



Physiology Team



Lecture : 13

Eye and refraction

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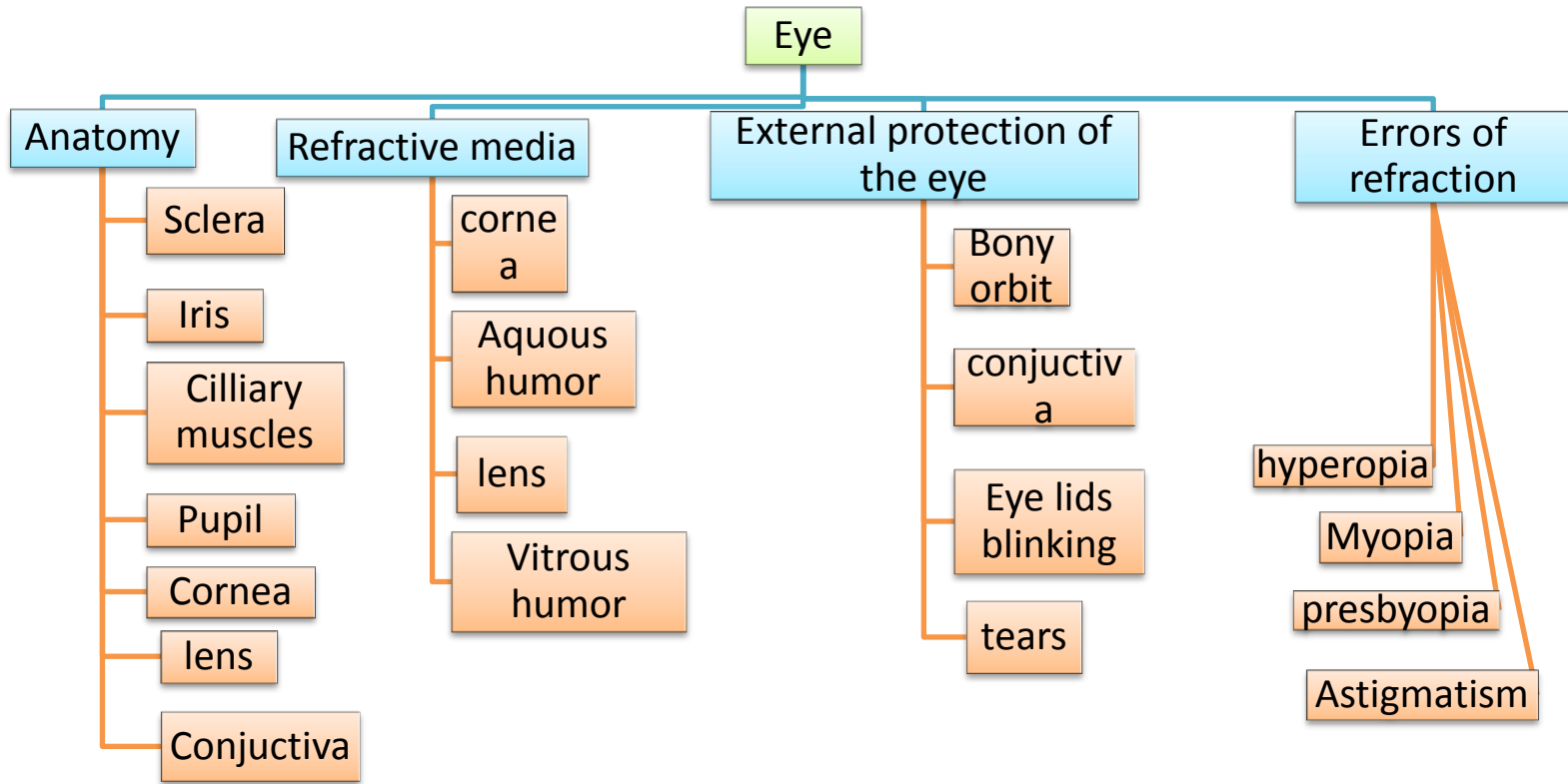
Reviewed By: Shaimaa Al-Refaie

OBJECTIVES

At the end of this lecture, student should be able to :

- Describe different components of the eye and function of each and understand the eye protection media
- Describe the refraction of light as it passes through the eye to the retina, identifying the refractive media of the eye
- Know glaucuma and binocular vision
- Know layers of retina, blind spot, and fovea centralis
- explain the different light sensitivities of the fovea, peripheral retina and optic disk
- Know principles of optics and errors of refraction
- light and eye

MIND MAP

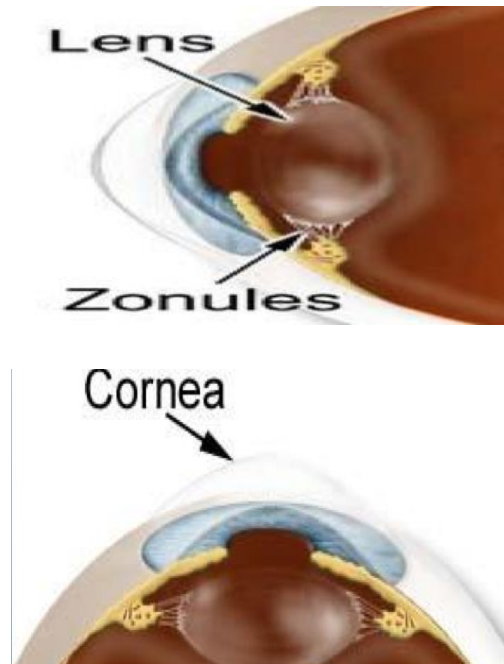
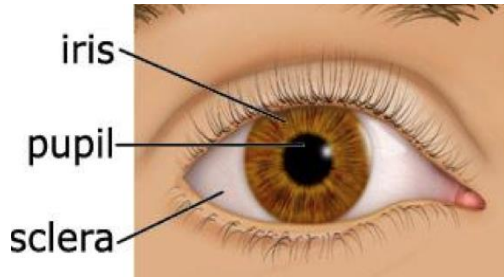


Anatomy of the eye

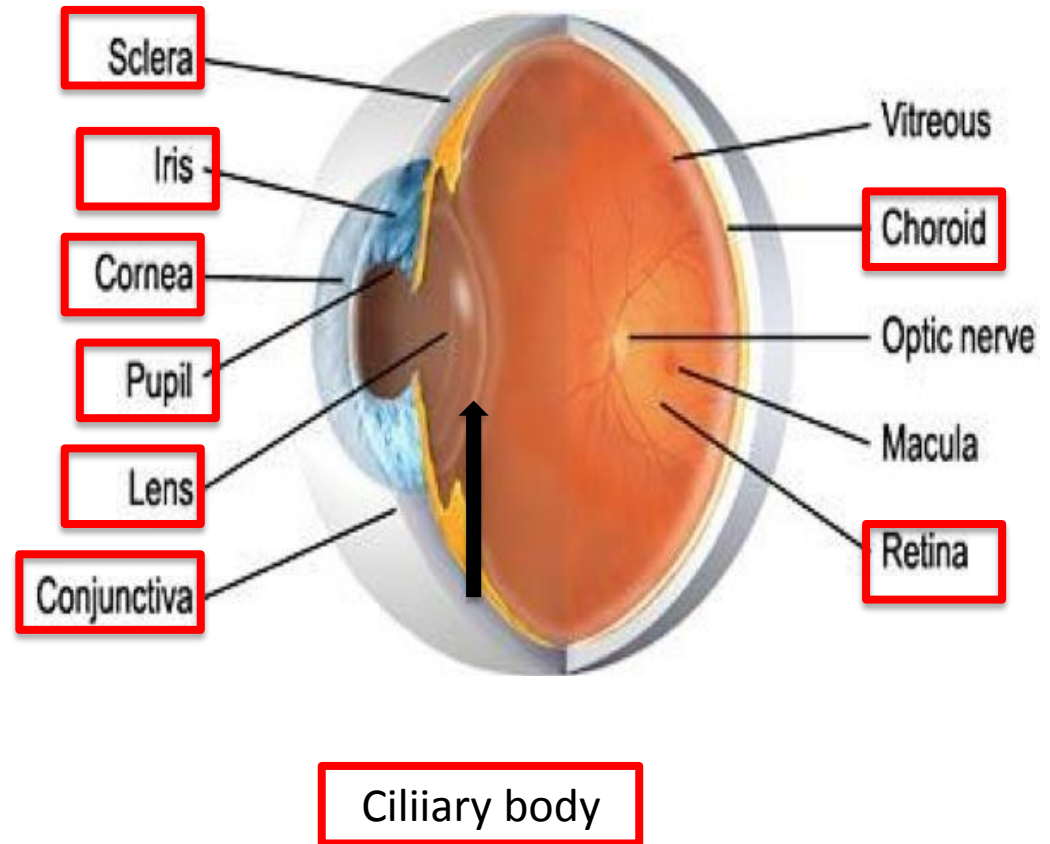
1.Sclera	2.Cornea	3.Conjunctiva	4.Pupil
<ul style="list-style-type: none"> • for protection (Fibrous connective tissue) • spherical appearance • choroids <u>inside sclera</u> for nutrition (Blood Vessel to supply retina with blood) , post 2/3 of choroid has retina innermost layer. 	<ul style="list-style-type: none"> • modified anterior 1/6 of sclera. • Transparent and <u>Avascular</u>, to allow light to enter the eyes . • Refractive or dioptric power 40-45 Dioptre at its anterior surface. 	<ul style="list-style-type: none"> • Transparent membrane. • Covers anterior surface of eye. • Reflected on inner surface of eye lids. • Covered with thin film of tears for protection, wetness, cleaning. 	<ul style="list-style-type: none"> • behind center of cornea. • allow light to enter the eye (retina).

Cont.

5.Iris	6.Ciliary muscles (body)	7.lens	8.Uvea
<ul style="list-style-type: none"> • colored part • It consist of (<u>radial muscle</u> dilates the pupil supplied by sympathetic) , and <u>circular muscles</u> constrict the pupil supplied by parasympathetic) 	<ul style="list-style-type: none"> • thick anterior part of choroid. • Attached <u>suspensory ligaments (zonule)</u> they connect the <u>ciliary body with the lens.</u> 	<ul style="list-style-type: none"> • Transparent • biconvex • semisolid • dioptric power 15-20 D • held in place by zonule (lens ligament= suspensory ligament) attached to ant part of ciliary body (choroid) 	<p>It is the middle layer of the eye which consist of :</p> <ul style="list-style-type: none"> • Choroid • Iris • ciliary muscles <p>No fluid and it's not transparent</p>

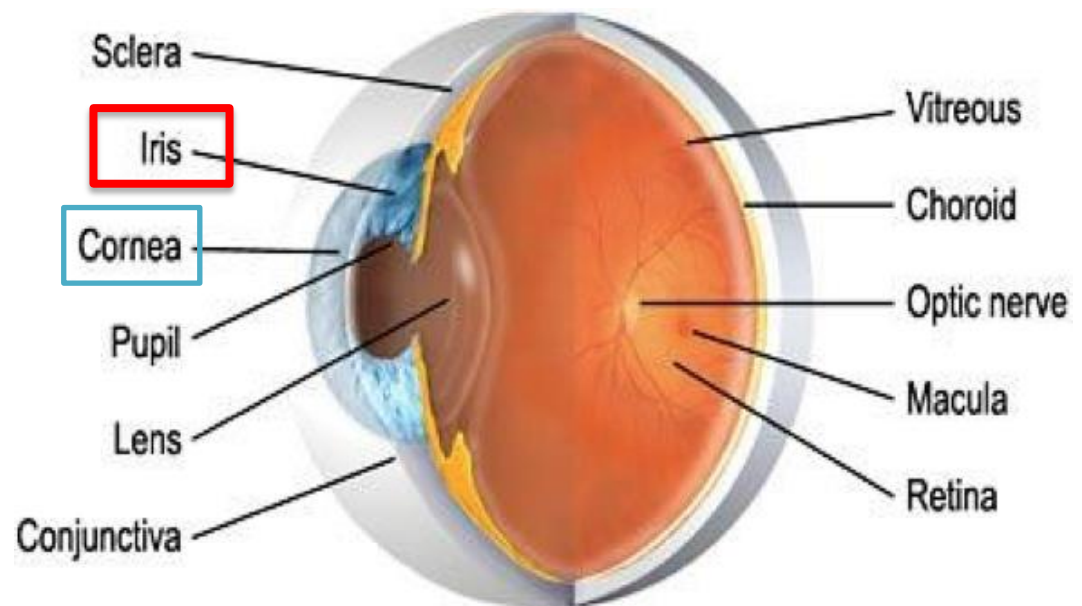


Cataract is degenerative process happens to the lens >> deposition to some particle makes it solid



The **iris** divides the eye into two chambers :

- **Anterior** chamber : between iris and **cornea**
- Posterior chamber : between iris and (ciliary body + **suspensory ligament**)





Refractive media of the eye :

When the light enters the eye it gets refracted first by cornea > to the anterior chamber which is filled by aqueous fluid but the light is refracted weakly in the ant chamber > to the lens and finally to vitrous humor.

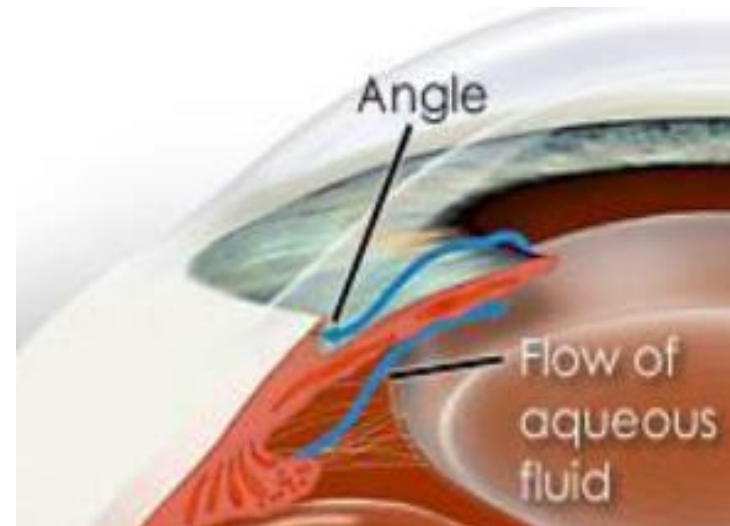
1. **Cornea** (the greatest refraction of the light) : Dioptric power (40 – 45 D) at anterior surface (2/3 of refractive power of the eye)
2. **Aqueous humor** : is a fluid produced by the ciliary body , to posterior chamber > to pupil > to anterior chamber > to canal of schlemm at angle of anterior chamber then finally to the vein of the nose . Its function is to nourishing a small part of the retina , the anterior structures of the eye and all the other structures of the eye. It causes an intraocular pressure (10 -20 mmHg)
3. **Lens** : dioptric power 15-20 D - (1/3 refractive power of eye) , more important than cornea.
4. **Vitrous humour** : (between retina & lens for nourishing retina & keep spheroid shape of the eye)

Remember that :

- In refraction the most important structure is the lens then the cornea
- The aqueous and vitrous humore are less important than lens and cornea

What is glaucoma ??

Glaucoma happens when the **intraocular pressure increases to more than 20 mmHg**, if it's not treated and continue to a long period it may lead to blindness because it damages the optic nerve and lead to degeneration of it.

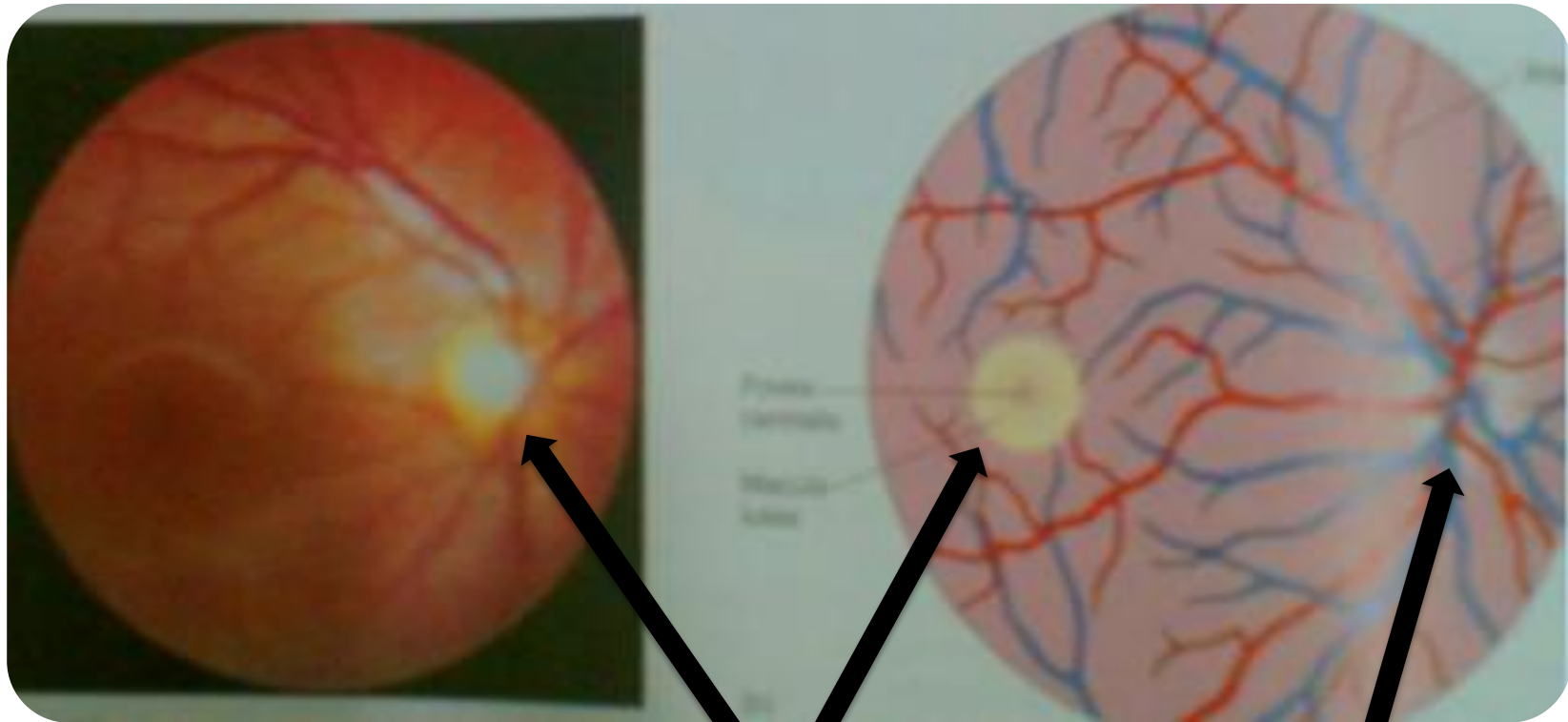


External protection of the eye

1. **bony orbit** : a groove in the skull which the eyes are situated .
 2. **lids blinking** keep cornea moist and also it washes the eye from any foreign body enters in it.
 3. **Conjunctiva** cleaning and moistening
 4. **tears** from lacrimal gland has antibacterial because it contain lysozyme , lubricating effect , keep cornea moist & clear.
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Retina الشبكية it consists of :

- Photoreceptors (RODS + CONES) : the receptors of light
- OPTIC DISC (**blind spot**) : 3mm medial & above post pole of eye, optic nerve leave & retinal blood vessels enter + **no photoreceptors**)
- FOVEA CENTRALIS : depression in macula lutea , yellow pigmented spot at post pole of eye + **only cones** no rods . It is important because visual acuity is very strong in fovea centralis , see colors through it , and it makes us see the details of an object .



Macula lutea which contain fovea centralis

Optic disc (blind spot) where the optic nerve leaves and the BV enters

■ Slides

■ Important

■ Doctor's Notes

■ Explanation

■ Boy's Slides

The importance of BINOCULAR VISION

1. Large visual field
2. cancel the effect of blind spot
3. stereoscopic vision (**three-dimensional vision**)
4. one eye lesion does not affect vision

Rules of optic

- biconvex lens(**converge**) **محدبة** & - biconcave lens(**diverge**) **مقعرة**
- Diopter (measure of refractive power = RF) = $1 / \text{Principal focal distance}$ in **meters**.

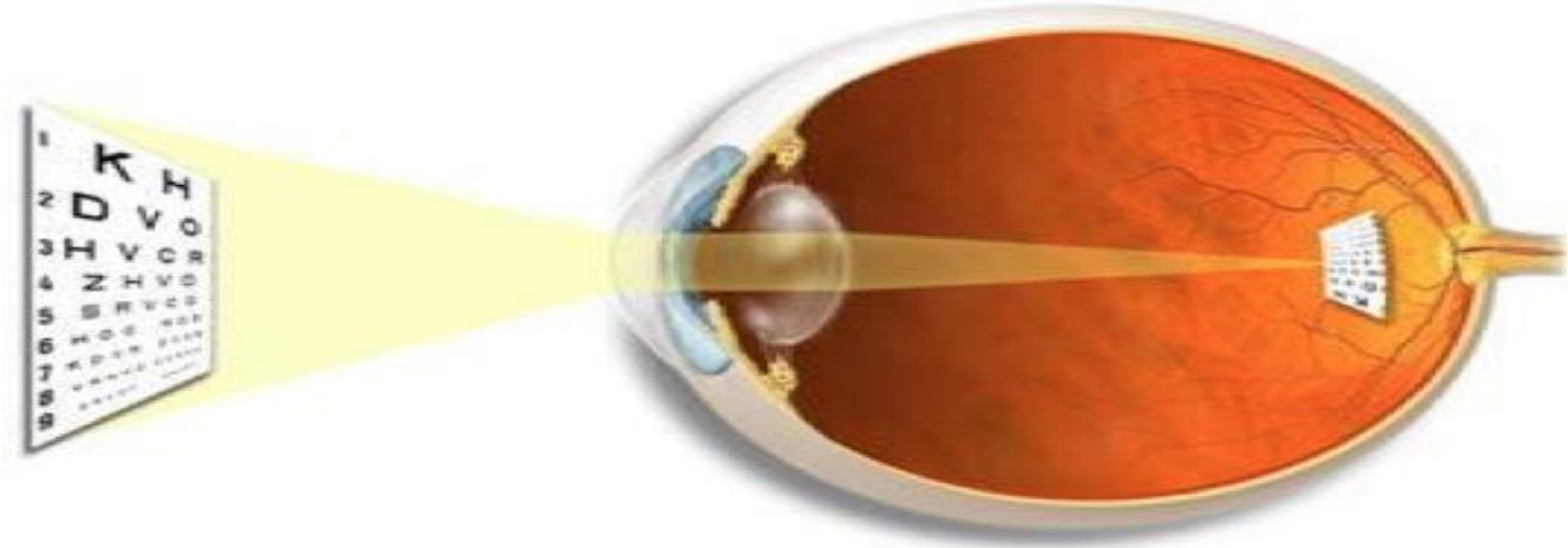
Example : if Principal focal distance of a lens is 25cm ,how much is RF?

$$\text{RF} = 1 / 0.25 = 4 \text{ diopter}$$

- The greater the curvature of the lens , the greater the refractive power of the eye
- Emmetropic eye: normal eye has image on retina (**without glasses**) , has dioptric power 60D (**40 cornea + 20 lens = 60**) .
- Lens--retina distance =**15mm**

(all of these rules are in the normal eye)

Visual acuity



- The ability of the eye to collect parallel layers on the retina
- It is measured by snellen chart

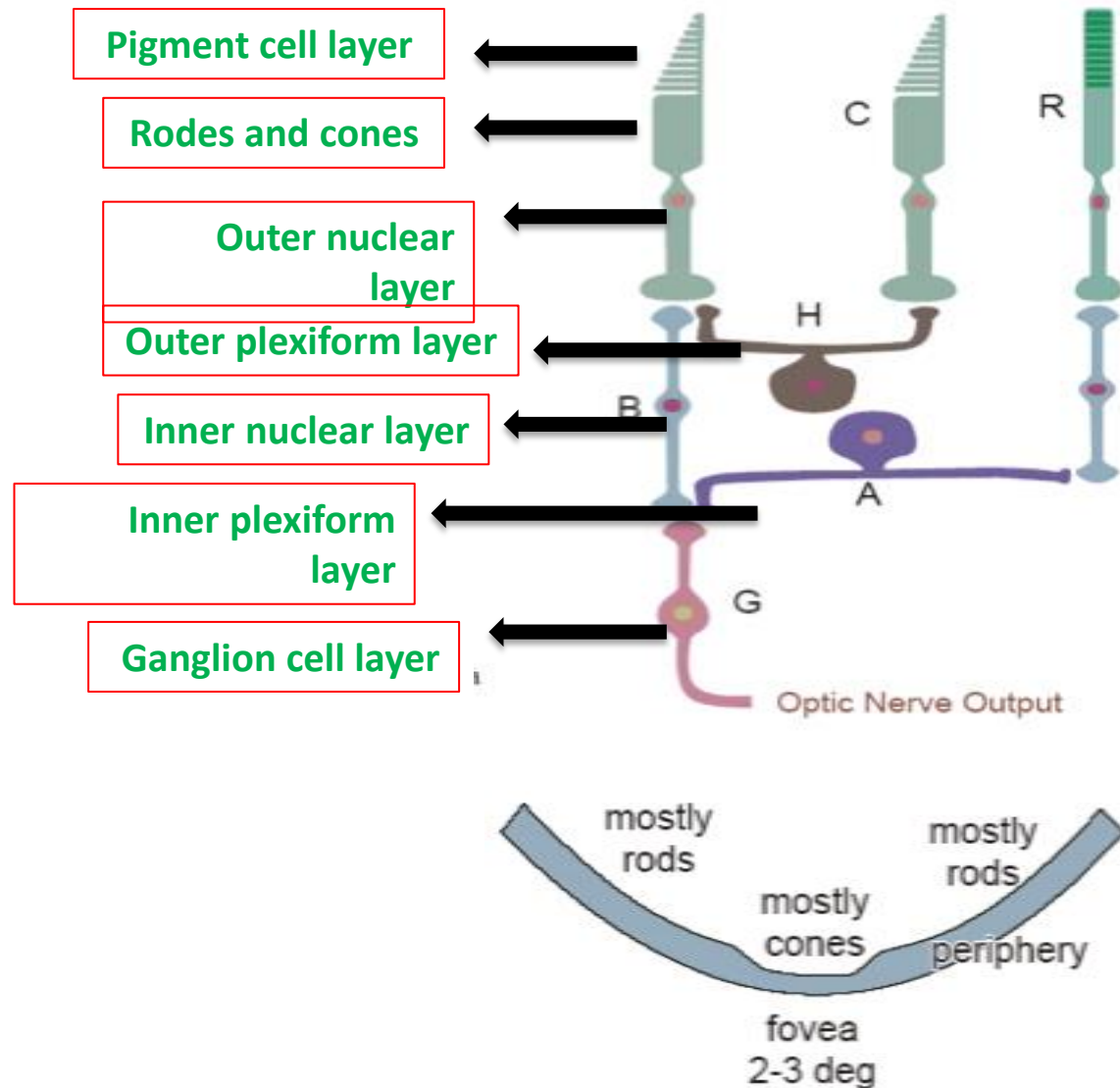
Errors of refraction

Hypermetropia (hyperopia) Headache + blurred vision	Myopia	Pressbyopia	Astigmatism
farsightedness (blurred vision when looking at objects close and clearer vision when looking at objects in the distance) .	Nearsightedness (clear vision when looking at objects close but distant objects will appear blurred	<ul style="list-style-type: none"> • Farsightedness • eye near point recedes by age (usually more than 45 years old) due to loss of accommodation. • Only in old people 	blurred vision
<ul style="list-style-type: none"> • The eye ball is short therefore the image of nearby object is formed behind the retina • Because the eye ball is short , the lens accommodate to bring image on retina which will increase the muscle effort and then it will cause a headache. If convergence by accommodation is prolonged it will result in squint 	Genetic large eye ball , long antero-posterior diameter or extensive close work as in studying cause focus in front of retina. The eye ball is big therefore light from s distant object forms an image before it reaches the retina .	It happens because with age the lens loses its elasticity as a result it can't accommodate	uneven & ununiform (not smooth) corneal curvature , as a result the rays refracted to different foci which will lead to blurred vision
Corrected by Biconvex lens	Corrected by biconcave lens to diverge rays before srtike lens	Corrected by biconvex lens	corrected by cylindrical lens

LAYERS OF RETINA (10 layers) the most important are:

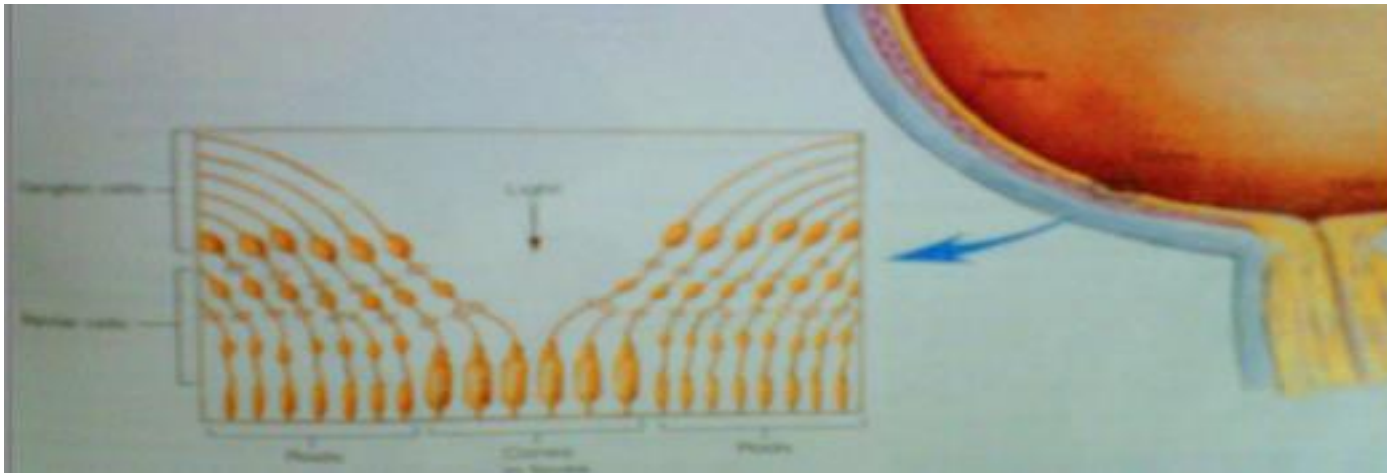
1. Pigment cell layer (**outermost layer**) : **colored layer** filled with **vitamin A** which absorb light and prevent its reflection back .
2. Rods & cones (**their outer& inner segments**), but not cell bodies(rods 120 million & cones 6 million) . Describe their distribution ? **Cones are in the center of the eye and it decrease in number in the peripherals , rods are concentrated in the periphery and it decreases in number in the center.**
3. outer nuclear layer(cell bodies of rods & cones)
4. outer plexiform layer mainly of Horizontal cells.
5. Inner nuclear layer (bipolar cells)
6. inner plexiform layer.(**amacrine cells**)
7. Ganglion cell layer
8. Optic nerve fibers (1.2 million fibers)

- Horizontal cells (outer plexiform layer) (Make synaptic connections with receptors)
- Amacrine cells (inner plexiform layer) (make synaptic connections with ganglion cells)



pathway of light in the eye

Light absorbed by pigment cell layer that contain melanin pigment , impulses pass from rods & cones to rest of layers finally to ganglion cell layer then finally to optic nerve



SUMMARY

The eye is made of many structures that allow the light to enter to the retina and form an image . The most important structure for refraction of the light **is the lens** . Errors of refraction can be either : hyperopia , myopia , presbyopia and astigmatism . the retina consists of ten important layers . The outer most layer which is called pigment cell layer is filled with **vitamin A** that help absorb the light then impulses pass from rods and cones to the rest of the layers until it reaches the optic nerve

QUESTIONS

Q1: A

Q2: B

Q3: A

Q4: A

Q1: What is the most important structure for refraction of light in the eye ?

- A. Lens
- B. Cornea
- C. Aqueous humor
- D. Vitreous humor

Q2: Presbyopia is corrected by :

- A. Biconcave lens
- B. Biconvex lens
- C. Cylindrical lens

Q3: Pigment cell layer is filled with :

- A. Vitamin A
- B. Vitamin E
- C. Vitamin K

Q4: The dioptric power of the lens is

- A. 15-20 D
- B. 40-45 D
- C. 20-25 D

THE END

**If there are any Problems or Suggestions,
Feel free to contact:**

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THANK YOU