

430 Ophthalmology Team

1st lecture:

BASIC ANATOMY AND PHYSIOLOGY

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The slides were provided by doctor (Dr. abdullah alotaibi)

Important Notes in red

Copied slides in

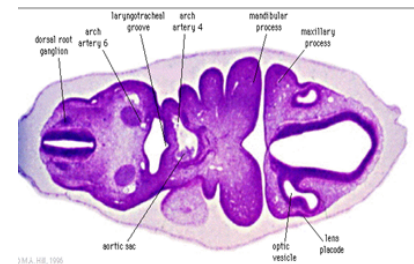
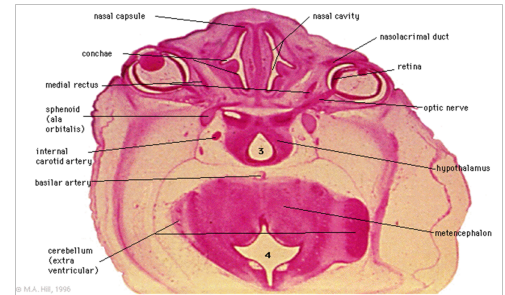
Your notes in green/ blue

Titles and subtitles in this color

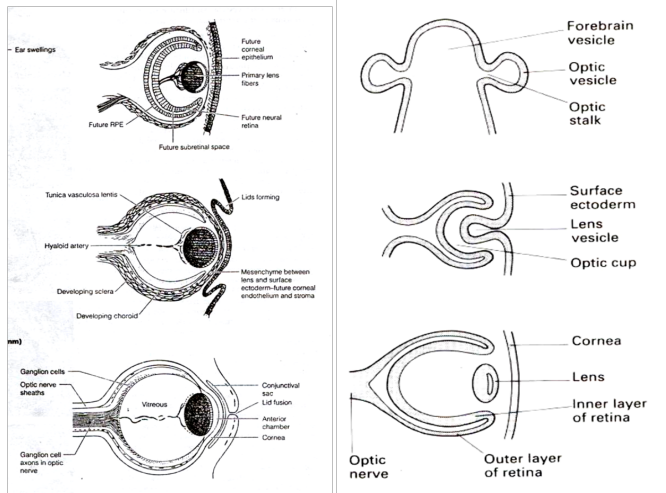
Highlight possible MCQs mentioned or pointed by the doctor

EMBRYOLOGY OF THE EYE :

- This highly specialized sensory organ is derived from neural ectoderm, mesoderm and surface ectoderm.
- n The eye is essentially an outgrowth from the brain (neural ectoderm).
- Started as **Optic vesicle** connected to the forebrain by **Optic stalk**.
- Invagination of both the optic vesicle to form **Optic cup** and the optic stalk to form **Choroidal fissure** inferiorly.
- n Surface ectoderm invaginate to form the lens vesicle.
- Mesodermal tissues invade the developing eye to share in vascular, muscular and supportive tissues of the eye.



day 42 Human Embryo



from this pictures :

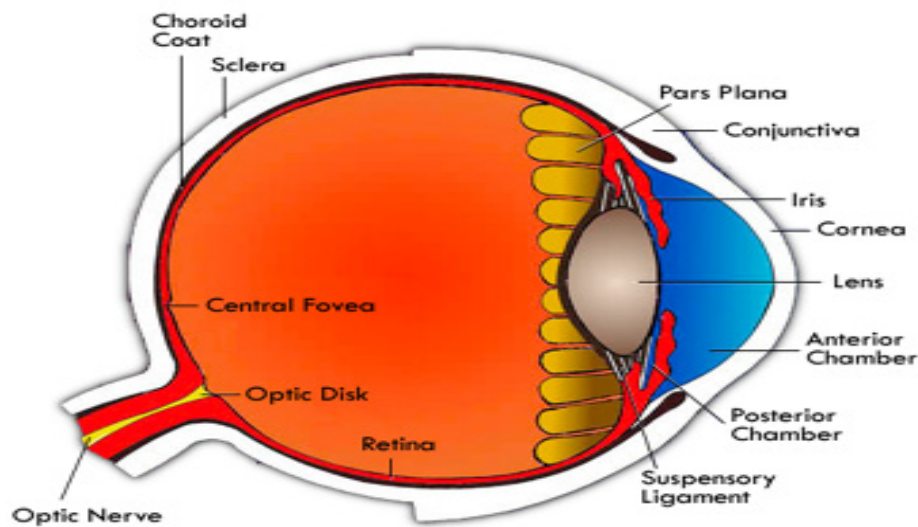
- Optic vesicle start to form vitreous , anterior of the eye and optic nerve .
- Early on cornea will separate from lens and inner layer would be form the ?? Minute 1:32 (sorry I did not get it)
- If there is abnormality in pregnancy or hazardous like radiation or medication the lens will affected and will have congenital cataract and corneal problem as well as anterior segment dysgenesis.
- Formation of the eye start early in the first month of pregnancy
- The surface ectoderm will form cornea and lens ... (no need to memorize each layer deviation)
- Mesodermal tissue invade and develop muscular support tissue of the eye
- Invagination of vesicle to form optic cup and optic stalk to form choroidal fissure inferiorly.
- Vitreous is the space between lens and retina

DEVELOPMENT OF THE EYE AFTER BIRTH :

- At birth, the eye is relatively large in relation to the rest of the body.
- n The eye reaches full size(**adult size**) by the age of 8 years. **70% eye complete development by 2 years.**
- n The lens continues to enlarge throughout the life. **That's why we get cataract later on.**



- n The iris has a bluish color due to little or no pigment on the anterior surface.



Cornea is the out most layer, transparent and form from collagen . It continues with the sclera

- Sclera is the tough part of the eye and its formed of collagen as well, the same type of collagen form the cornea, but the way of collagen arrange itself in cornea is different from the way of collagen arrange itself in sclera, that's why we have transparent cornea and sclera is relatively non transparent

- Sclera goes back until it reaches the optic nerve where it gives a hall to make optic nerve go to the brain.

- The retina and optic nerve are part of CNS

Corneal thickness .5 mm = 500 microns

Length of eye 20- 24 mm = 1 inch

Sclera is the toughest layer of the eye (it has different thickness and it is very thin under muscle) .3 mm = 300 microns thickness.

The space behind cornea = anterior chamber formed by cornea anteriorly and iris postriorly. 2.5 mm filled with aquas humorous (comes from ciliary body which has glands secrets all aquas humorous fluid, drained from anterior chamber through trabecular mesh work)

Aquas humorous is continually formed & drained .

aquas humorous function is for corneal nutrition, because its avascular (that's why its transparent) to maintain its transparency .

Cornea has many layers (the one that facing aquas humerus called endothelium layer it take the aquas and deal with it)

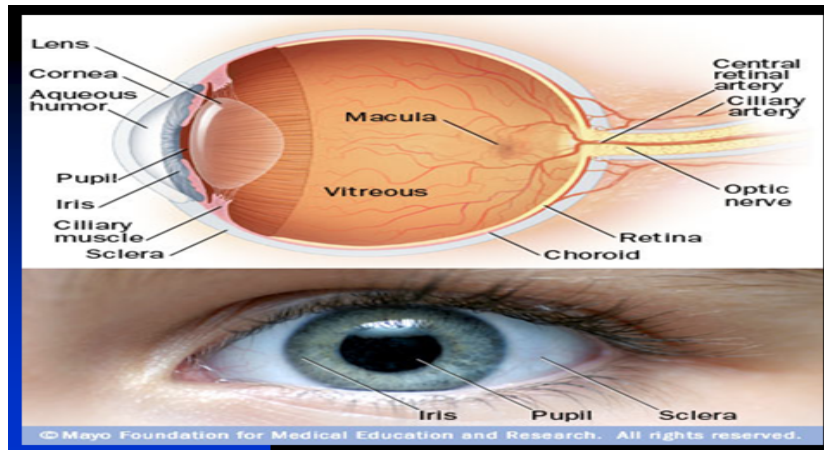
If we have the aquas come from ciliary to mesh work and had stuck any where > glaucoma.

-If the iris stuck to lens > pupillary block glaucoma (acute glaucoma) > IOP increase > pt will have pain and will affect the optic n.> part of CNS >damage of optic n. > irreversible > visual impact.

-Iris stuck to cornea in the area where the mesh work >angle closure glaucoma

-When we got cataract the lens become beggar and swallow > push the iris > block the little area .

Open iris by laser to bypass aquas humorous > the ultimate treatment is by remove the cataract.

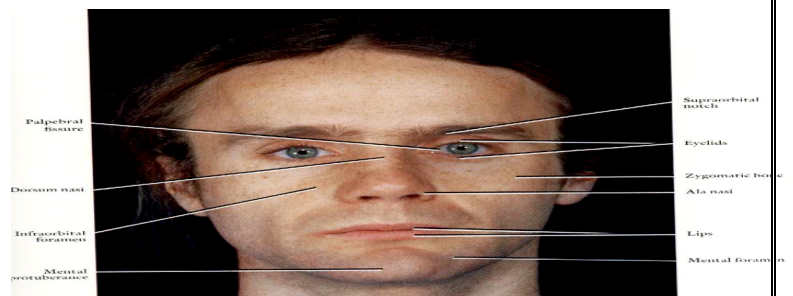


Pupil is in the middle of iris where the light come and enter the eye

- Pupil is like the sphincter that dilate and constrict, supplied by both sympathetic and parasympathetic but, the majority of control is by parasympathetic > when we go to sleep the pupil constrict from parasympathetic > in flight and flight pupil constrict by sympathetic cuz we need more light .
- So sympathetic dilate the pupil however parasympathetic constrict it.
- Behind the pupil is the lens which is in the posterior chamber
- Posterior chamber formed by iris in front and zonuls , which hold the lens posteriorly .
- lens is a transparent structure to allow the light to pass through and its function is to focus the light into fovea in order to see clearly, images has to focus in to the central fovea where the highest concentration of cones are there .
- The power of the eye is from lens and cornea
- The optical power of the eye is 60 diopter > 2/3 from cornea > 1/3 from lens
- Cornea is more important than lens.
- lens in addition to focus the light in fovea it has function called accommodation
- Accommodation is a physiological process which is involuntary process that occurs at the level of zonuls (zonuls are come from ciliary body and hold the lens)
- ciliary body is a rounded structure form a sphincter like around the zonuls > when we look for far object no need for accommodation however, when we look to near object we need more power to focus the image into fovea so accommodation used and increased< accommodation occur at level of ciliary body ms. and zonuls get stretch and relax
- Accommodation lost by age of 45 -50 where they need to wear a reading glasses to increase the power (convex glasses) which is called presbyopia
- Accommodation is very high at birth and decrease with age until it lost to a presbyopia .
- After lens > vitreous cavity > the largest cavity compared to anterior and posterior chamber > from lens to fovea > 4/5 of eye size > space filled with vitreous which is a transparent has a protein firm gel like structure attaché to retina in the early of life > start to liquefy by 45 y/o > with ageing liquefaction(fluid) > become loose > posterior vitreous detachment > it moves with fluid when moving the eyes > see flutes (الذبابة الطائرة) when we move our eyes to right and left
- vitreous detachment is a physiological disease patient is old and complain of seeing fly.
- optical power: the eye like a camera if u look to a far object u relax the power , if u look to near object u need power to focus (involuntary process) it measure by diopter .
- again and again cornea is the focus power of the eye because it's the 1st structure facing the light, in addition toning power needed from the lens.
- Cataract : lens is made by protein that's transparent in early of life > with aging it lose its transparency and become opaque > opacity increase > become white > the light cannot pass through it so its aging process > artificial lens need to be put inside.
- Behind the vitreous is retina it has many layers has a sensory layer which carries rods and cons
- Lights het the retina > initiate electrical chemical reaction > optic nerve> brain > analyze it and see the image.
- Thus why retina is an important structure to start the visual process .

- Lids are the protective layer of the eyes.
- Lids are closed and open(blinking) involuntarily, when lids are closed it spread the tear film of the cornea to keep the cornea wet all the time.
- Iris is important for vision to prevent excess light, thus why we feel pain when expose to light from constriction of the iris to make the pupil small to decrease the amount of light passing through the eye.
- If u don't have iris all light well go inside the eye and will get scattered retina > can't see well > nystagmus (in albinism children they don't have pigmentation of the iris thus why the light will go inside the eye excessively and will have poor vision)
- Pt born without iris called aniridia.
- ciliary ms holding the zonuls holding lens.
- The most important part of retina is macula > area between big artery (central retinal artery) and the center of macula is fovea.
- Central retinal artery brings the blood to the retinal and supply it with nutrients, if we have a problem in this area such as cholesterol or emboli the retina will die and will have acute visual loss (central artery occlusion).
- Pt come to emergency with embolus that travel to central retinal artery if not corrected within 10-6 minutes > retinal will die > irreversible
- Visual loss :
 - 1- chronic visual loss > cataract (gradual and comes by years)
 - 2- acute visual loss > central artery occlusion and acute glaucoma

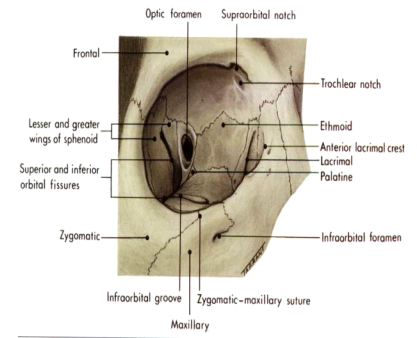
the doctor did not mention it >



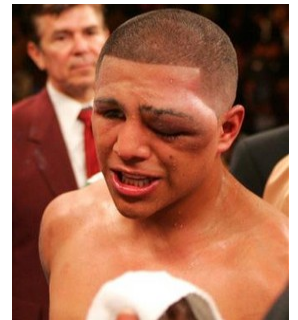
THE ORBIT:

- As a socket, contains the globe and form of bones
- n The main function is to protect the eye.
- n The weakest parts are the floor & the medial wall.
- n Seven bones contribute the bony orbit.
- n Surrounded by nasal sinuses.
- n Important openings are:
 - n Optic foramen < carries the optic nerve and ophthalmic artery.
 - ◆ Superior orbital fissure.
 - u Inferior orbital fissure
- The eye is surrounded by sinuses to lighten the skull and protection, but if there is infection in the sinus it goes to the eye (orbital cellulitis)
- orbital cellulitis is infection of the orbits which is the space were the eye sit on not the globe that caused by sinusitis such as maxillary sinus infection, ethmoidal sinus infection.. If orbital cellulitis not treated it will go back to the brain and cause total visual damage to the optic nerve.
- During ENT surgery (sinus surgery) may complicated with cutting the optic chiasm which lead to blindness in both eye especially with ethmoid sinus
- The space between both lids called palpebral fissure
- If someone hit by a fist usually have fracture of the floor of the orbit.
- Patient with fracture of the orbital floor < inferior rectus sit in the floor will trapped in the fracture so pt cannot look up > diplopia < the fracture should be immediately repair.

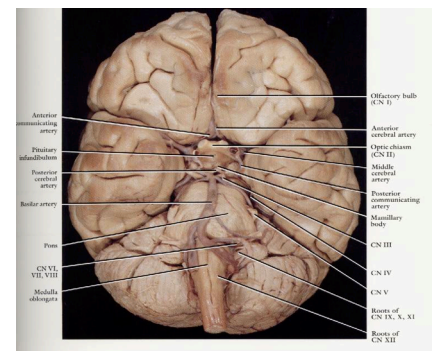
- Seven bones contribute the bony orbit : Greater and lesser wings sphenoid , zygomatic , ethmoid, lacrimal, palatin, frontal and maxillary bone



- a boxer hit by a fist is a great example of inferior orbital fracture with a black eye.



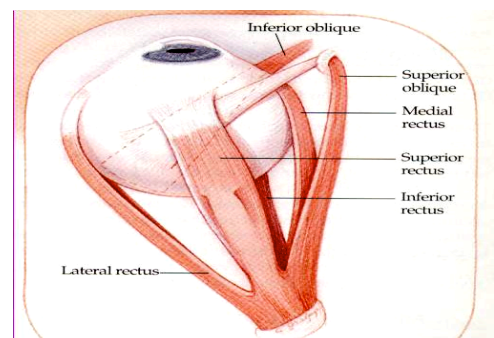
- The doctor mentions these structures :
 Optic chiasm (usually the ENT cut it by mistake)
 Pons
 Medulla oblongata
 Basilar artery



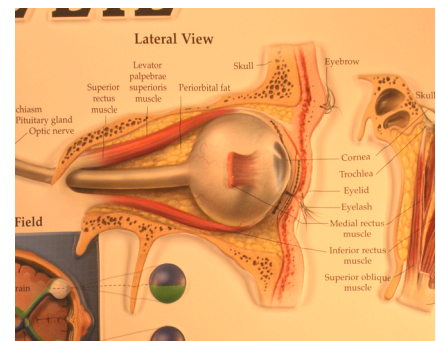
THE EXTRAOCULAR MUSCLES :

- Four recti & two oblique muscles.
- n All are supplied by Oculomotor n. except superior oblique (Trochlear n.) & lateral rectus (Abducent n.).

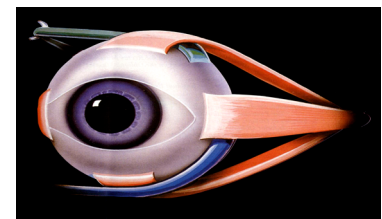
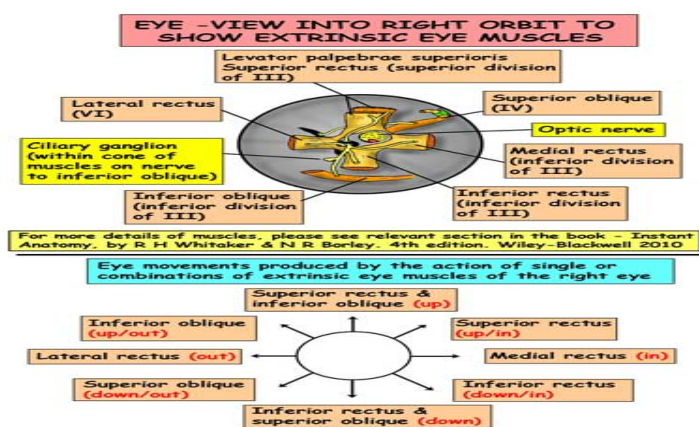
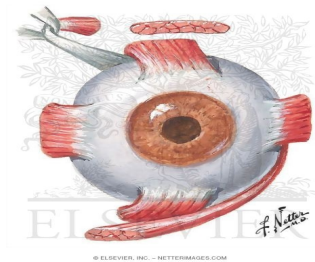
- In this pic it is the Left eye .
- Also it has levator muscle which elevate the eye .



- The globe sits in the orbit surrounded by fat tissues that work as a cushion of the globe and goes forward until the eyelid.
- Some ppl when they get aged > fat herniation < because the septum that prevents the fat from coming out becomes weak.
- Blood trauma > the eye will be pushed backward and then released forward < depending on the degree of force < some have cut in optic n. (optic n. avulsion) irreversible damage to optic n. no TREATMENT.



- Optic nerve and the four recti muscles meet at the annulus of Zinn (the origin of the four recti muscles) > that's why when pt has Myositis it can affect the optic nerve. When we do strabismus surgery we cut (maximum 2 muscles)



Blood supply of the eye :

Ophthalmic artery (#1 in figure).

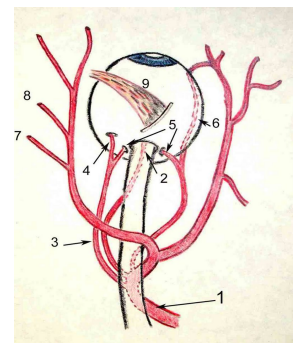
Central retinal artery (#2 in figure).

Ciliary arteries (#3 in Figure) on each side of the optic nerve.

2 long posterior ciliary arteries(#4 in Figure) and ~20 short posterior ciliary arteries (only one on each side is shown in the diagram #5).

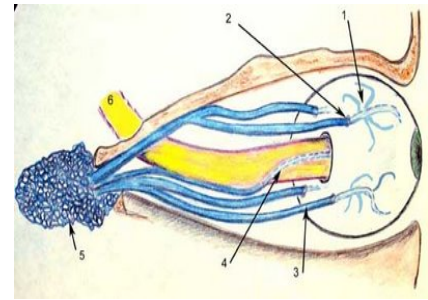
The short posterior ciliary arteries directly supply the choroid and the long posterior ciliary arteries travel in the suprachoroidal space anteriorly (#6 in Figure) then supply the choroid anteriorly via recurrent branches.

The ophthalmic artery (#1 in Figure) continues to provide branches for the posterior (#7 in Figure) and anterior (#8 in Figure) ethmoidal vessels.

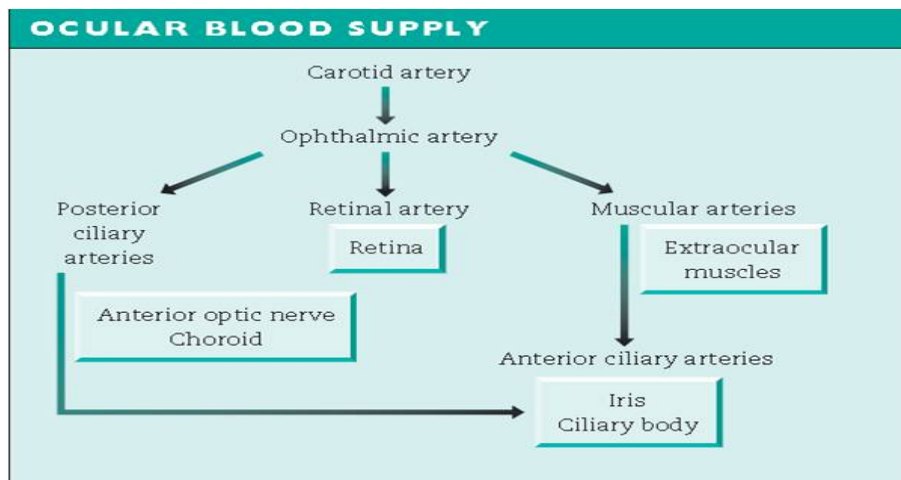
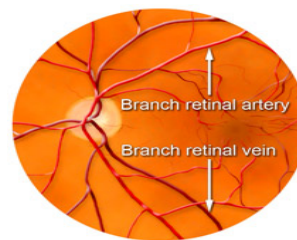


- All blood supply comes from ophthalmic artery > gives branches > ciliary artery > long and short posterior ciliary artery > short posterior ciliary artery supply choroid > long posterior ciliary artery supply outer structure.
- Furthermore, ophthalmic artery gives ciliary artery that supply lacrimal gland, muscular structure and ethmoidal sinus.

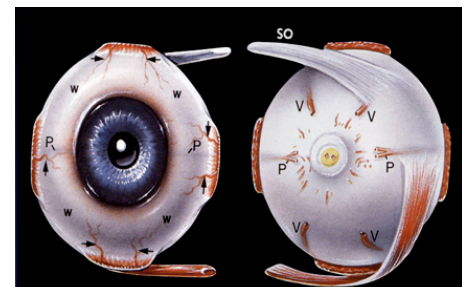
- choroid to drain into 4-6 vortex veins from cornea
 - The vortex veins emerge just posterior to the equator (#2 in Figure)
- vortex veins will drain into the superior and inferior ophthalmic veins.2,3
- cavernous sinus #5
 - Pt with cavernous sinus thrombosis < avulsion of the eye and loss of vision < serious case



- The black is vein and the bright is artery
- Artery looks smaller than vein
- Veins are dark <small peripherally



- these small vessels in conjunctive are come from muscles > give supply to iris and ciliary body.
- In strabismus surgery we cut the muscles, if u do it for three muscles> anterior segment ischemia < cus one muscle is not enough to supply iris and ciliary body. Maximum we cut 2 muscles and later on do the rest cus collateralizations will formed.



Nerve supply:

3rd, 4th, 6th cranial nerves are controlling the eye

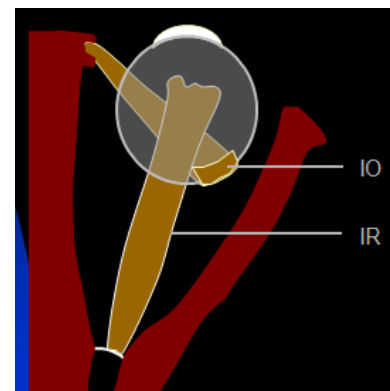
-5th trigeminal > sensory .

-7th facial > orbicularis oculi > closure of eye.

If pt cant close his eye during sleep < problem in facial nerve.

Attachment of eye muscles:

IO < come from the back of eye < goes down to the lacrimal crest
(that's why it's an oblique ms)

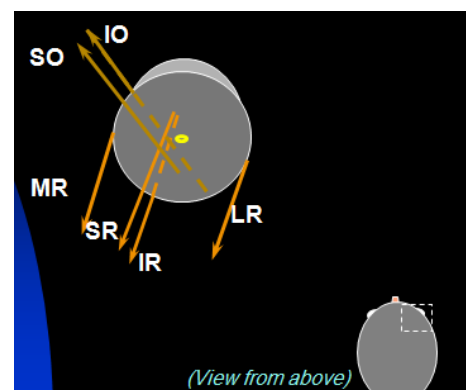
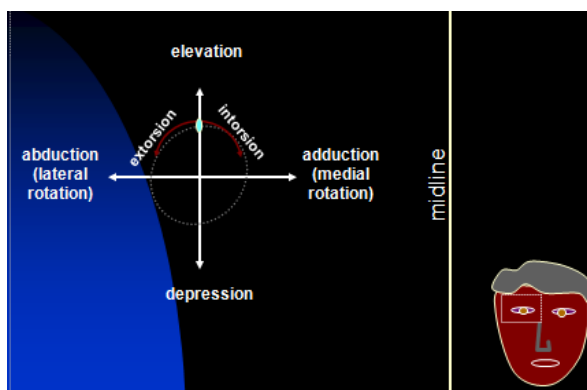
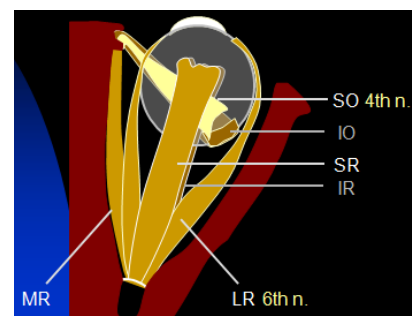


From this pic the dr mentions:

SO by 4th

LR 6th

IO, SR, IR & MR all by 3rd



-MR (medial rectus) < adduction

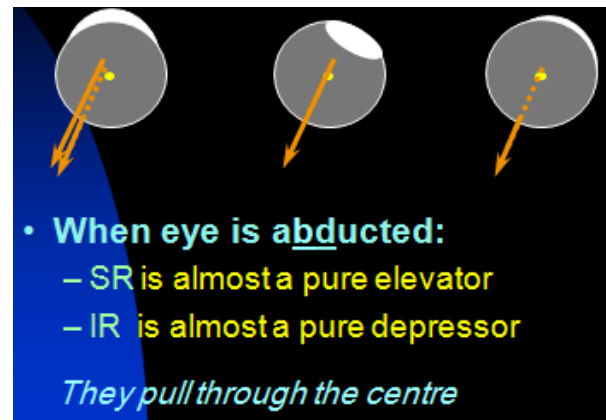
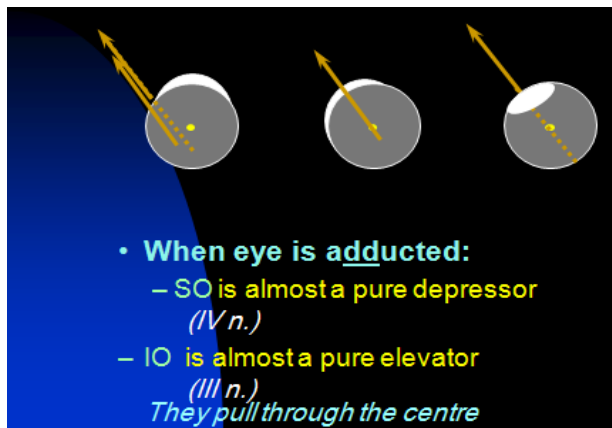
LR< abduction

SR<elevation

IR<depression (but if there is damage to the floor of the orbit it will trapped in between the fractured bone so pt can't look up<mechanical prevention)

-Oblique muscles cause intorsion and extorsion of the eye

Rotation of the eyes is mainly controlled by oblique muscles



Hence for clinical test:

Direction to look

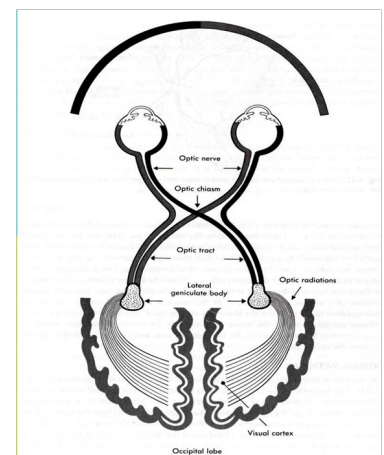
<input type="checkbox"/> SO	<	Down and in
<input type="checkbox"/> IO	<	Up and in
<input type="checkbox"/> SR	<	Up and out
<input type="checkbox"/> IR	<	Down and out

The Visual Pathway :

- Visual Pathway: Three neurons
 1. Bipolar cell, lies within the retina.
 2. Ganglion cell, synapse in lateral geniculate body.
 3. Third neuron terminates in visual cortex.

- The visual pathway starts from < nasal and temporal parts join at optic nerve < optic chiasm < decussate (the nasal part cross over the chiasm, so the right nasal nerve goes to the right temporal .. < right optic tract (right visual field) and left optic tract < lateral geniculate body< gives optic radiation to occipital cortex

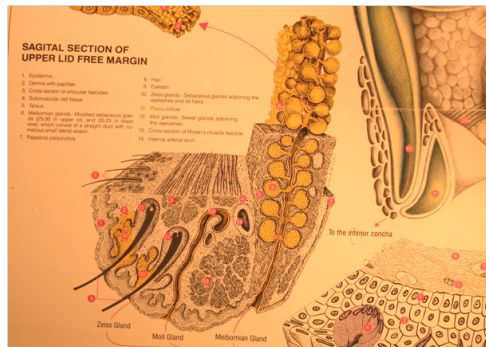
- So the visual pathway start in the globe and ends in the brain < the brain will process, upright, magnify and join the images from both sides.



THE EYELIDS :

- They provide a protective covering for the eye.
- The lids are closed by Orbicularis oculi muscle (Facial n.) and opened with levator palpebrae muscle (Oculomotor n.), Muller's muscle (Sympathetic supply) & Lower lid retractors.
- So if we have 3rd nerve palsy < ptosis (lid cover the eye).
- Facial palsy < open eye < long time < dryness of cornea < will damage the cornea.

comes from meibomian gland and its prevent the evaporation of the tear film.



the doctor did not mention it >

CONJUNCTIVA

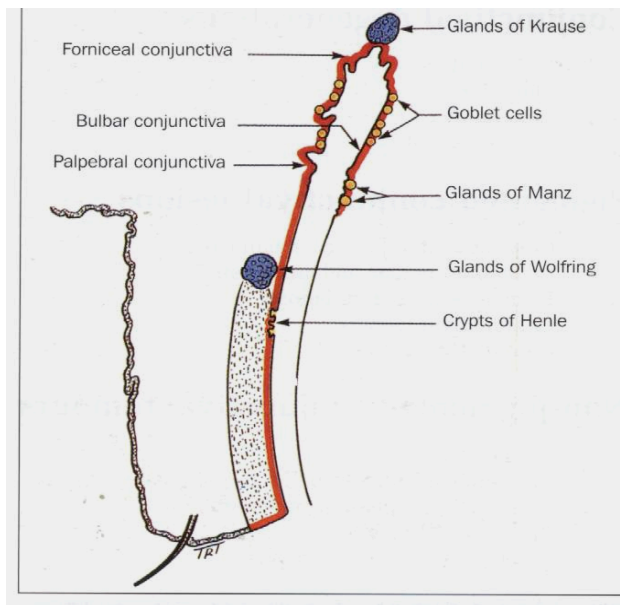
■ Three parts:

1. Bulbar conjunctiva. (cover anterior part of globe)
2. Palpebral conjunctiva. (cover the eye lid from inside)
3. Forniceal conjunctiva. (where palpebral and bulbar meet)
4. Limbus. (the junction between cornea and sclera)

■ The stroma (no adenoid tissues until 3 months after birth).

■ Follicles & Papillae.

■ Injection and chemosis. (injection = dilation of conjunctival Vasculature)



*Gland of conjunctiva secrete the mucin layer of tear film

Goblet cell

Glands of Krause

Glands of Manz

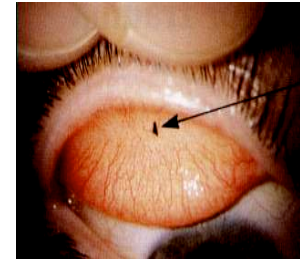
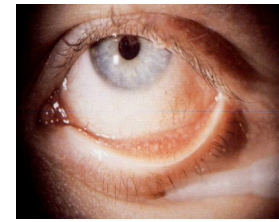
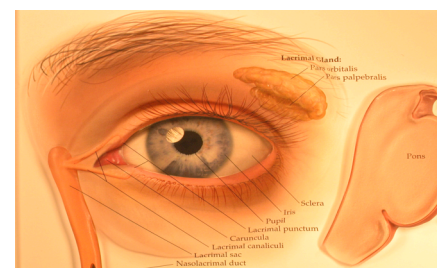
Glands of wolfring

THE LACRIMAL APPARATUS:

- **Lacrimal gland secretes tears into the upper fornix of the conjunctival sac which are spread over the surface of the cornea as a tear film by blinking of the lids.**

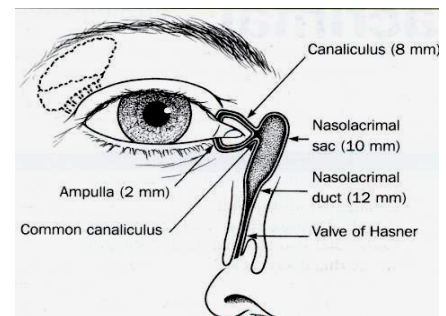
- **Tears accumulate at the inner canthus and drain into the lacrimal sac via the puncta & canaliculi.**

The sac is continuous inferiorly with the nasolacrimal duct which opens into the nasal cavity just beneath the inferior turbinate



*Lacrimal gland is reflex gland in case of trauma or emotion
The lacrimal gland start working otherwise our daily tear film coming from conjunctival gland

- congenital nasolacrimal obstruction is relatively common
- in children (site of obstruction in nasolacrimal duct)



Lacrimal Apparatus

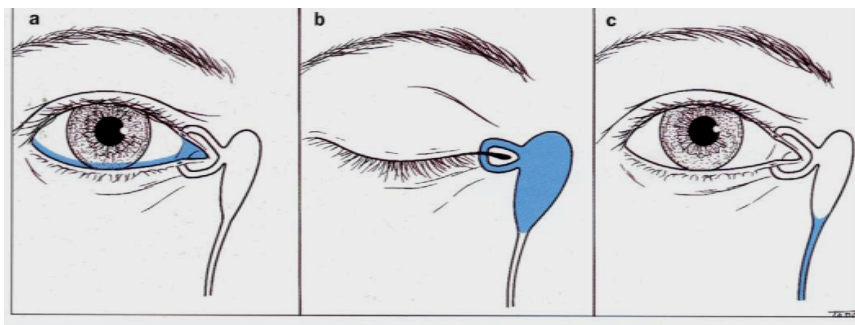
- Tear secretion.
- Layers of precorneal tear film.

The tear film (10 μ m thick) covers the external ocular surface and comprises three layers:

- thin mucin layer in contact with the ocular surface and produced mainly by the conjunctival goblet cells
- aqueous layer produced by the lacrimal gland
- surface oil layer produced by the tarsal meibomian glands and

- delivered to the lid margins.

Drainage of tea



THE EYE (GLOBE)

- Two spheres with different radii:
 - Cornea, window of the eye.
 - Sclera, opaque shell.

*** The eye measures approximately 24 mm in all its main diameters.

The coats of the eye

* **Three layers:**

- The outer: inelastic coat, transparent cornea and opaque sclera.
- The middle, vascular coat, The Uvea: choroid, ciliary body and iris.
- The inner: The Retina, extends forwards to within 6 mm of the limbus.

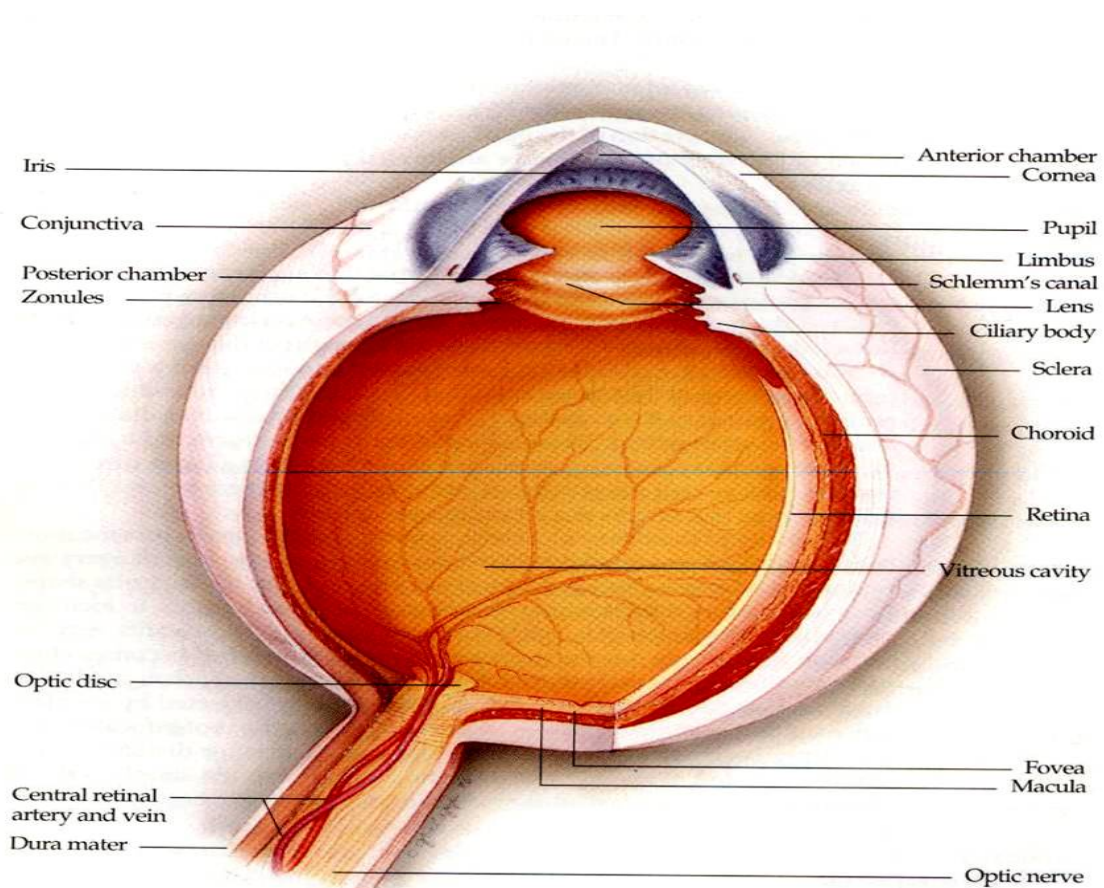
The Chambers of The Eye

*** **Three optically clear spaces:**

- The anterior chamber, in front of the iris (between cornea and iris)
- The posterior chamber, immediately behind the iris. (between lens and iris) These two chambers which communicate through the pupil are filled with clear aqueous humour.
- The vitreous cavity: filled by gel-like structure,
- The Vitreous.

The Lens

- The crystalline lens is the only structure continuously growing throughout the life.
- Changeable refractive media.
- Capsule, epithelium and lens fibers.
- Congenital anomalies and effect of systemic diseases.
- Cataract.



Retina and Vitreous

Vitreous : Is a clear gel occupying two-thirds of the globe.

Vitreous attachment.(attached anteriorly to the peripheral retina, pars plana and around the optic disc, and less firmly to the macula and retinal vessels)

- Optic nerve head, macula, fovea, retinal background, Ora serrata, and retinal vasculature.
- Effect of systemic diseases.
- Retinal detachment.

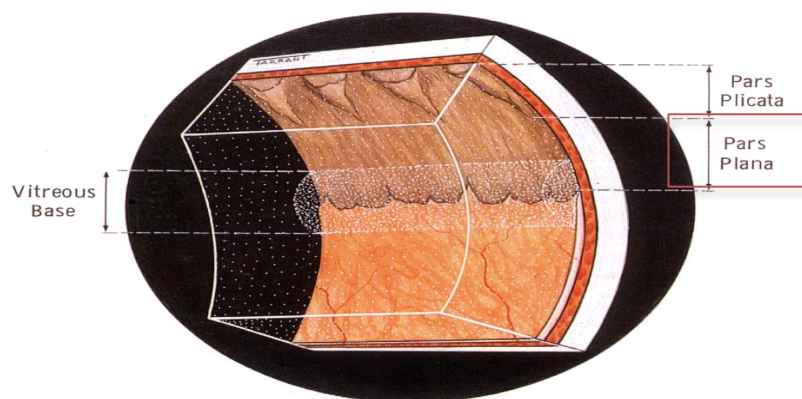
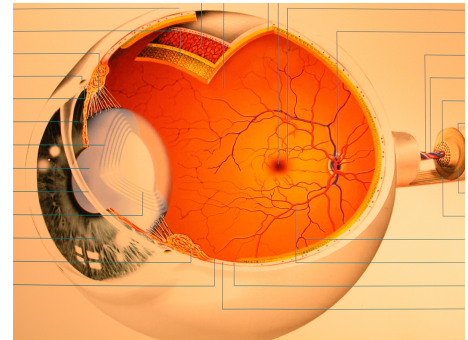
Vitreous keep retina in its place if it is empty retina will Collapse

Type of retinal detachment :

1-traction retinal detachment

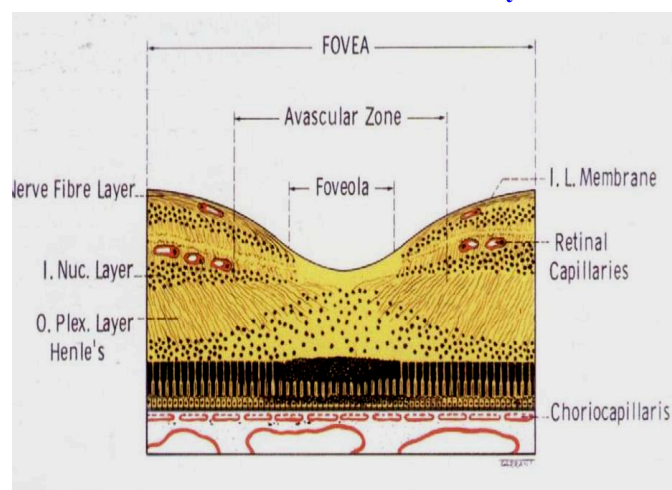
2-rhegmatogenous retinal detachment (Liquefaction of vitreous , occurs later in life , lead to posterior retinal detachment)

3-exudative retinal detachment

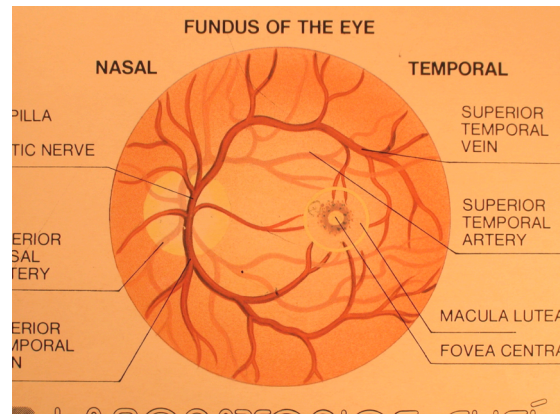


THE PARS PLANA

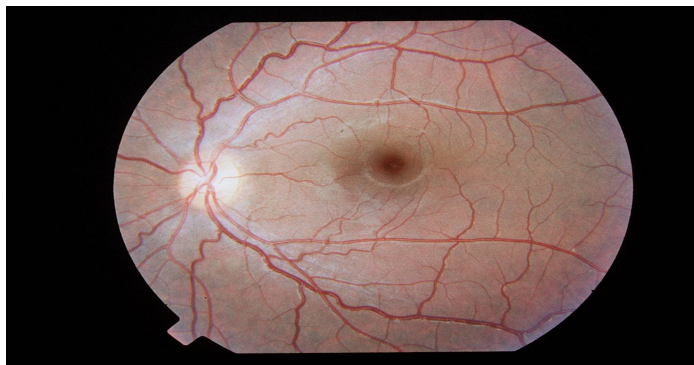
- This comprises a relatively avascular stroma covered by an epithelial layer two cells thick.
- It is safe to make surgical incisions through the scleral wall here to gain access to the vitreous cavity.



Fove : depression in retina , it is the thinnest layer of retina .Cones is highly concentrated in fovea



Fundoscopy = back of the eye
Red reflex > is coming from pigmented retinal epithelium

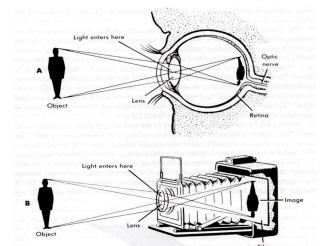


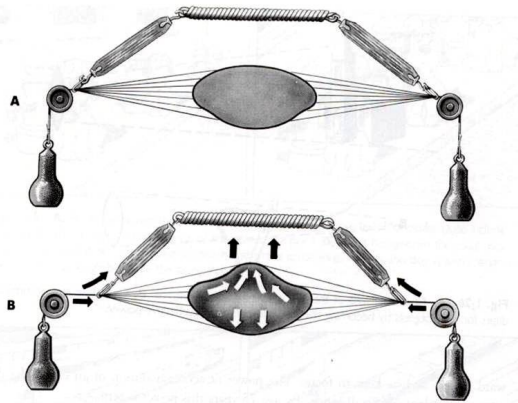
***Dark=vein**
Bright = artery

Optics of the Eye

The eye is like a camera. Light must have a clearly pathway to be clearly focused on the sensory receptors of the retina, i.e., Clear cornea, anterior chamber, lens and vitreous cavity.

- The Refractive power of the eye is about ± 58 dioptres.
- **The cornea is the major refracting element of the eye with a power of approximately 40 dioptres.** If the curvature is greater in one meridian than the other → Astigmatism
- The refractive power of the lens is about 17 dioptres at rest. Accommodation able to change the power of the lens markedly depends on age.

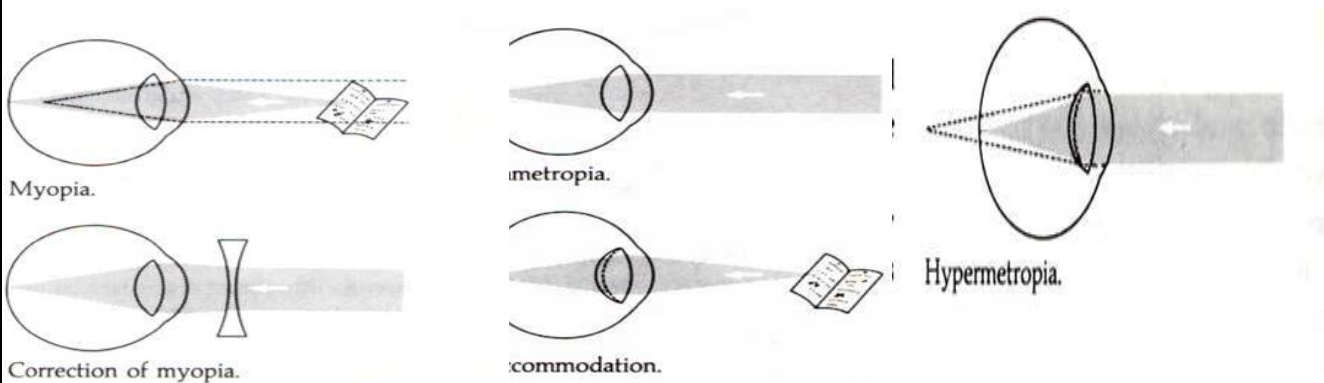




*Accommodation : increase in refractive power of lens in order to see near object

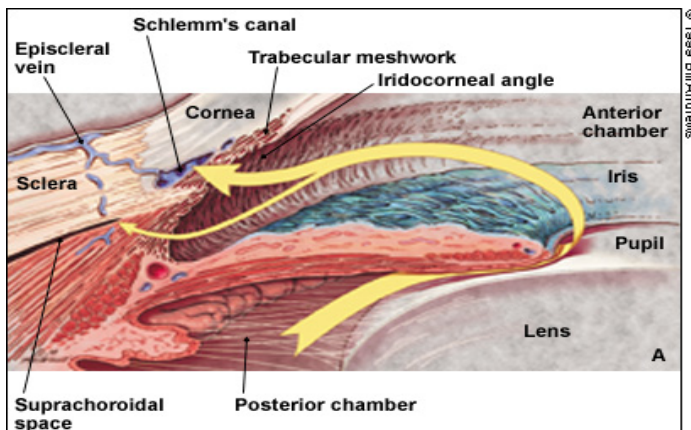
*Contraction of ciliary muscle by parasympathetic

- **Emmetropia:** Optically normal eye in which rays of light from a distant object are focused on the retina without accommodation.
- **Myopia:** Light focused on front of the retina, corrected by concave lens.
- **Hypermetropia (hyperopia):** Light focused behind the retina, corrected by convex lens.

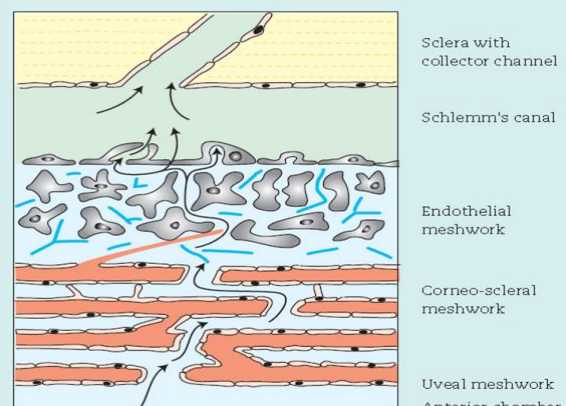


The intraocular pressure

- The pressure within the eye is maintained at a steady level by continuous formation & drainage of aqueous.
- Aqueous is secreted by the ciliary epithelium → posterior chamber → anterior chamber (through the pupil) → drained through the anterior chamber angle.
- The intraocular pressure, (IOP), is normally 10 - 21 mmHg; increased IOP called Glaucoma.
- High IOP almost always due to an obstruction of aqueous outflow.



TRABECULAR MESHWORK STRUCTURE

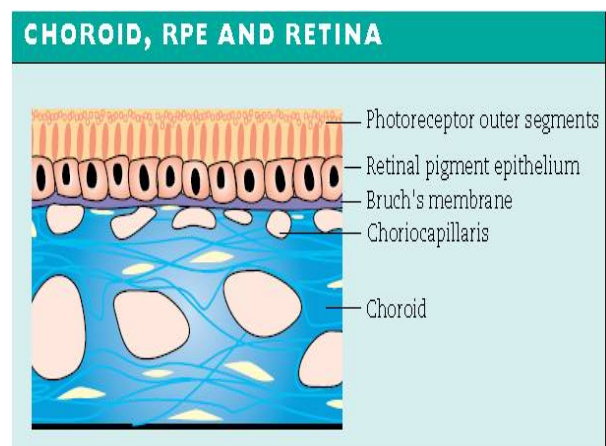
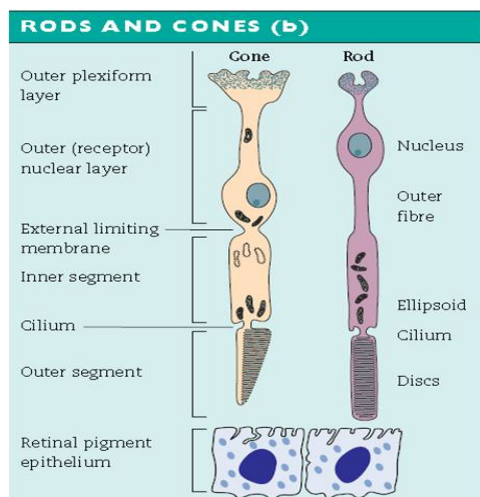
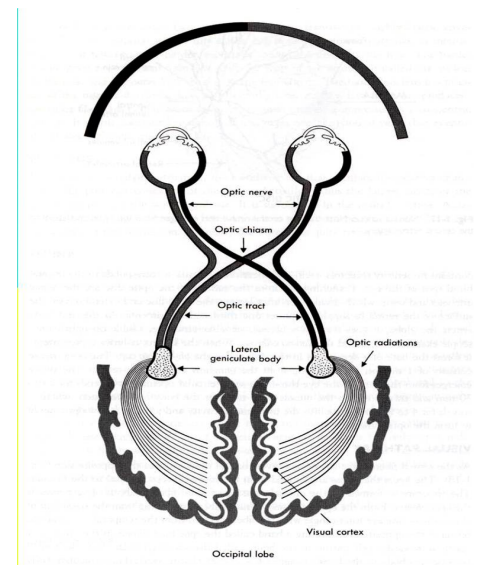


The retina:

- The central retina contains yellow pigment, Xanthophyll, the so called macula lutea (yellow spot).
- It is divided into retinal pigment epithelium & neurosensory retina.
- - Photoreceptors contains visual pigment which consists of a large protein (opsin) attached to retinal (vitamin A aldehyde).

VISION

- Light splits the opsin from the retinal with initiation of a graded electrical potential → Transmitted through the visual pathway to be processed in the visual cortex (occipital lobe) → vision sense.
- Visual Pathway: Three neurons
 1. Bipolar cell, lies within the retina.
 2. Ganglion cell, synapse in lateral geniculate body.
 3. Third neuron terminates in visual cortex.



Doctor didn't mention any thing on these photo

