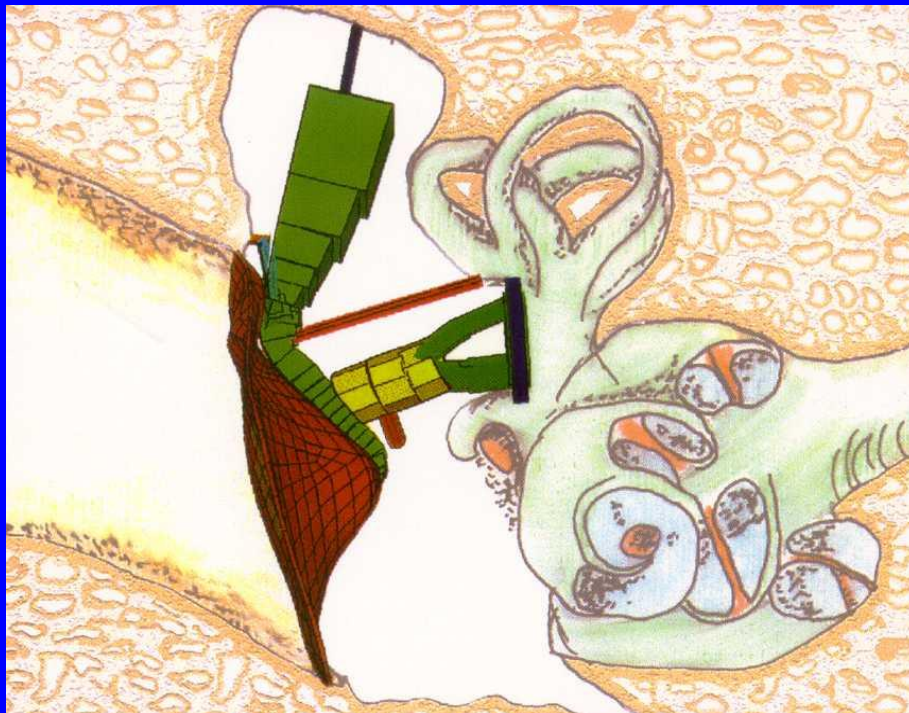


# Hallásélettan

## A fülsebész szemszögéből



Dr. Pytel József

Emeritusz Professor

PTE ÁOK

Fül-, Orr-, Gégészeti és Fej-, Nyaksebészeti Klinika

# Érzékszervek

Hallás

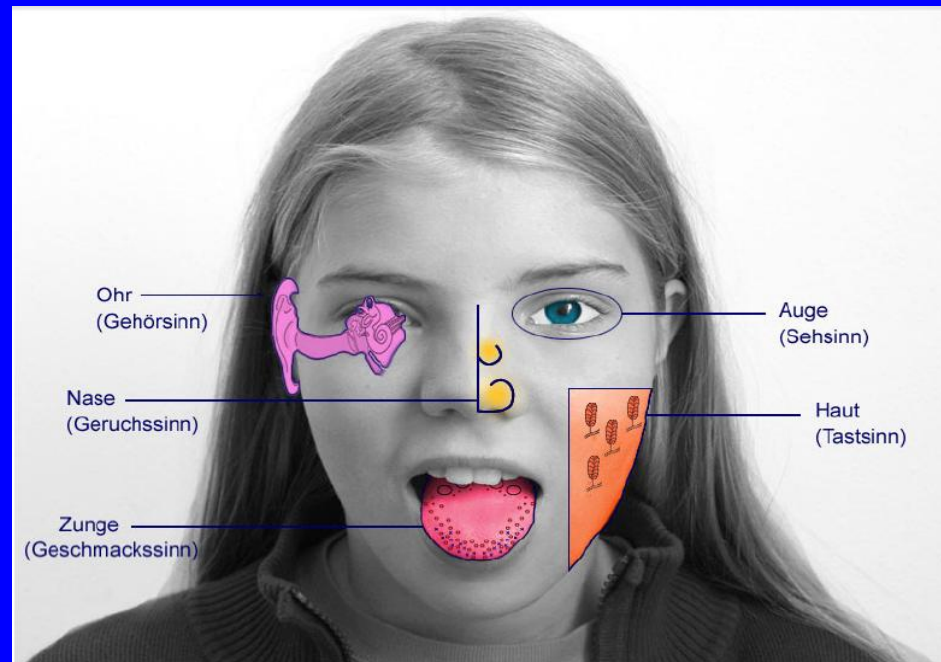
Egyensúly

Íz-érzés

Szaglás

Látás

Tapintás stb



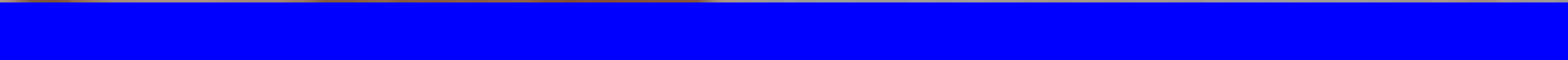
## Kommunikáció

Hallás → **Siket-néma**

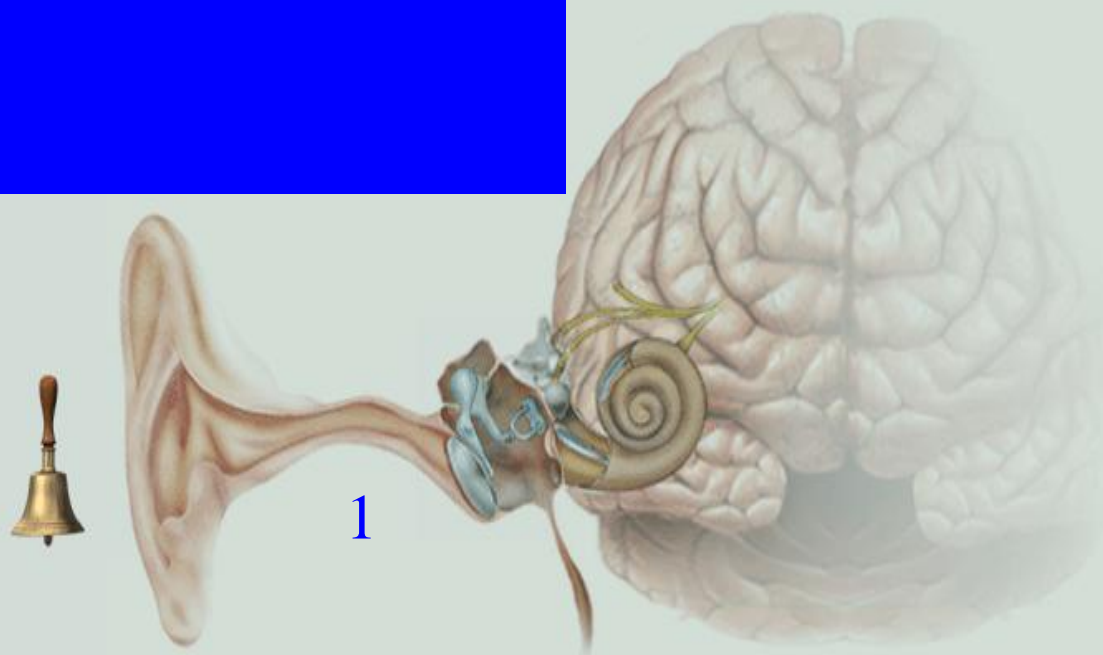
Beszéd

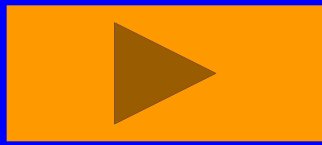
**Person Per-sonum**

Metakommunikáció



## A hallás megértése



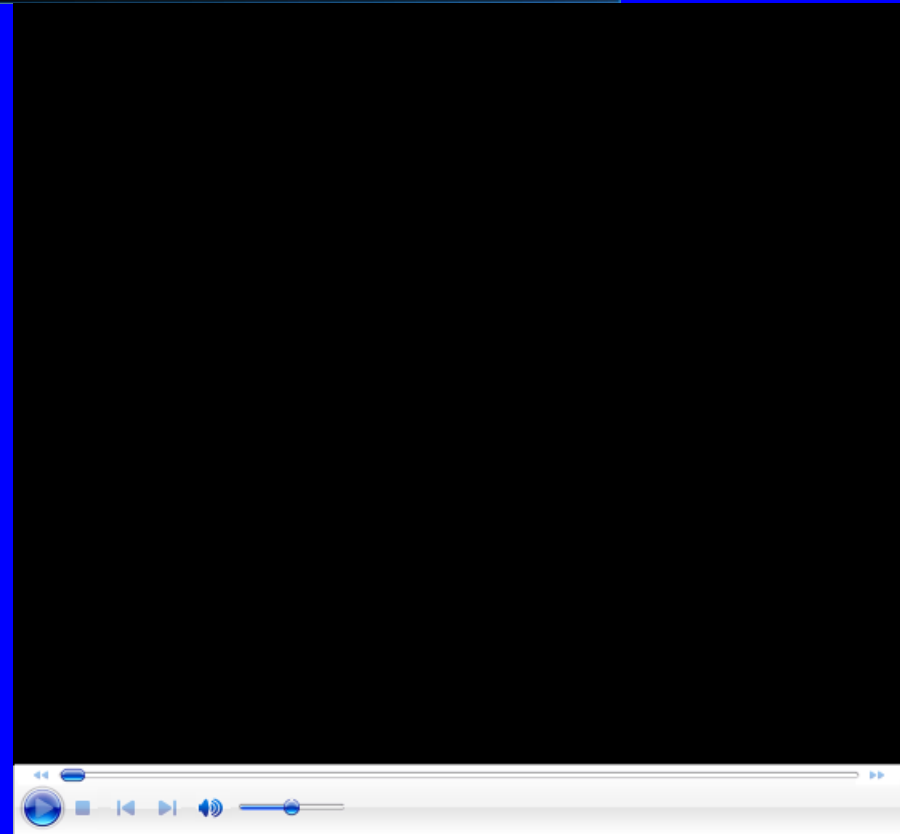
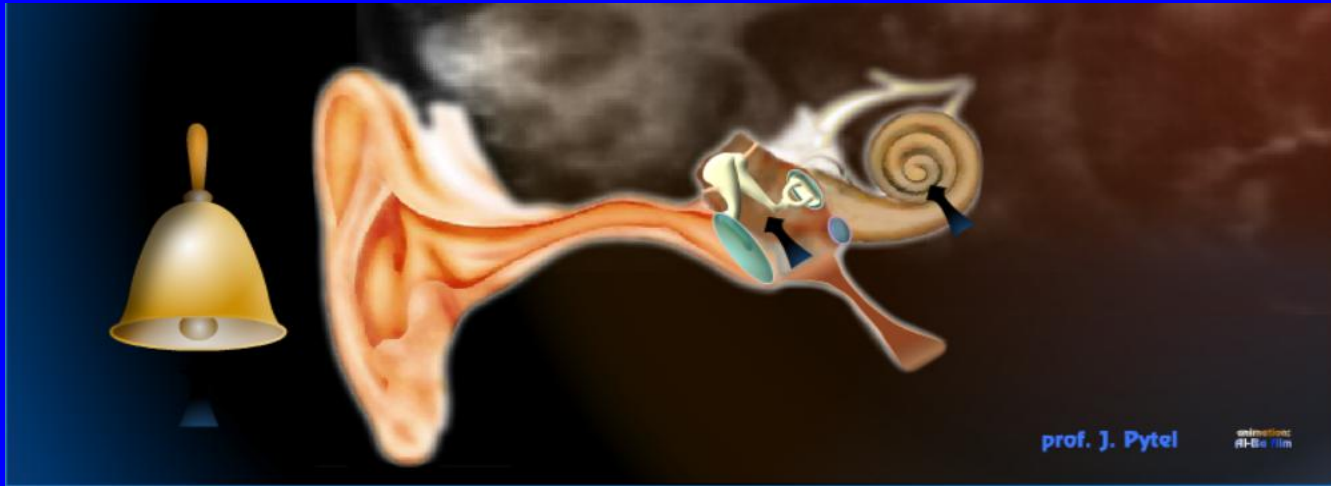


Fülkagyló

Sápadt denevér



# Hallójárat



# Dobhártya



Ép dobhártya

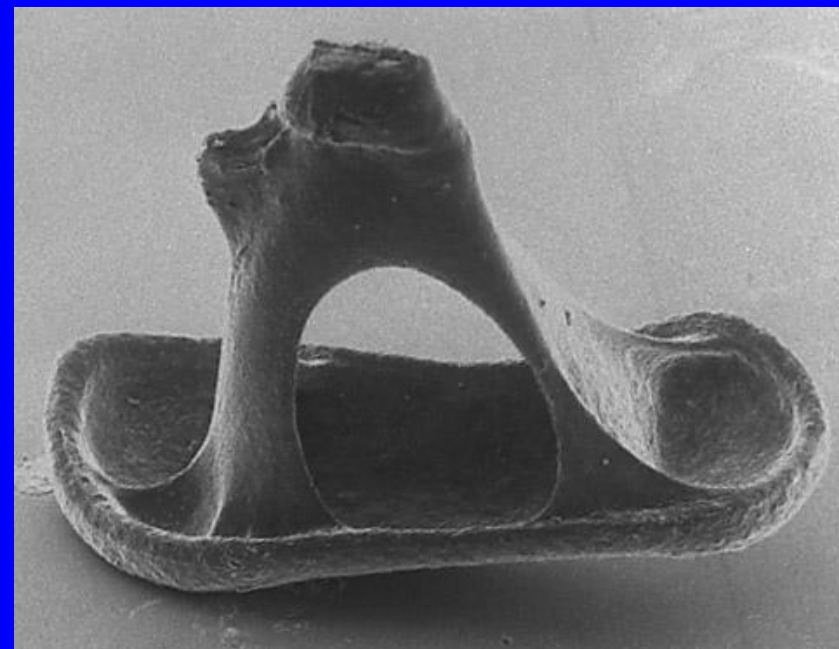
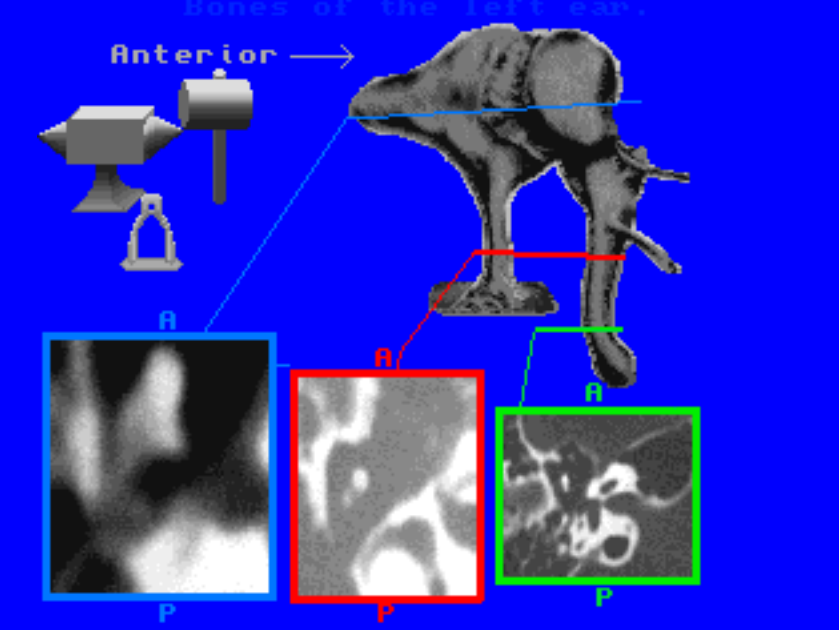
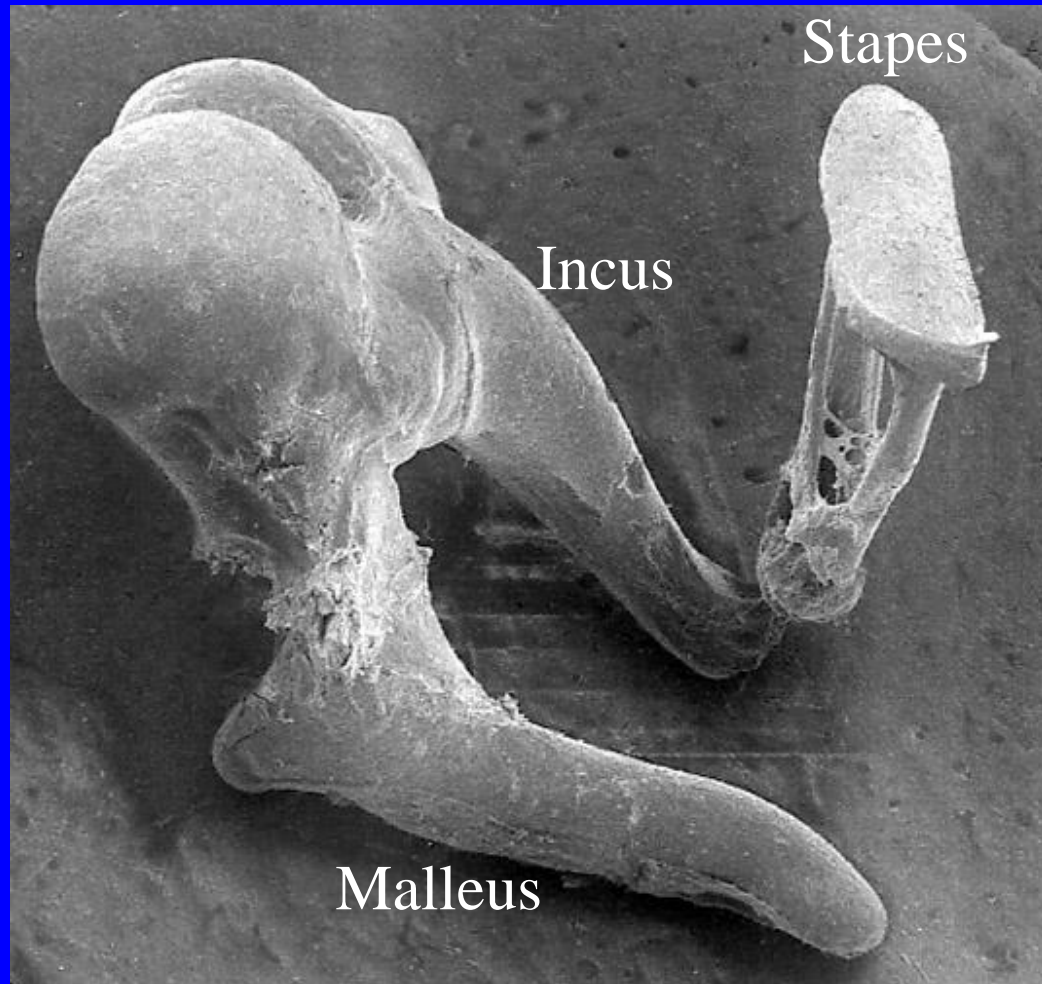


# Hallócsontok

Malleus – Kalapács

Incus – Üllő

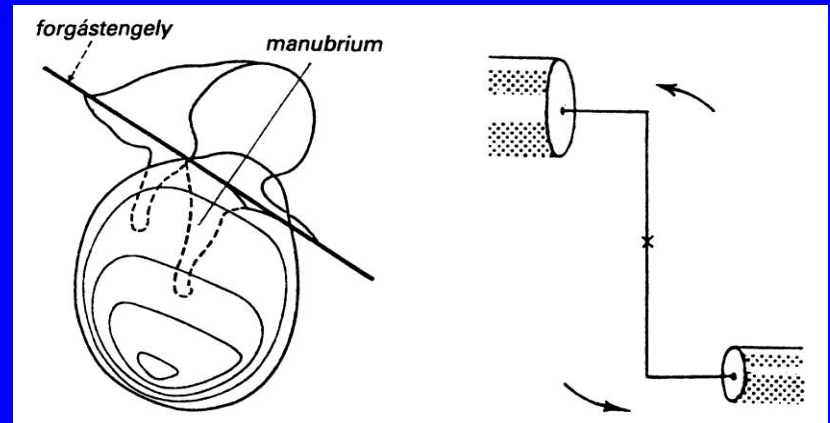
Stapes – Kengyel



# Hangvezető rendszer: Impedancia illesztés



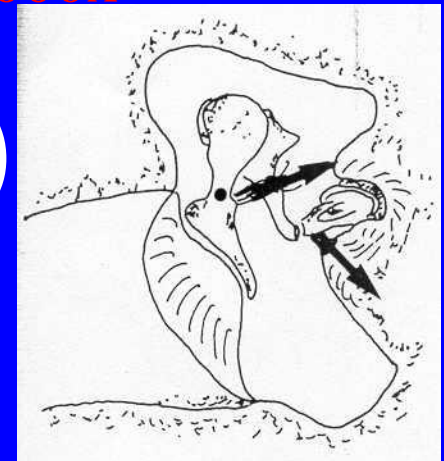
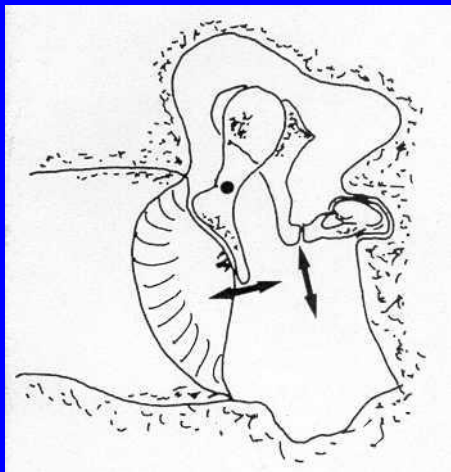
**Erősítő**



**Védelem**

**(puffer hatás)**

1000x



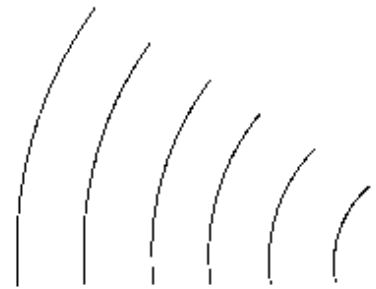
Átvitt  
hang

1x

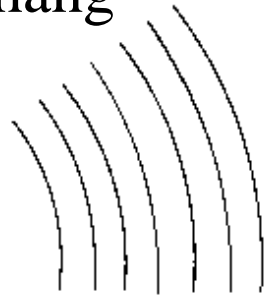
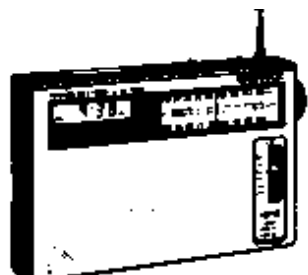
$10^3$

3Bel=  
30dB

E  
l  
n  
y  
e  
l  
t  
h  
a  
n  
g



Visszavert hang



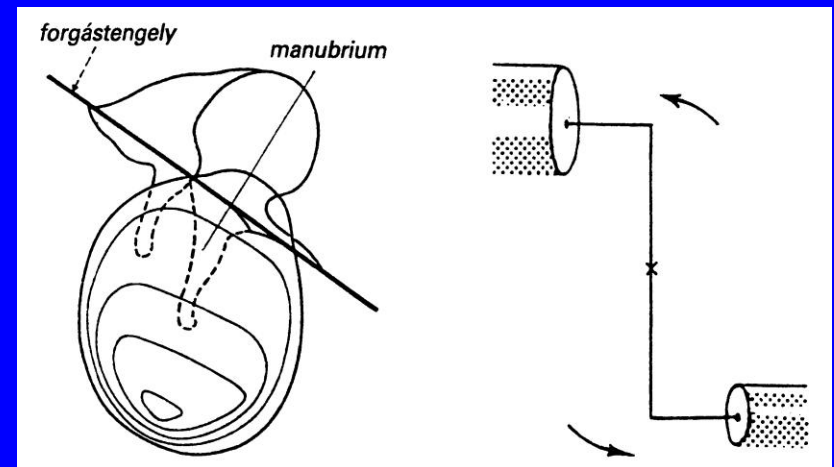
Hangforrás



# A hangvezető rendszer erősítő komponensei:

☞ Dobhártya/ovális ablak aránya

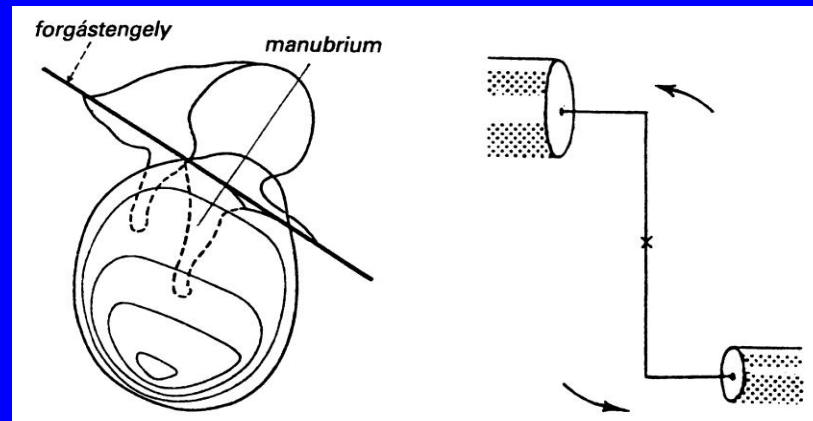
☞ Kalapács-  
üllő emelő  
hatás

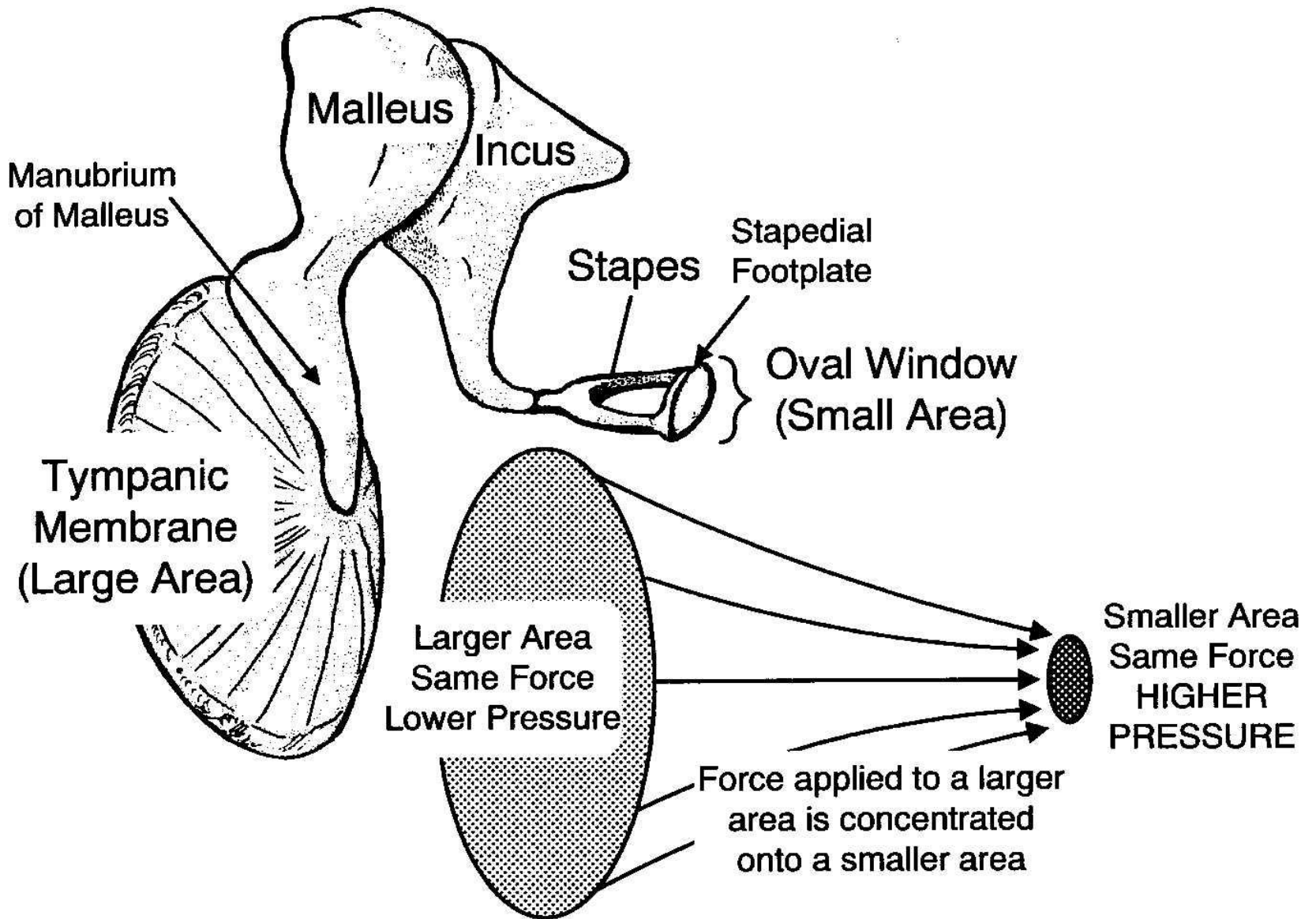


☞ **Dobhártya/ovális ablak aránya**

$$55 \text{ mm}^2 / 3.2 \text{ mm}^2 = 17.19$$

$$\text{dB} = 20 * \log(p1/p0) = 24.7 \text{ dB}$$





# A dobhártya szerepe:

## Békésy - féle isovibrációs vonalak

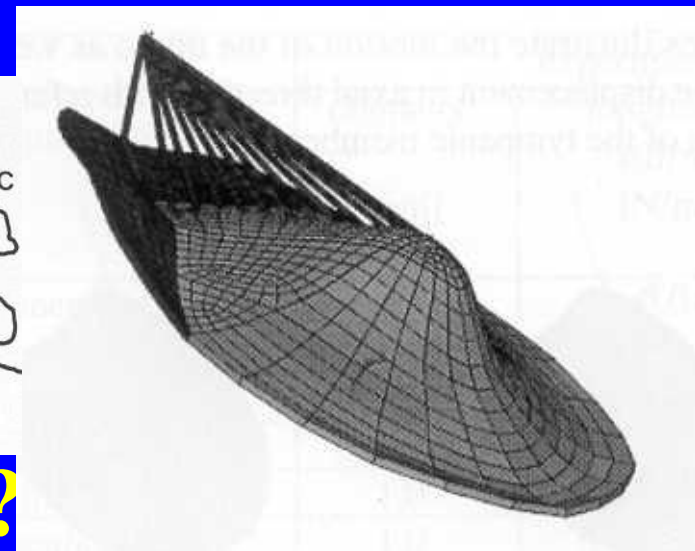
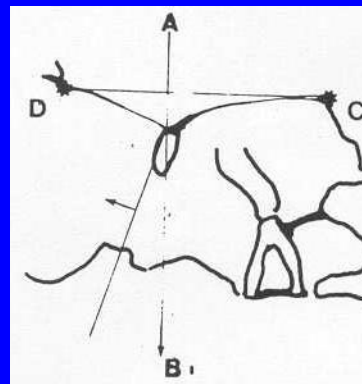
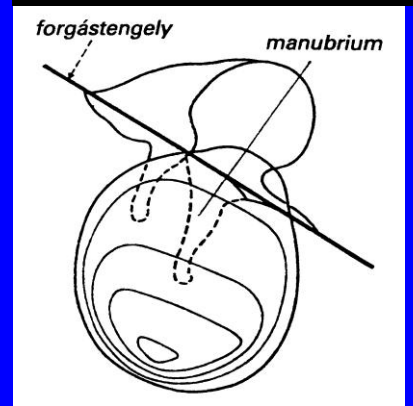
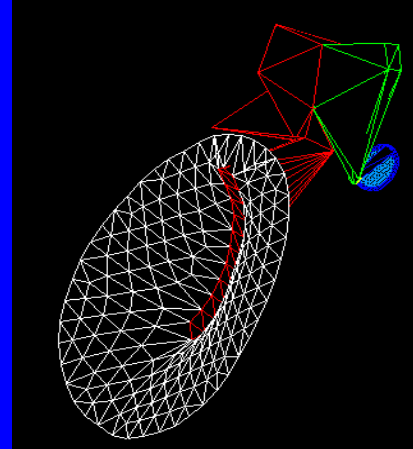
**Minnél kisebb a perforatio, annál jobb az eredmény**

## Kúphatás:

**1 mm = .5 dB**

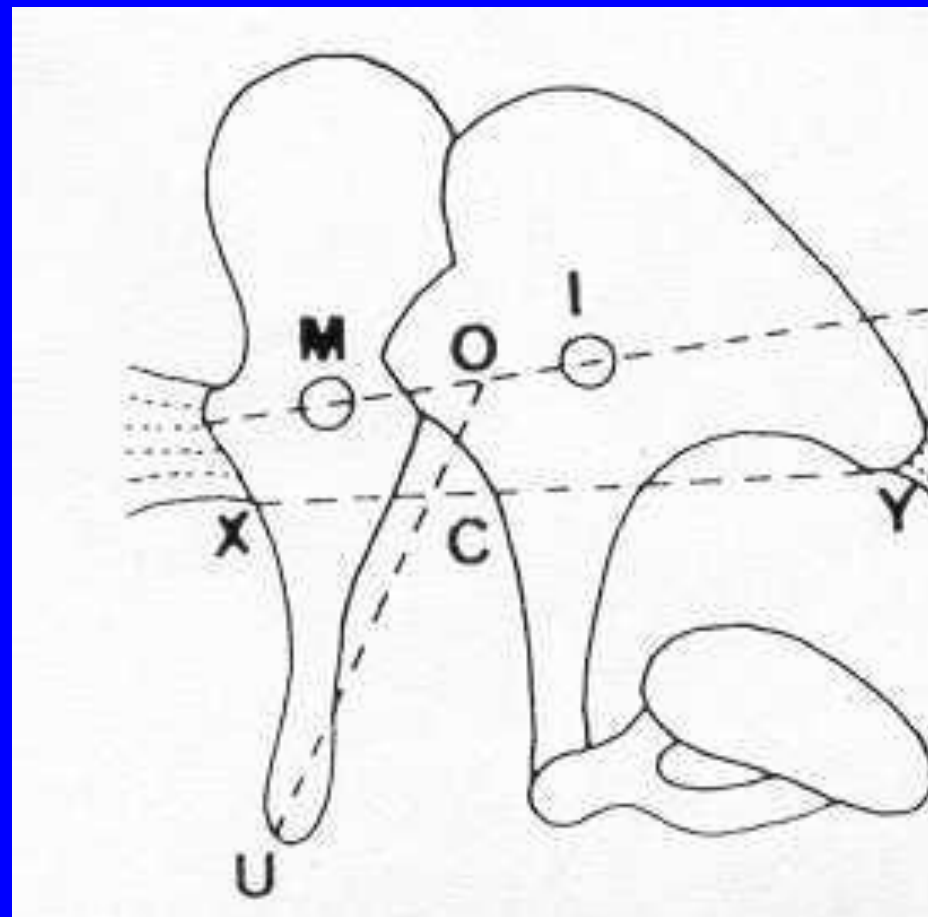
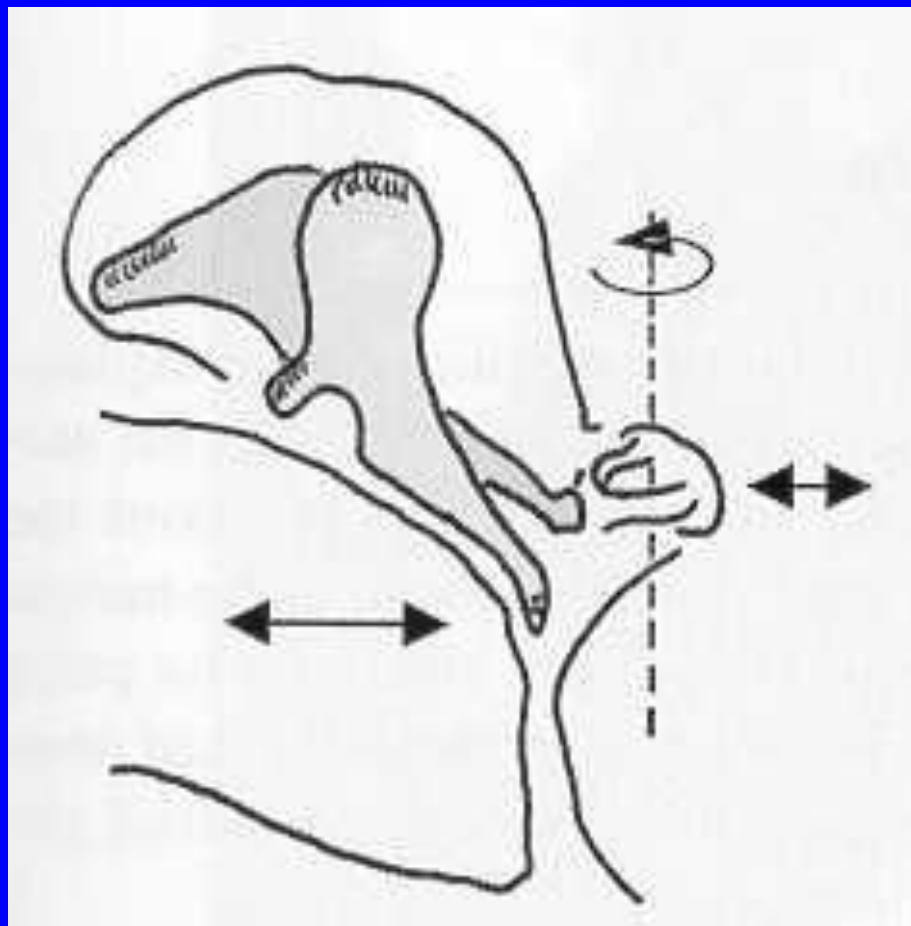
**2 mm = 1.8 dB**

**Cornea, pallisade technika?**

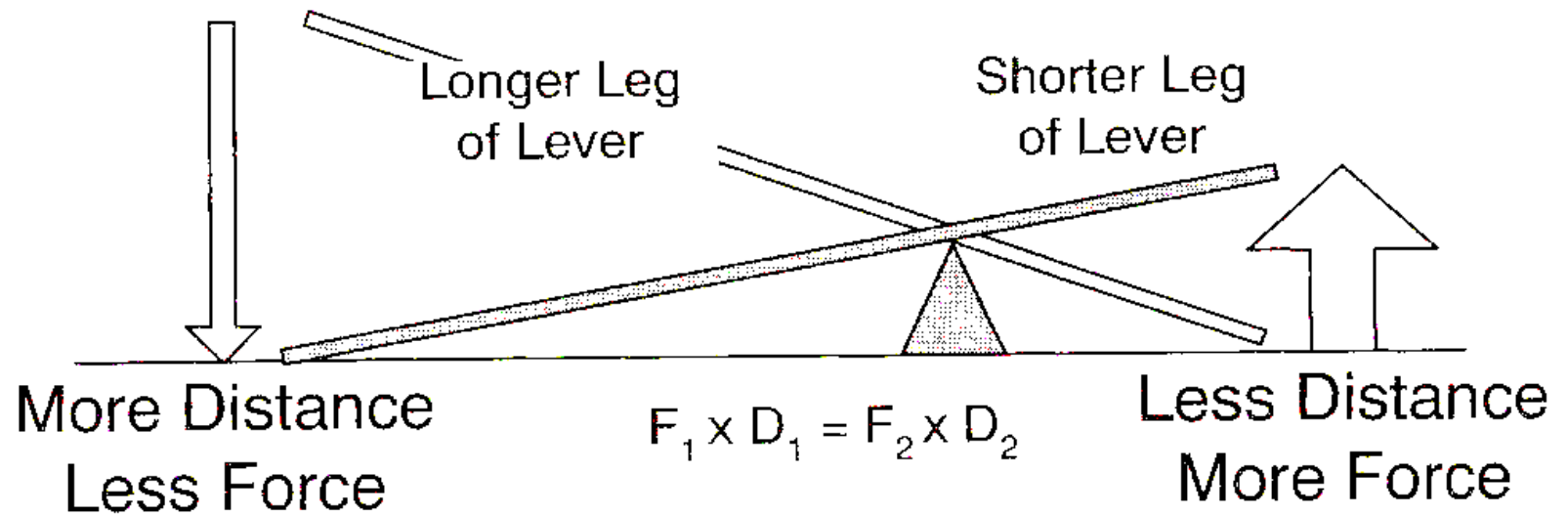
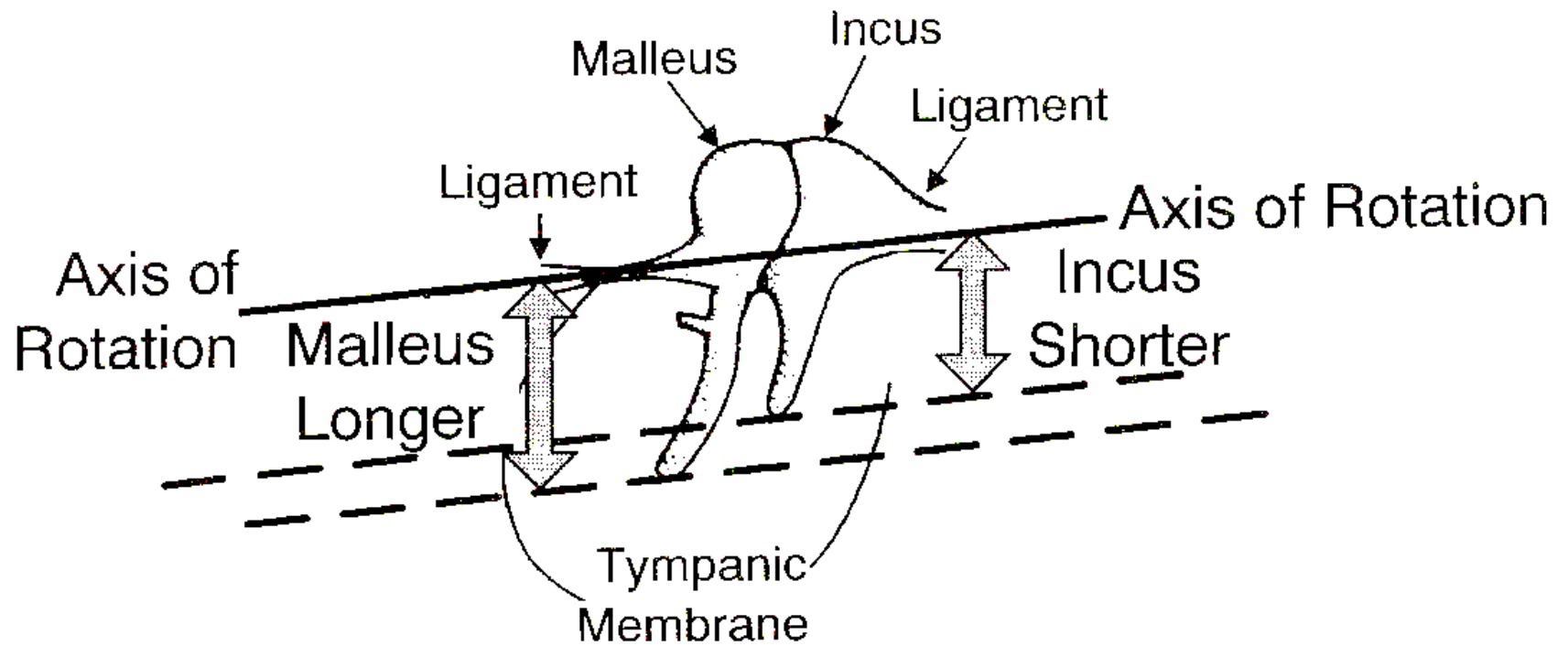


☞ **Kalapács/üllő emelő  
hatás**

$$\text{dB} = 20 * \log(1.3) = 2.28 \text{ dB}$$







# Együttes erősítés:

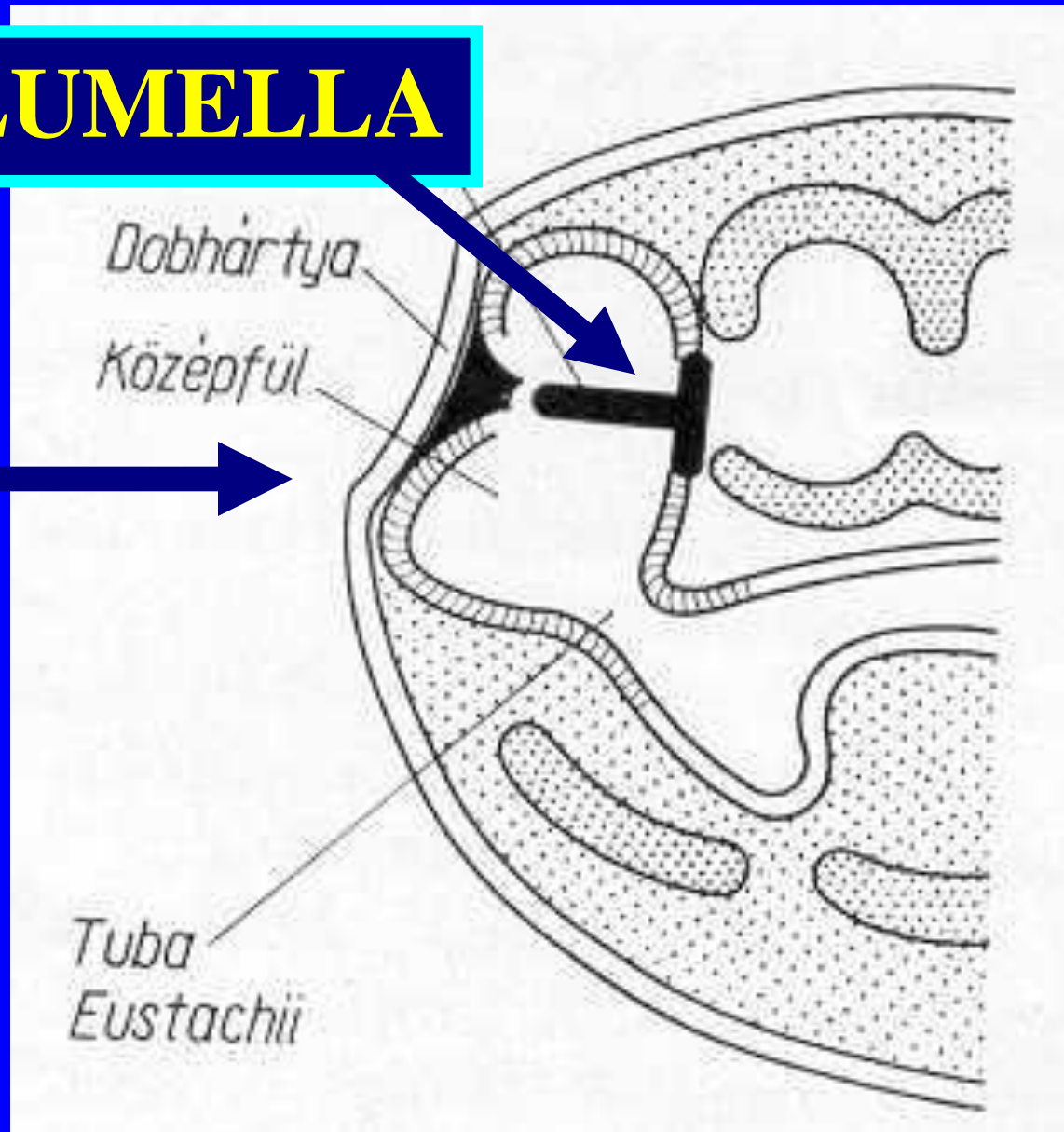
$$24.7 + 2.28 = 26.98 \text{ dB}$$

**27 dB ~ 30 dB**

# Veszteség műtétnél:

**COLUMELLA**

**Madárfül**



**Veszteség műtétnél:  
Dobhártya kúphatás:  
.5 - 1.8 dB**

**+**

**Kalapács/üllő emelőhatás:  
2.28 dB**

**=**

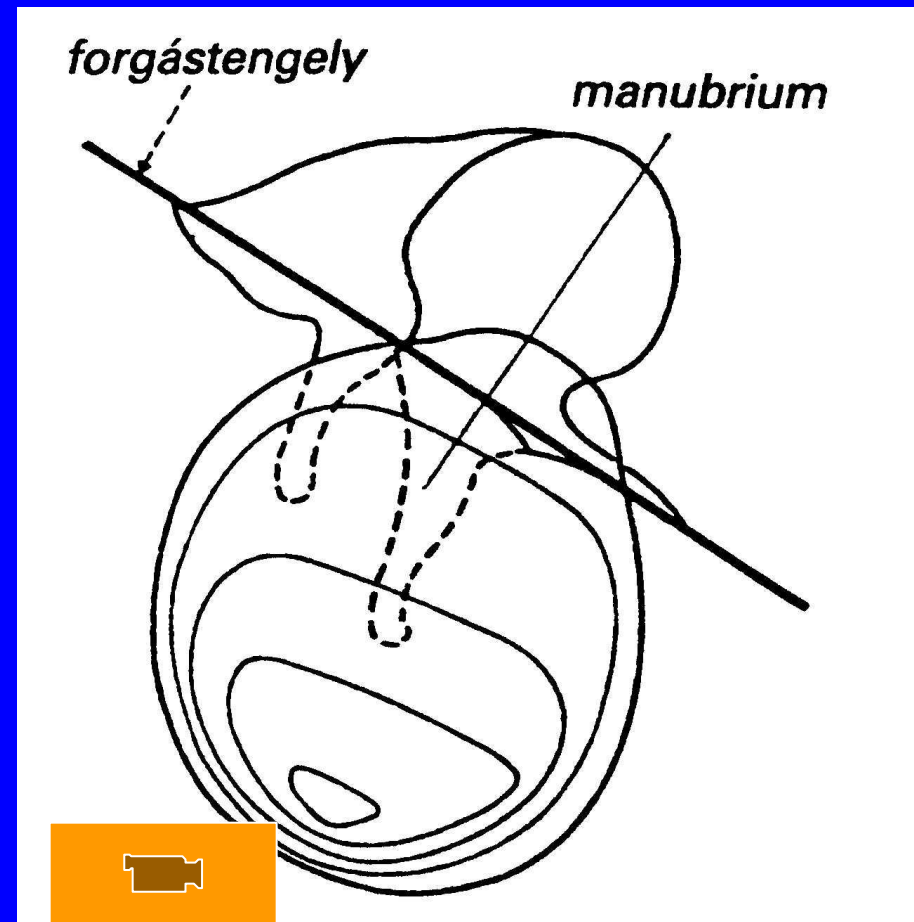
**2.78 - 4.08 dB ~ 5 dB**

**Mérési hibahatár - de: OAE!**

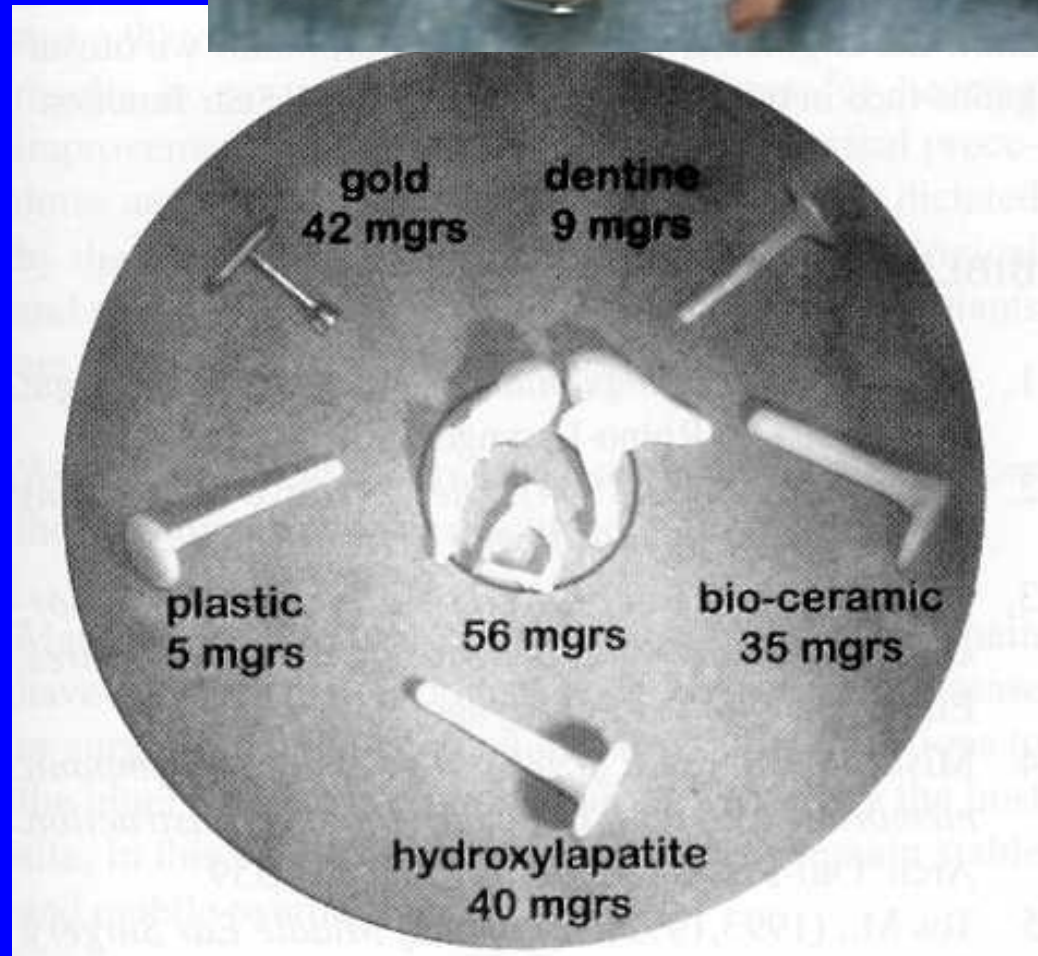
# Veszteség műtétnél:

## Dobhártya rezgőképessége: elveszíthetjük mind a 27 dB-t!

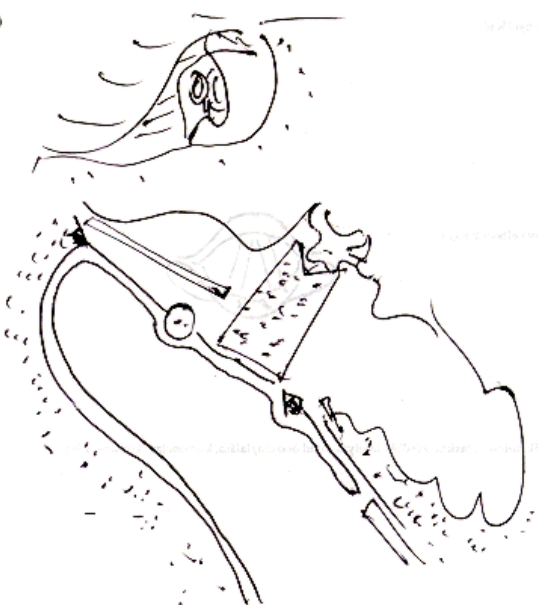
**Tubafunctio!!**

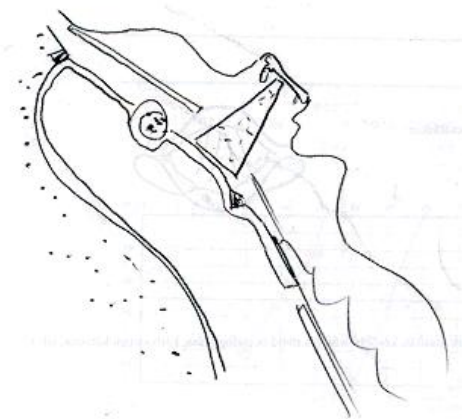


# Columella tömege



# Hallójárat alakja

Műtét i l a p				
A műtét napja: 19 <u>91</u> év <u>X</u> hó <u>10</u> nap		A műtét tartalma: _____ óra _____ perc		
Műtő: <u>Bzd</u>	Műtét neve: <u>Gulyás Strömé</u>			
Segédlet: _____	Műtét neve: <u>Pérszomph. l. s. J. s.</u>			
Műszerelő: <u>Alabai</u>	Műtét neve: <u>St. II. d. p. II</u>			
Alttátás		Érzéstelenítés		
orvos	Zavartalan:	orvos		
Lefojtás	Szövődmények	Hely érzéstelenítés: cm <sup>3</sup> %	Kifogástalan 36 tűrhető rossz	
Végezte		Végezte		
aethylchlorid cm <sup>3</sup>		novocain-tonogen		
aether cm <sup>3</sup>		Vezetékes érzéstelenítés: cm <sup>3</sup> %		
gramm intravénásan		novocain tonogen; helye:		
Gyógyszerek				
A műtét előtt:		A műtét alatt:		
Részletes műtési javaslat:				
A műtét leírása: (Eltávolított szervek)				
				

Műtét i l a p				
A műtét napja: 19 _____ év _____ hó _____ nap		A műtét tartalma: _____ óra _____ perc		
Műtő: <u>91 VII 01</u>	Műtét neve: _____			
Segédlet: <u>Pytil</u>	Műtét neve: _____			
Műszerelő: <u>Alabai</u>	Műtét neve: <u>T. s. p. p. p.</u>			
Alttátás		Érzéstelenítés		
orvos	Zavartalan:	orvos		
Lefojtás	Szövődmények	Hely érzéstelenítés: cm <sup>3</sup> %	Kifogástalan 36 tűrhető rossz	
Végezte		Végezte		
aethylchlorid cm <sup>3</sup>		novocain-tonogen		
aether cm <sup>3</sup>		Vezetékes érzéstelenítés: cm <sup>3</sup> %		
gramm intravénásan		novocain tonogen; helye:		
Gyógyszerek				
A műtét előtt:		A műtét alatt:		
Részletes műtési javaslat: <u>PAD</u>				
A műtét leírása: (Eltávolított szervek)				
				

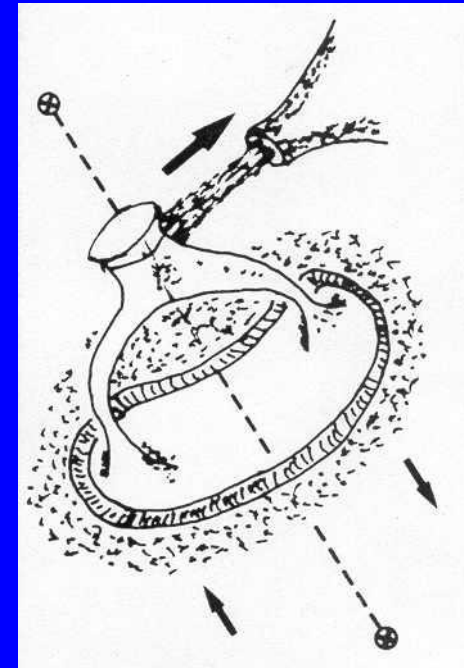
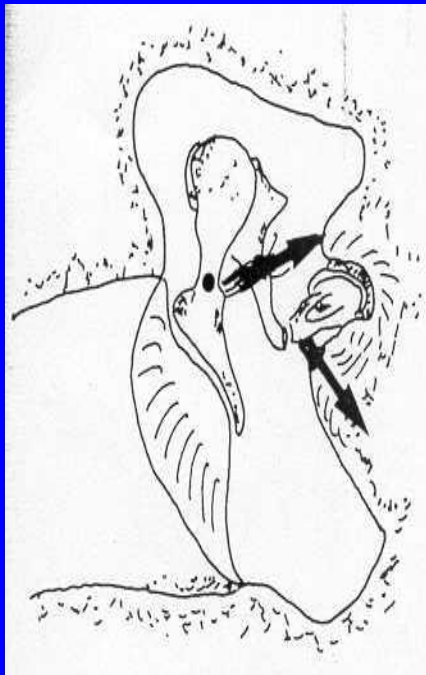
Védőhatás:

**Középfül izomreflexek**

Stapedius ín meghagyása

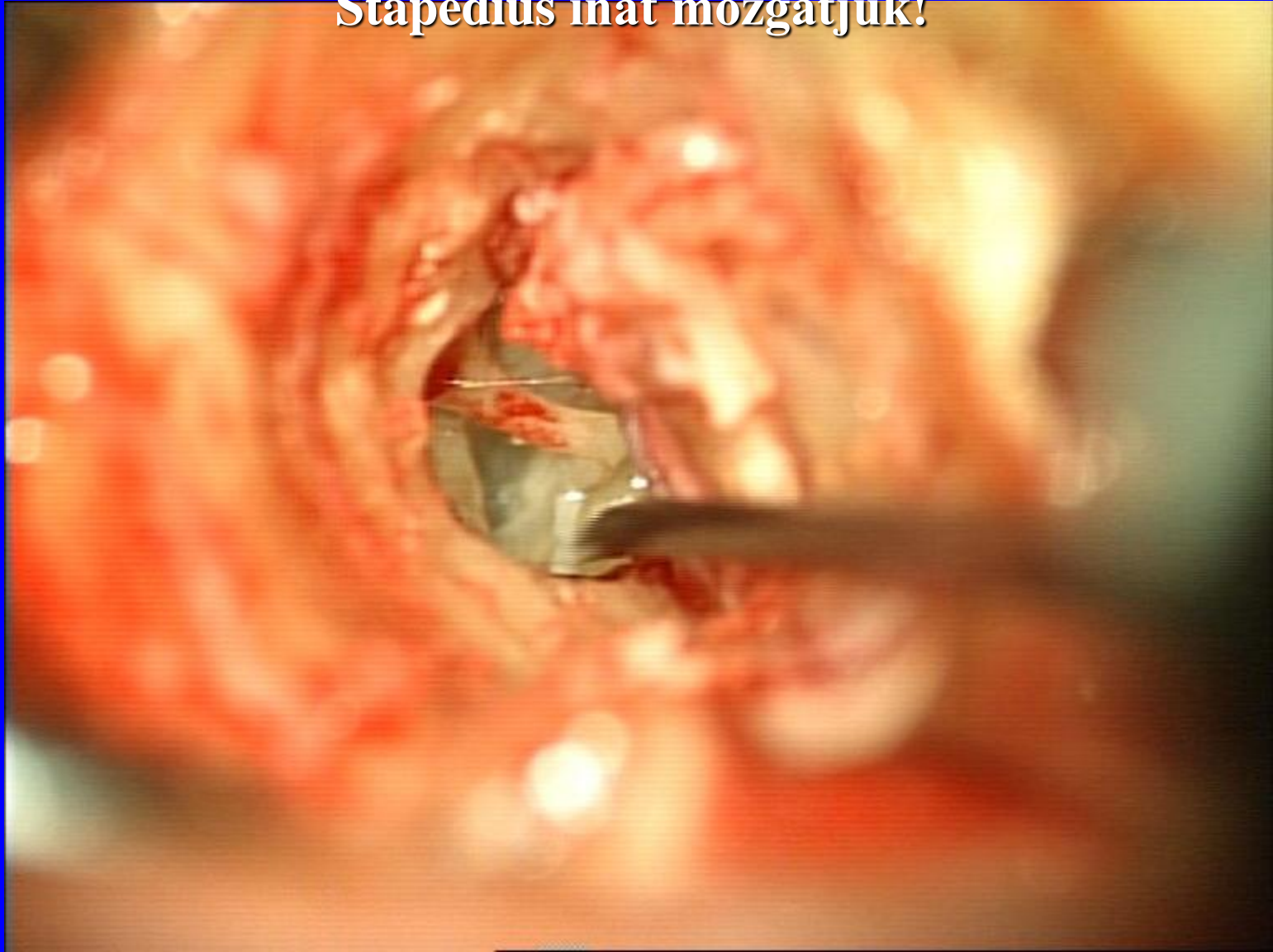
vagy

helyreállítása

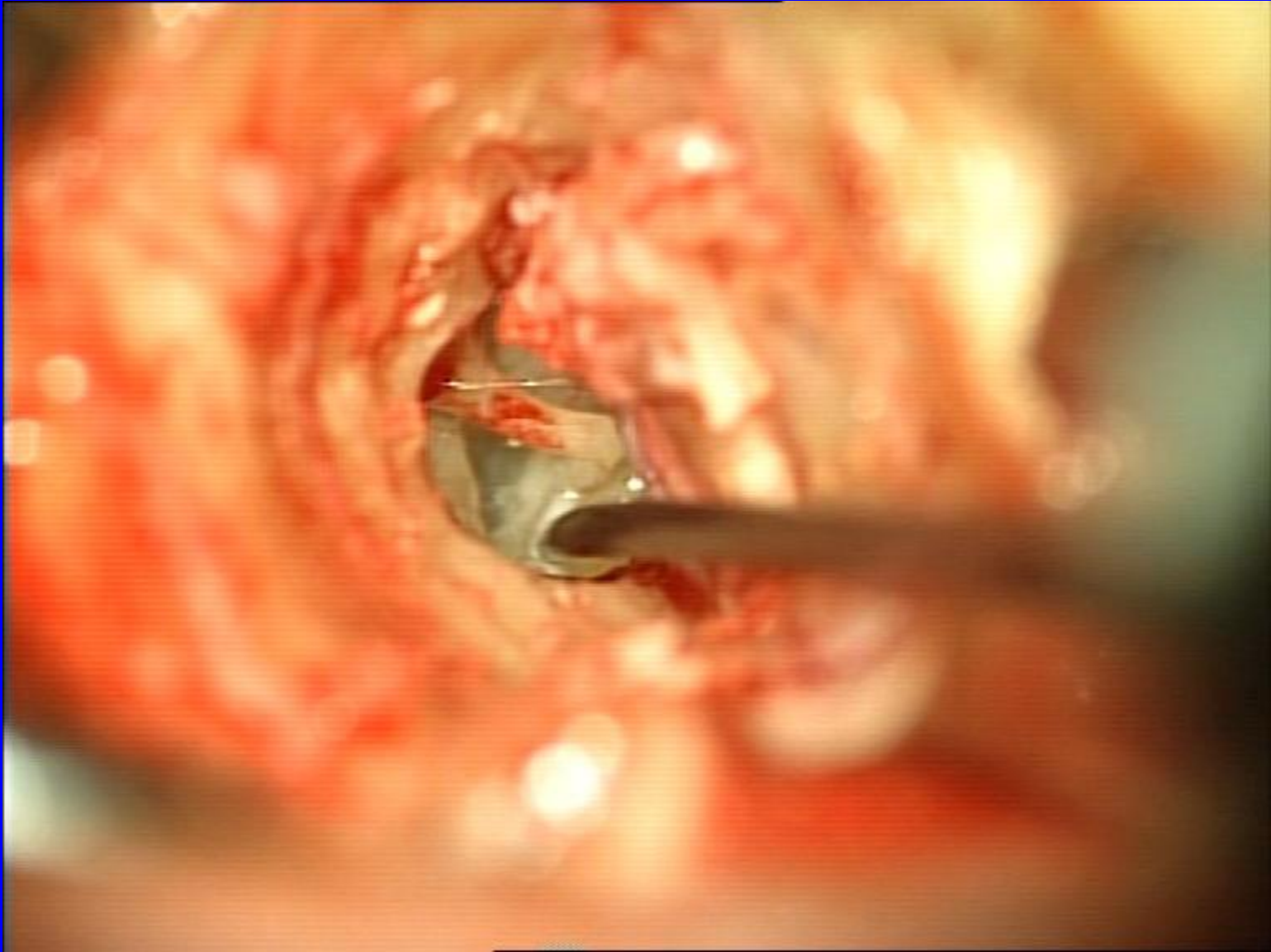




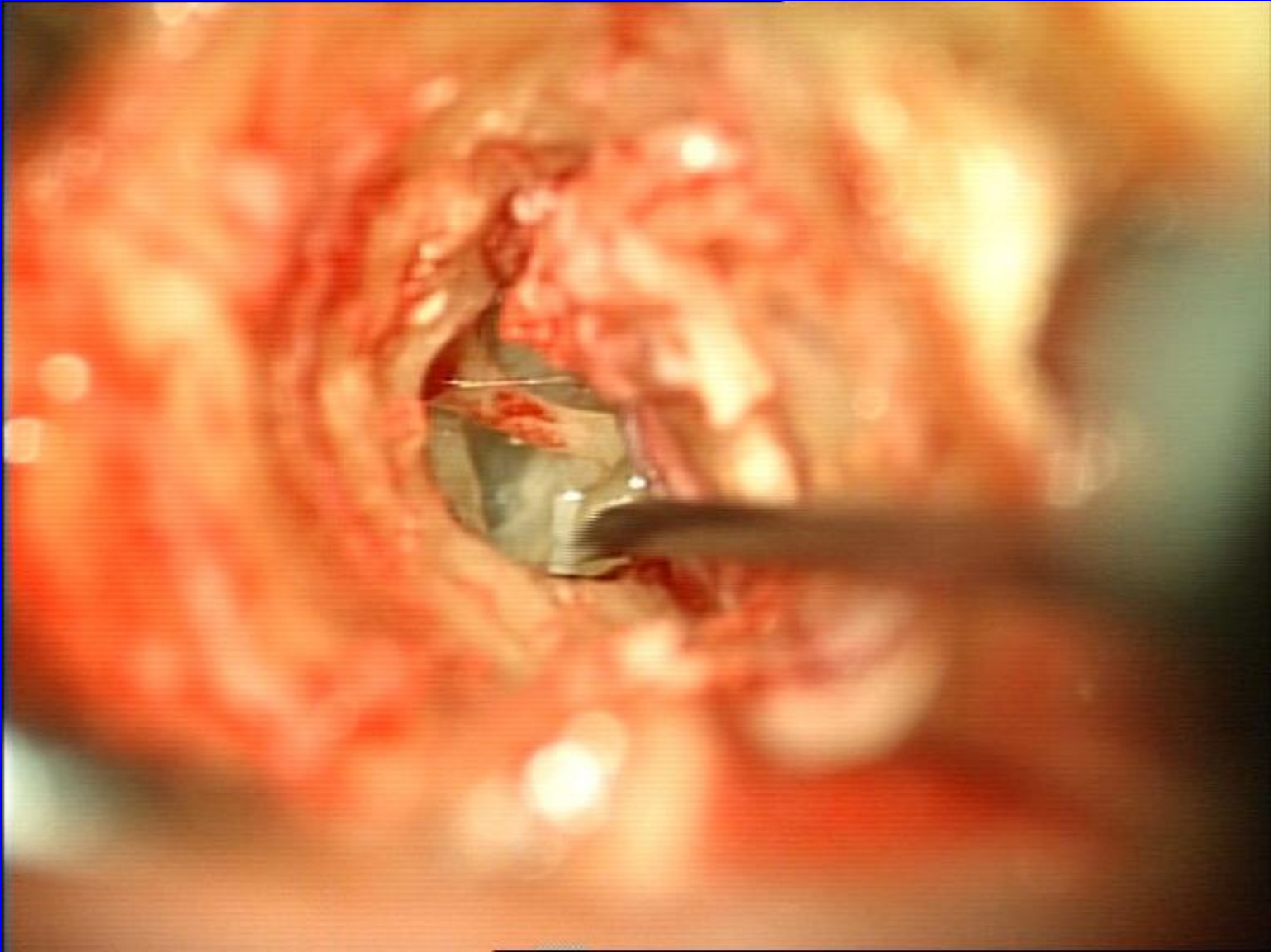
**2.10. Stapes merevség vizsgálata (Bauer)  
Stapedius inát mozgatjuk!**



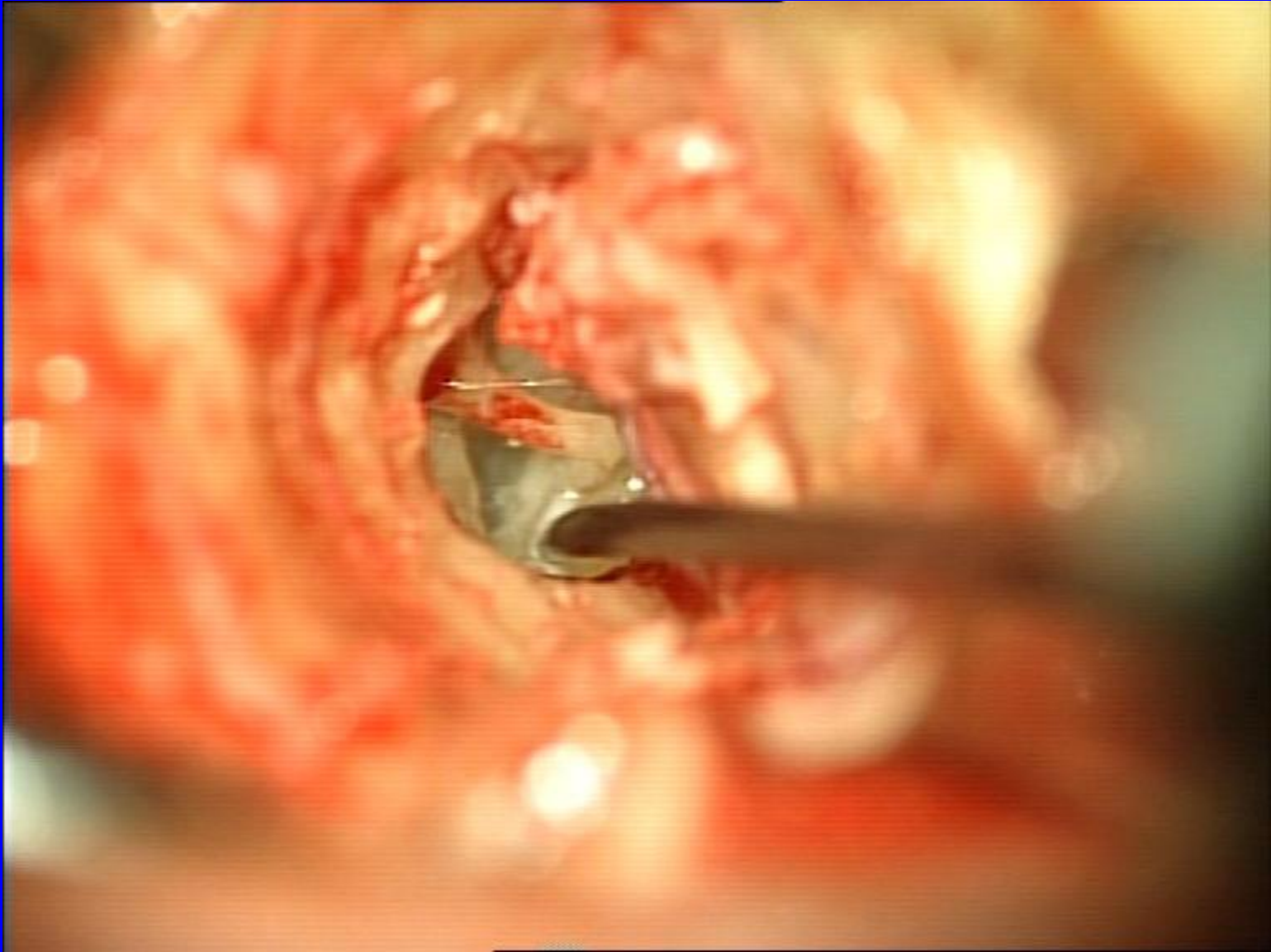
## 2.10. Stapes merevség vizsgálata (Bauer)



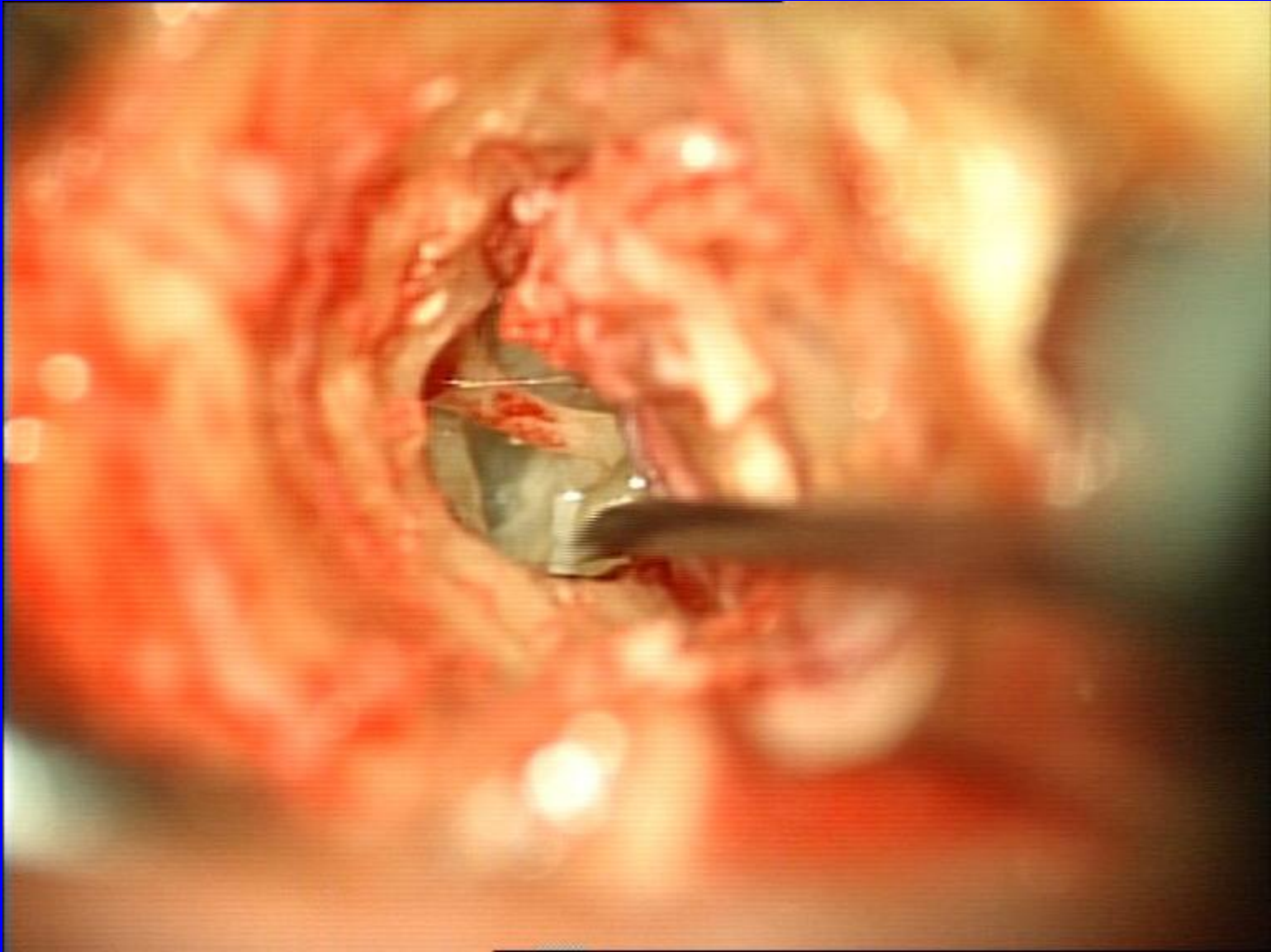
## 2.10. Stapes merevség vizsgálata (Bauer)



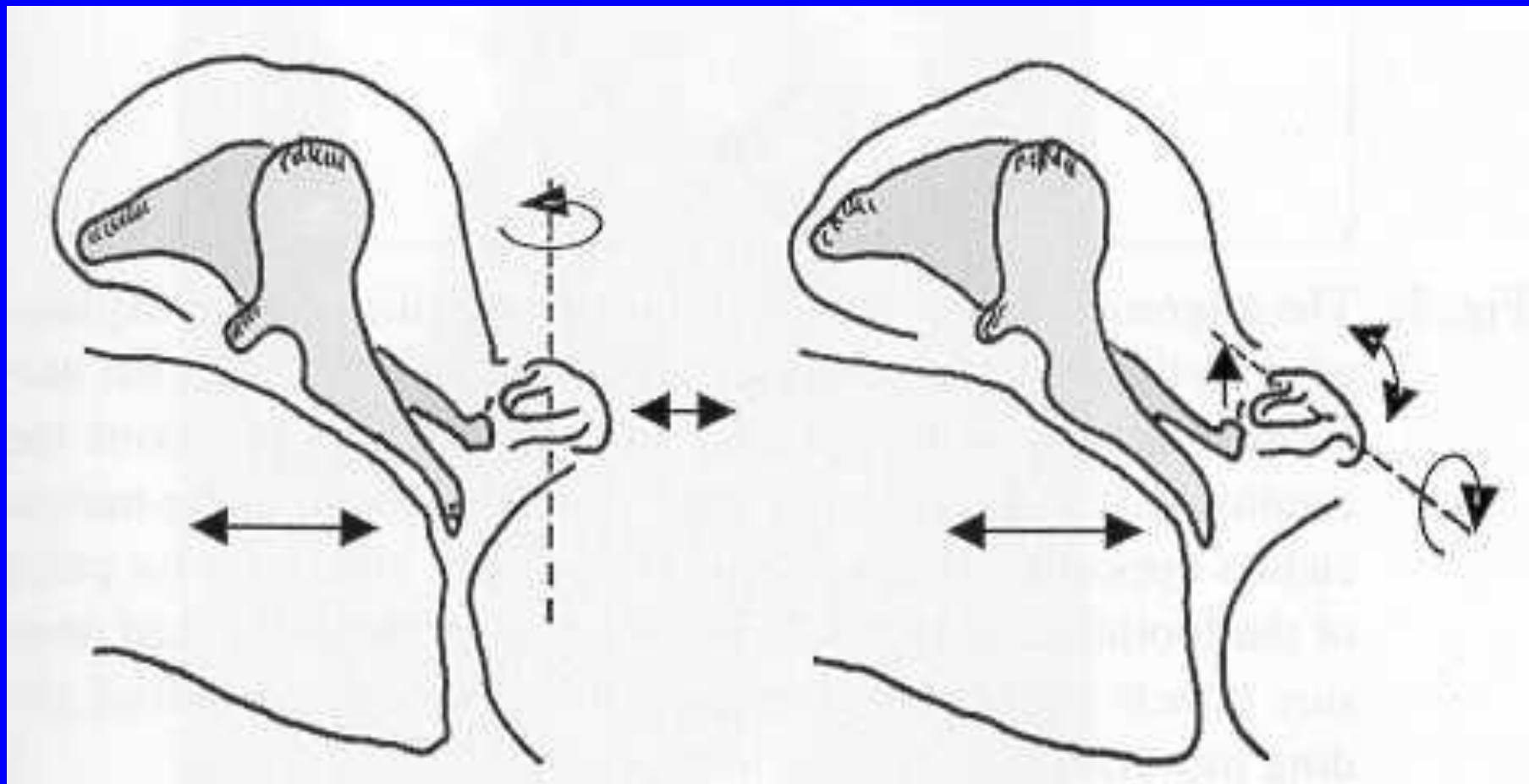
## 2.10. Stapes merevség vizsgálata (Bauer)



## 2.10. Stapes merevség vizsgálata (Bauer)



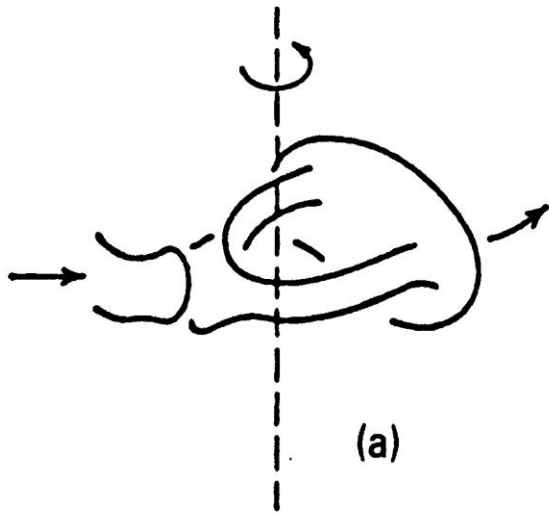
# Védőhatás: Kalapács/üllő puffer:



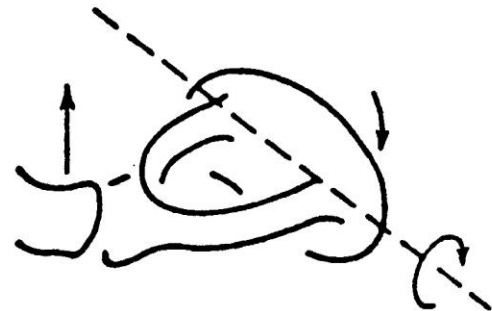
# Védőhatás:

## Incudo-stapedialis ízület

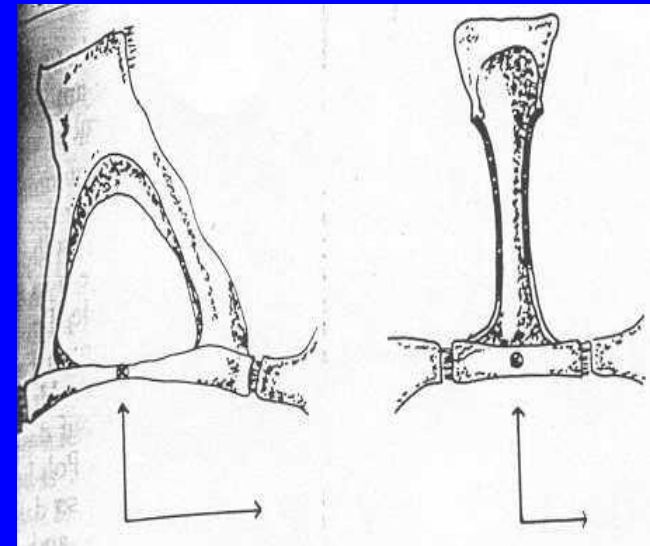
### Stapes mozgástengelye



(a)

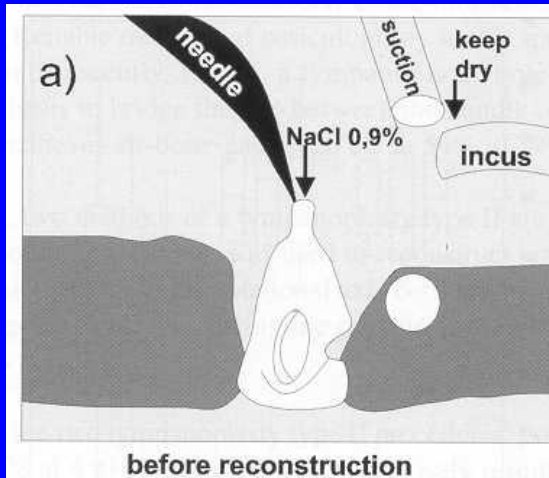


(b)

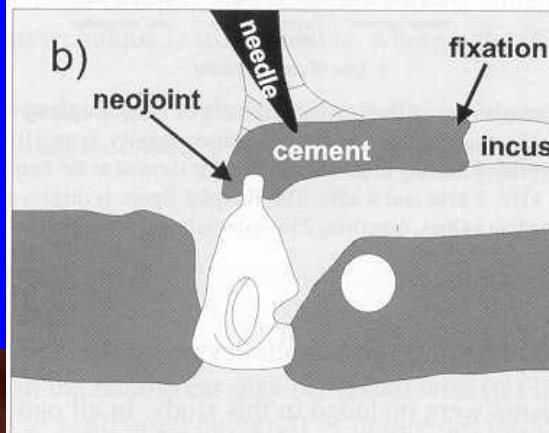


# Hallócsontlánc újraépítése ionomer cementtel

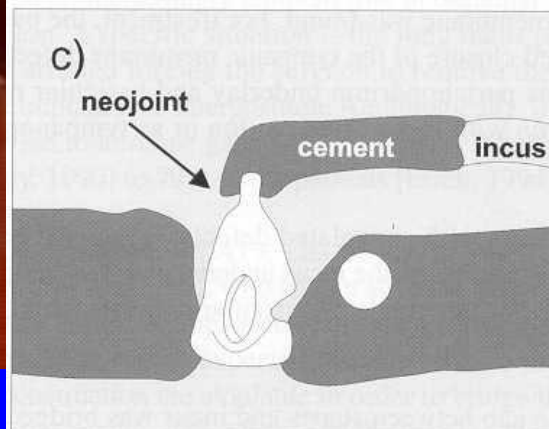
## LASER!



before reconstruction

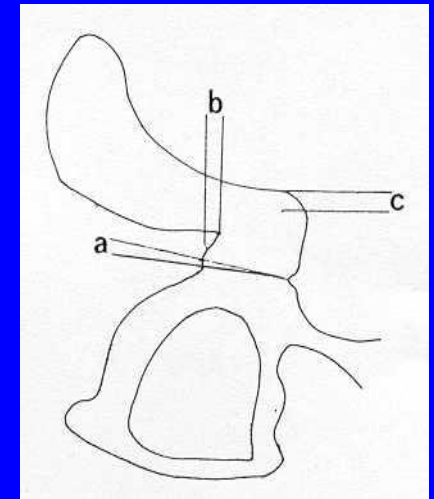
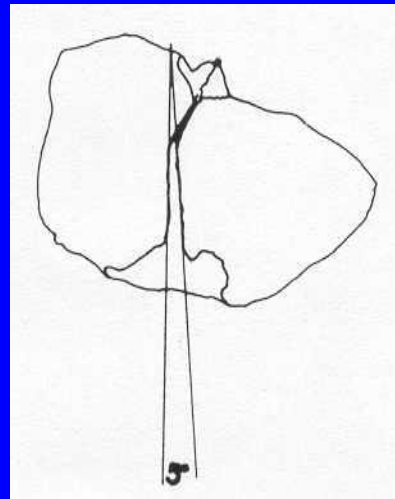
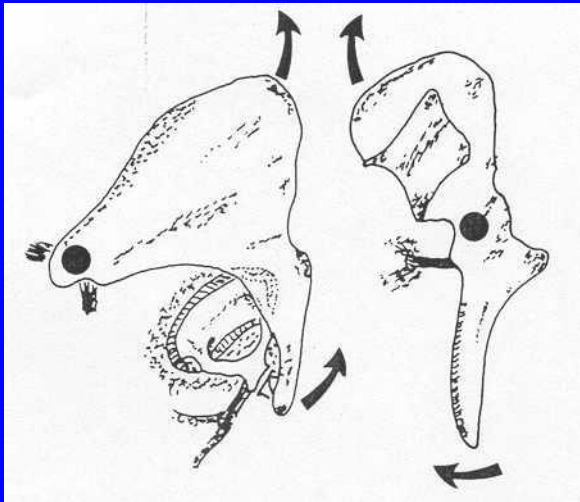


application of ionomeric cement





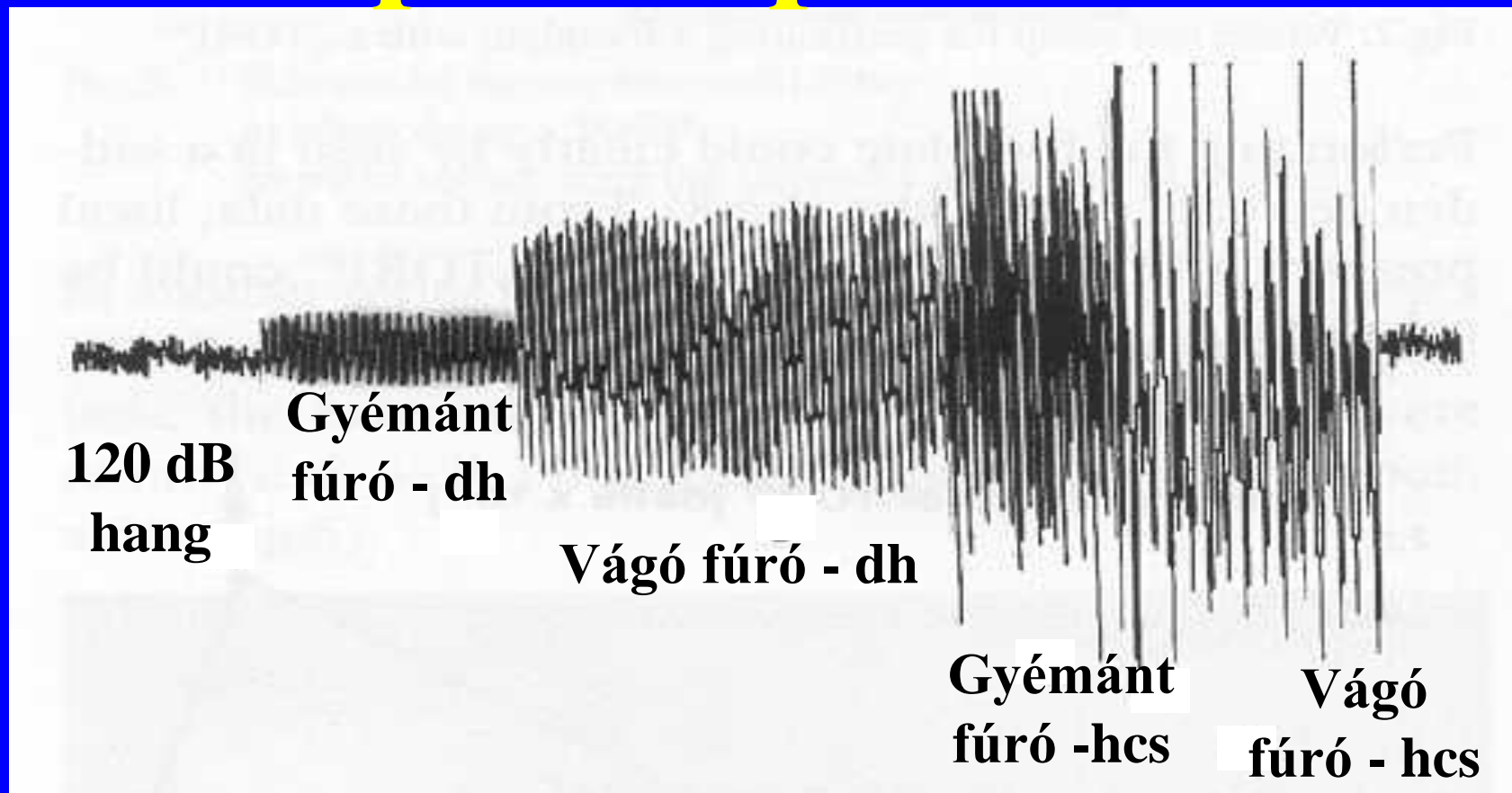
# Védő-(puffer)-hatás: Incudo-malleolaris ízület Incudo-stapedialis ízület



**Mechanikus high-pass filter**

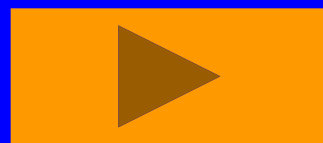
# Vibráció

## a stapes talpon mérve



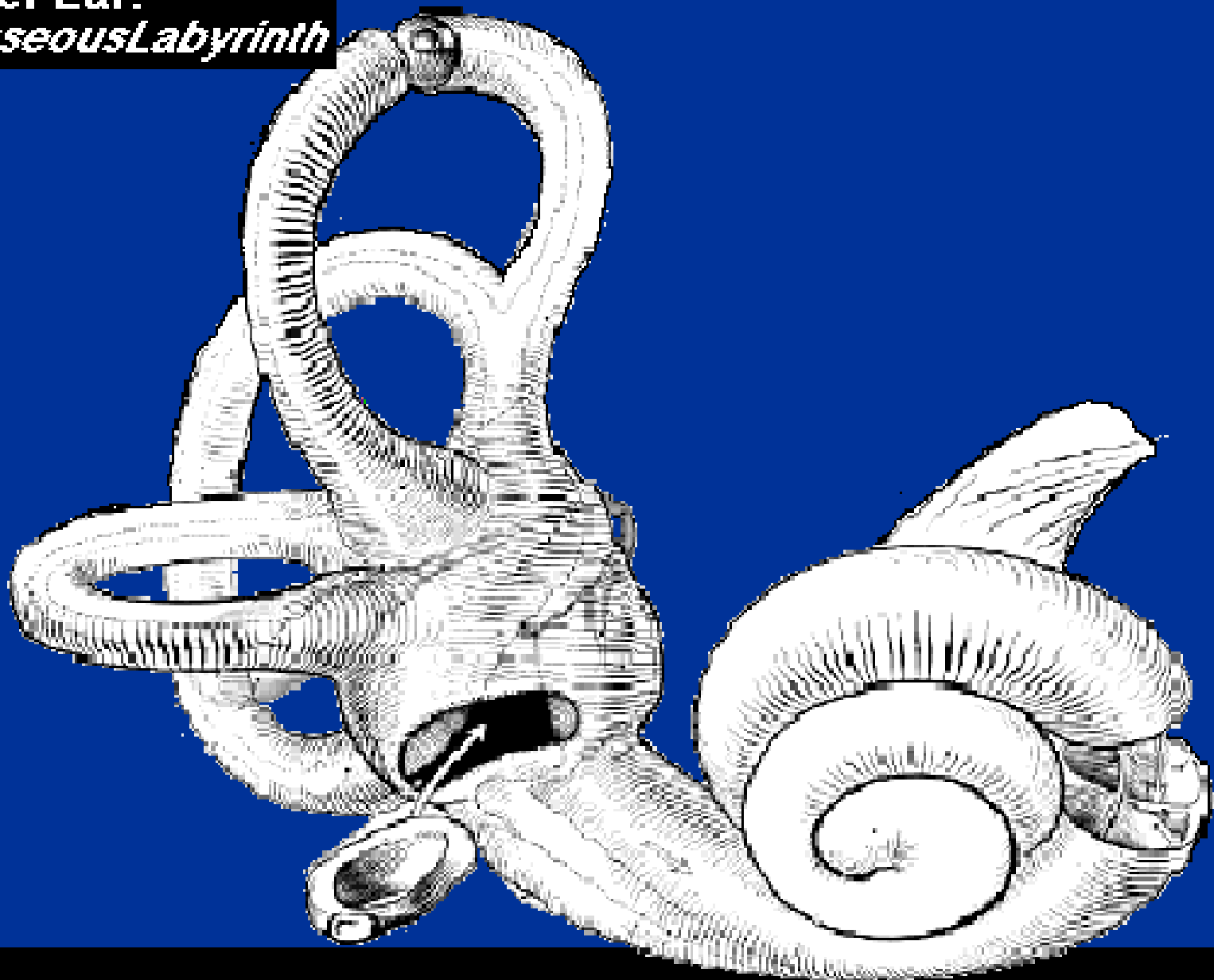
Take a tour through the ear to see how each part functions.

Click on the bell to the left of the ear.



# Belsőfül

**Inner Ear:**  
*Osseous Labyrinth*

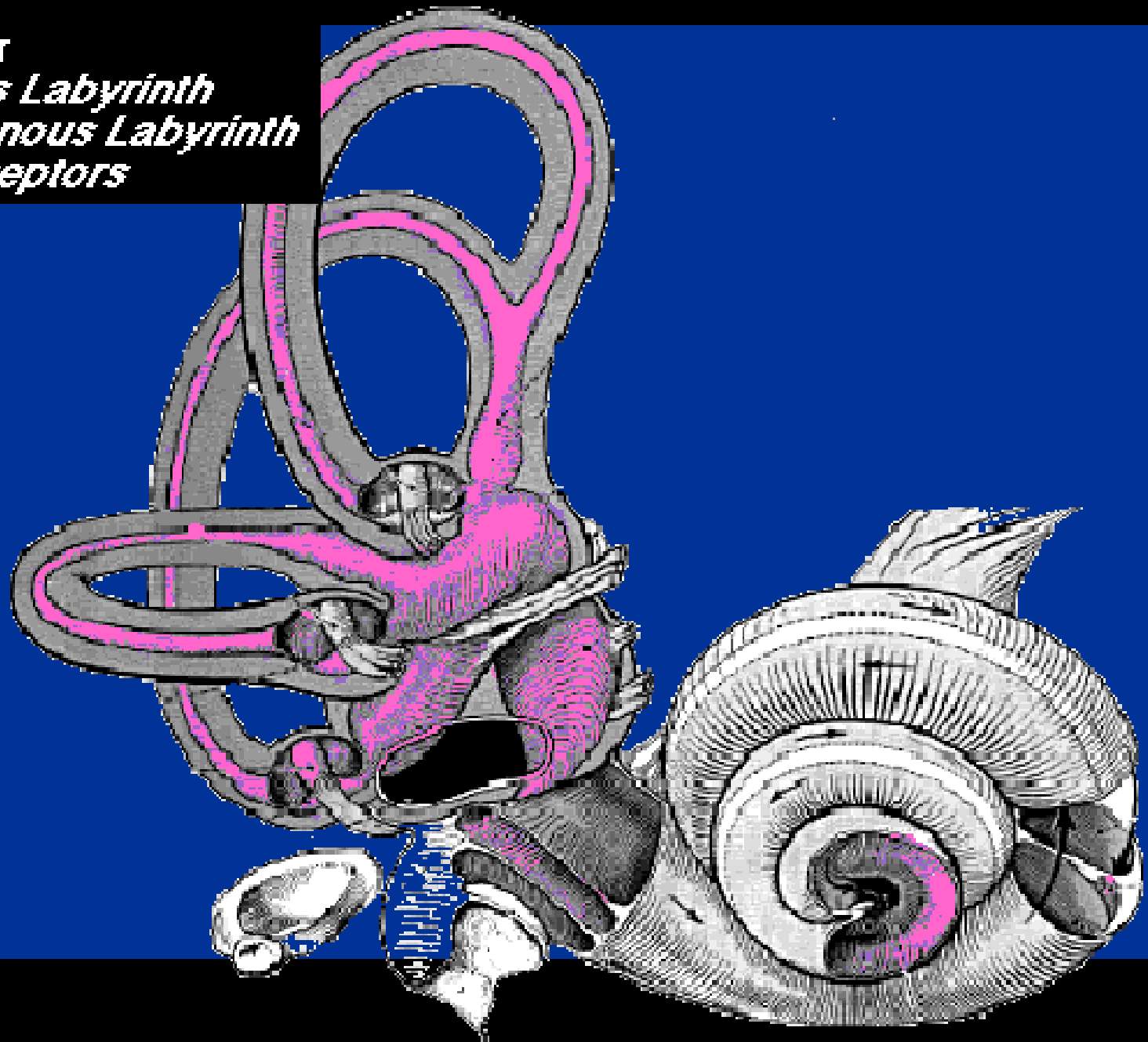




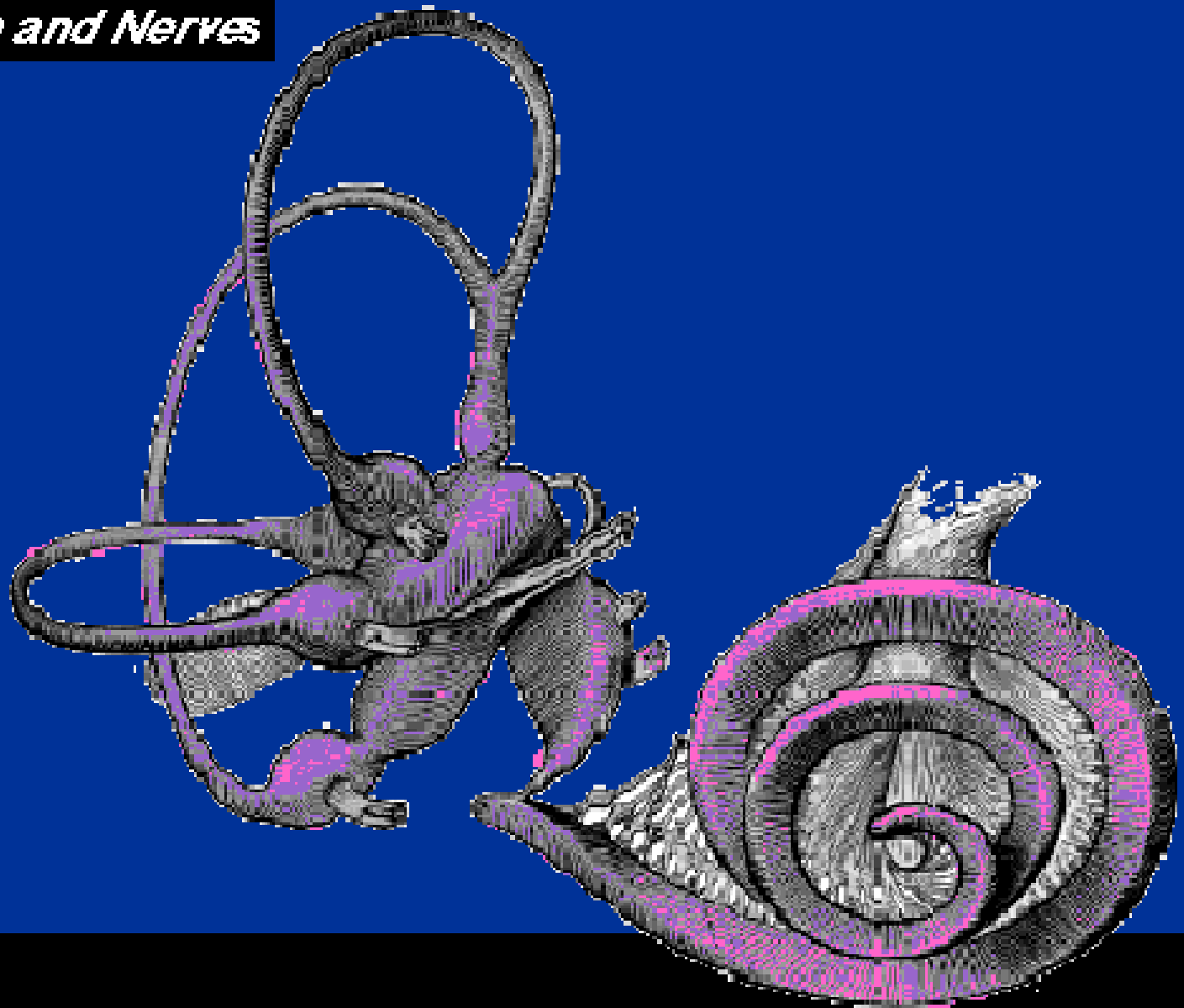


# Inner Ear

*Osseous Labyrinth  
Membranous Labyrinth  
and Receptors*

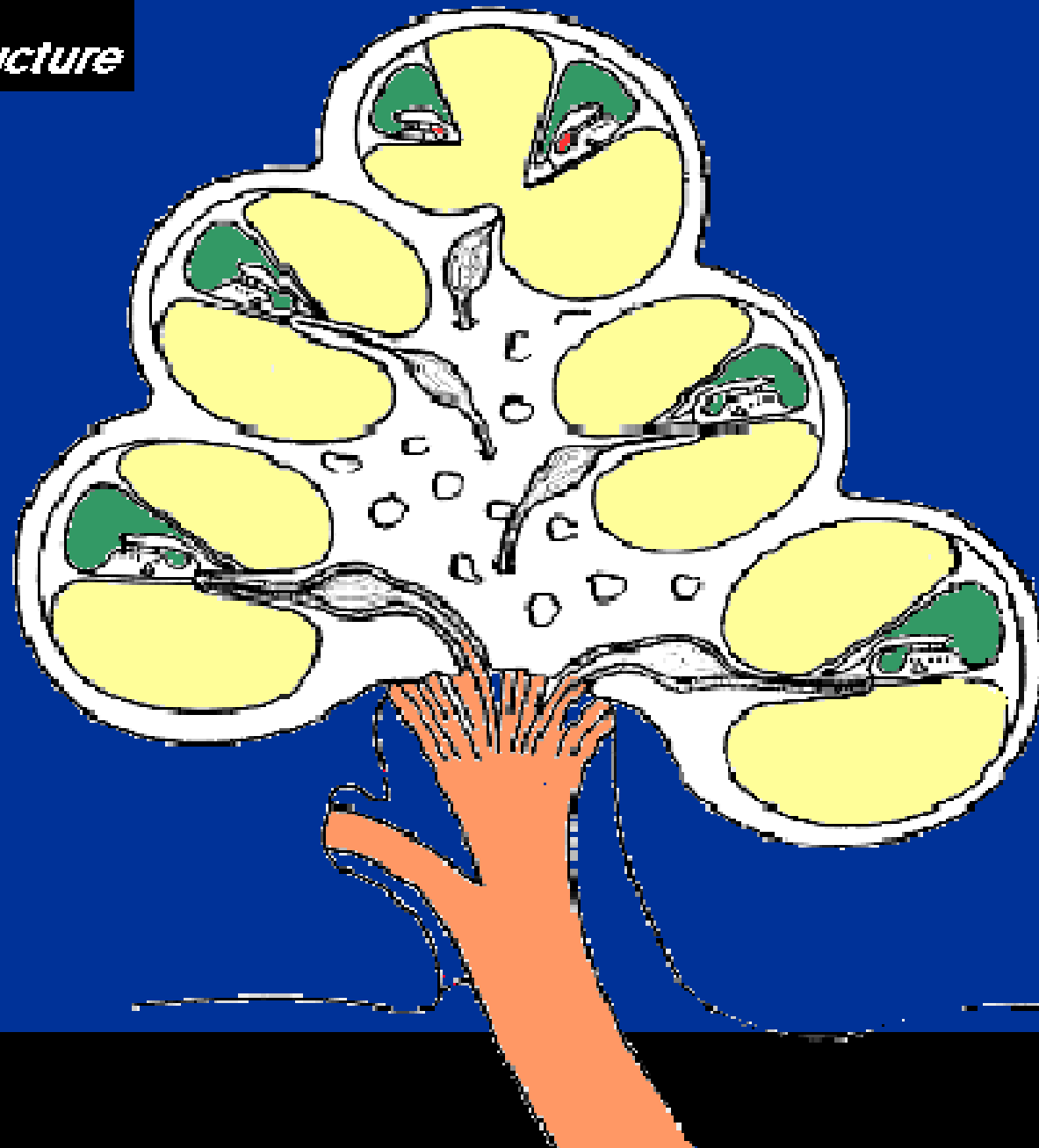


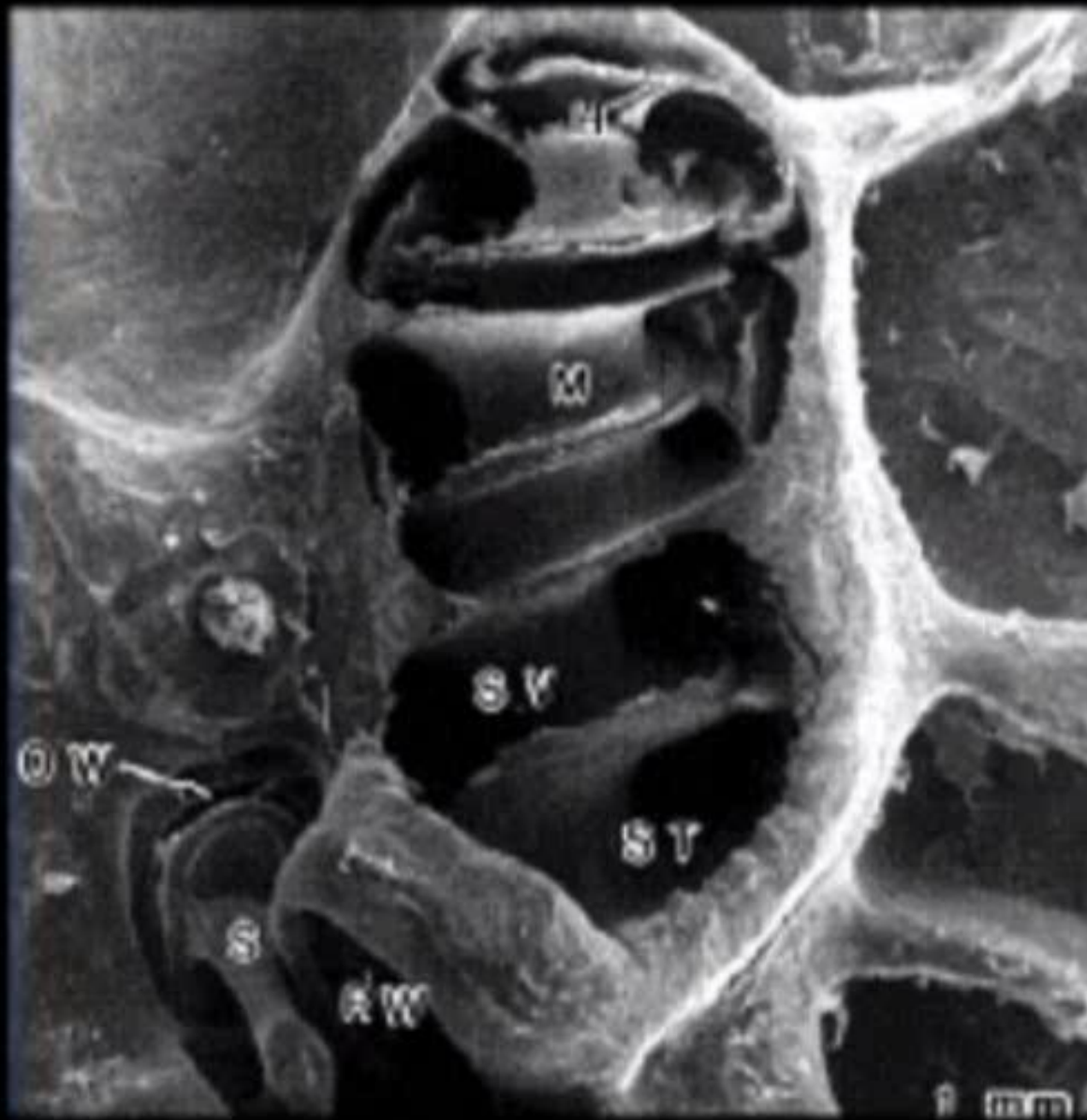
**Inner Ear**  
*Membranous  
Labyrinth and Nerves*



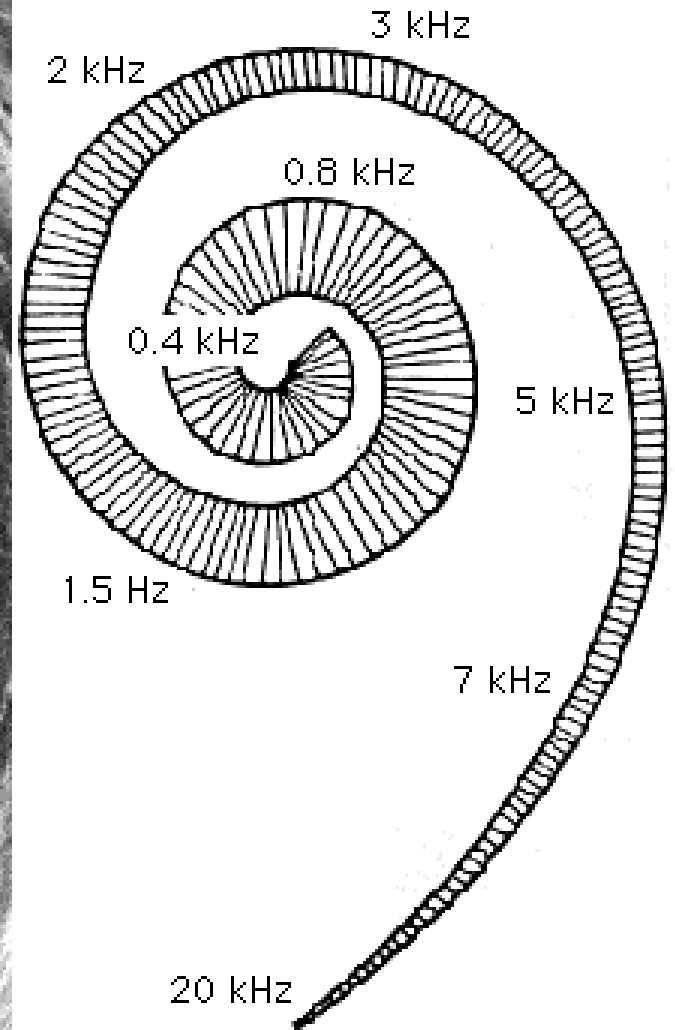
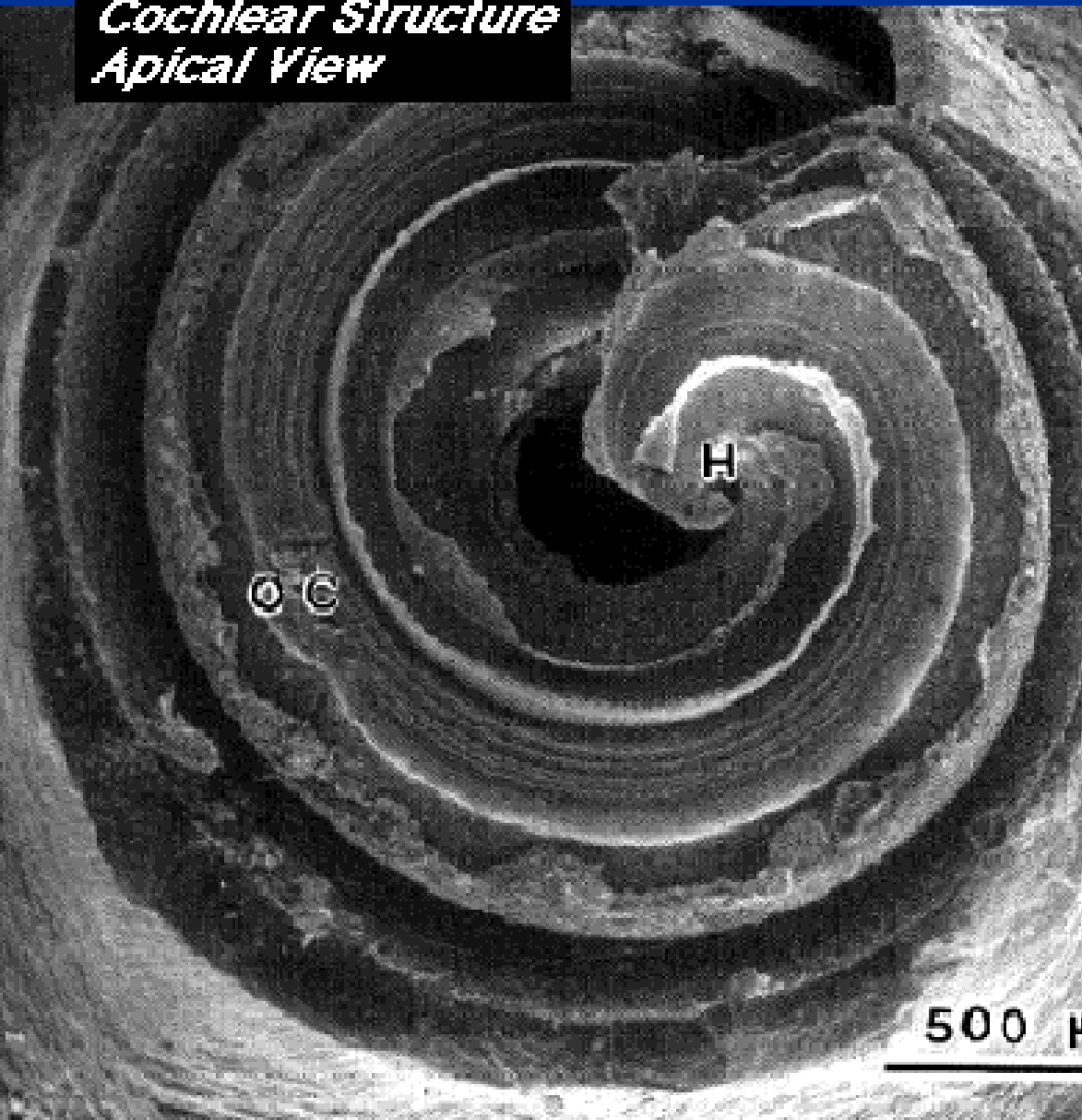


**Inner Ear**  
*Cochlear Structure*





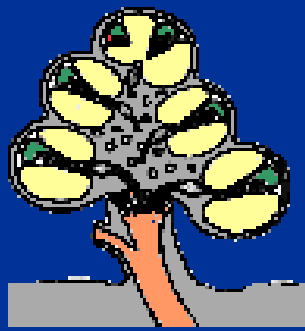
**Inner Ear**  
*Cochlear Structure*  
*Apical View*



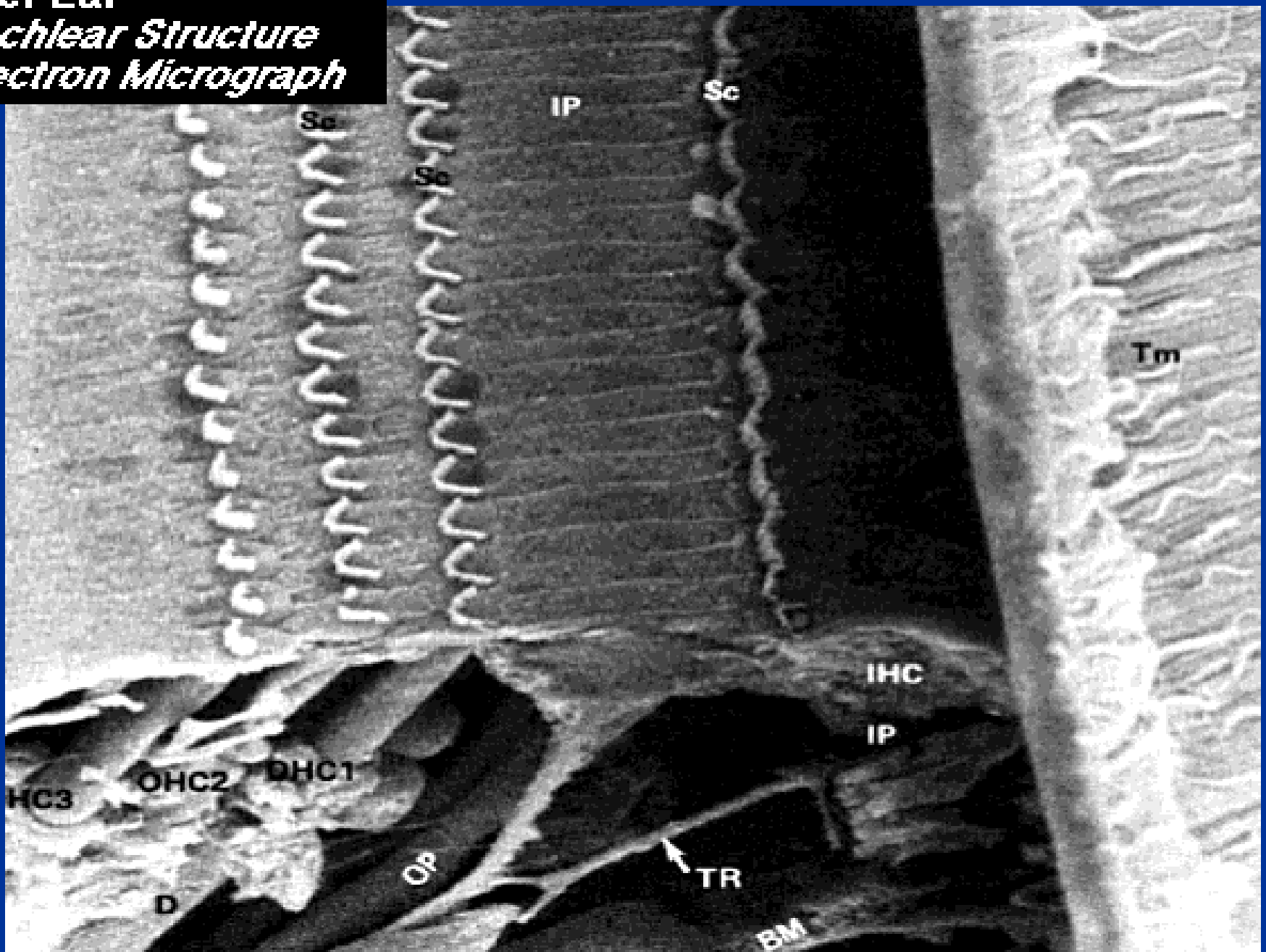
# Inner Ear

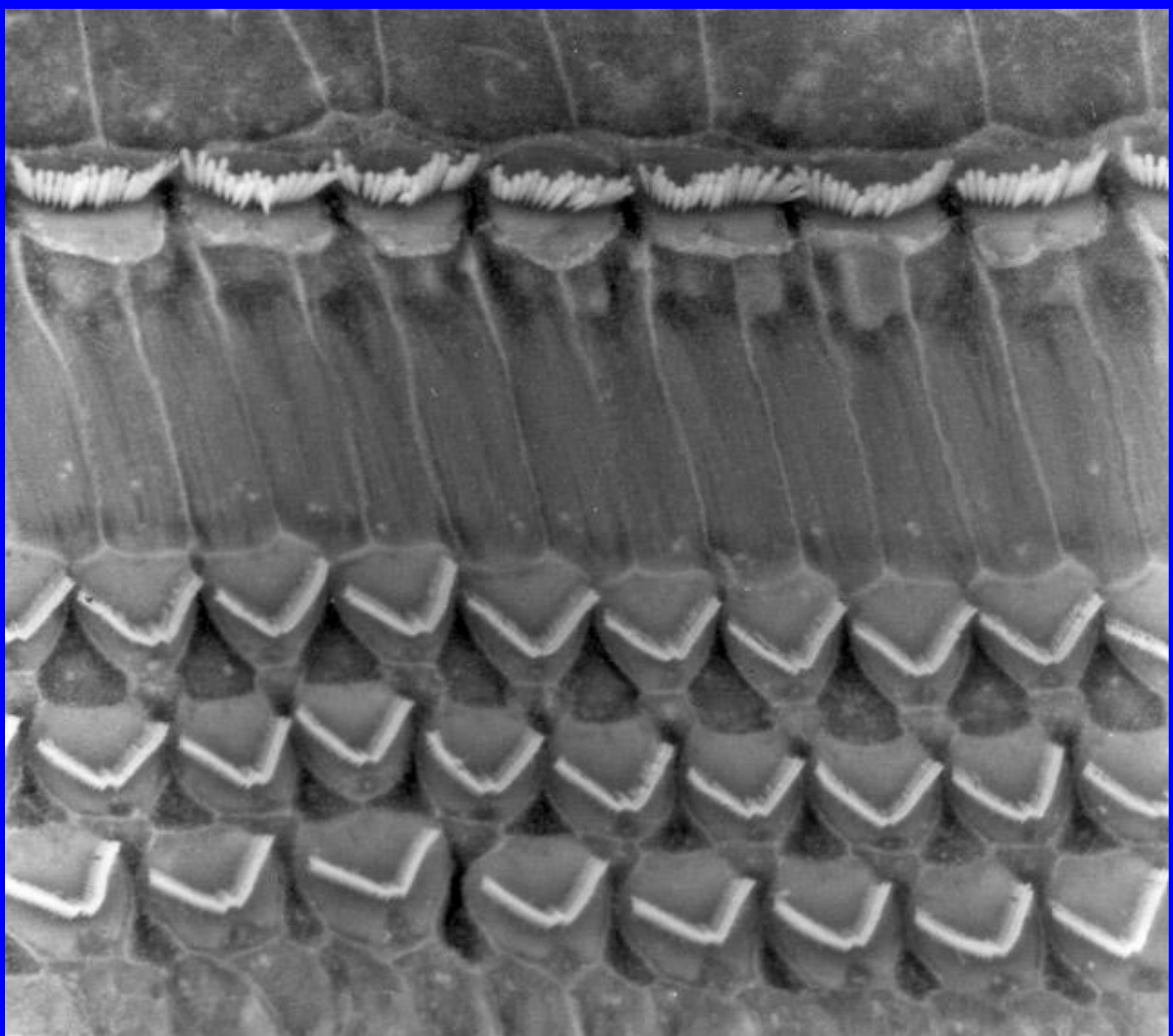
## *Cochlear Structure*

### *Single Cochlear Turn*

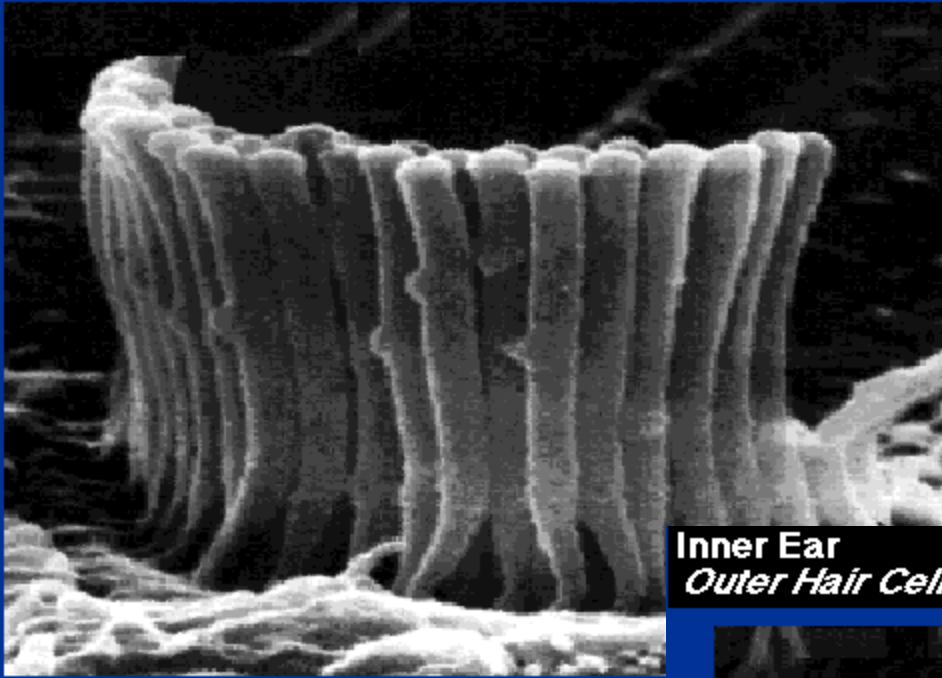


**Inner Ear**  
*Cochlear Structure*  
*Electron Micrograph*

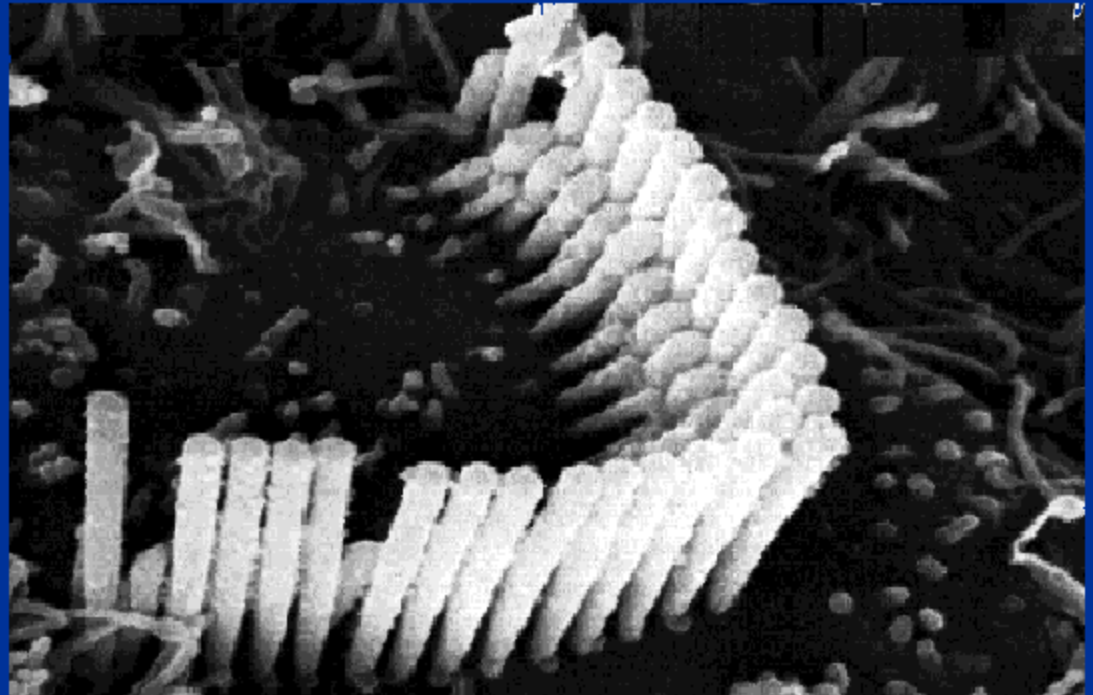




**Inner Ear**  
*Inner Hair Cell Stereocilia*



**Inner Ear**  
*Outer Hair Cell Stereocilia*

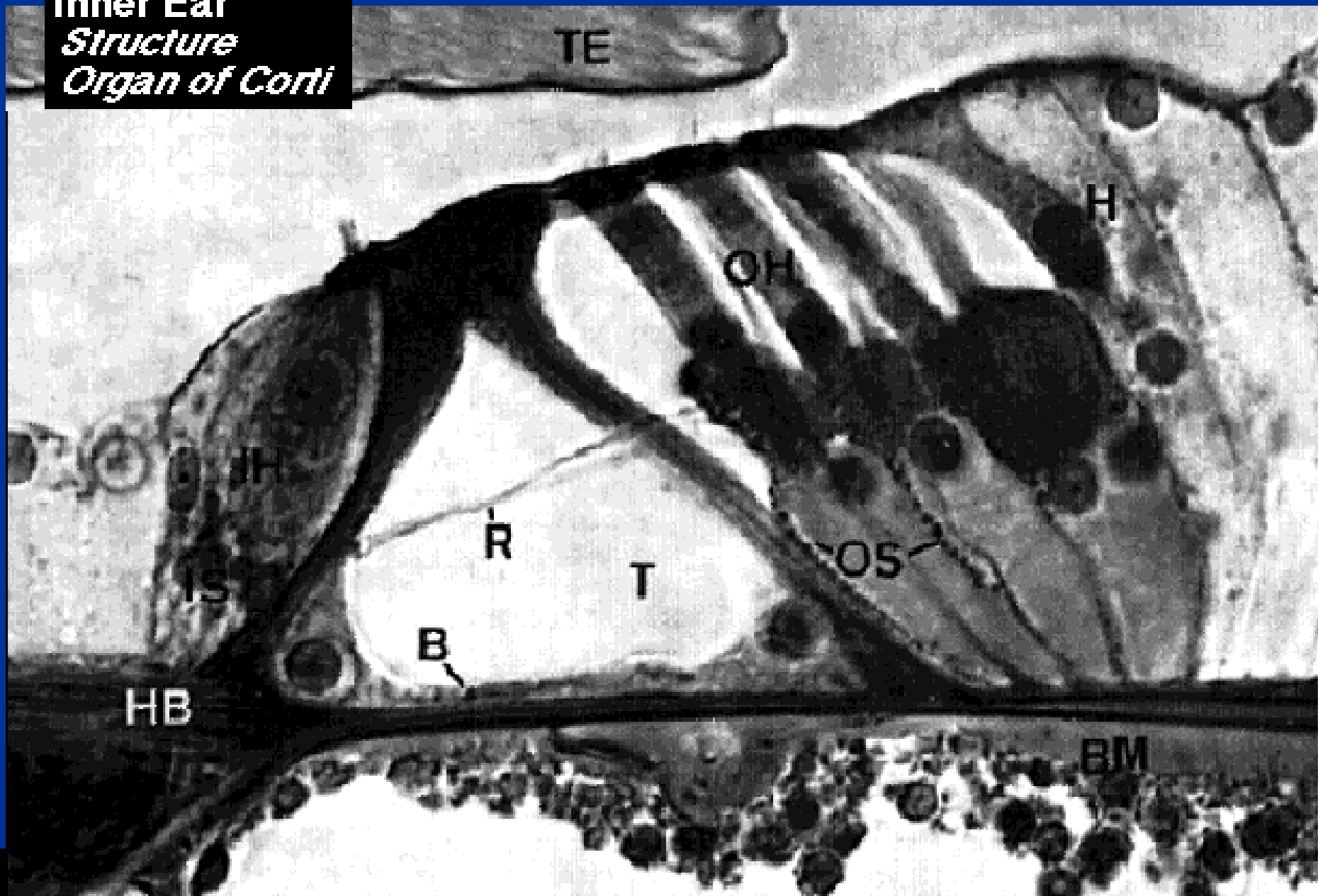


**Inner Ear**  
*Structure*  
*Organ of Corti*

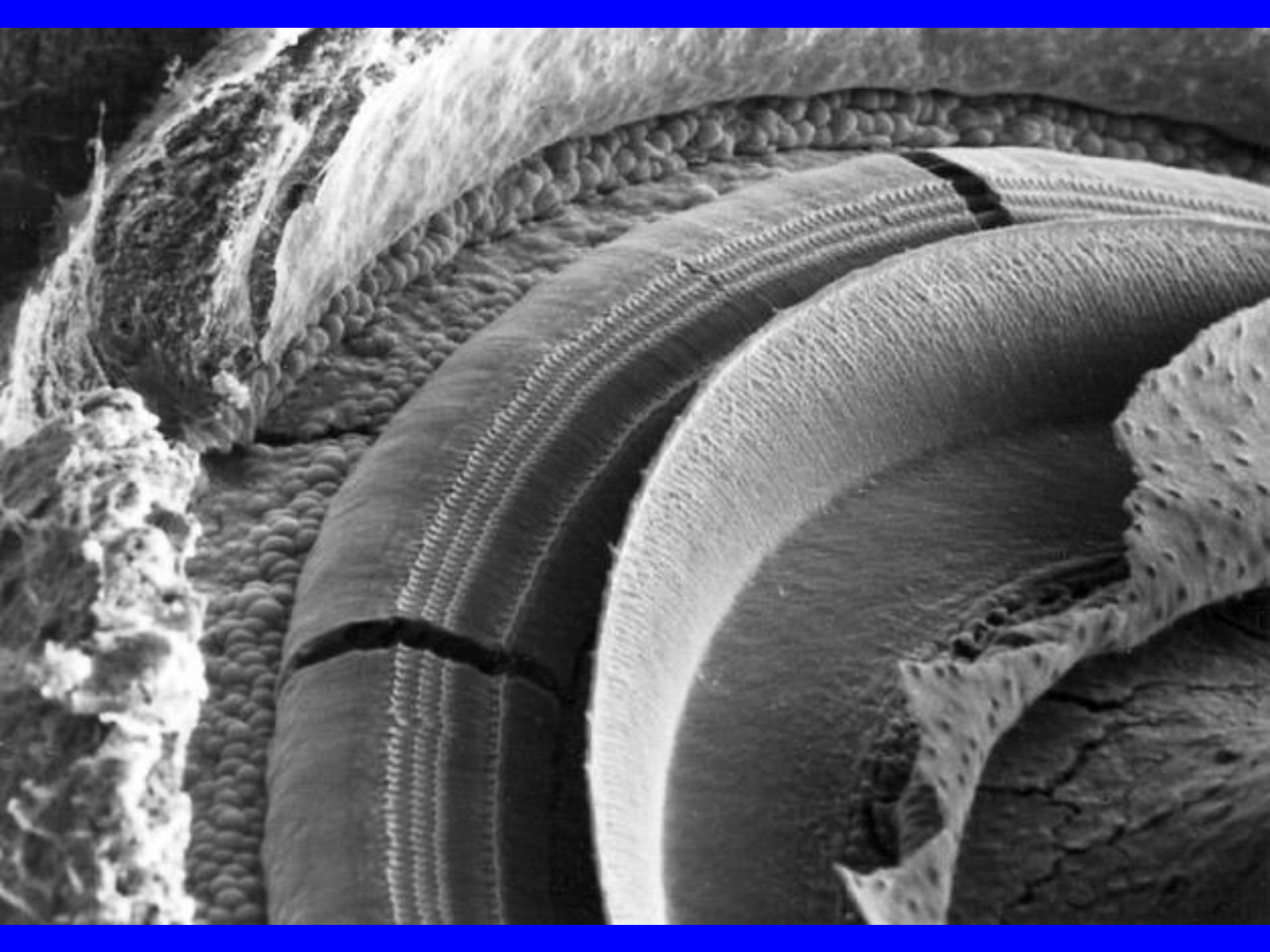


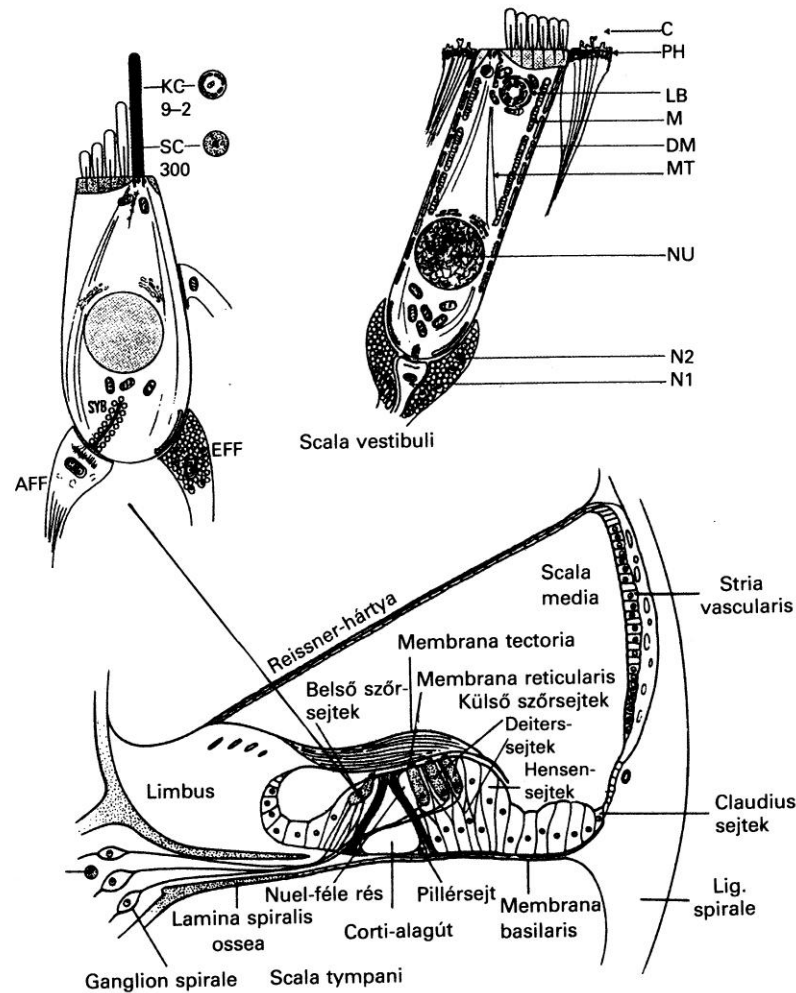


**Inner Ear**  
*Structure*  
*Organ of Corti*









3.3. ábra. A ductus cochlearis keresztmetszete, szerkezete, valamint a szőrsejtek kinagyítva.

Bal oldalt felül: szenzoros szőrsejtek (Engström alapján)

KC = Kinocilium (felnőtt cochleában rendszerint már csökevényes)

SC = Stereociliumok

SYB = szinaptikus oszlopok (Synaptic bars, cochleában kisebbek)

Jobb oldalon: külső szőrsejtek (Engström):

C = stereociliumok

DM = corticalis membran rendszer

PH = támasztósejtek nyúlványai

NU = sejtmag

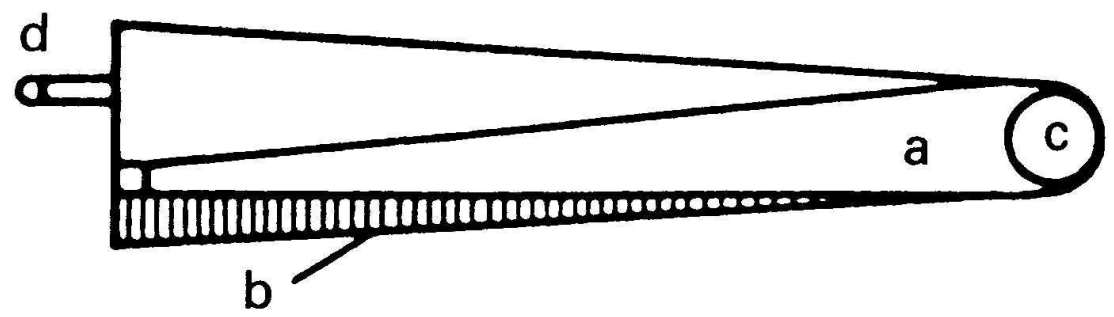
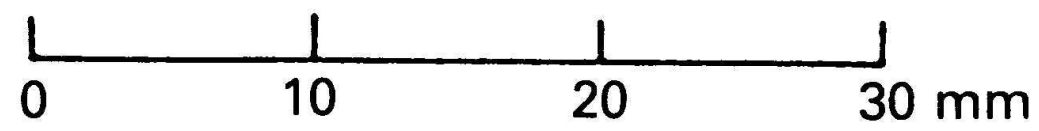
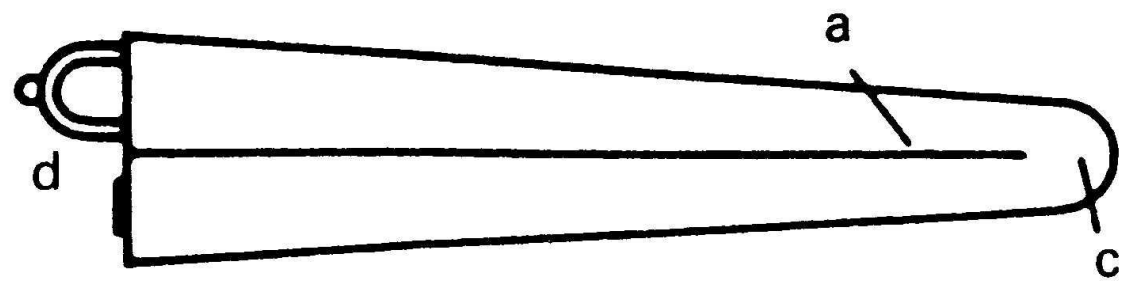
LB = lemezes testek (laminated body)

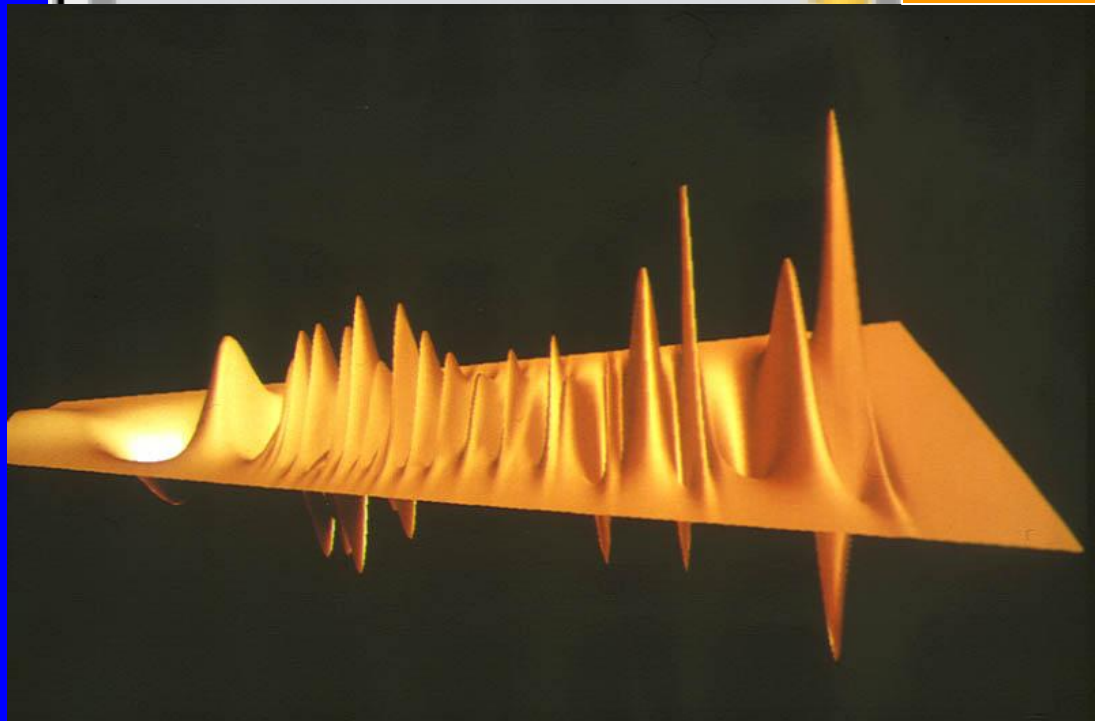
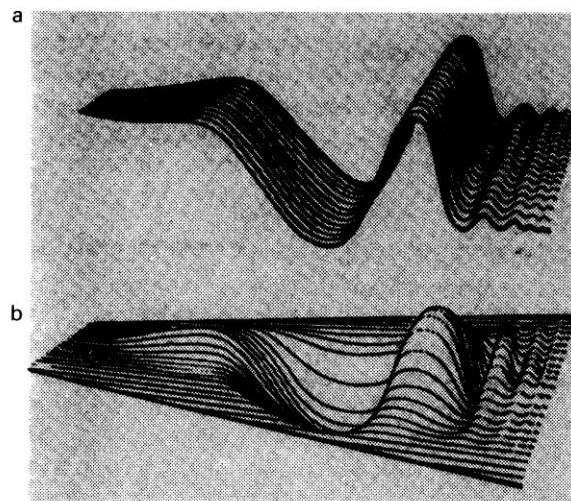
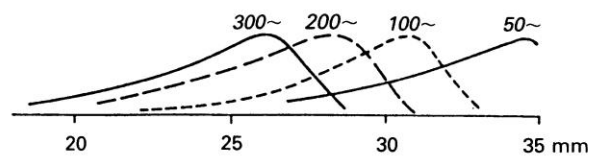
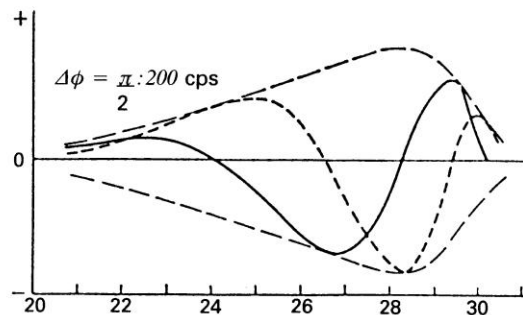
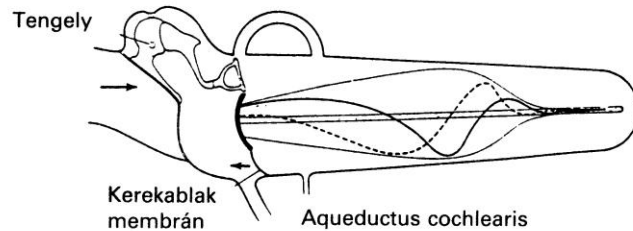
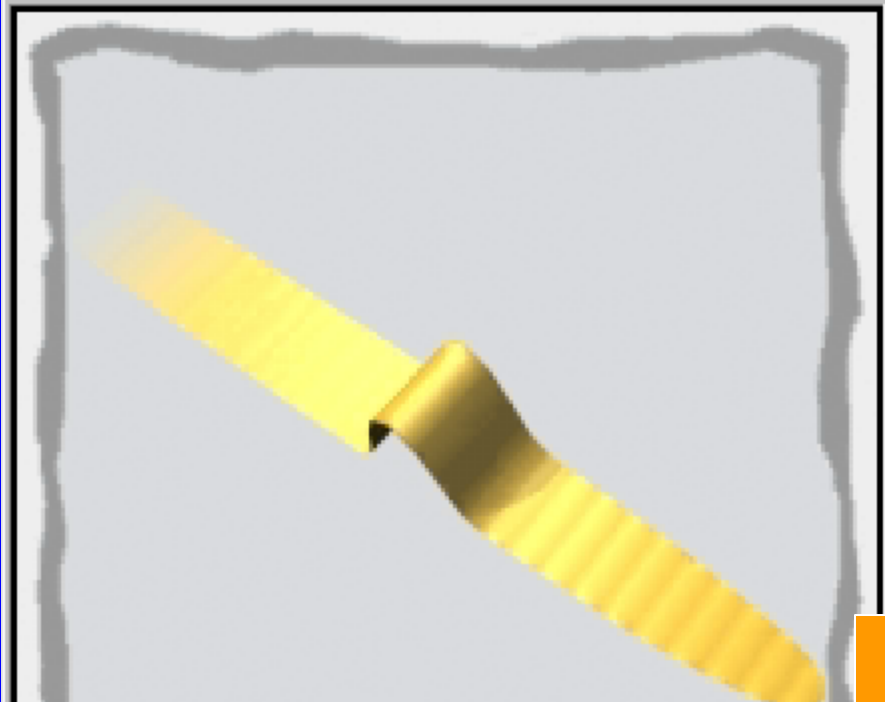
N1 = afferens idegvégződés

M = mitochondrium

N2 = efferens idegvégződés

20  
16  
8  
4  
2  
1  
0,8  
0,4  
0,2  
0,1  
0,02 kHz

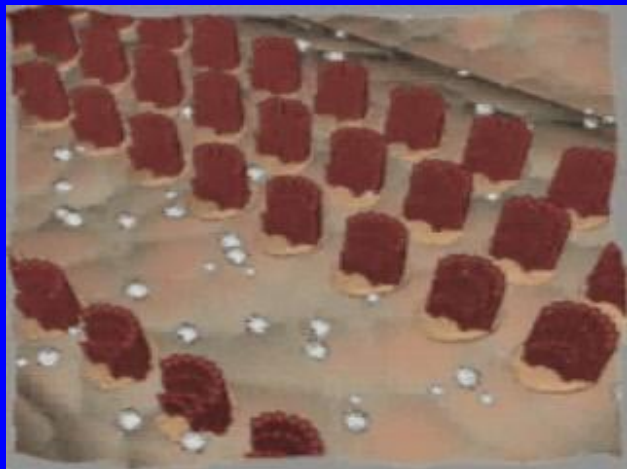
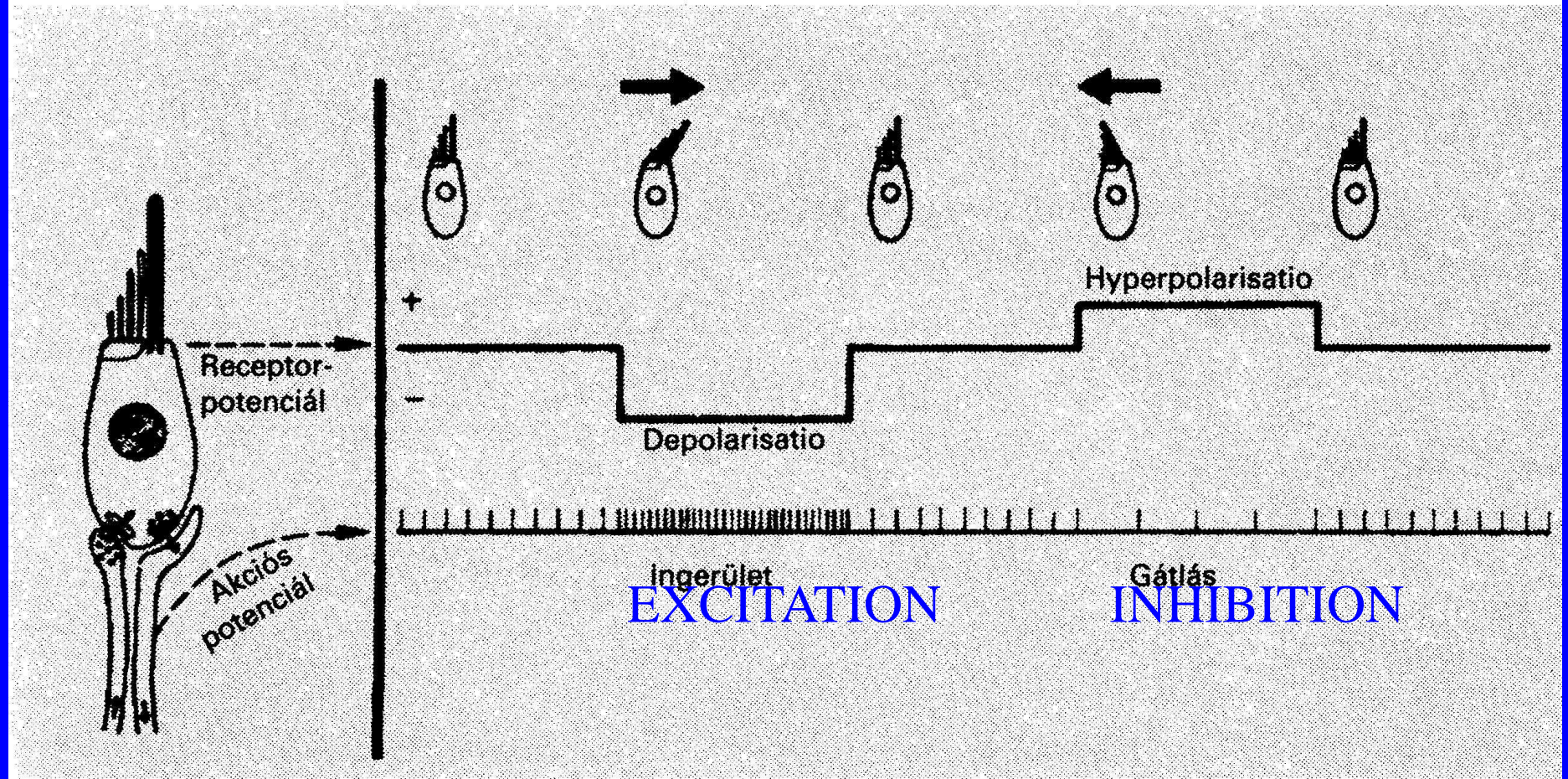




T18.mov

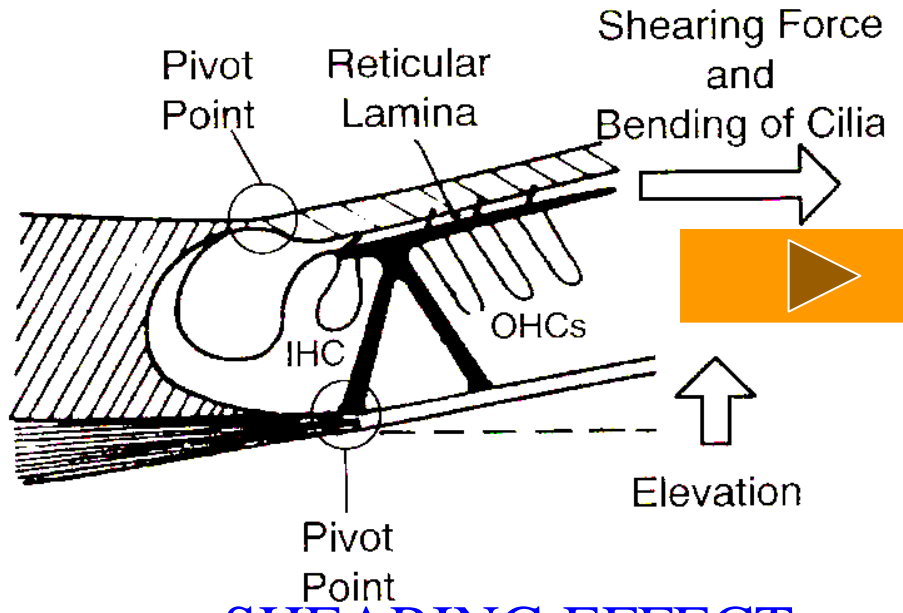
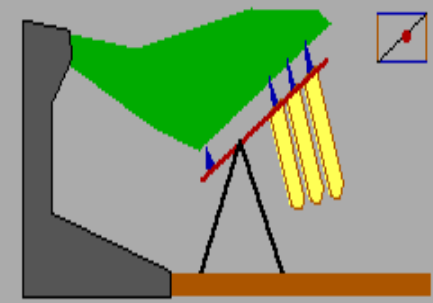
**Frekvenciakódolás:** Mely frekvenciára hangolt szőrsejt(ek) jön(nek) ingerületbe

**Hangerő kódolás:** hány szomszédos szőrsejt jön ingerületbe, minél több, annál hangosabb

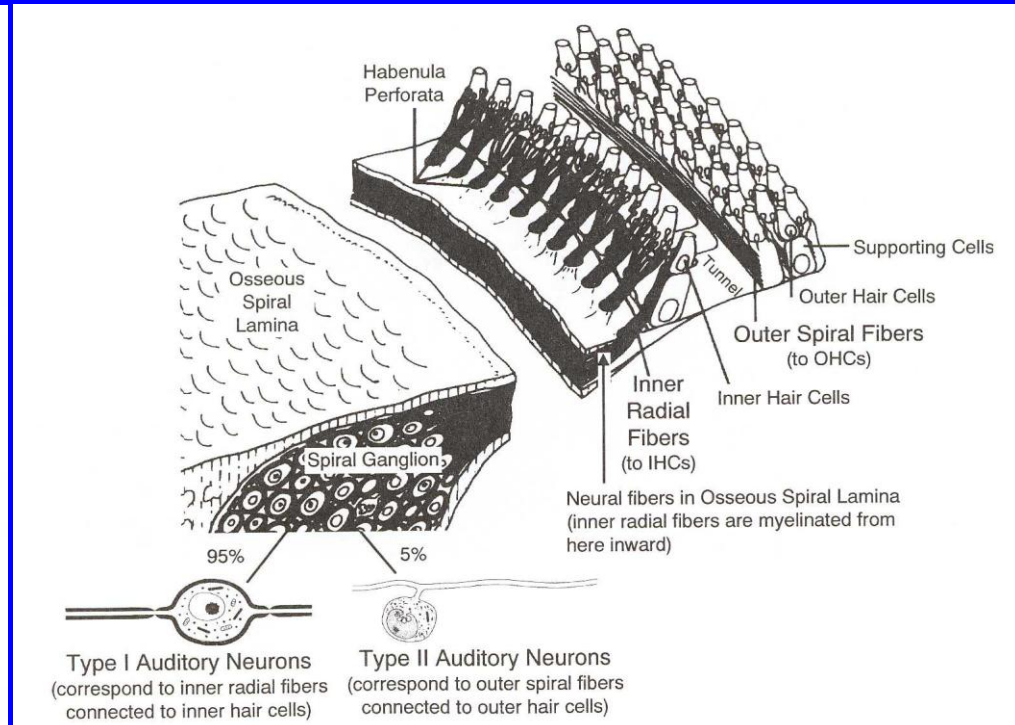
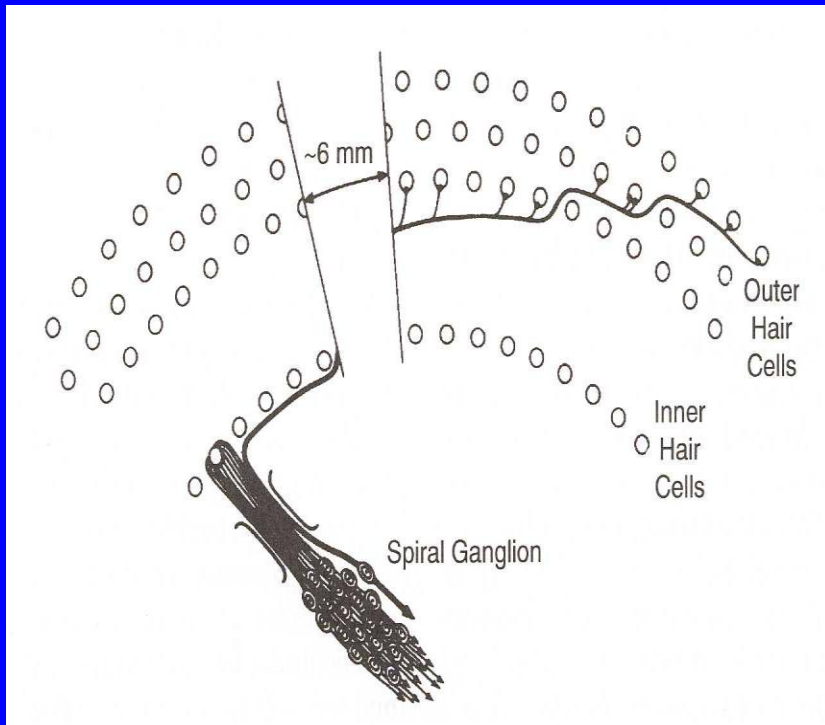




Inner Ear  
Cochlear Structure  
Single Cochlear Turn



**SHEARING EFFECT**



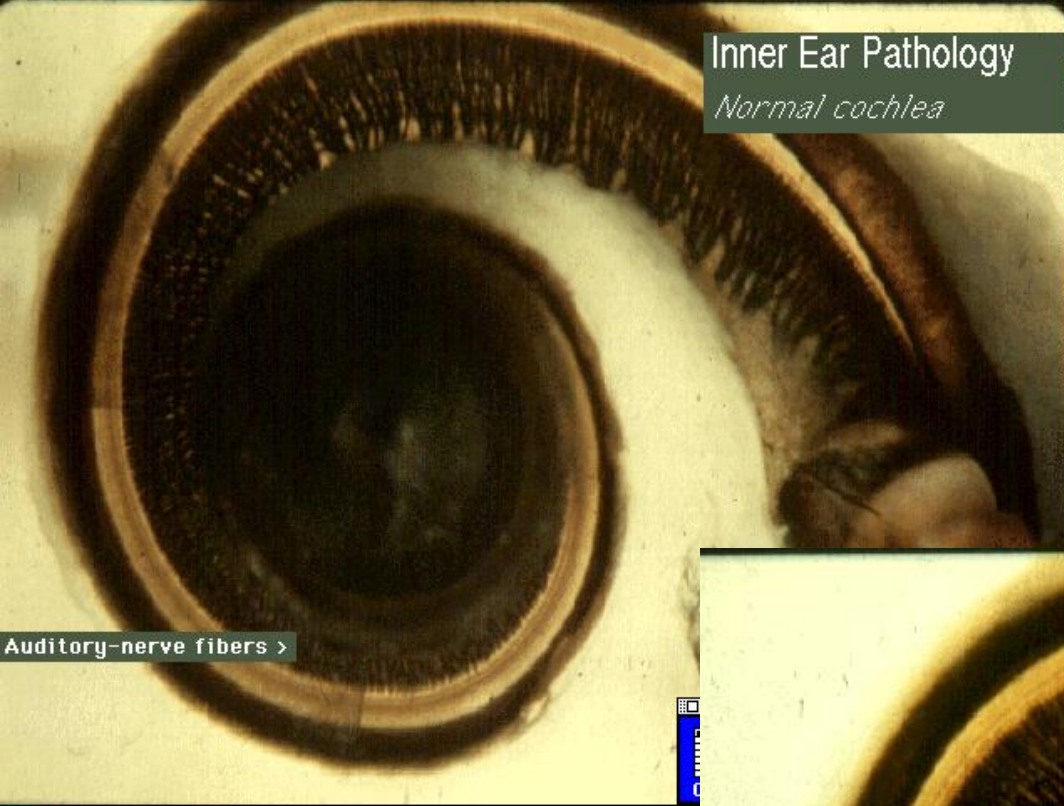
Videofilm a cochlea tonotopiájáról

(BBC)



# Inner Ear Pathology

*Normal cochlea*



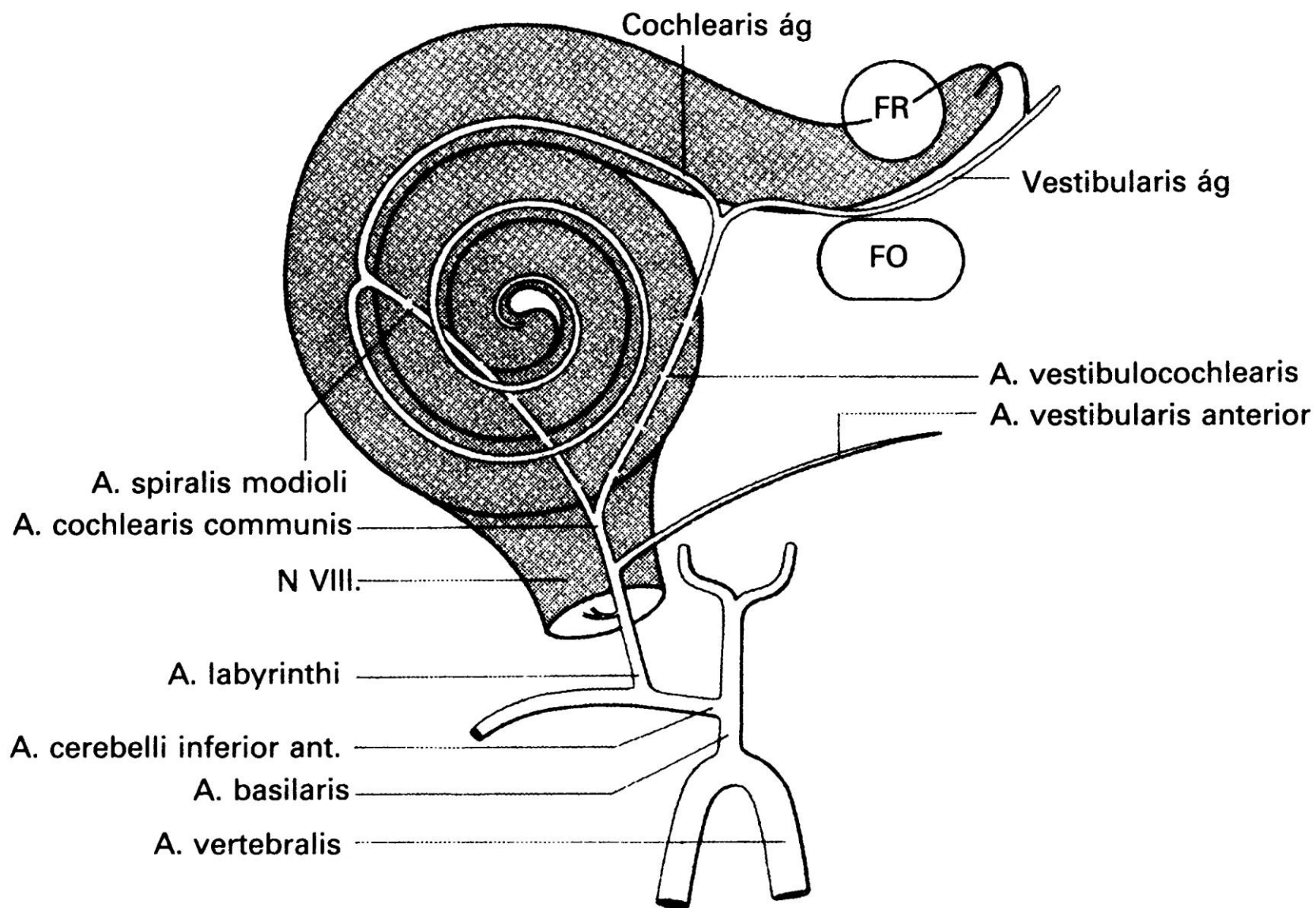
Auditory-nerve fibers >

# Inner Ear Pathology

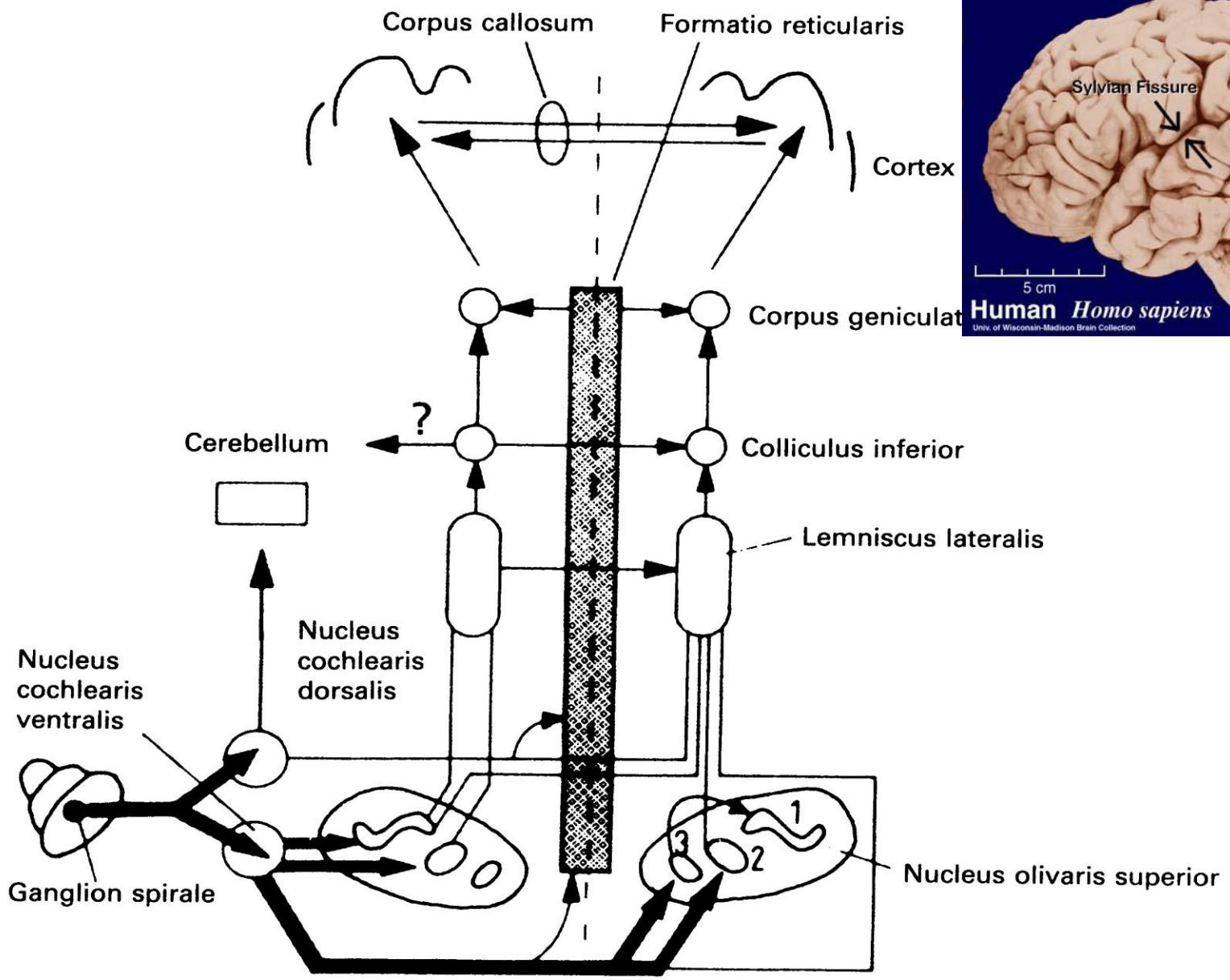
*Moderate damage*



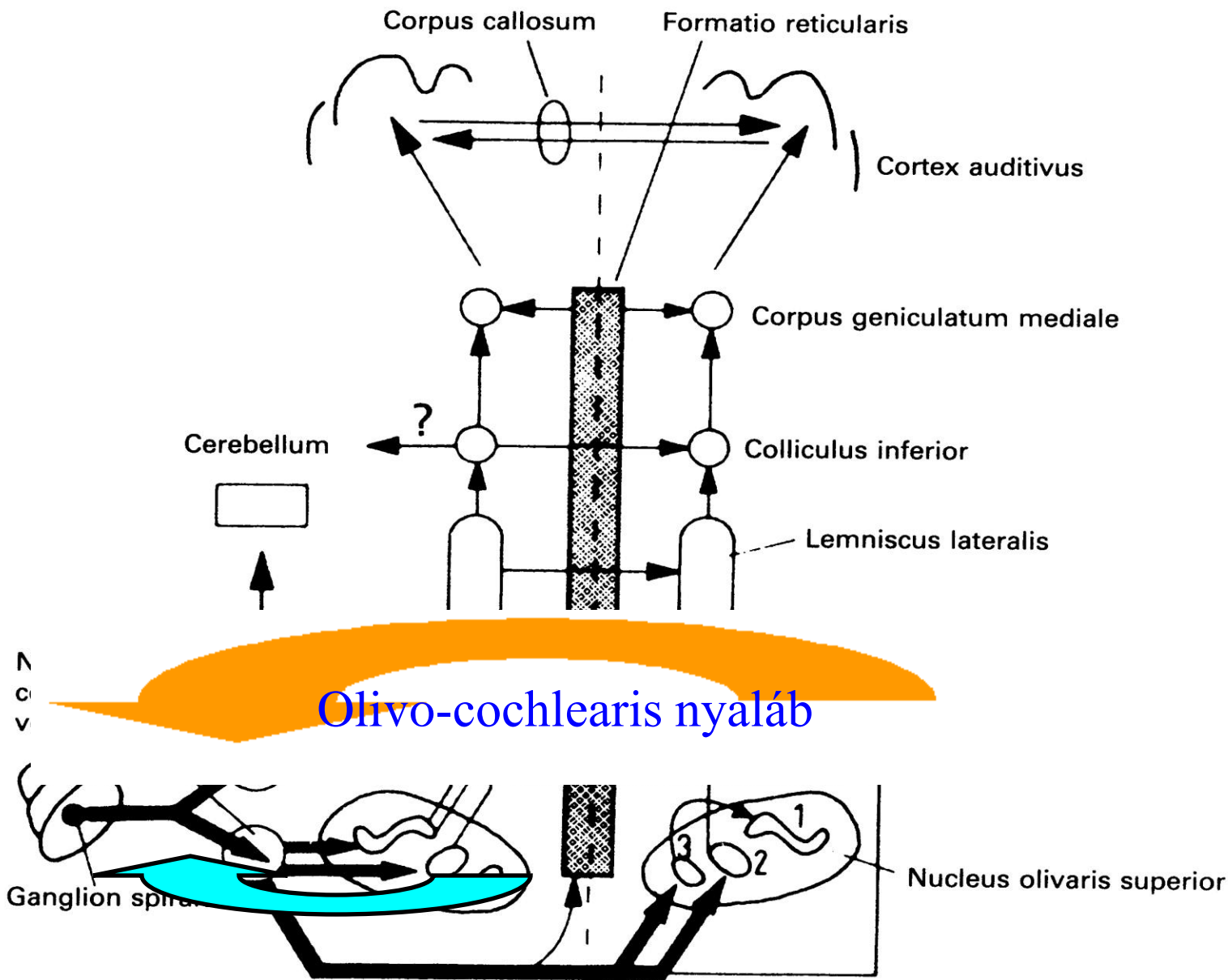
Auditory-nerve fibers >



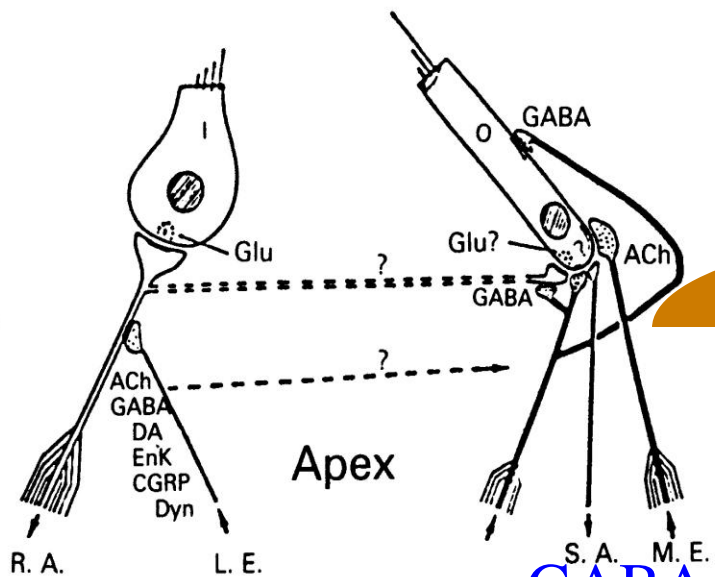
# A COCHLEA ÉRELLÁTÁSA



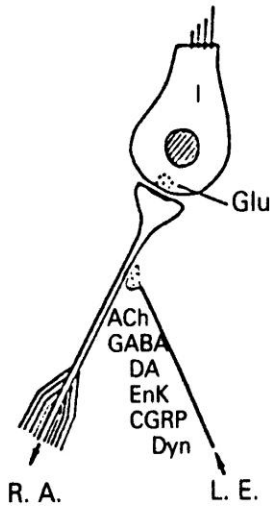
# A COCHLEA AFFERENS BEIDEGZÉSE



# A COCHLEA EFFERENS BEIDEGZÉSE

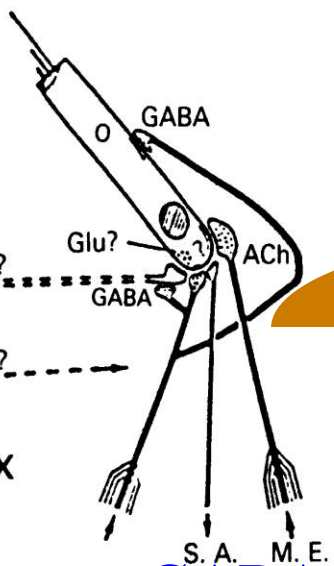


Glutamat



Bázis

A.

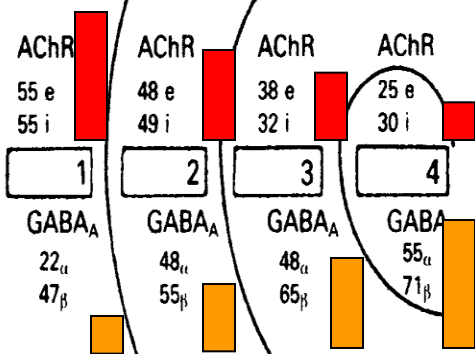


GABA

AChR



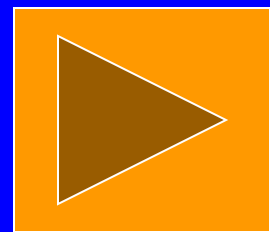
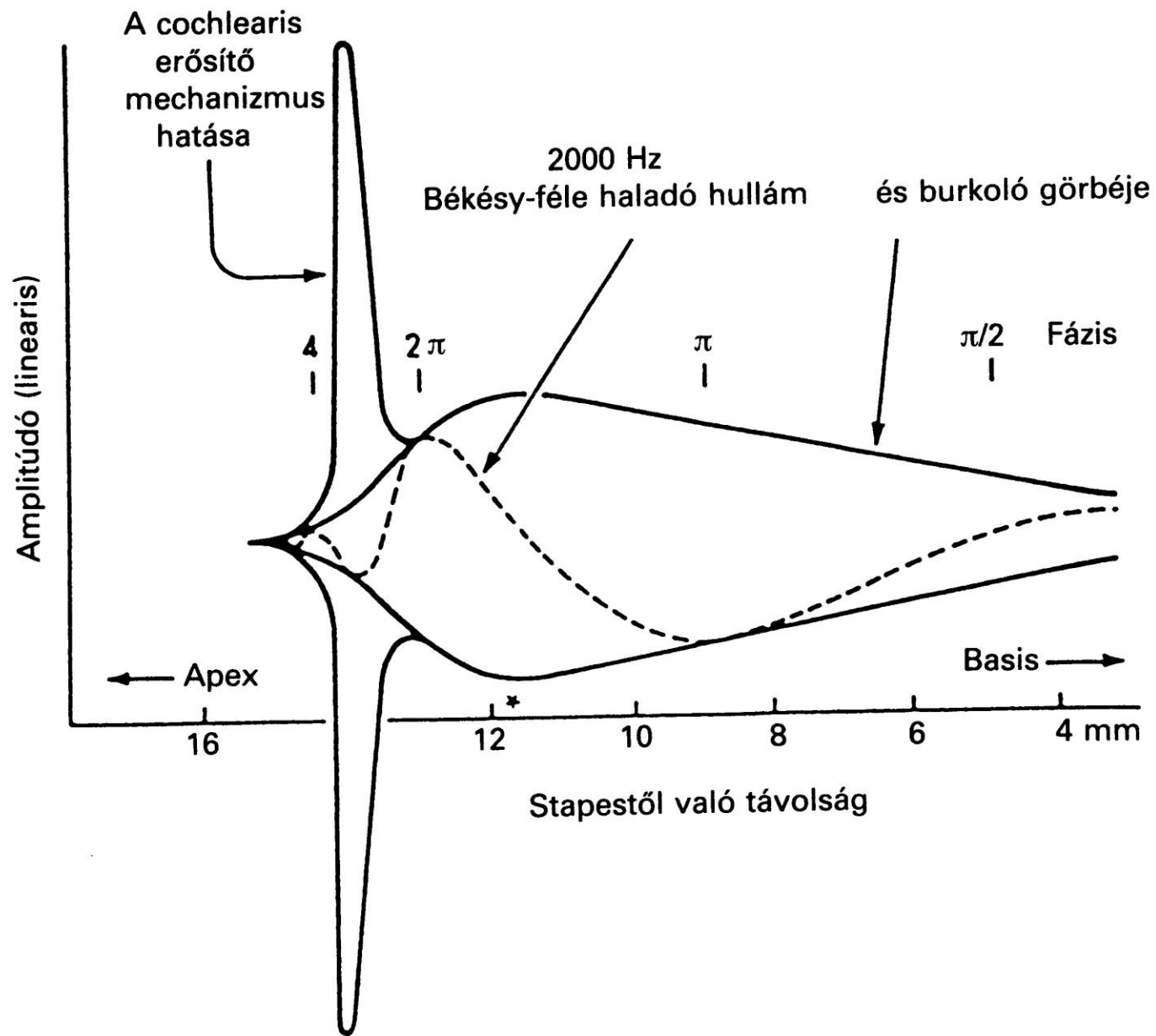
GABA



AChR

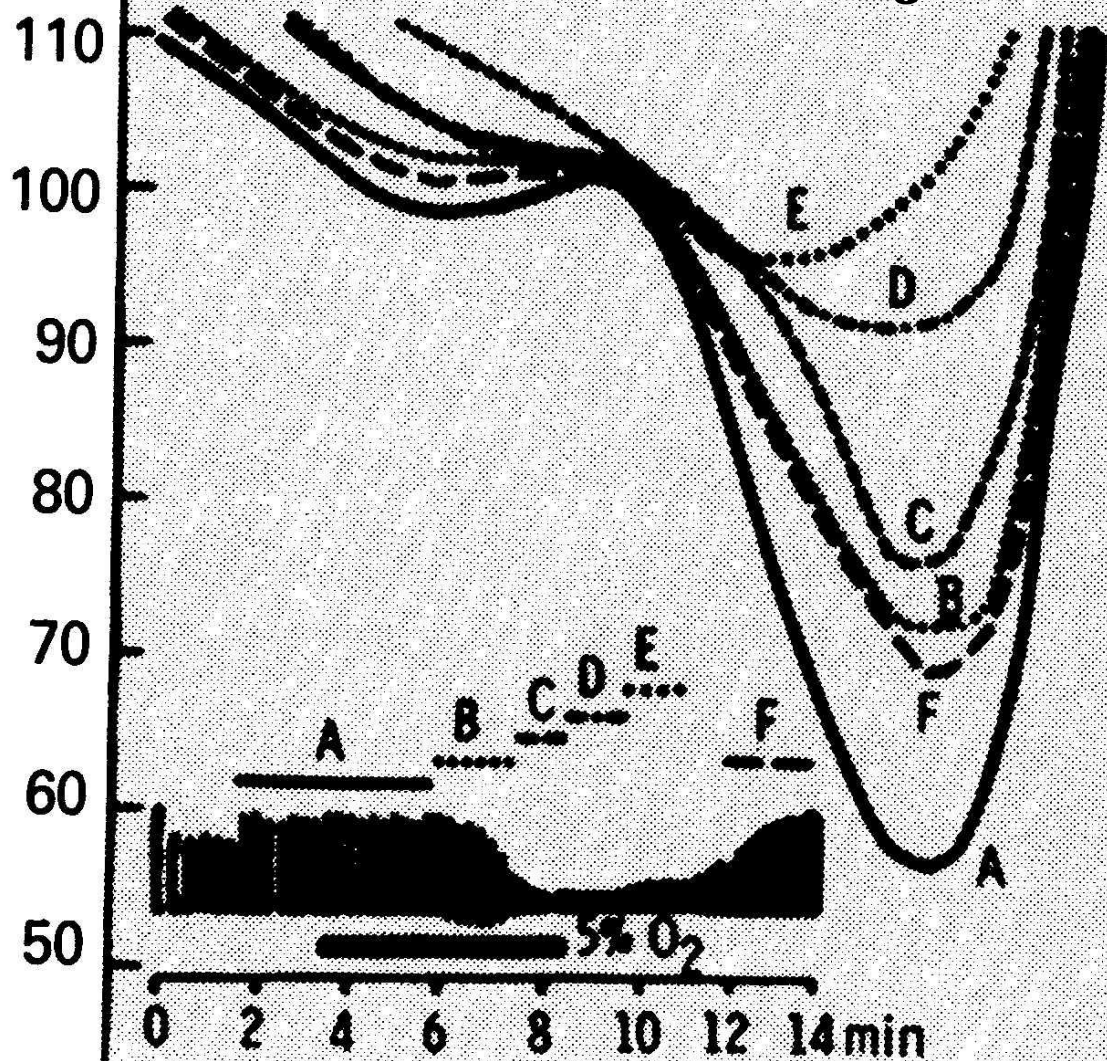
B.

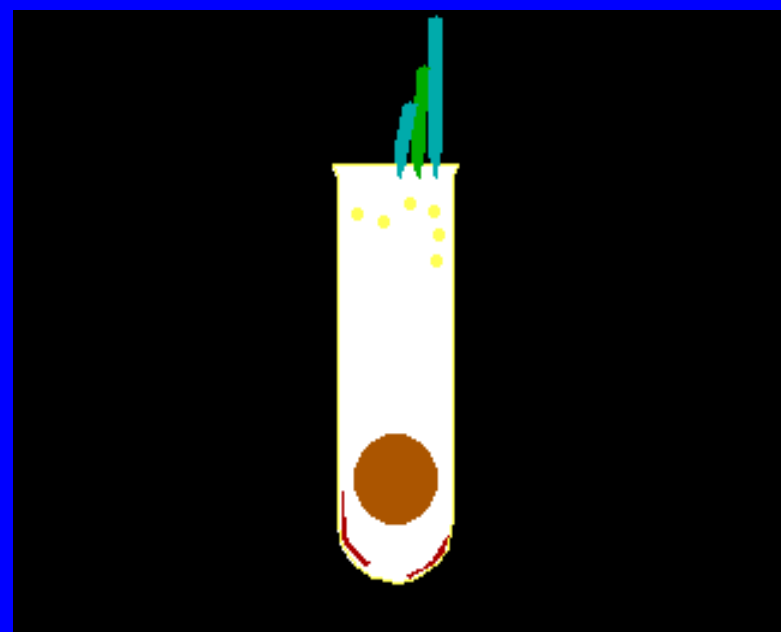
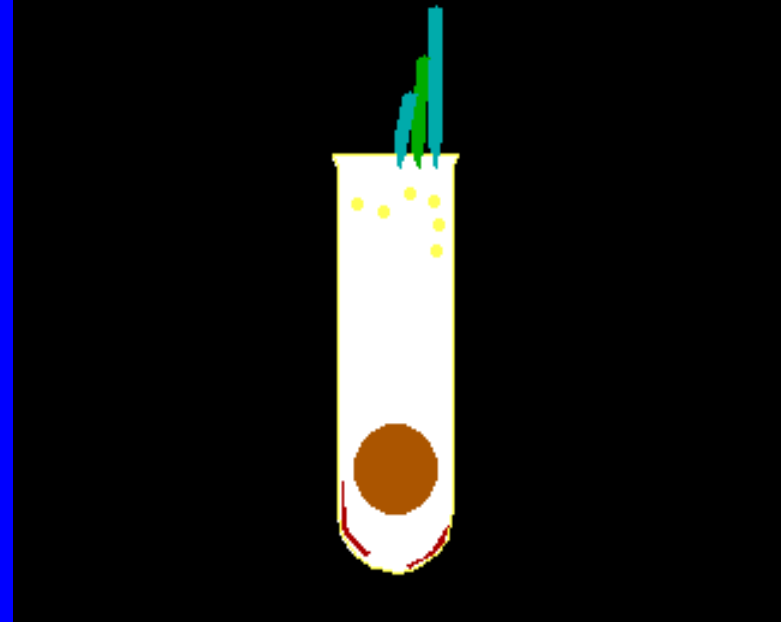
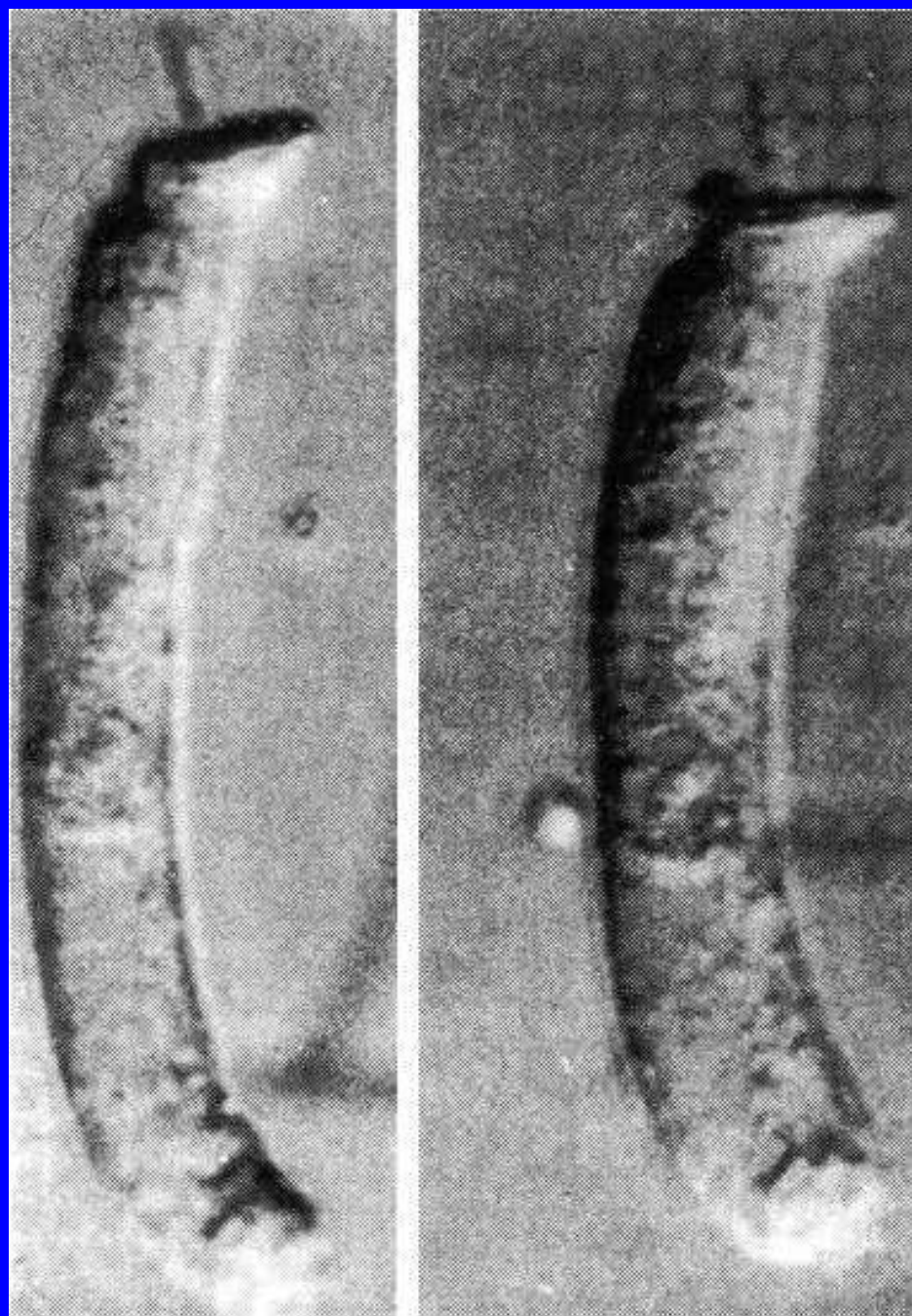




# Külső szőrsejtek

24865



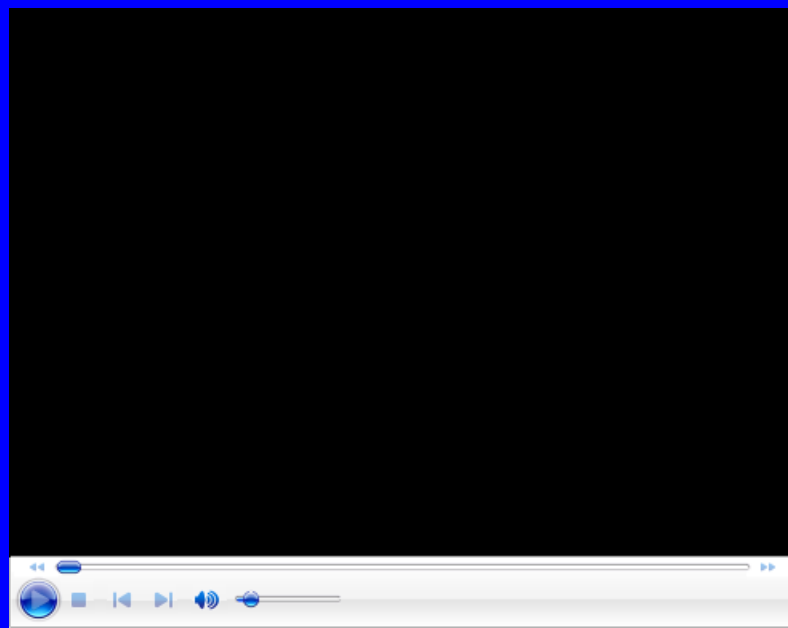
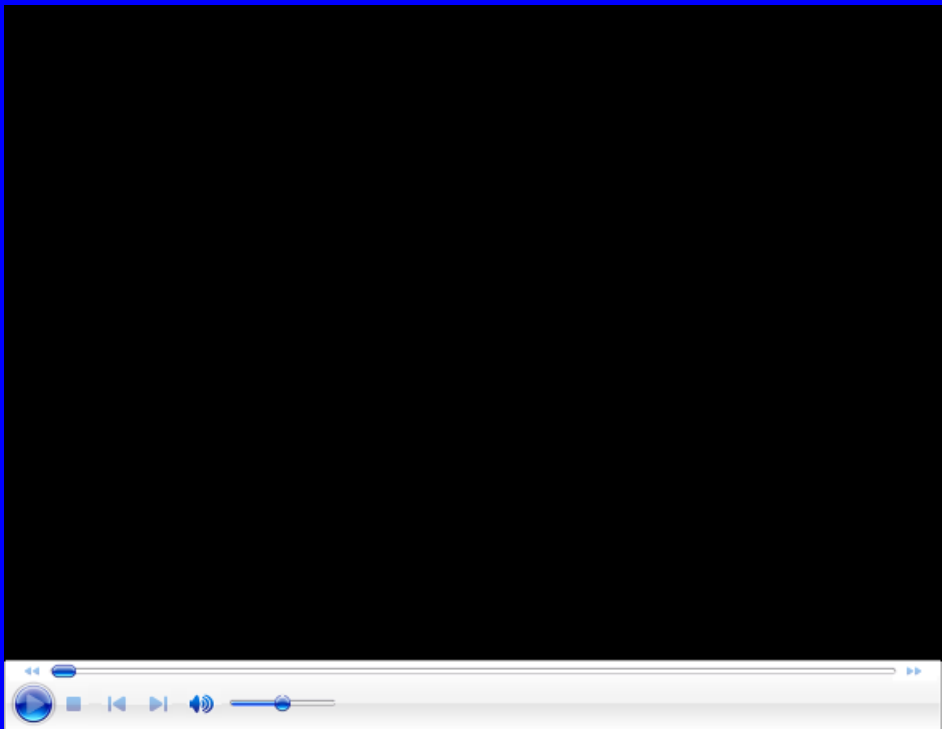




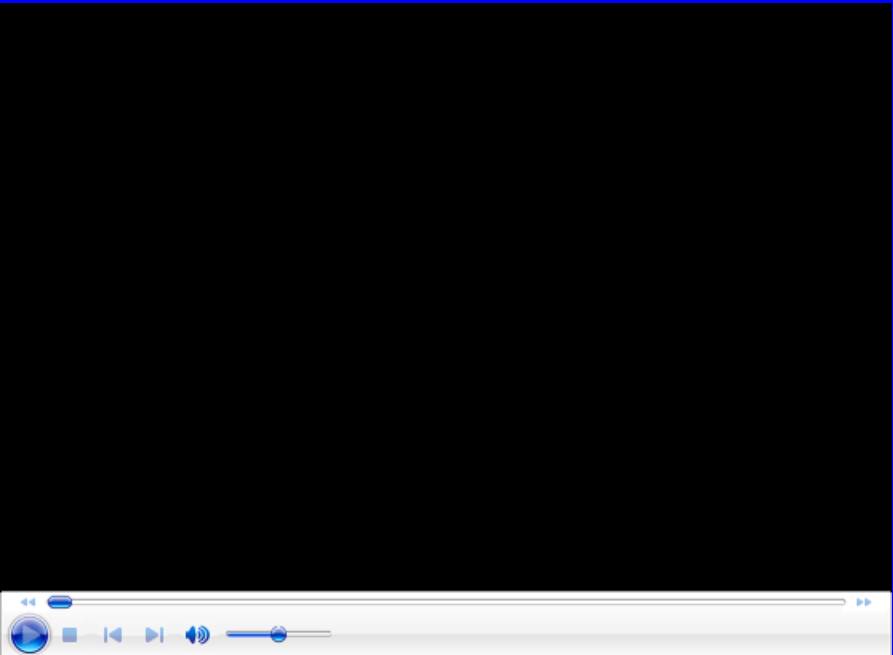


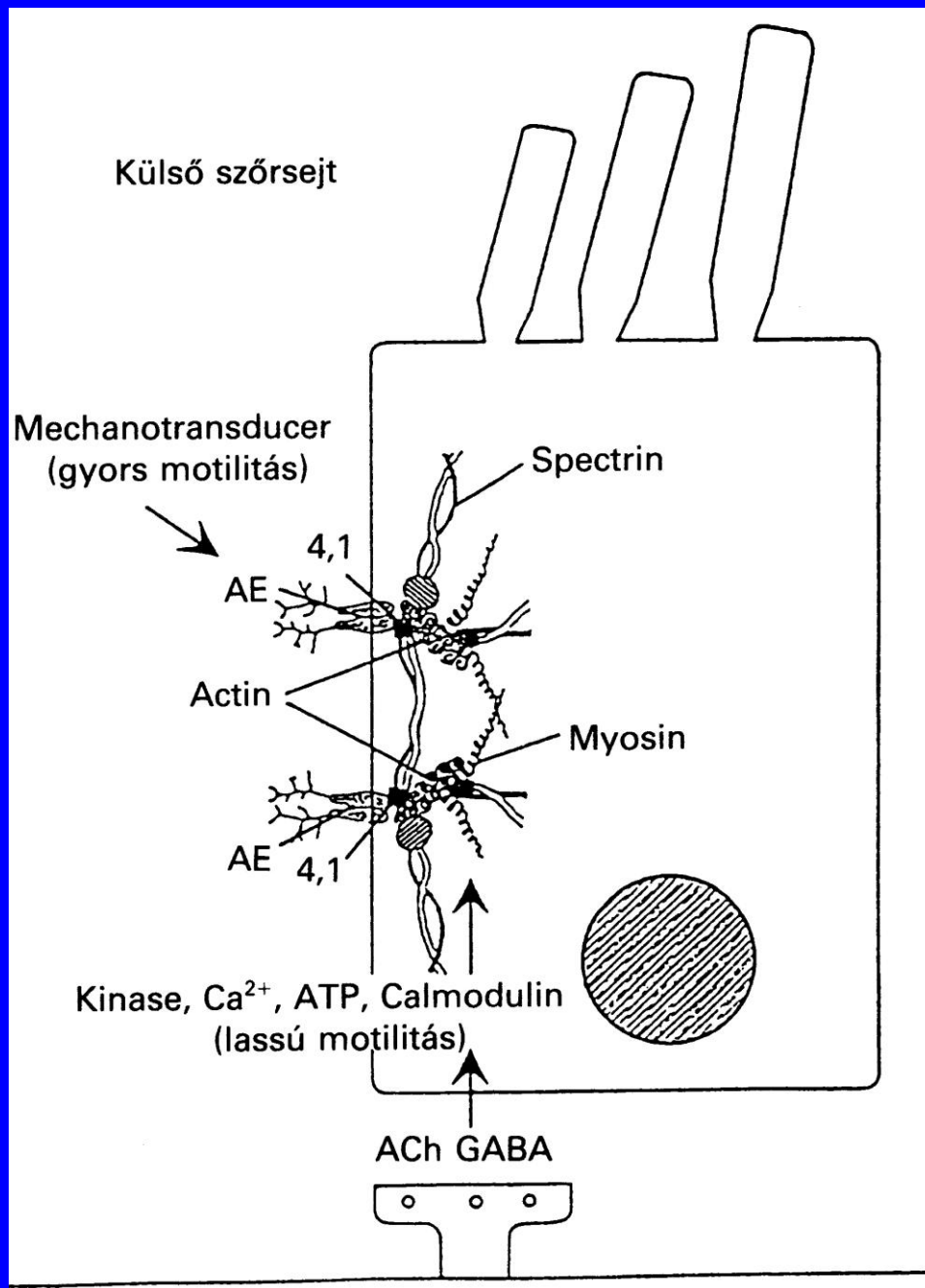
# Swing-Swang





# Die Resonanz Katastrophe (Tacoma Brücke)



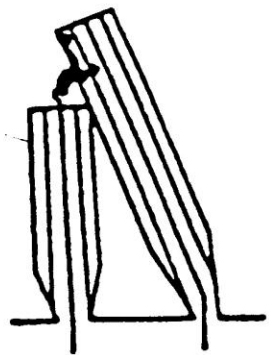


# „Motoros sejt”

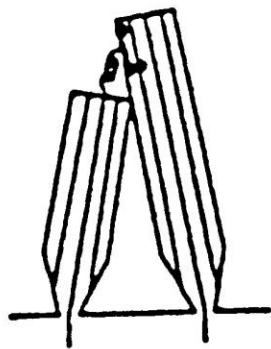
Dallos Péter

**PRESTIN**





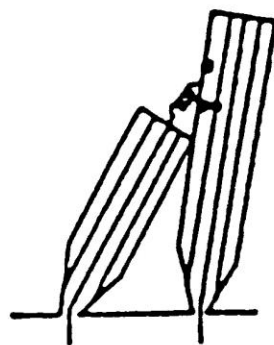
Gátlás



Nyugalmi helyzet

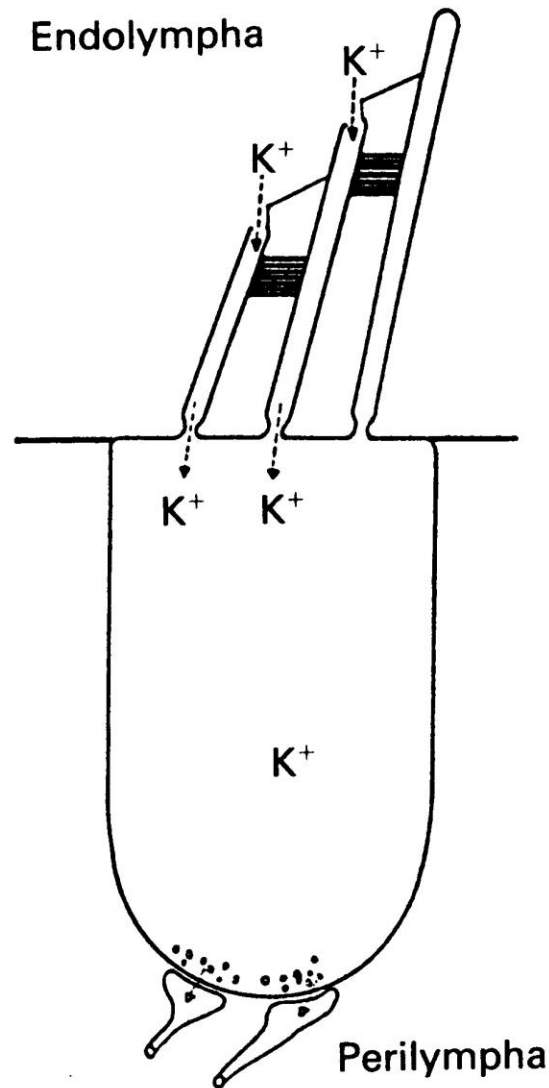


Ingerület

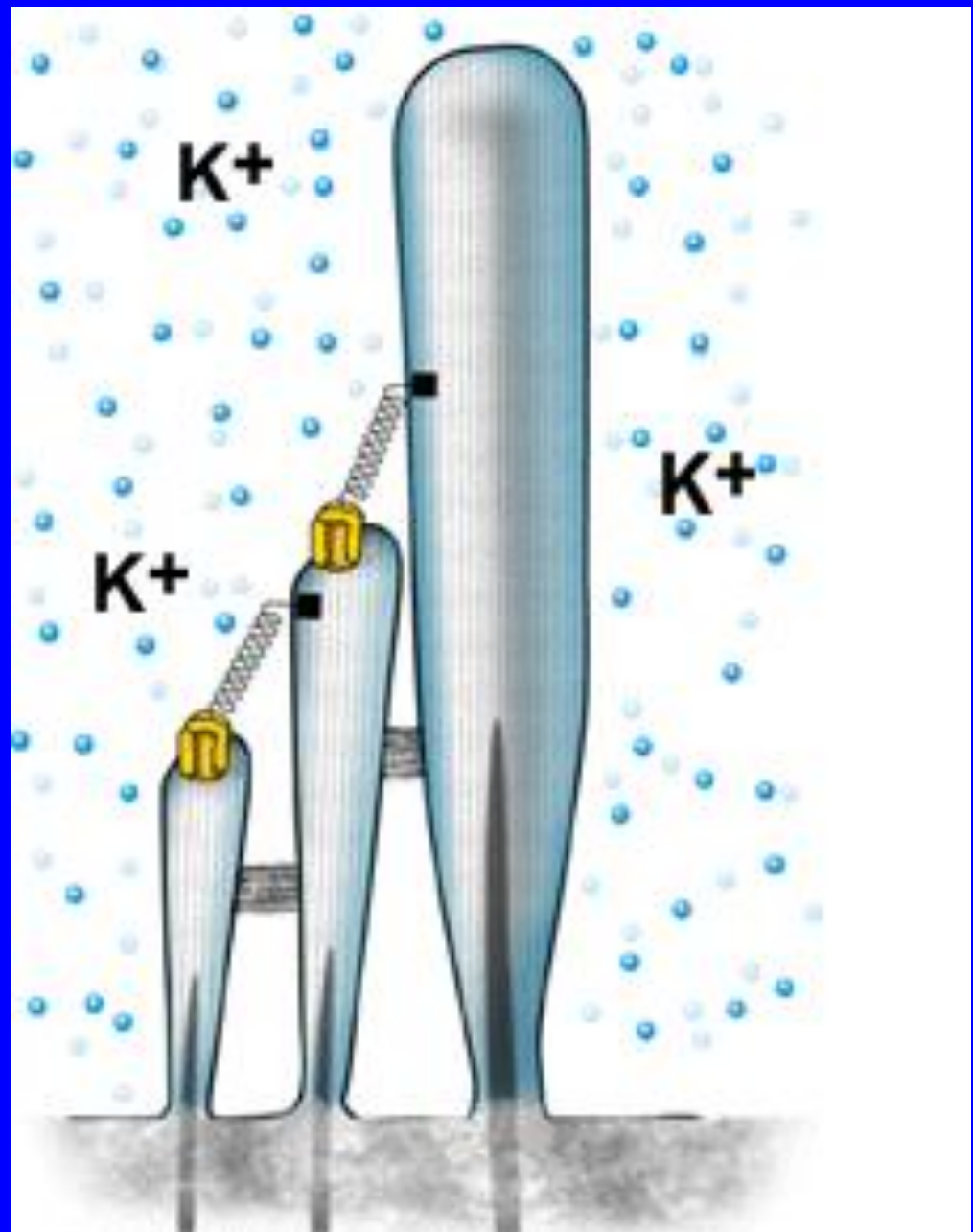
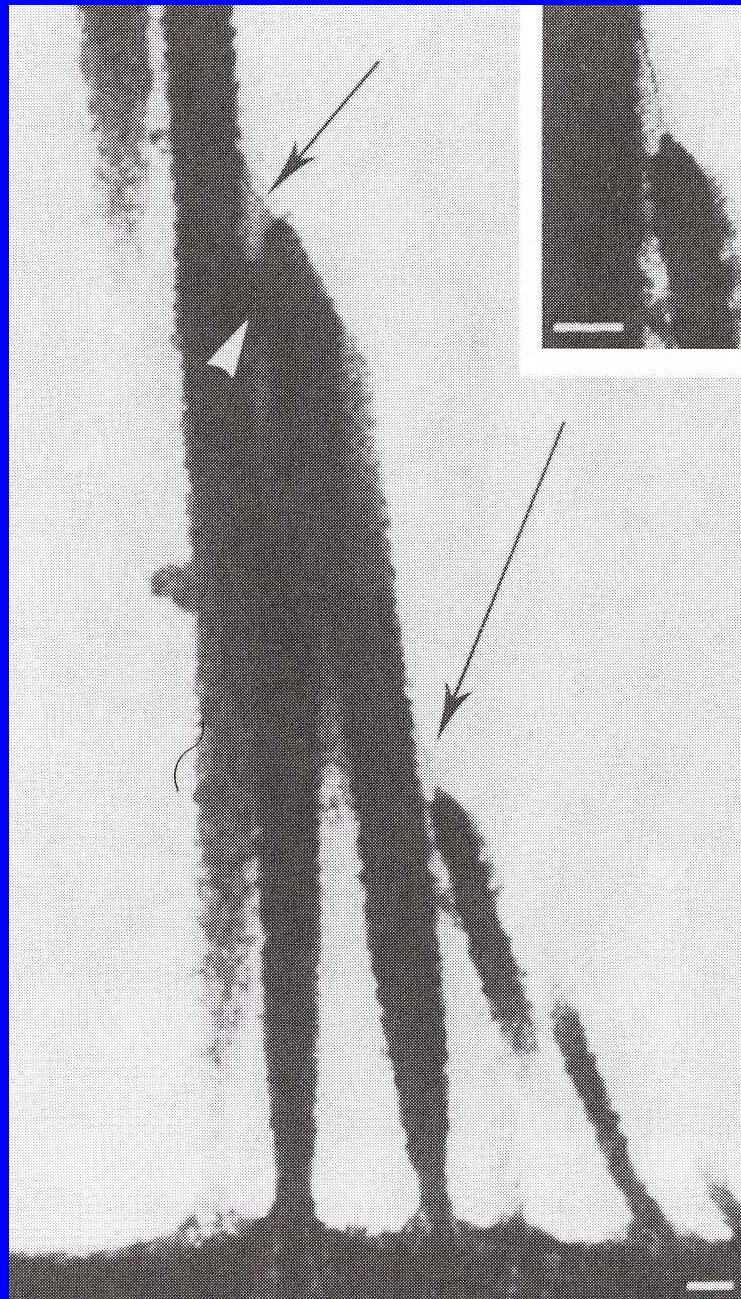


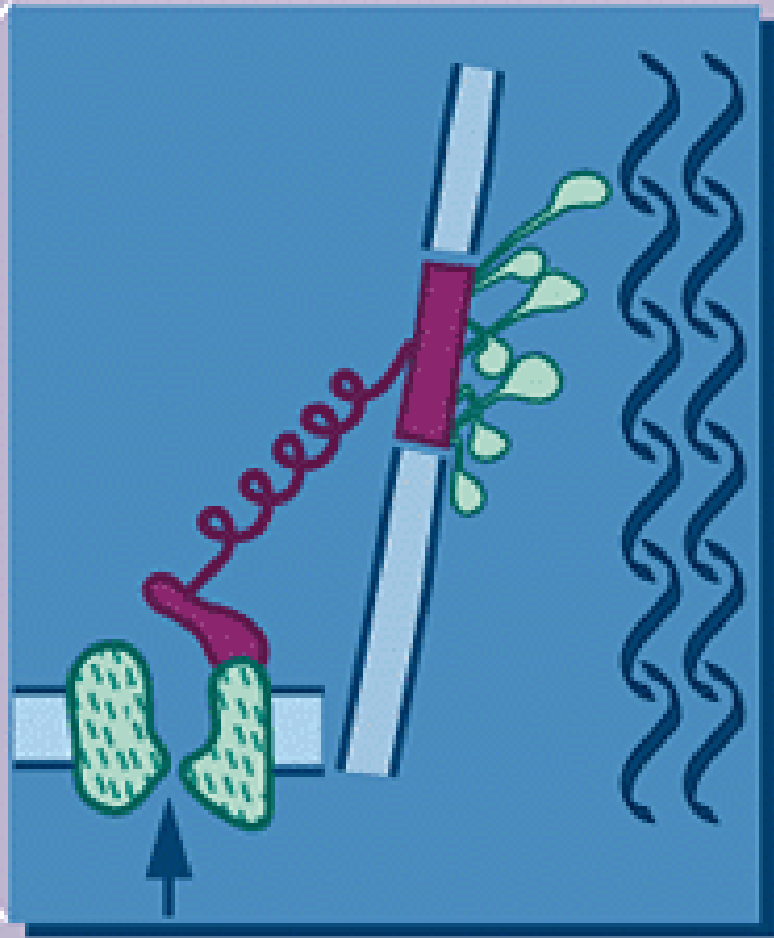
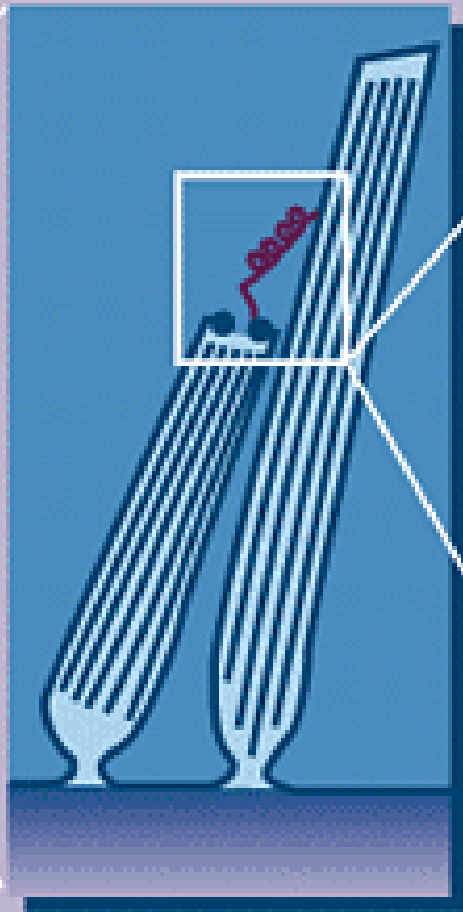
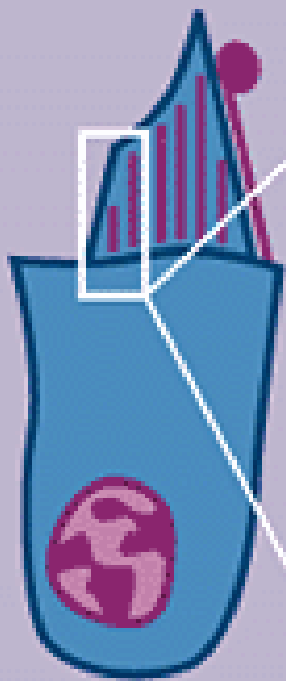
Adaptáció

A

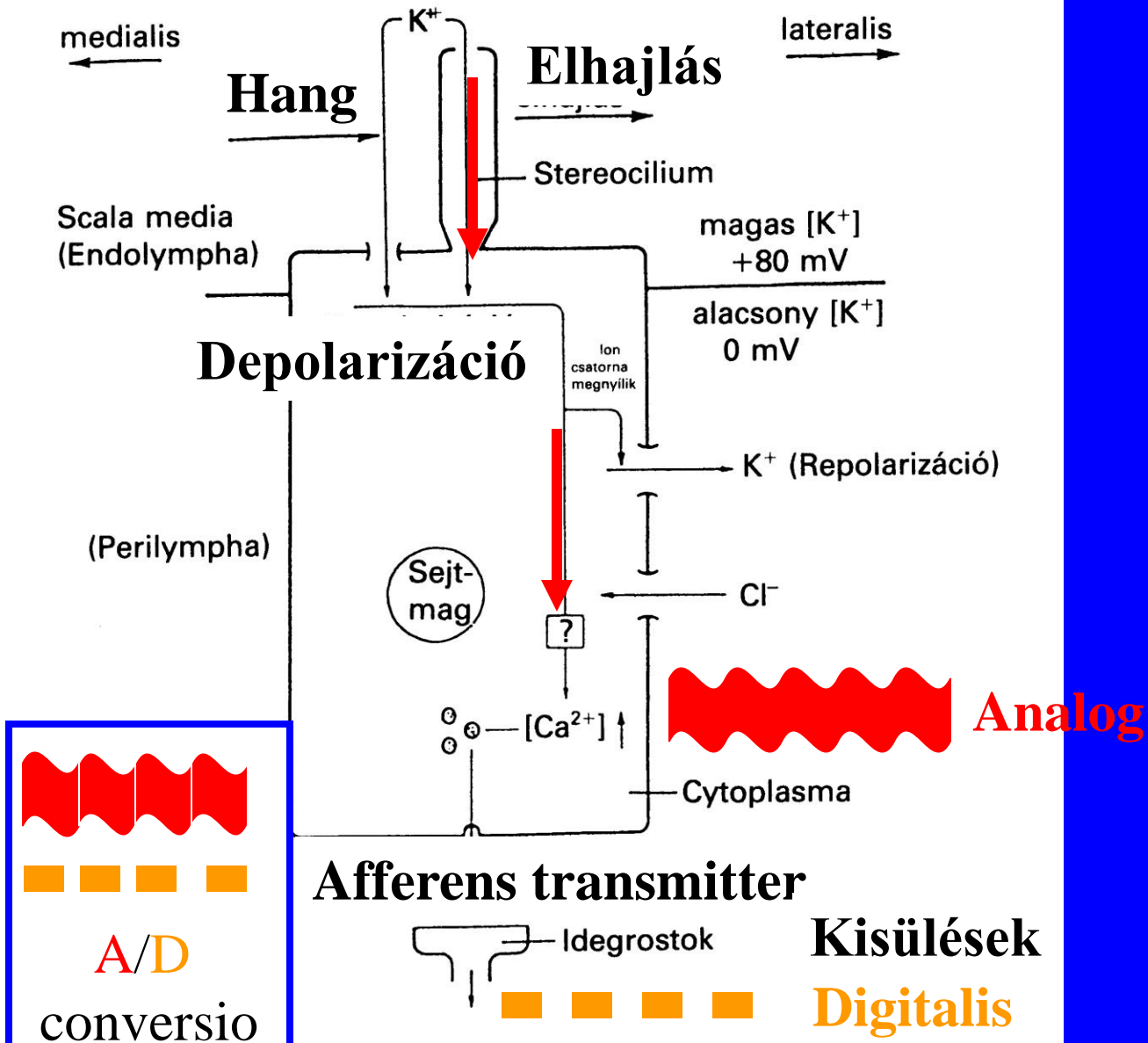


B



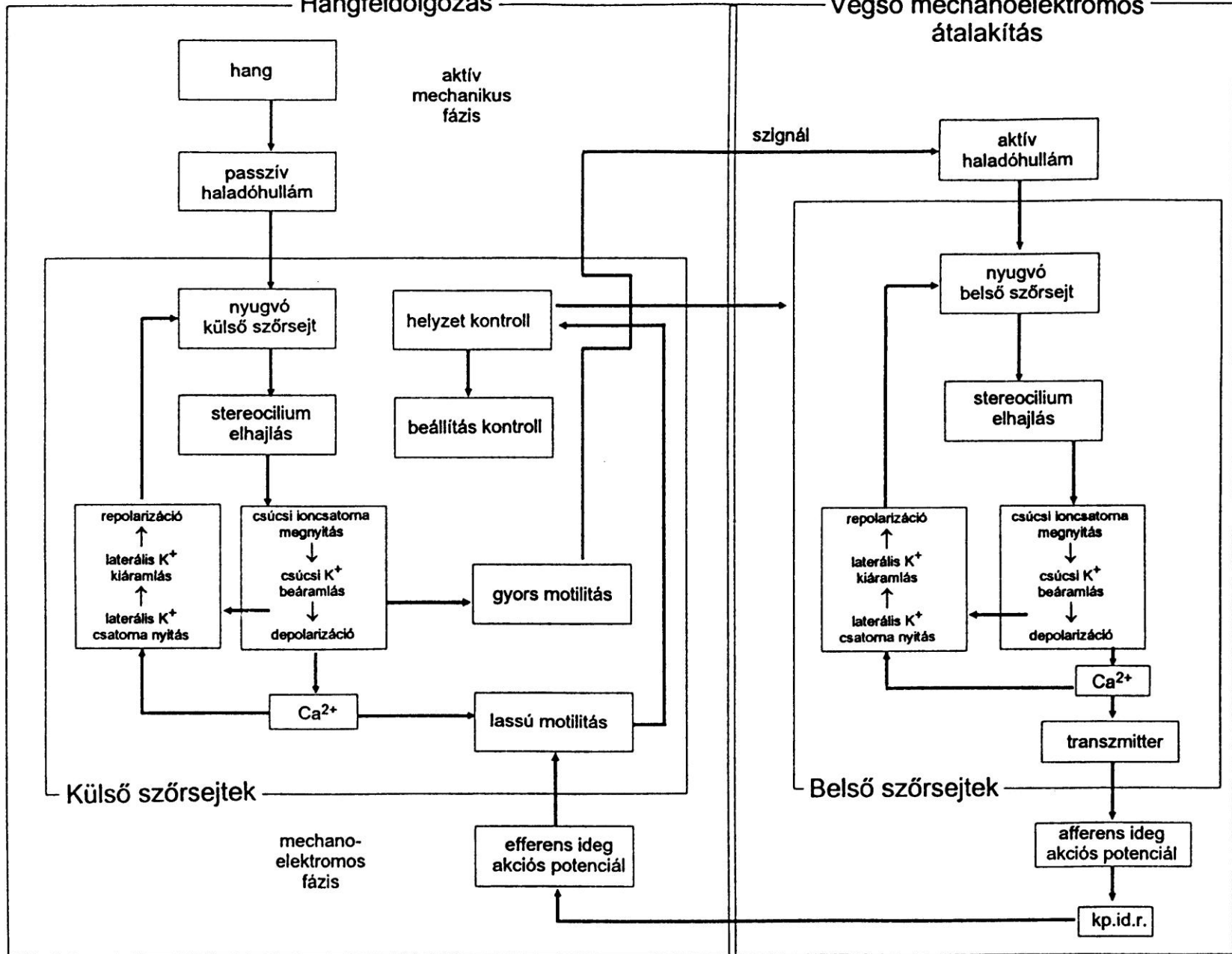


# Cochlearis szőrsejt



# Hangfeldolgozás

# Végző mechelektromos átalakítás



# Köszönöm a figyelmet!

