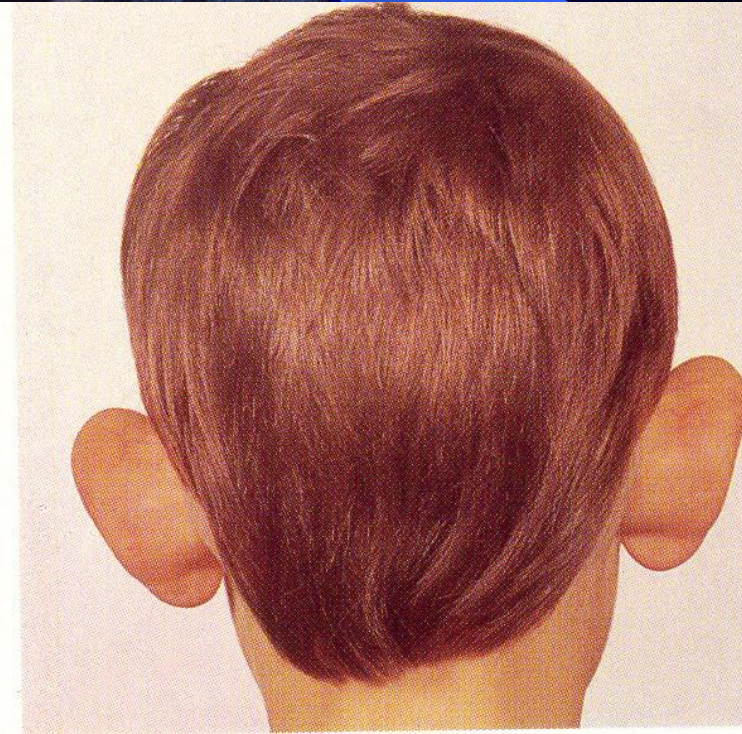
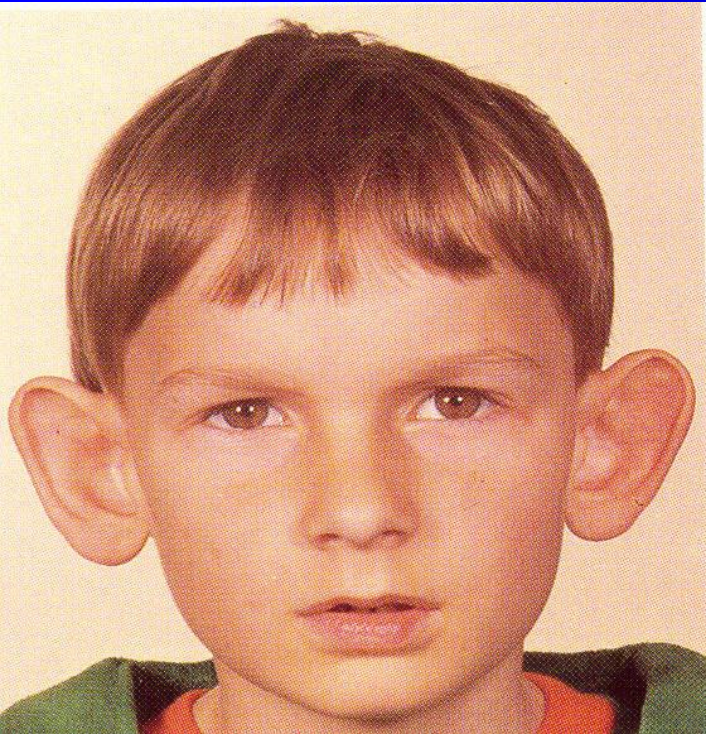
Hearing loss occurs in about half of all affected individuals; hearing loss is caused by defects of the three small bones in the middle ear, which transmit sound, or by underdevelopment of the ear canal. People with Treacher Collins syndrome usually have normal intelligence.



Apendices praeauriculares



Apostasis auriculae



**Erysipelas
bullosa
auricullae**



Herpes zoster oticus (part of Ramsley-Hunt syndrome)

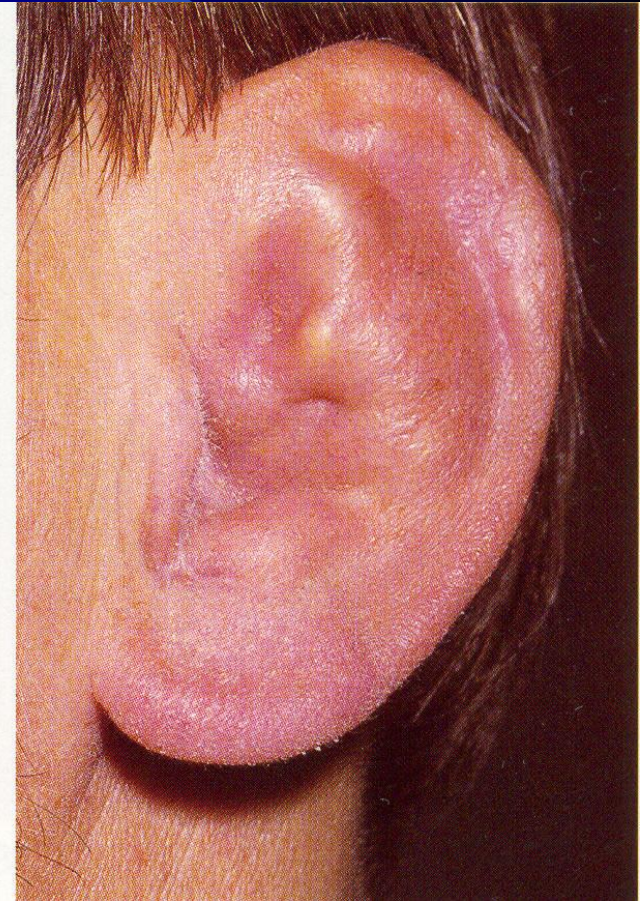
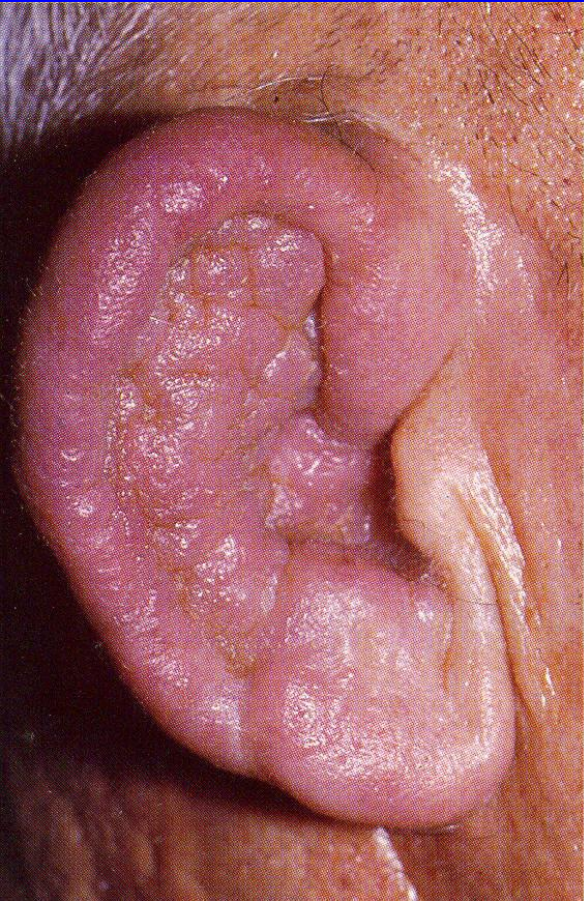
acute finding– after 3 days – after 10 days



Perichondritis



Chronic polychondritis – allergy- cauliflower ear

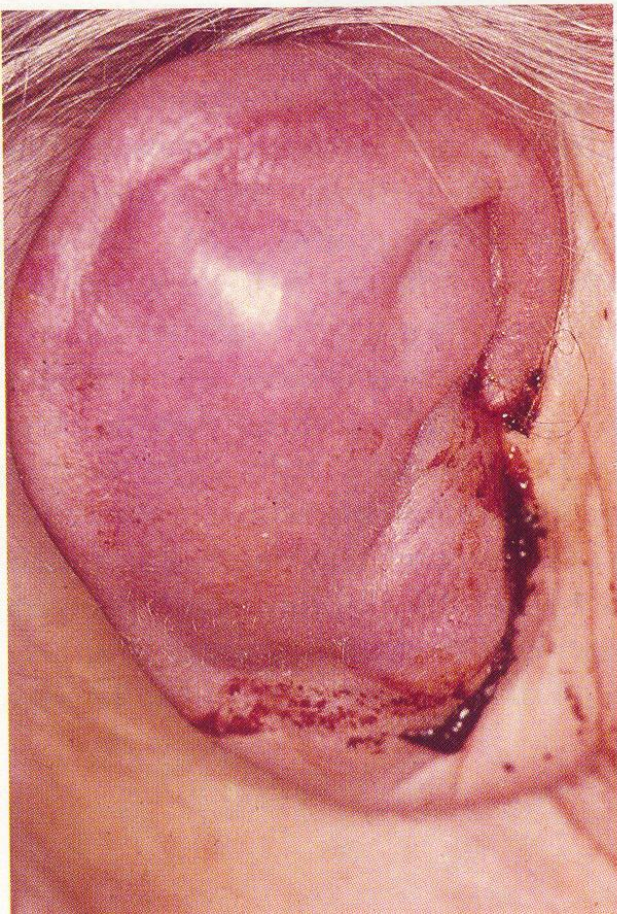


Spinocellular cancer of auricle

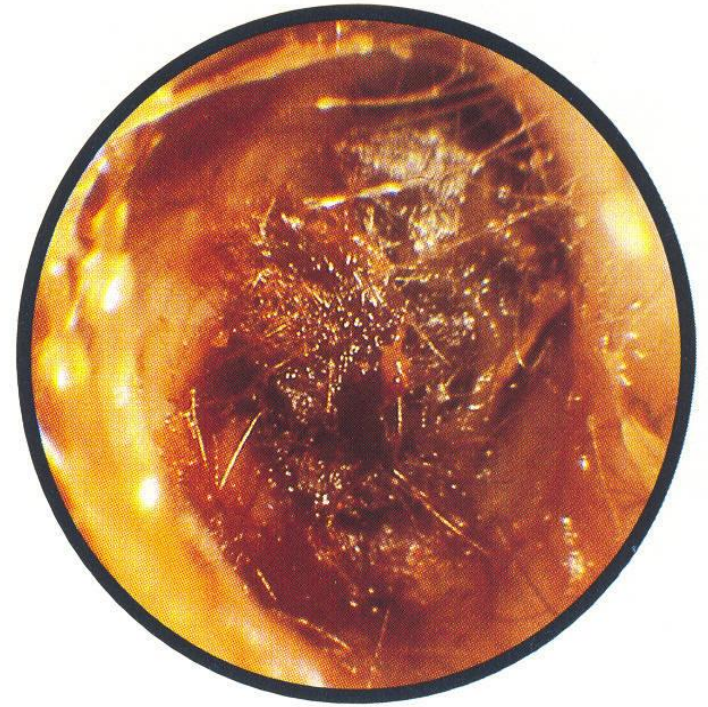


Othematoma

(čerstvý úraz, po 14 dnech, po několika měsících)



Cerumen

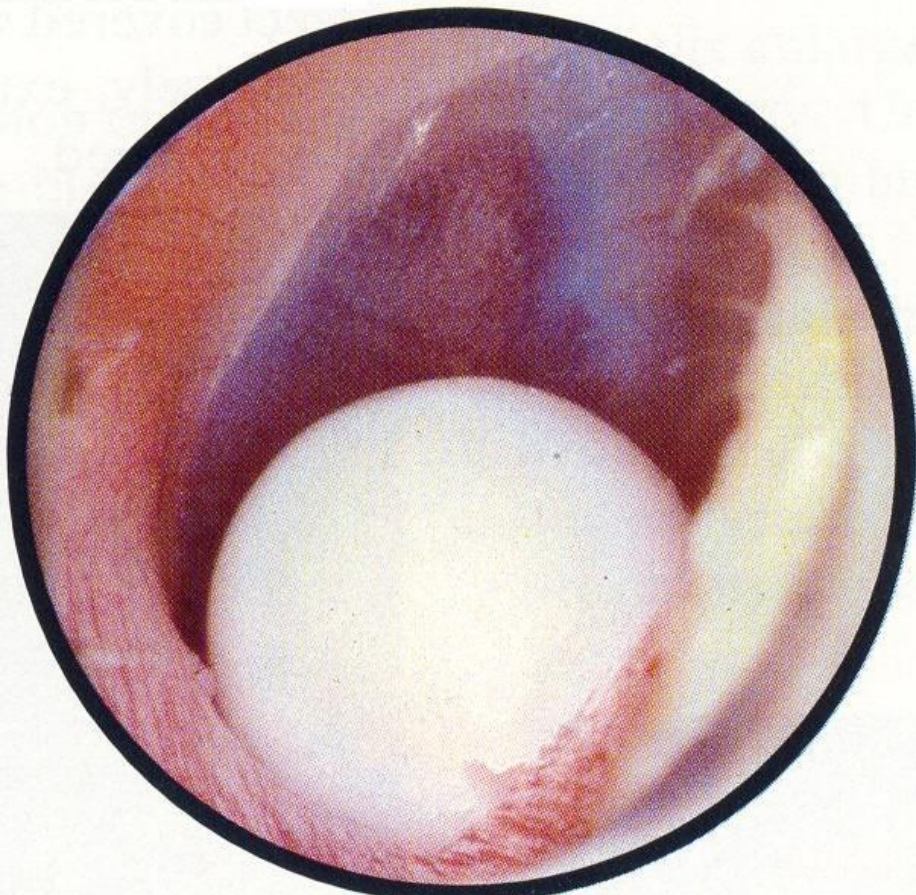


Foreign body in external meatus - insect

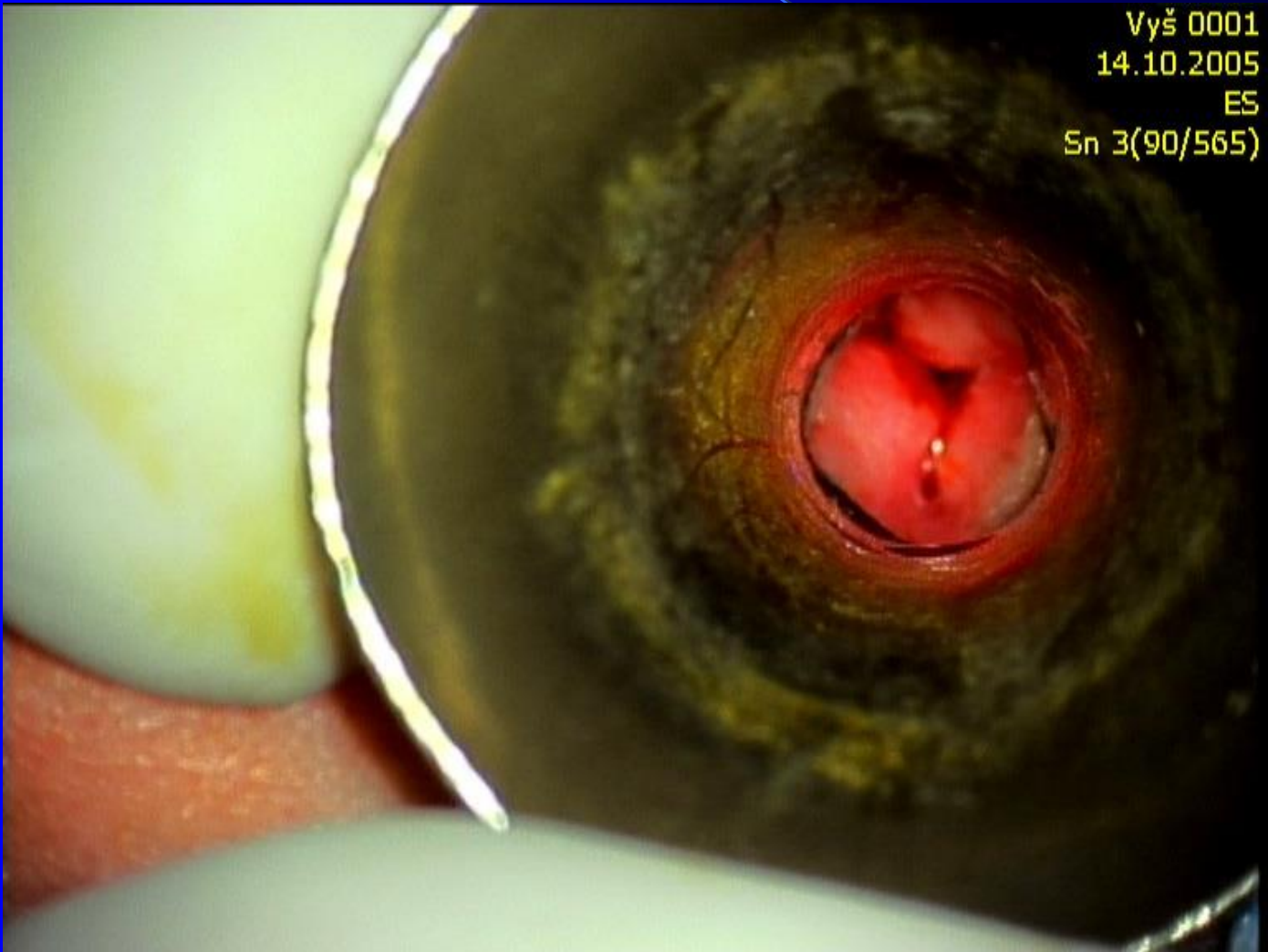
Ventilační trubička
k drenáži
středouší
(nezávislý nálezn)



Foreign body in external meatus bead, piece of wood, blood



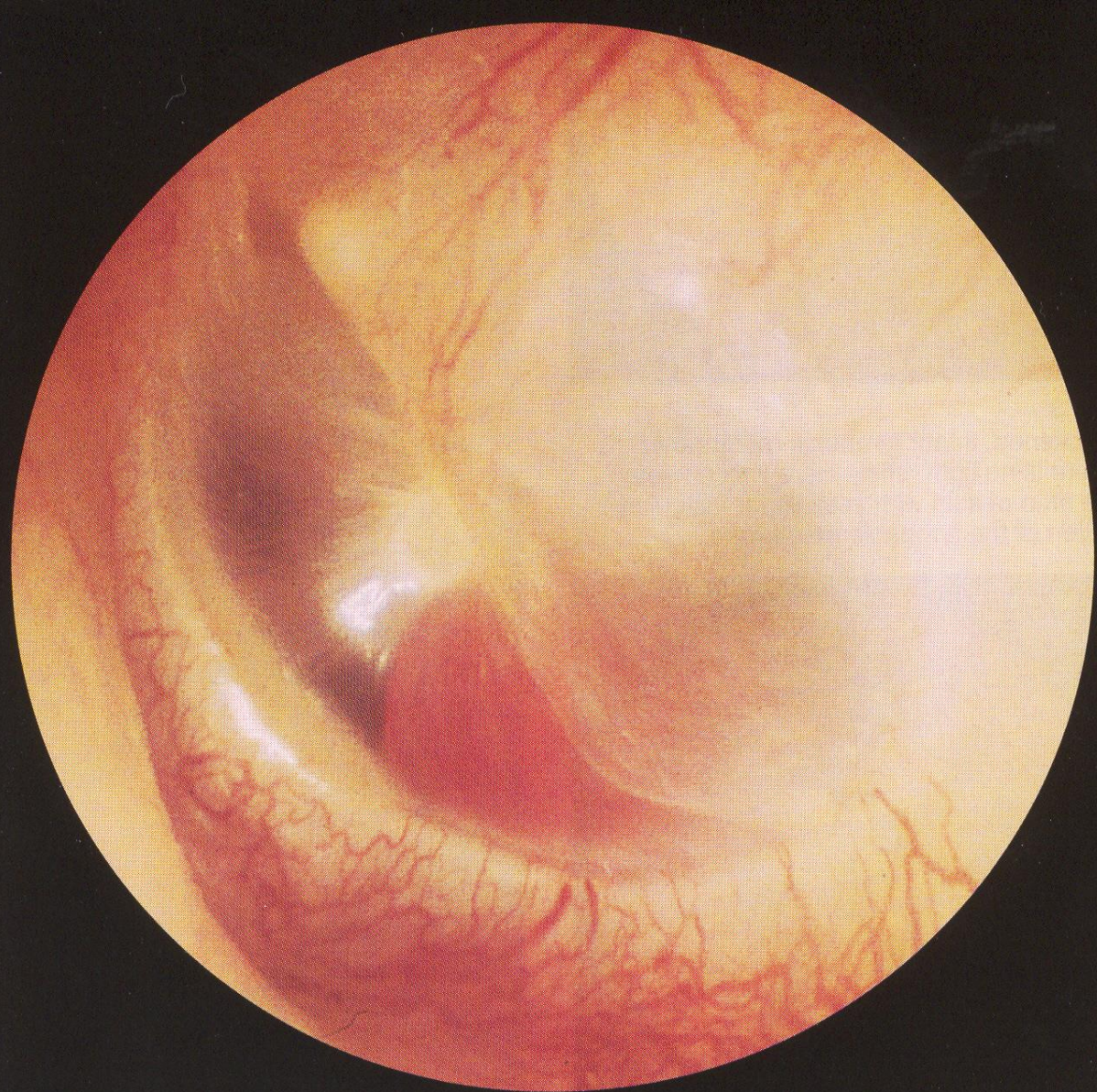
Exostosis in ext. meatus right



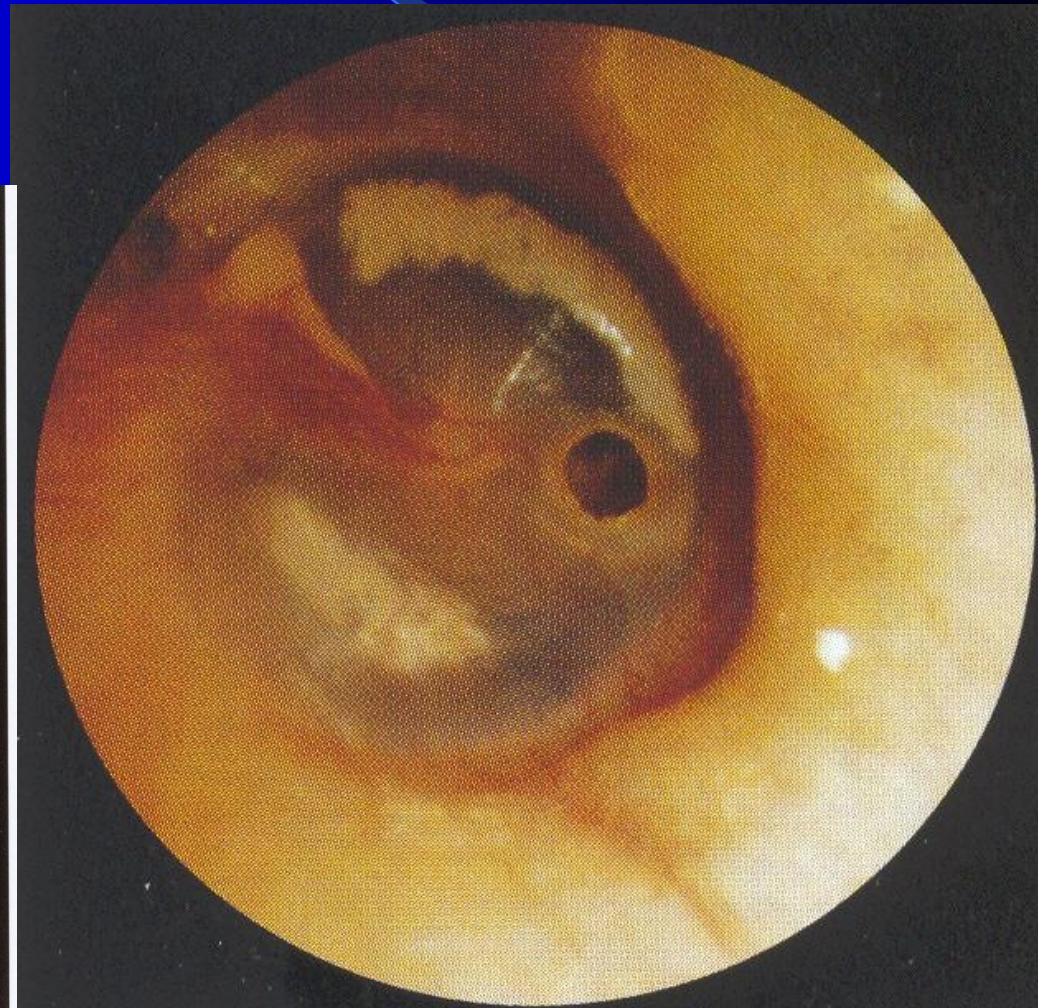
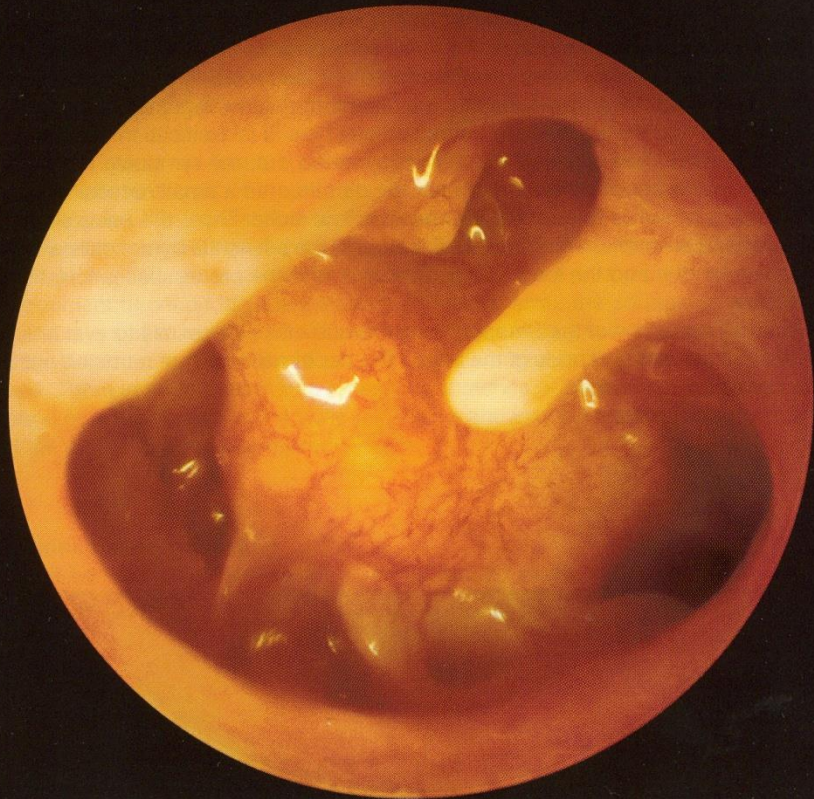
**Furunculus of
external
meatus**



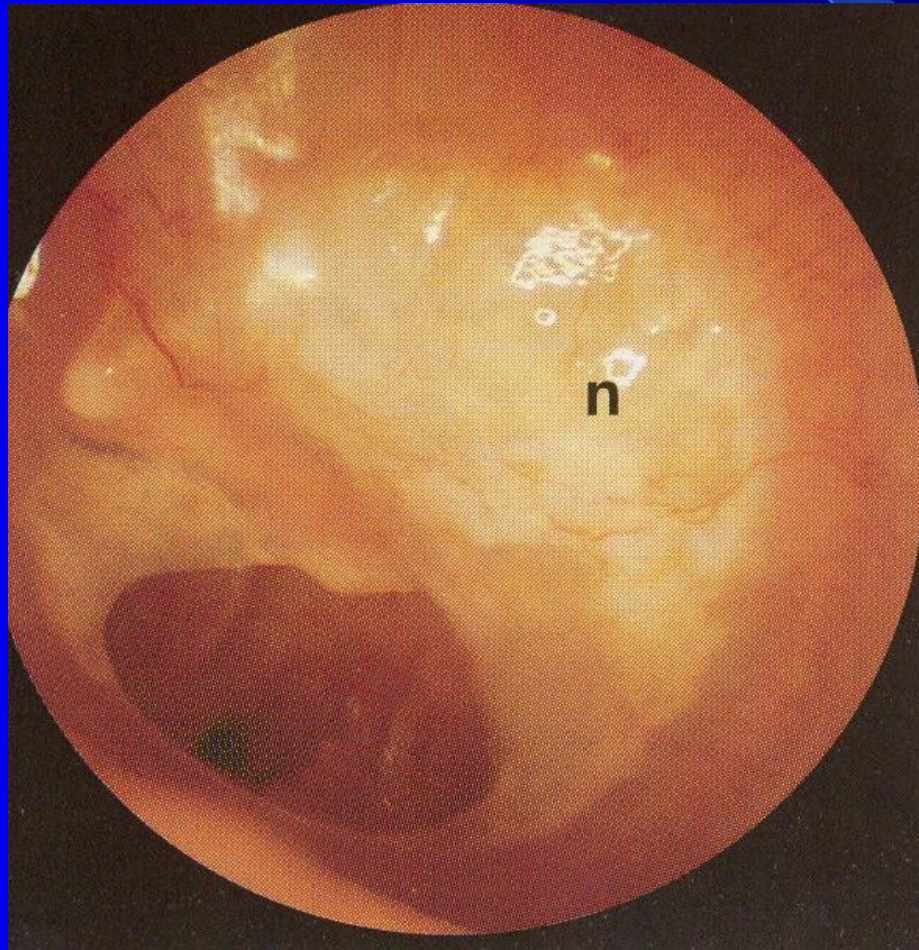
Tympanojugular chemodectoma



Central perforation

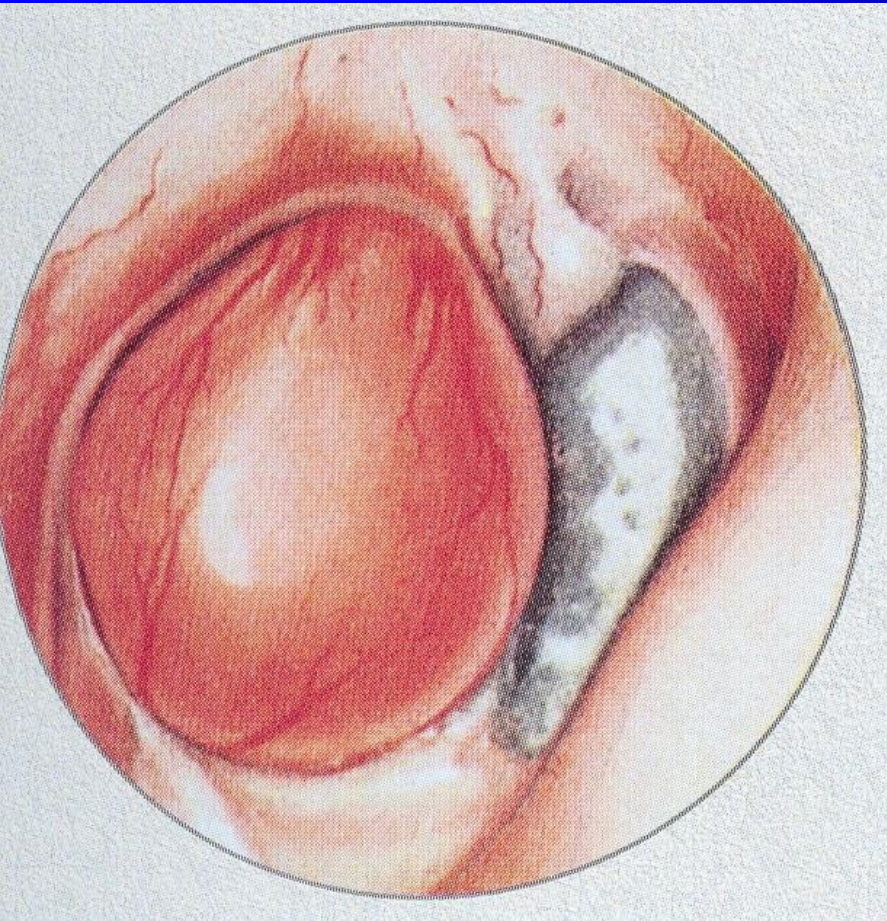


Central perforation in antero-inferior quadrant



Velký stopkatý polyp u chro. zánětu středouší

Defekt epitympanálních prostorů po odstranění cholesteatomu



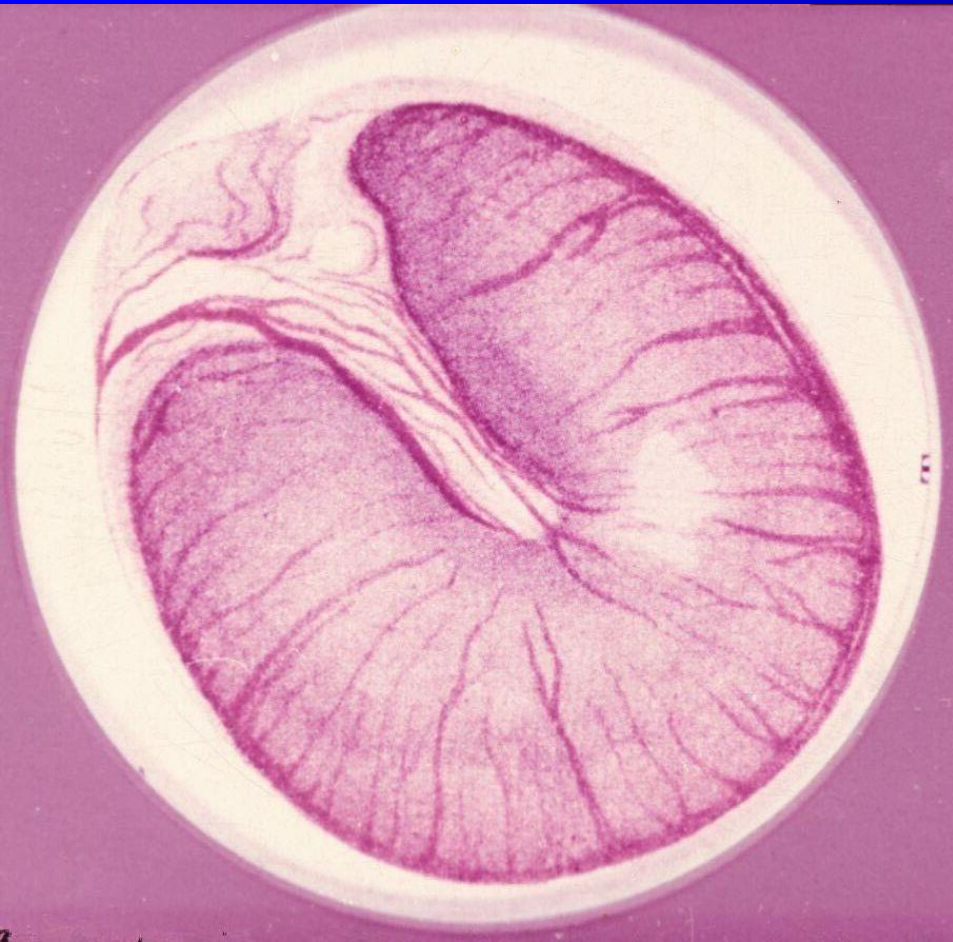
**Hemotym
panum,
vpáčený
bubínek**



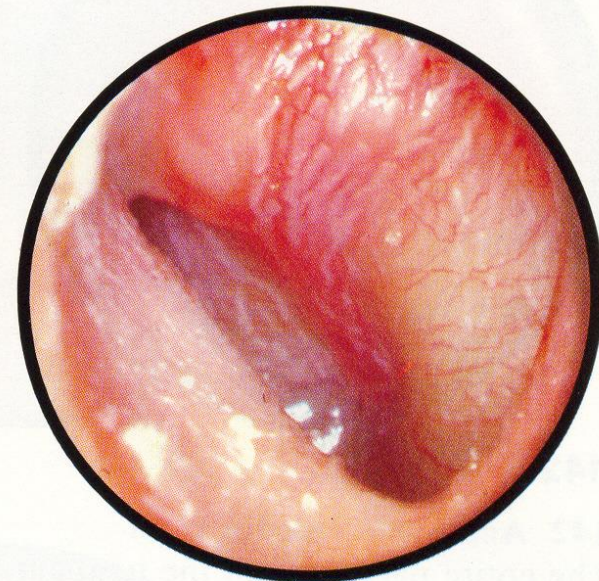
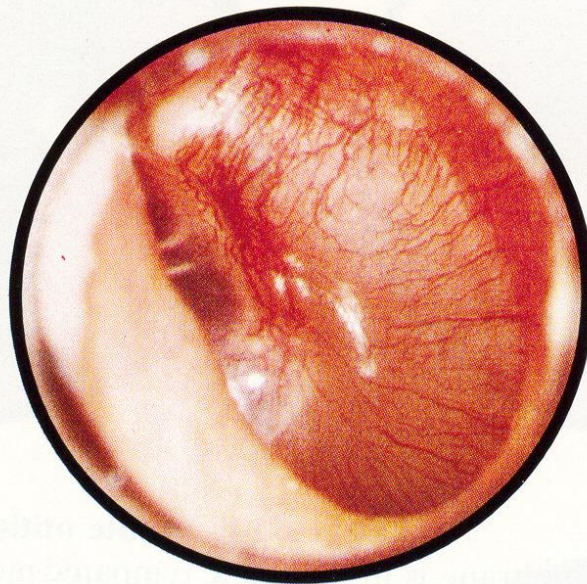
Traumat.
perforace



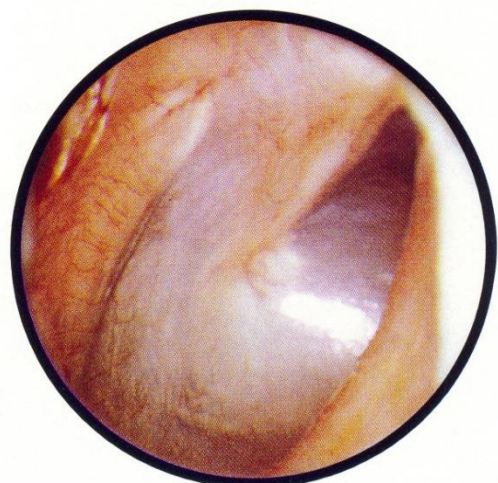
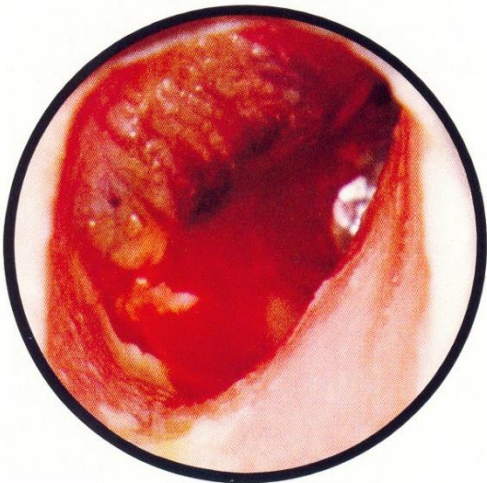
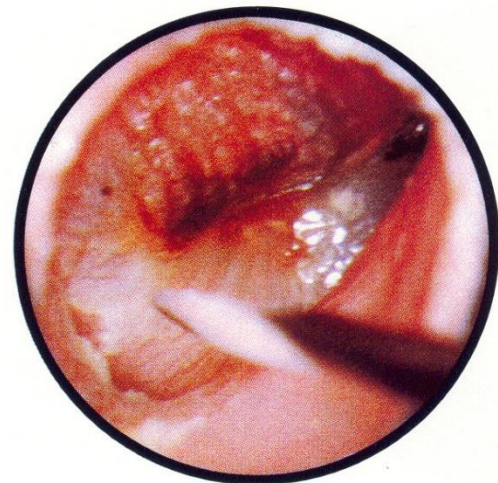
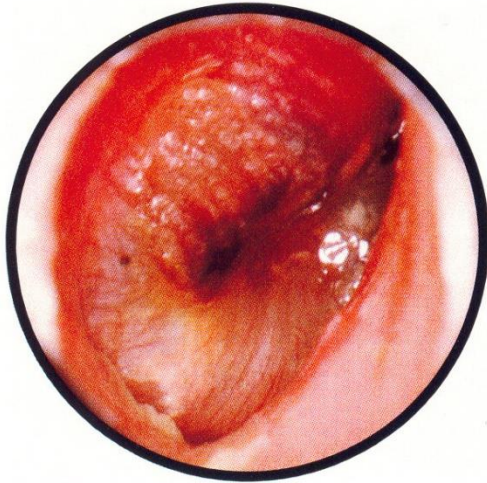
Otitis media acuta



Otitis med. ac. l. sin. – progressive inflam. changes



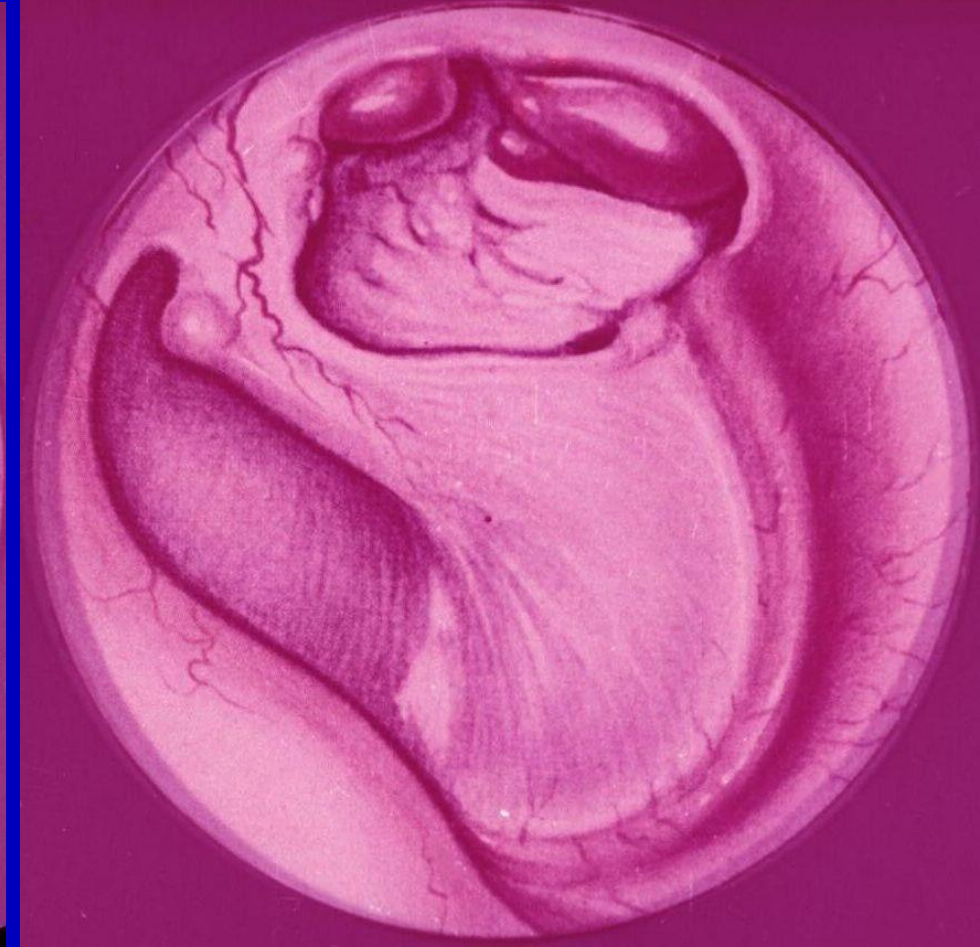
Otitis med. ac. sin. with myringotomy and restitution



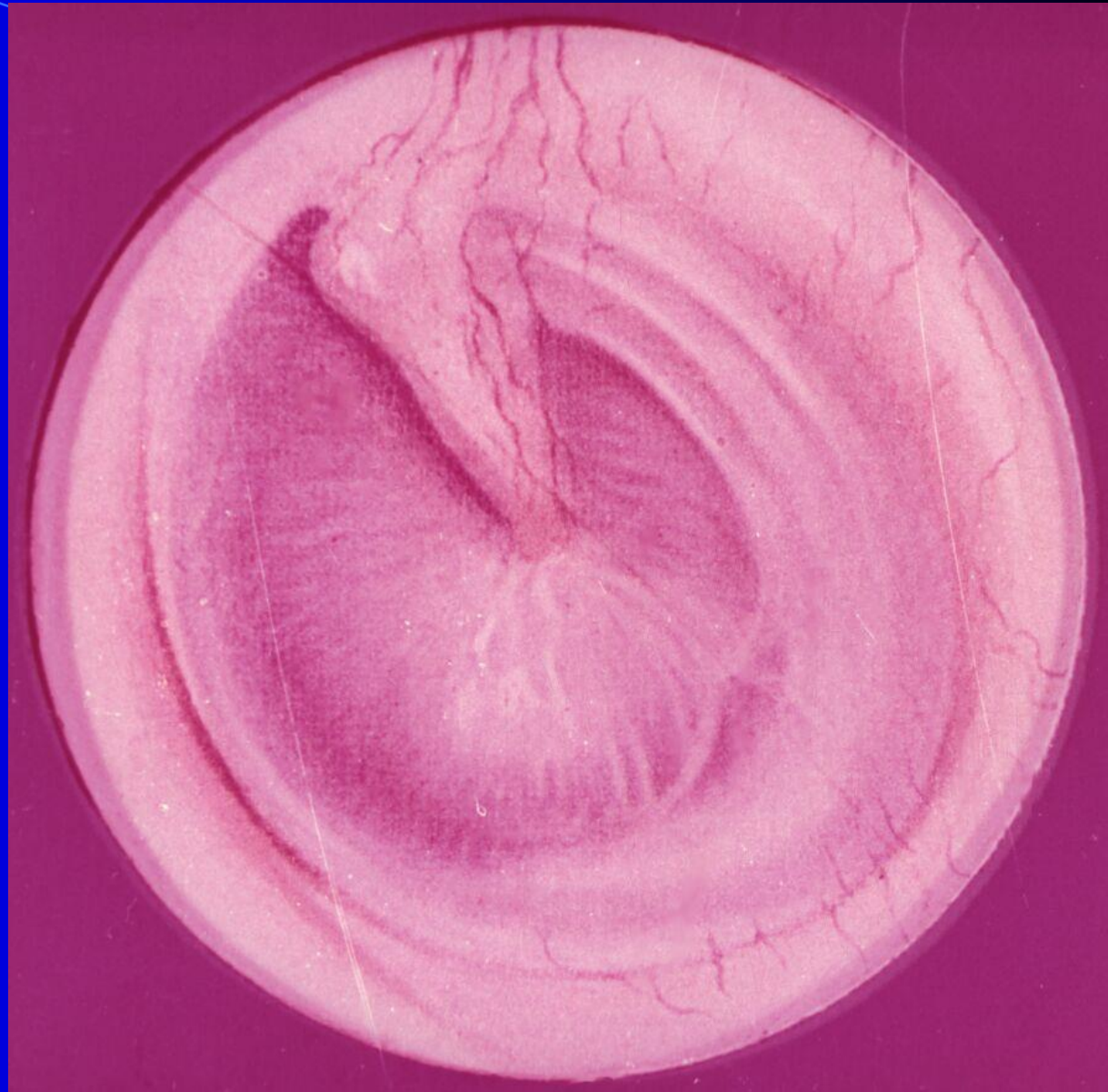
Paracentesis



Perforation of ear drum



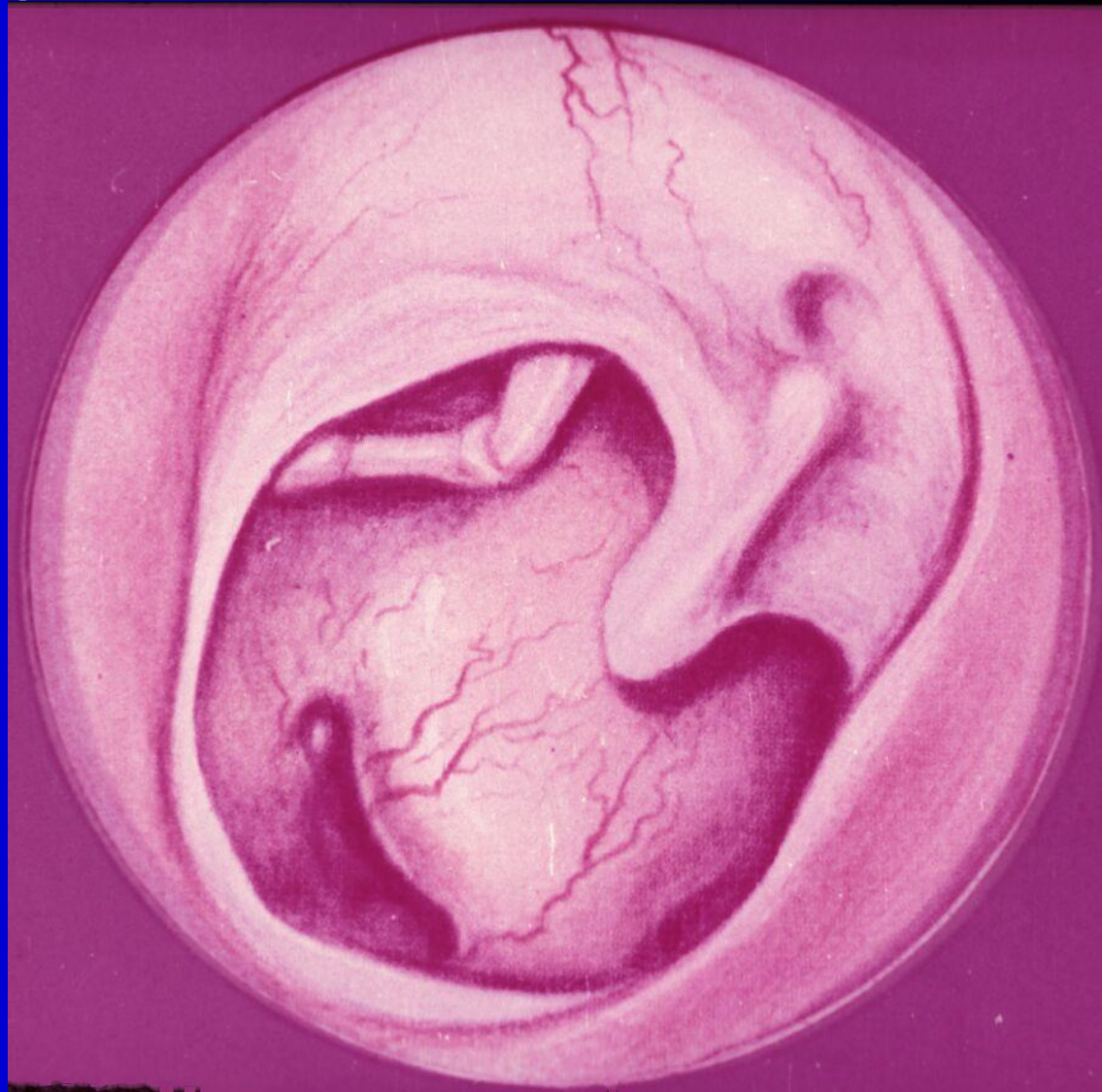
**Scared
thickened
ear drum
after otitis**



**Scared
thickened
ear drum
with
calcification**



Subtotal perforation of ear drum



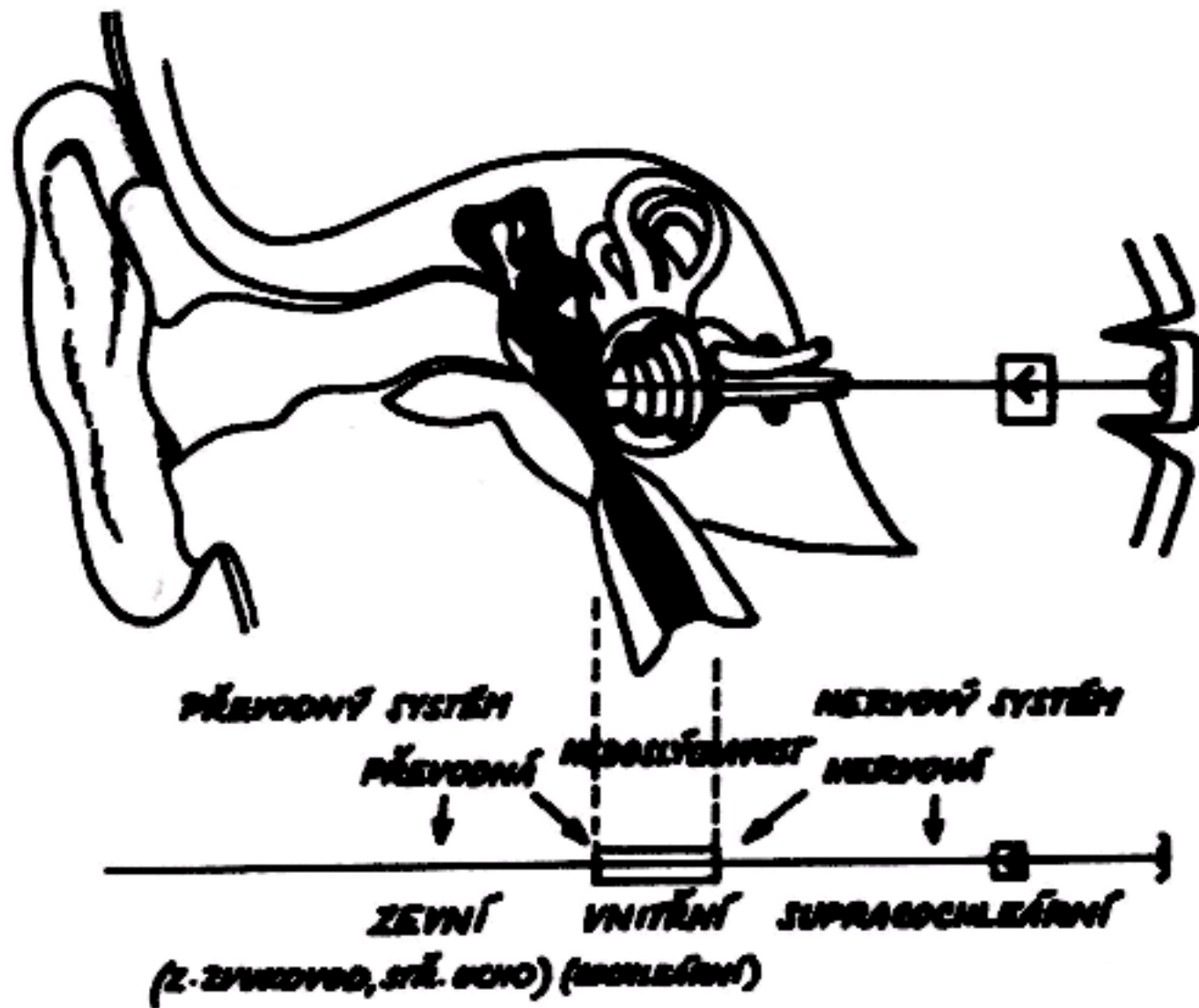


Schéma sluchového analyzátoru

Basic types of hearing disorder

Sensorineural deafness

Weber unto better hearing
Rinne positive
Schwabach shorter

Conductive hearing loss

Weber unto worse hearing
Rinne negative
Schwabach longer

Mixed hearing loss

Schwabach shorter
Rinne negative

Peripheral

until entry the VIII nerve
into brainstem

Central

Central hearing pathways
and centers

Retrocochlear

Cochlear

Basic types of hearing disorder

P		L
4	V	10
0,5	Vs	10
	→W→	
	+ R +	
zkr.	Sch	norm

Hypacusis perceptiva (Sensorineural deafness)

Weber unto better hearing ear

Rinne posit

Schwabach shorter

Peripheral = until entry the VIII nerve into brainstem Retrocochlear

Central = central hearing pathways and centers Cochlear

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

Hypacusis conductiva (Conductive hearing loss)

Weber unto worse hearing ear

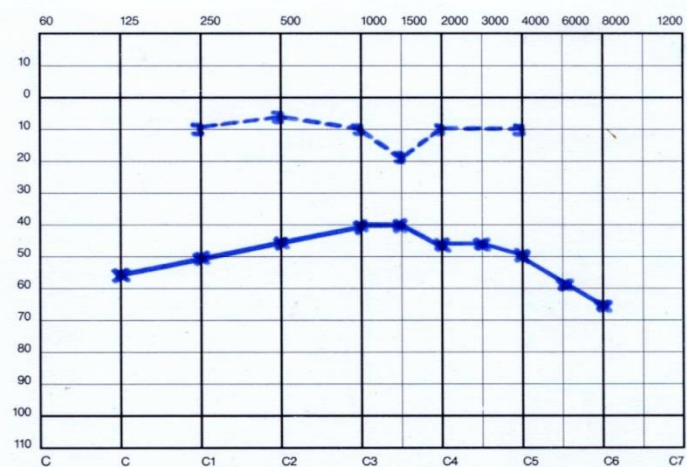
Rinne negat

Schwabach longer

Hypacusis mixta (Mixed hearing loss)

Schwabach shorter

Rinne negat.



AUDIOGRAM

Číslo 1-5. dubna 2004

Razítko ústavu:

111

Jméno: Dne .. / .. / 20 ..

Bydliště: Adamov rodné č.: ..

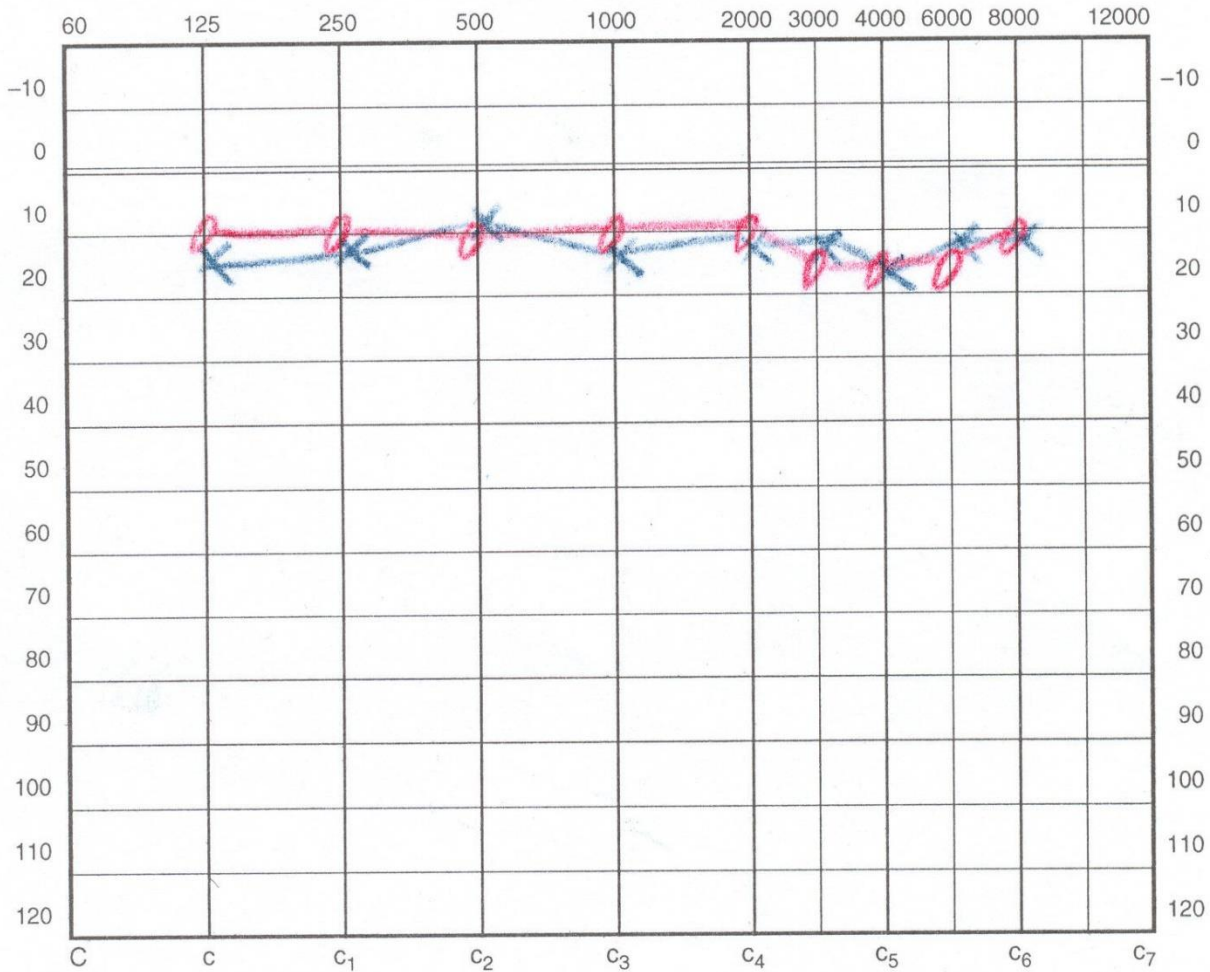
Audiometr

AL-40

Č. ambulant. protokolu

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

	Vpravo	Vlevo
Ztráta sluchu v %		
Celk. ztráta v %		



Srovnání hlasitosti

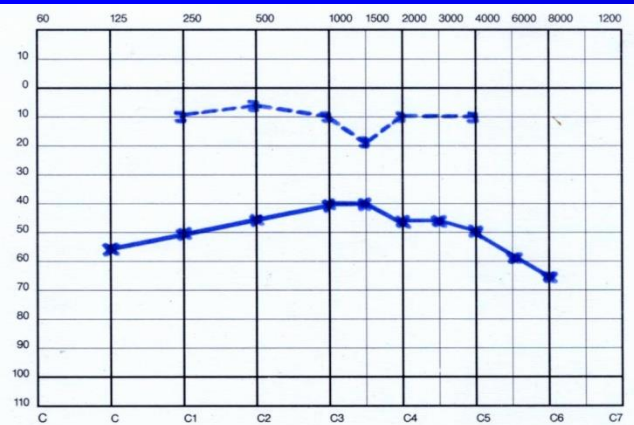
Ztráta sluchu v decibelech

Poznámky:

Jan!
podpis

Hypacusis

Conductive Sensorineural Mixed



- 6. dubna 2004!

AUDIOGRAM

Číslo

Razítko ústavu:

111

Jméno:

Dne / / 20

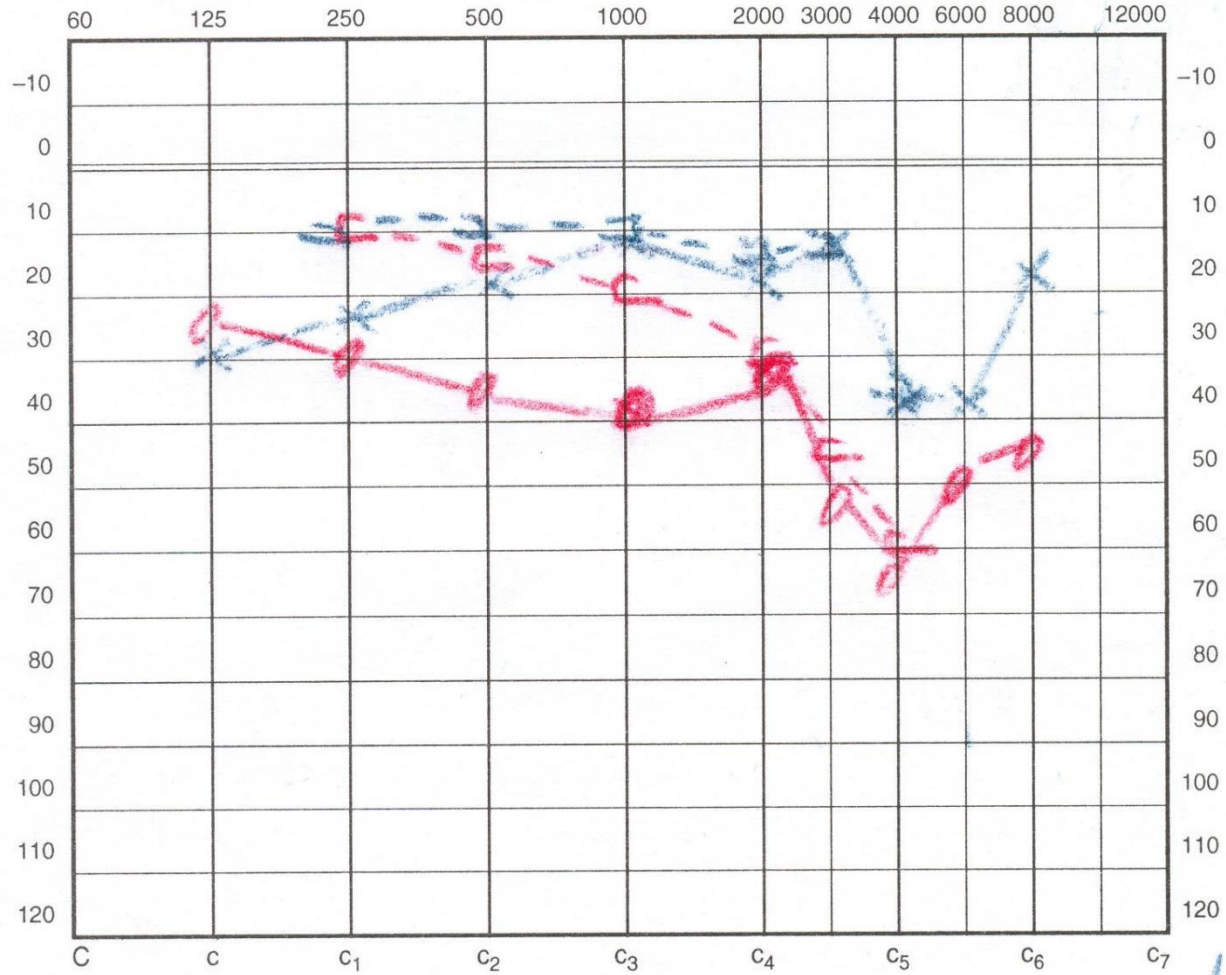
Bydliště:

IVANOVICE

rodné č.:

Srovnání hlasitosti

Ztráta sluchu v decibelech



Audiometr
AC-40

Č. ambulant. protok

Vedení	vzduchem	kosť
Vpravo	- o -	[
Vlevo	- x -]

Vpravo	Vlevo

Ztráta sluchu v %

Celk. ztráta v %

Poznámky:

Jan Kus
podpis

OLPRINT ŠLAPANICE 307

AUDIOGRAM

Číslo

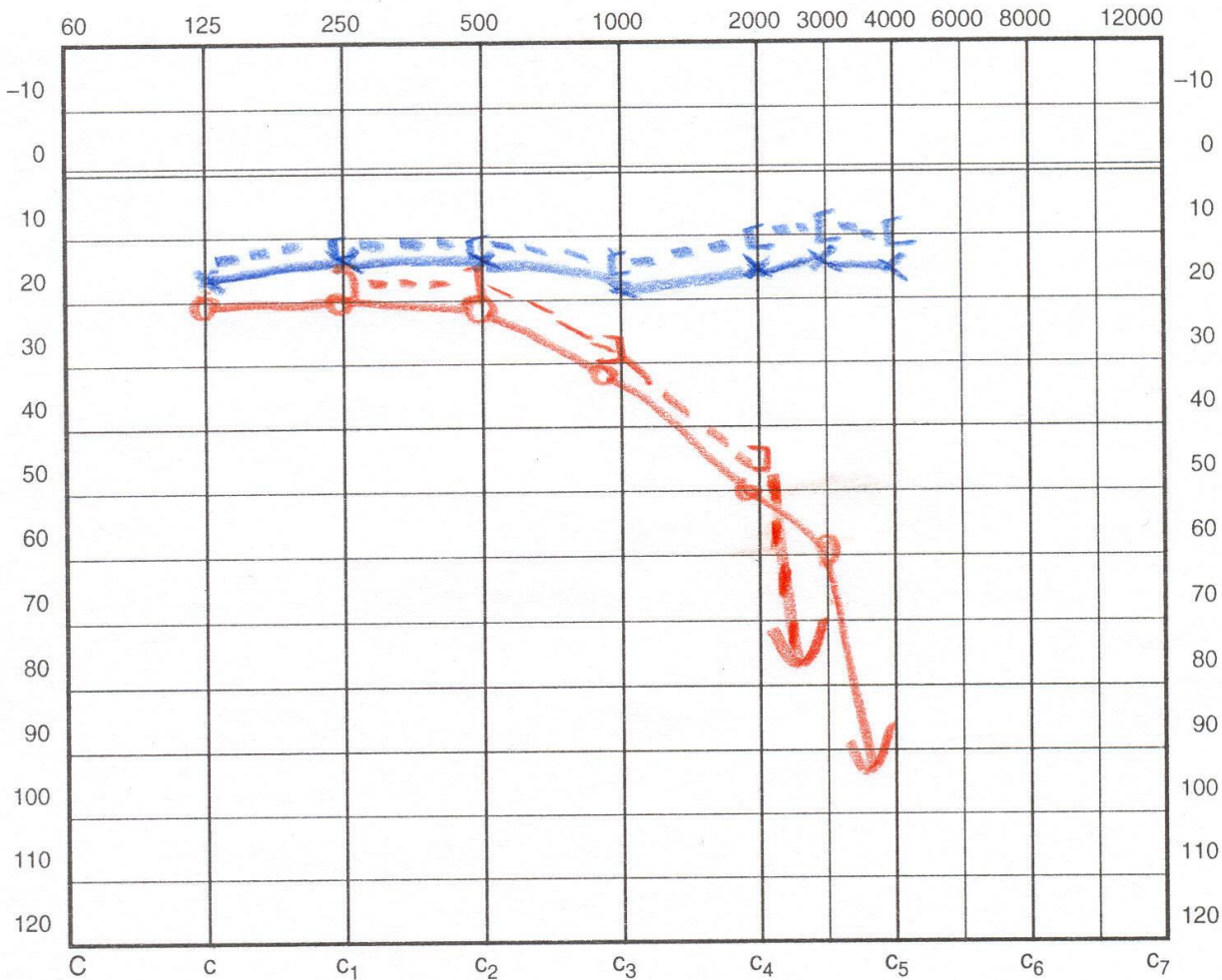
Razítko ústavu:

Jméno: Dne / / 20

Bydliště: rodné č.:

Srovnání hlasitosti

Ztráta sluchu v decibelech



Audiometr

Č. ambulat. protokolu

Vedení	vzduchem	kost
Vpravo	- o -	[
Vlevo	- x -]

Vpravo	Vlevo

Ztráta sluchu v %
Celk. ztráta v %

Poznámky:

..... podpis

AUDIOGRAM

MILAN

Číslo

20. března 2004

111

Razítko ústavu:

Jméno:

Dne / / 20

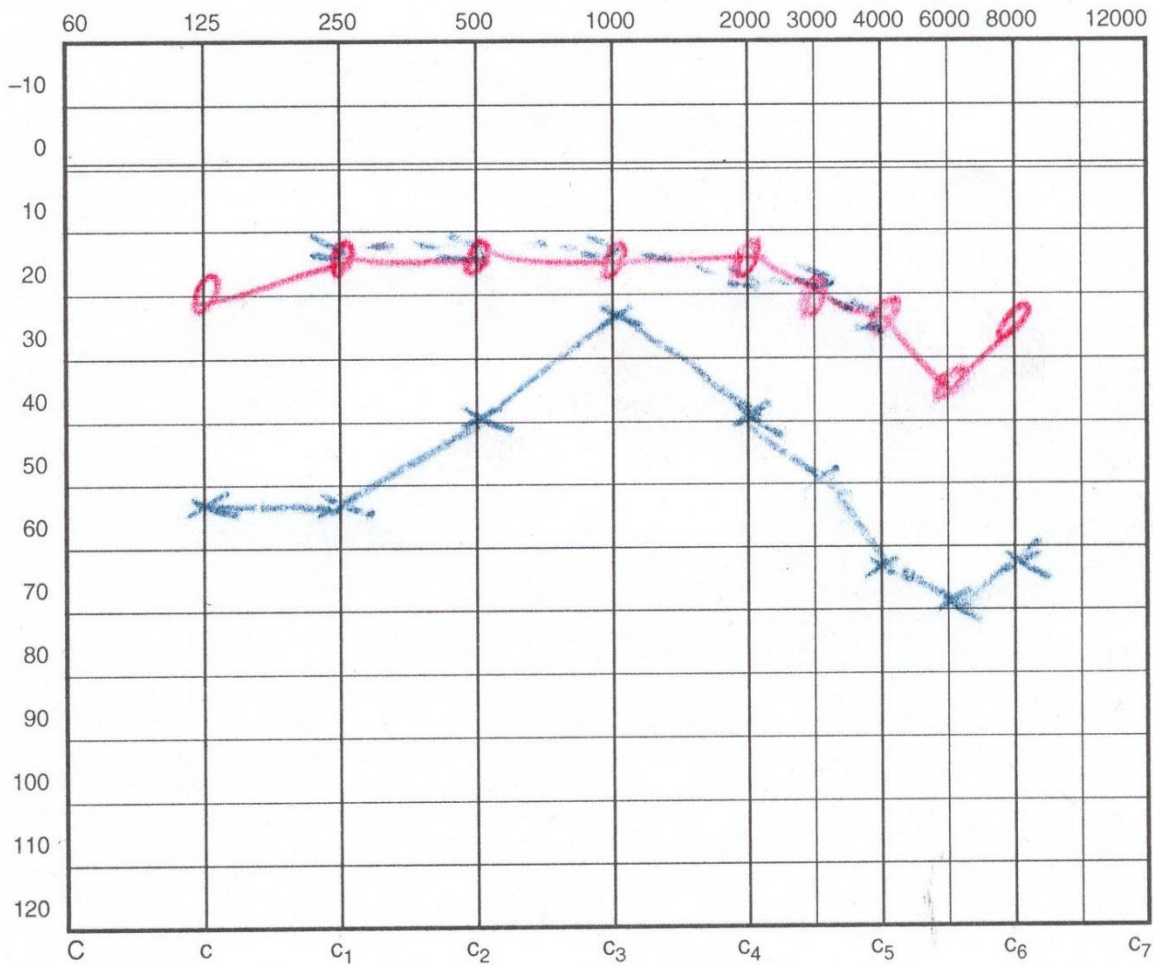
Bydliště:

BRNO

rodné č.:

Srovnání hlasitosti

Ztráta sluchu v decibelech



Audiometr

AC-40

Č. ambulat. protokolu

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

	Vpravo	Vlevo
Ztráta sluchu v %		
Celk. ztráta v %		

Poznámky:

Milan Zl

podpis

Razítko ústavu:

AUDIOGRAM

90/60/90/120 (1a)

Číslo

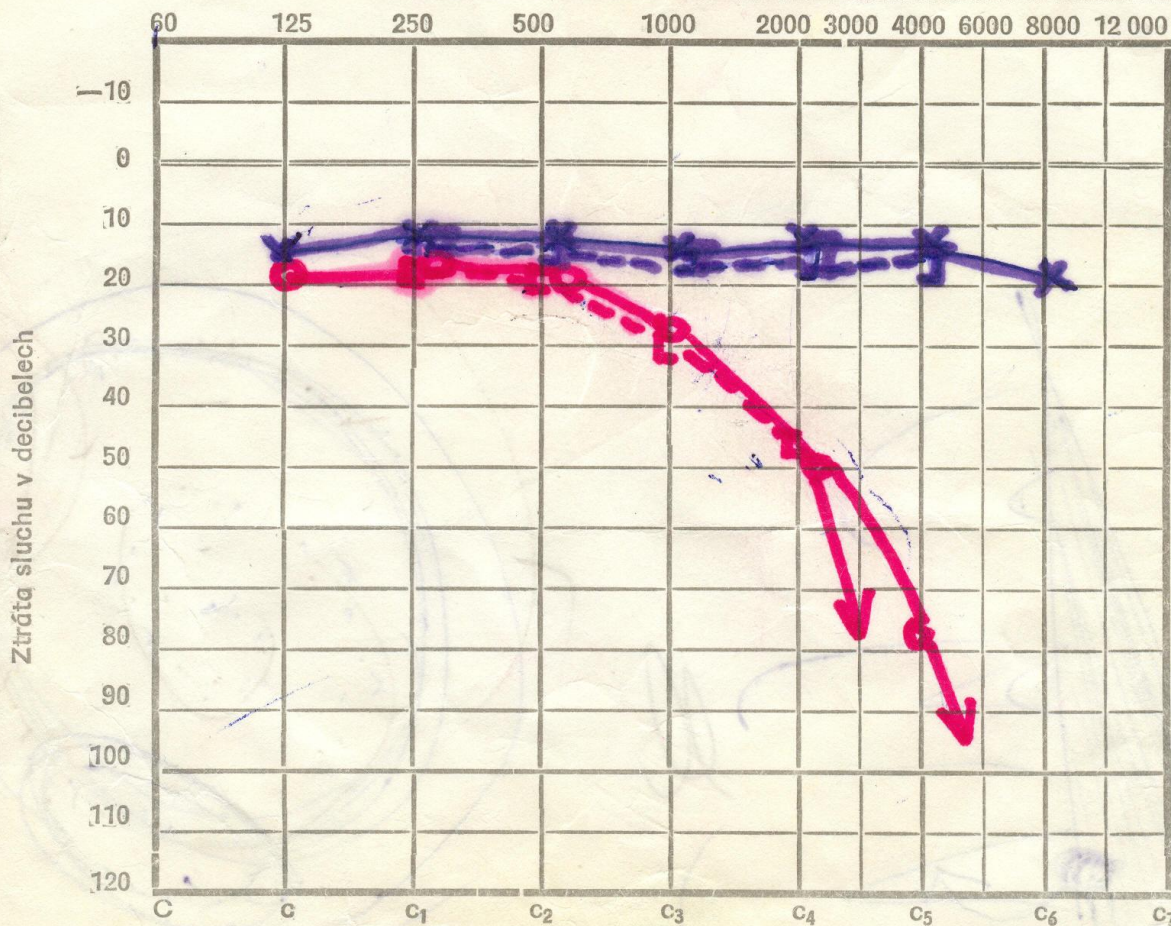
Jméno: Zuzana Tichelová (Live)

věk 15 r.

Dne 21.12. 2000

Diagnóza:

Srovnání hlasitosti



Audiometr

C. ambulant. protokolu

Vedení	vzduchem	kostí
Vpravo	-O-	[
Vlevo	-X-]

Vpravo	Vlevo
Ztráta sluchu v %	
Celk. ztráta v %	

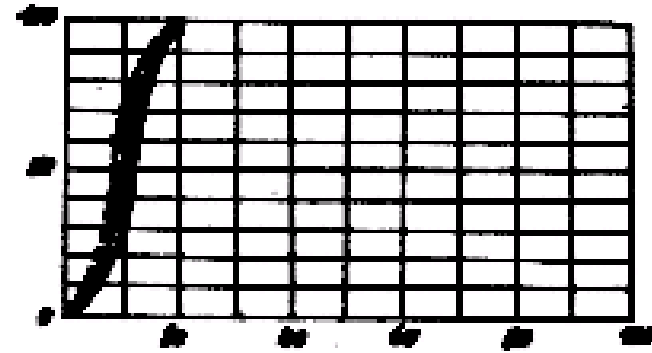
Poznámky:

podpis

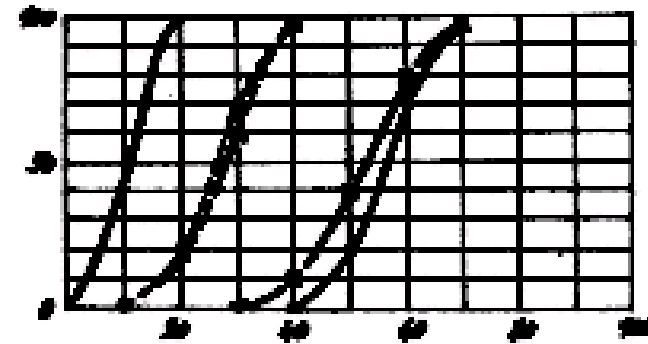
Speech audiometry

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

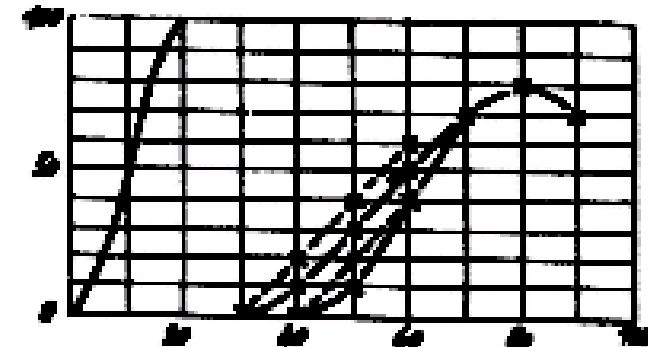
Normal hearing



Fluctuating deafness

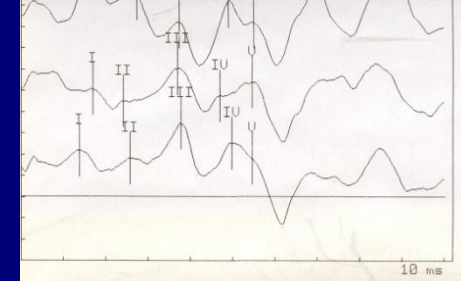
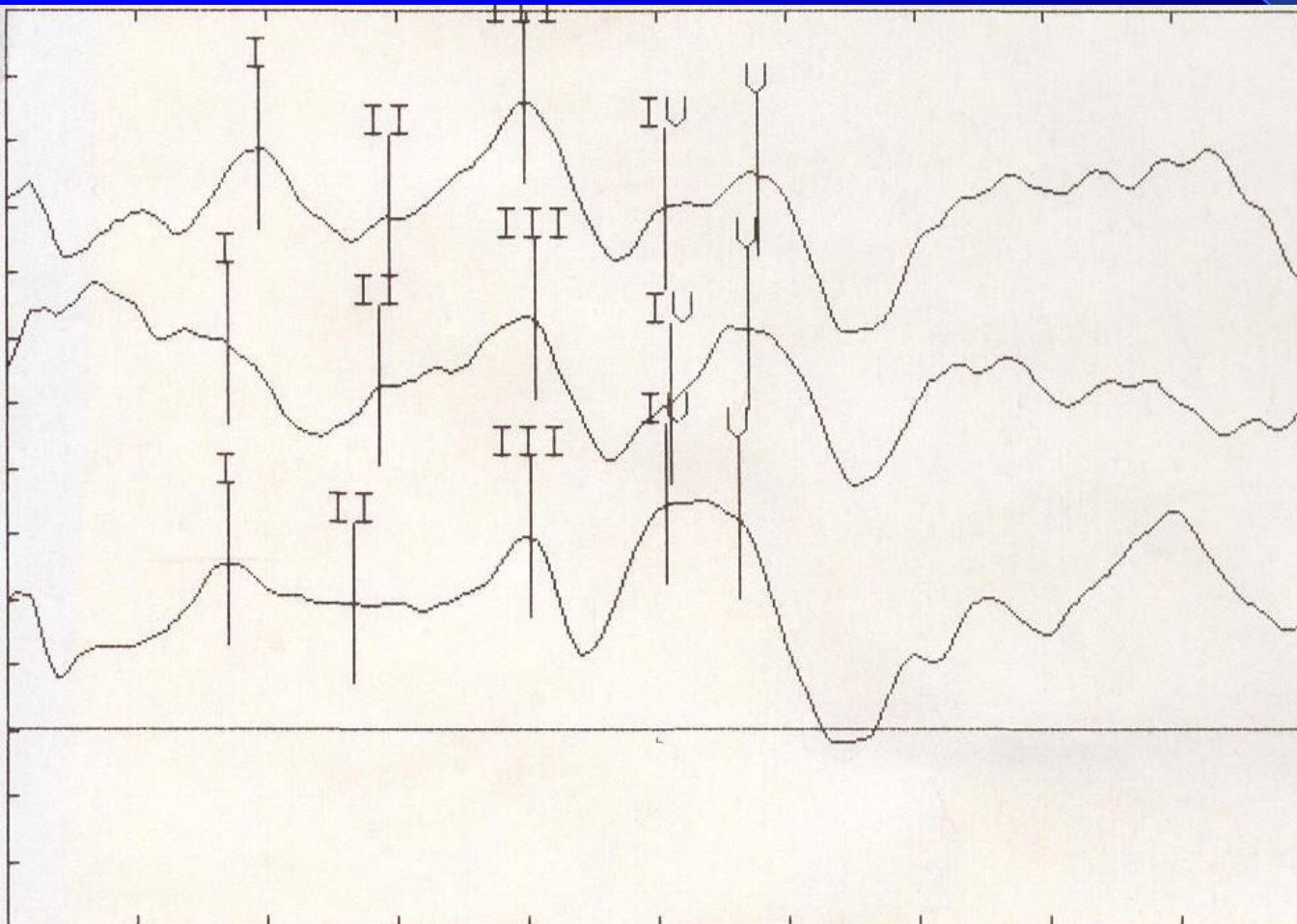


Normal deafness



BERA

–prodloužená latence o 0,2 ms –
suspekce na malý neurinom n. VIII



SENSITIVITY		SIDE		LABEL	
1	100 nV/div	1	LEFT	1	
2	100 nV/div	2	LEFT	2	
3	100 nV/div	3	LEFT	3	

LAT	
L1	00.00 ms
L2	00.00 ms
L3	00.00 ms

STIMULUS	INTENSITY	FREQUENCY	MASKING
1	CLICK 100 dB ReSPL	1	50 dB SPL
2	CLICK 110 dB ReSPL	2	60 dB SPL
3	CLICK 120 dB ReSPL	3	70 dB SPL

# OF SUMS	RATE	POLARITY
1	2000	1
2	2000	2
3	2000	3

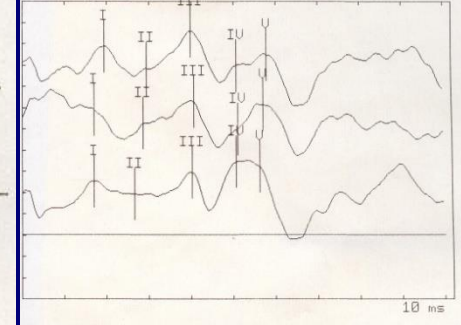
LAT	I	II	III	IV	U
1	1.600 ms	2.760 ms	3.760 ms	4.920 ms	5.520 ms
2	1.720 ms	2.440 ms	3.720 ms	4.720 ms	5.480 ms
3	1.400 ms	2.600 ms	3.800 ms	5.000 ms	5.480 ms

DIFF	I-III	III-U	I-U
1	2.080 ms	1.760 ms	3.840 ms
2	2.000 ms	1.760 ms	3.760 ms
3	2.400 ms	1.680 ms	4.080 ms

AMP	A1	A2	A3	A4	A5
1	00.00 nV	00.00 nV	00.00 nV	00.00 nV	00.00 nV
2	00.00 nV	00.00 nV	00.00 nV	00.00 nV	00.00 nV
3	00.00 nV	00.00 nV	00.00 nV	00.00 nV	00.00 nV

DELTA	A3-A1	A5-A3	A5-A1
1	00.00	00.00	00.00
2	00.00	00.00	00.00
3	00.00	00.00	00.00

ORL klinika FN u sv. Anny v Brne; otoneurologie
MODALITY: REP TEST: EARLY REP
PATIENT: DATE: 04-06-1904



SENSITIVITY		SIDE		LABEL	
1	100 nV/div	1	RIGHT	1	
2	100 nV/div	2	RIGHT	2	
3	100 nV/div	3	RIGHT	3	

Sensorineural hearing loss

Dle průběhu audiometrické křivky

- Basokochleární
- Pankochleární
- Apikokochleární
- Mediokochleární

Dle lokalizace léze

- Kochleární
- Retrokochleární



Cochlear lesion

- bothering, but not life threatening

Retrocochlear lesion

- bothering, but also they could life threaten

Sensorineural hearing loss **cochlear**

= damage of cochlear structures

- **Etiology:**

- **Presbycusis**
- **Heredodegenerativní**
- **Nois damage**
- **Toxic damage**
- **Menier´s disease**
- **Acute sensorineural hearing loss**
- **... atd.**

Sensorineural hearing loss

retro- (supra-) cochlear

= damage of structures proximal from cochlea

Etiology:

Demyelination

- atherosklerosa
- sclerosis multiplex

Inflammation

- boreliosa
- neurovirý
- meningitida
- meningoencefalitida

Tumors

- neurinom akustiku
(vestibulární schwannom)
- meningeom
- jiné nádory MK a koutu MM

Trauma

- komoce, kontuze
- fraktury base lební ... atd

Diferencialni diagnostika ochliva/retroochliva

1. Subjektivni testy:

- vysoce namahavé
- aktivni spolupráce pacienta
- složitá pro pochopení
- relativně nízká validita

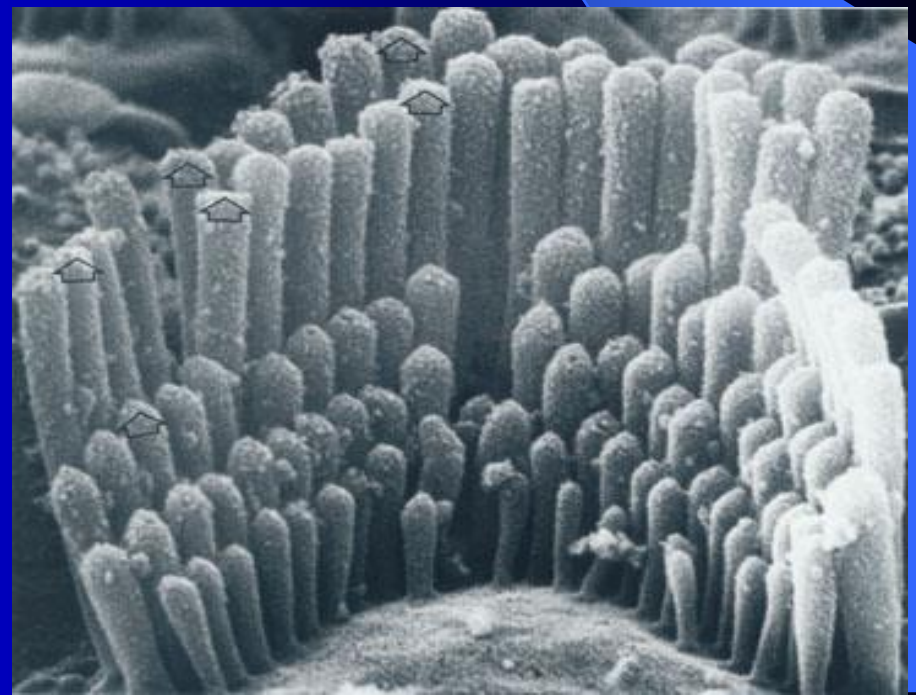
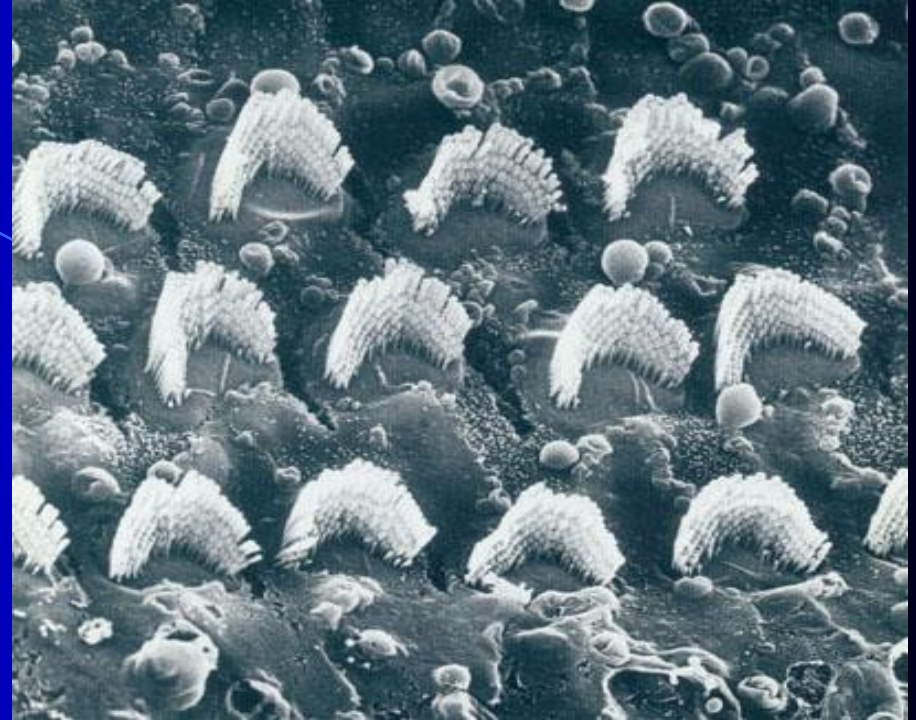
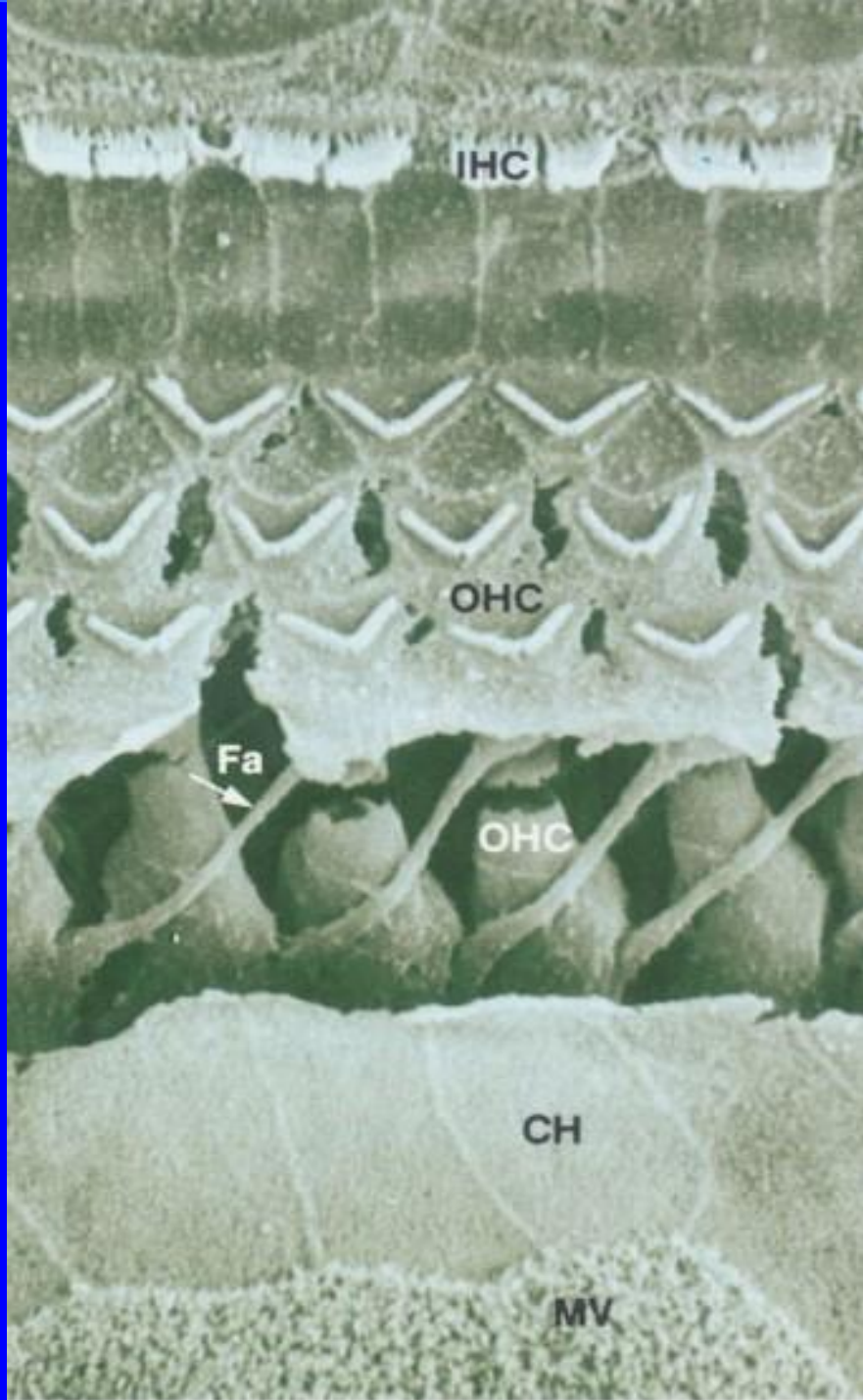
2. Objektivni testy :

- časově obvykle méně náročné
- vyžadují pasivni spolupráci pacienta
- náročné na technické vybavení
- mají vysokou validitu

Subjektivní testy

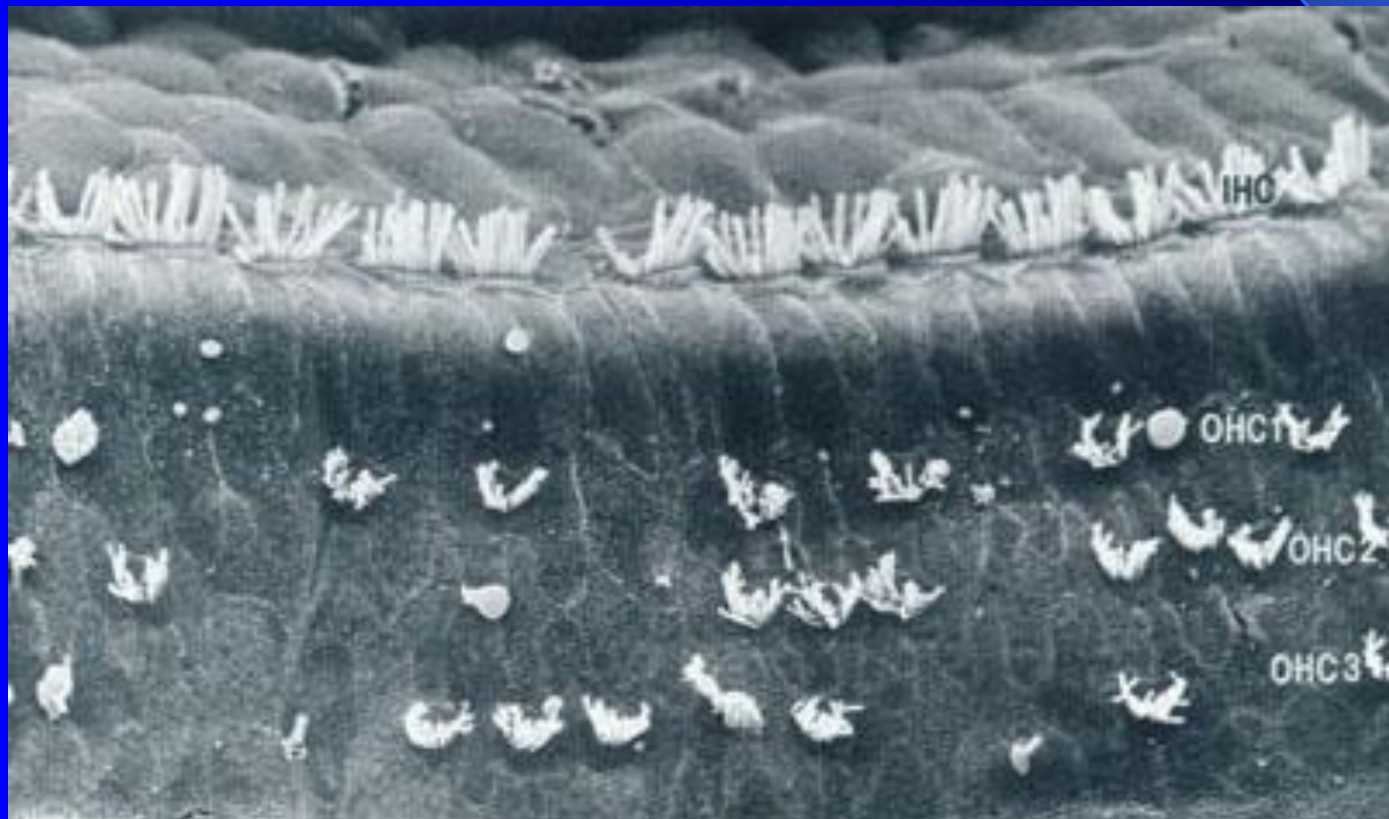
Založeny na principu průkazu:

- **recruitment fenomenu**
- **maskovacího efektu šumu**
- **míry únavnosti sluchového orgánu**



Recruitment phenomenon

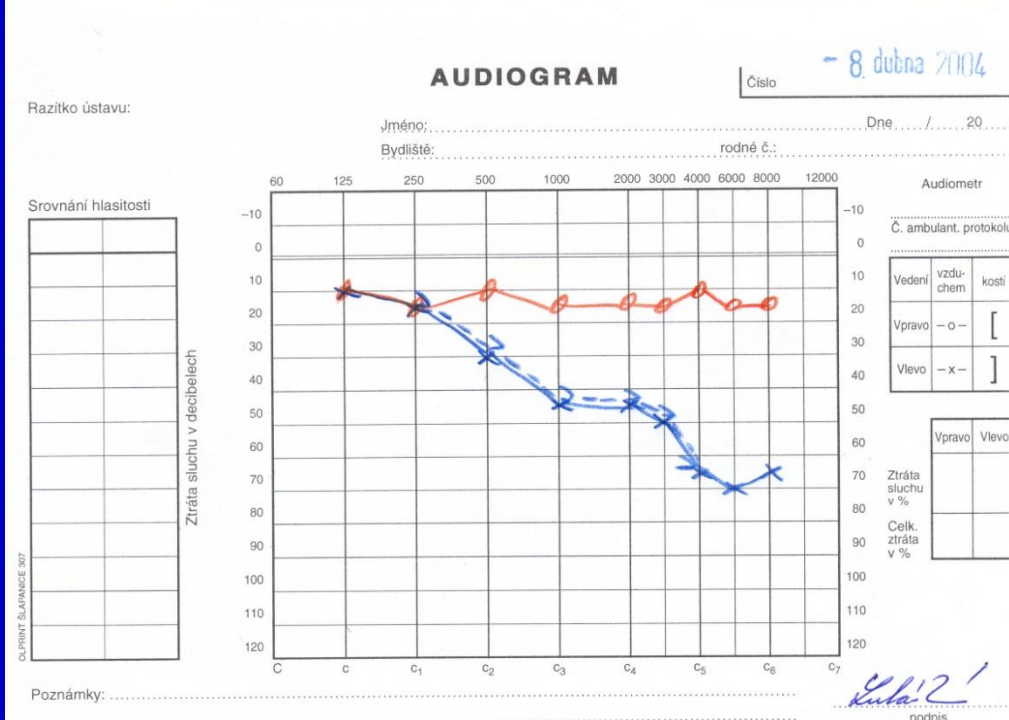
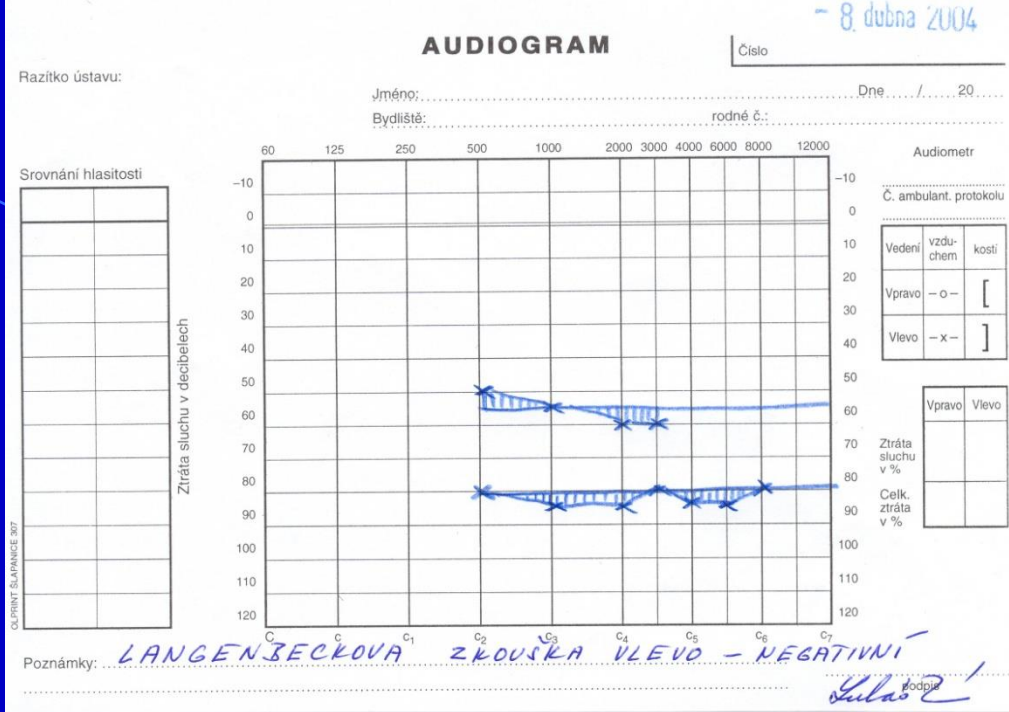
= abnormal increase of loudness in above-threshold in damage of OHC and normal function IHC



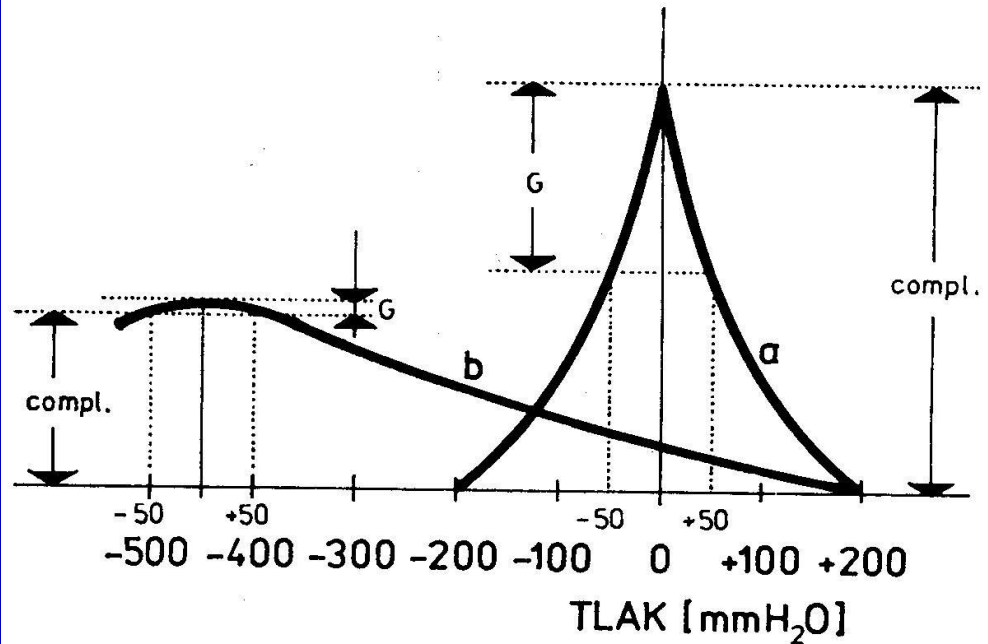
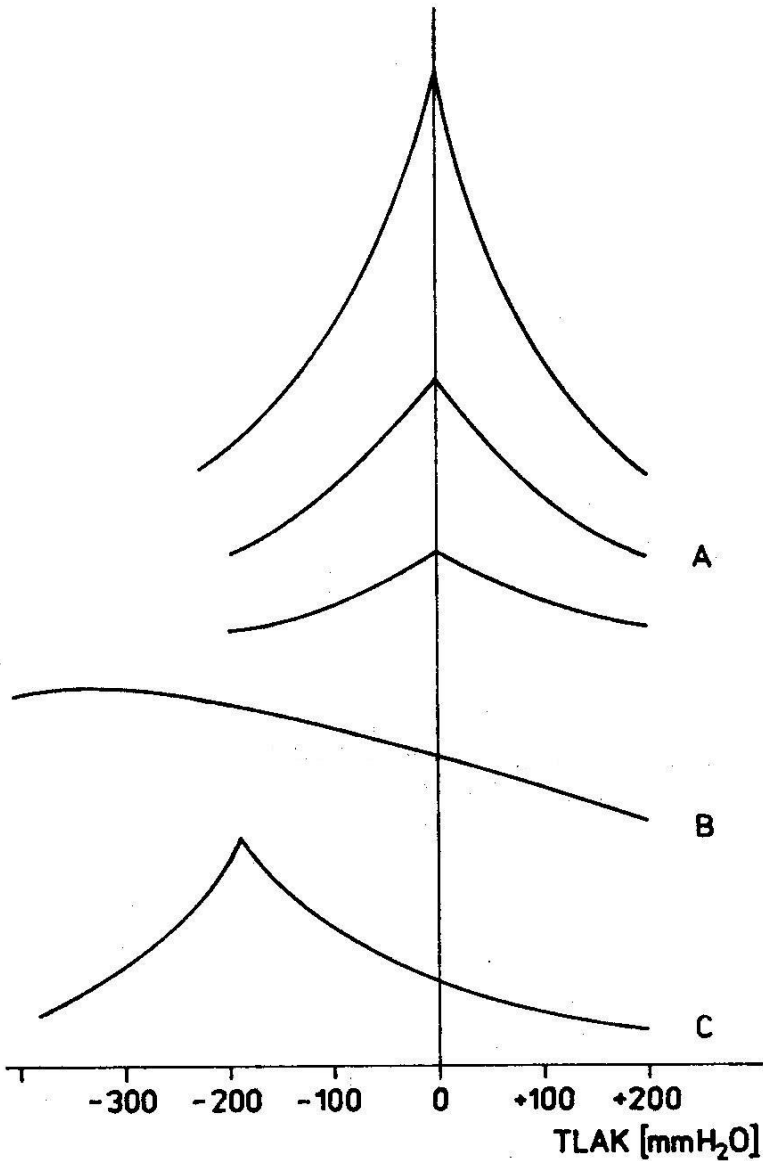
„Hum“ audiometry

Langebeck test

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



Tympanometry



Surgery for otitis media -Sanation surgery

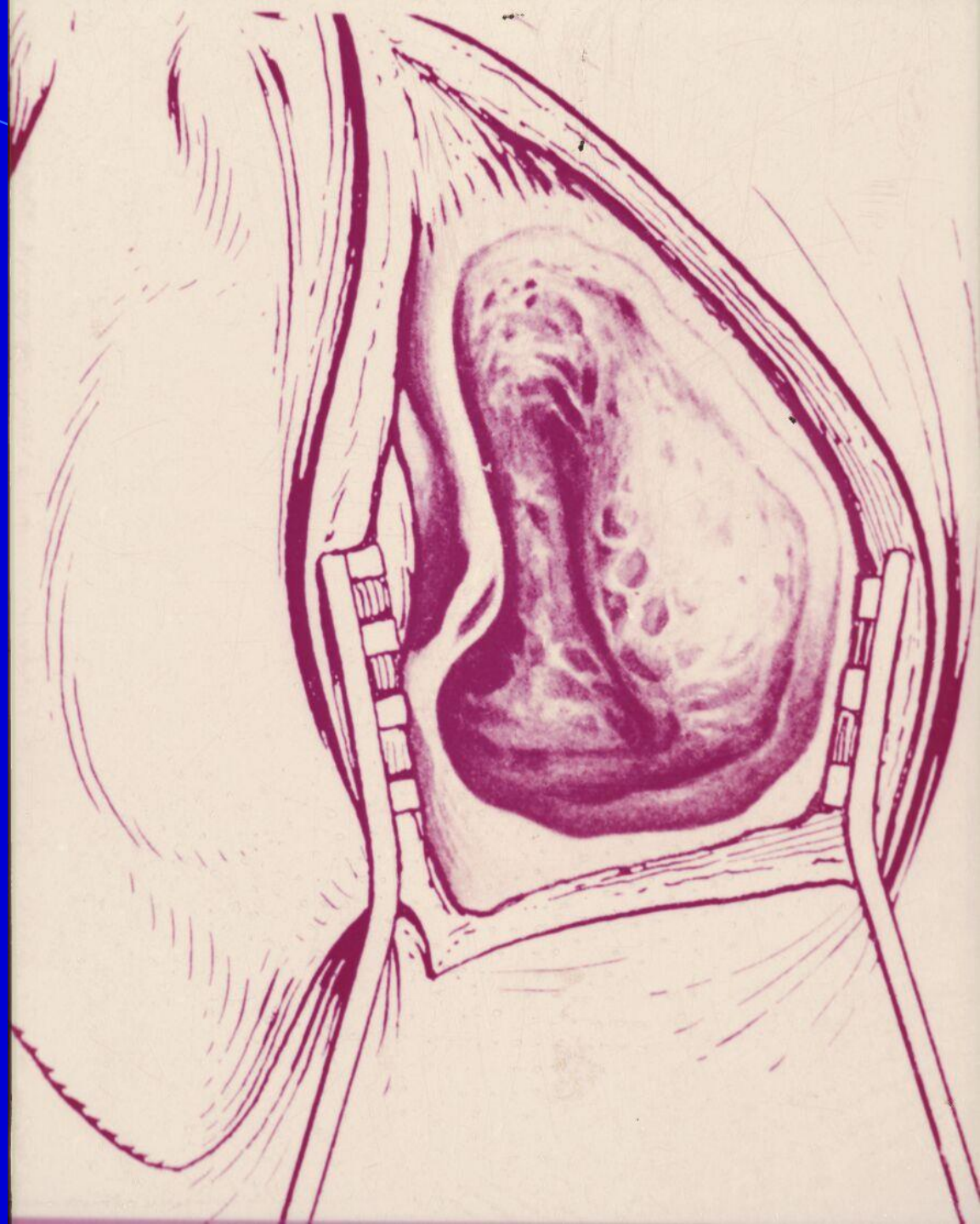
Approach

- **Schwartz** - via planum mastoideum into antrum
- **Stake** - via atticus into antrum
- **Zaufal** – via posterior wall into aditus ad antrum and from this anteriorly and posteriorly

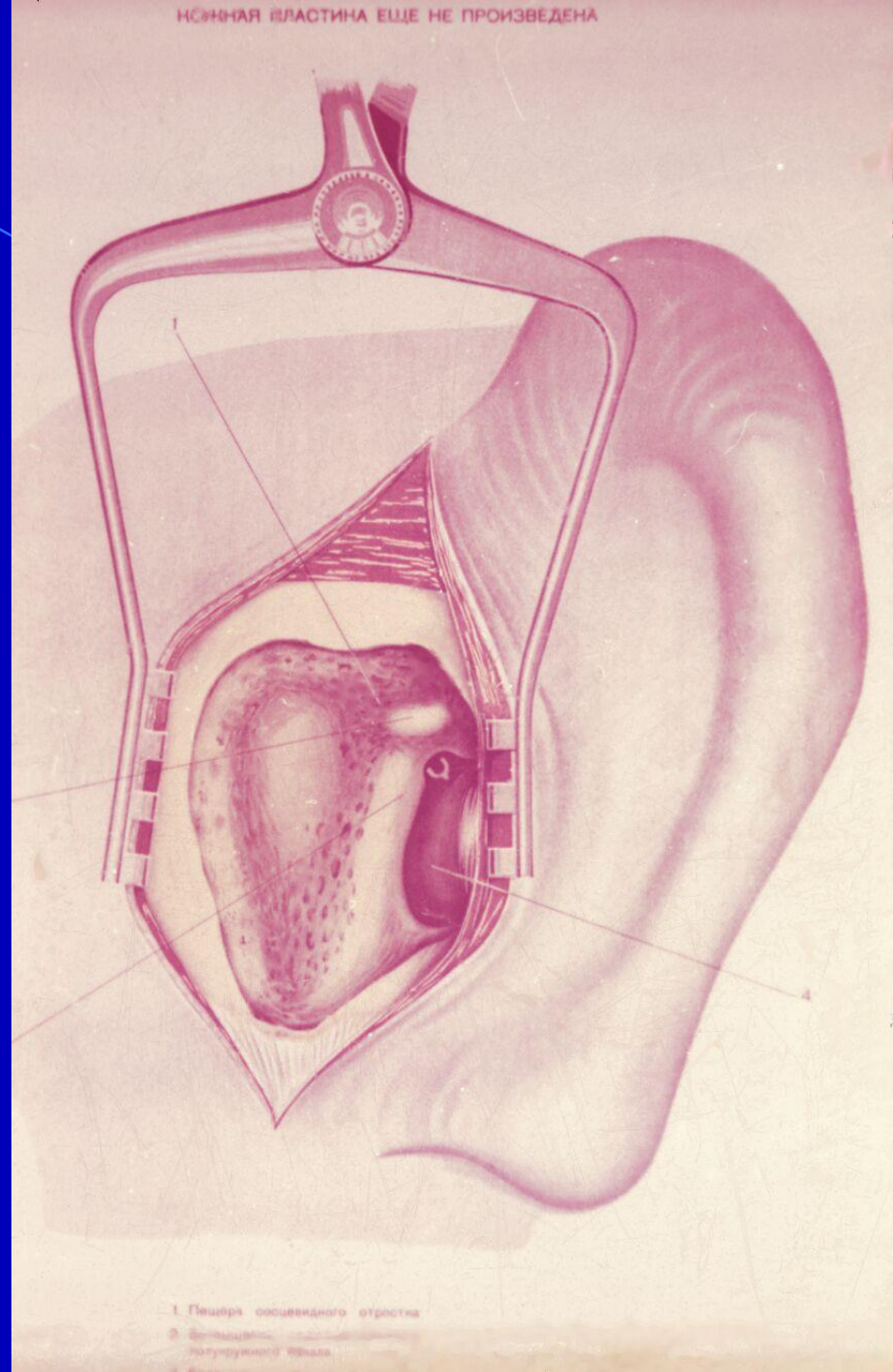
Sanation surgery

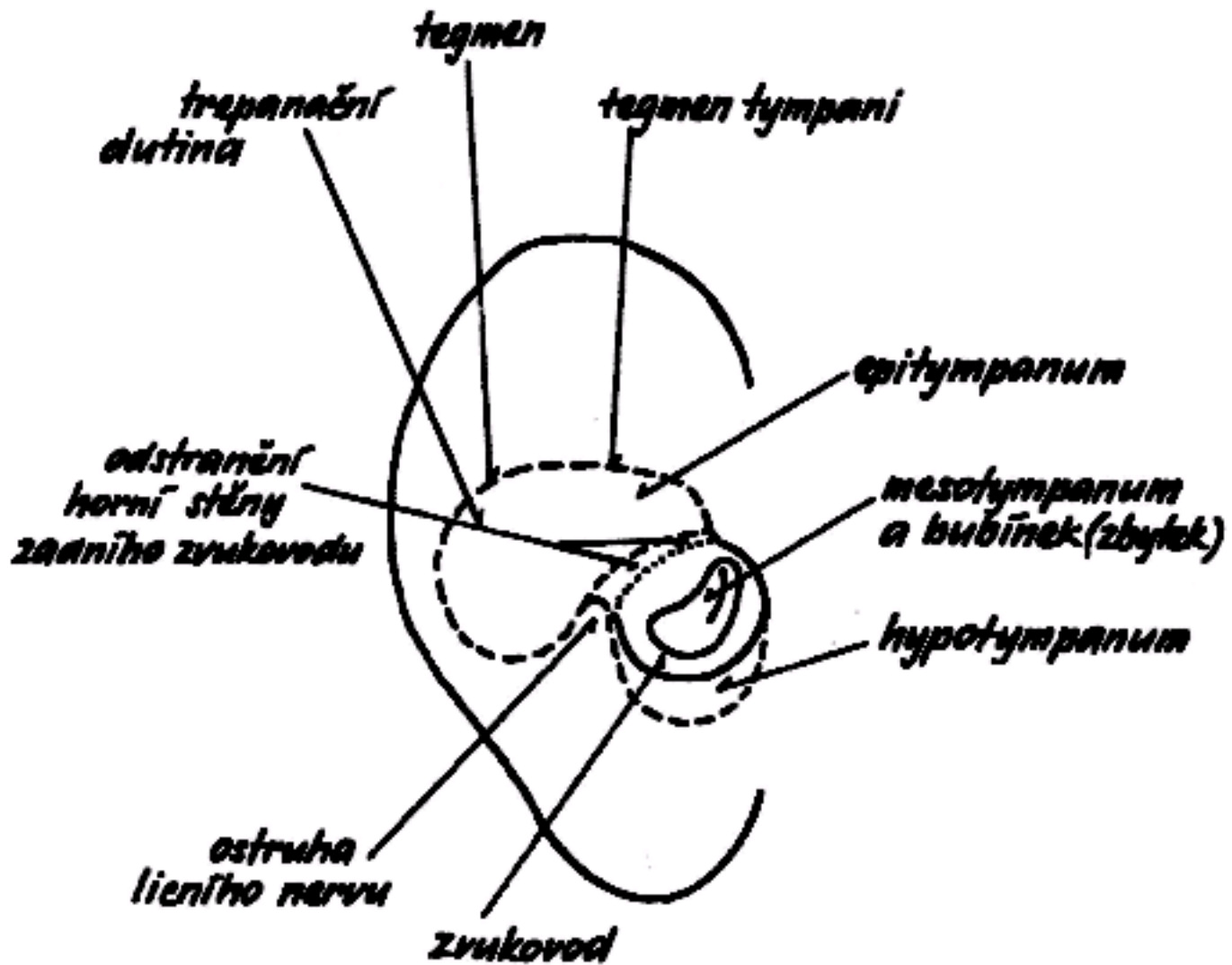
- **atticotomy**
- **meatoantrotomy**
- **atticoantrotomy**
- **tympanomastoidektomy**

**Status
post
mastoid-
ectomiam**



Status post atticoantrotomy I.dx.





Relationship of external meatus to trepanation cavity

Possibility for improvement of hearing by surgery and prosthetics

Improvement of hearing

Middle ear surgery



Middle ear implant



External bone hearing aid



System for direct bone conduction



BAHA



PONTO



Otomag

Hearing aid for air conduction

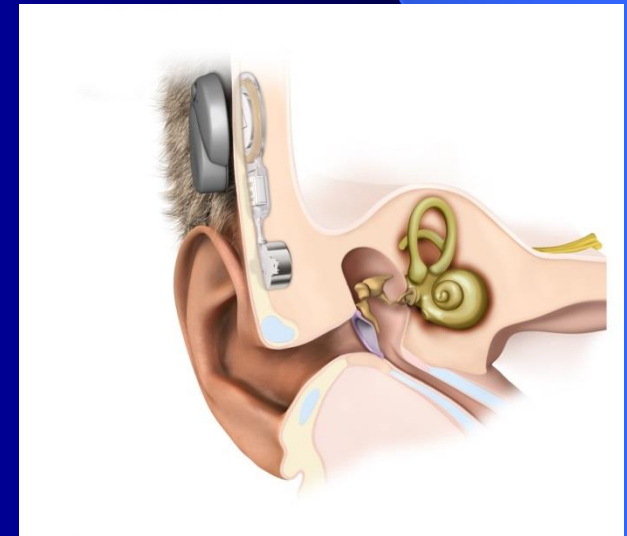
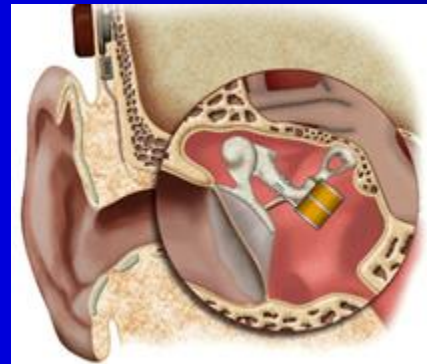


BONEBRIDGE



Implantable hearing aids

- Cochlear implants
- Middle ear implants (MEI)
- Bone conduction implants



Systems for bone conduction

Vibration direct to bone

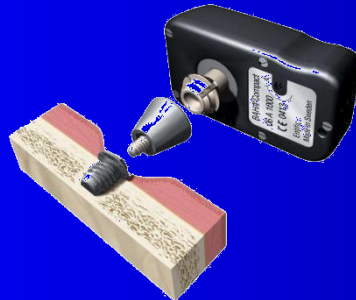
Generating behind skin

System pro kostní vedení s aktivním implantátem (BONEBRIDGE)



Transcutaneous conduction

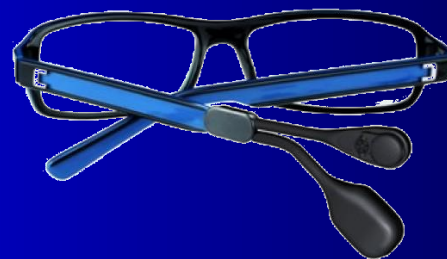
Zevní systém ukotvený v kosti (BAHA)



Vibration over skin

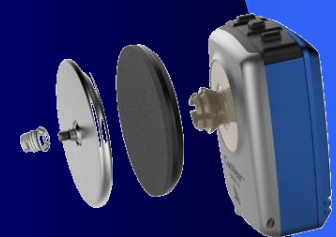
Hold by the pressure from outward

Brýle s kostním vibrátorem
Kapesní sluchadlo s vibrátorem na čelence



Hold by implanted magnet

System pro kostní vedení s pasivním implantátem (BAHA Attract, Sophono)



Solution for first treatment before BB implantation

- Bone conduction headband

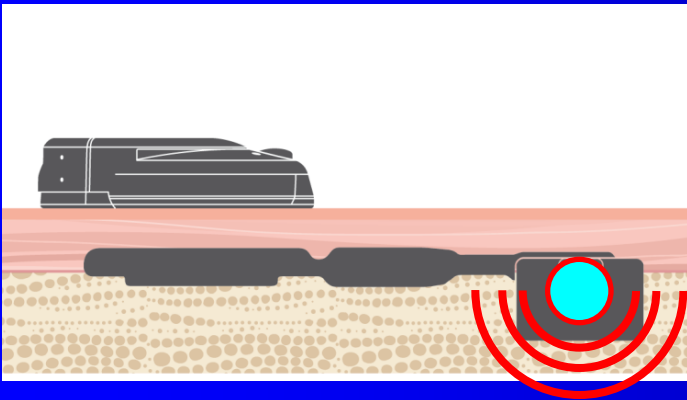
contact.
mini

- Also for preoperative evaluation

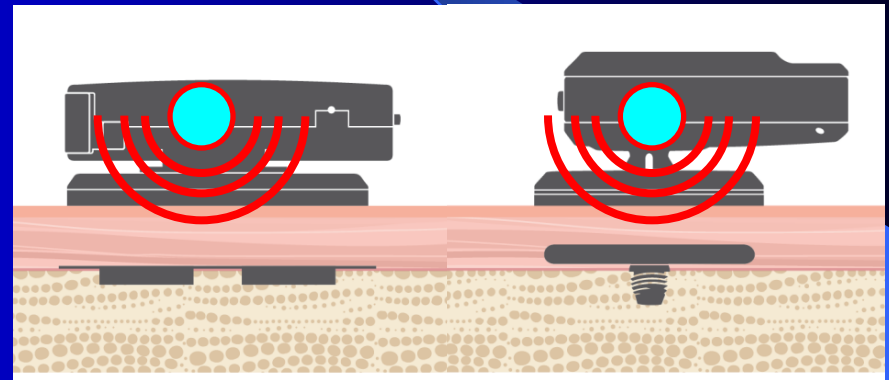


Bone conduction with active and passive implant

Active implant



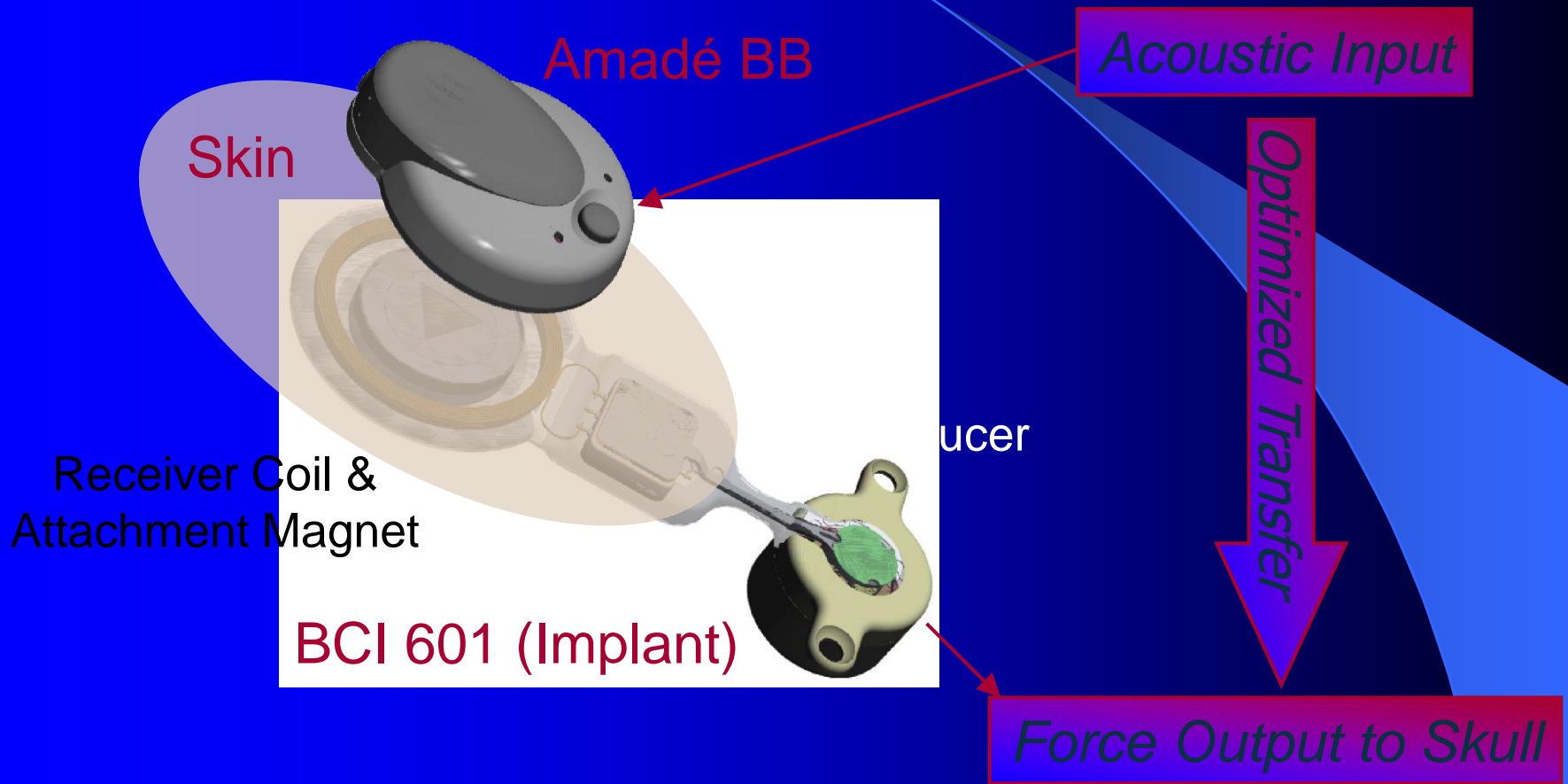
Passive implant

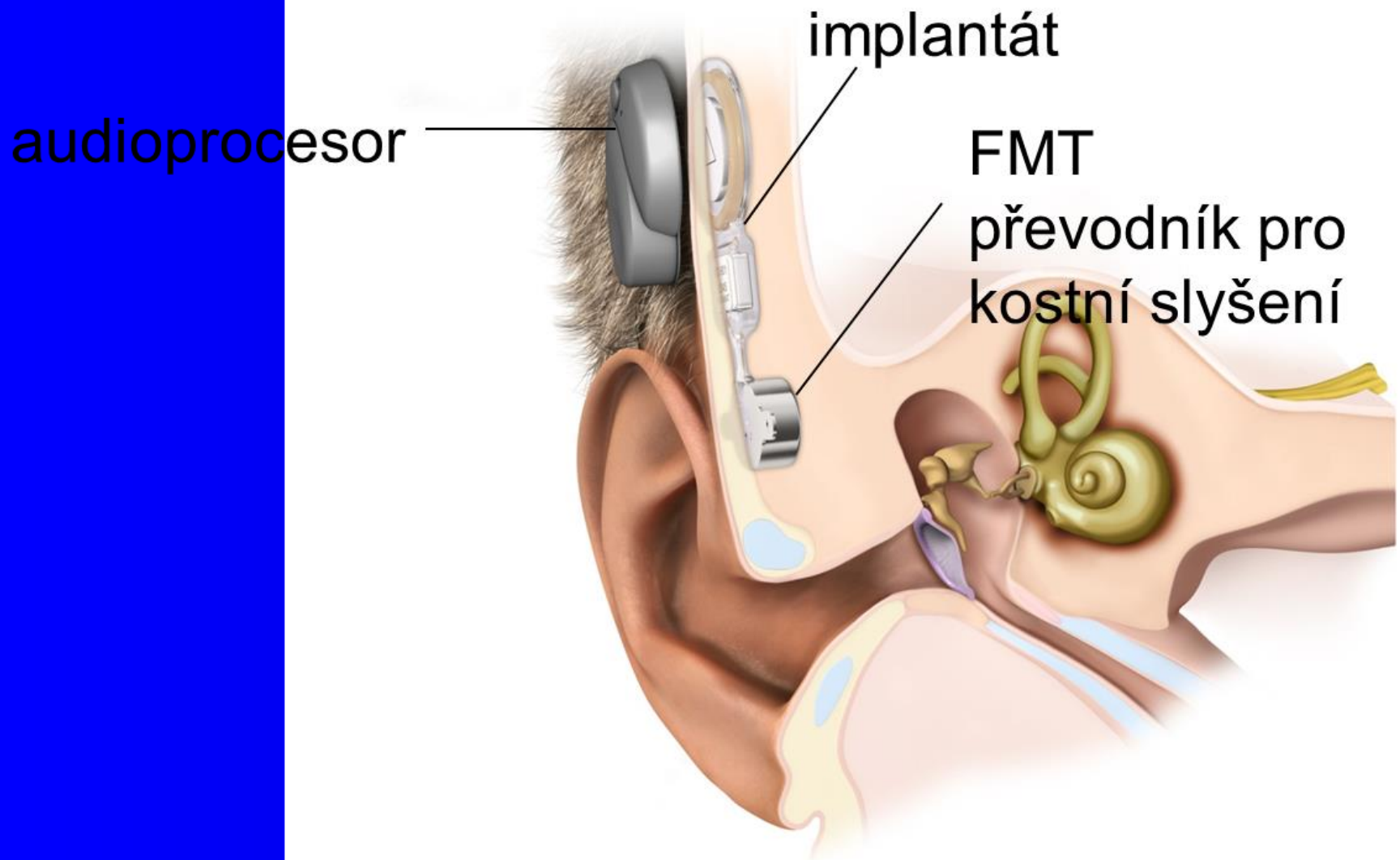


BONEBRIDGE



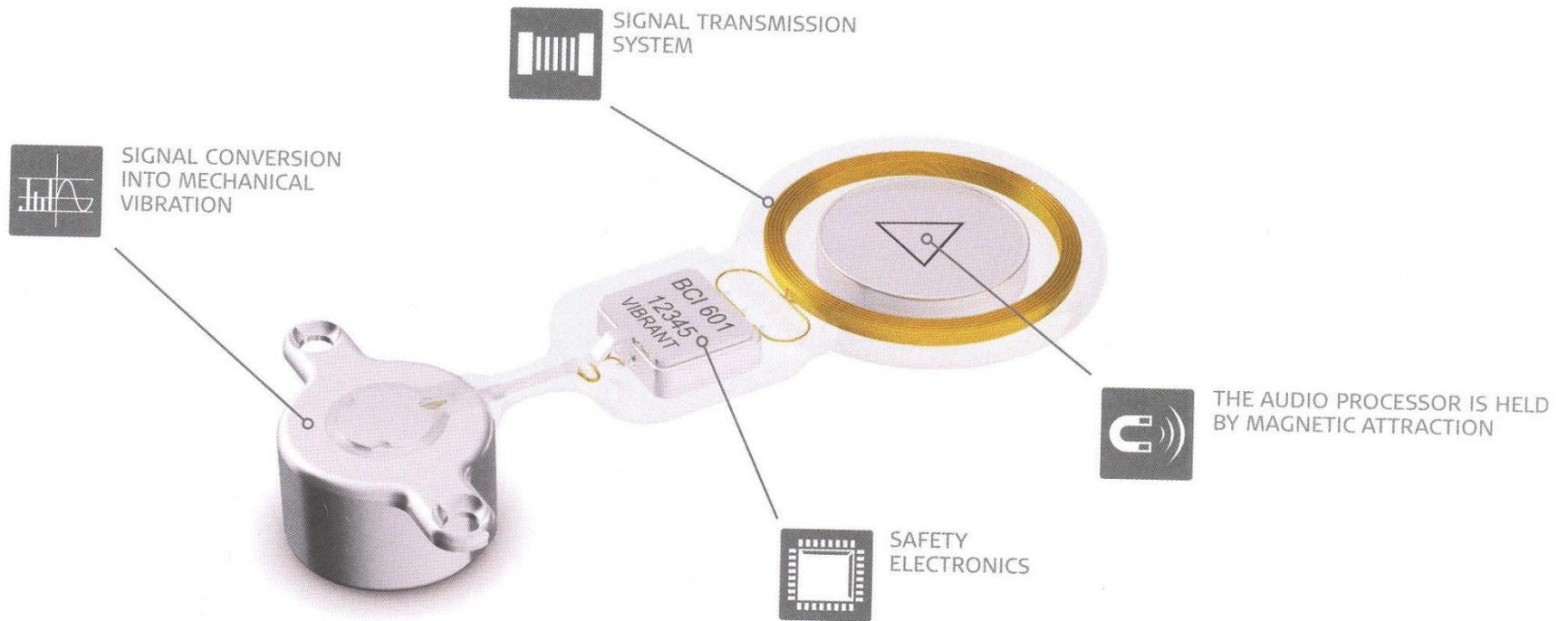
Bonebridge System Overview





BC-FMT = Bone Conduction Floating Mass Transducer

Bonebridge

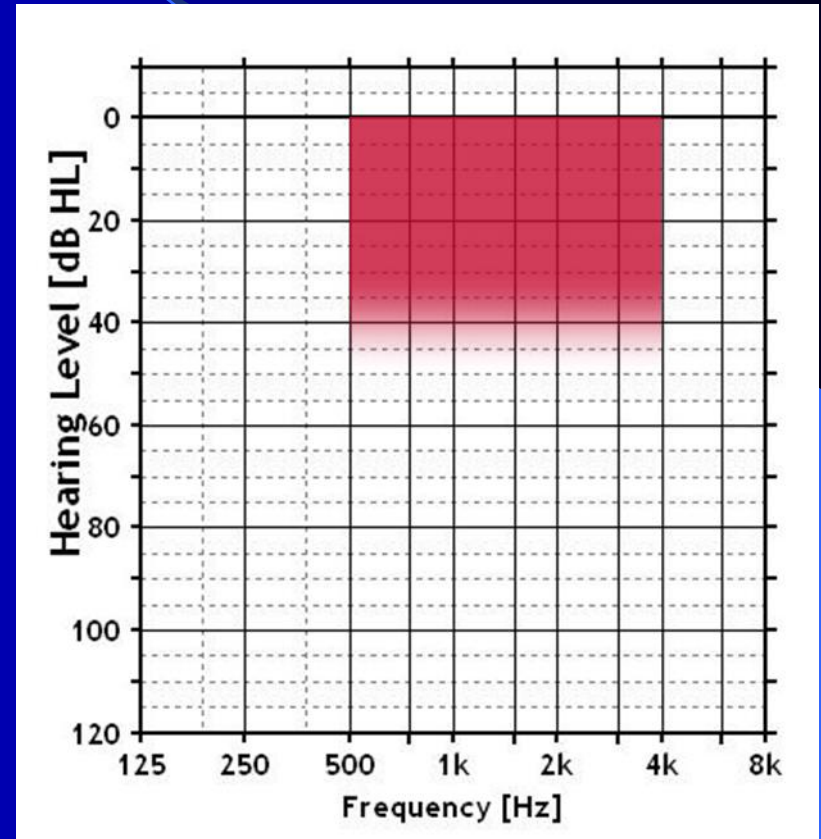


Audiological Indication

Conductive and Mixed Hearing Loss

Bone conduction thresholds
within the shaded area

F (Hz)	500	1000	2000	3000
BC _{limit}	45	45	45	45



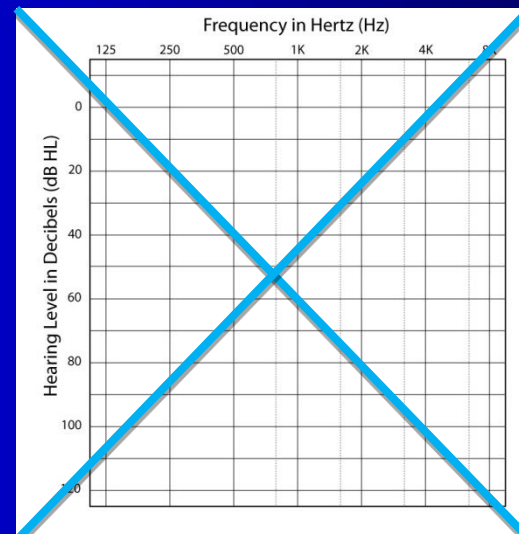
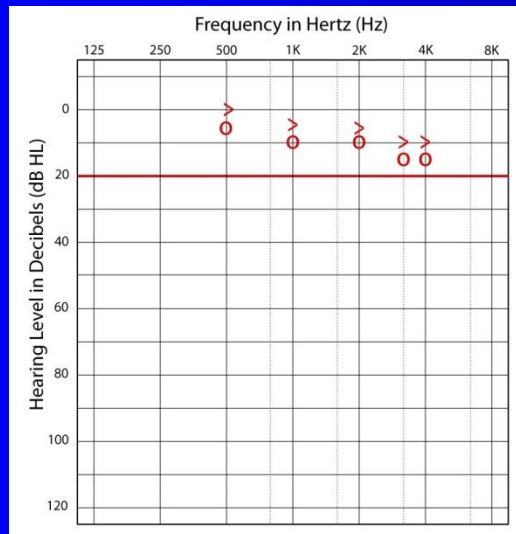
Bone conduction thresholds

Audiological Indication

Single Sided Sensorineural Deafness

- Profound unilateral SNHL
- Normal hearing contralateral ear

F (Hz)	500	1000	2000	3000
Contralateral HL _{limit}	20	20	20	20

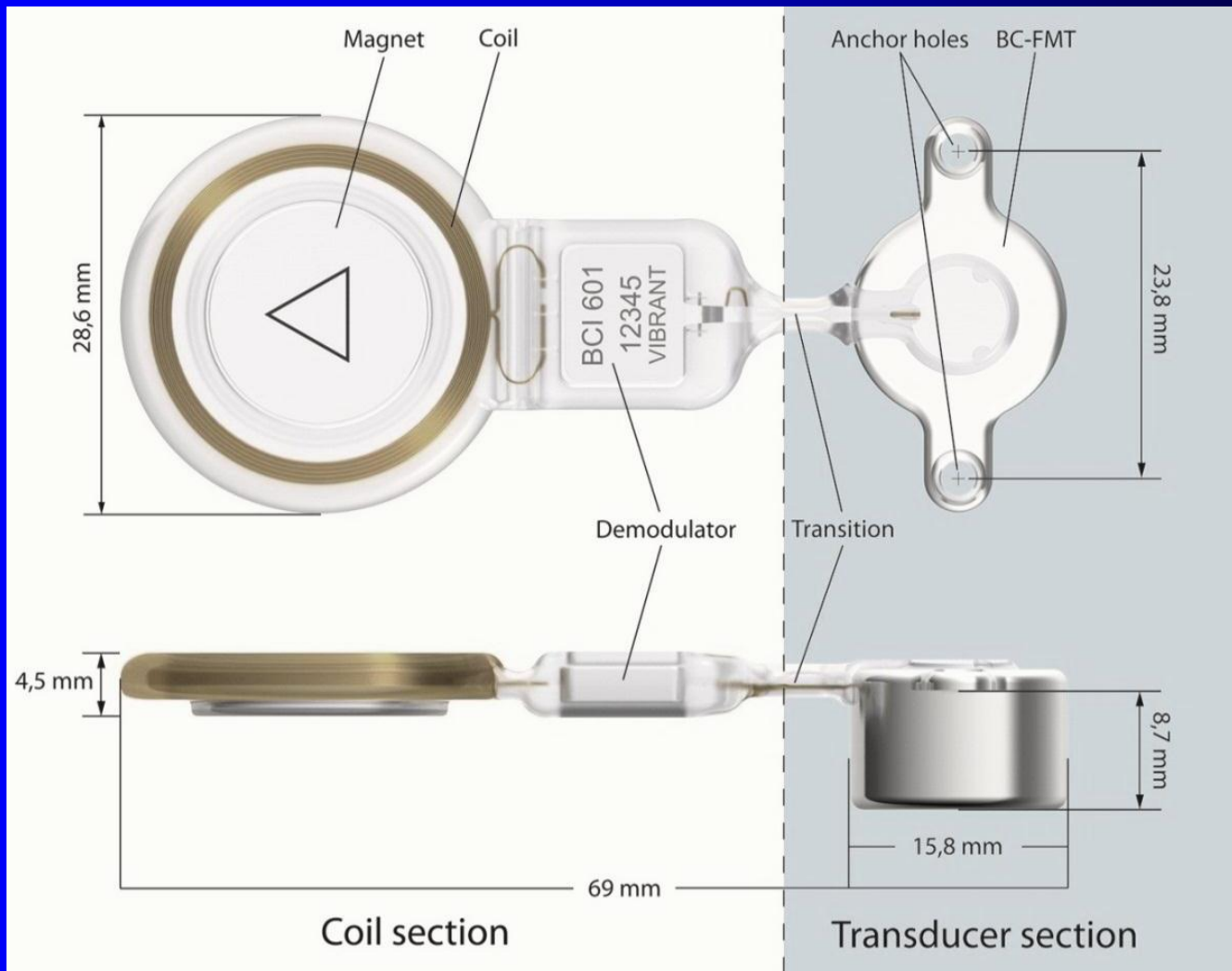


Contraindications

- Intolerance to the following materials
 - Medical grade silicone elastomer (BCI)
 - Titanium (BCI)
 - Titanium alloy (screws)
 - Xylex ® Resin (Amadé BB)
- Skin or scalp conditions precluding AP attachment
 - medical history, medical checkup
- Retrocochlear component
 - speech test
- Pathological situation precluding BCI placement
 - Osteoiditis
- Anatomical situation precluding BCI placement
 - high resolution CT scan!

Radiological Planning

Key-Dimensions of the BCI



Anatomical Considerations

Analysis of the CT Scan

- Positioning of the coil
 - Sound quality, comfort
- Positioning of the BC FMT:
 - Avoid the sinus as first priority
 - Assess where to expect the dura
- Positioning of the screws
 - There should be enough cortical bone to position the screws
 - Screws should be on the same plane



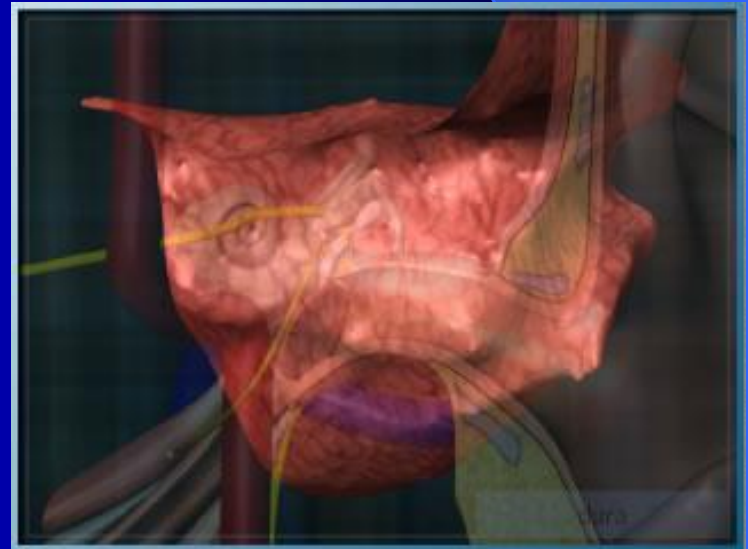
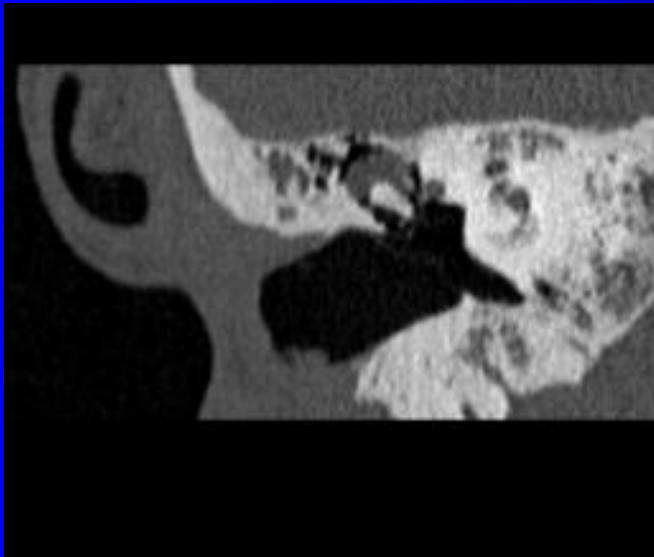
Anatomical Considerations

Structures to preserve

Sigmoid Sinus

Dura

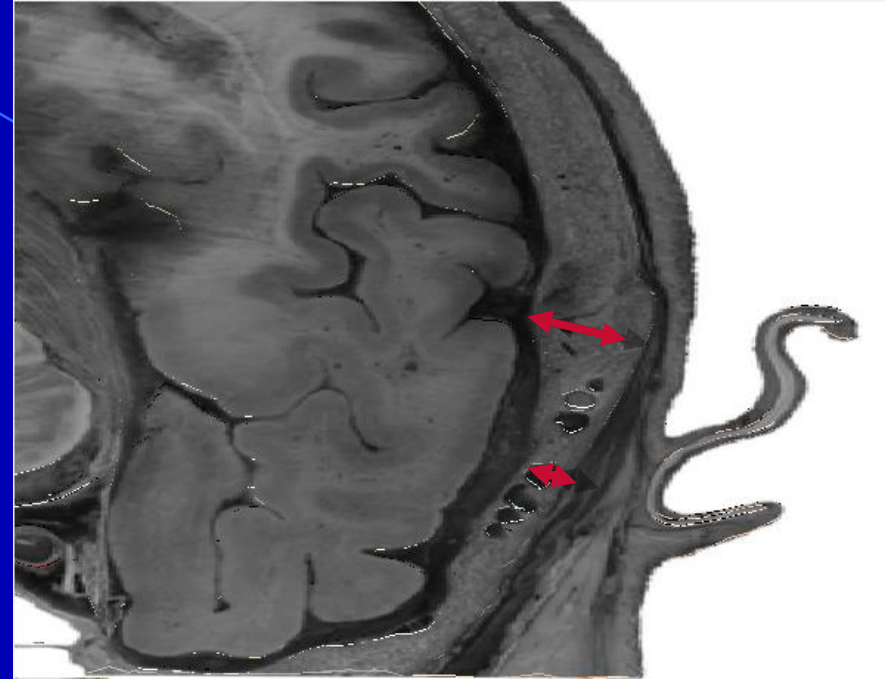
EAC



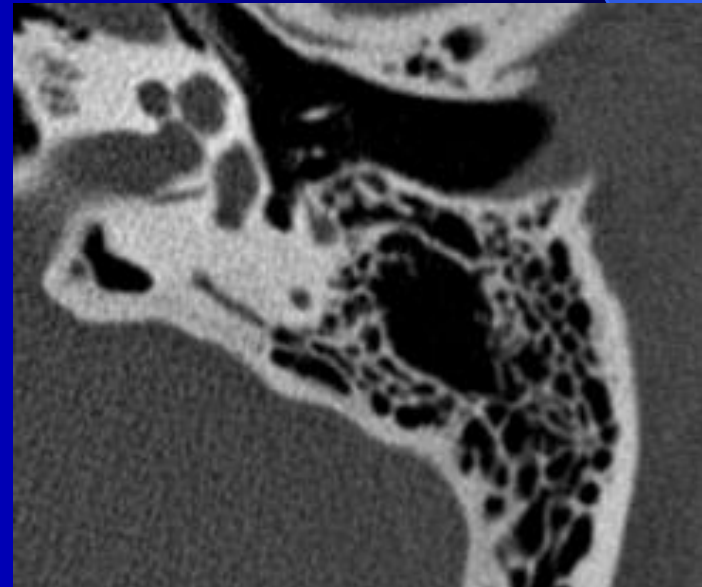
Anatomical Considerations

Structures to consider

Thickness of the skull



Cortical part of the skull



Cortical Screws – Energy transfer

- Standard screws as used in trauma surgery are packaged with the active implant
- Screws are self-cutting, but not self-drilling
- Total length 6mm, drill depth 4mm

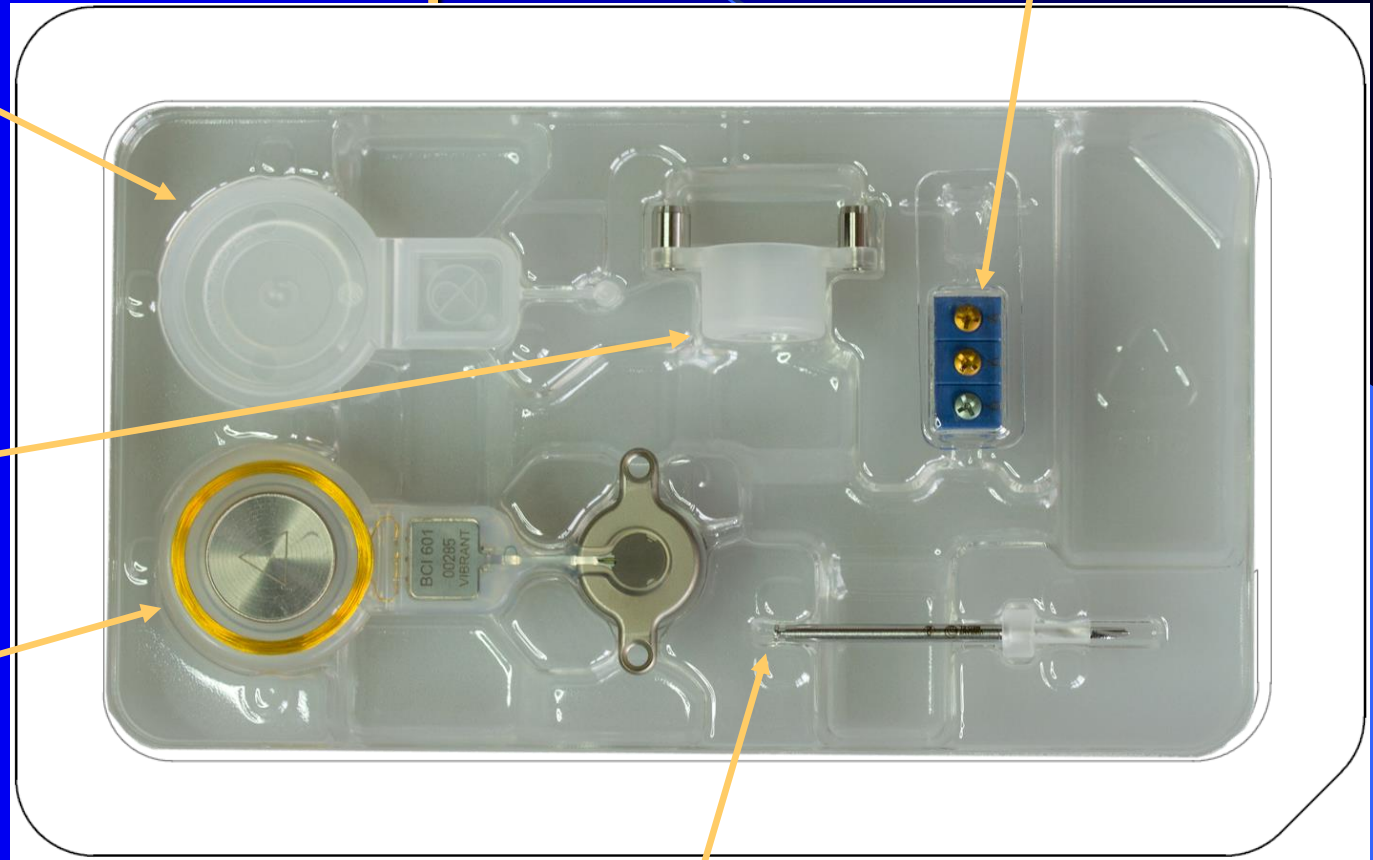


- **Energy/Sound transfer exclusively via the screws!**



C-Sizer, T-Sizer, Drill: The Complete Kit

Cortical screws
2 standard
1 „emergency“



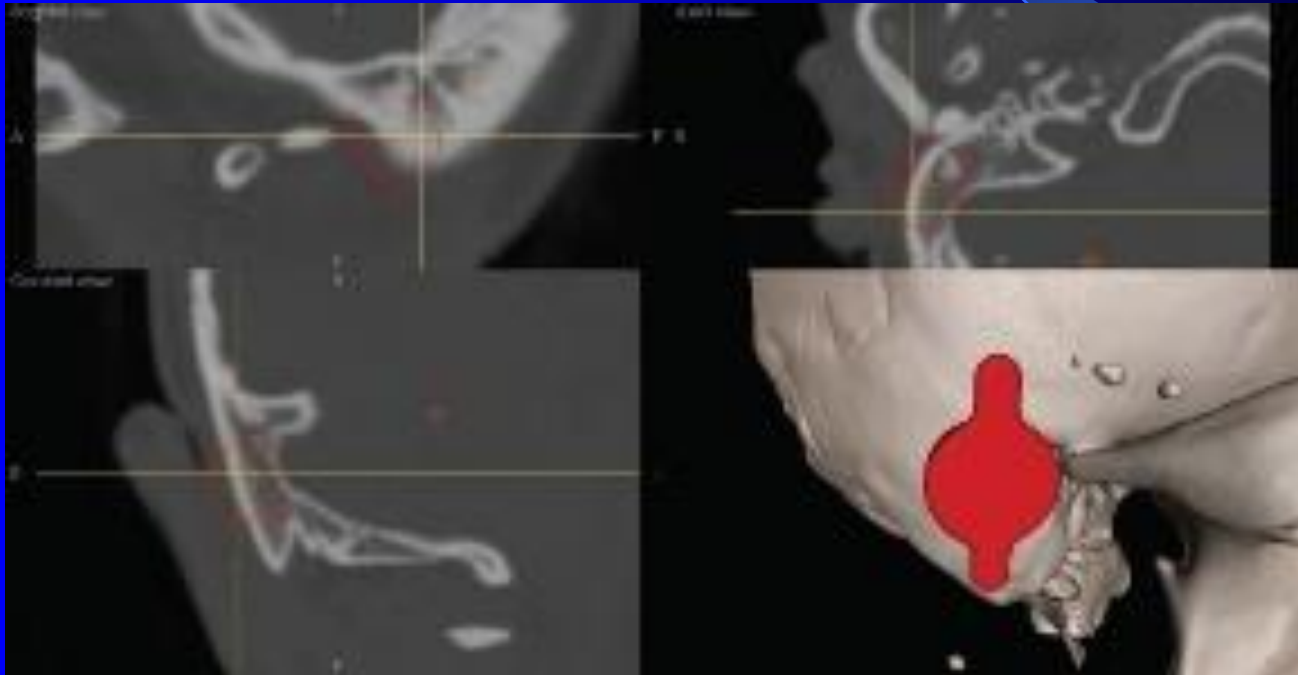
C-Sizer (Coil-Sizer):
To create the skin flap

T-Sizer
(Transducer-Sizer):
To create the X-ducer
bed, also serves as a
drill guide

Active implant

Drill 1.5mm: To pre-drill for screws, includes a stopper

Bonebridge- fast view

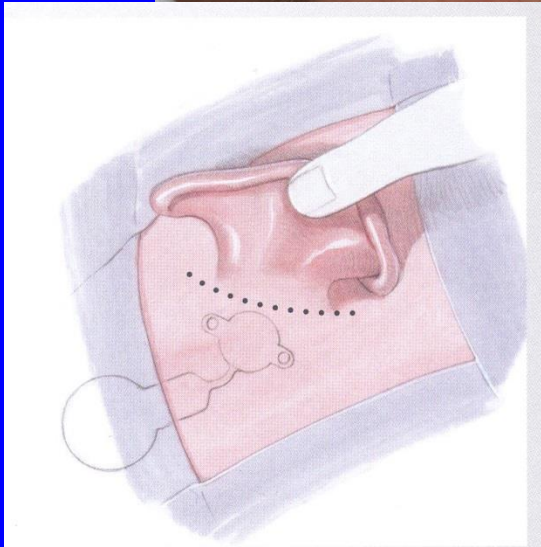


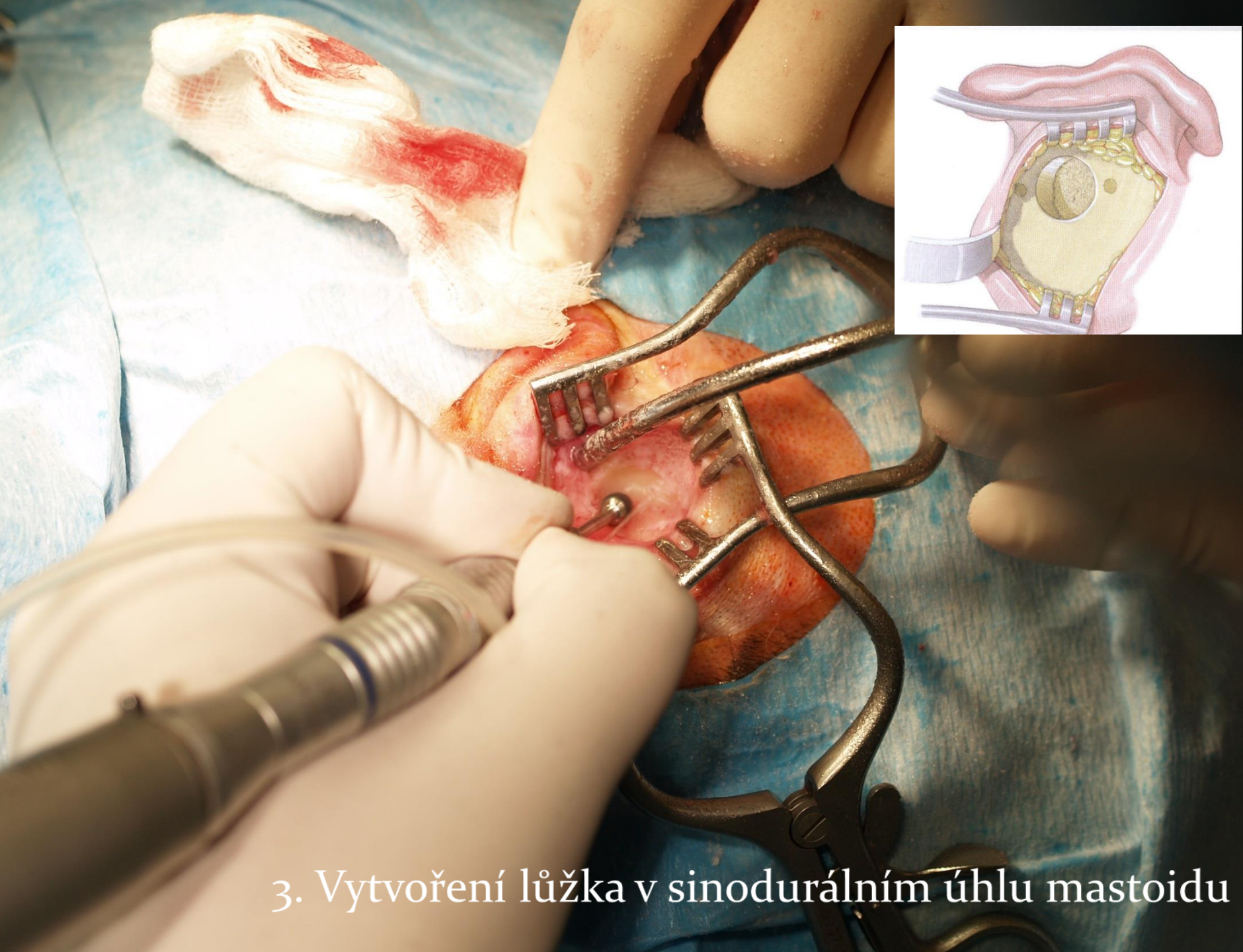
První implantace BONEBRIDGE v ČR

- Pacient s Treacher-Collinsovým syndromem a atresií zvukovodů
- Normální kostní vedení a plná kochleární rezerva oboustranně
- Operace proběhla na sále Kliniky otorinolaryngologie a chirurgie hlavy a krku při FN u sv. Anny v Brně dne 29.8.2014
- Výkon i pooperační hojení bez komplikací

1. Příprava

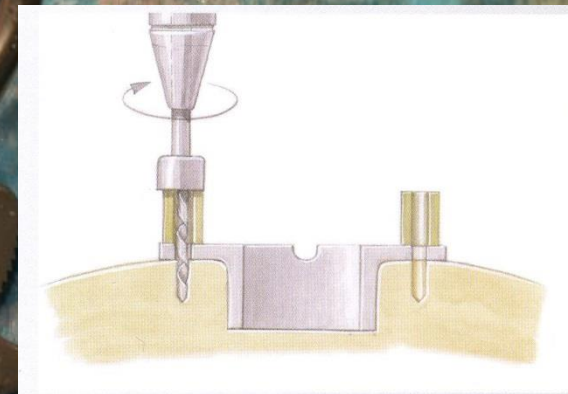
– vyholené vlasy, naznačená



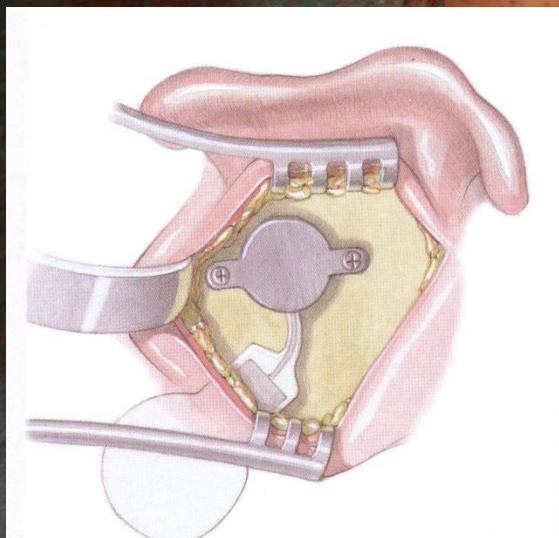


3. Vytvoření lůžka v sinodurálním úhlu mastoidu

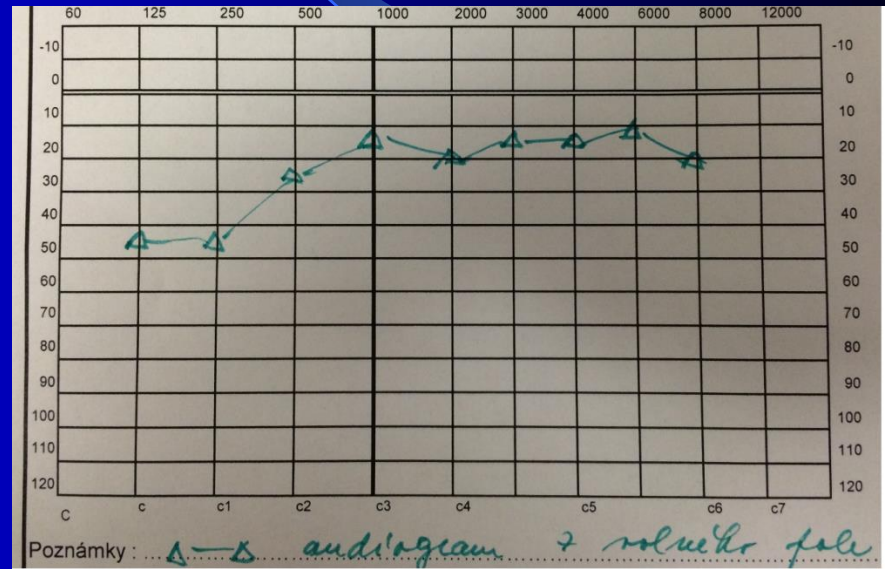
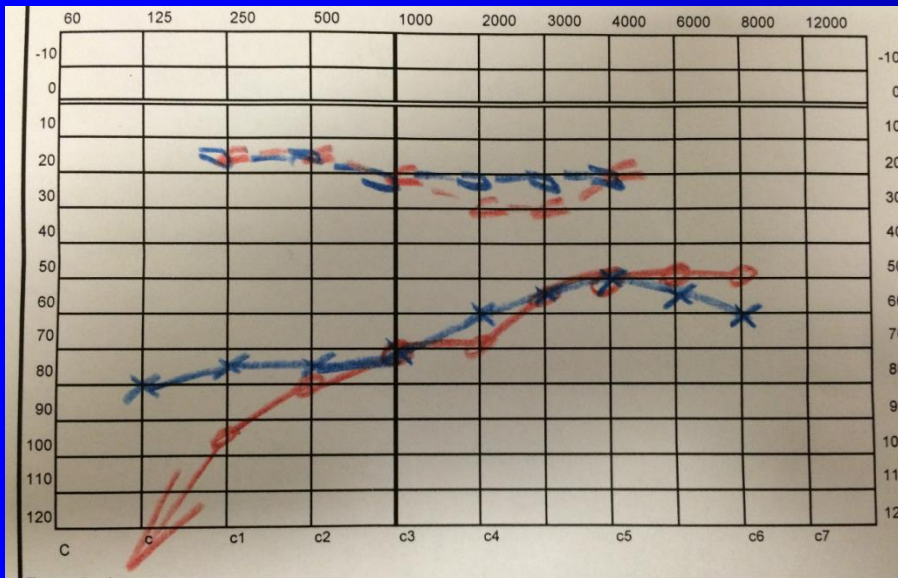
3. Vytvoření lůžka, zavedení měrky pro převodník (T-sizer)

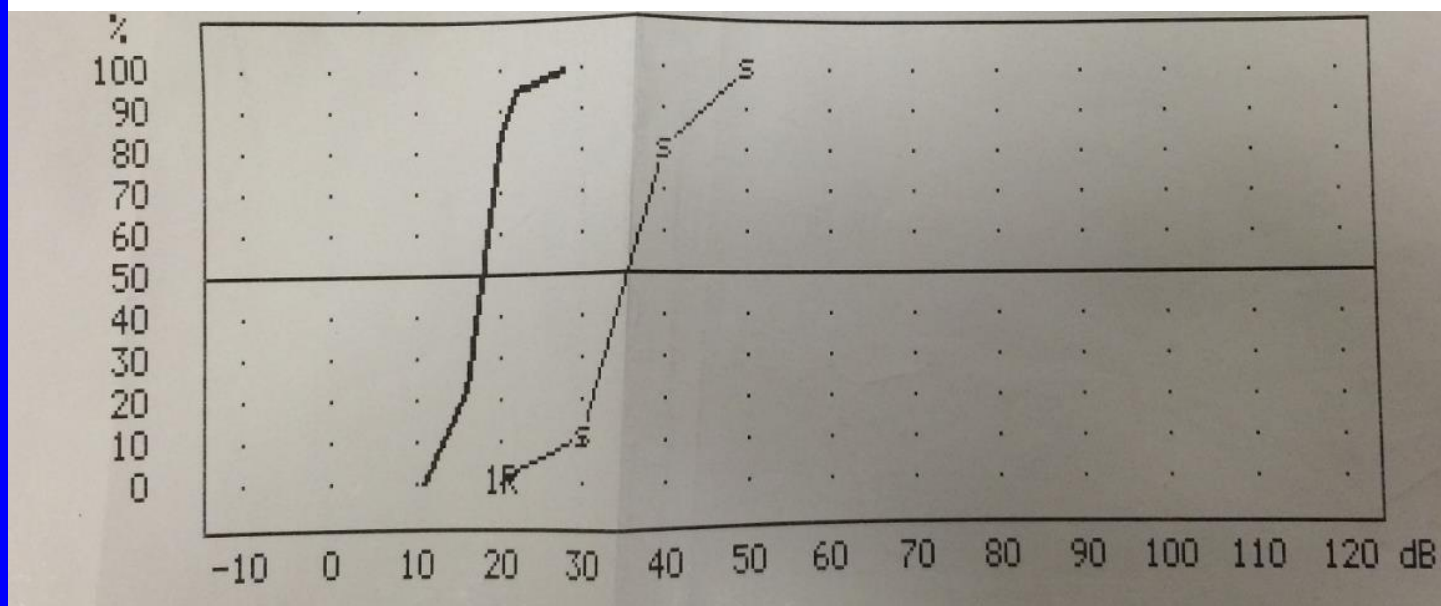
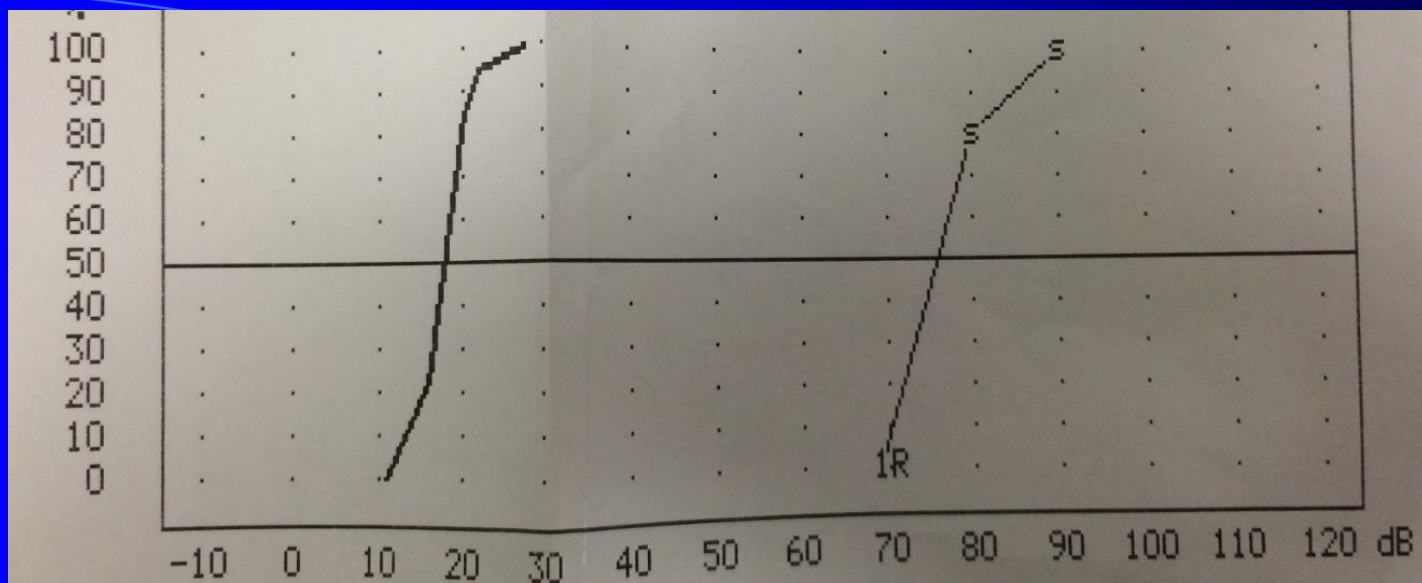


6. Fixace „převaděče“ a uzávěr rány

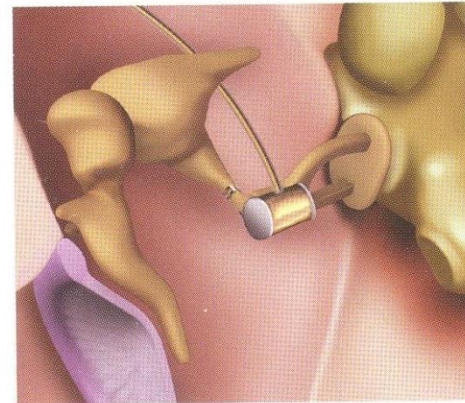
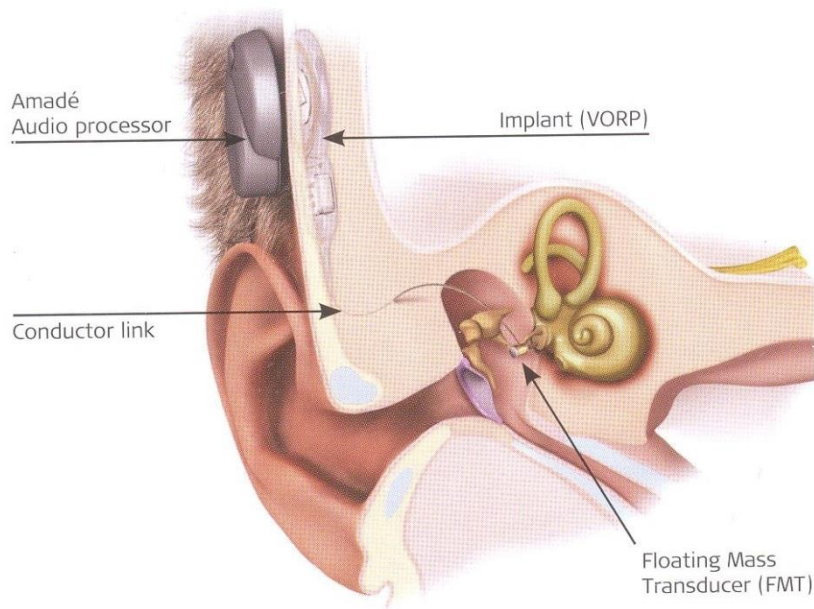


Hearing before and after surgery

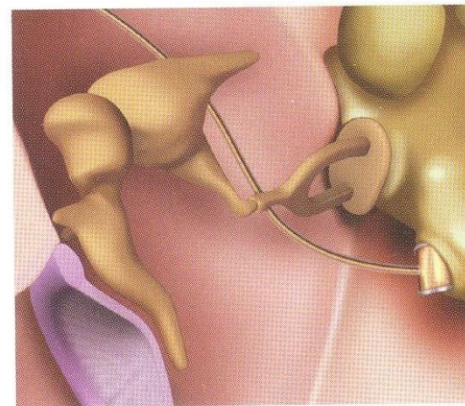




Vibroplasty - soundbridge



Incus Vibroplasty
used to treat
sensorineural hearing loss



Round Window
Vibroplasty
used to treat conductive
and mixed hearing loss

**Surgery treatment of middle ear
inflammation – reconstructive surgery
(tympanoplasty)**

According to prof. Wulstein:

I. Myringoplasty

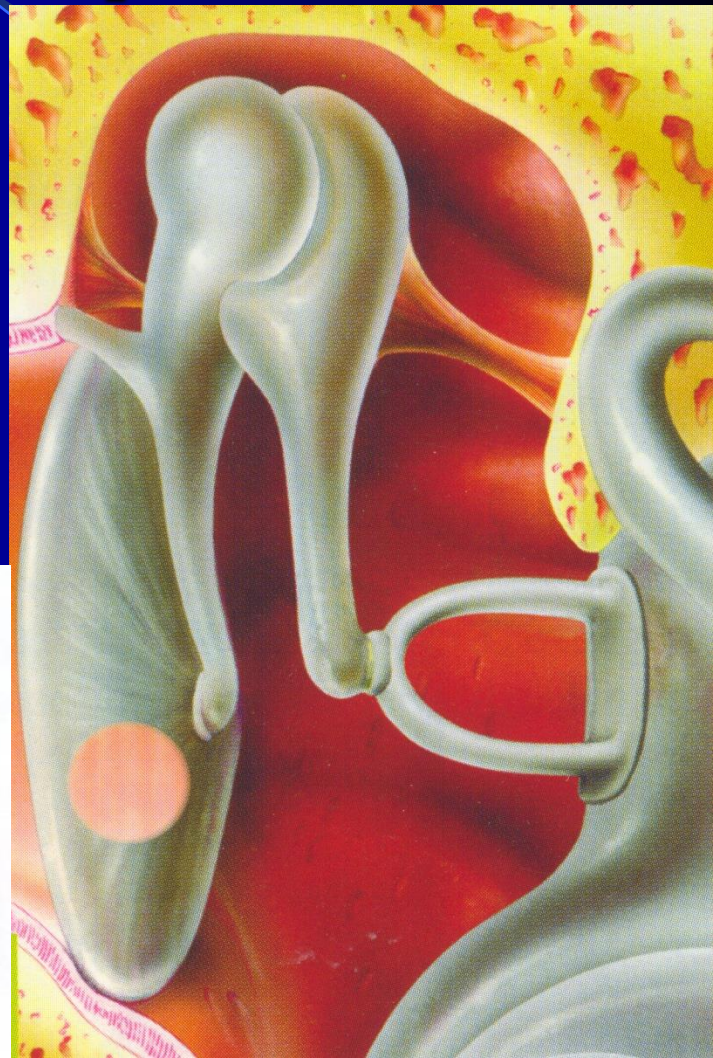
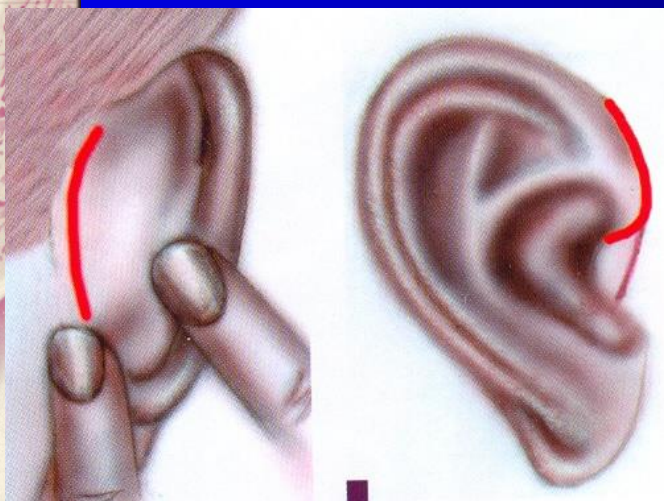
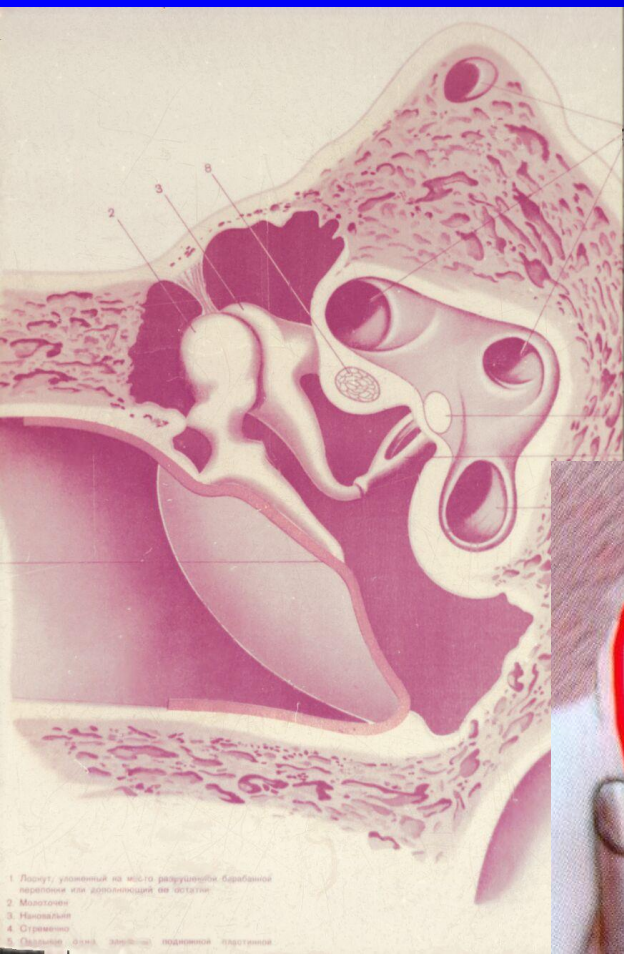
II. Columelisation of incus

III. Columelisation (stapes)

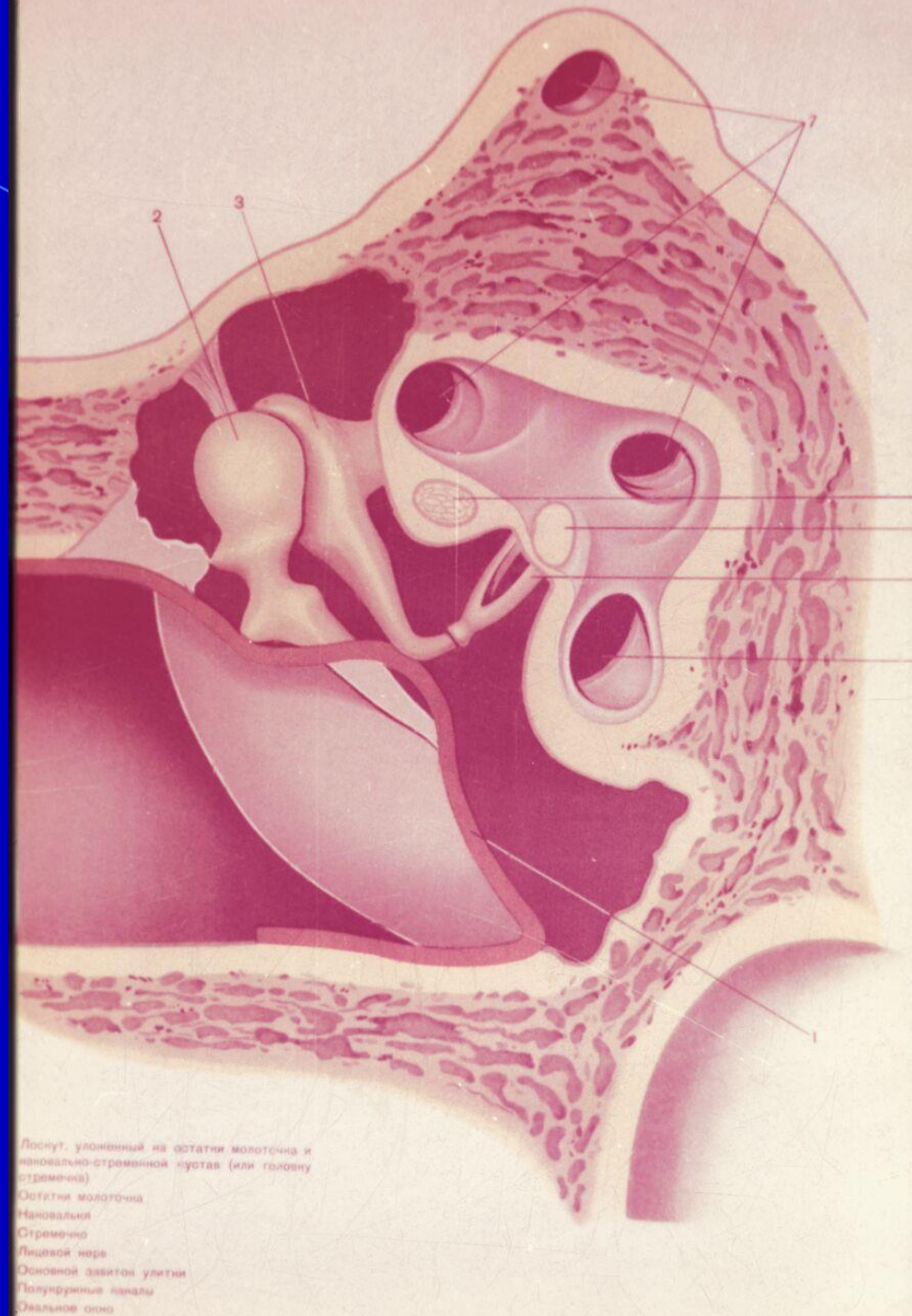
**IV. Ekranisation (zástín okrouhlého
okénka**

V. Fenestration of labyrinth

Tympanoplasty - typ I. Myringoplasty



Tympanoplasty II. Incus columelisation



Tympanoplasty type III.a

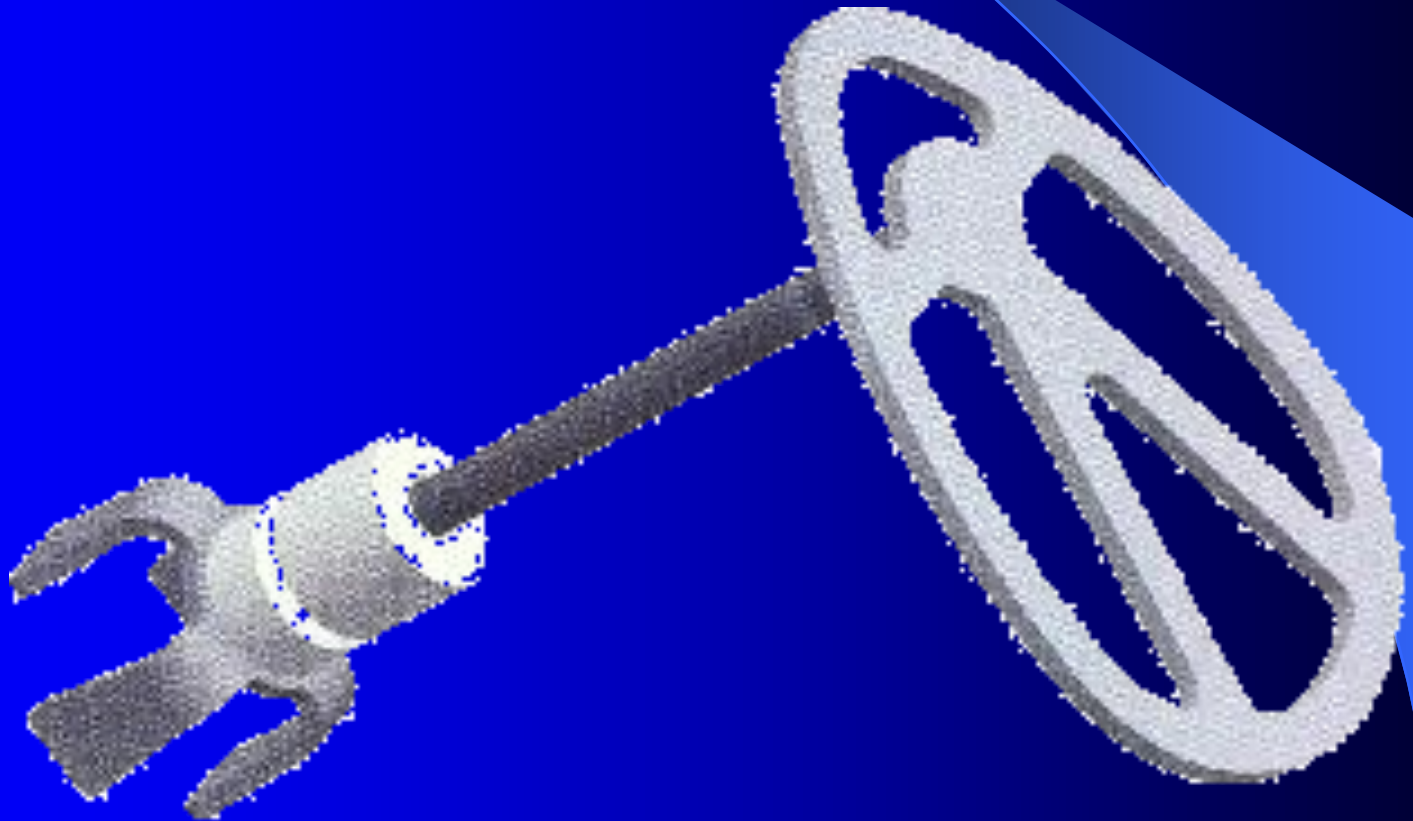
**damaged incus and
maleus; stapes intact,
sound conducted by
prosthesis PORP**



PORP
partial
ossicular
replacement
prosthesis

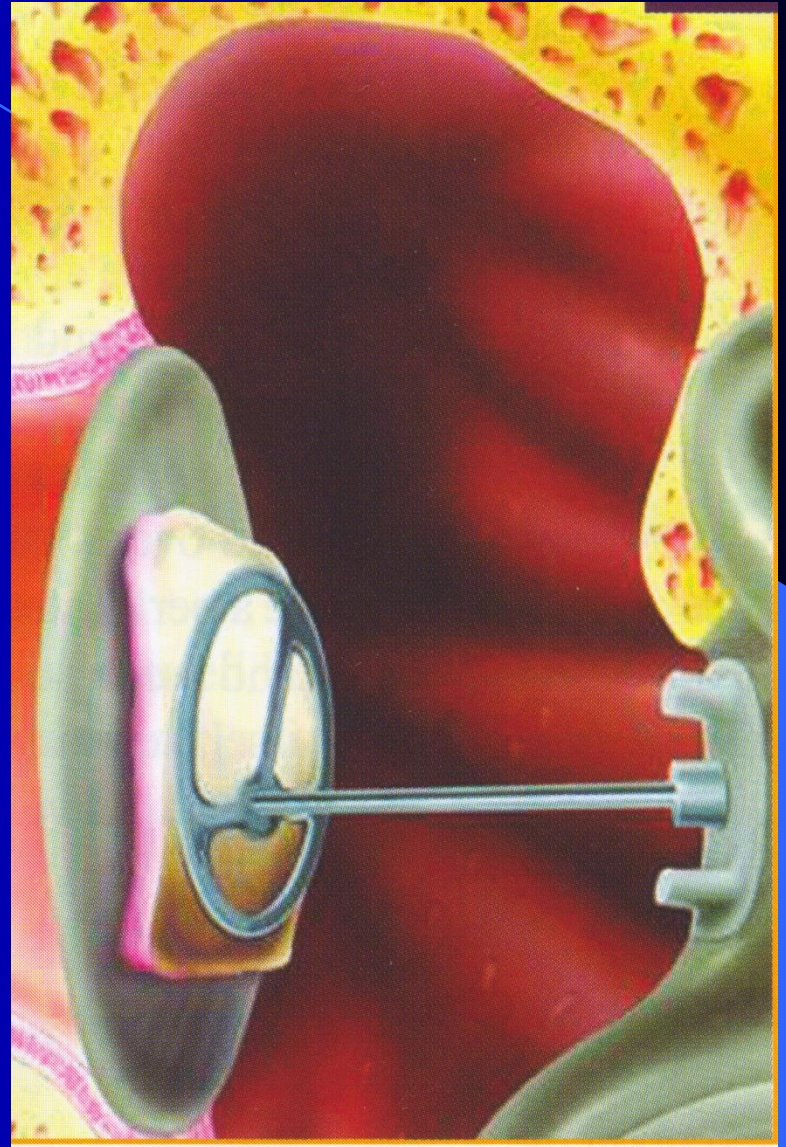


PORP



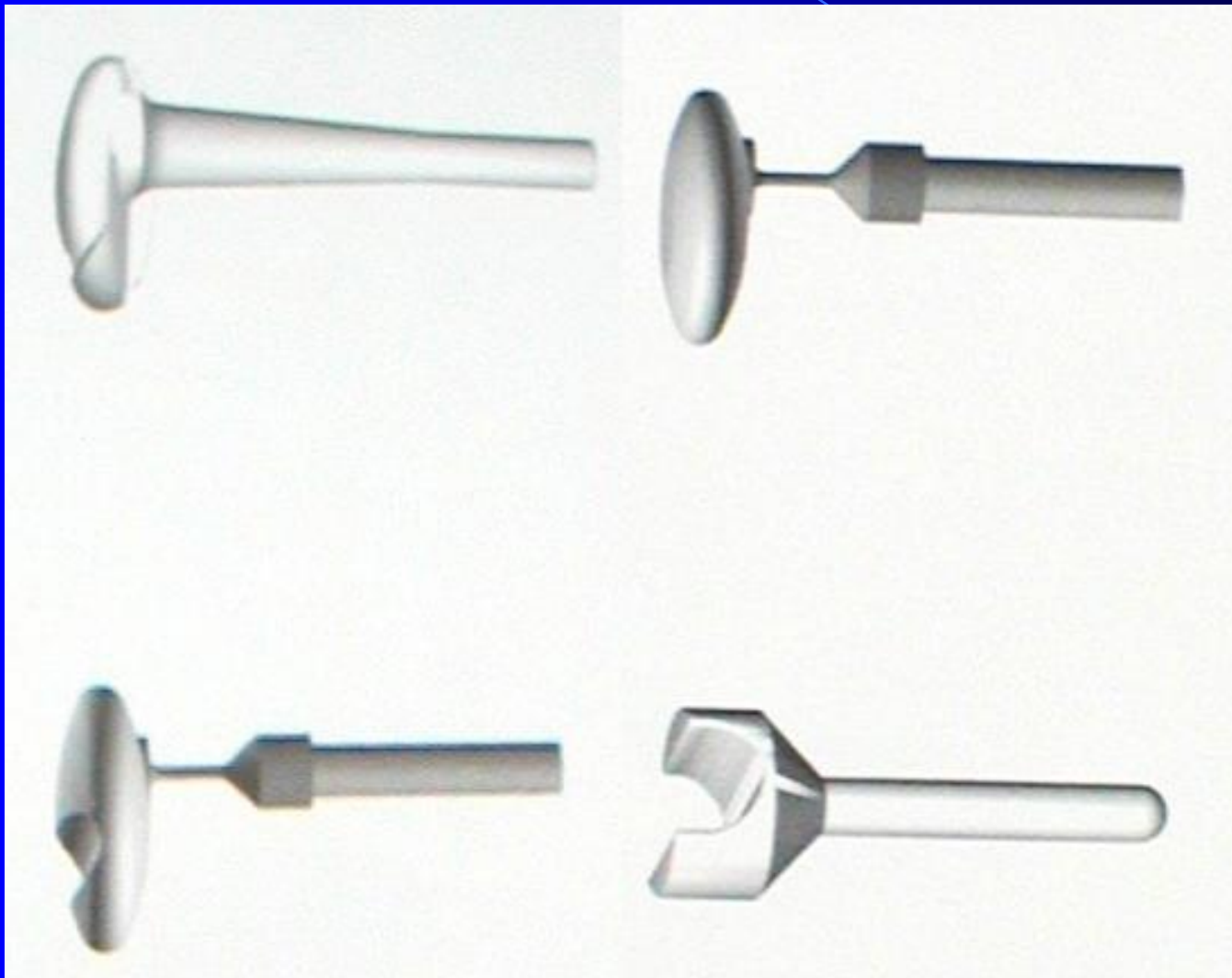
Tympanoplastika typ III.b

**damaged incus, malleus and
suprastructure of stapes,
sound conducted by
prosthesis TORP**

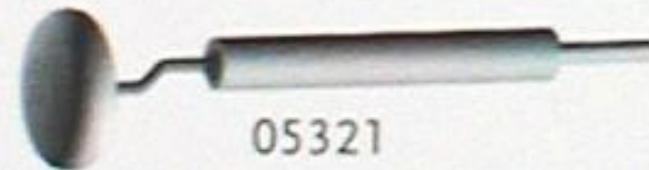
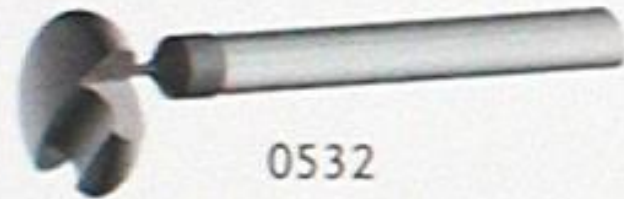


TORP

Total ossicular replacement prosthesis



TORP



Tympanoplastika typ III.c Kolumelisation

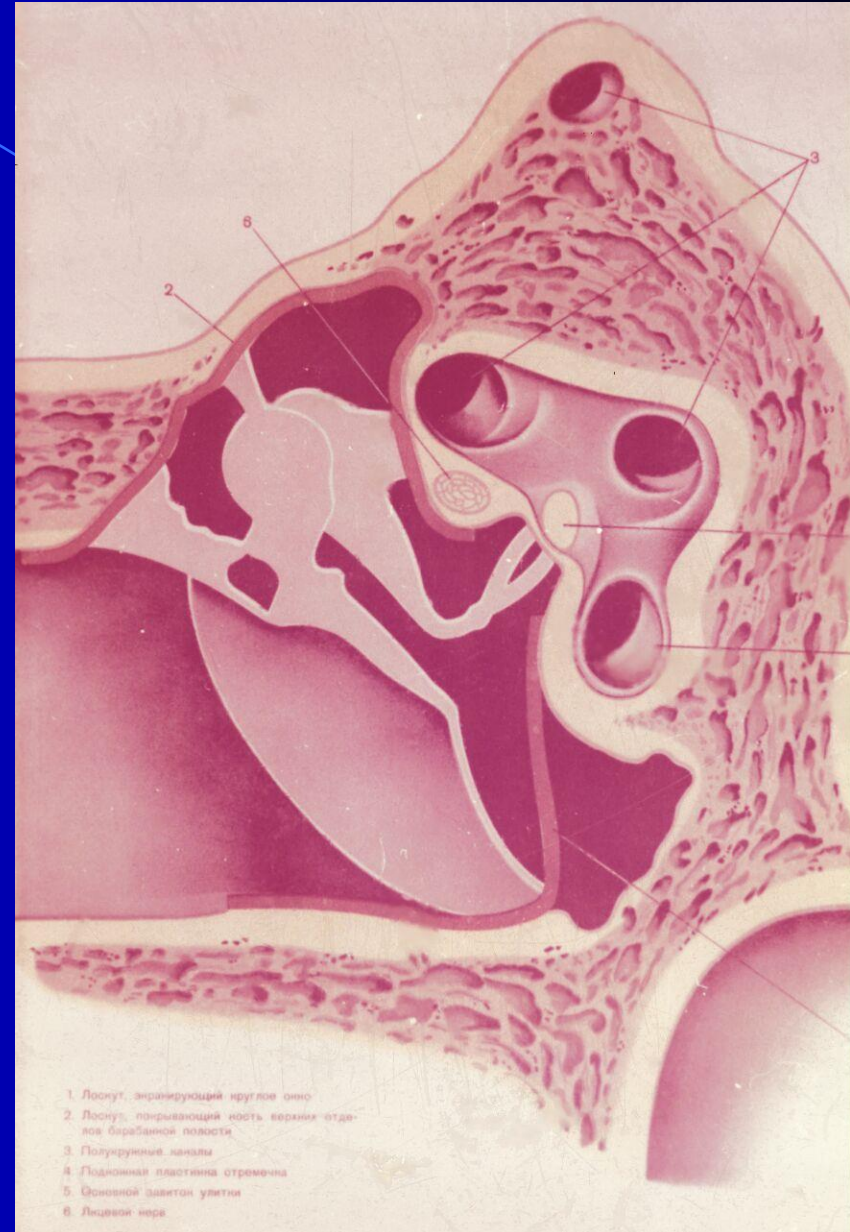
damaged incus and
maleus; stapes intact,
connected direct to
myrinx -
myringostapedopexie



Tympanoplasty

type IV.

Ekranisation
(cover of round window)



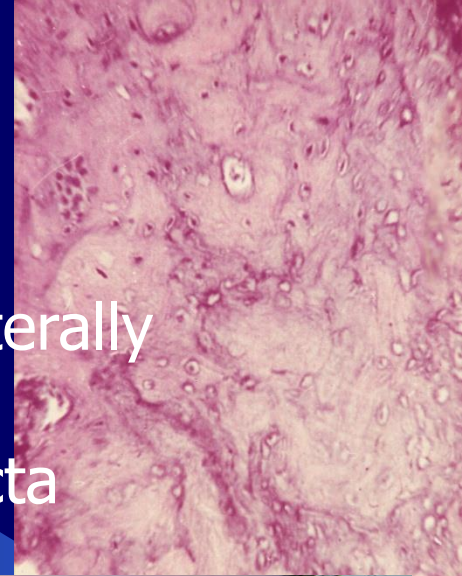
Tympanoplasty type V.

Fenestration
(created new window
into labyrinth by
surgery)

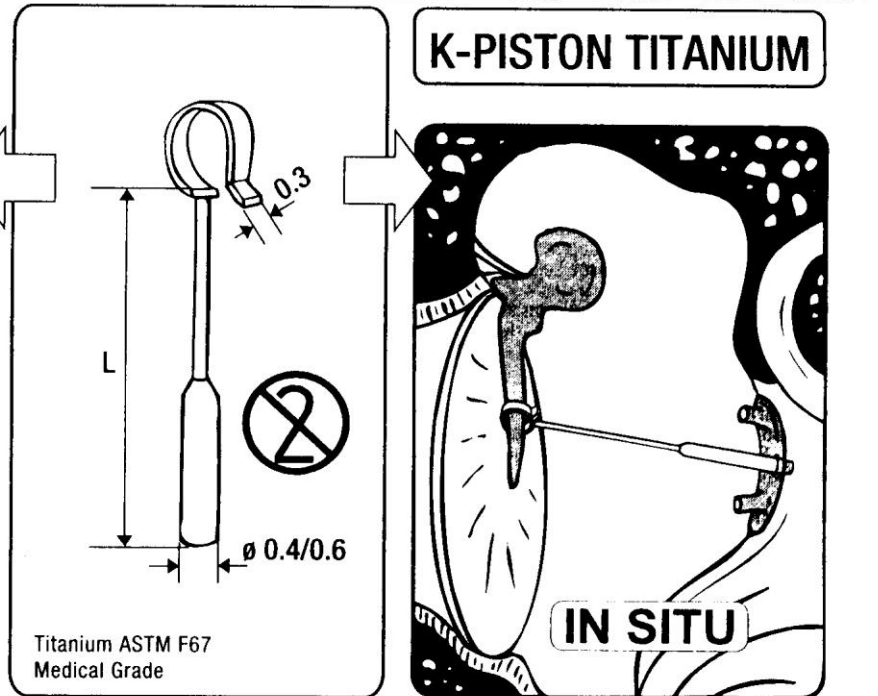
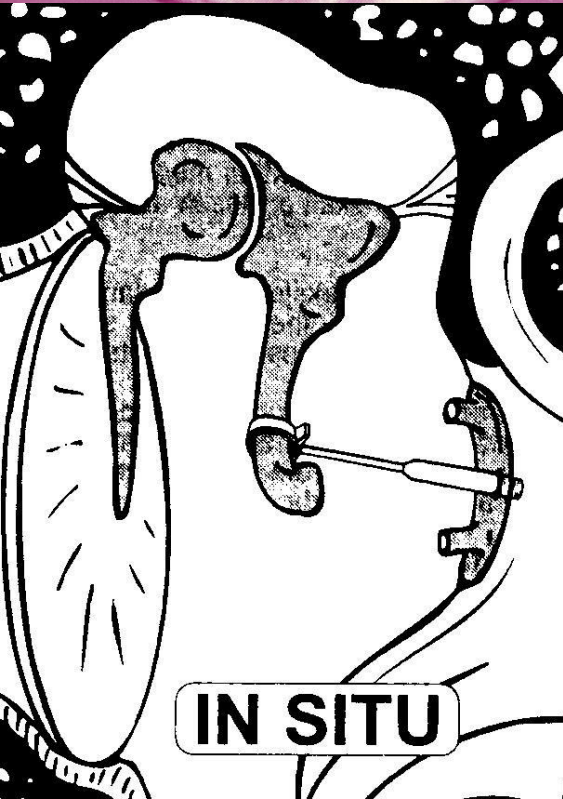
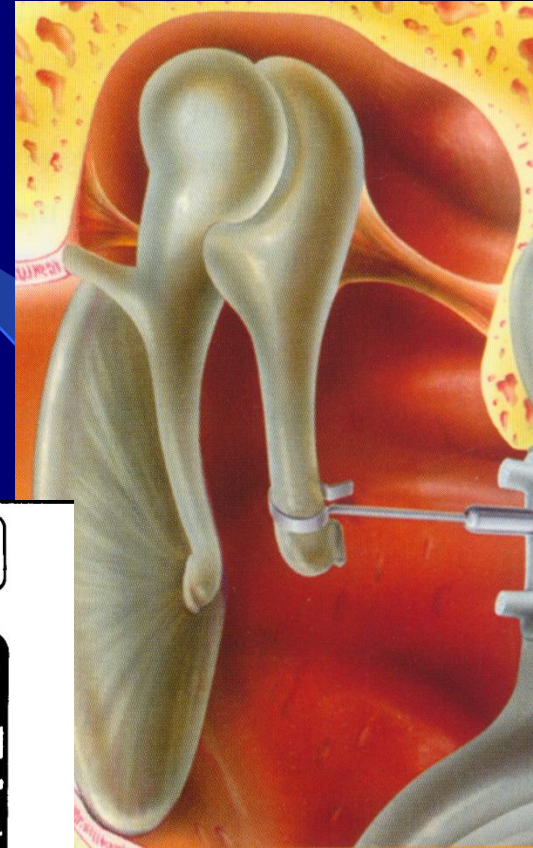
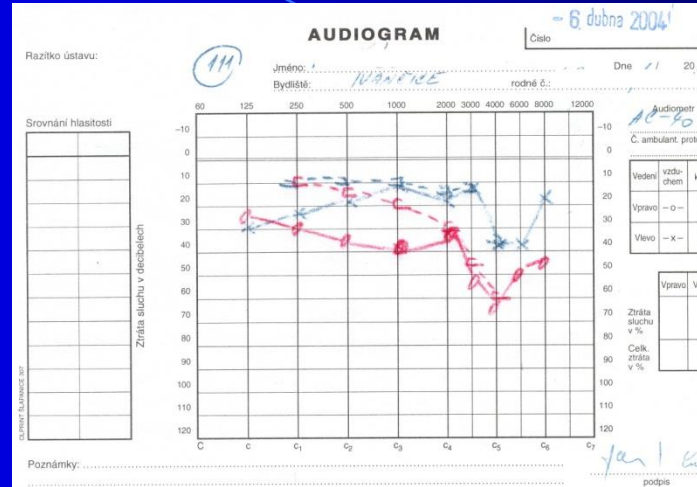
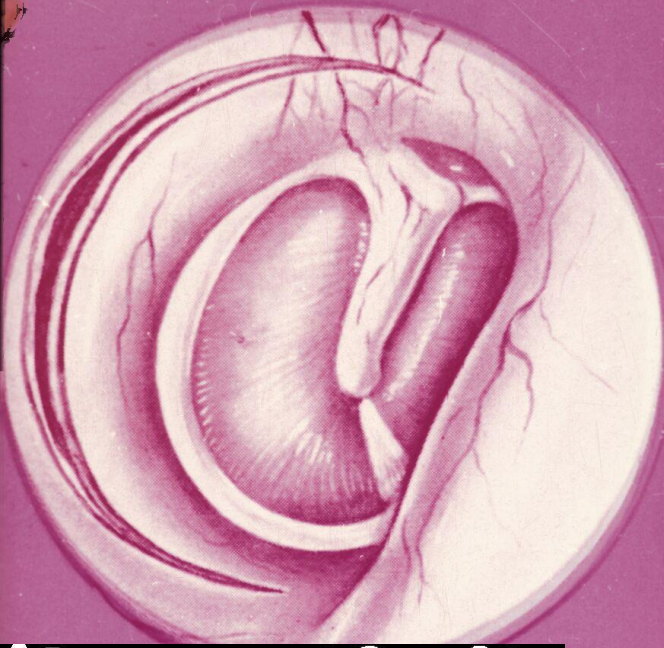


Syndroma: Van den Hoeve de Klein Otosclerosis

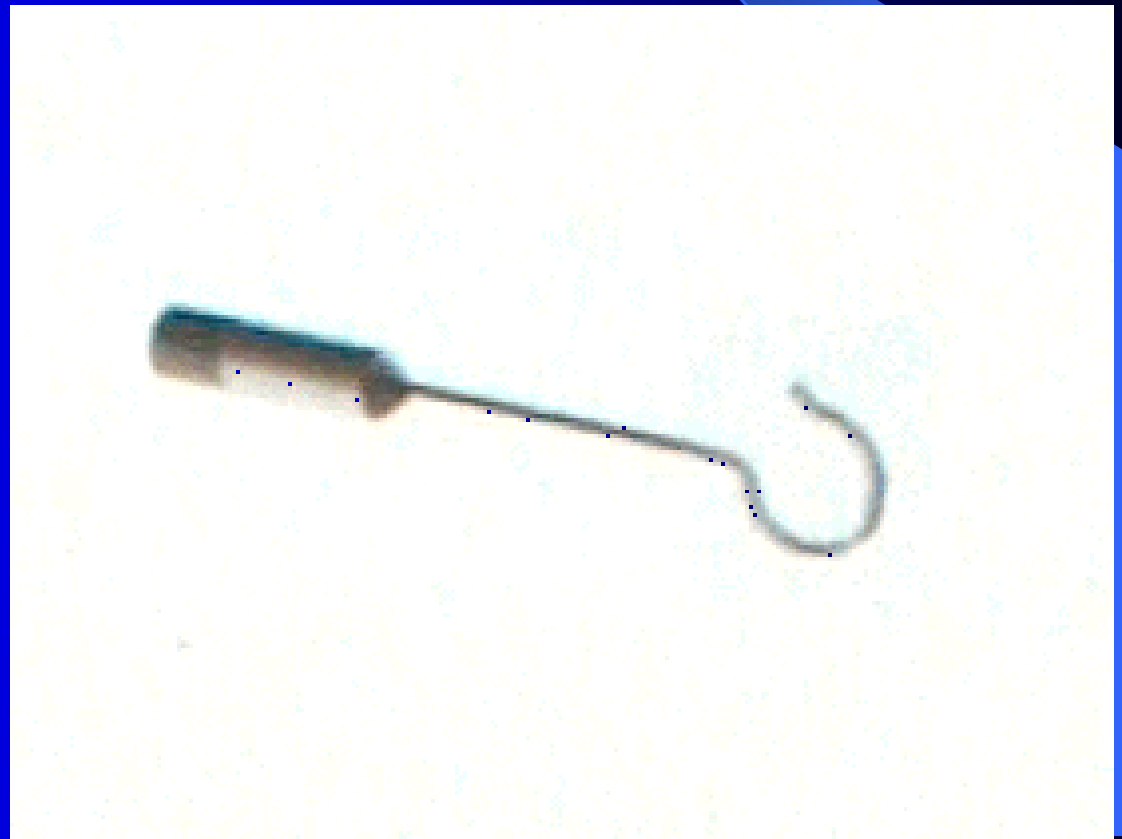
- Fixation of stapes bilaterally
- Blue sclera
- Osteogenesis imperfecta



Stapedoplasty



PISTONS



How cochlear implants work

Cochlear implants have external (outside) parts and internal (surgically implanted) parts that work together to allow users to hear.

1 First a speech processor with a microphone collects and digitizes sound. Then it sends sound to a transmitter, which sends signals to a receiver implanted under the skin.

Wiring connects microphone to transmitter/receiver

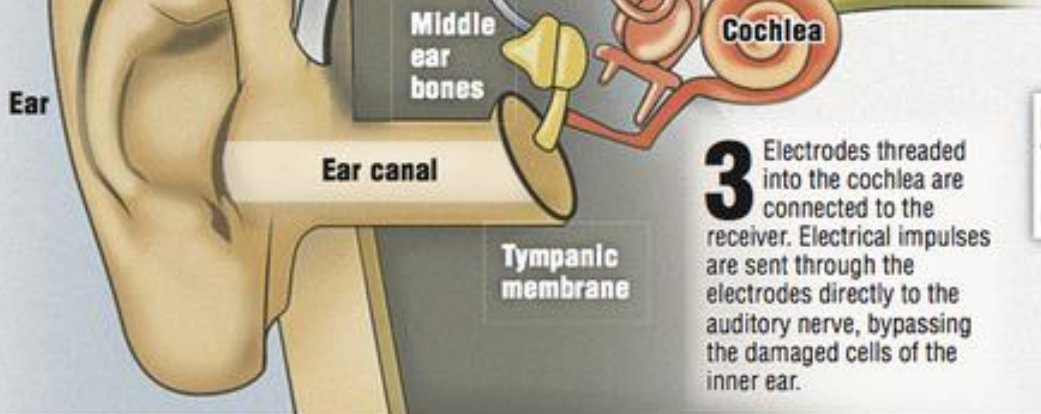
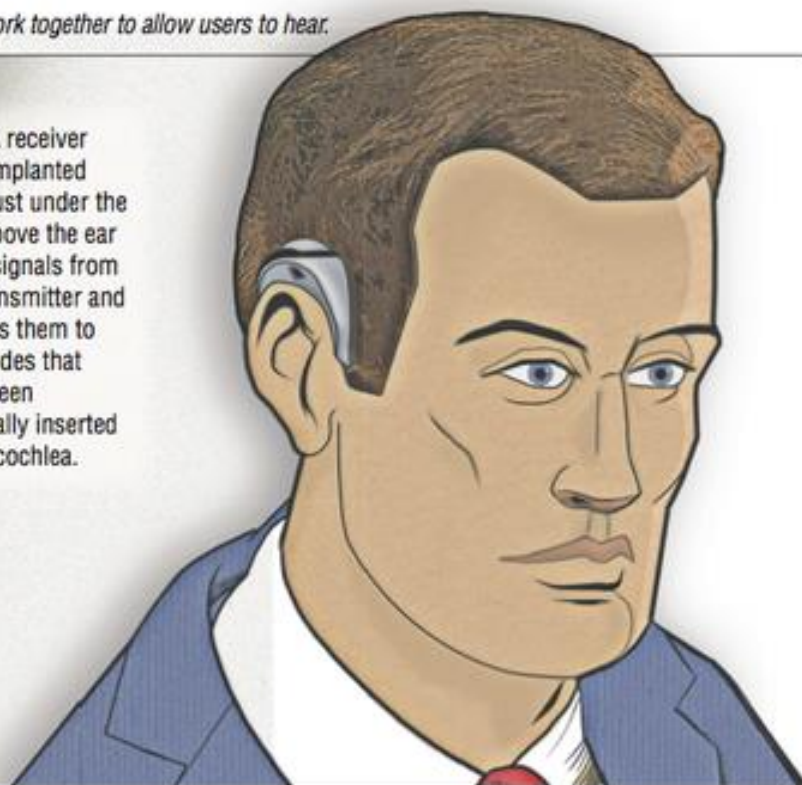
Processor microphone worn over the ear

Transmitter (External)

Receiver (Internal)

Wiring connects transmitter/receiver to electrode array

2 A receiver implanted just under the skin above the ear takes signals from the transmitter and delivers them to electrodes that have been surgically inserted in the cochlea.



Middle ear bones

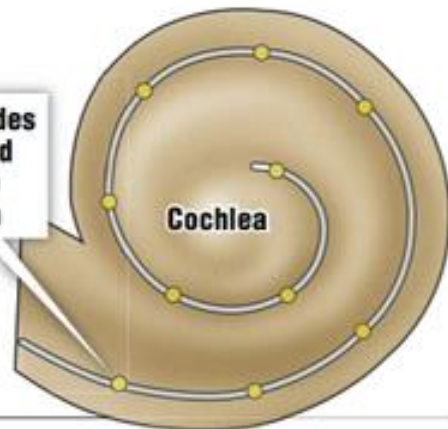
Cochlea

Ear canal

Tympanic membrane

3 Electrodes threaded into the cochlea are connected to the receiver. Electrical impulses are sent through the electrodes directly to the auditory nerve, bypassing the damaged cells of the inner ear.

Electrodes threaded into the cochlea



Cochlea