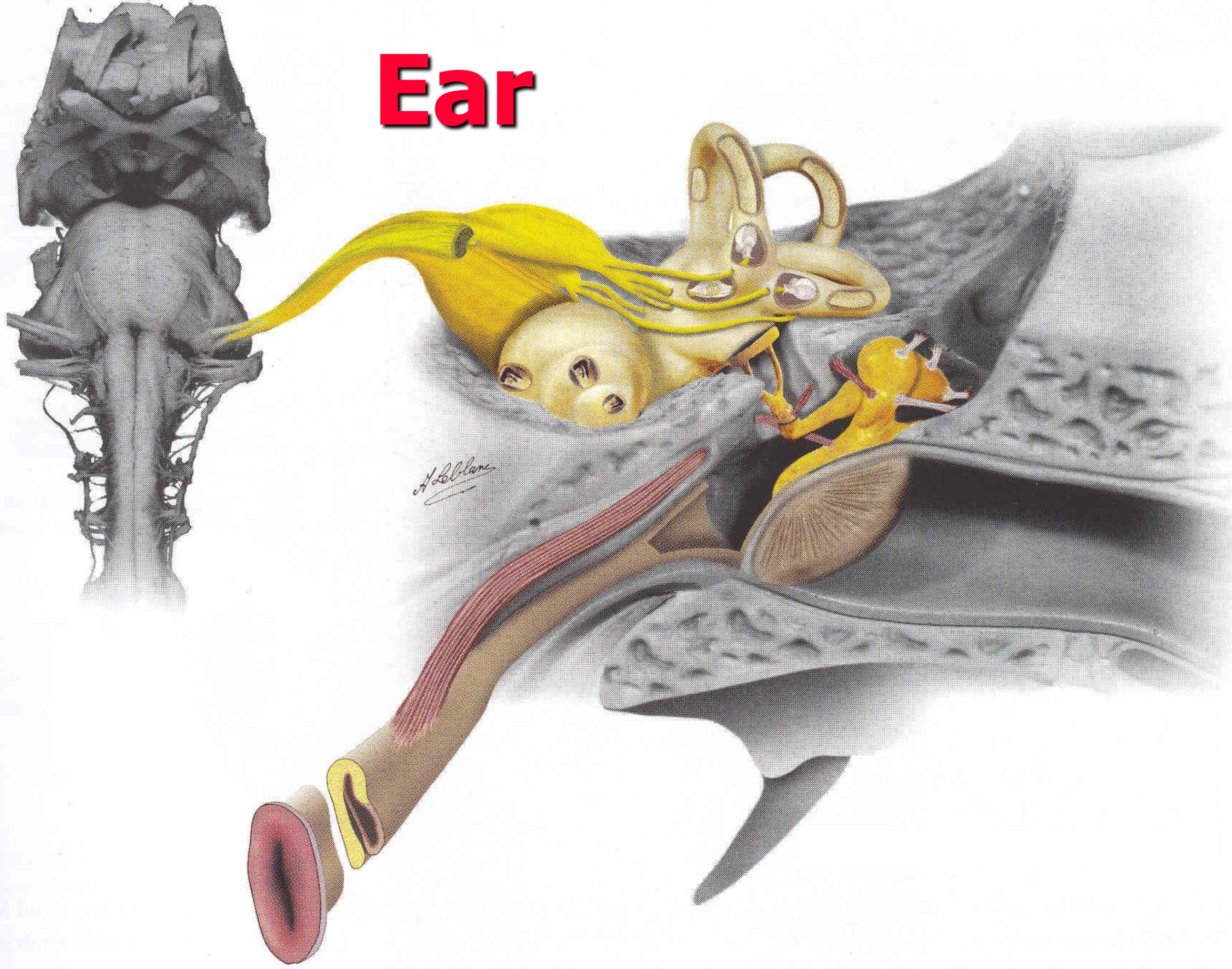


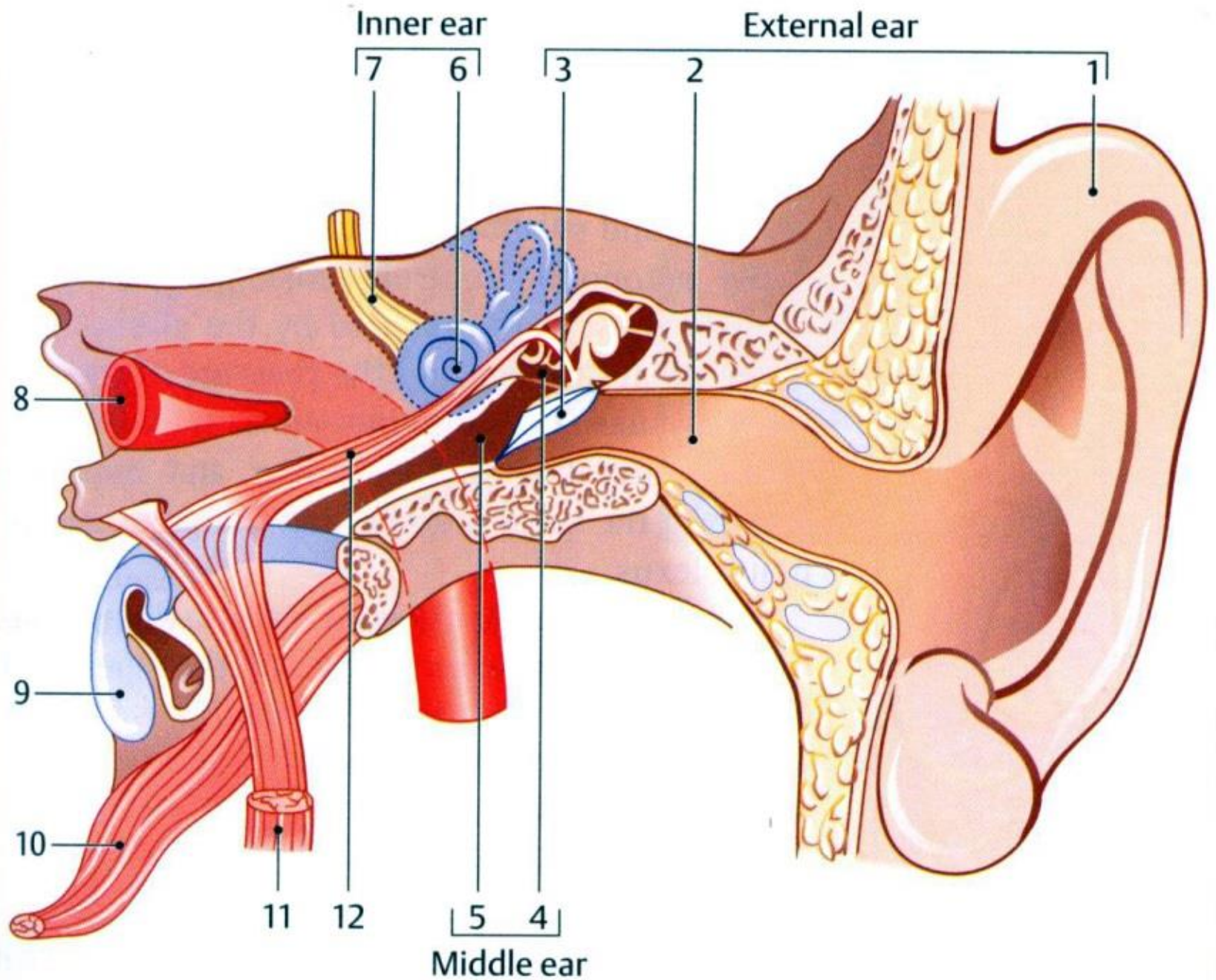
# Literature:

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.

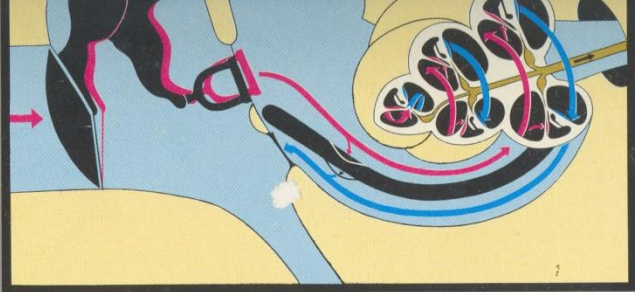
**Med Servis** Mgr. Jaroslava Wilhelmová, Všetičkova 29,  
602 00 Brno. Tel./fax. 05/43241146 .

# Ear

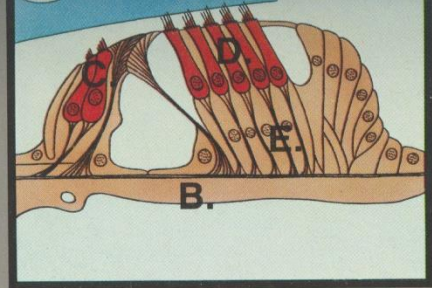




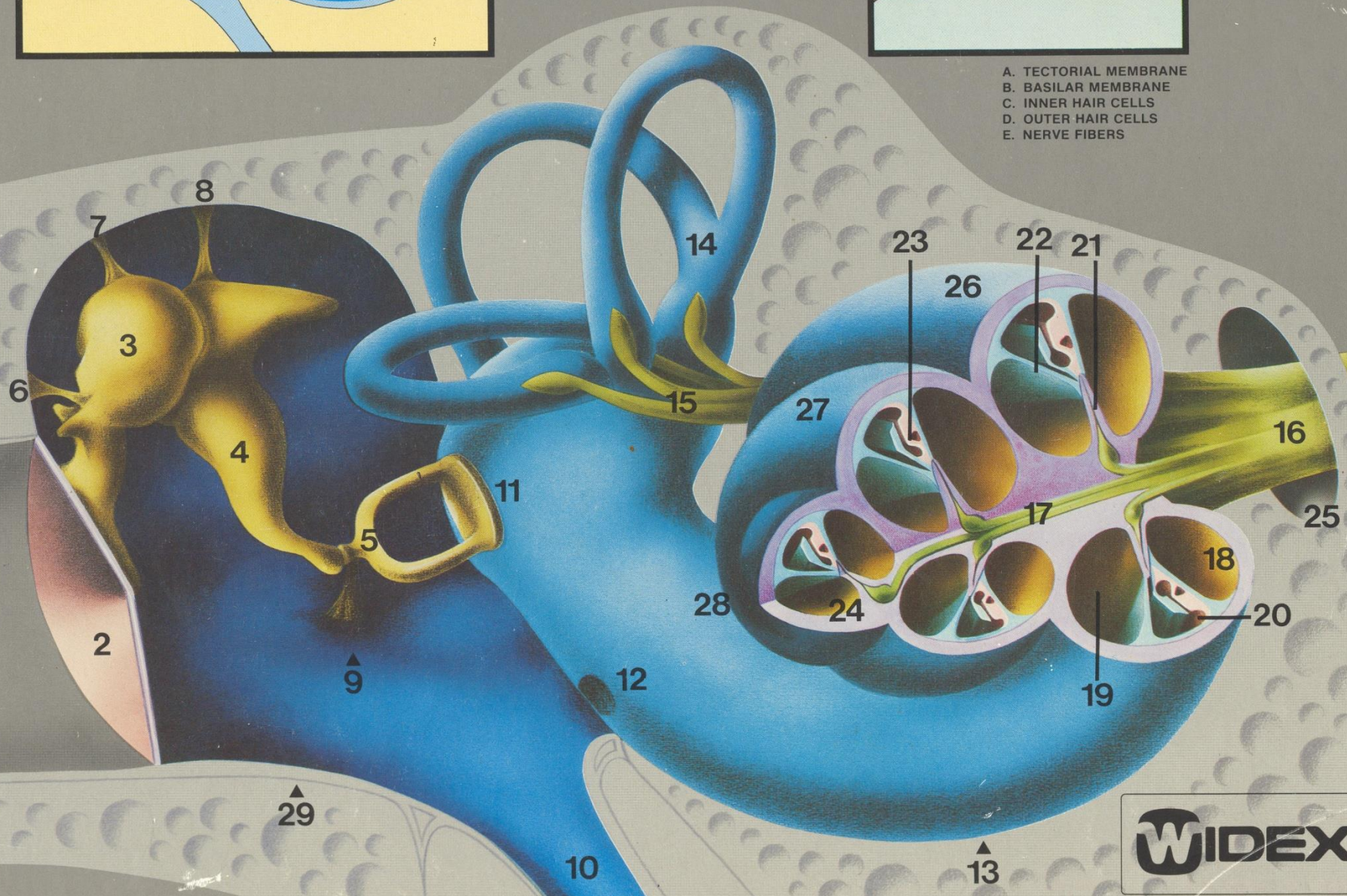
ossicles.  
to the inner ear.  
oval window are  
the scala vesti-  
ugh Reissner's  
chlear duct and  
ne to the scala  
the round win-  
with the oval win-  
a second later

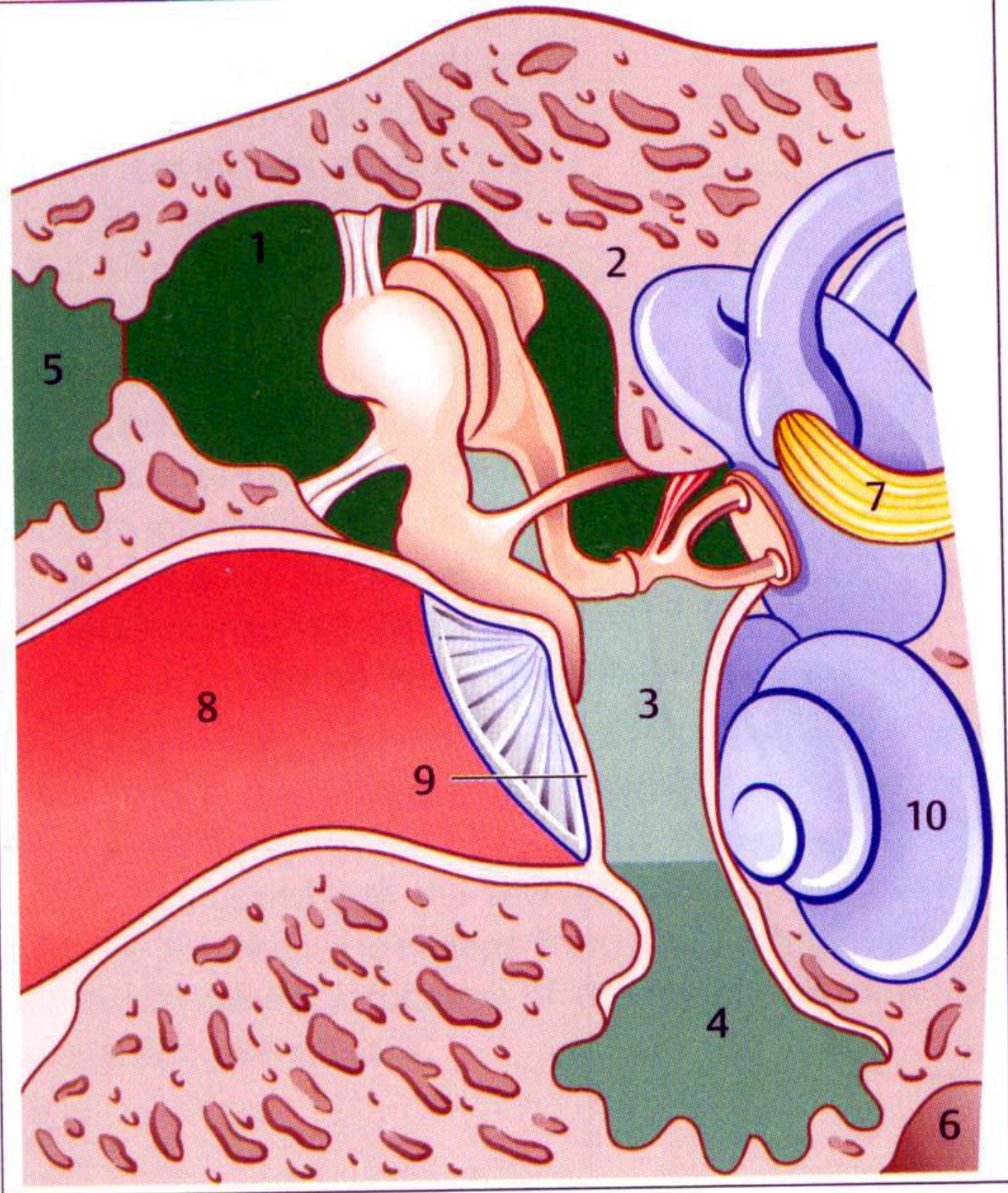


Overhanging the hair cells is a gelatinous structure known as the tectorial membrane. As vibrations from the stirrup are transmitted upwards in the scala vestibuli and through the Reissner's membrane, shearing forces between the tectorial membrane and the hair cells transduce waveform energy into electrical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

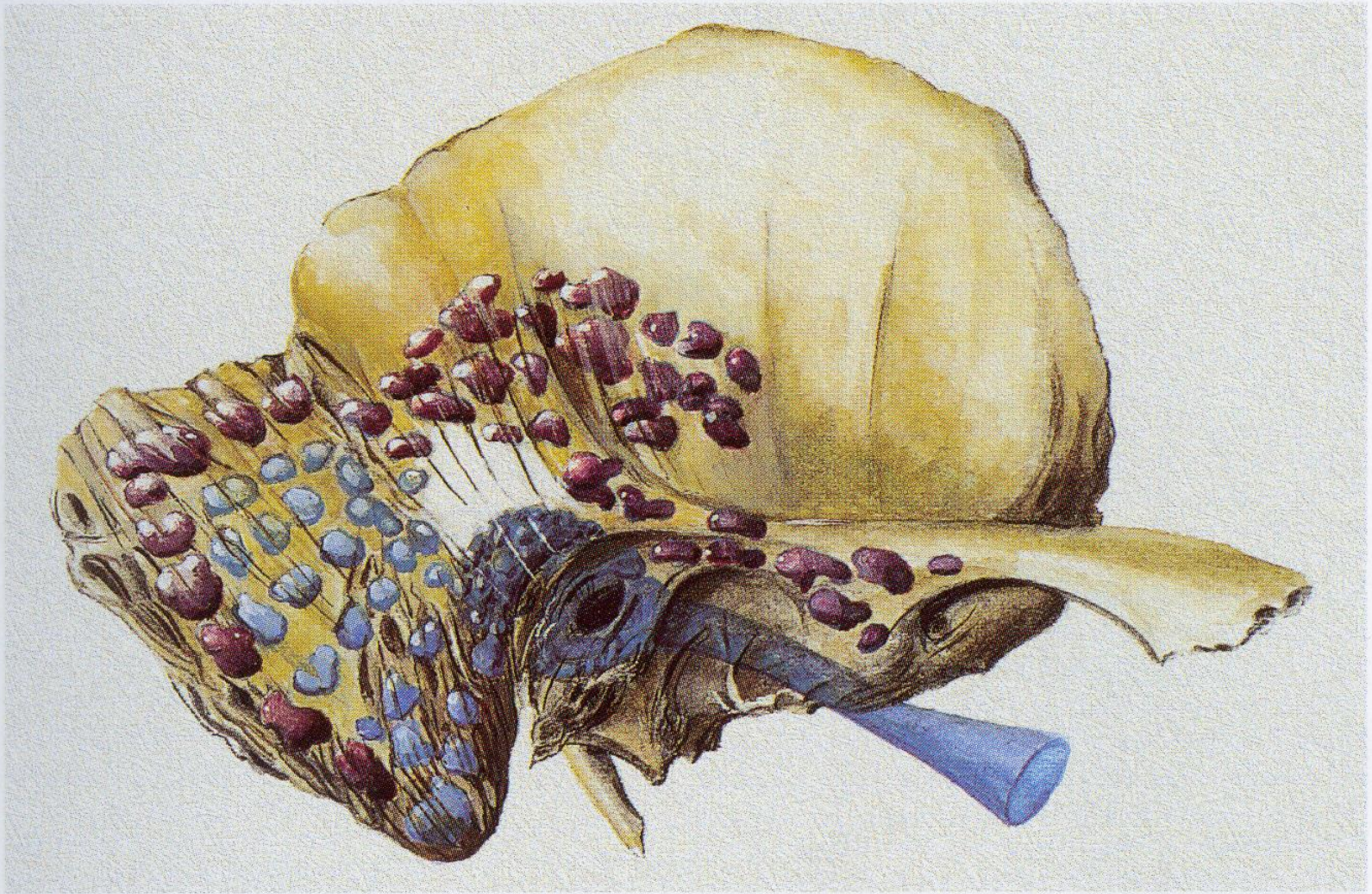


A. TECTORIAL MEMBRANE  
B. BASILAR MEMBRANE  
C. INNER HAIR CELLS  
D. OUTER HAIR CELLS  
E. NERVE FIBERS





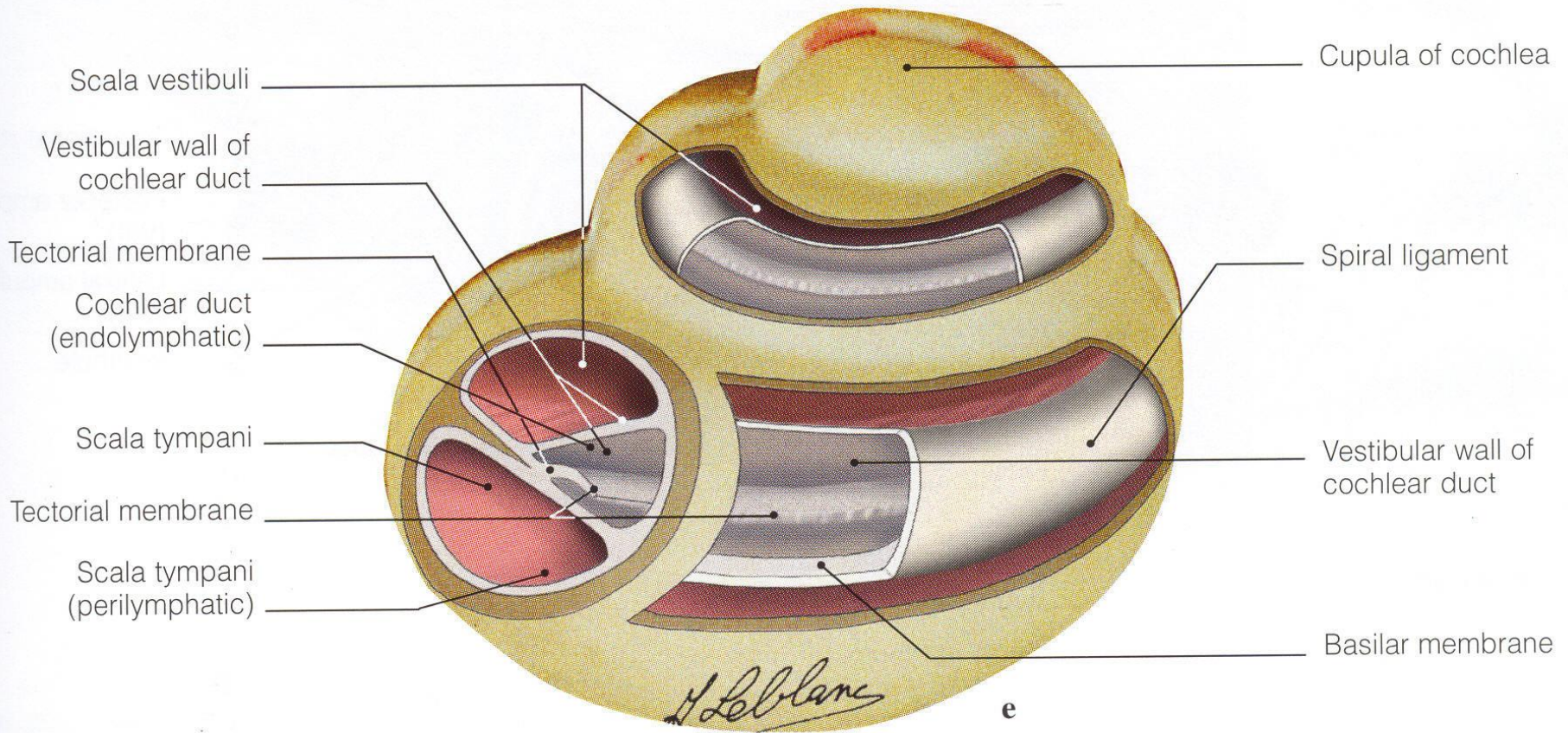




Pneumatization types of the petrous bone

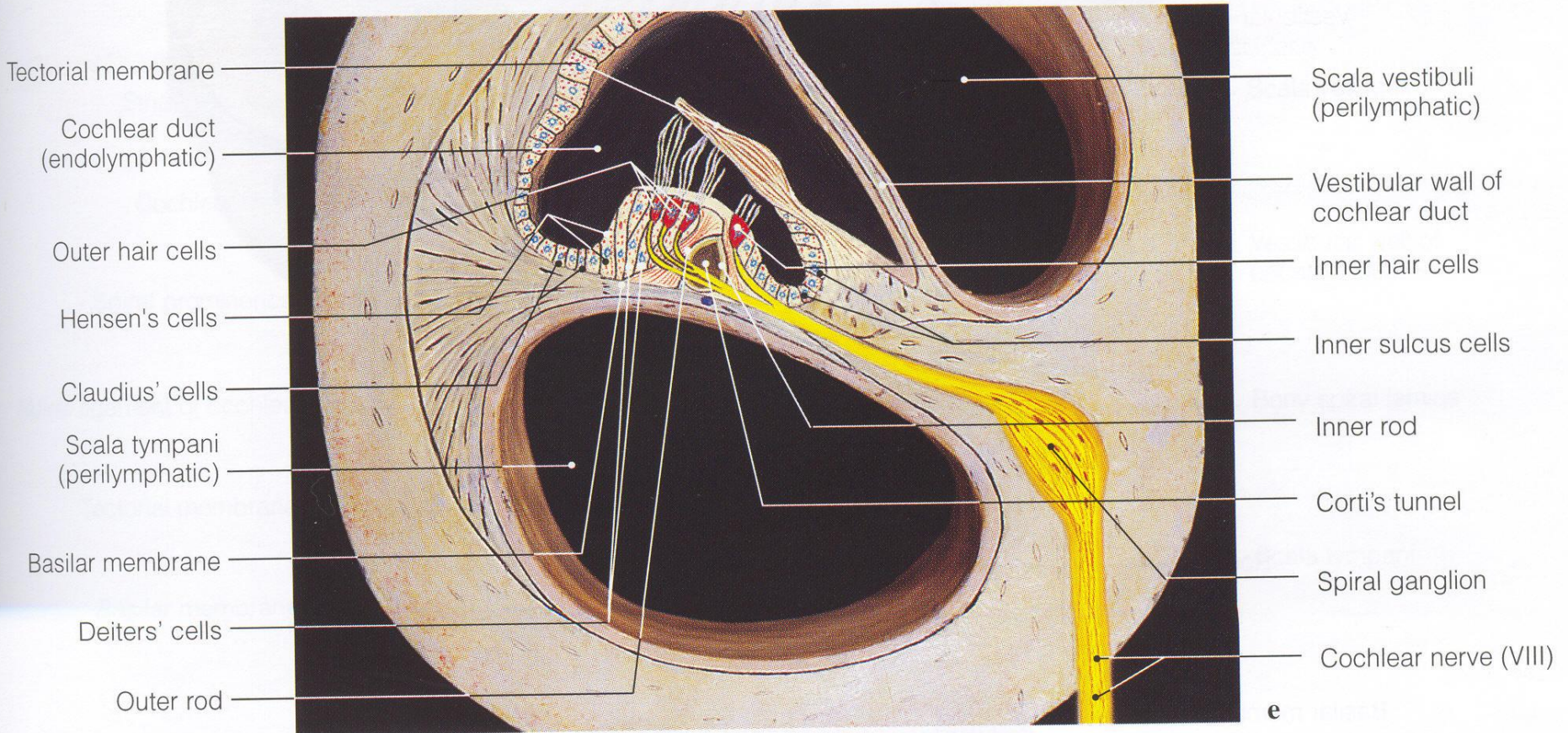
- compact mastoid process
- restrained pneumatization
- good pneumatization

# Cochlear cross-section

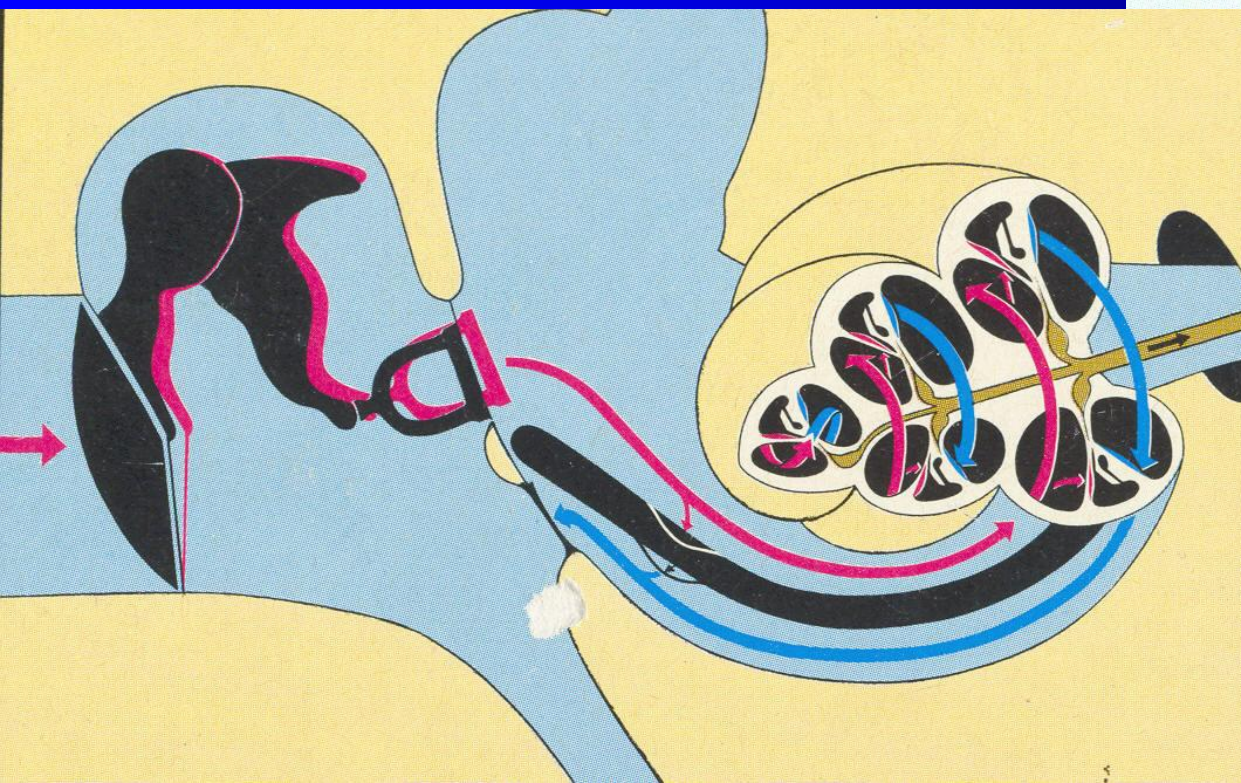
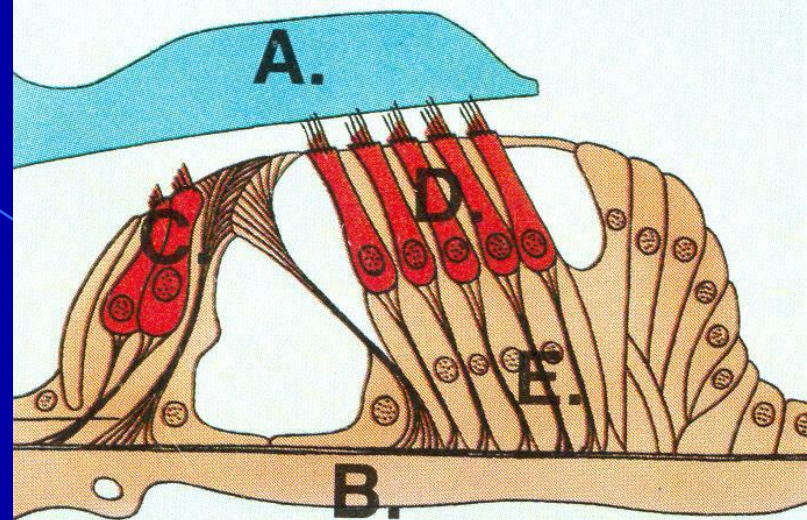




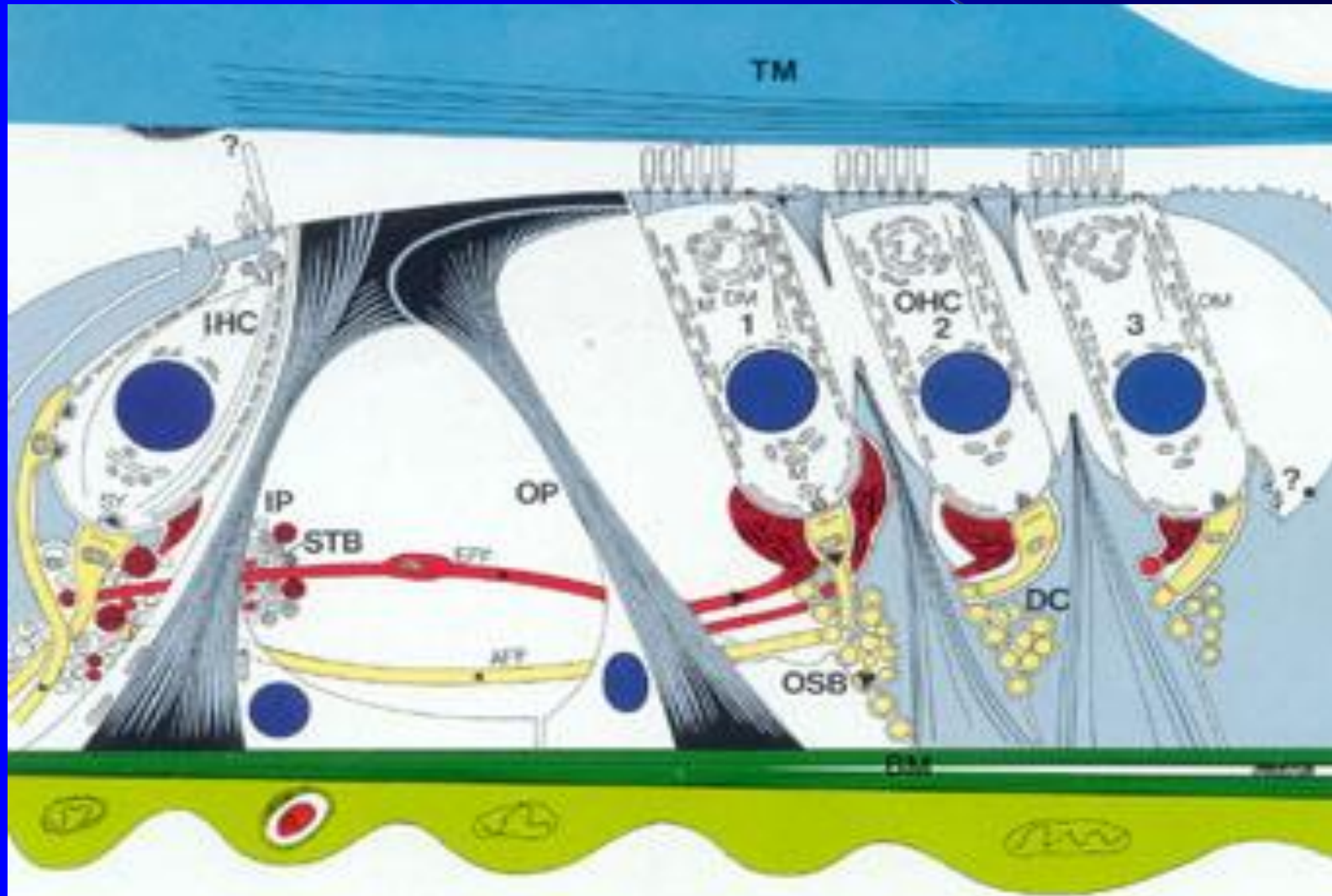
# Cochlear duct cross-section



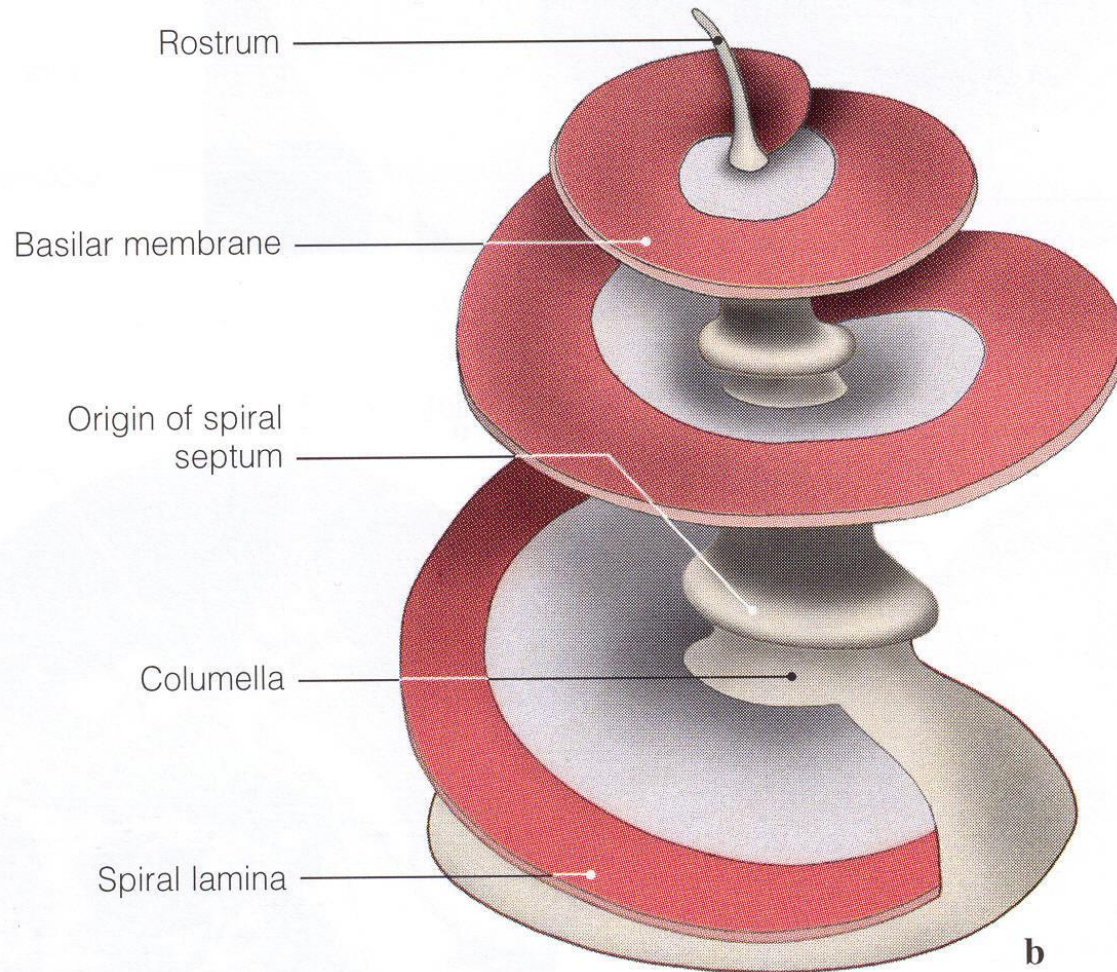
**Conductio of vibration  
from tymp.membr.  
through cochlea,  
Organon Corti**



# 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)**

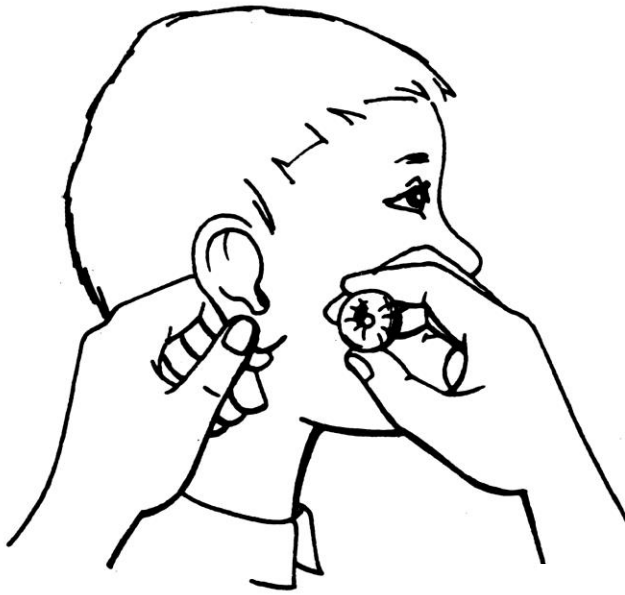
# **History of disorder – ear disease symptomatology**

- **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.



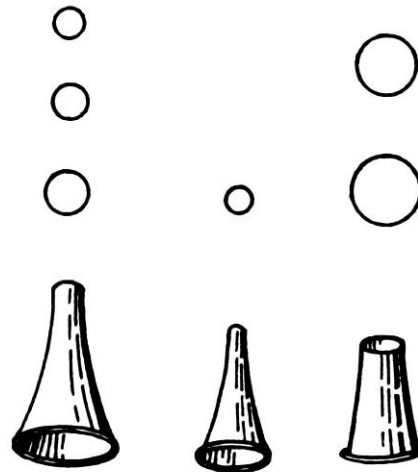


Obr. 13: Zavádění ušního zrcátka u dítěte



Obr. 12: Zavádění ušního zrcátka u dospělého

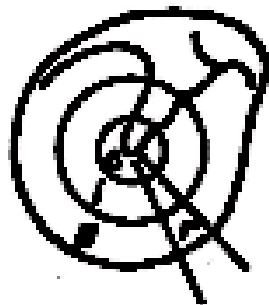
**Otoscopy**  
eye evaluation of  
deeper parts of  
external meatus  
and ear drum



Obr. 11: Ušní zrcátka



# Otoscopy – tympanic membrane quadrants and zones



*p - prominencí malleolus*

*i - ústí malleolus*

*e - umbo*

*r - reflexní reflex*

*Kvadranty:*

*pl - přední dolní*

*ph - " horní*

*zl - zadní dolní*

*zk - " horní*

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

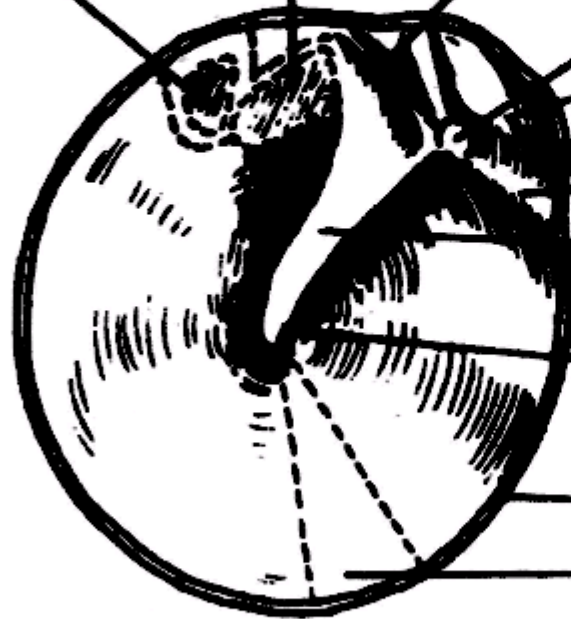
**Rozdělení bubínku na kvadranty a zóny**

# 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*



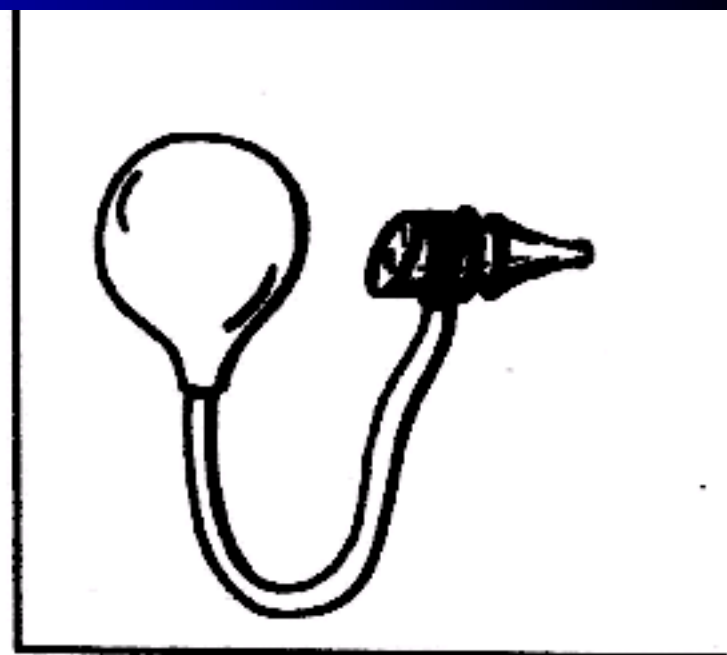
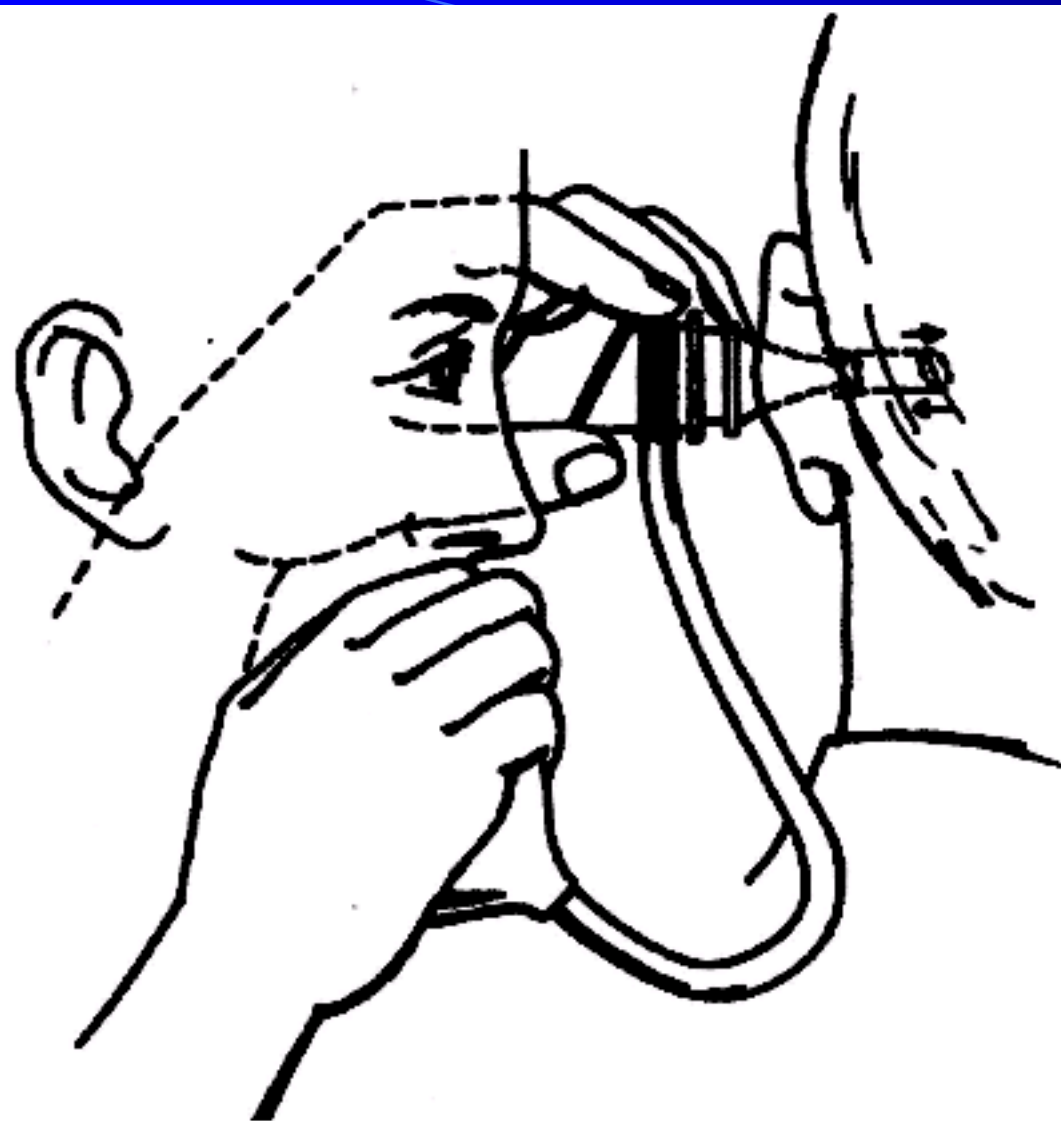
*ruptura bubínku*



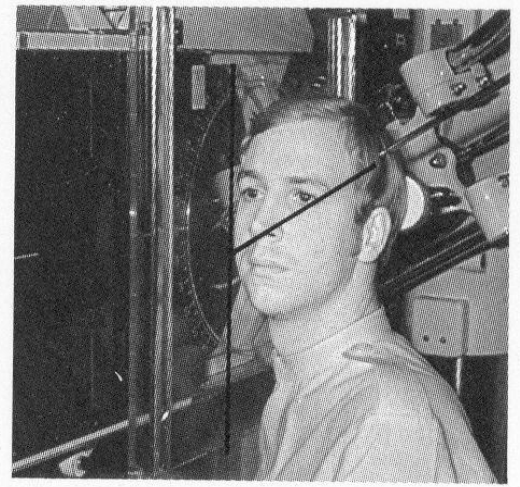
*okrajově perforace*



*okrajově a centrální perforace*

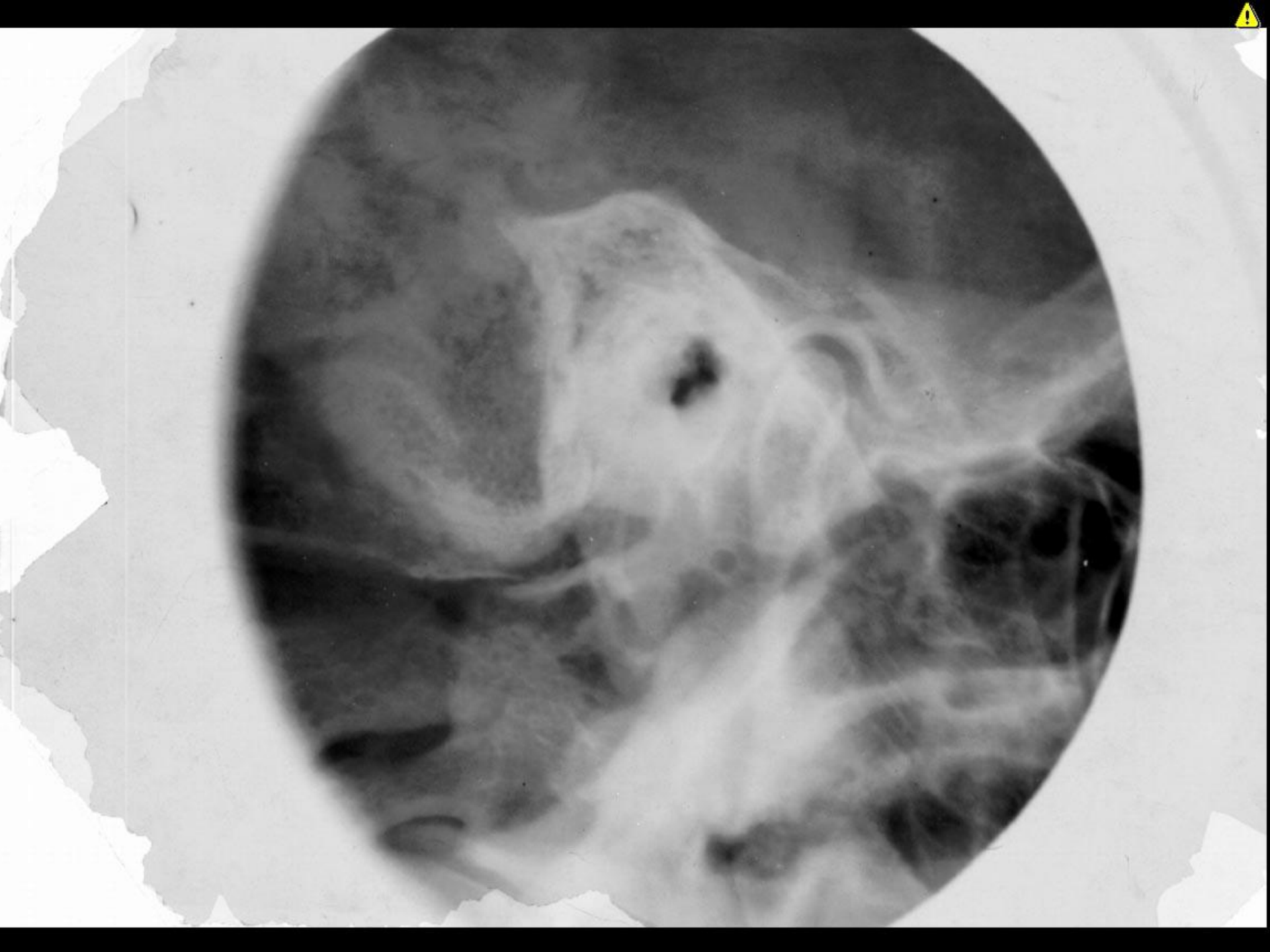


**Vyšetřování Sieglovým zrcátkem**



**Projekce die Schüllera**

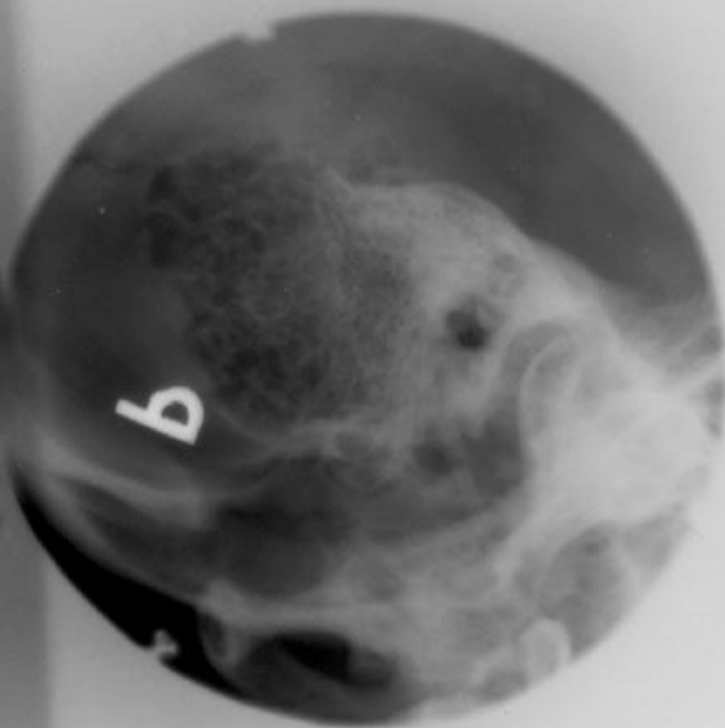
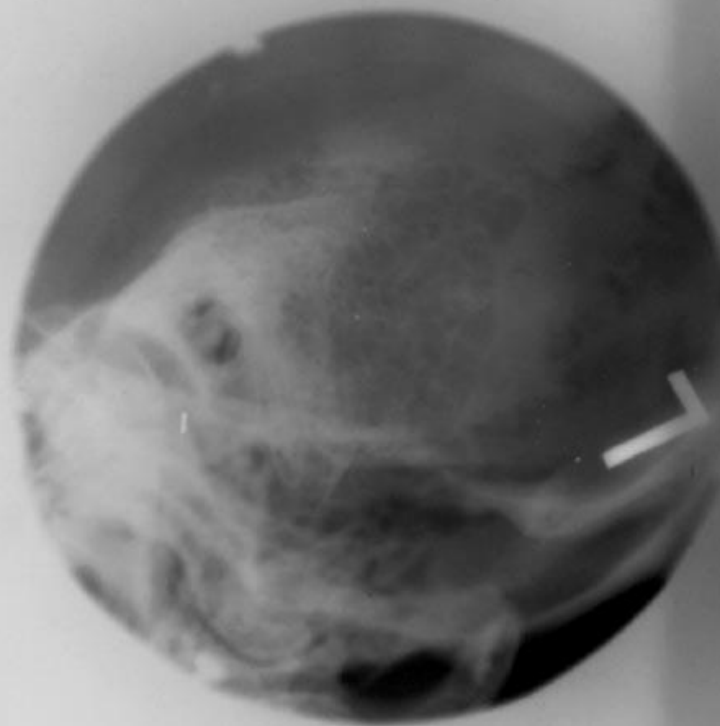




Mladtrava

Ohňo med sup. ac. o. mastoidní  
(akutí gastrickú pneumotické systém)

Normální výhled.

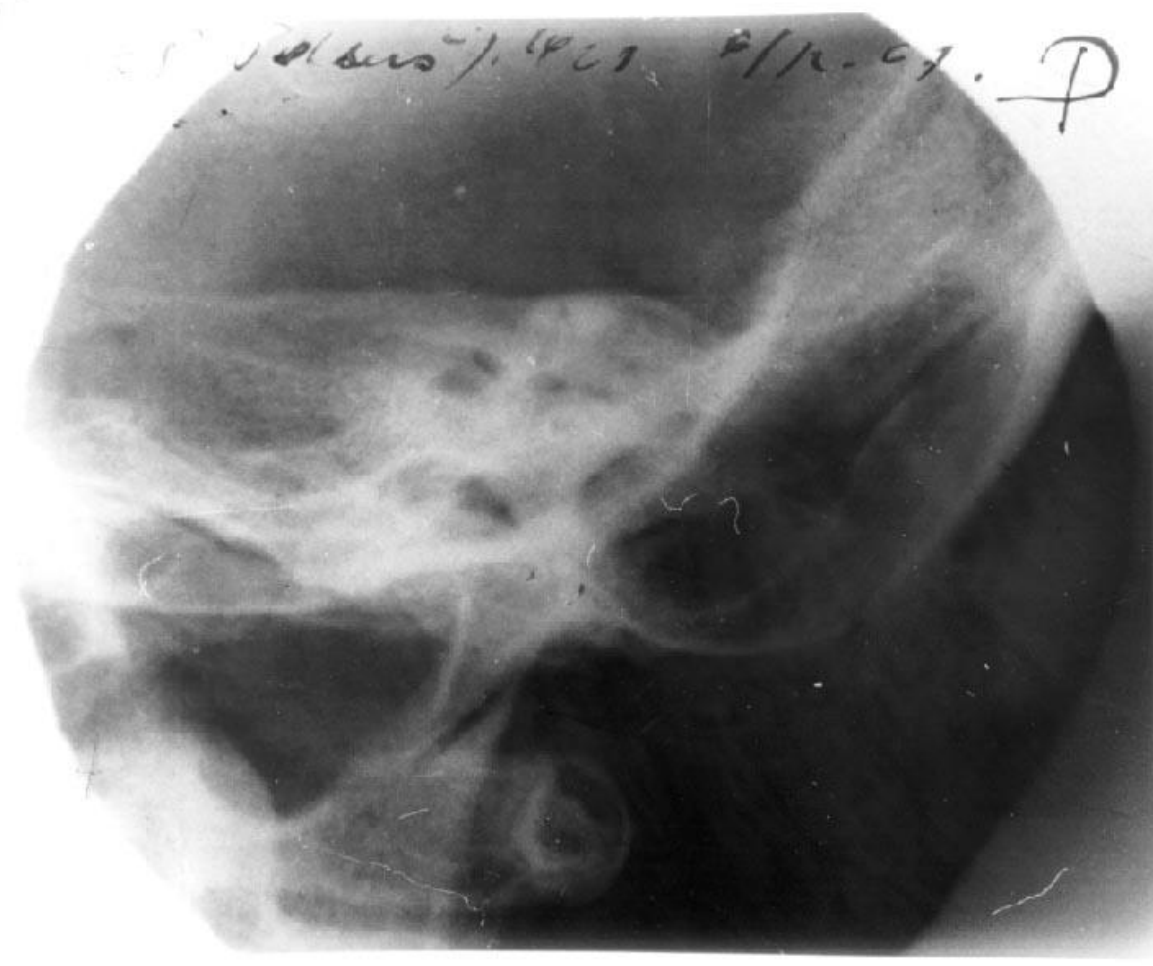




PHOTOGRAPHED BY THE RADIOLOGICAL DEPARTMENT OF THE UNIVERSITY OF CHICAGO

7

55 Polaris 1.465 8/12.07. P



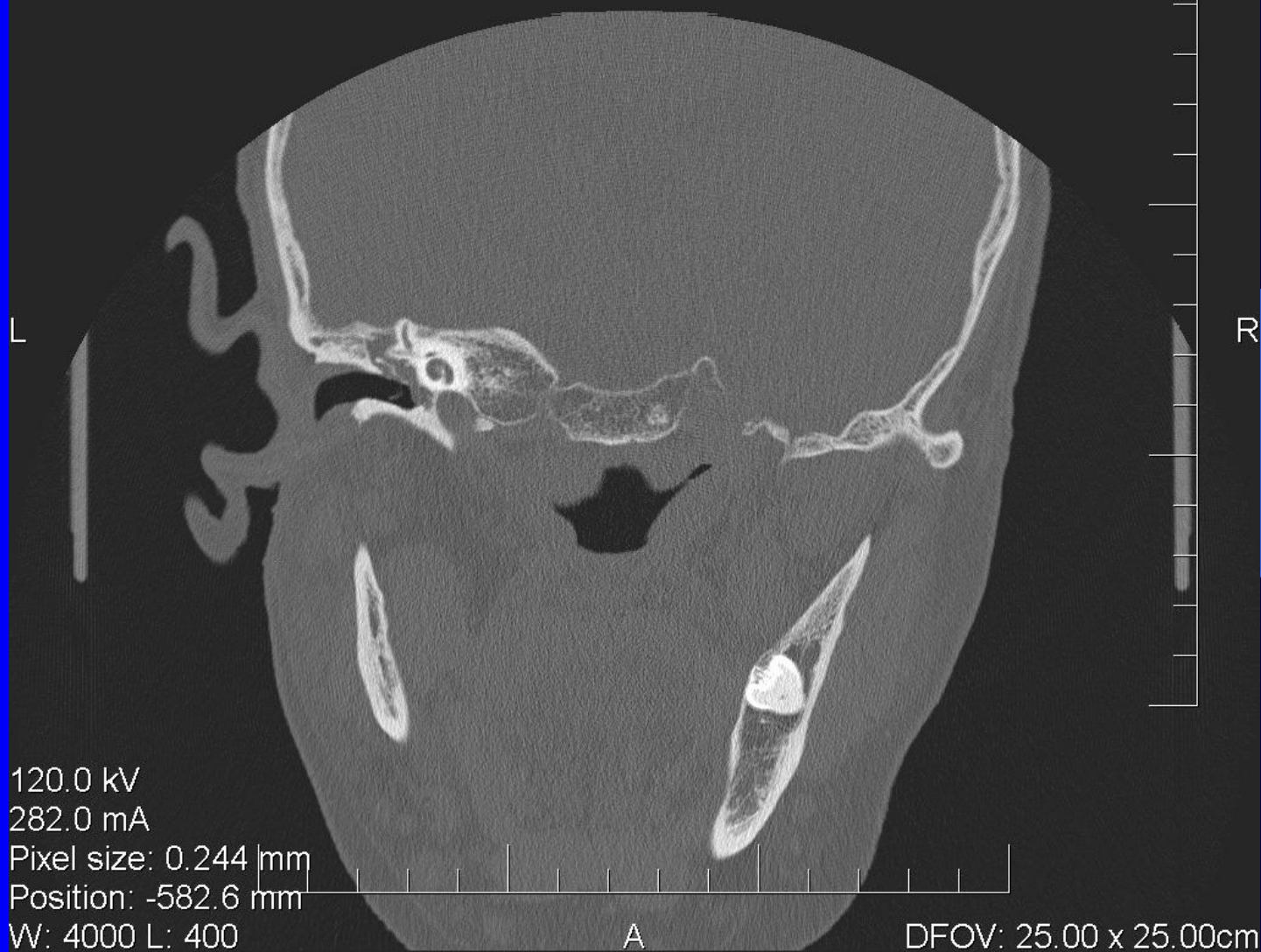




CT/835/12  
Axial F->H

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

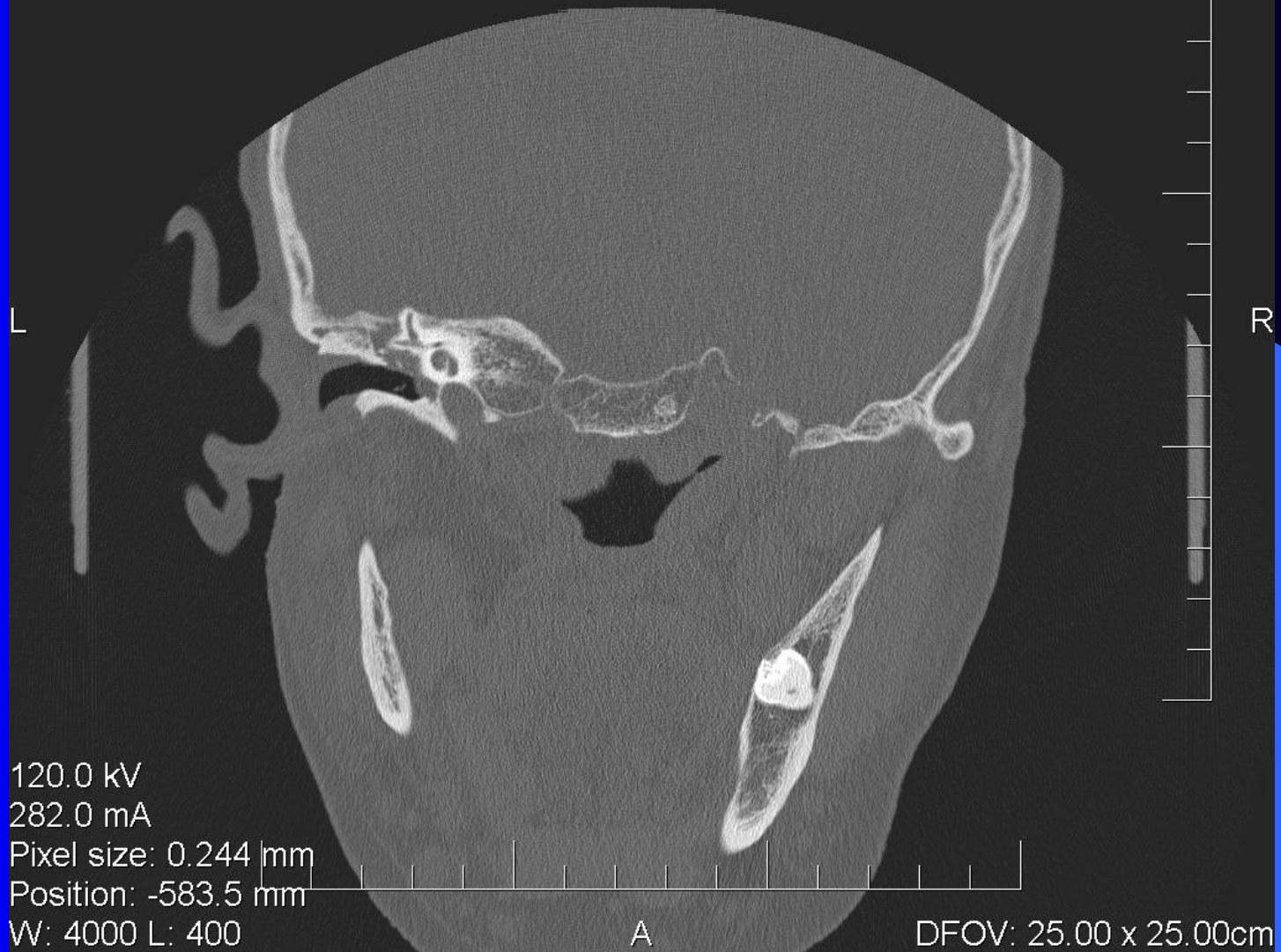
A

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

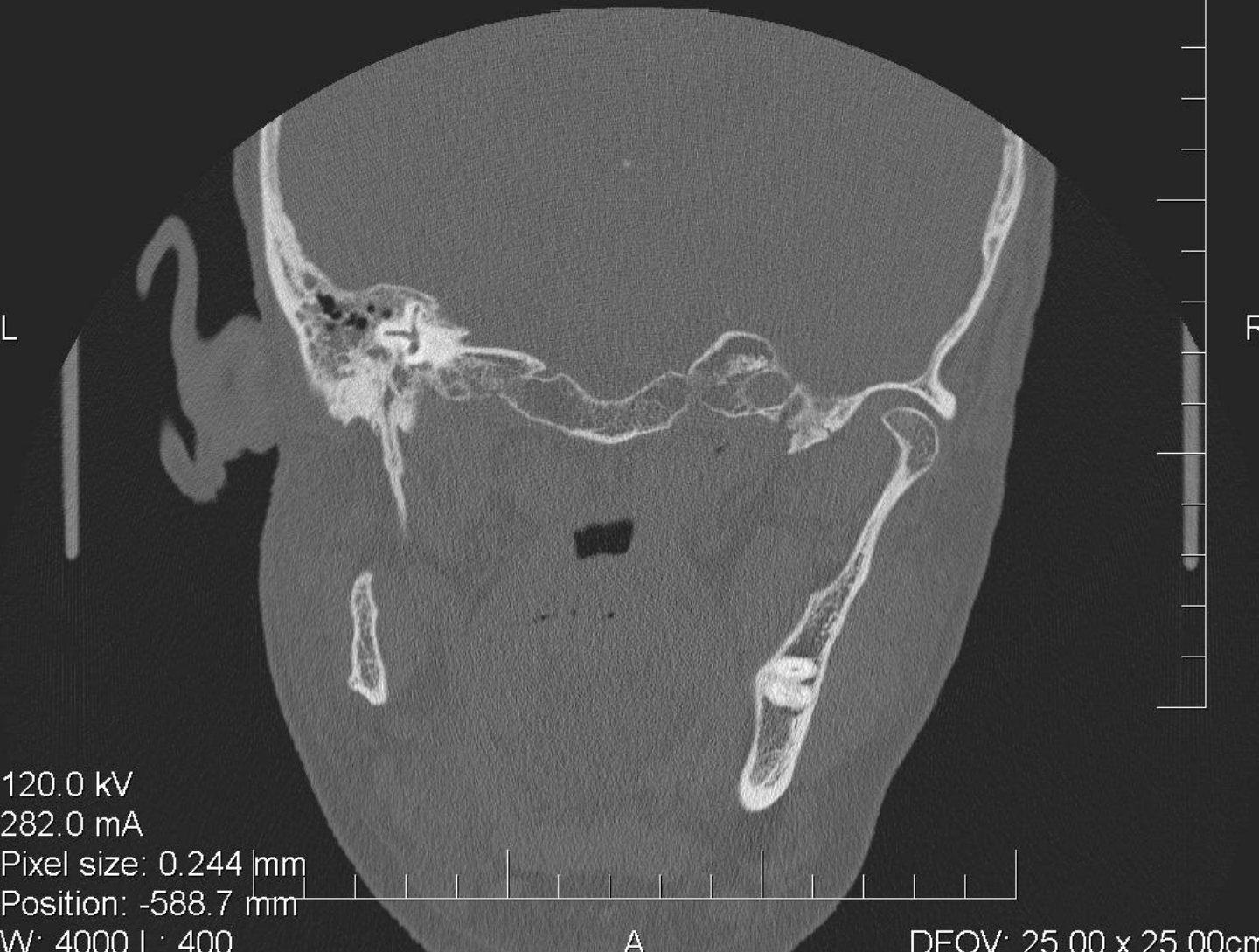


CT/835/19  
Axial F->H

P

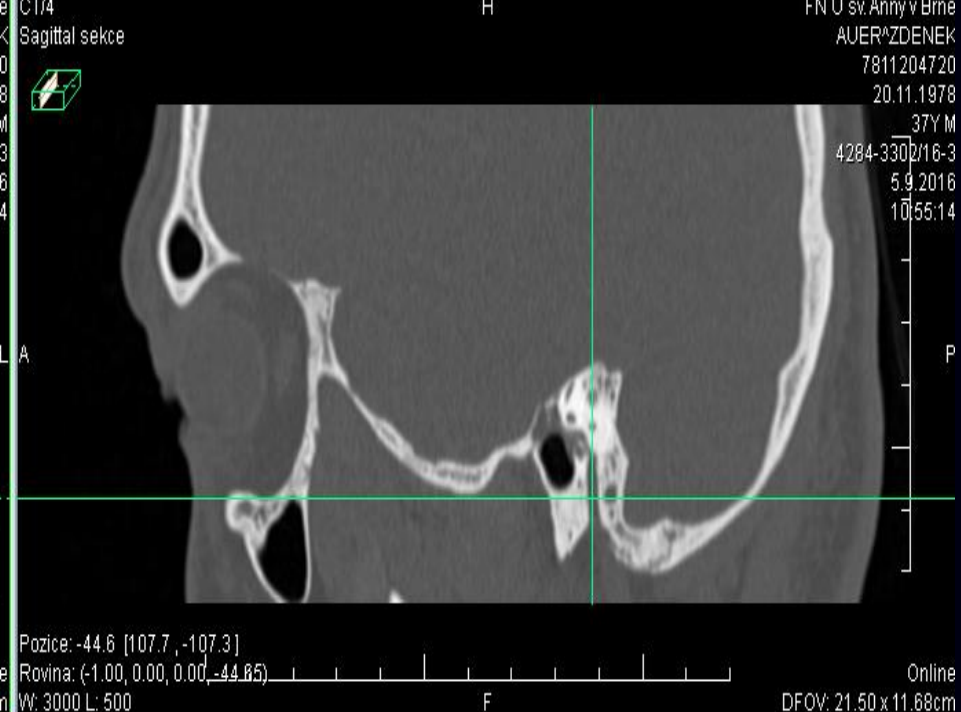
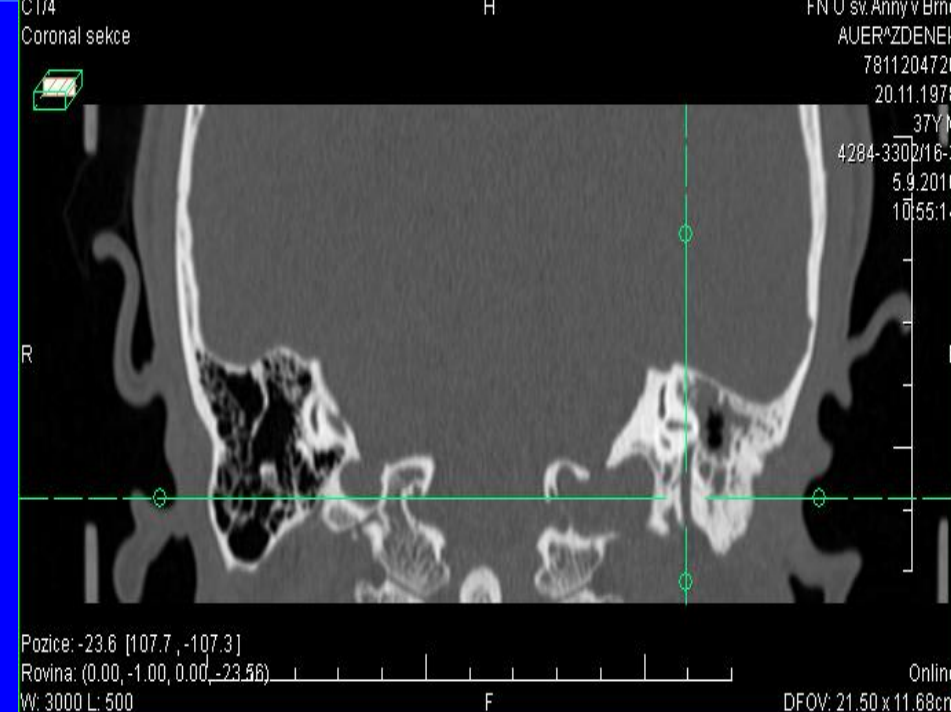
FN U sv.Anny v Brne  
JANECEK^DRAHOSLAV  
280912/403  
M  
4284-1764/06  
2006/3/13  
10:23:21

Canalis  
Fallopi



120.0 kV  
282.0 mA  
Pixel size: 0.244 mm  
Position: -588.7 mm  
W: 4000 | 400

DFOV: 25.00 x 25.00cm



# 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).

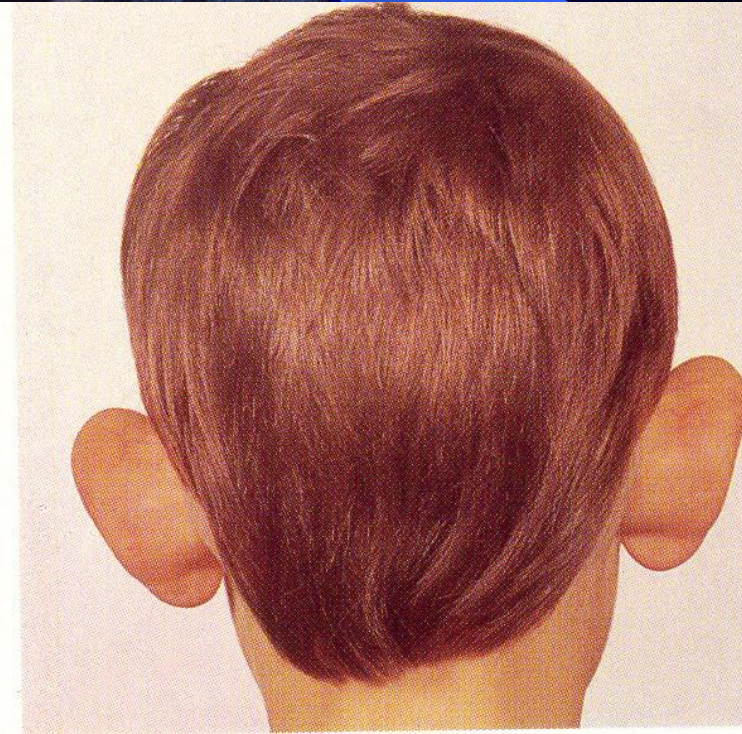
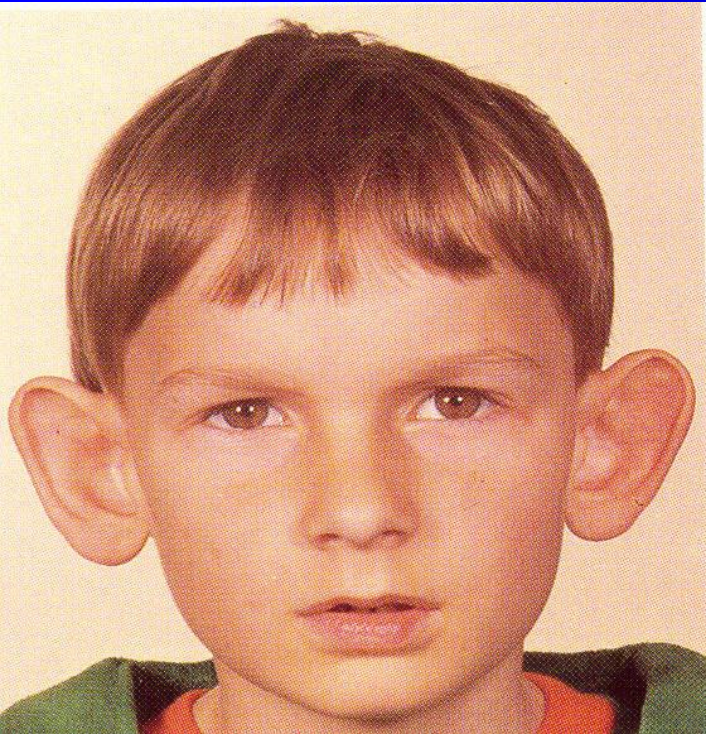
Hearing loss occurs in about half of all affected individuals; hearing loss is caused by defects of the three small bones in the middle ear, which transmit sound, or by underdevelopment of the ear canal. People with Treacher Collins syndrome usually have normal intelligence.



# Apendices praeauriculares



# Apostasis auriculae



**Erysipelas  
bullosa  
auricullae**



# Herpes zoster oticus (part of Ramsley-Hunt syndrome)

acute finding– after 3 days – after 10 days

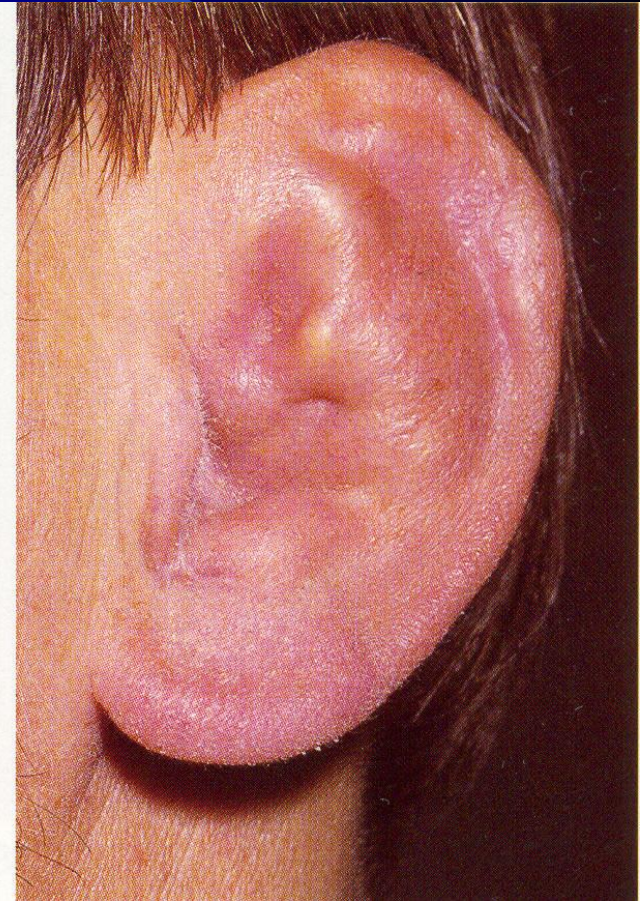
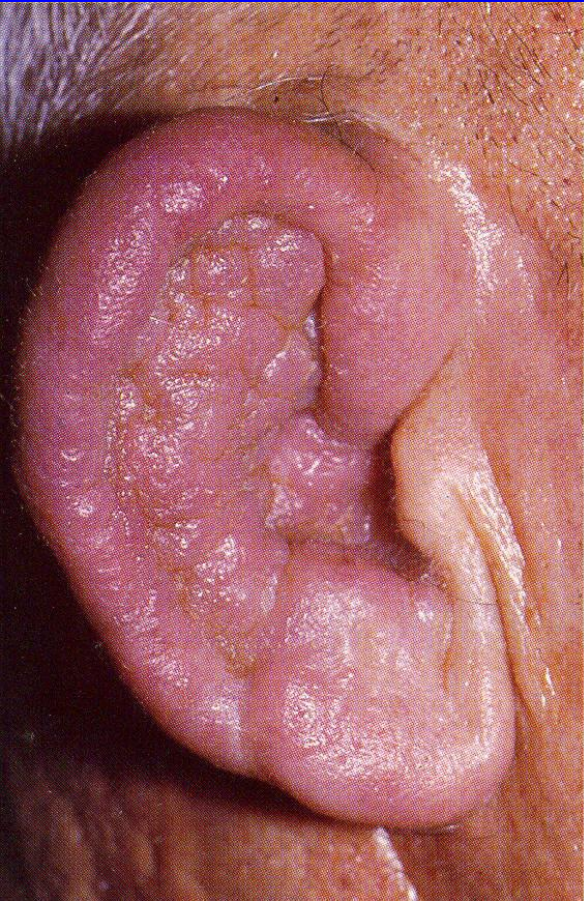




# Perichondritis



# Chronic polychondritis – allergy- cauliflower ear

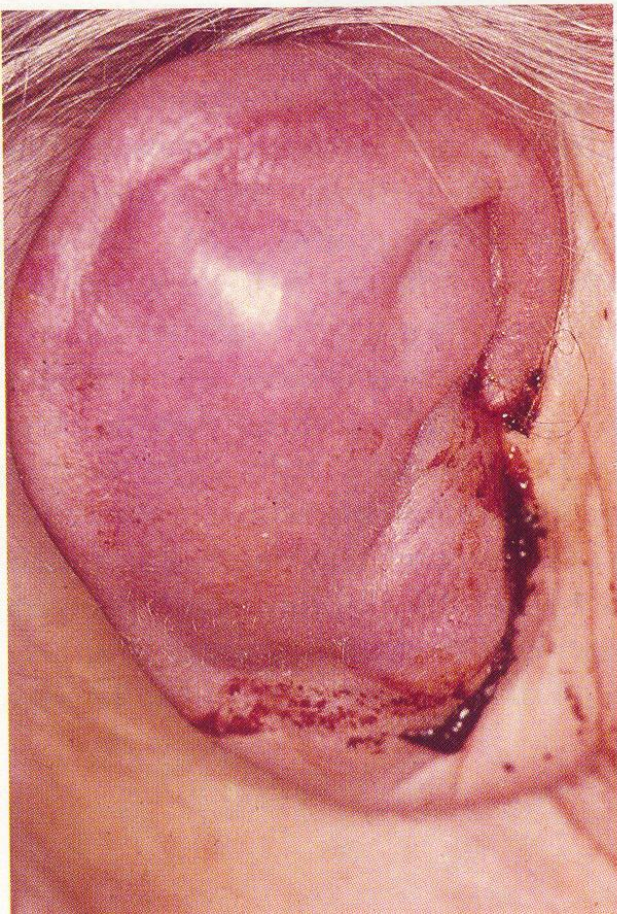


# Spinocellular cancer of auricle

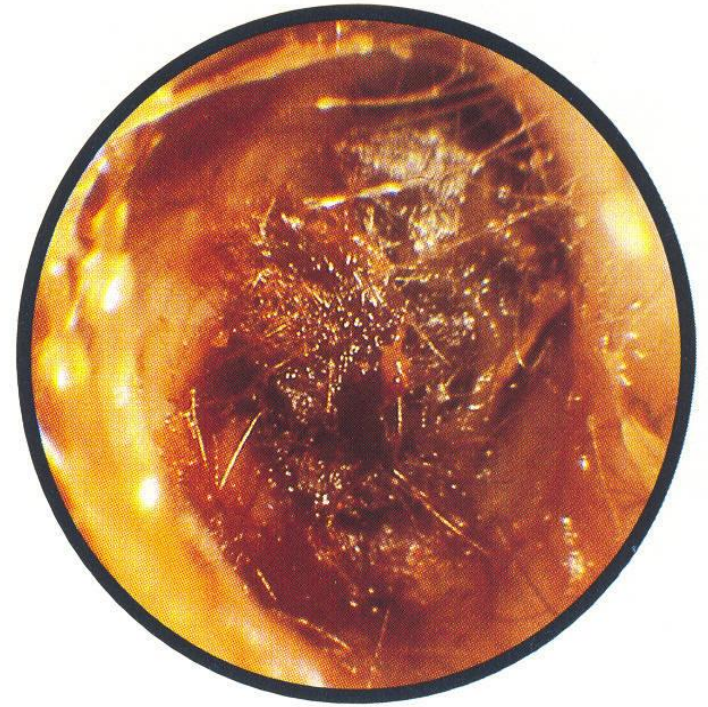


# Othematoma

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



# Cerumen

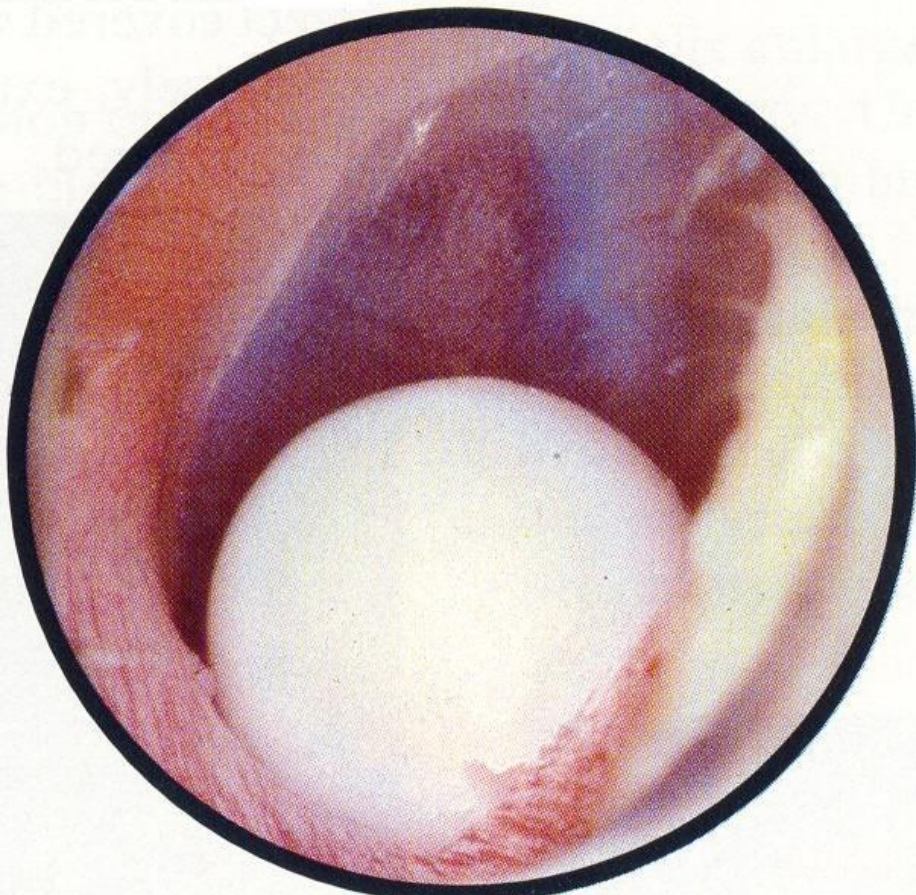


# Foreign body in external meatus - insect

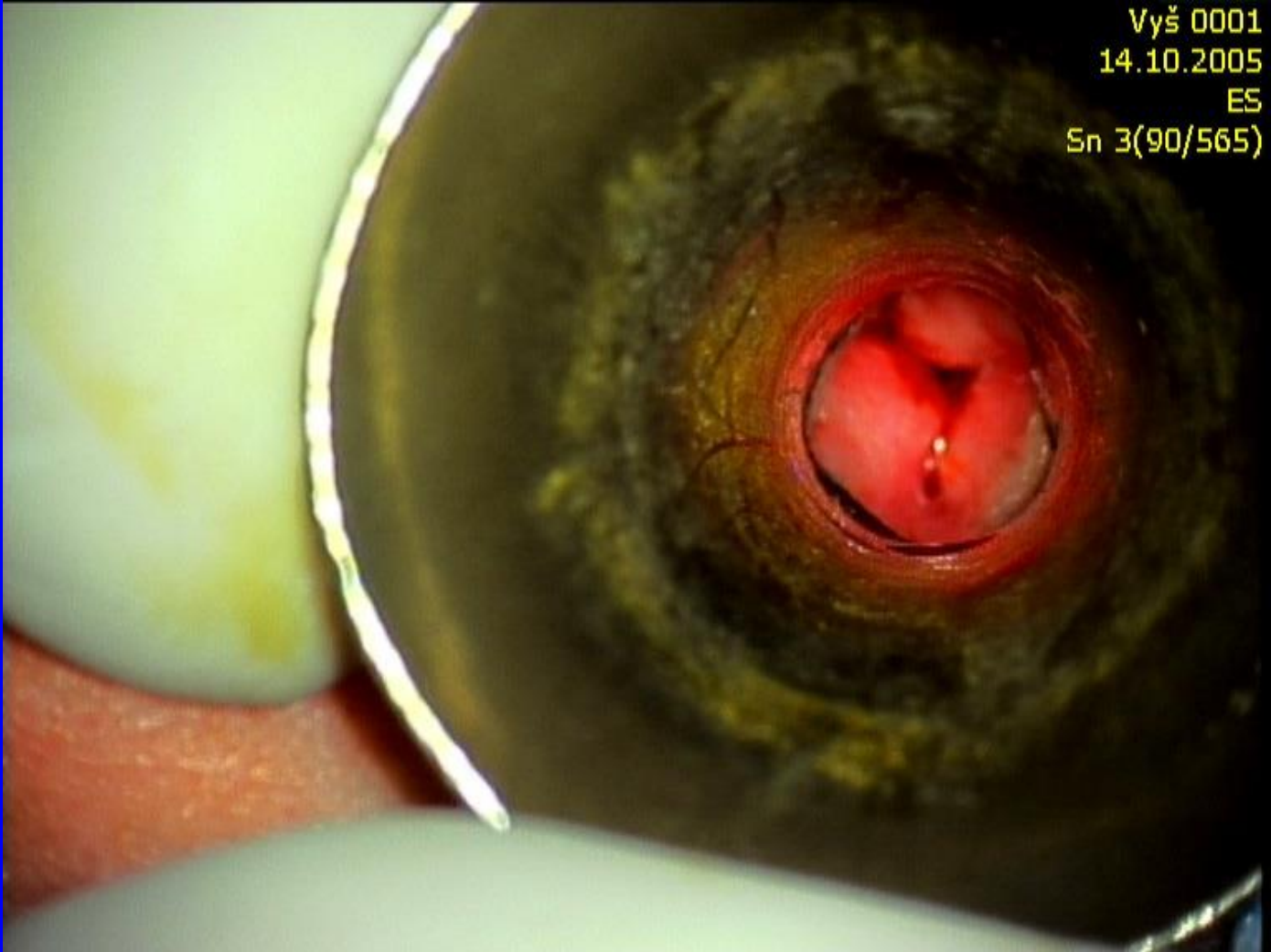
Ventilační trubička  
k drenáži  
středouší  
(nezávislý nález)



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



# Exostosis in ext. meatus right

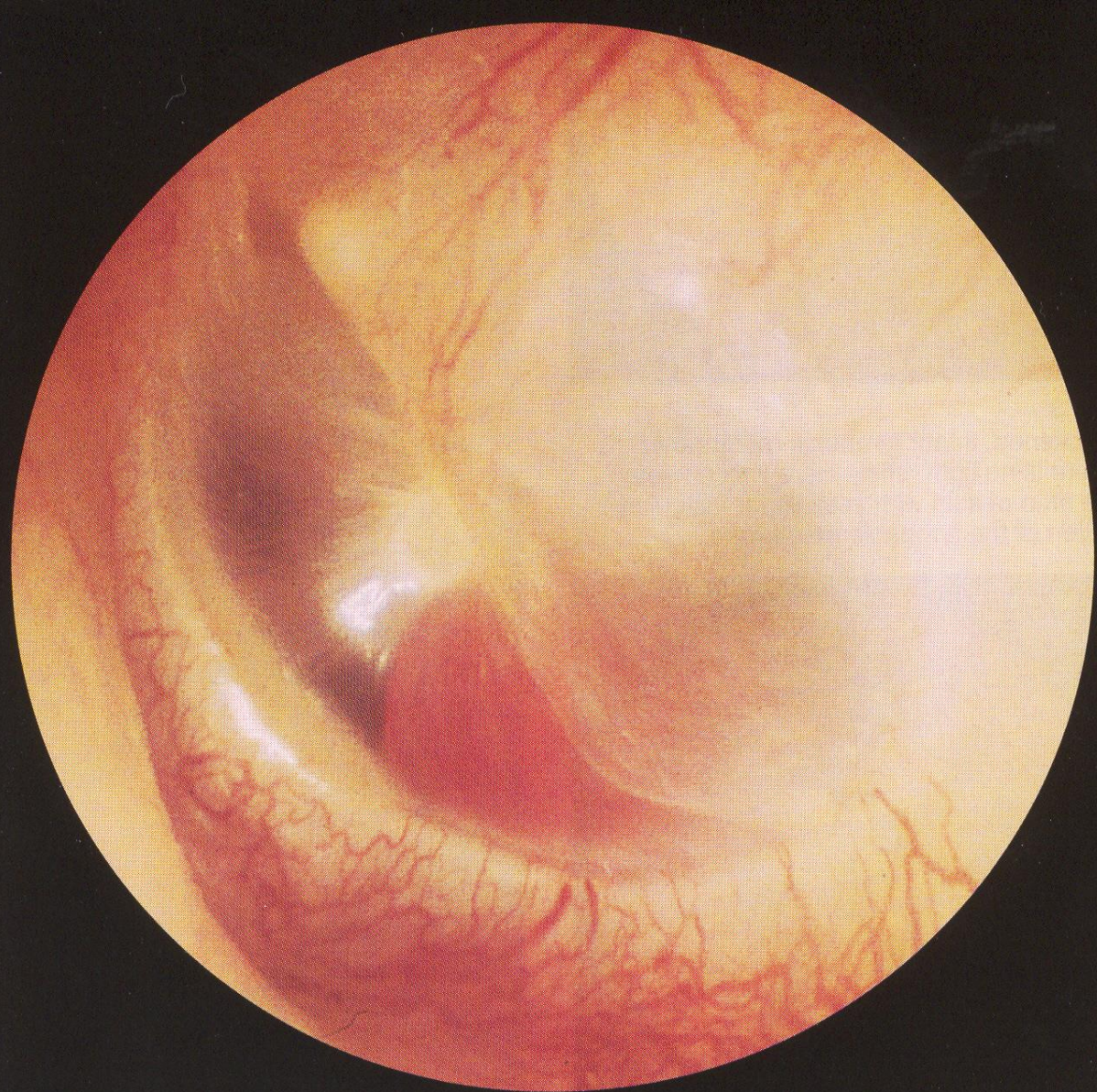




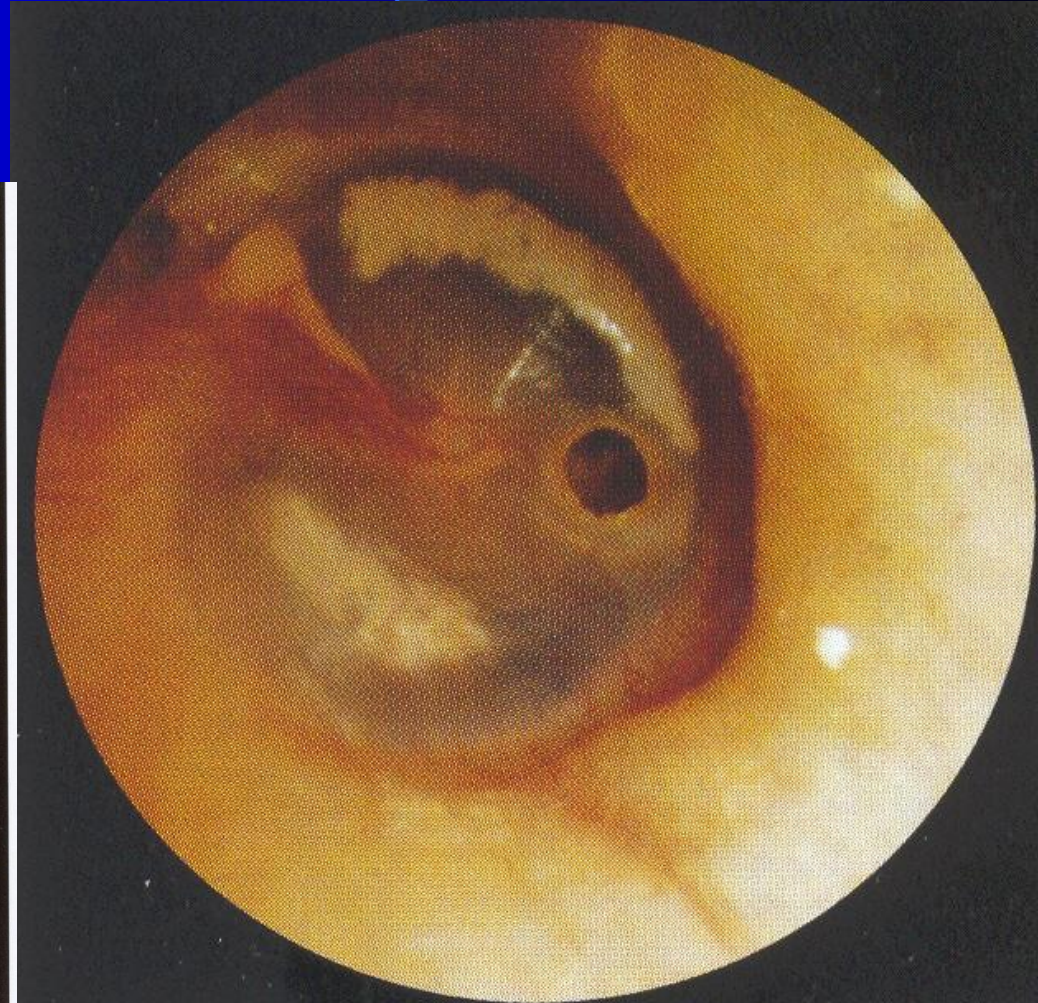
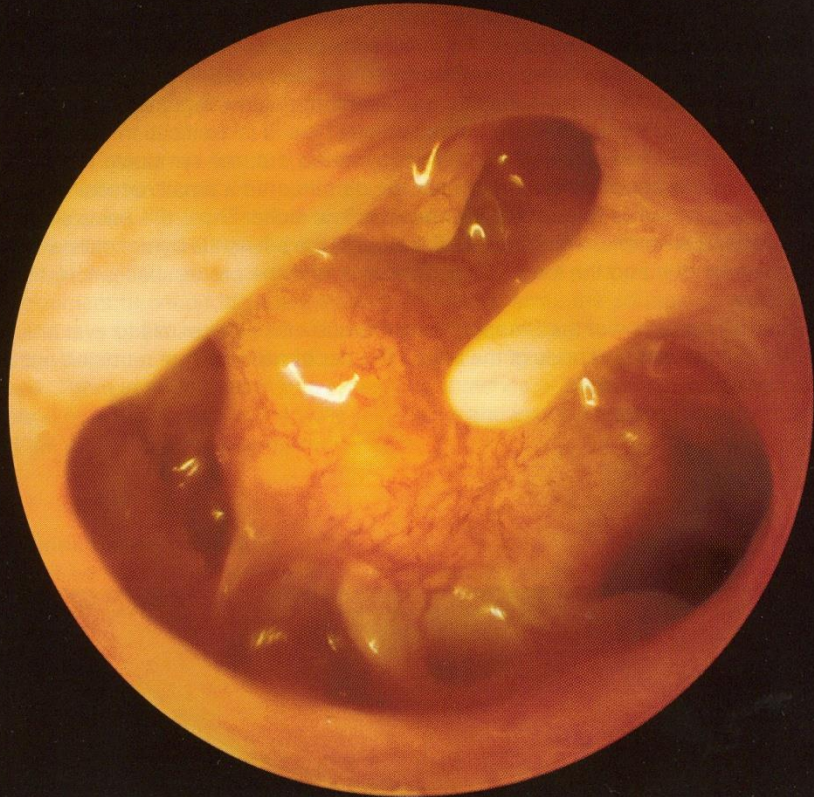
**Furunculus of  
external  
meatus**



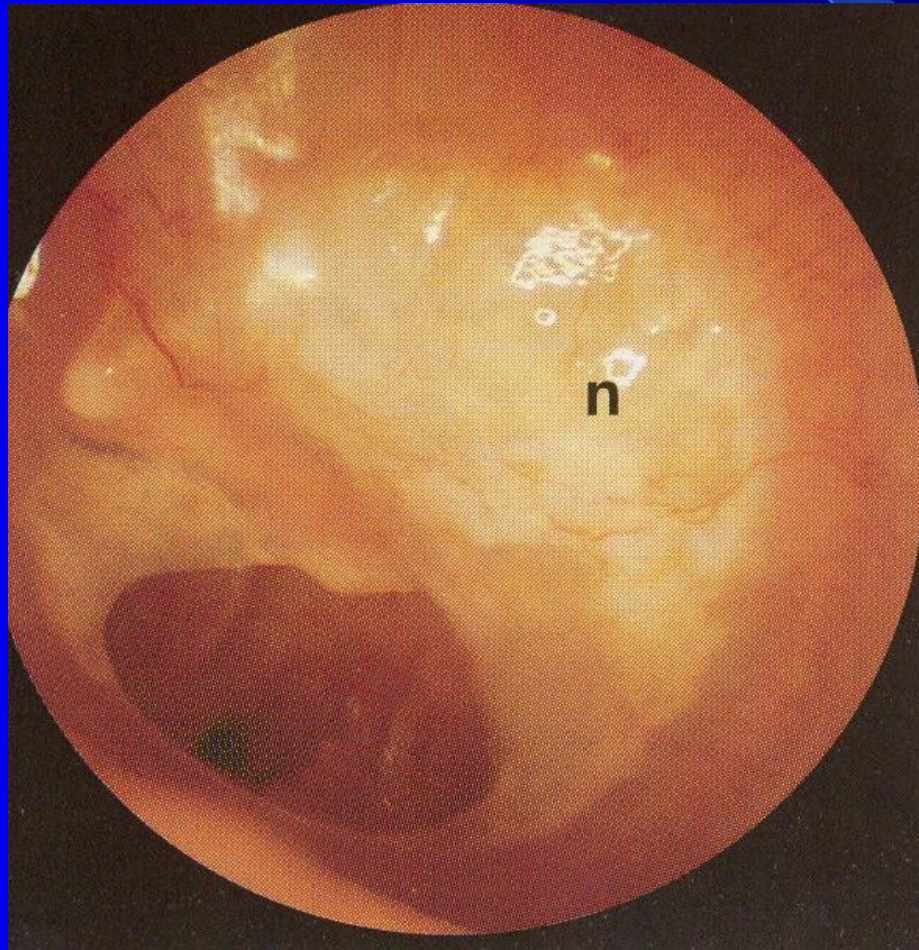
# Tympanojugular chemodectoma



# Central perforation

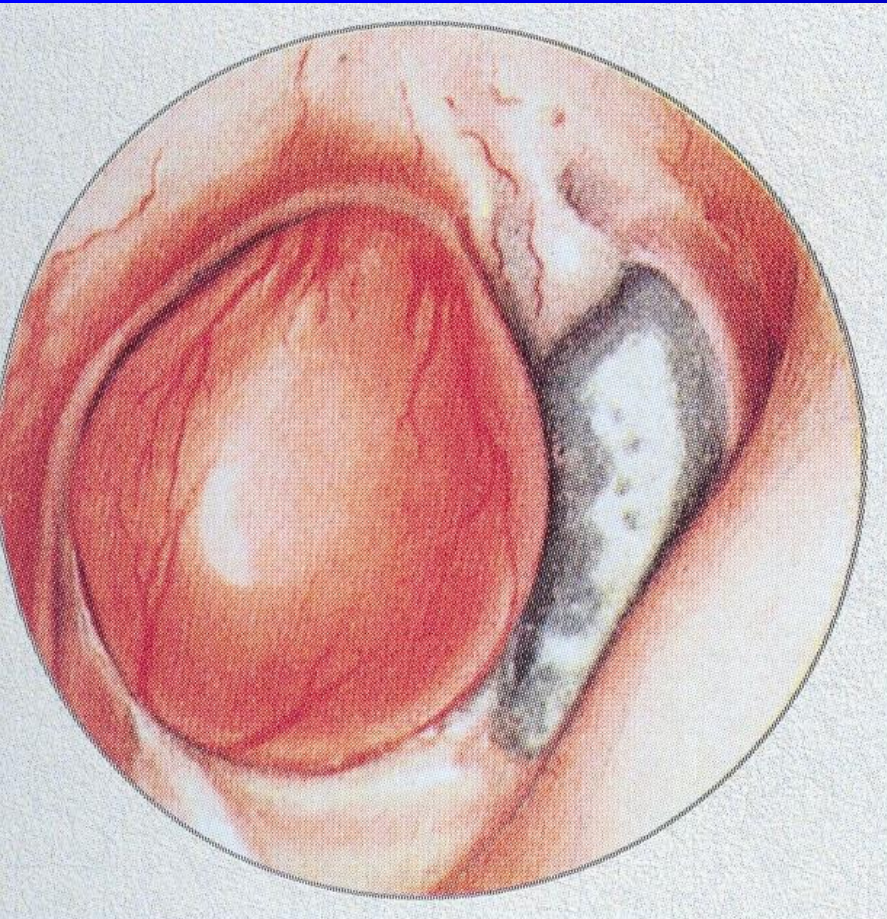


# Central perforation in antero-inferior quadrant



# Velký stopkatý polyp u chro. zánětu středouší

## Defekt epitympanálních prostorů po odstranění cholesteatomu



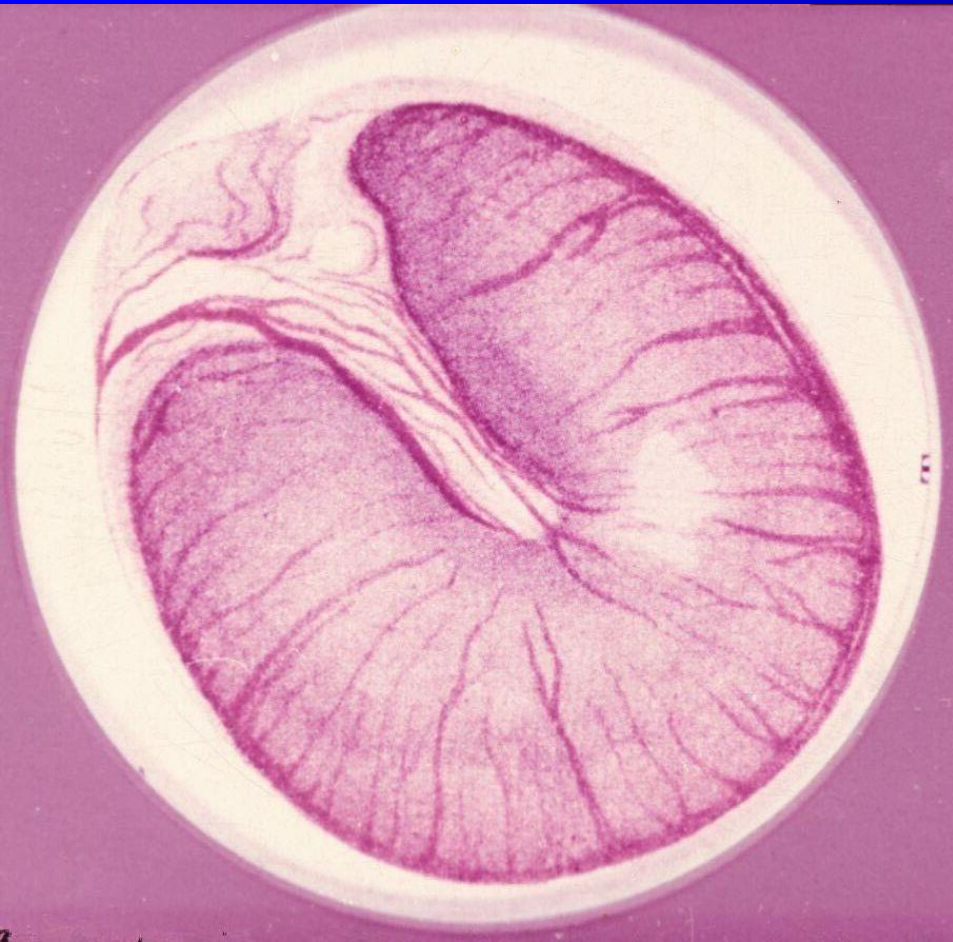
**Hemotym  
panum,  
vpáčený  
bubínek**



Traumat.  
perforace

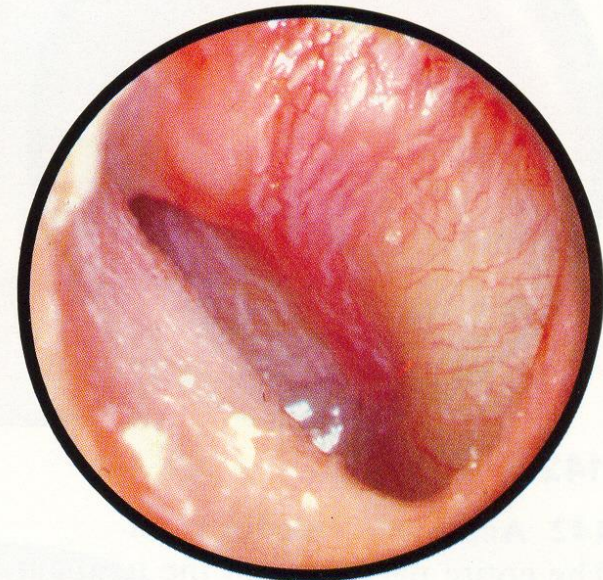
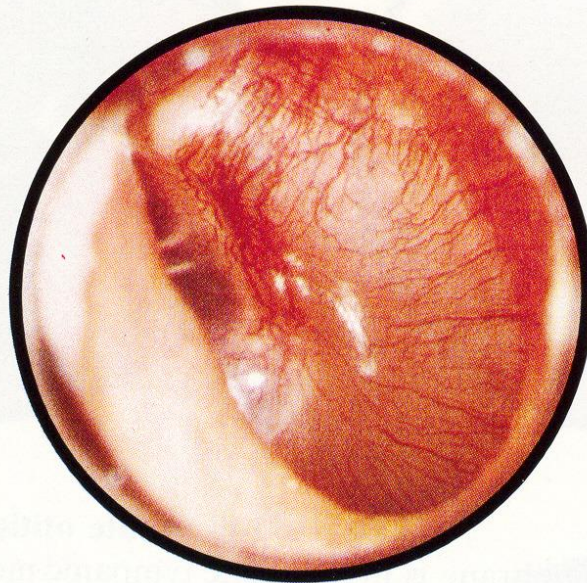


# Otitis media acuta

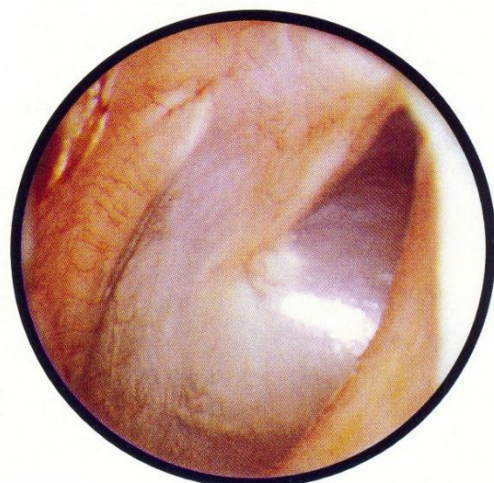
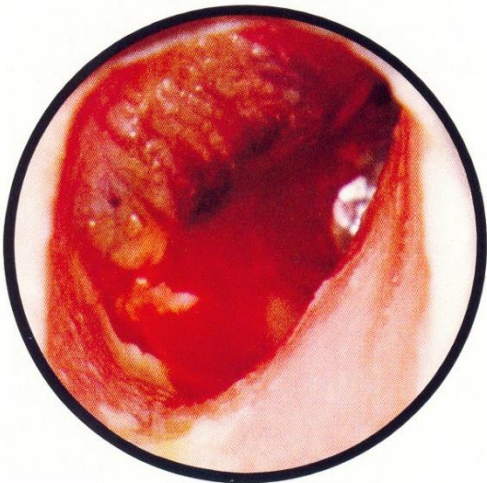
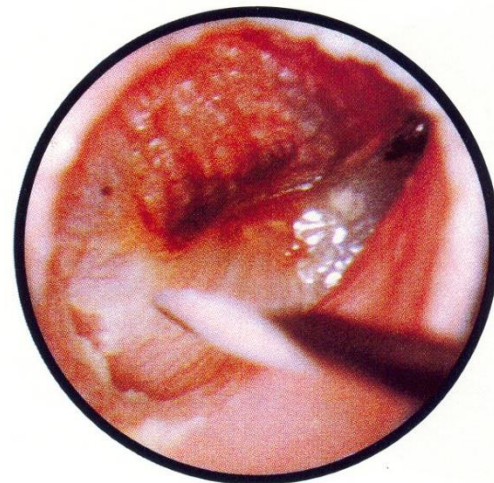
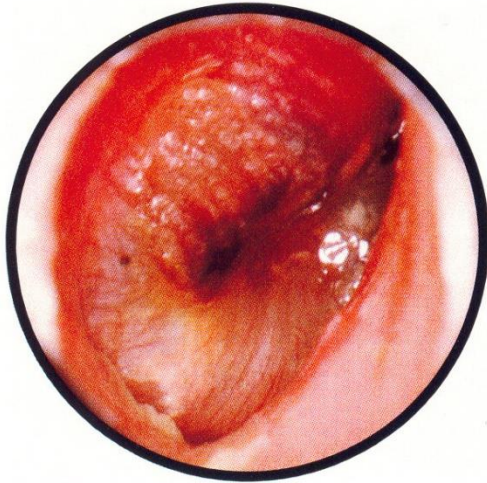




# Otitis med. ac. l. sin. – progressive inflam. changes



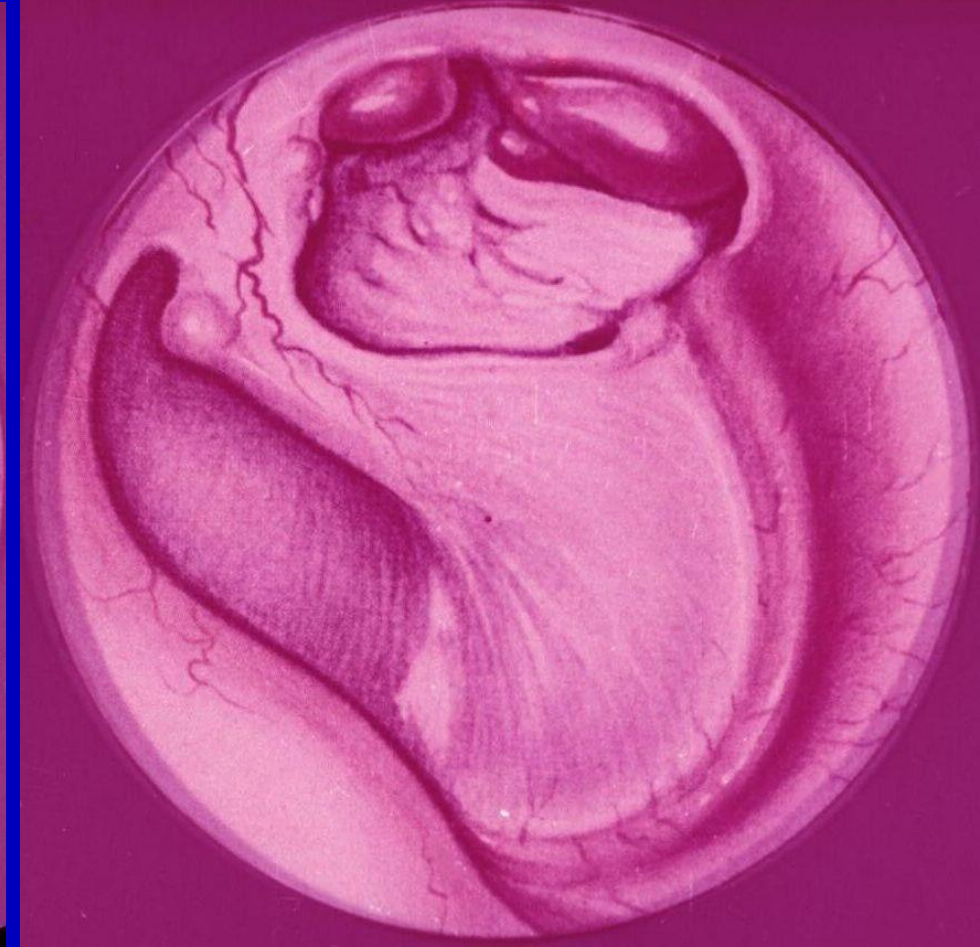
# Otitis med. ac. sin. with myringotomy and restitution



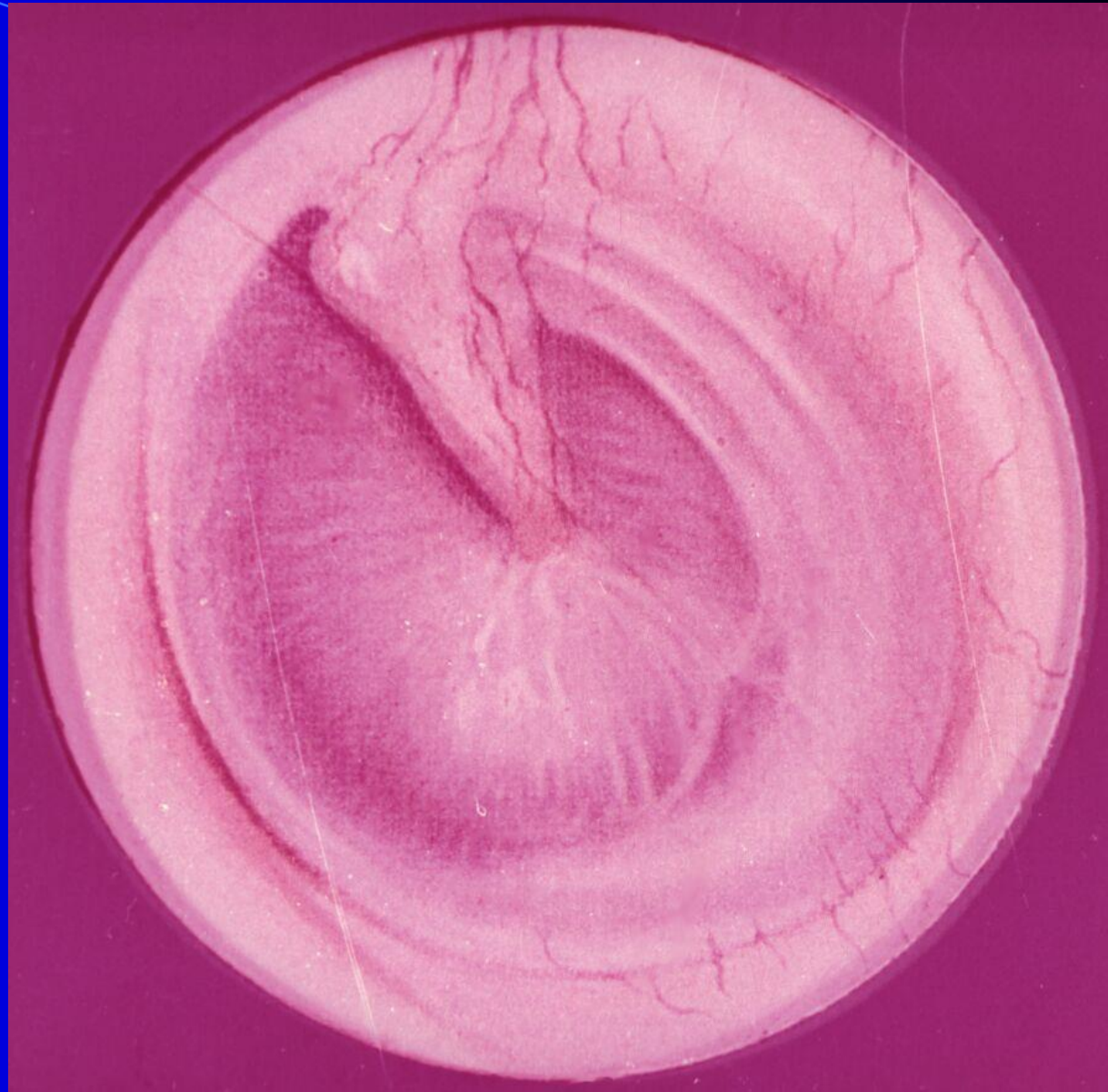
# Paracentesis



# Perforation of ear drum



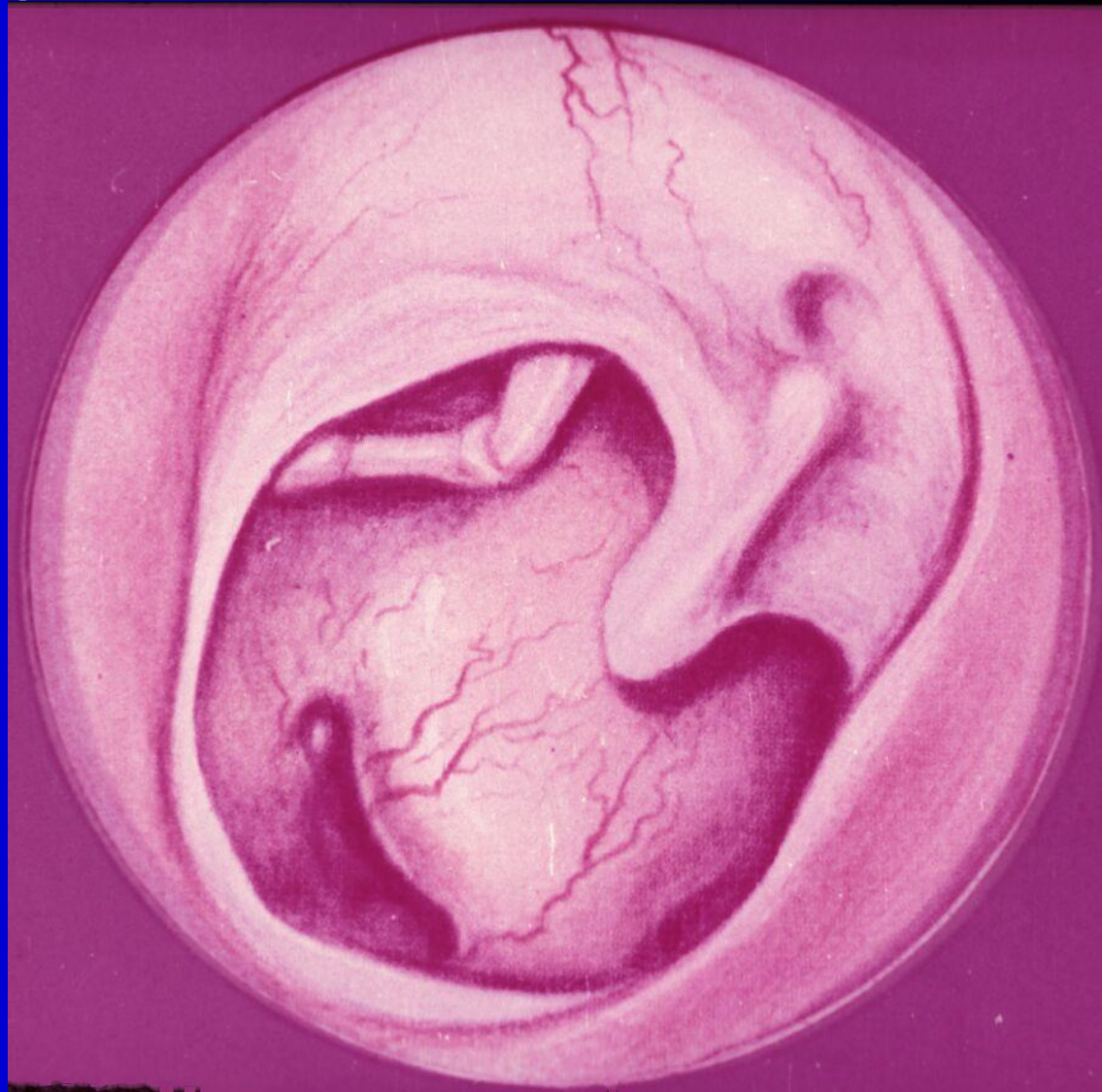
**Scared  
thickened  
ear drum  
after otitis**



**Scared  
thickened  
ear drum  
with  
calcification**



# Subtotal perforation of ear drum



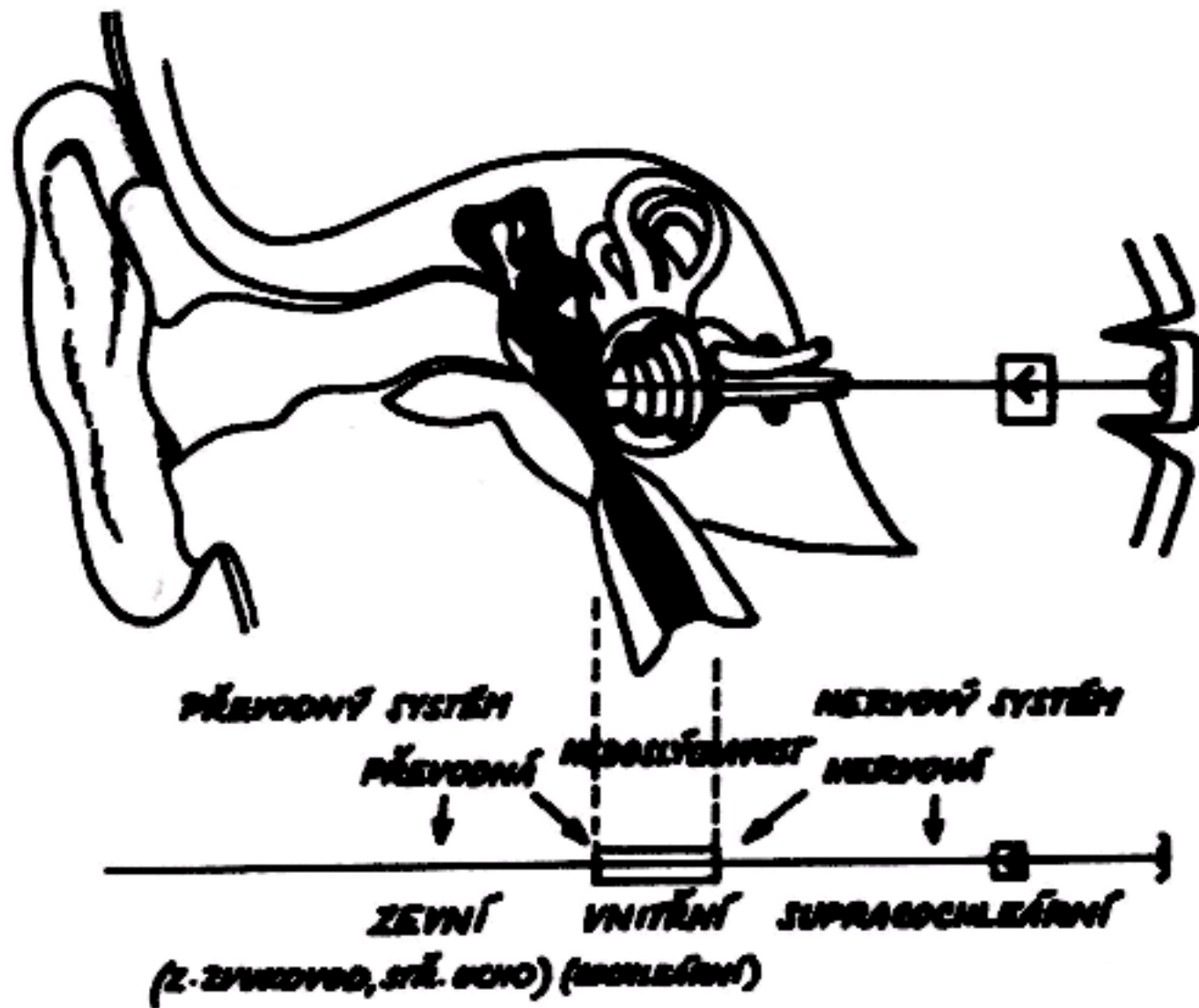


Schéma sluchového analyzátoru



# 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

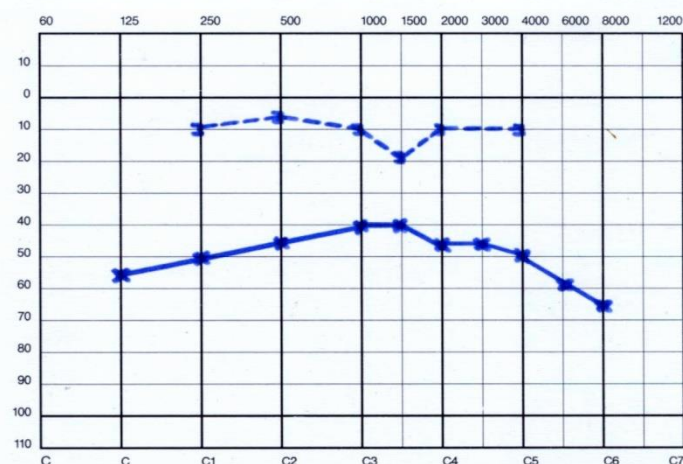
Rinne negat

Schwabach longer

### Hypacusis mixta (Mixed hearing loss)

Schwabach shorter

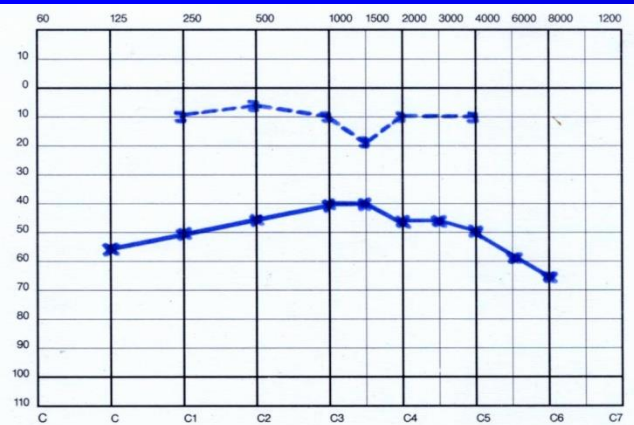
Rinne negat.





# Hypacusis

Conductive Sensorineural Mixed











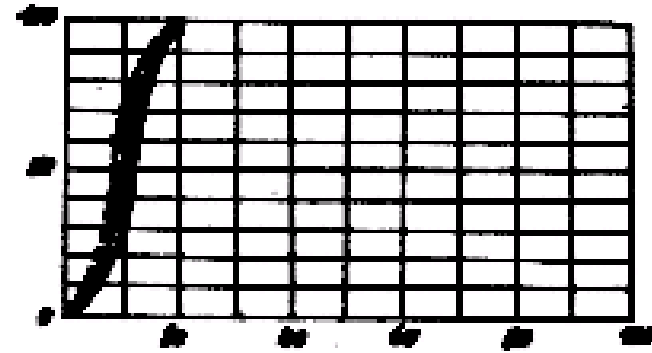




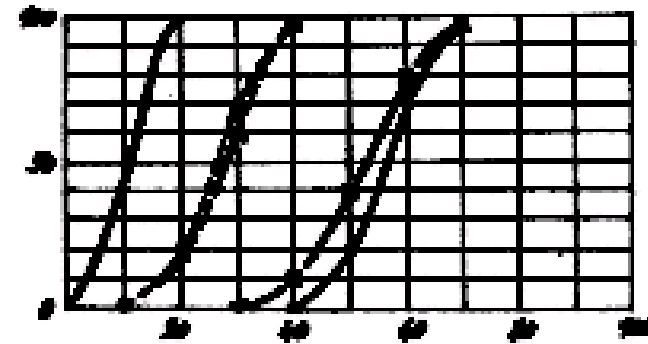
# Speech audiometry

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.

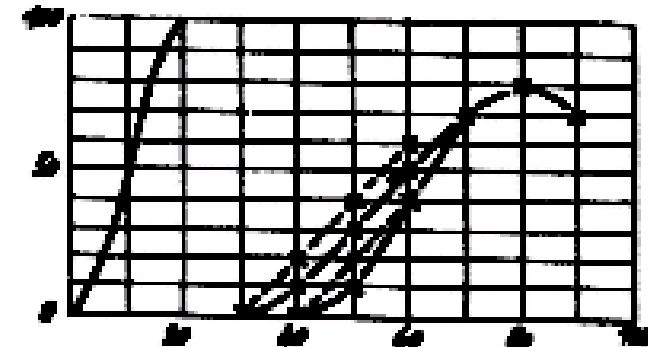
*Normal hearing*



*Fluctuating deafness*

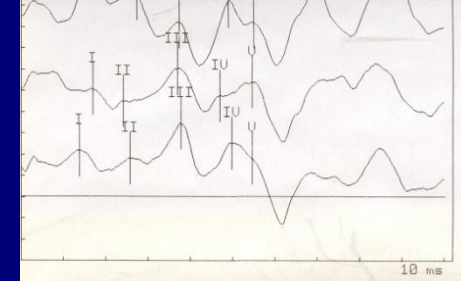
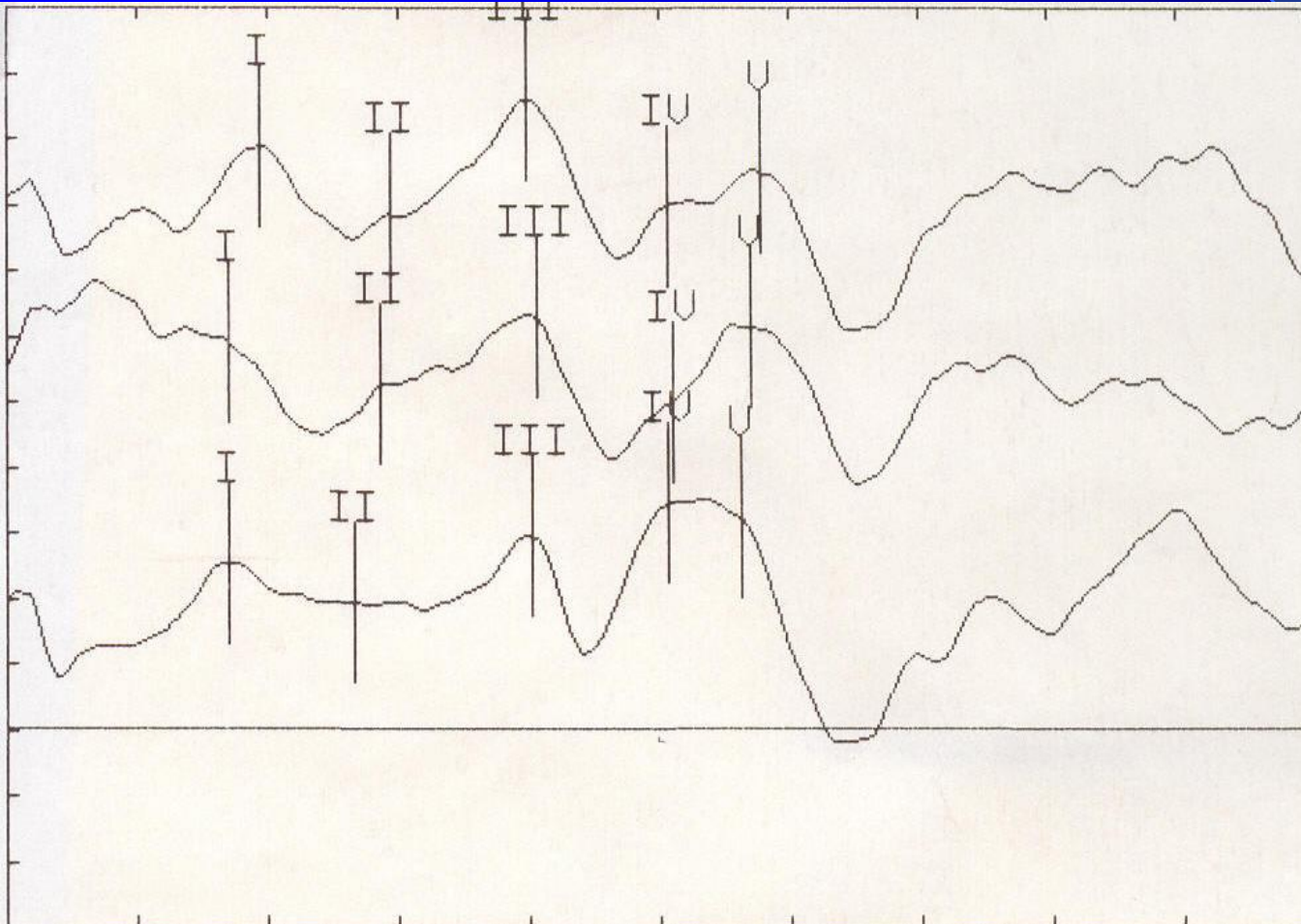


*Normal deafness*



# 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	1/2	50 dB SPL
2	CLICK 110 dB ReSPL	1/2	60 dB SPL
3	CLICK 120 dB ReSPL	1/2	70 dB SPL

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

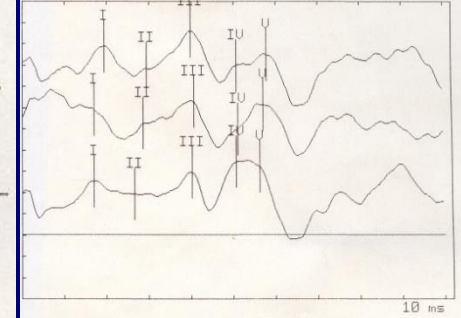
LAT	I	II	III	IV	U
1	1.600 ms	2.760 ms	3.760 ms	4.920 ms	5.520 ms
2	1.720 ms	2.440 ms	3.720 ms	4.720 ms	5.480 ms
3	1.400 ms	2.600 ms	3.800 ms	5.000 ms	5.480 ms

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
- neuroviry
- 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 :

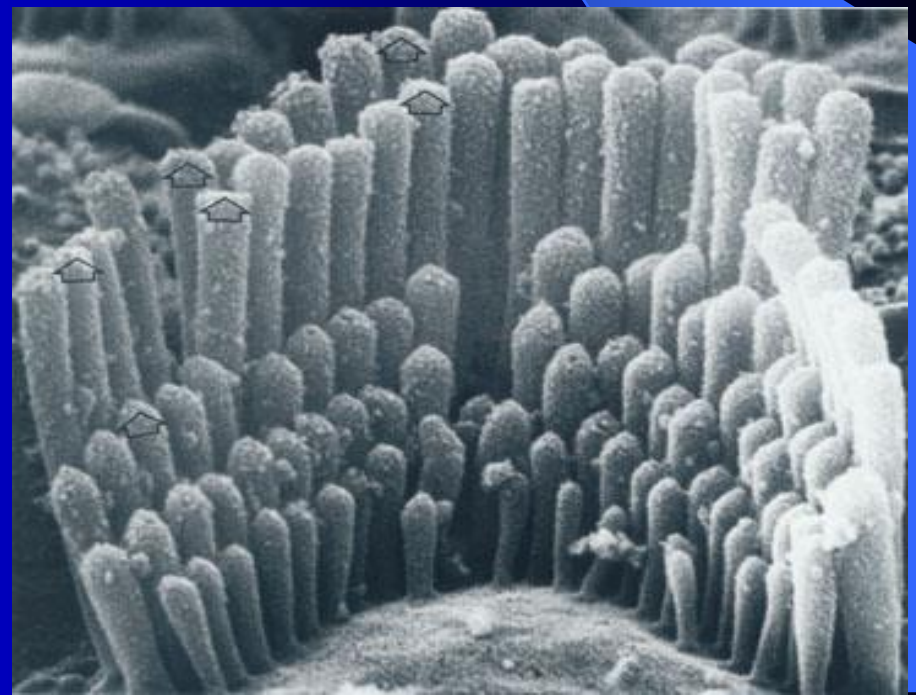
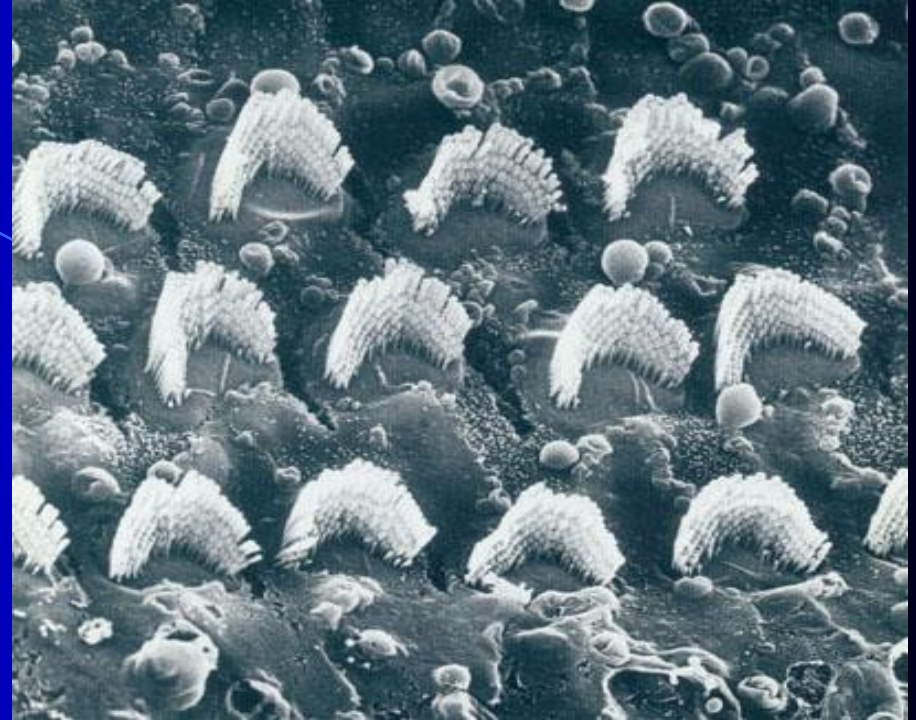
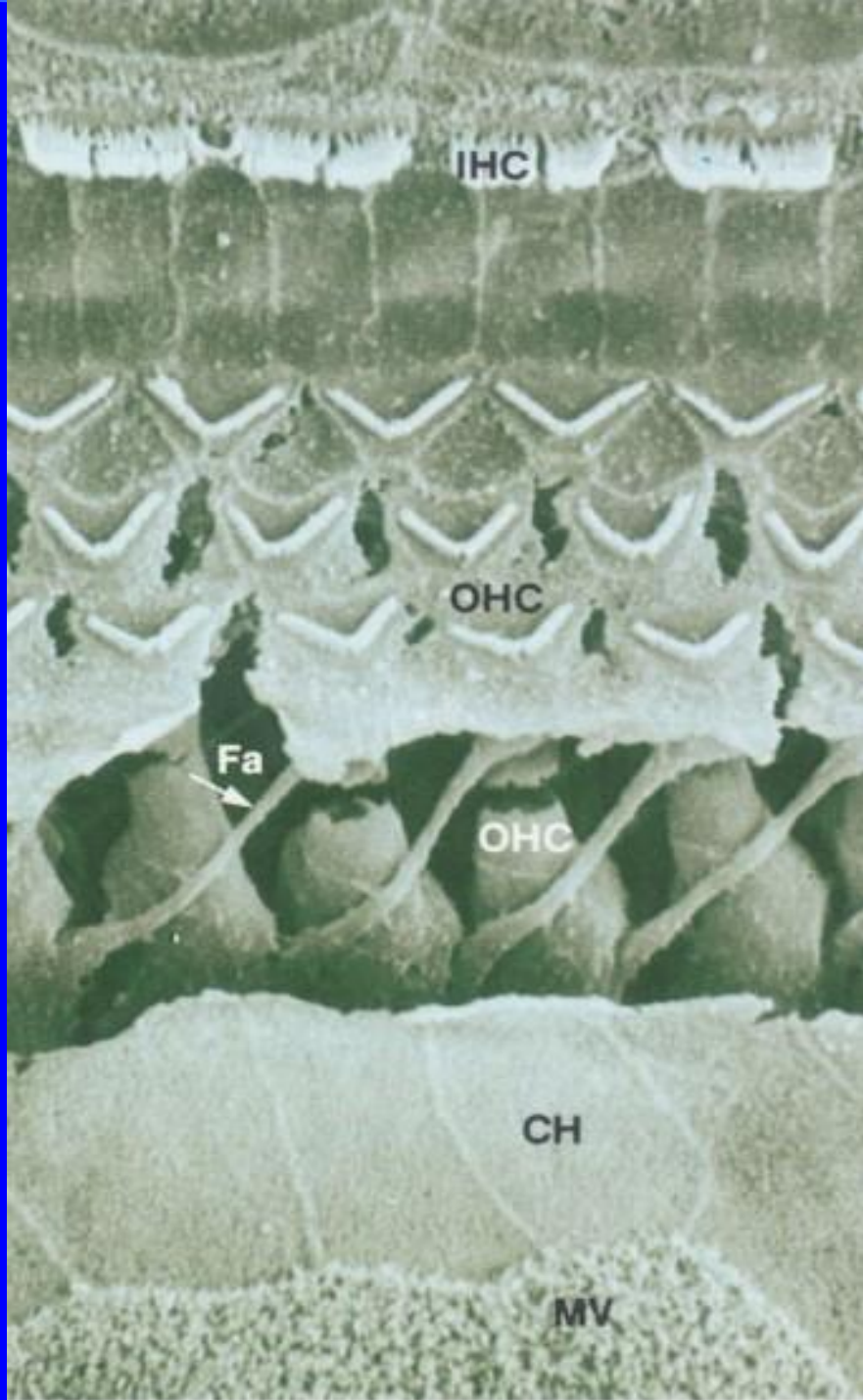
- časově obvykle méně náročné
- vyžadují pasivni spolupráci pacienta
- náročné na technické vybavení
- mají vysokou validitu



# Subjektivní testy

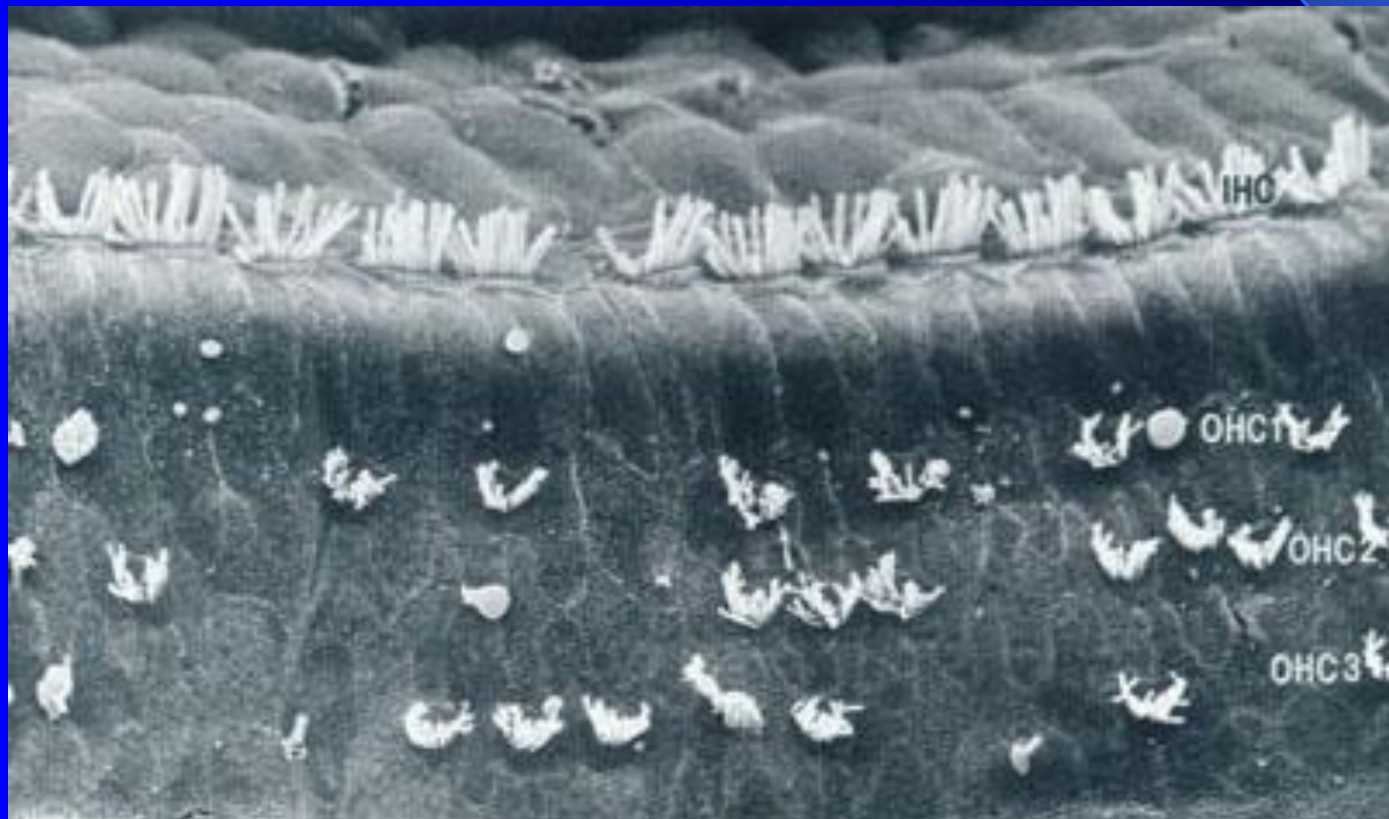
**Založeny na principu průkazu:**

- **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

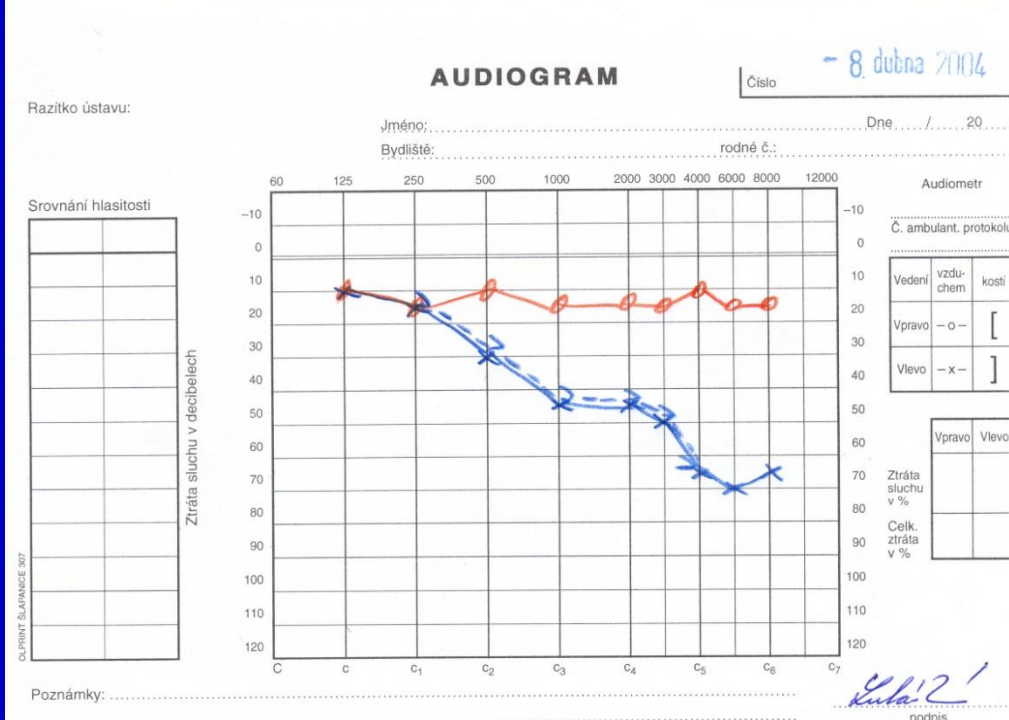
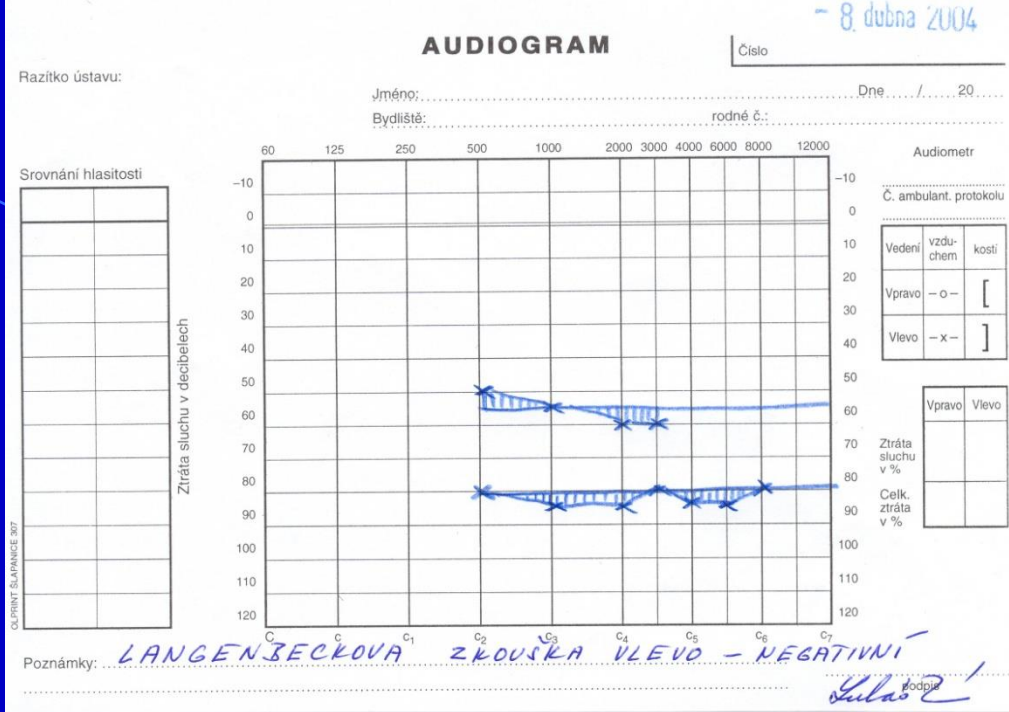




# „Hum“ audiometry

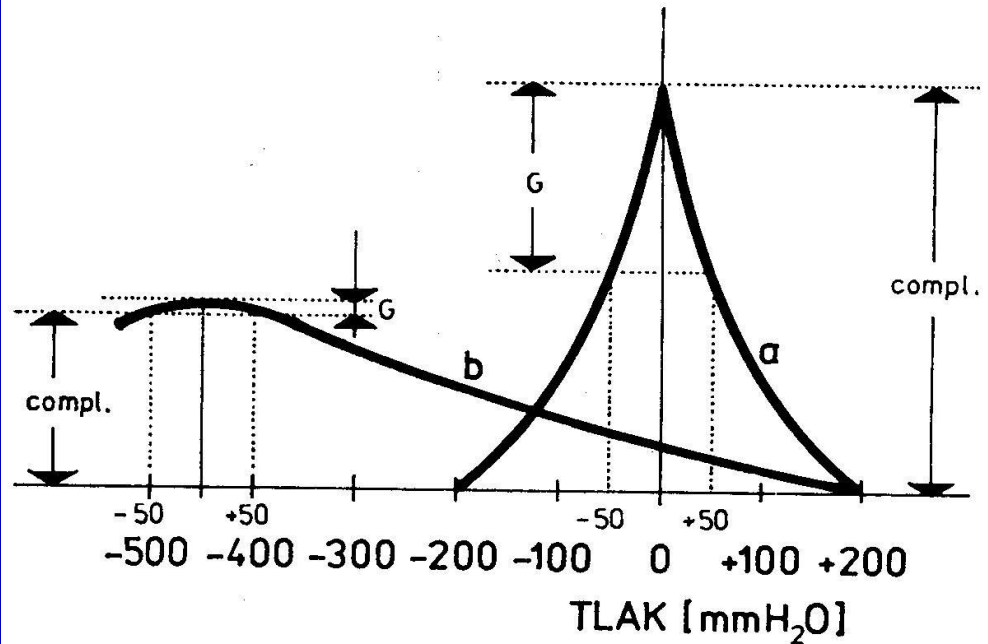
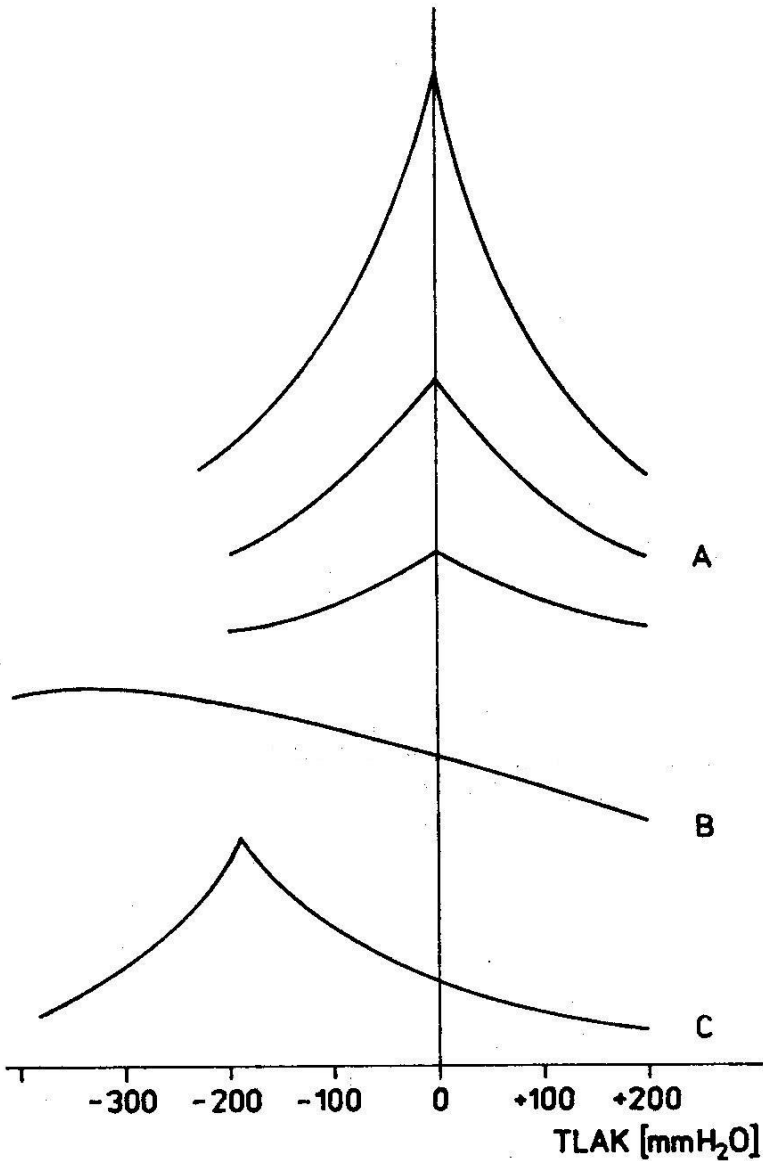
## Langebeck test

= 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**

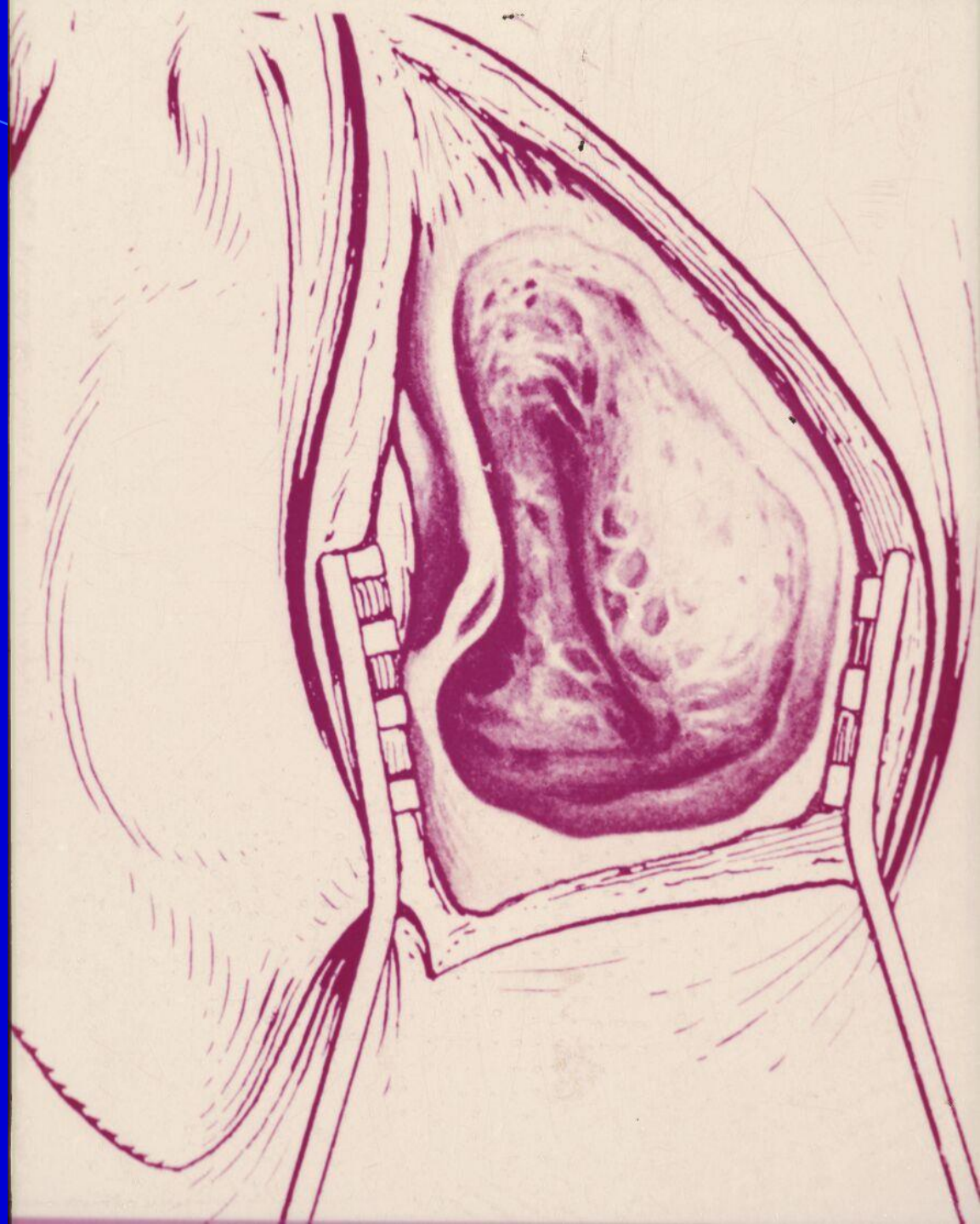
- **Schwartz** - via planum mastoideum into antrum
- **Stake** - via atticus into antrum
- **Zaufal** – via posterior wall into aditus ad antrum and from this anteriorly and posteriorly

## **Sanation surgery**

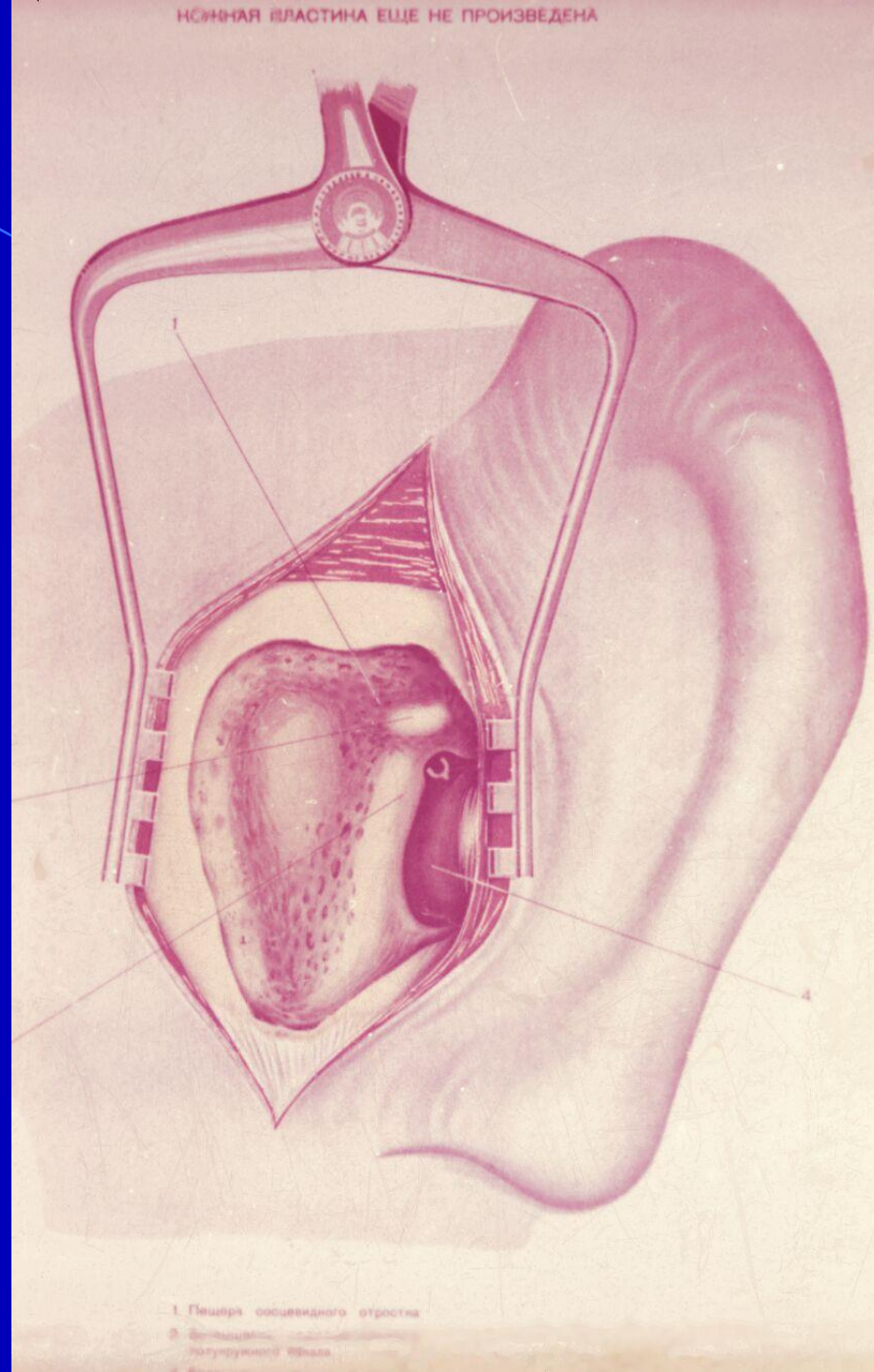
- **atticotomy**
- **meatoantrotomy**
- **atticoantrotomy**
- **tympanomastoidektomy**

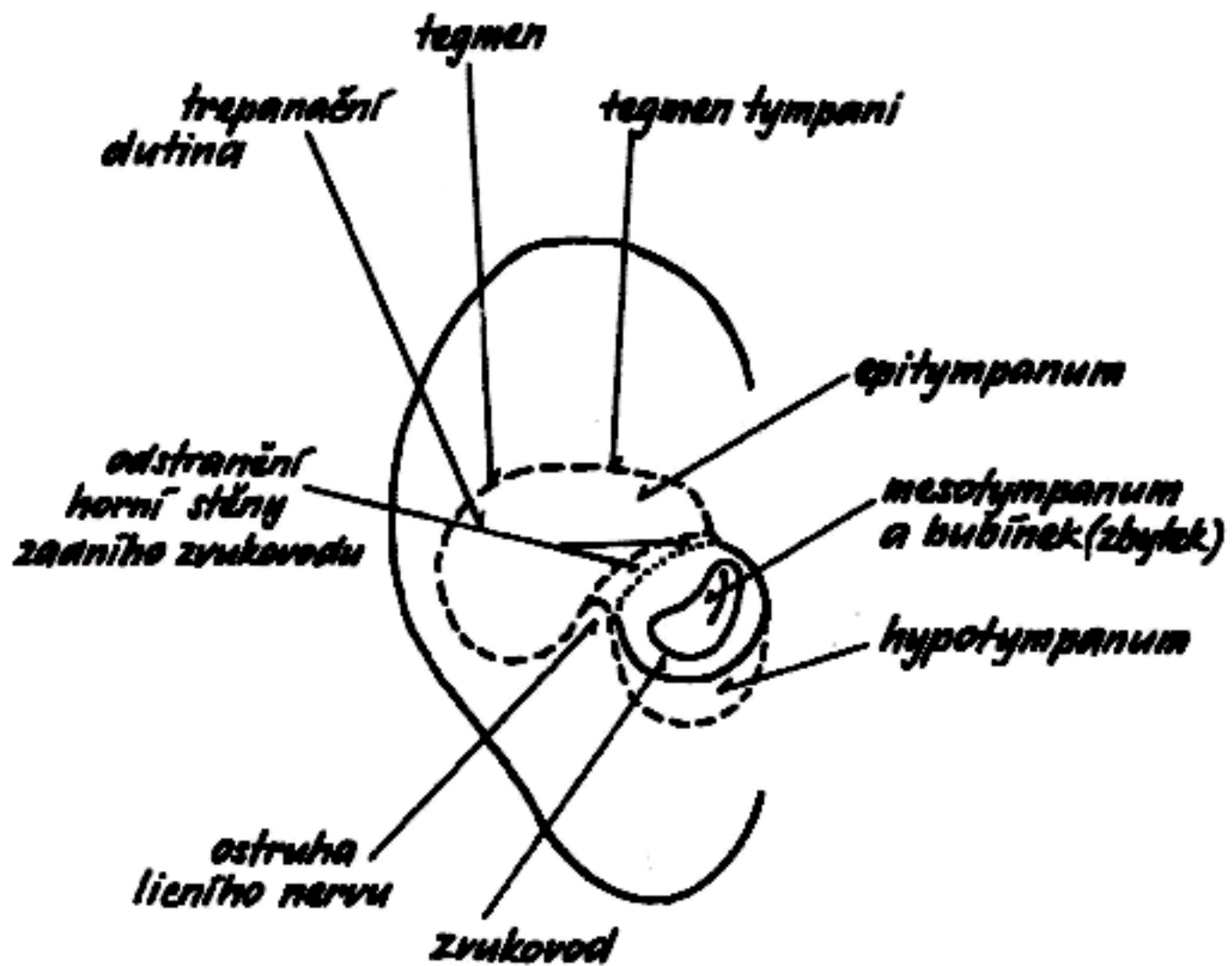


**Status  
post  
mastoid-  
ectomiam**



**Stav po  
atticoantrotomii  
(radikálně  
konzervativní  
operaci)**





Vztah zevního zvukovodu k trepanační dutině

# 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

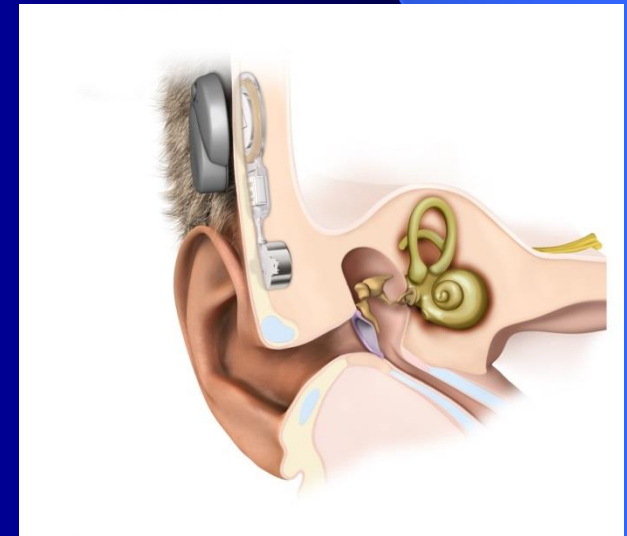
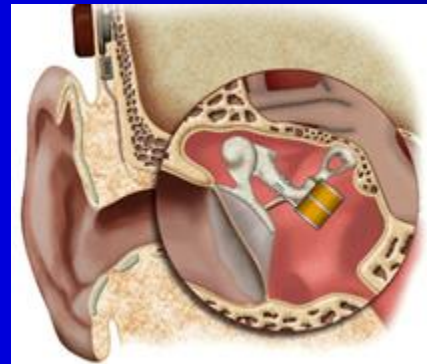


BONEBRIDGE



# Implantable hearing aids

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



# Systems for bone conduction

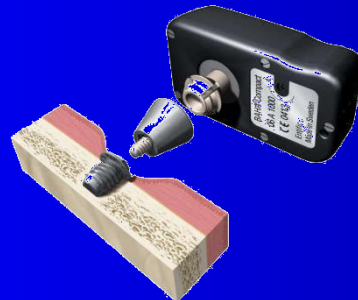
## Vibration direct to bone

Generating behind skin

Transcutaneous conduction

System pro kostní vedení s aktivním implantátem (BONEBRIDGE)

Zevní systém ukotvený v kosti (BAHA)



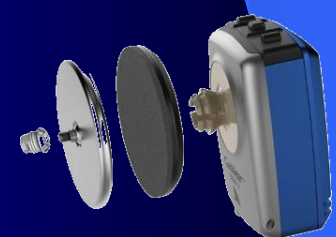
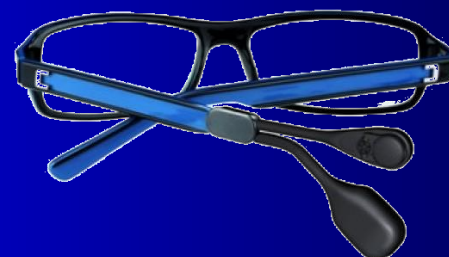
## Vibration over skin

Hold by the pressure from outward

Hold by implanted magnet

Brýle s kostním vibrátorem  
Kapesní sluchadlo s vibrátorem na čelence

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



# Solution for first treatment before BB implantation

- Bone conduction headband

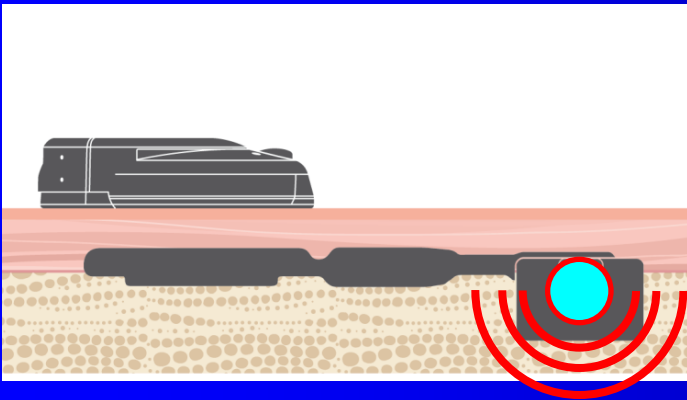
contact.  
mini

- Also for preoperative evaluation

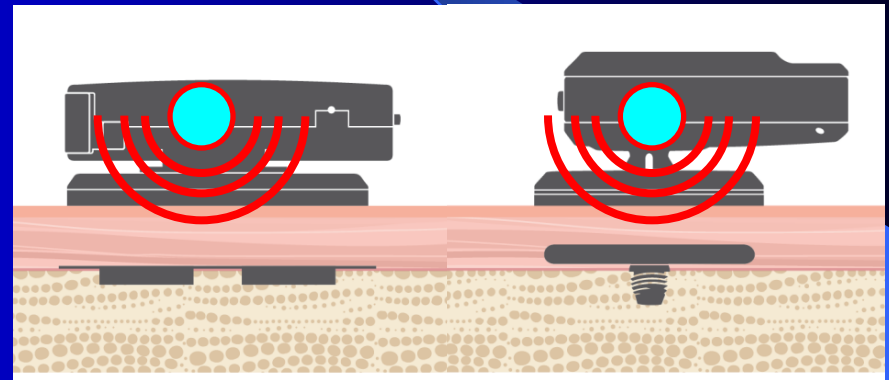


# Bone conduction with active and passive implant

Active implant



Passive implant

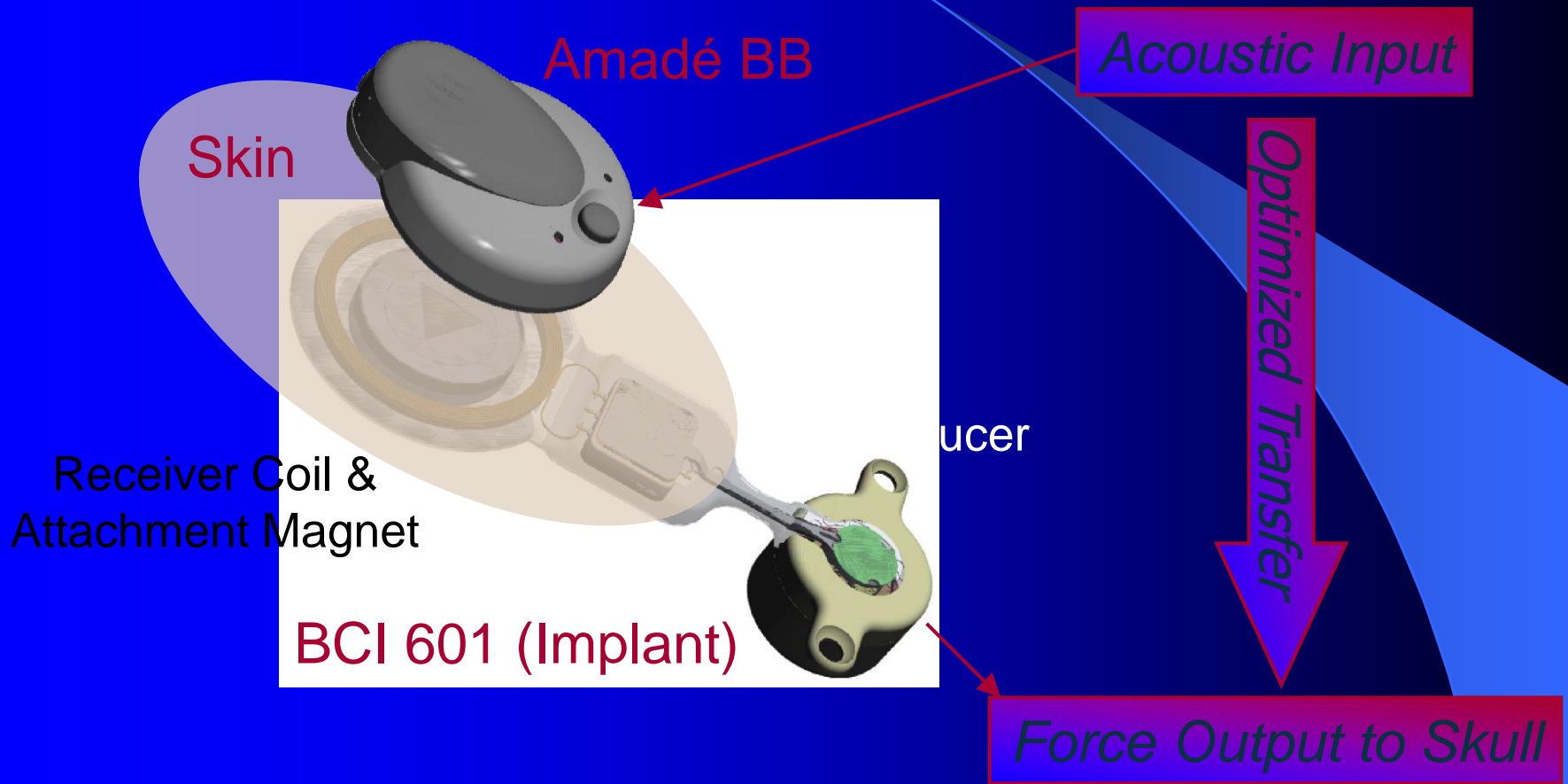


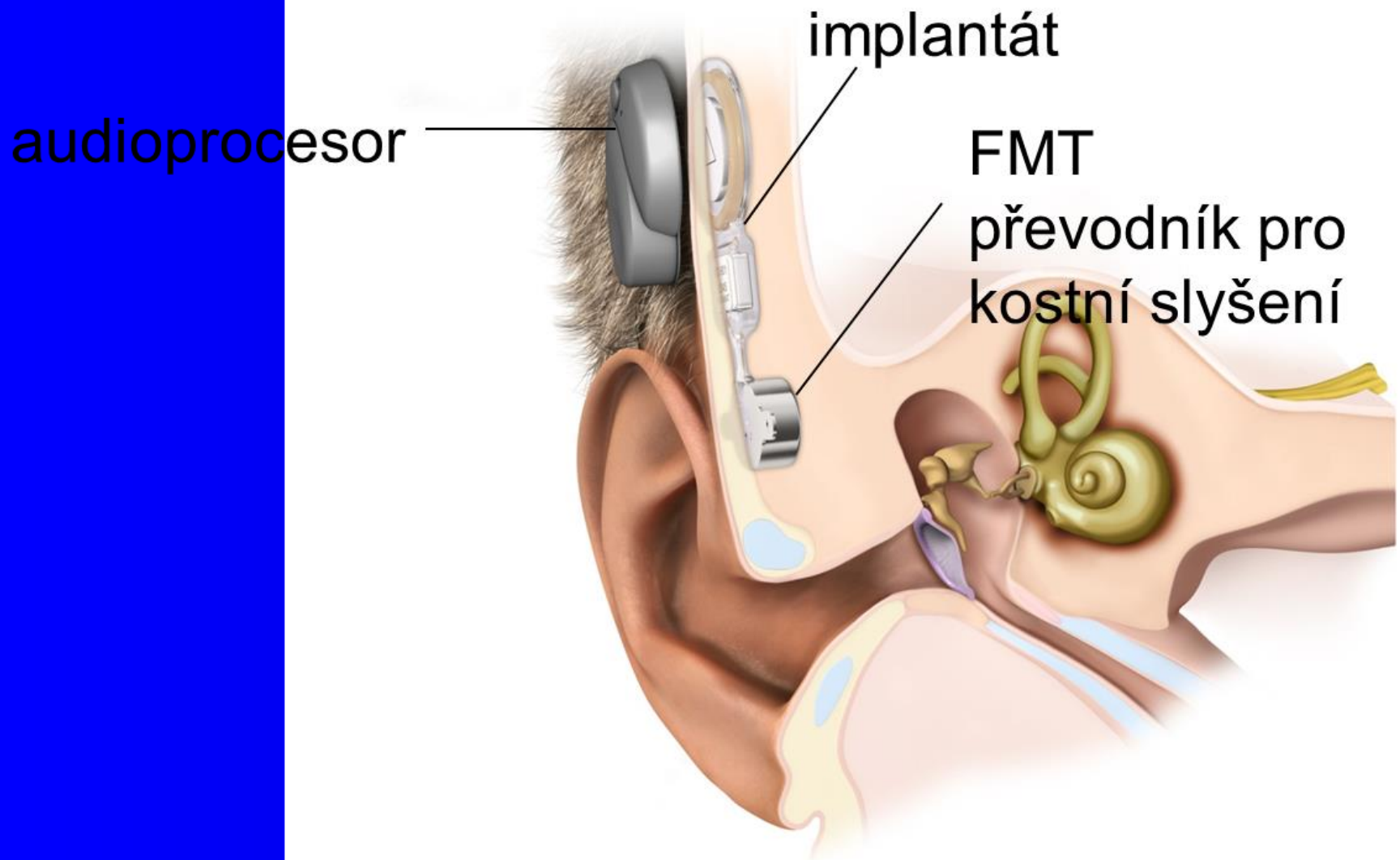


# BONEBRIDGE



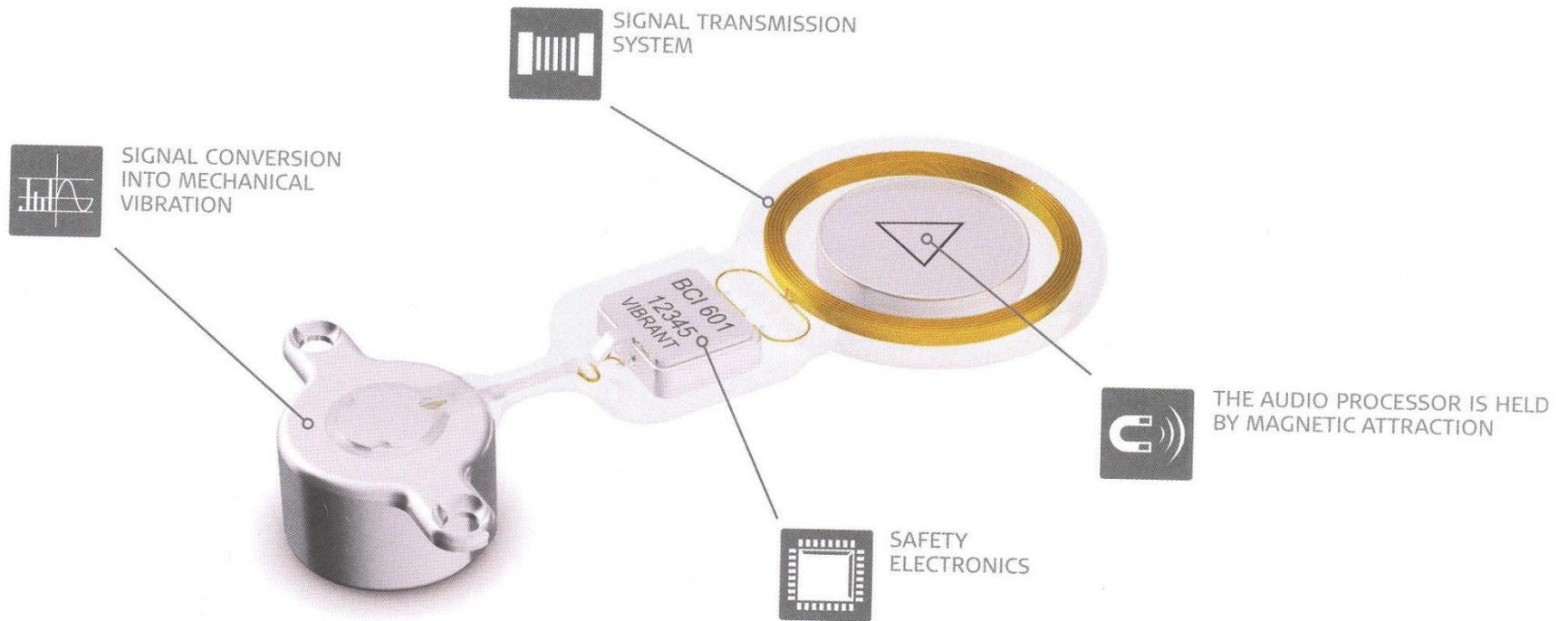
# Bonebridge System Overview





**BC-FMT = Bone Conduction Floating Mass Transducer**

# Bonebridge

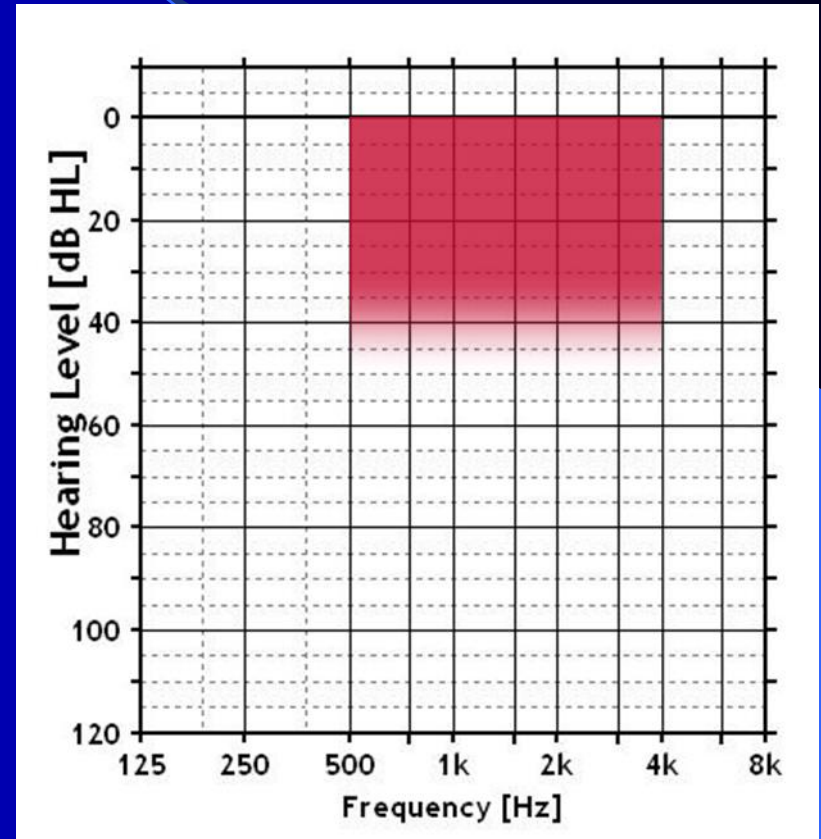


# Audiological Indication

Conductive and Mixed Hearing Loss

Bone conduction thresholds  
within the shaded area

F (Hz)	500	1000	2000	3000
BC <sub>limit</sub>	45	45	45	45



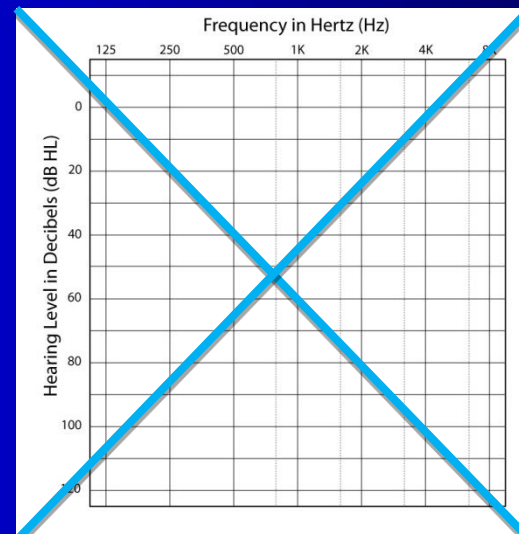
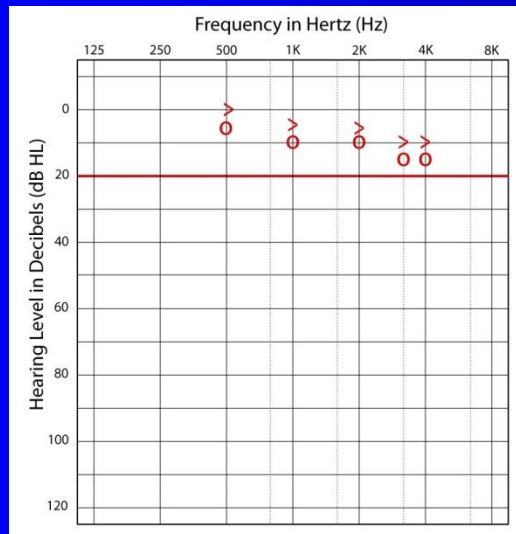
Bone conduction thresholds

# Audiological Indication

## Single Sided Sensorineural Deafness

- Profound unilateral SNHL
- Normal hearing contralateral ear

F (Hz)	500	1000	2000	3000
Contralateral HL <sub>limit</sub>	20	20	20	20



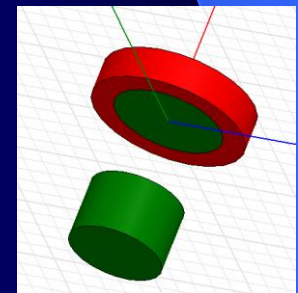
# Contraindications

- 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!

# Výhody vs. nevýhody

- Minimální dráždění kůže nad převaděčem, ten je zcela chráněn kůží
- Malé rozměry zevního procesoru – esteticky i funkčně příznivé
- Převaděč upevněný pomocí šroubků snese působení sil při MRI vyšetření do 1,5 T
- Hermeticky uzavřený převaděč
- Není nutné čekat na osseointegraci fixačních šroubků

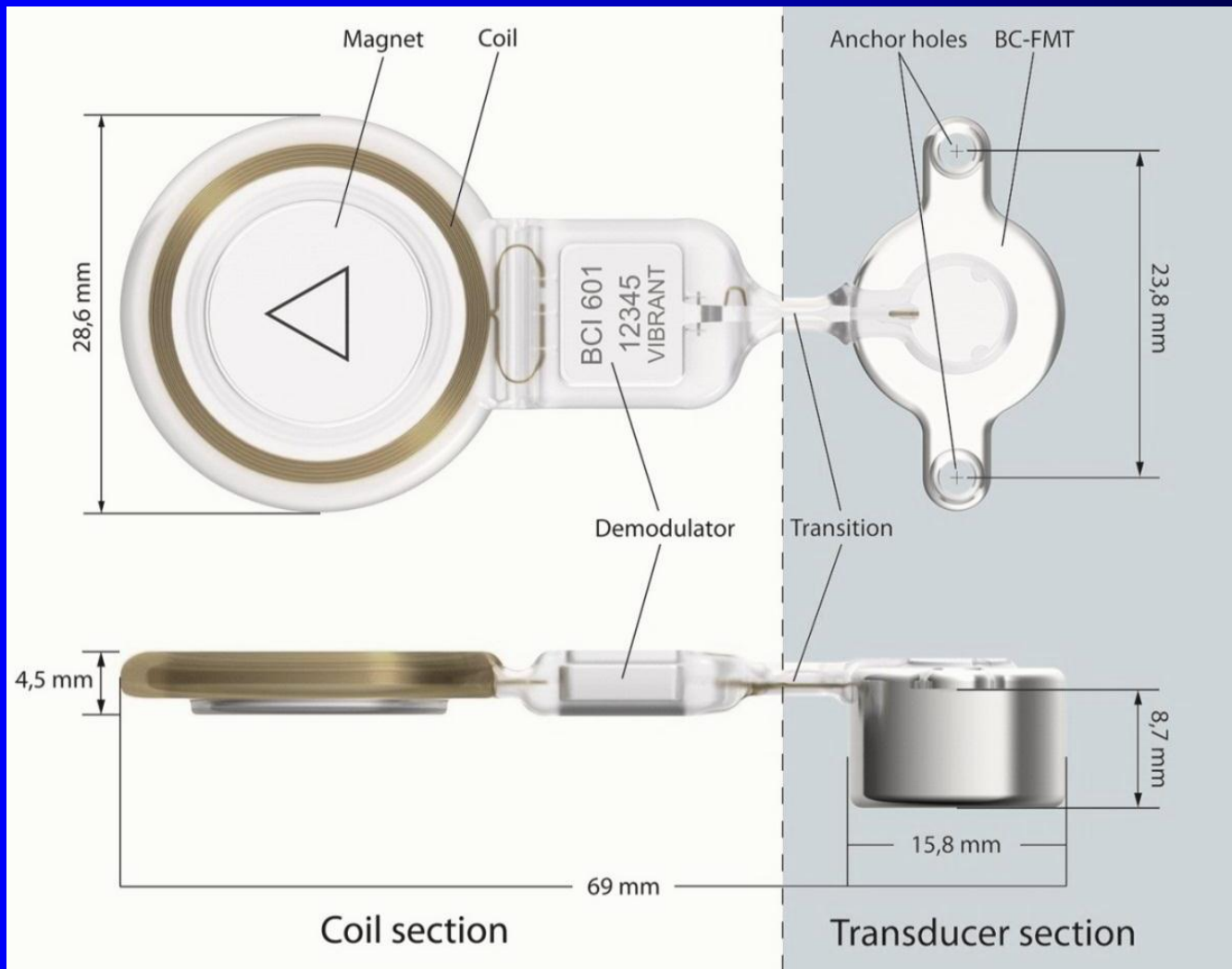
Nevýhody  
Vyšší cena





# 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



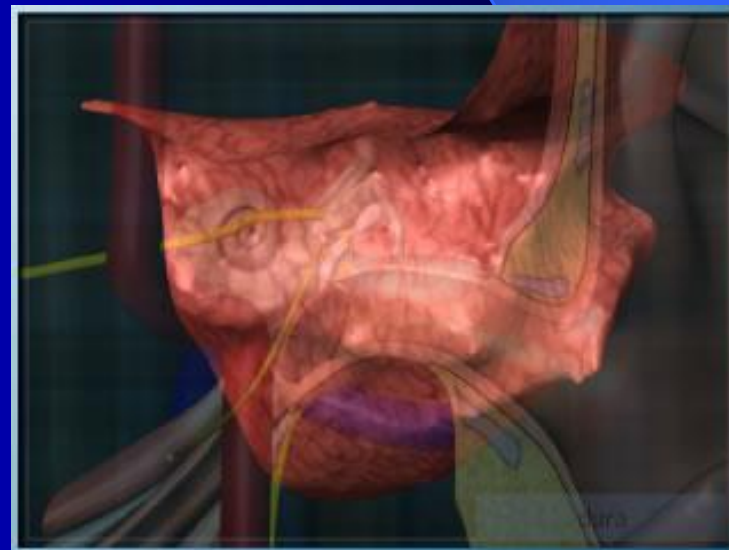
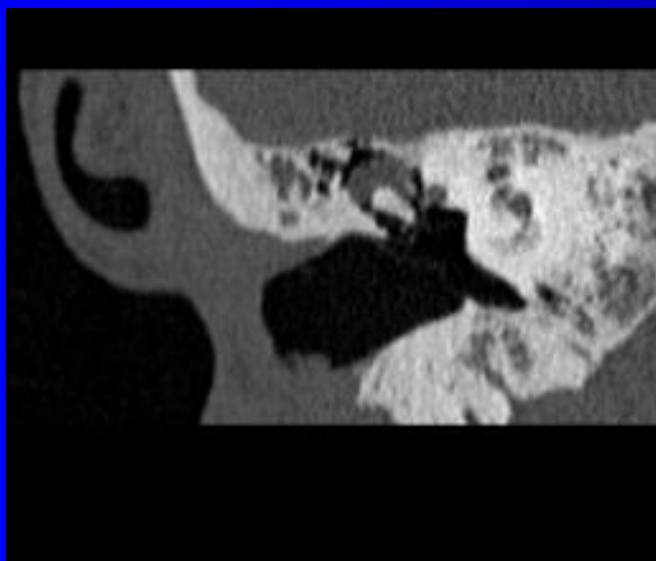
# Anatomical Considerations

## Structures to preserve

**Sigmoid Sinus**

**Dura**

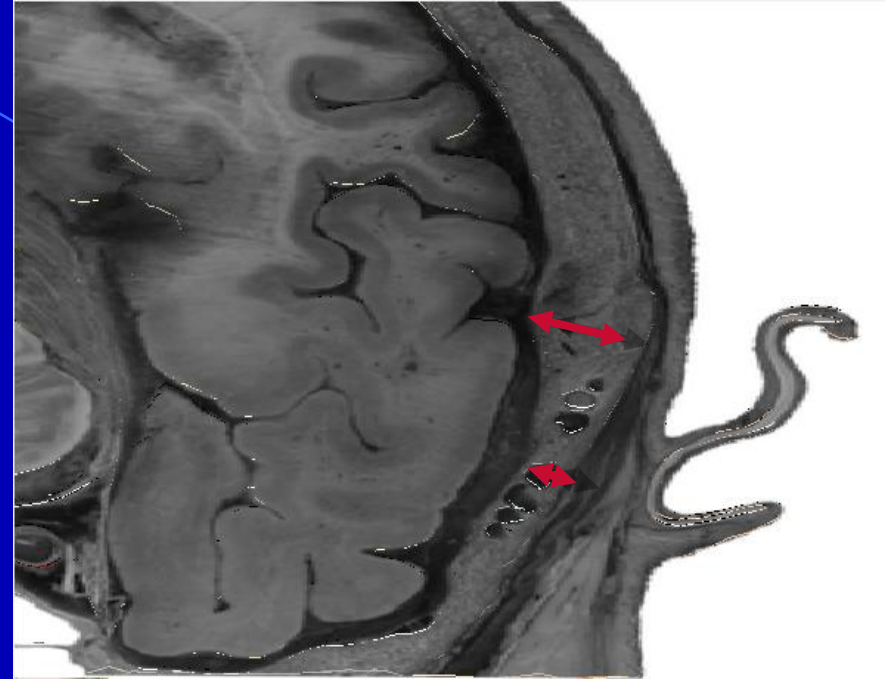
**EAC**



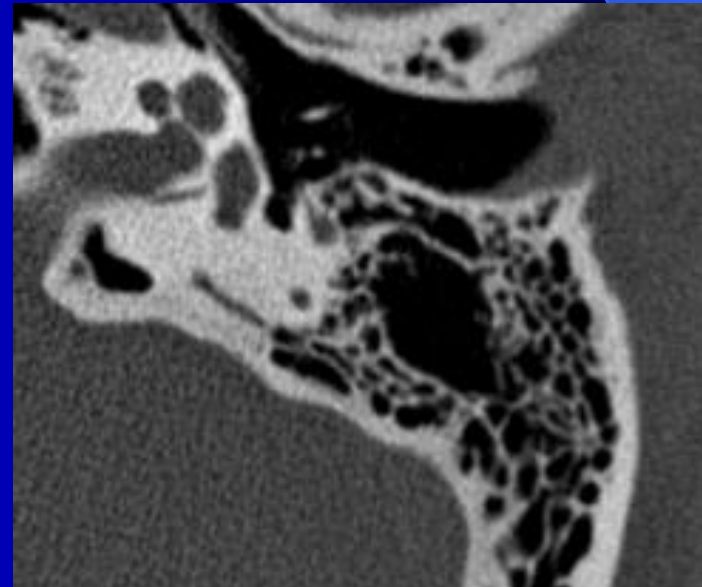
# Anatomical Considerations

## 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

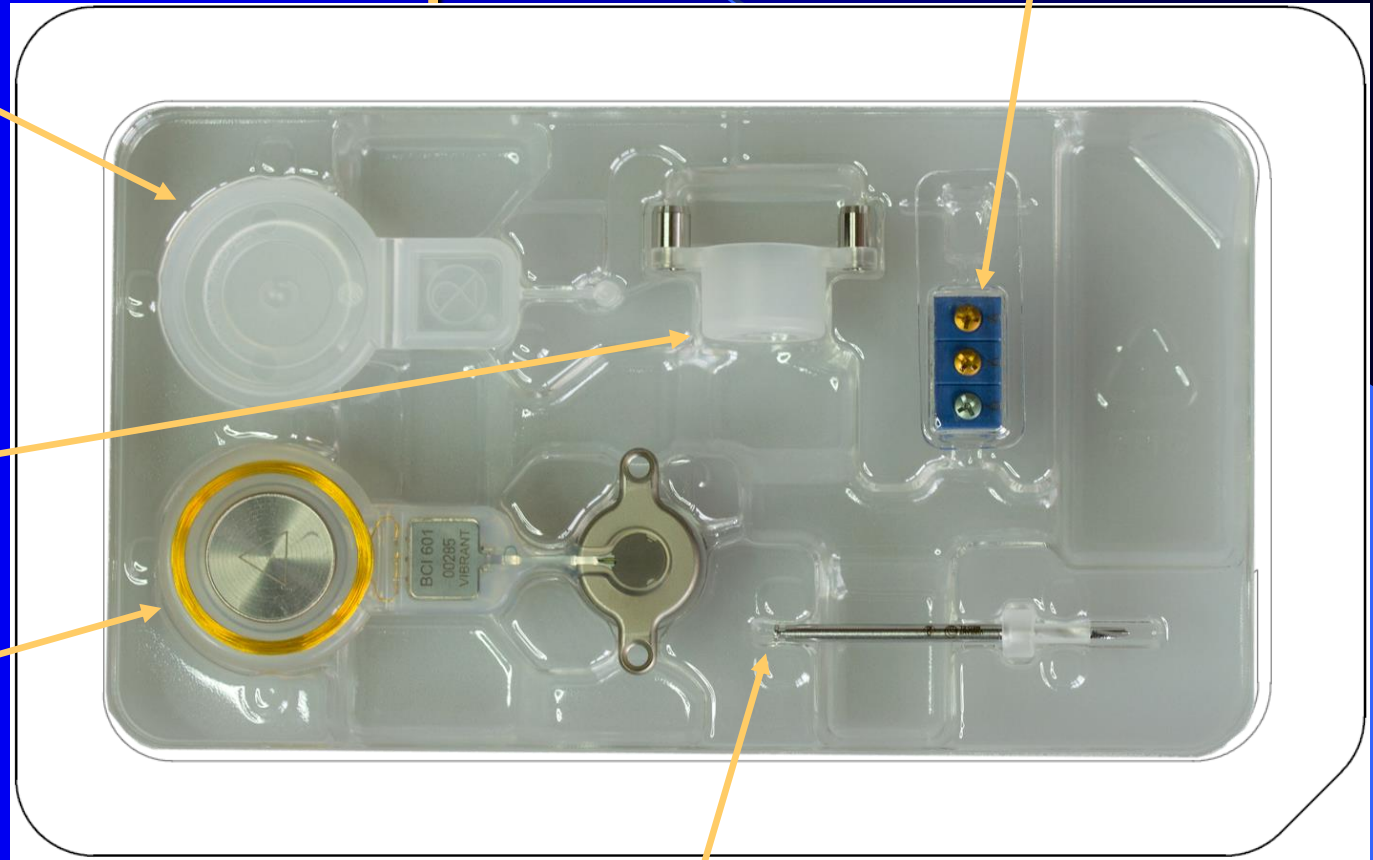


- **Energy/Sound transfer exclusively via the screws!**



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

Cortical screws  
2 standard  
1 „emergency“



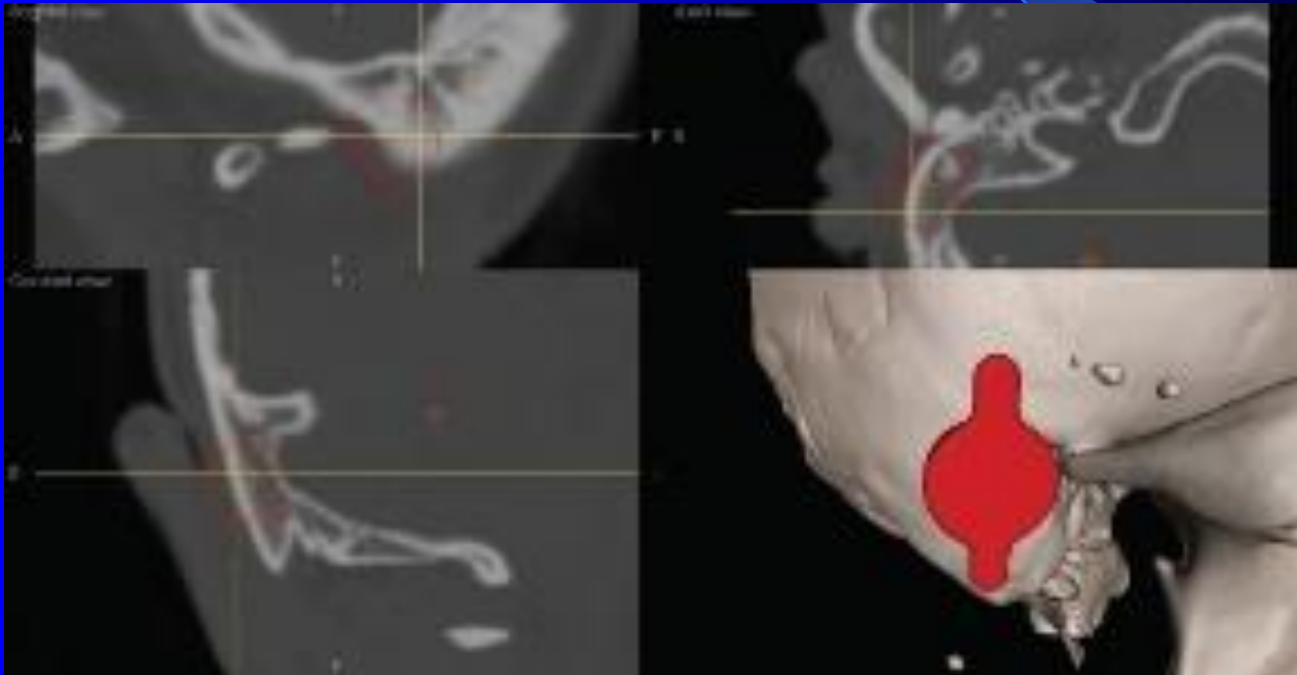
C-Sizer (Coil-Sizer):  
To create the skin flap

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



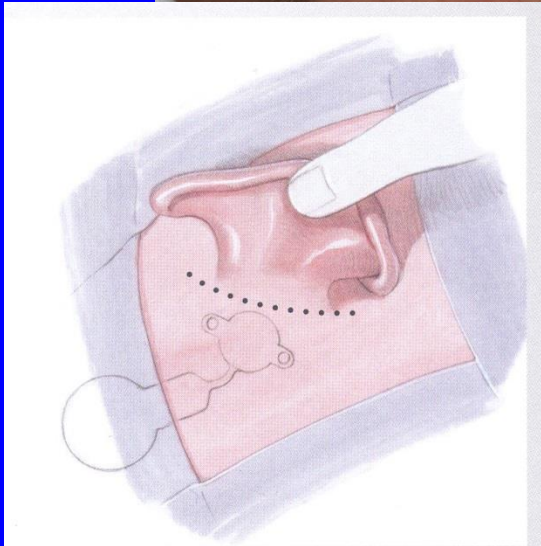
# První implantace BONEBRIDGE v ČR

- Pacient s Treacher-Collinsovým syndromem a atresíí 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

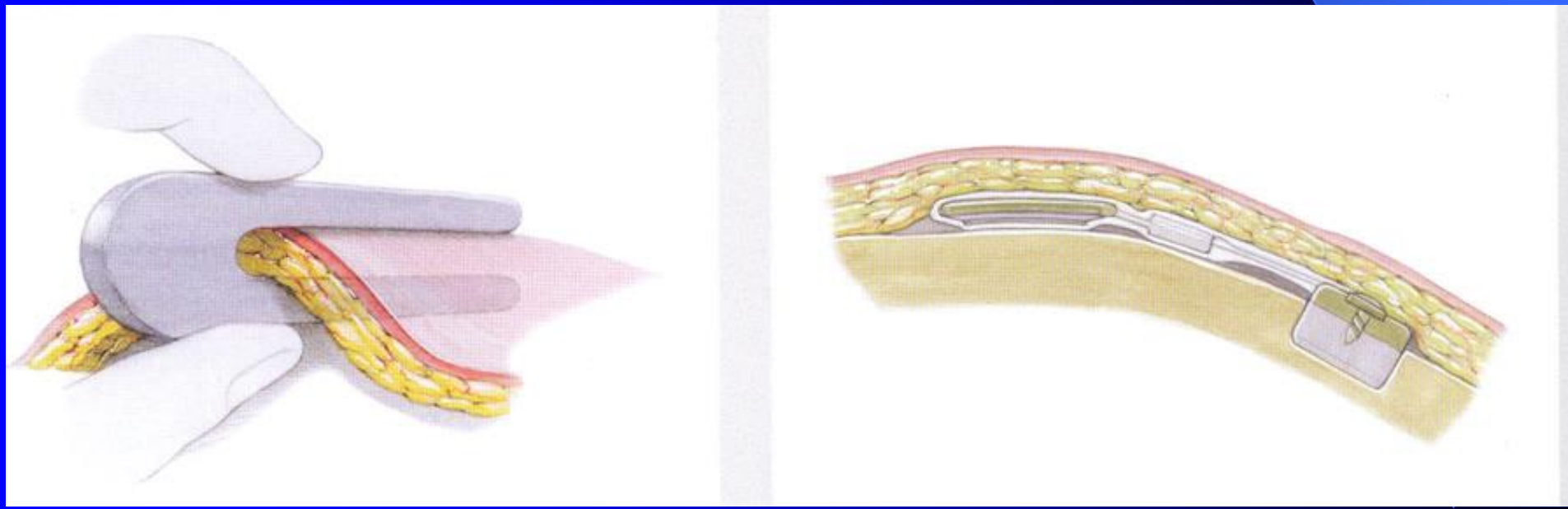


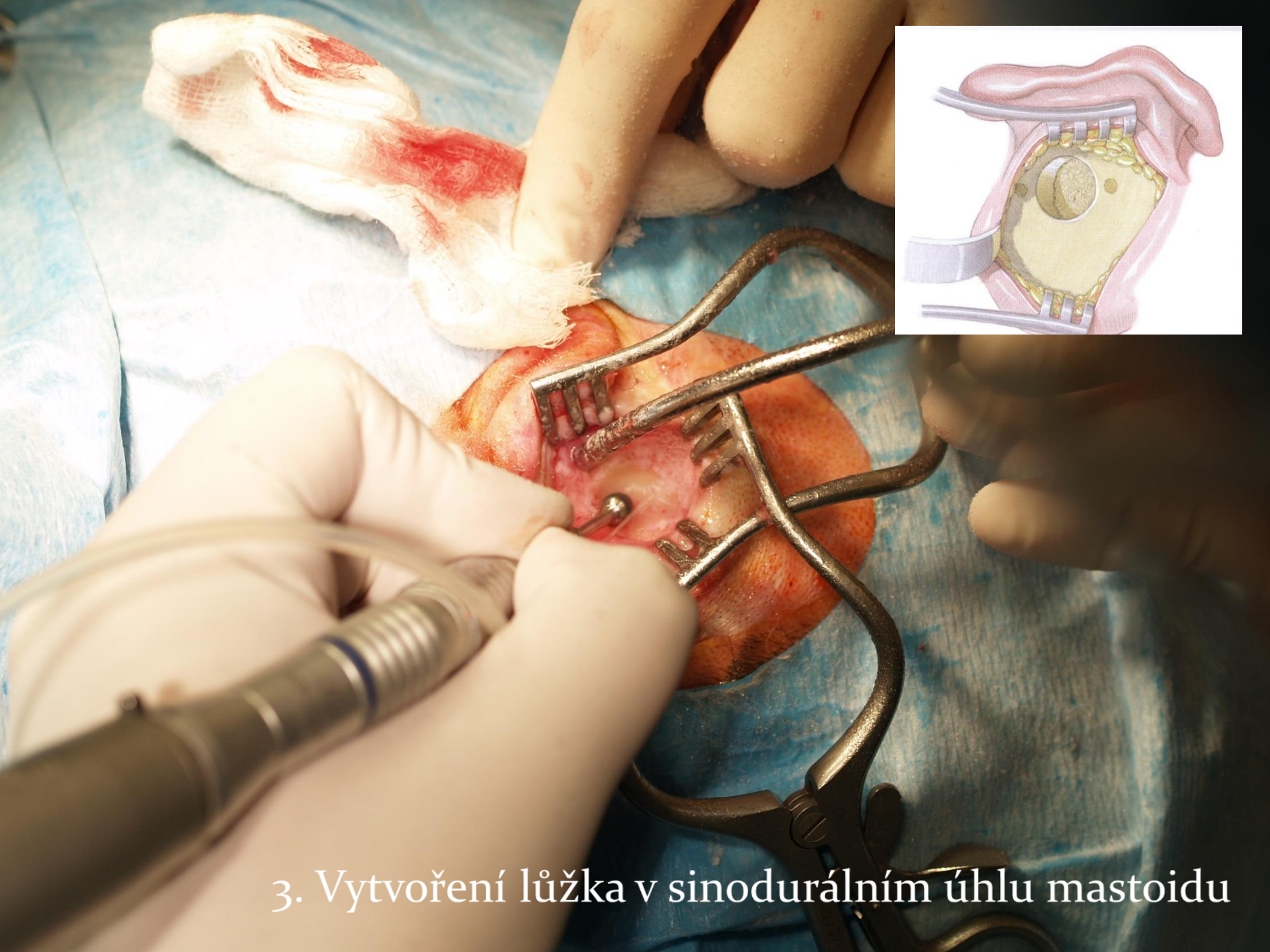
## 2. Incise

Incize a příprava kož. laloku

Umístit měrky

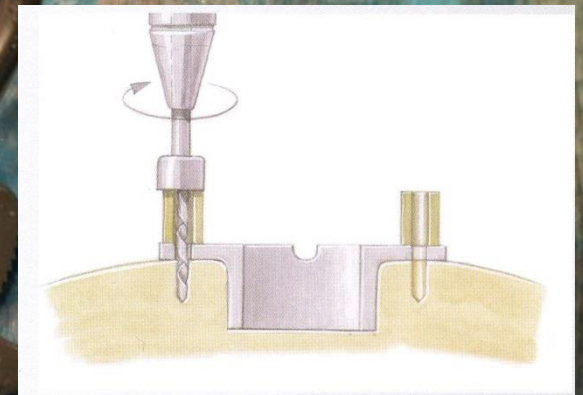
Odhad tloušťky kožního laloku (do 7 mm)

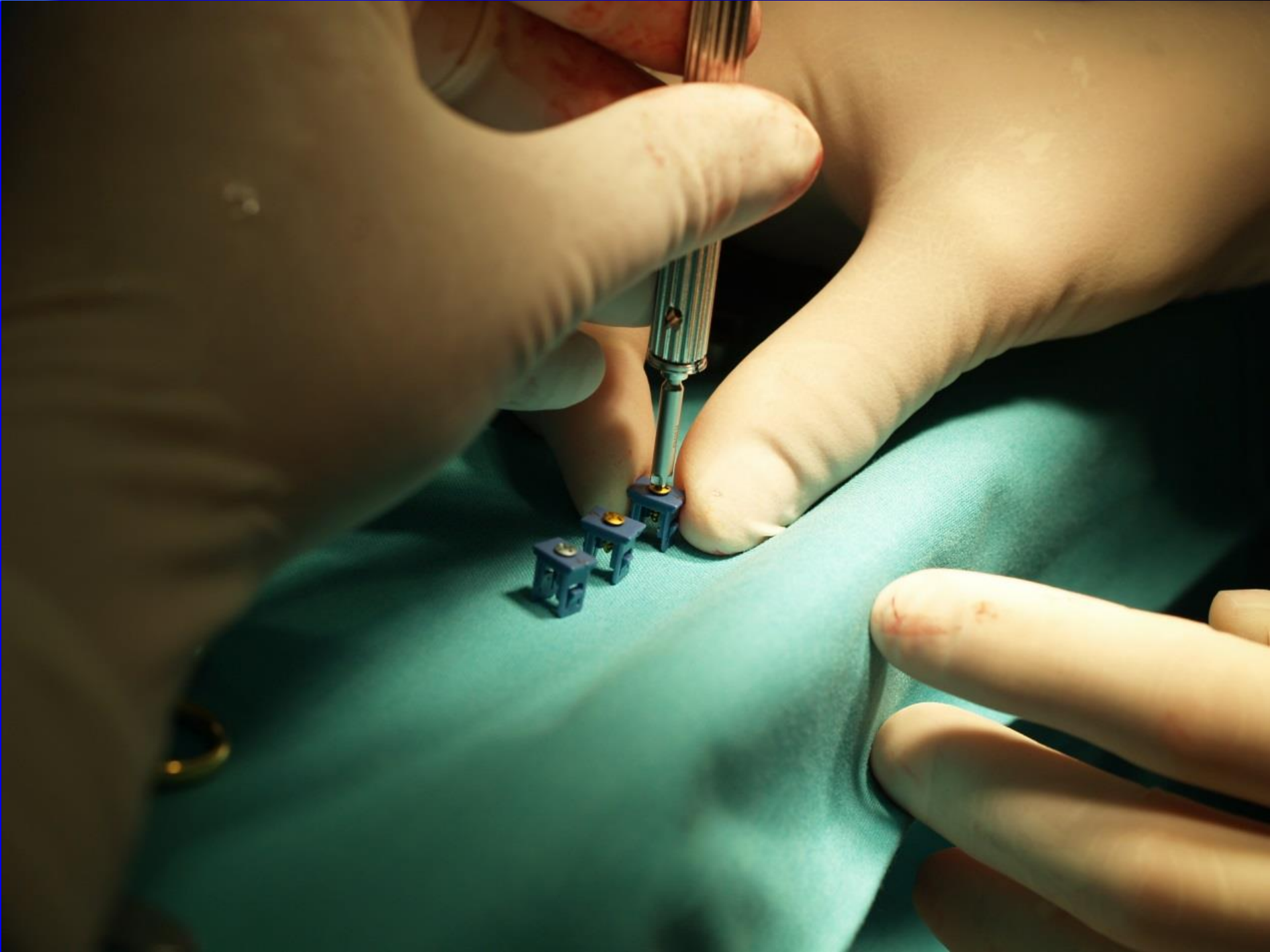




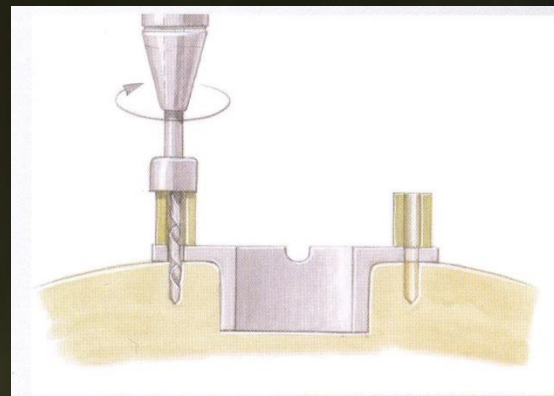
3. Vytvoření lůžka v sinodurálním úhlu mastoidu

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

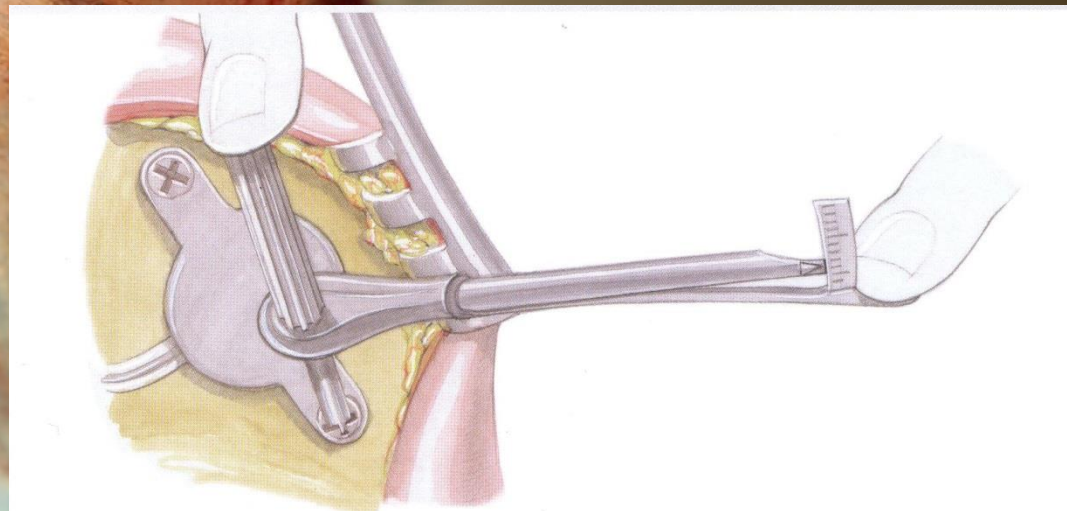
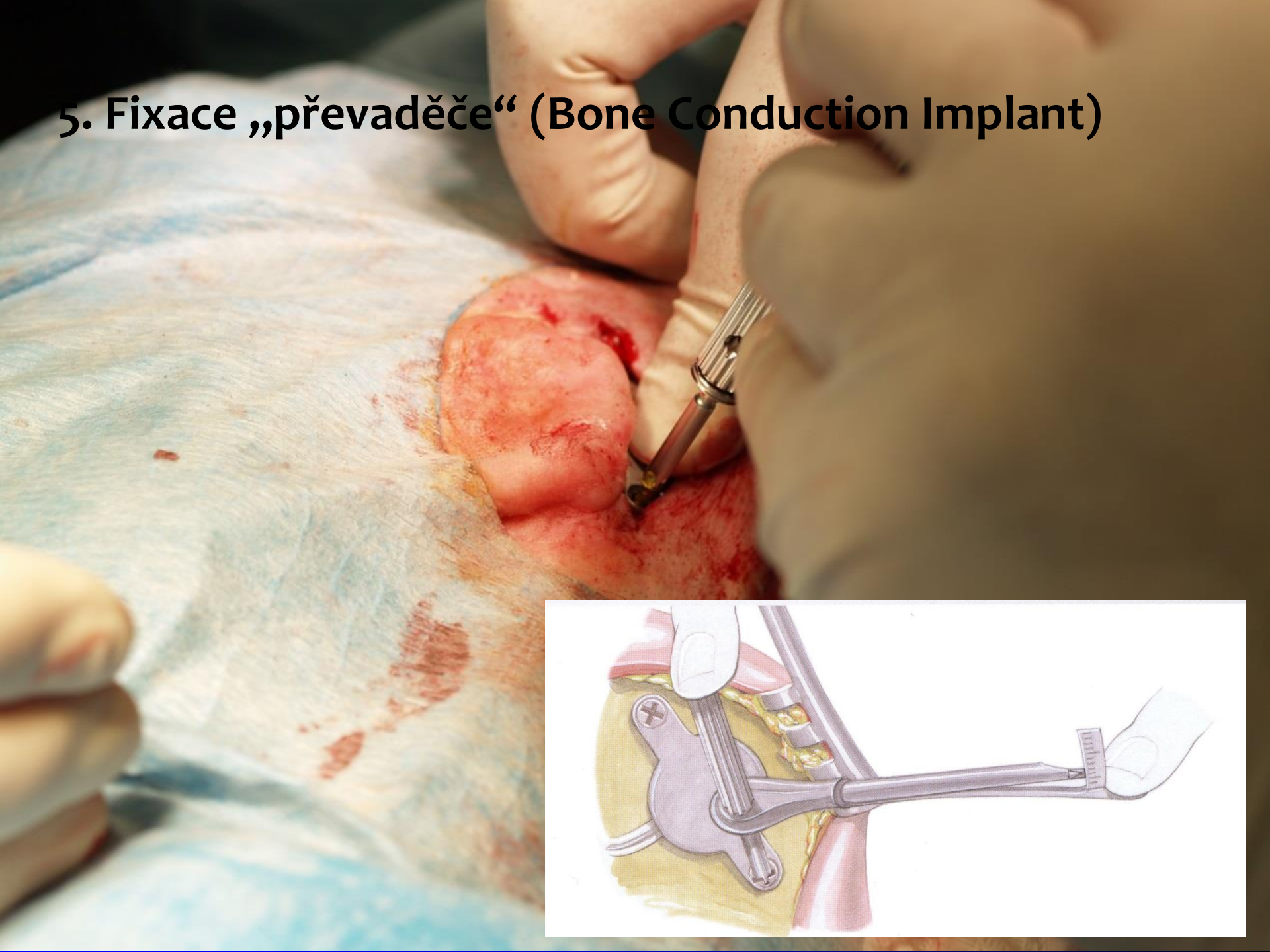




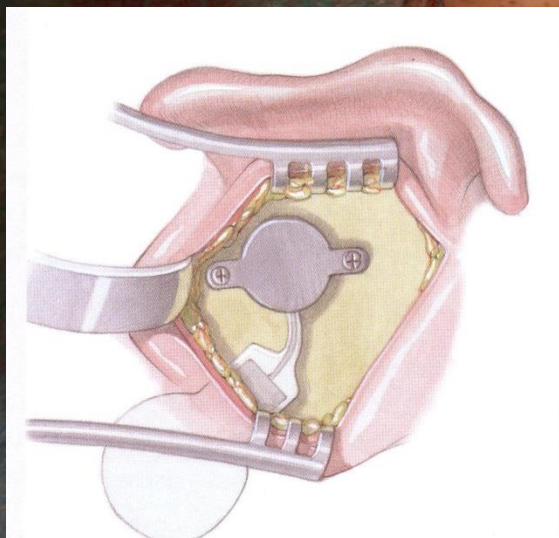
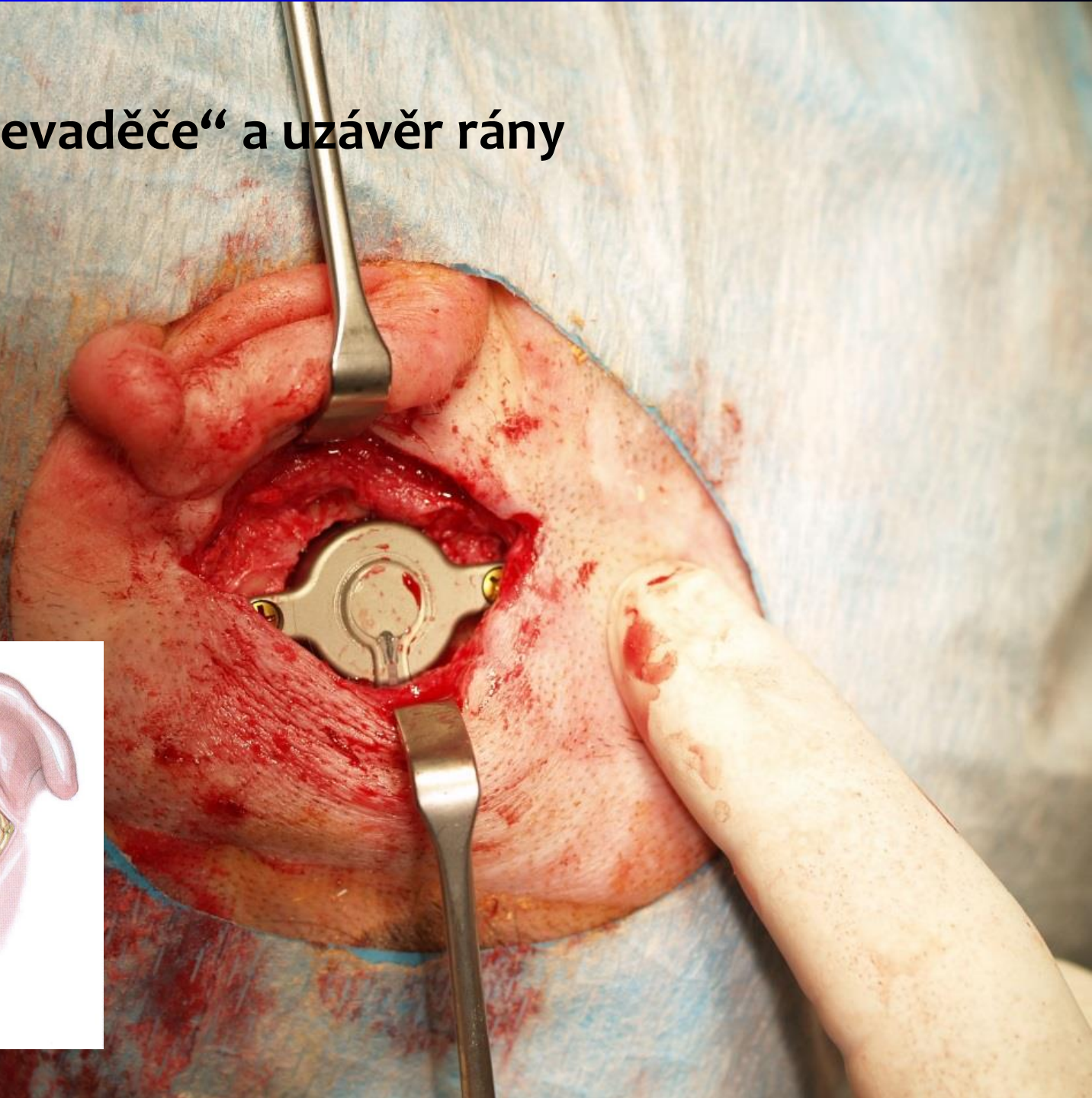
#### 4. Příprava fixace FMT převodníku



## 5. Fixace „převaděče“ (Bone Conduction Implant)

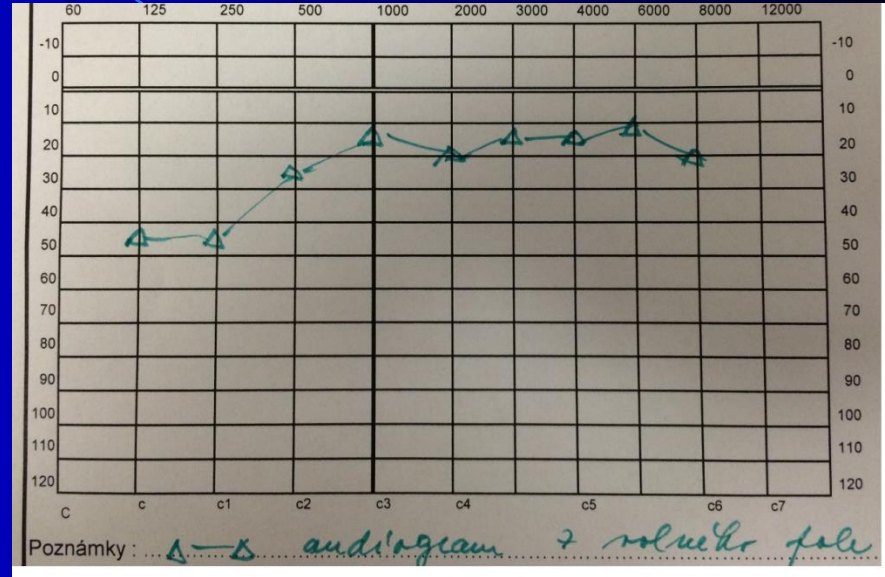
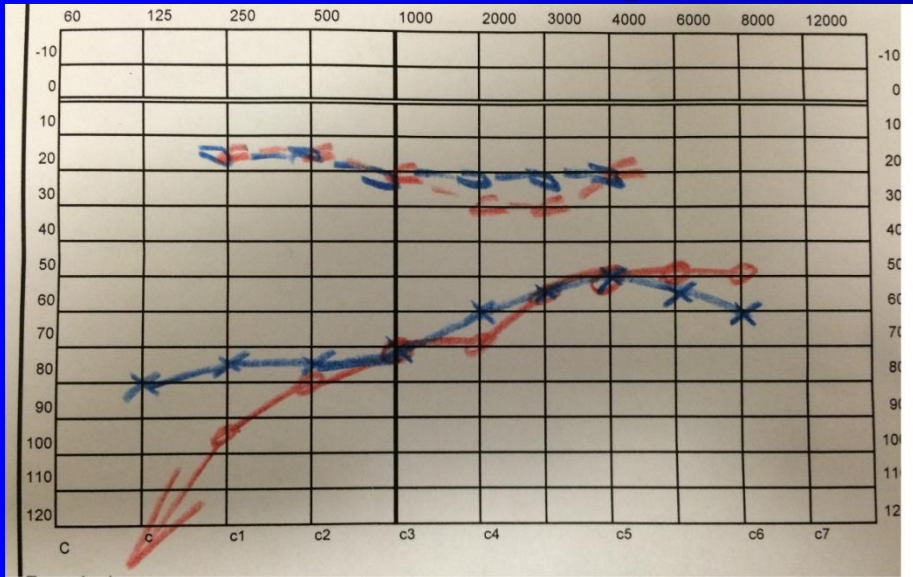


## 6. Fixace „převaděče“ a uzávěr rány

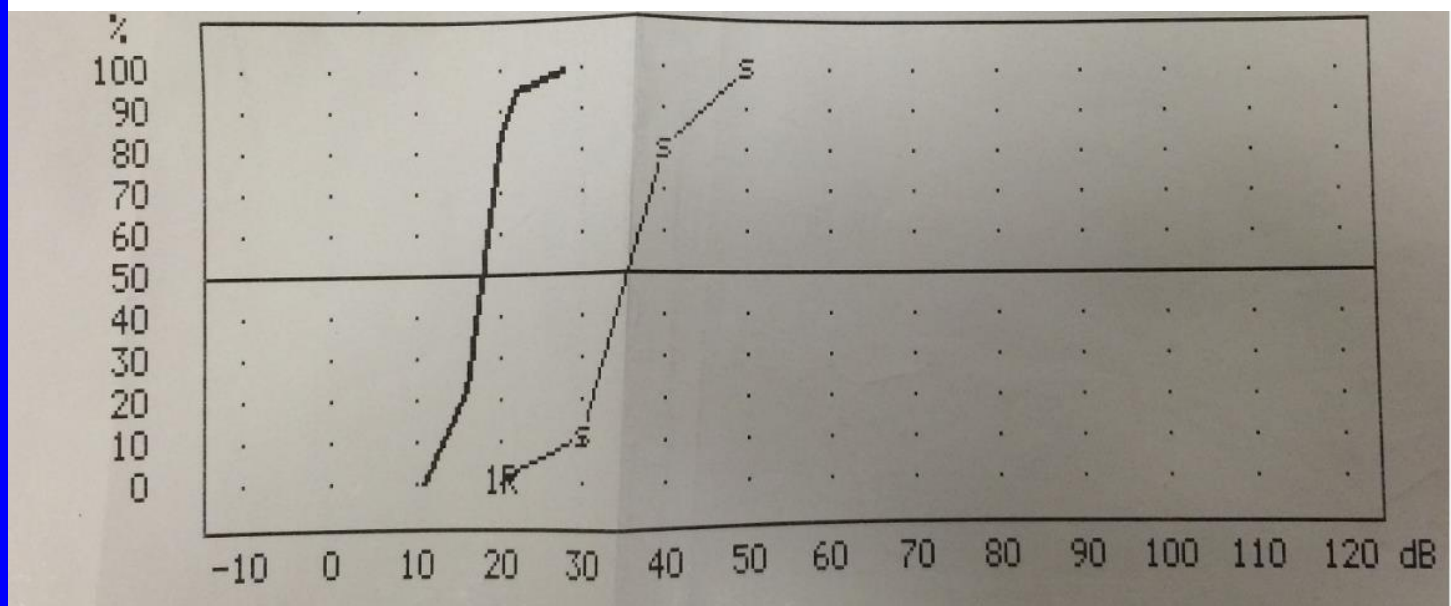
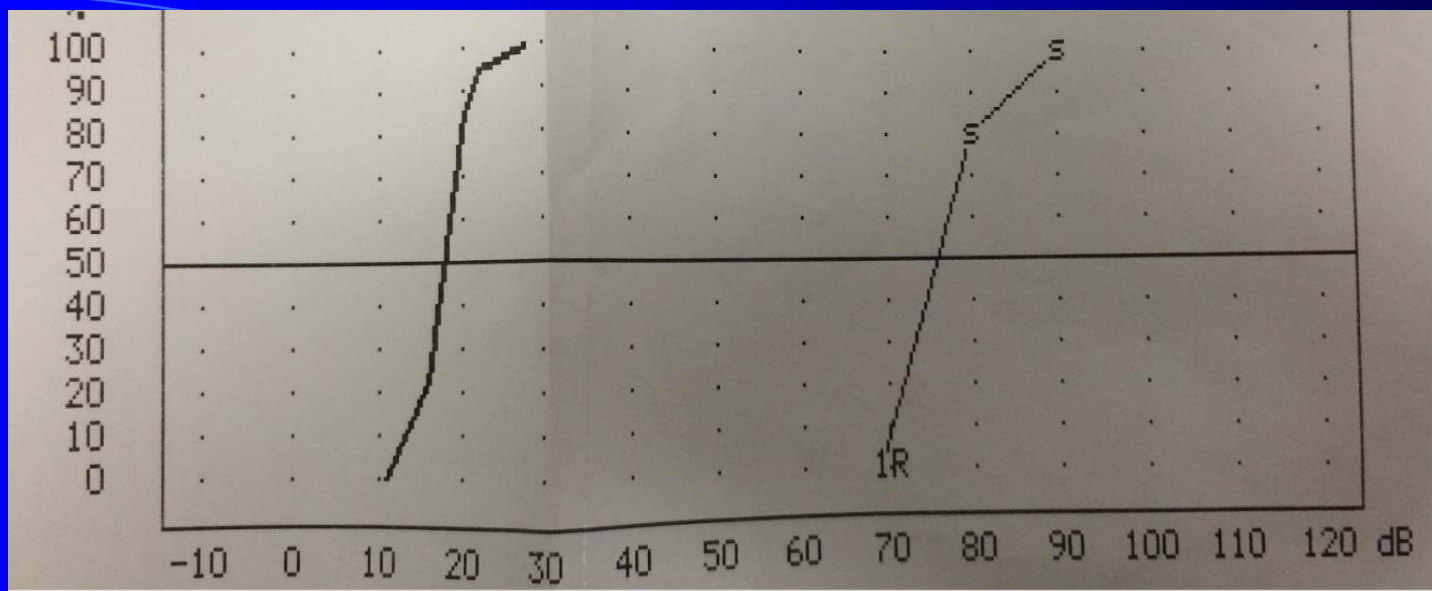




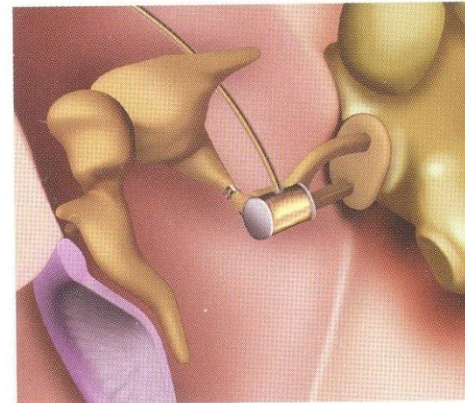
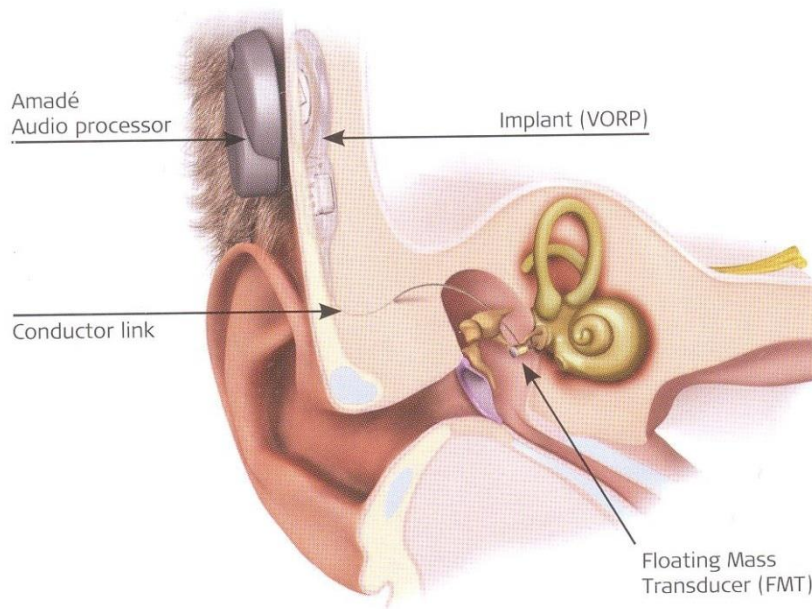
# Sluch před a po operaci



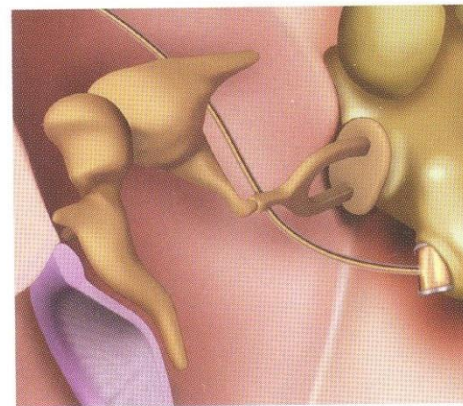
Poznámky : ...  $\Delta$  -  $\Delta$  audiogram + volněto žele



# Vibroplasty - soundbridge



Incus Vibroplasty  
used to treat  
sensorineural hearing loss



Round Window  
Vibroplasty  
used to treat conductive  
and mixed hearing loss

# **Chirurgická léčba zánětu středouší - rekonstrukční operace (tympanoplastiky)**

## **Dělení dle Wulsteina**

**I. Myringoplasty**

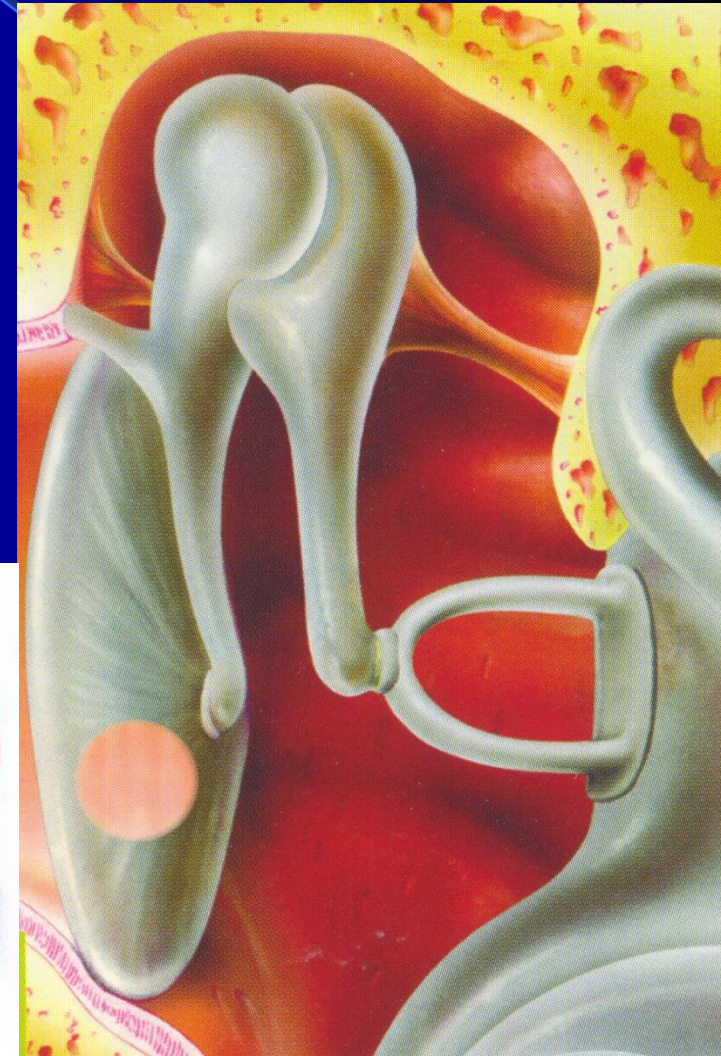
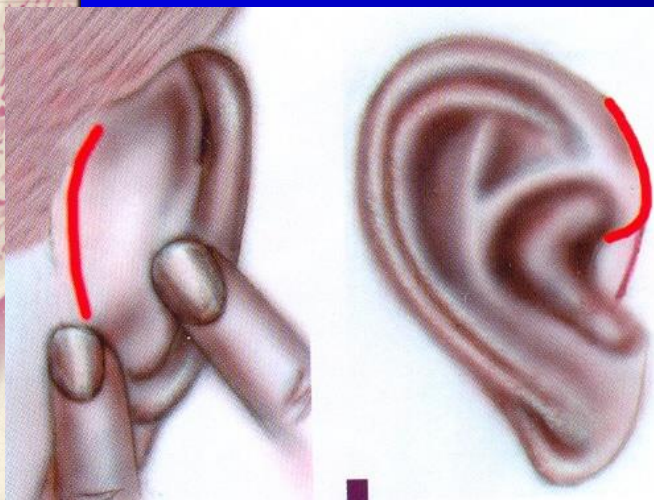
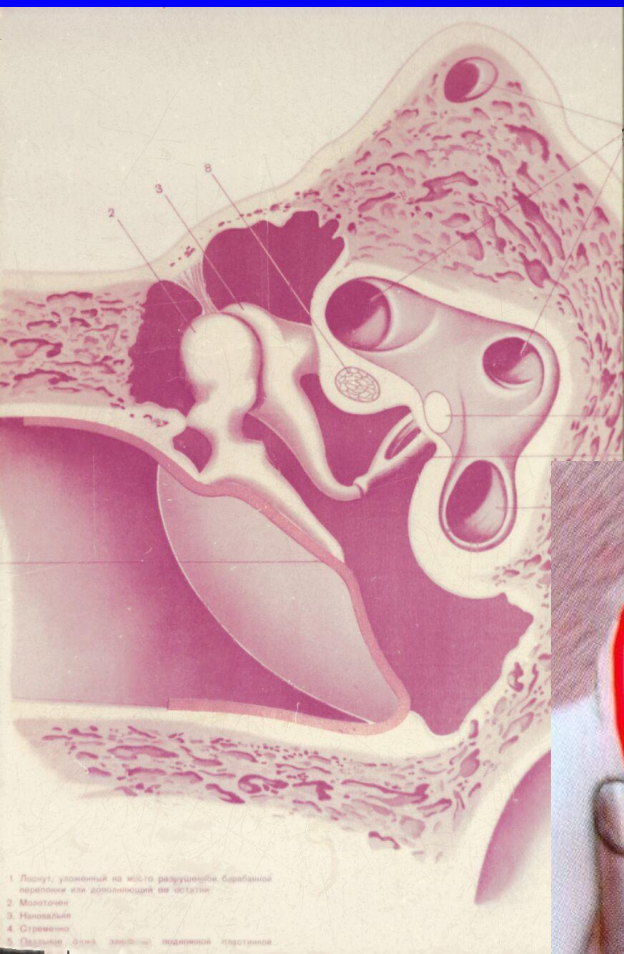
**II. Columelisation of incus**

**III. Columelisation (stapes)**

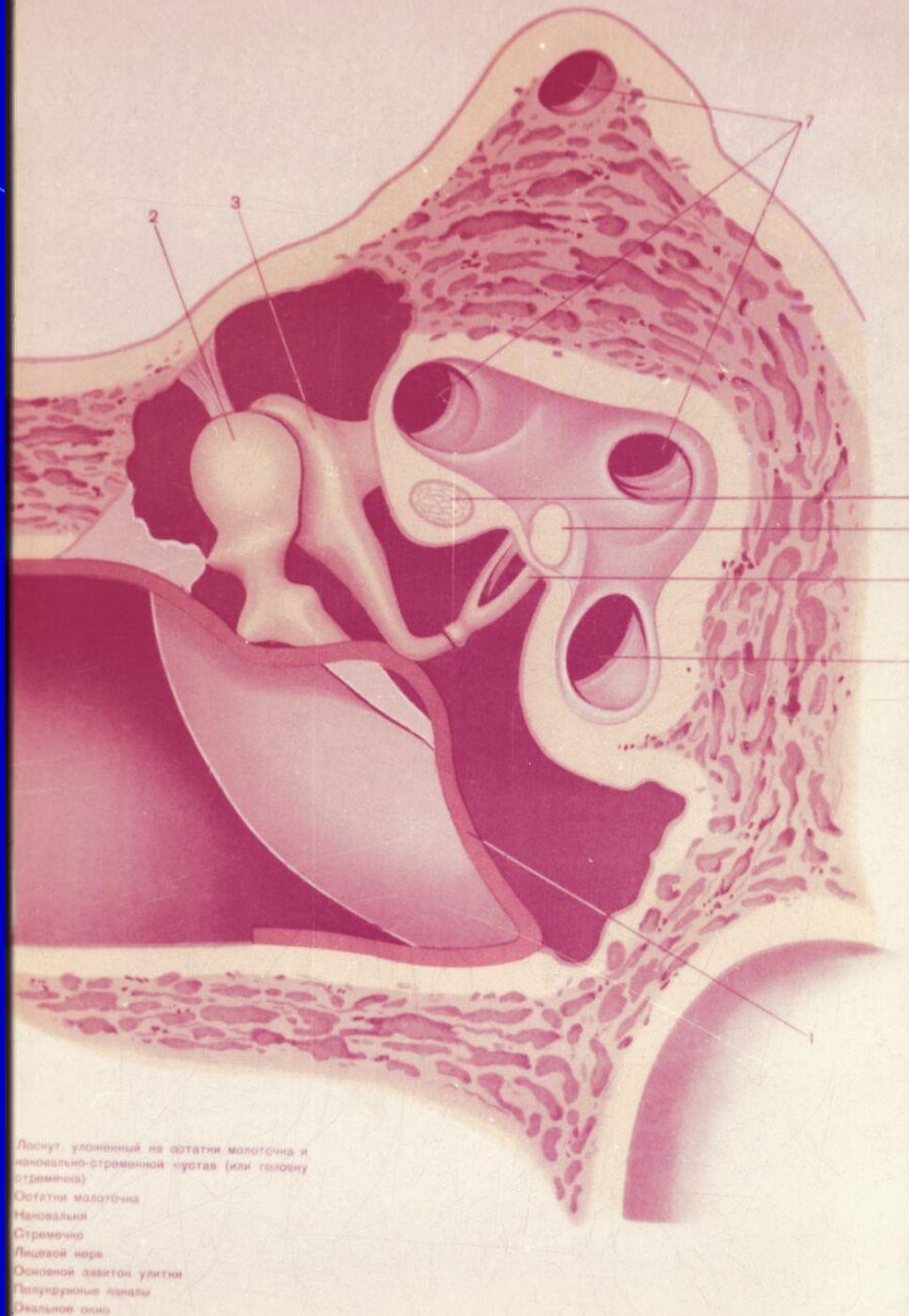
**IV. Ekranisation (zástín okrouhlého  
okénka**

**V. Fenestration of labyrinth**

# Tympanoplasty - typ I. Myringoplasty



# Tympanoplasty dle Wullsteina II. Kolumalizace kovadlinky



# Tympanoplasty typ III.a

zničená kovadlinka i kladívko, třmínek intaktní, zvuk přenášen protézou PORP, ta je podložena chrupavkou

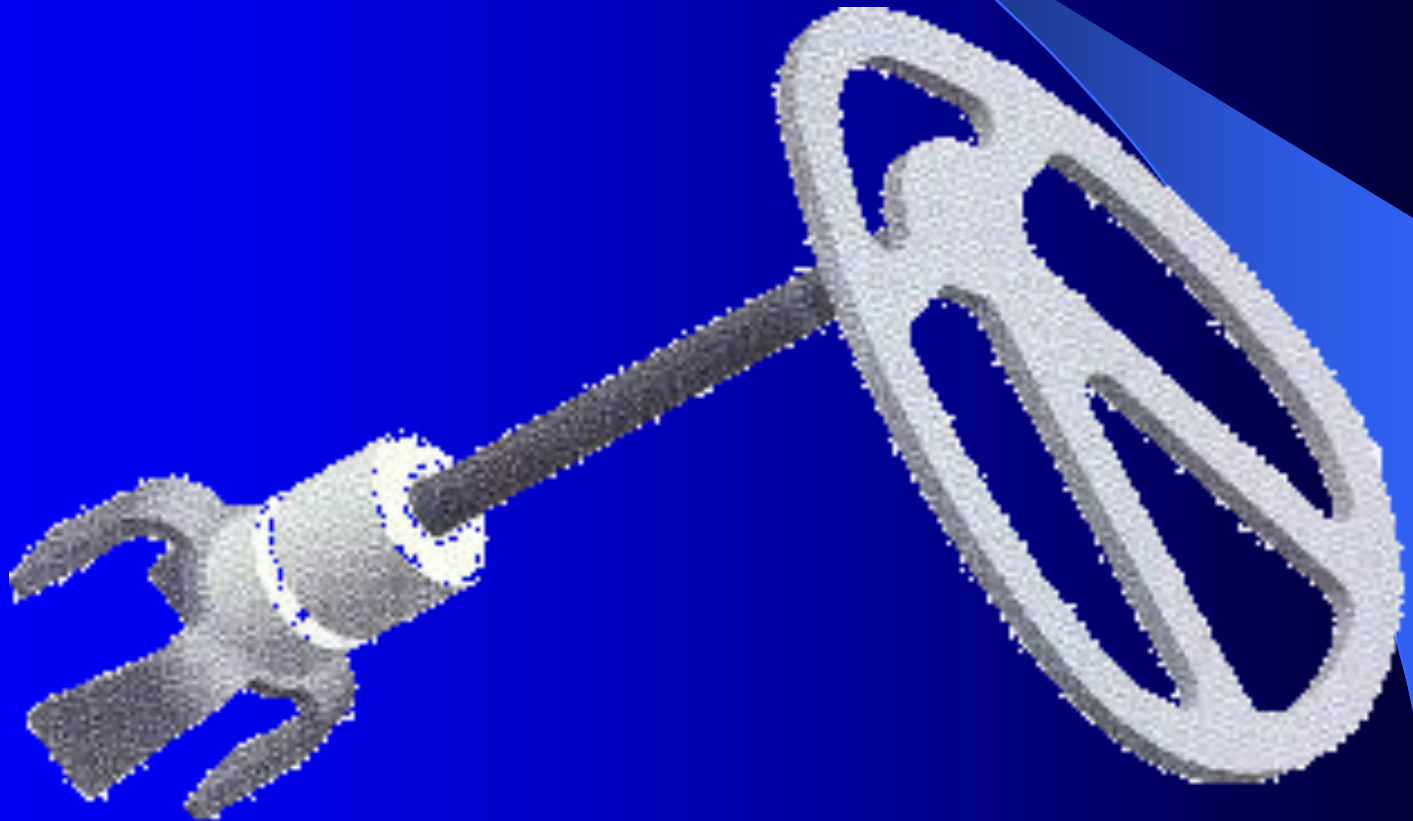


PORP  
partial  
ossicular  
replacement  
prosthesis



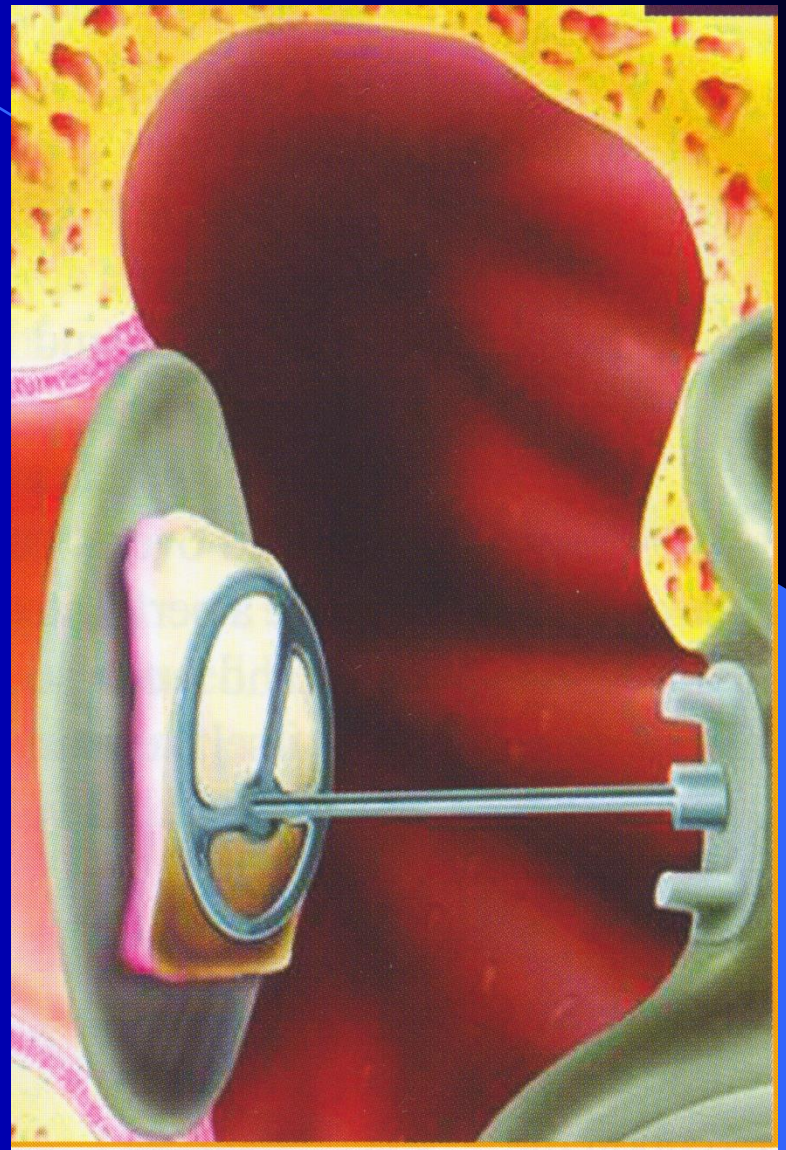


PORP



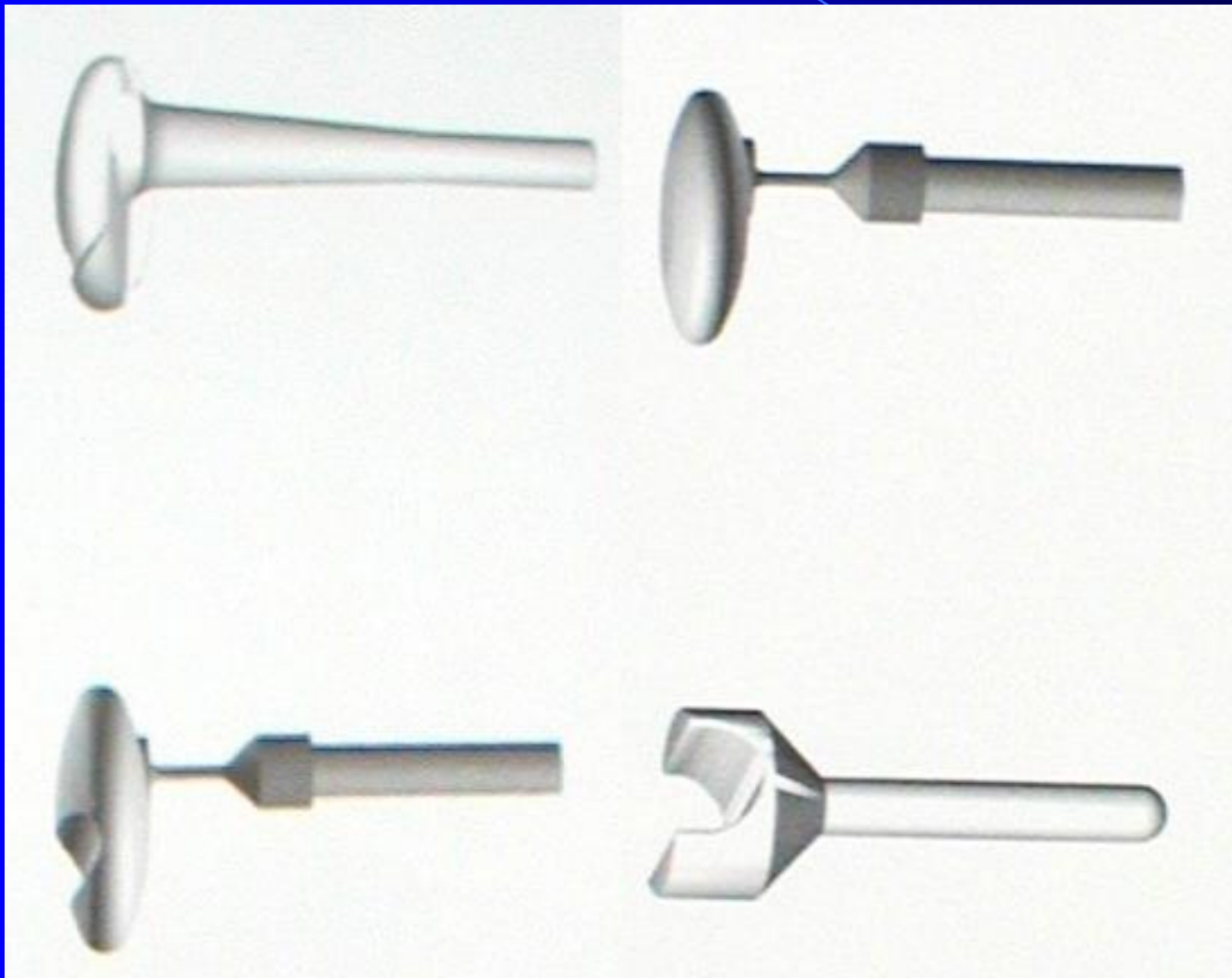
# Tympanoplastika typ III.b

zničená kovádlinka i  
kladívko, suprastruktury  
třmínku porušeny, zvuk  
přenášen protézou TORP  
přímo na ploténku třmínku,  
Protézka je podložena  
chrupavkou

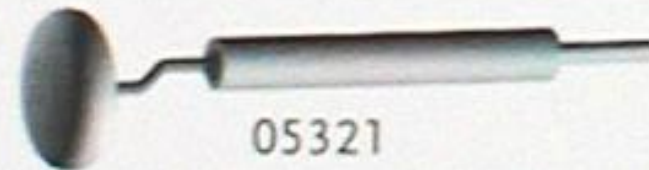
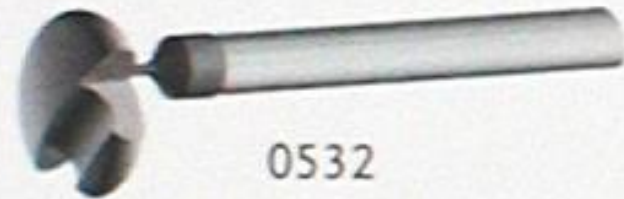
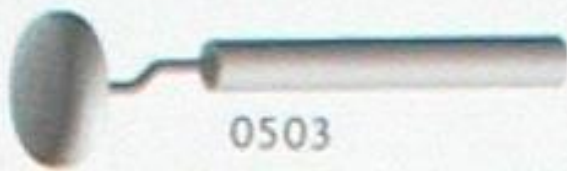


# TORP

Total ossicular replacement prosthesis



# TORP



# Tympanoplastika typ III.c Kolumelizace

zničená kovadlinka i  
kladívko, třmínek  
intaktní, spojen přímo s  
bubínkem -  
myringostapedopexe

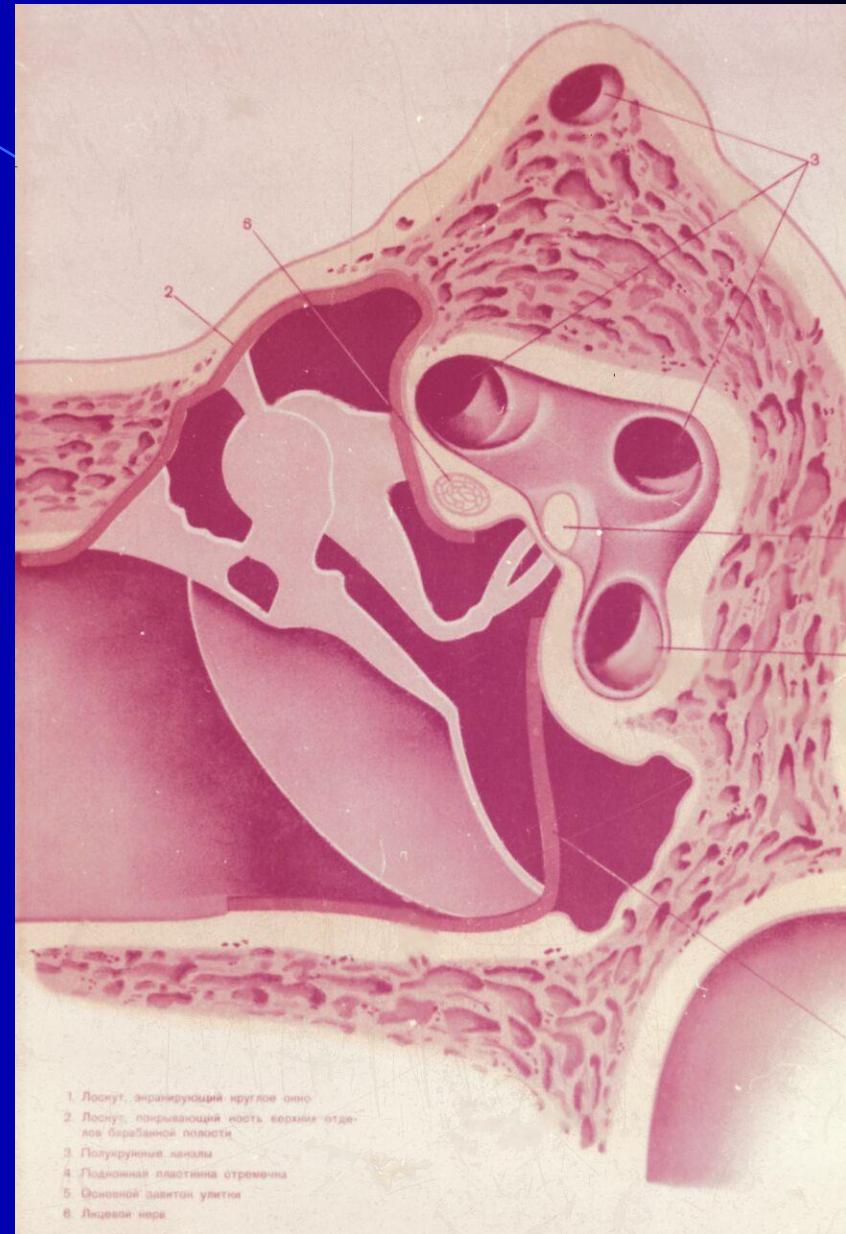


# Tympanoplastika

typ IV.

**Ekranizace**

(zástín okrouhlého okénka)

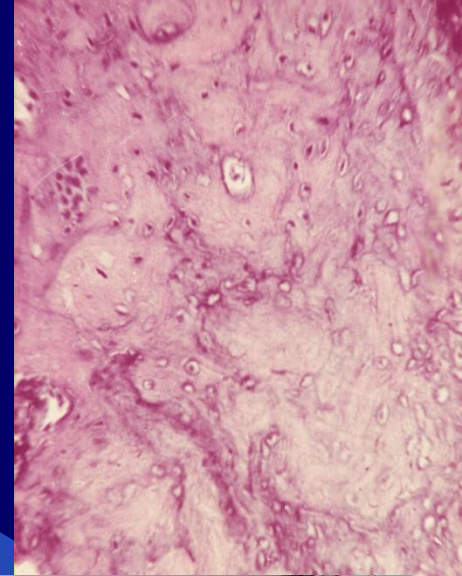


# Tympanoplastika typ V.

**Fenestrace**  
(chirurgicky vytvořeno  
nové okénko do  
labyrintu)



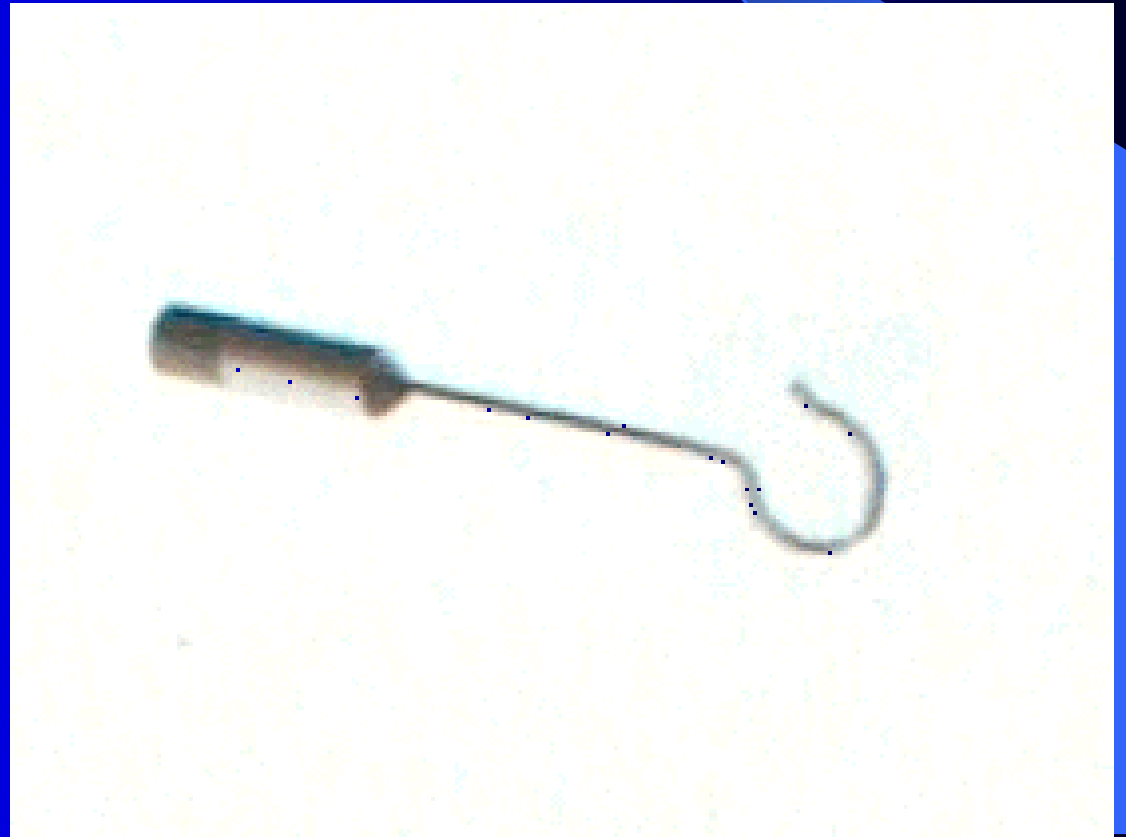
# Van den Hoeve de Klein Otosclerosis



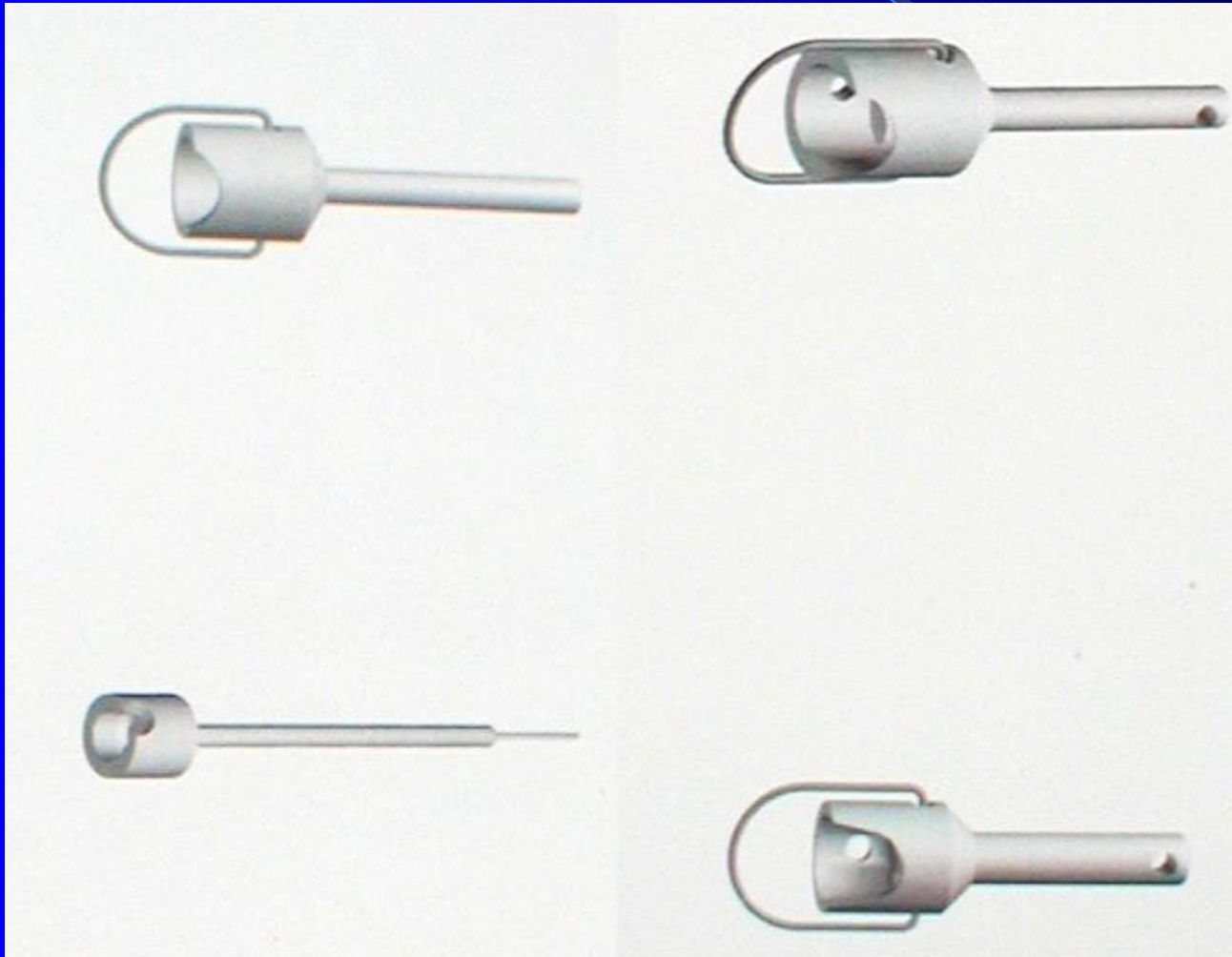




# PISTONY

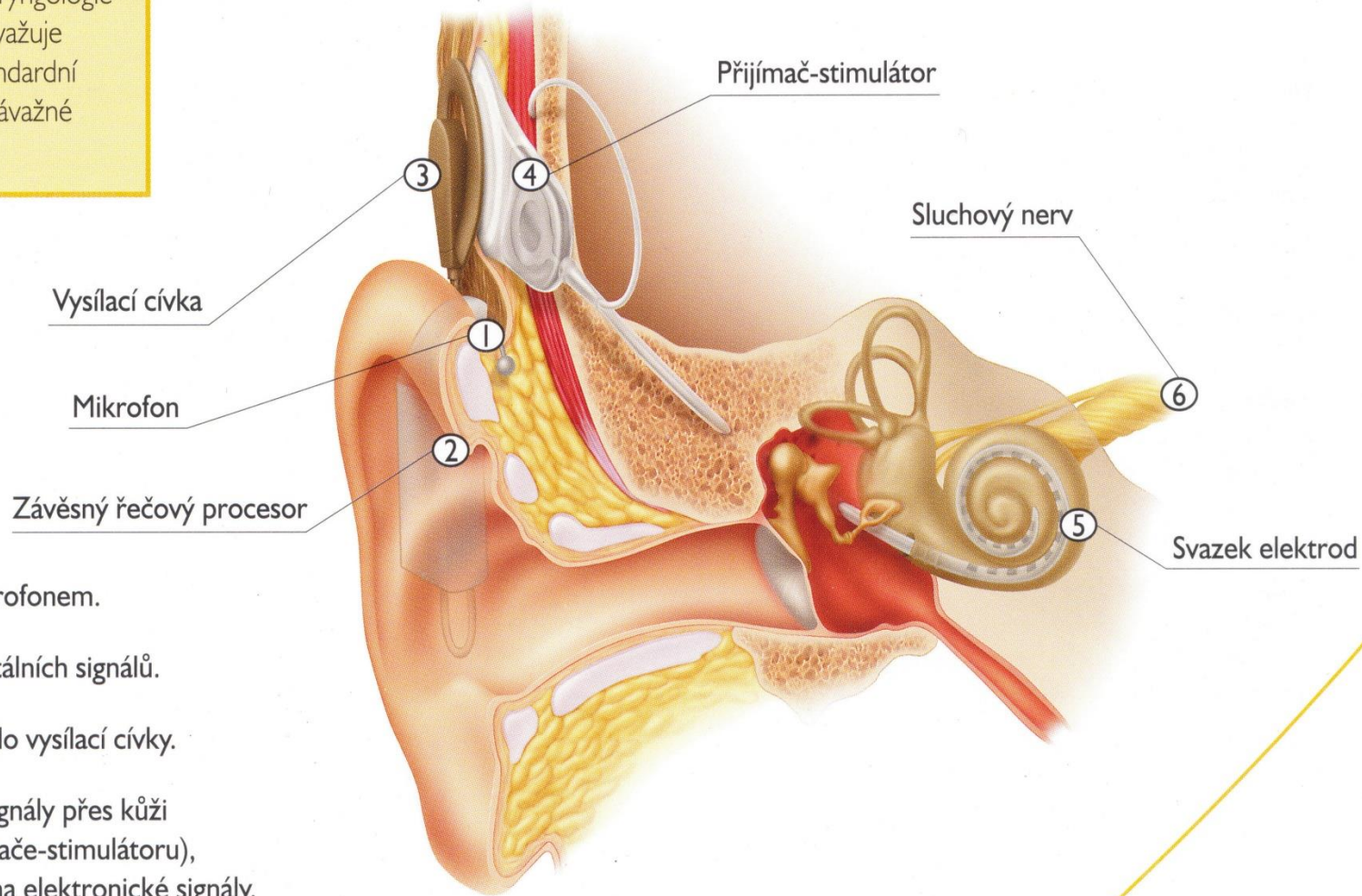


# PISTONY



# Jak slyšíme s kochleárním implantátem

Americká zdravotnická asociace a americká akademie otolaryngologie a chirurgie hlavy a krku považuje kochleární implantát za standardní léčbu oboustranné velmi závažné poruchy sluchu.



- ① Zvuk je přijímán mikrofonem.
- ② Je zakódován do digitálních signálů.
- ③ Signály jsou posílány do vysílací cívky.
- ④ Vysílací cívka vysílá signály přes kůži do implantátu (přijímače-stimulátoru), kde jsou převedeny na elektronické signály.
- ⑤ Signály jsou posílány do svazku elektrod, který dráždí vlákna sluchového nervu v hlemýždi.
- ⑥ Signály se přenášejí sluchovým nervem dále do mozku, kde jsou rozpoznány jako zvuky.

Pro více informací navštivte naši webovou adresu:

[www.cochlear.com](http://www.cochlear.com)





Děkuji za pozornost