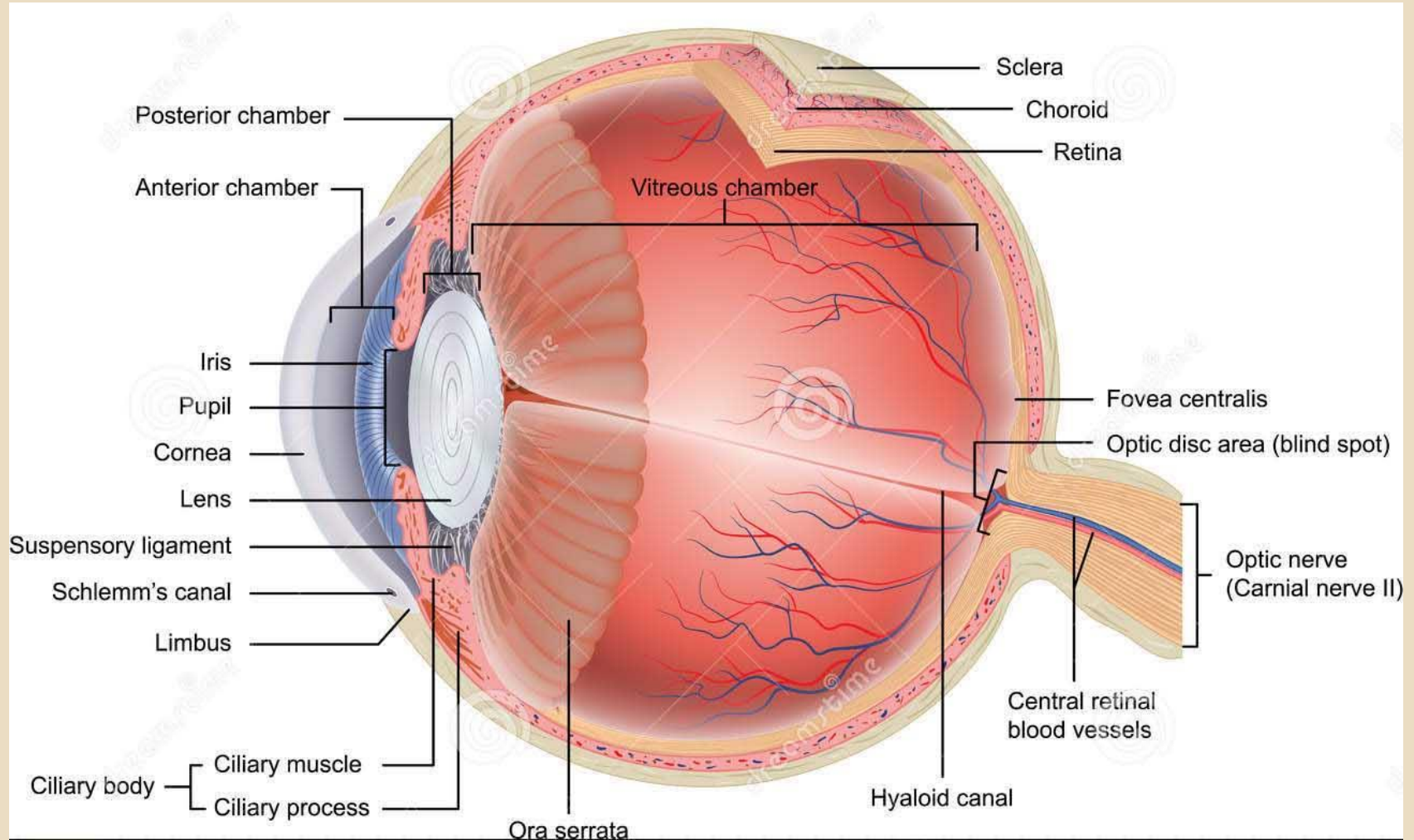


DISORDERS OF SENSORY ORGANS

M. CHALUPOVÁ

Eye anatomy



Involution eye changes

□ orbit

- volume of soft tissues diminished
- atrophy of orbital fatty tissue

□ eyelids

- skin of the eyelid relaxed
- loss of cilia

□ lacrimal gland

- loss of secretory function
- decrease in concentration of lysozyme

Involution eye changes

□ retina

- thinning of pigment epithelium
- sclerotization of vessels

□ optic nerve

- axonal degeneration and glial atrophy

□ cornea

- bigger curvature – astigmatism

□ sclera

- decrease of hydration, hyaline deposits

□ lens

- higher density of lens core

Functional changes

- decrease of lens ability to accommodate
- decrease in visual acuity
- loss of adaptability to light and darkness
- diminished sensitivity to colours
- narrowing of the visual field (1–3° in a decade)
- loss of retinal sensitivity

Common diseases

- **cataract** 38 %
- **macular degeneration** 14 %
- **diabetic retinopathy** 7%
- **glaucoma** 5 %
- **other retinal disorders** 7%

Cataract

- cloudy areas (opacities) in the eye lens leading to decrease of vision
- can be unilateral or bilateral

- aging
- trauma
- radiation
- diabetes



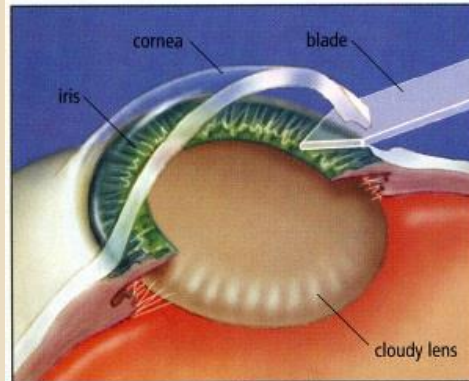
Cataract symptoms

- ❑ light does not pass through easily and the patient's vision becomes blurry - like looking through cloudy water or a fogged-up window
- ❑ faded colors
- ❑ halos around light
- ❑ trouble with bright lights
- ❑ trouble seeing at night

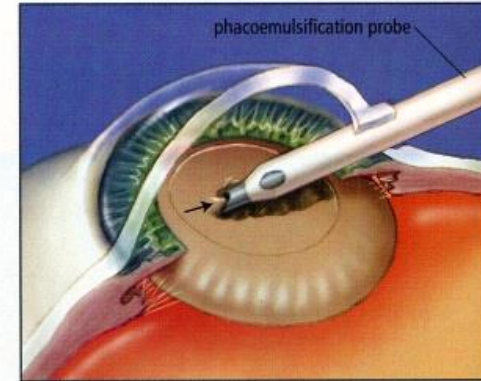
Cataract treatment

□ surgery

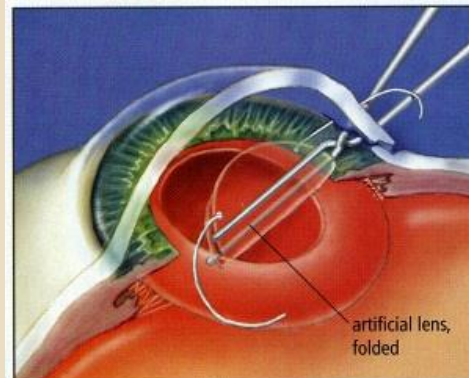
Cataract Surgery



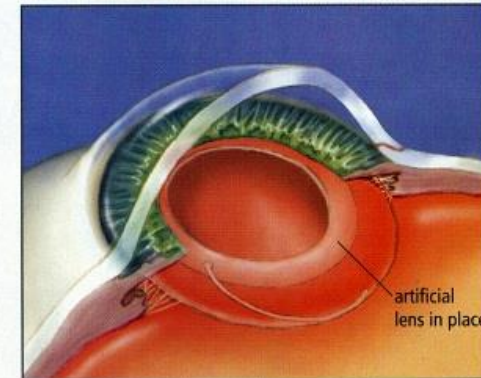
1. Incision: A small incision, approximately 3mm in width, is made at the corneal margin.



2. Emulsification: Phacoemulsification probe is inserted through corneal incision and ultrasound breaks cataract up into microscopic fragments, which can then be aspirated using the probe tip.



3. Intraocular Lens Implant: The artificial foldable intraocular lens is inserted and, once inside, the lens unfolds.



4. Result: The new lens is in place, the small incision heals naturally without the need for sutures, and vision is restored.

Macular degeneration

- **age-related macular degeneration (AMD)**
- blurred or lost vision in the centre of the visual field
- difficulties in recognizing faces, driving, reading

- pathogenesis is not well known
 - ▣ oxidative stress, inflammatory processes

- **dry AMD (nonexudative)**
- **wet AMD (exudative)**

Macular degeneration

Dry AMD

- cellular debris (drusen) accumulates between the retina and the choroid thus leading to retinal scarring and atrophy

Wet AMD (neovascular)

- abnormal fragile blood vessel growth (choroidal neovascularization)
 - ▣ hemorrhage, leaking, and scarring from these blood vessels cause irreversible damage to the photoreceptors and rapid vision loss
 - ▣ possible treatment with laser coagulation

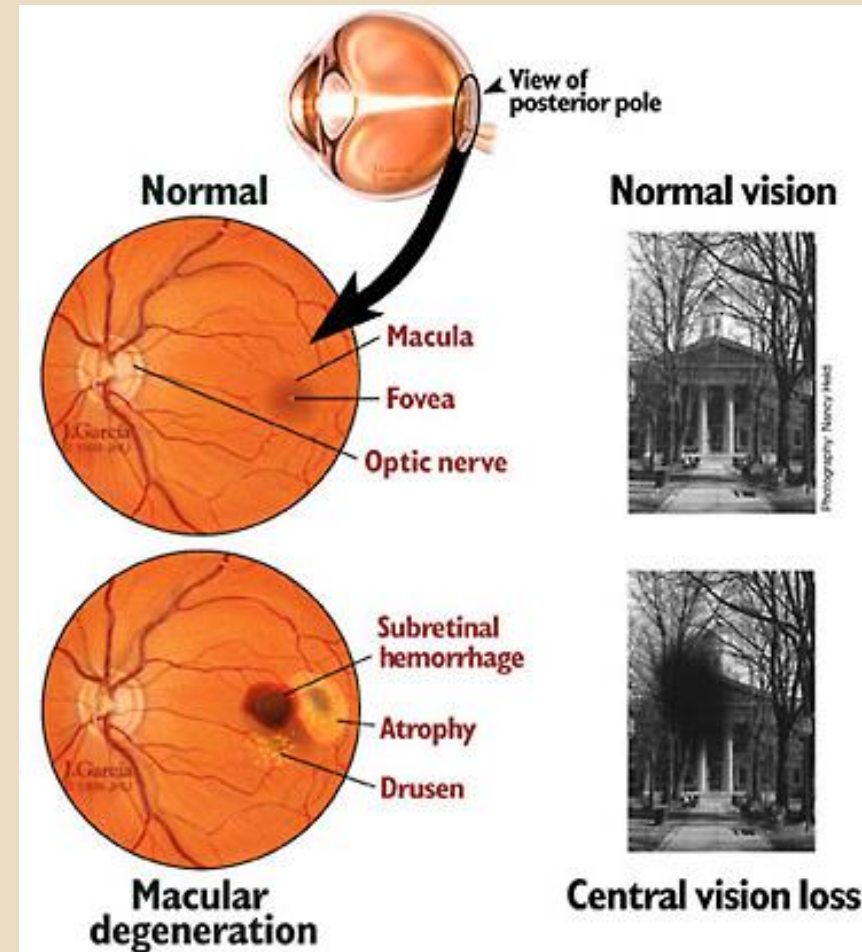
Macular degeneration



A healthy retina.

A retina showing "dry" macular degeneration with deposits, called drusen.

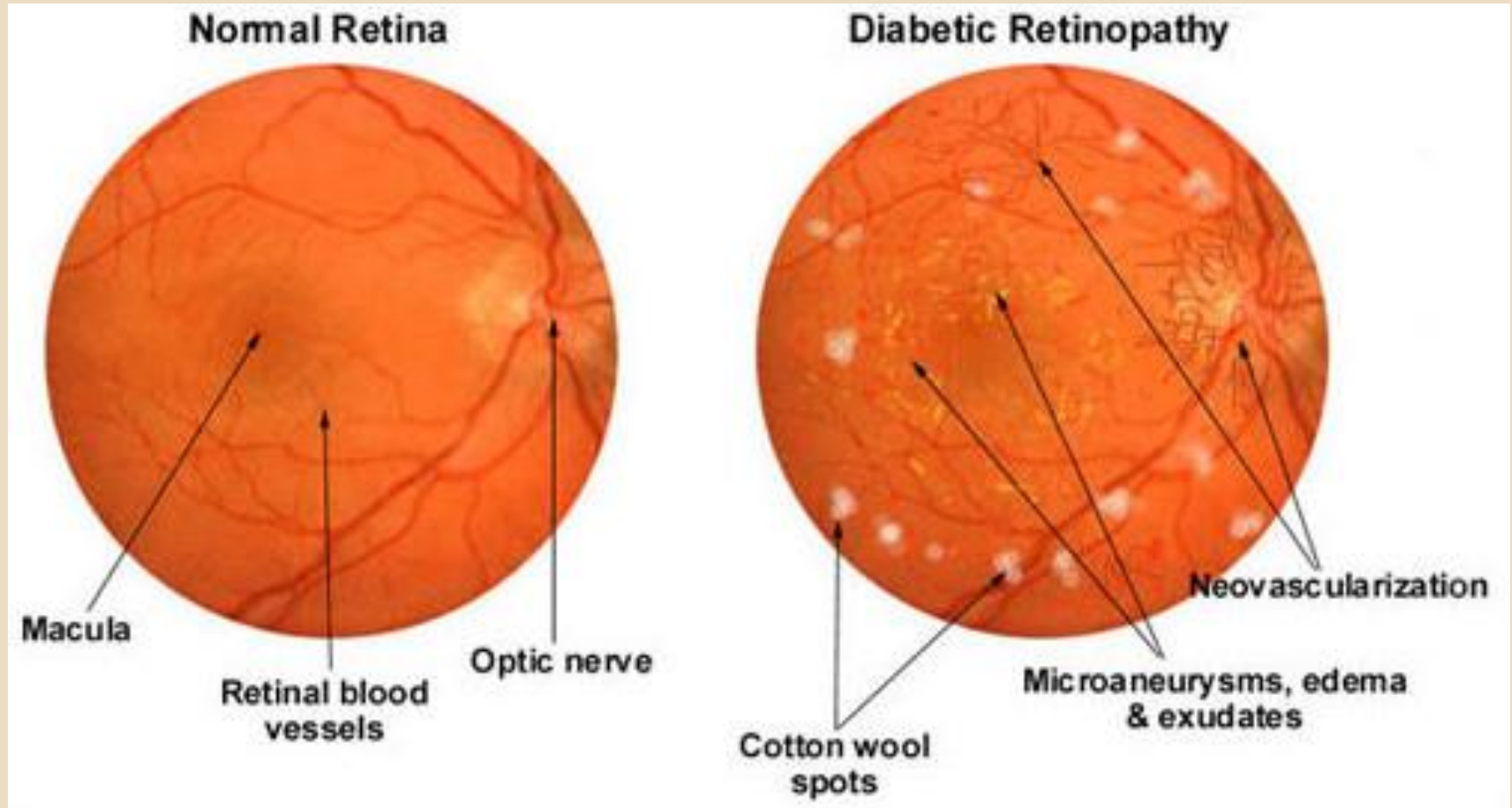
"Wet" macular degeneration revealing scarring and hemorrhaging on the retina.



Diabetic retinopathy

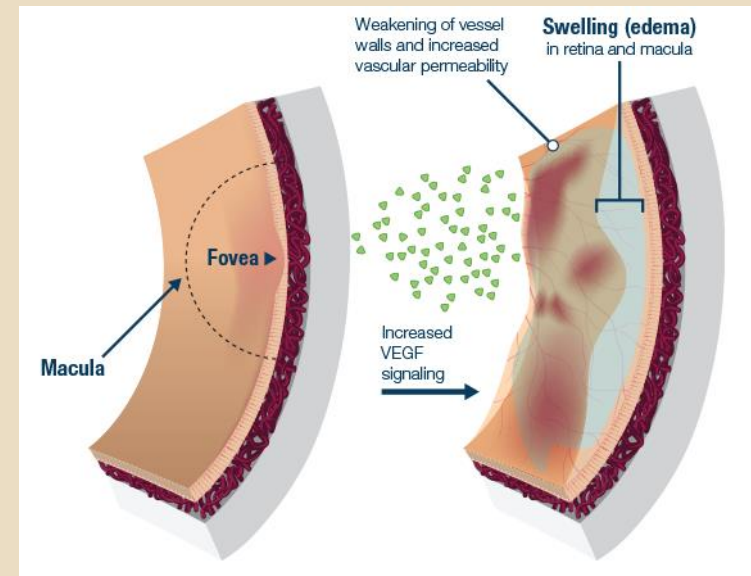
- retinal damage occurring due to diabetes mellitus
 - ▣ the longer a patient has diabetes, the higher the risk of development
 - ▣ hyperglycemia causes thickening and impairment of vascular basement membranes
- **non-proliferative diabetic retinopathy (NPDR)**
 - ▣ microaneurysms of retinal capillaries, lately swelling and distorting
- **proliferative diabetic retinopathy (PDR)**
 - ▣ growth factors secreted by the retina trigger the proliferation of new blood vessels that are fragile and tend to bleed
 - ▣ accompanying scar tissue can contract and cause retinal detachment

Diabetic retinopathy



Diabetic retinopathy

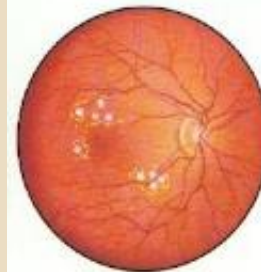
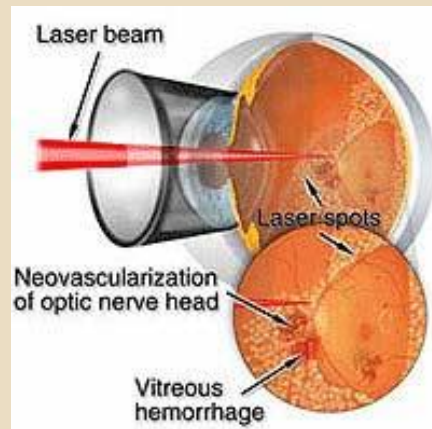
- **diabetic macular edema (DME)**
 - ▣ build-up of fluid (edema) in a region of the retina called the macula
 - ▣ the most common cause of vision loss among people with diabetic retinopathy
 - ▣ about half of all people with diabetic retinopathy will develop DME
 - ▣ more likely to occur as diabetic retinopathy worsens



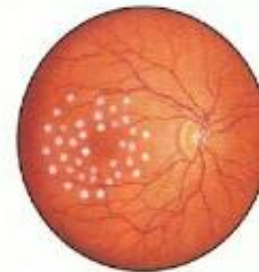
Diabetic retinopathy

- early stages have no symptoms
- bleeding can cause „floating spots“, blurred vision
- **anti-VEGF injection therapy**
 - bevacizumab (Avastin®), aflibercept (Eylea®), ranibizumab (Lucentis®)
- **focal/grid laser surgery**
- **corticosteroids**
 - dexamethasone (Ozurdex®)

Diabetic retinopathy laser surgery



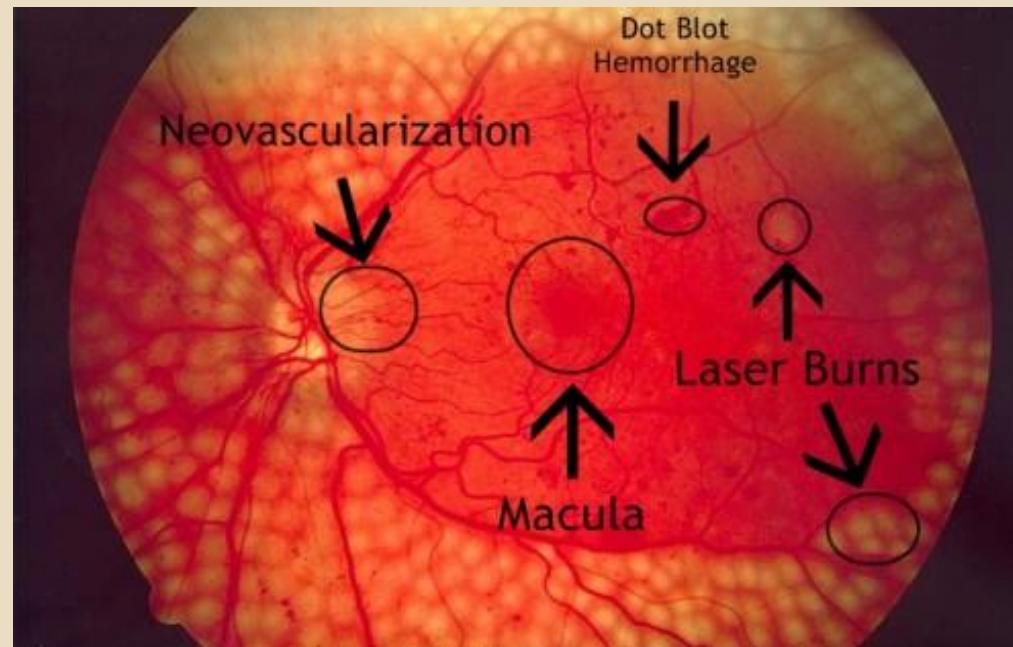
Focal treatment is used to treat macular edema due to focal leakage.



Grid treatment is used to treat macular edema due to diffuse leakage.

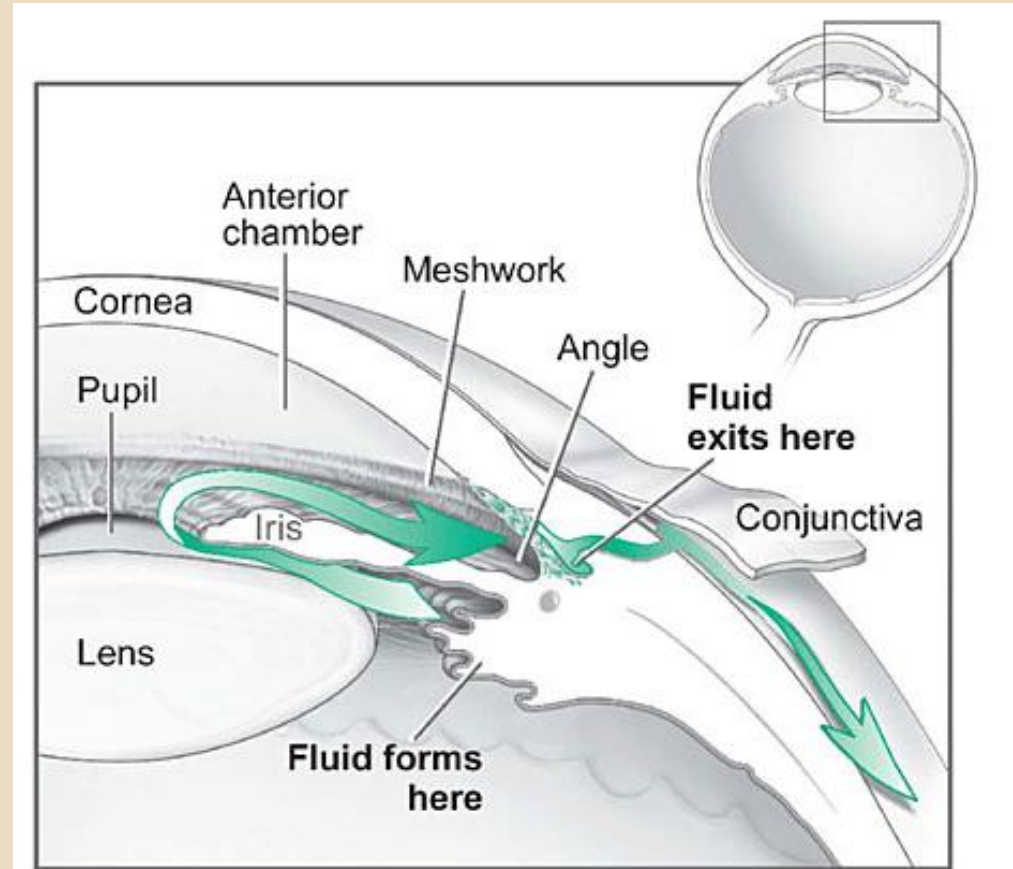


Panretinal treatment may be used to treat pre-proliferative and proliferative retinopathy.



Glaucoma

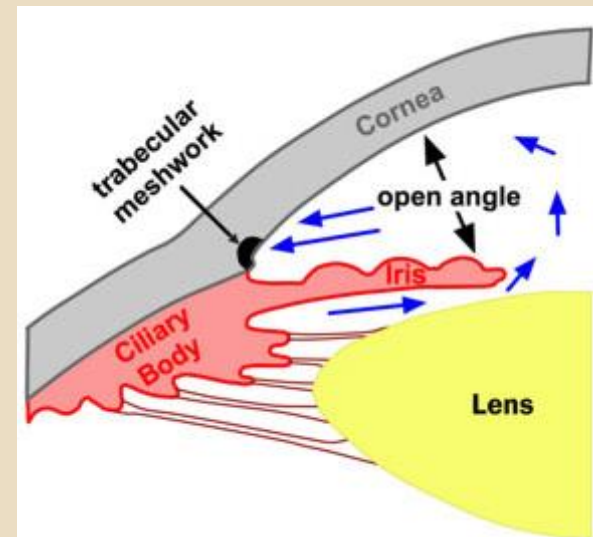
- group of diseases that damage the eye's optic nerve and can result in vision loss and blindness
- **open-angle**
- **closed-angle**



Glaucoma

□ open-angle

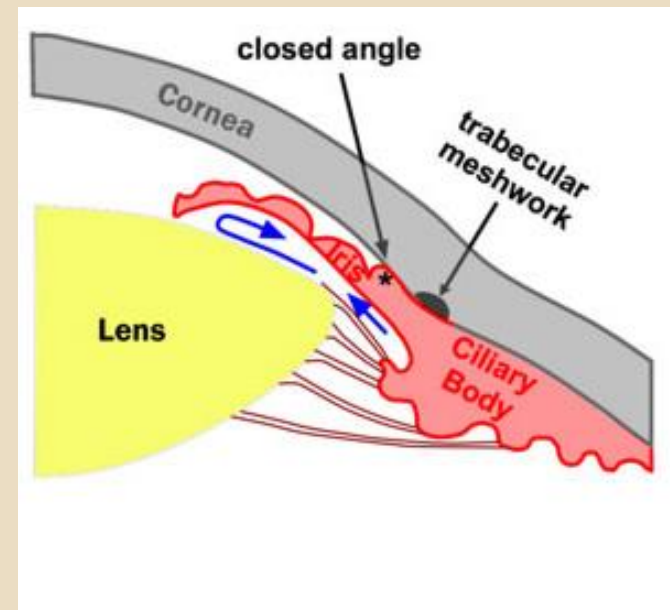
- slow clogging of the drainage canals resulting in increased intraocular pressure (IOP) leading to progressive optic nerve damage
- gradual loss of the visual field, starting with a loss of peripheral vision
- the most common cause (round 90 %)
- painless, no acute attacks



Glaucoma

□ closed-angle

- the iris bows forward and causes physical contact between the iris and trabecular meshwork, which in turn blocks the outflow of the humor from the eye
- can lead to acute closure of the angle – the onset of symptoms is sudden with pain



Glaucoma

□ **normal-tension glaucoma (NTG)**

- optic nerve is damaged, but IOP is in the normal range (12–22 mmHg)
- unknown cause

□ **secondary glaucoma**

- another disease, trauma, drug or procedure causes increased eye pressure, resulting in optic nerve damage and vision loss

Glaucoma symptoms and diagnosis

- gradually progressive visual field loss
- optic nerve changes

- in closed-angle acute angle closure can occur
 - ▣ sudden ocular pain, seeing halos around lights, red eyes, increased IOP (more than 30 mmHg)
- nausea, vomiting

- **eye tonometry**
- **gonioscopy**

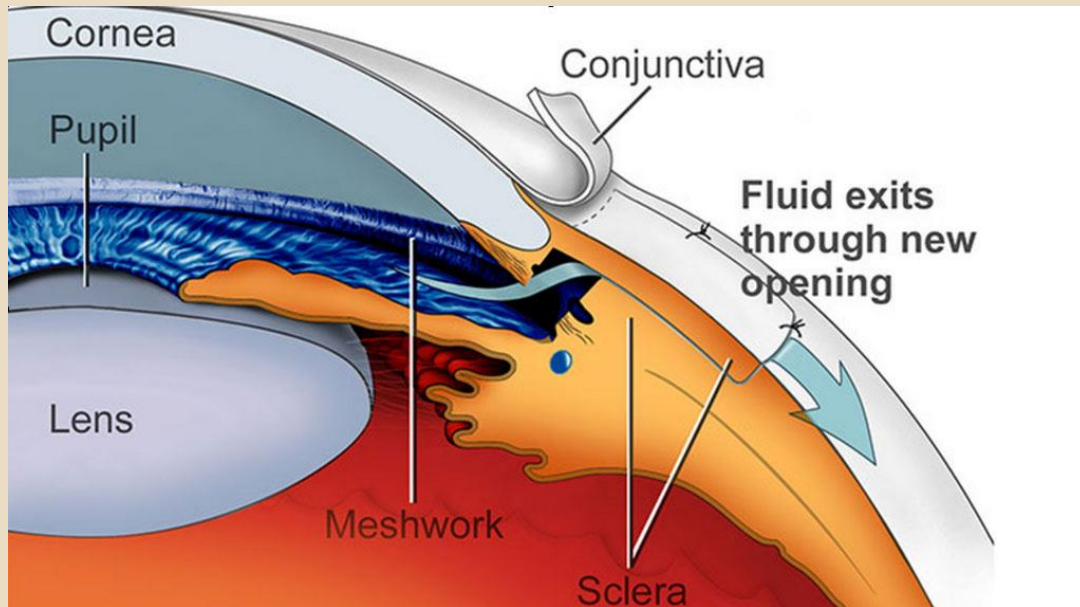


Glaucoma treatment

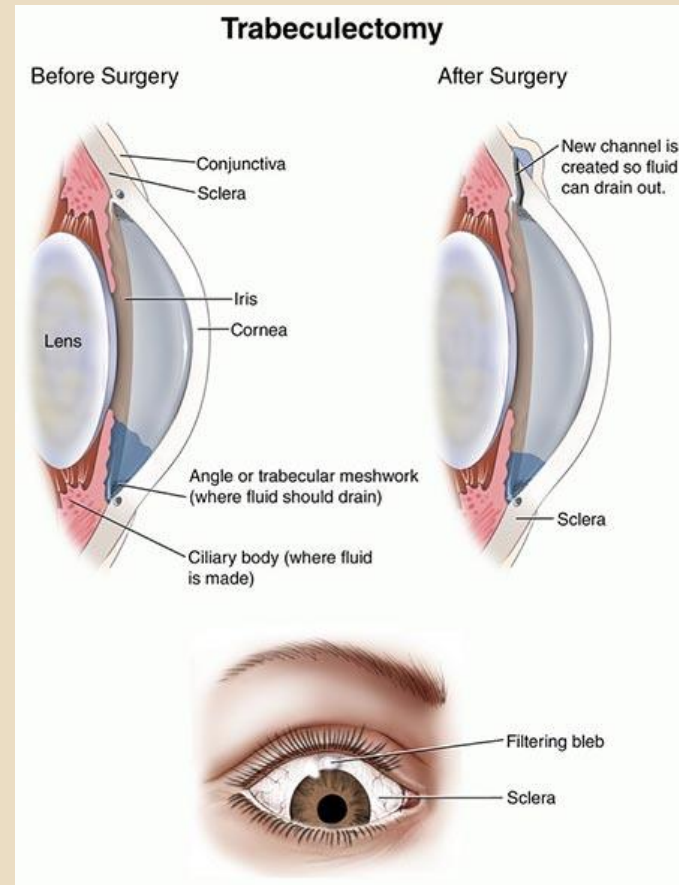
- medications in the form of *eye drops*
- **prostaglandin analogues** – increase uveoscleral outflow of aqueous humor
 - latanoprost, bimatoprost
- **beta-adrenergic receptor antagonists** – decrease aqueous humor production by ciliary body
 - timolol, betaxolol
- **carbonic anhydrase inhibitors** – lower secretion of aqueous humor by enzyme inhibiting in the ciliary body
 - dorzolamide, acetazolamide

Glaucoma treatment

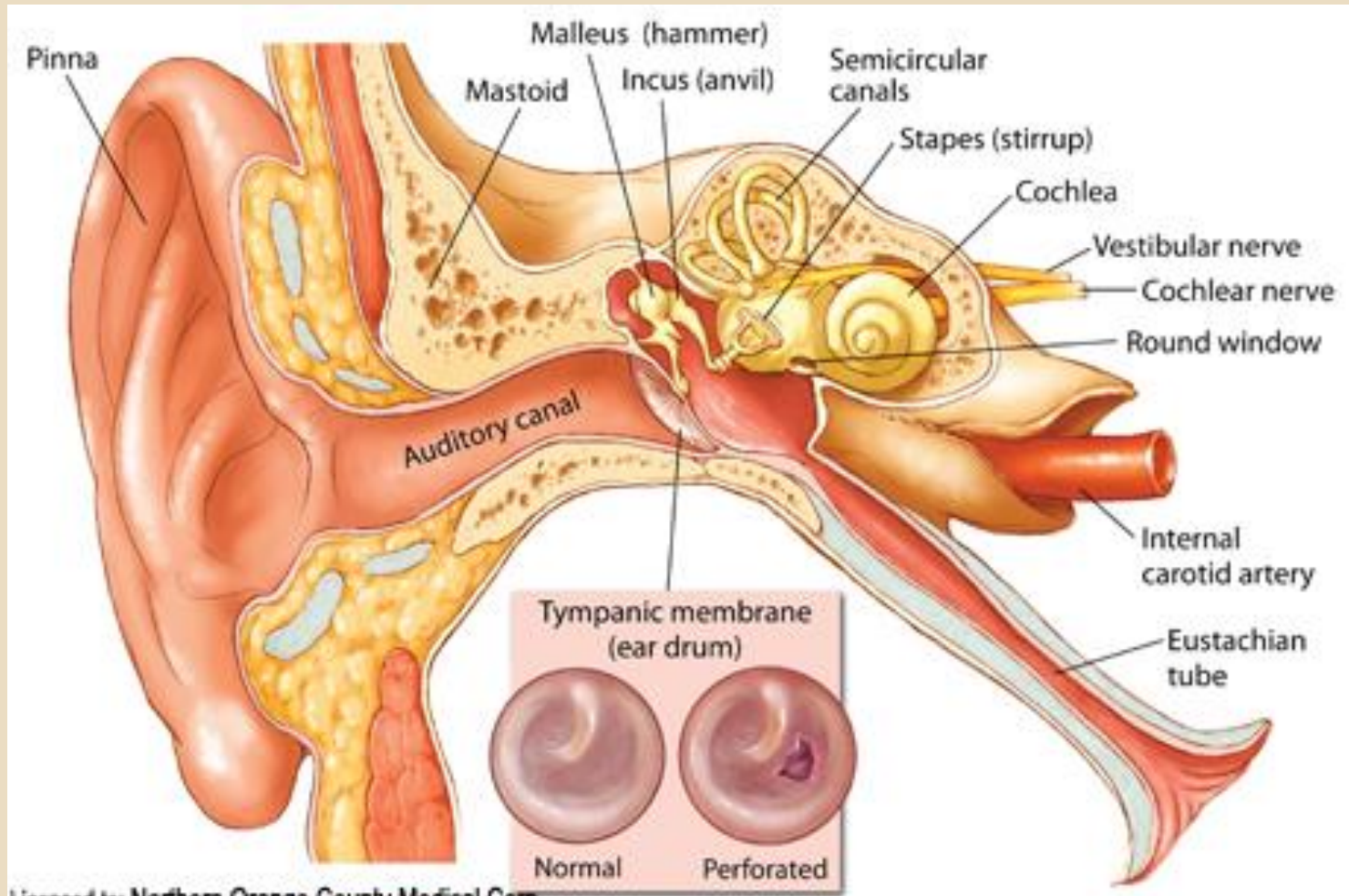
- **surgery (laser, classic)**
 - filtration surgery (trabeculectomy)
 - drainage implants



<https://www.glaucomaassociates.com/incisional-glaucoma-surgery/>

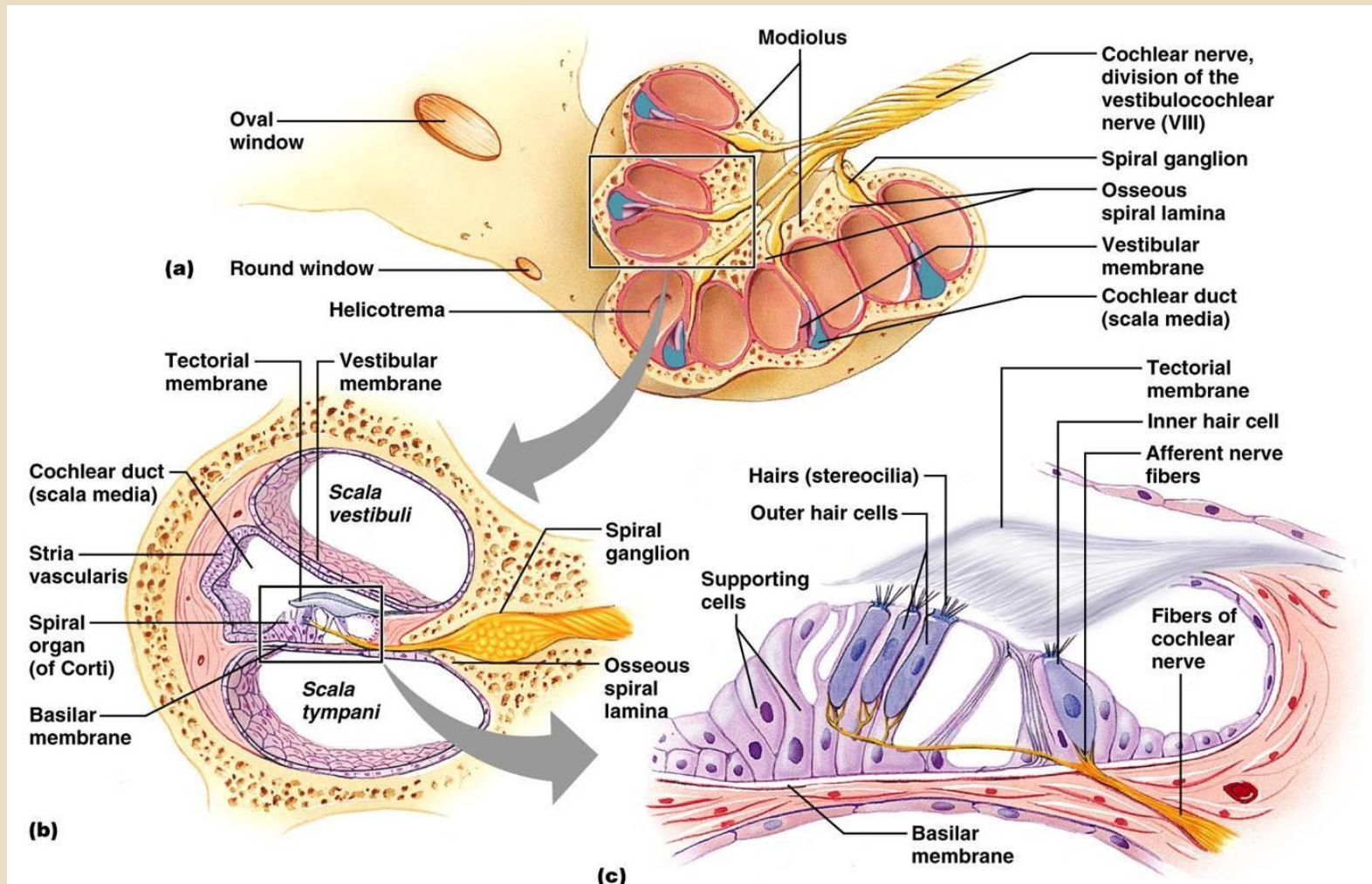


Ear anatomy



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Organ of Corti



Hearing loss

□ **conductive**

- caused by a blockage of sound transmission through the outer ear or middle ear
- auditory canal inflammations, auditory ossicles trauma
- hearing loss for bass tones or equal for all frequencies
- changes in the hearing of own voice – sounds rumblingly
- voice of other people is quiet without bass tones

Hearing loss

□ **perceptive**

- caused by problems with the inner ear or nerve pathways and brain auditory cortex
 - congenital, acquired (viruses, bacteria, toxins), noise, vascular impairment, aging (**presbycusis**)
- bigger hearing loss for **high-pitched tones**
- **peripheral hearing impairment** (auditory nerve, cochlea)
 - loss of sound reception and encoding of sounds
- **higher level impairment** (cortex)
 - sound reception is possible, but poor sound differentiation and understanding of the sense of words and sentences

Presbycusis

- aging of the inner ear and auditory pathway
- maximum loss in the area of **high-pitched tones**
- **necrosis of Corti organ** sensory cells
- toxic influences, noise, vascular damage, stress
- sometimes **tinnitus**

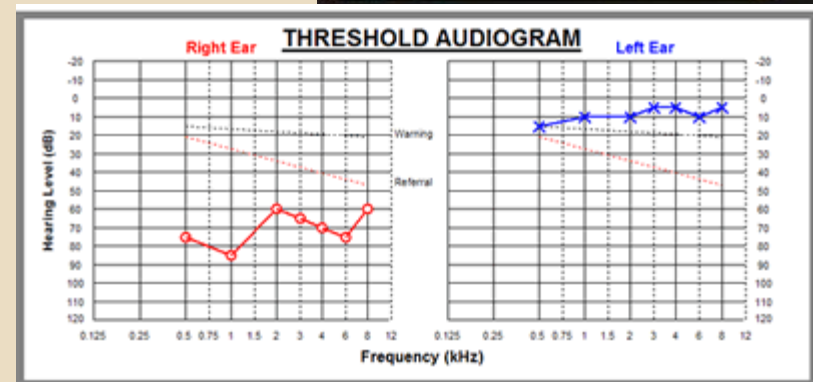
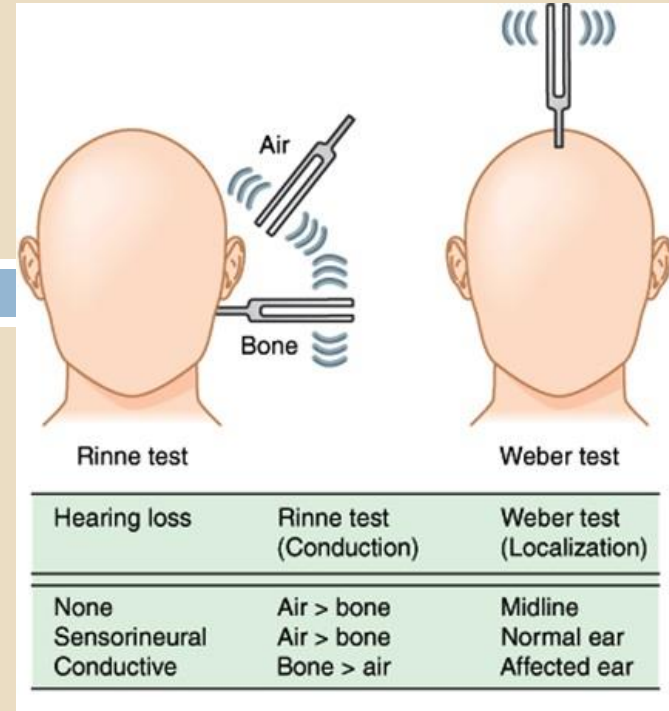
Diagnosis

□ tuning fork tests

- two-pronged, metal instruments that produce sounds when struck

□ audiometry

- presenting a range of sounds of various tones and indicating each time you hear the sound



Pharmacotherapy

- only minor and auxiliary effect
- improved blood circulation to the inner ear
- **Ginkgo bilobae leaf extract**
 - ▣ flavonoid glycosides and terpene lactones
- **betahistine**
 - ▣ H₃ receptor antagonist
 - ▣ Meniere's disease, vertigo, tinnitus



Special devices

- hearing aids
- cochlear implants

