vision

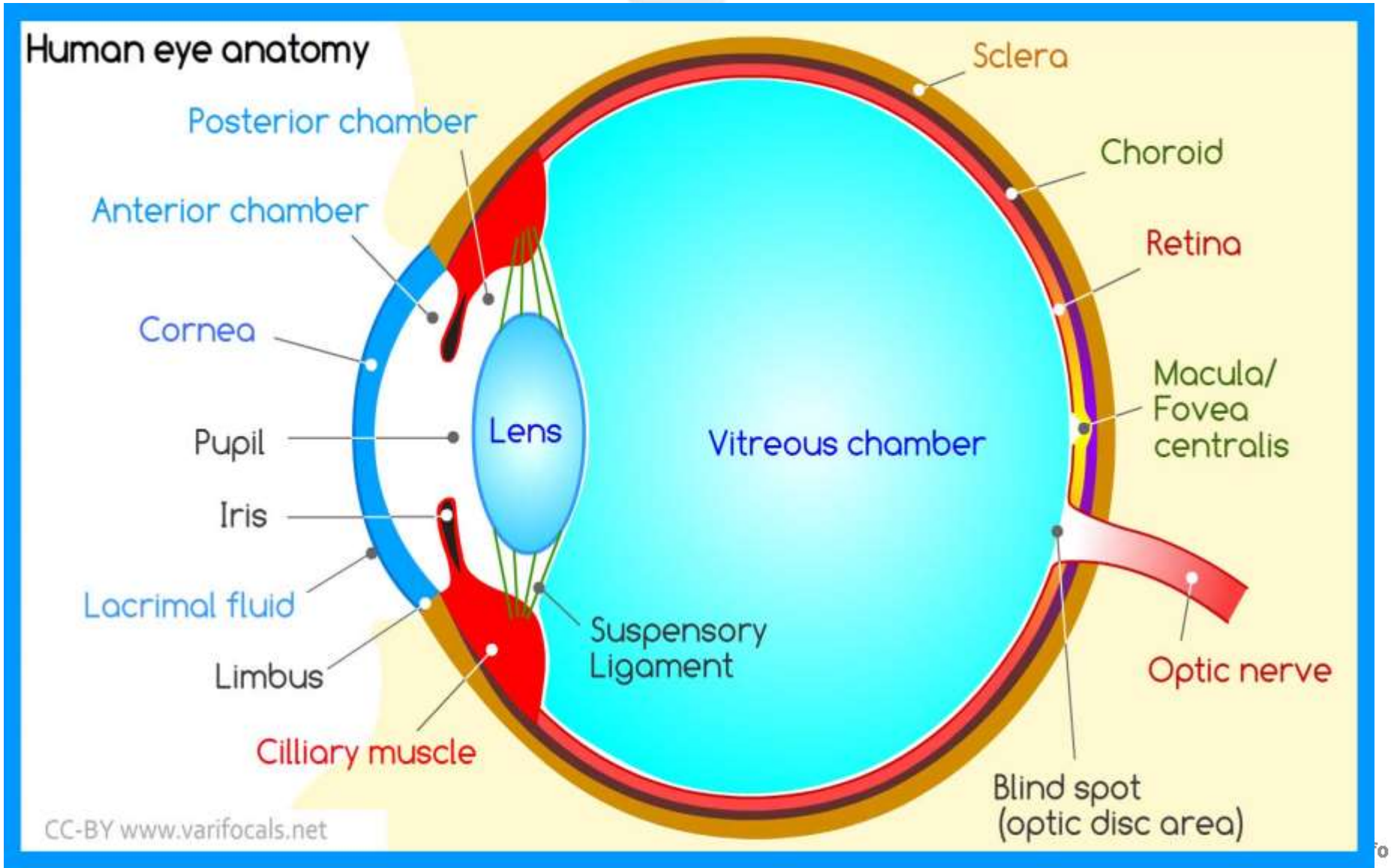
- Vision --- 3 steps
- Image formation in retina
- conduction of image to visual cortex via optic nerve
- interpretation by visual cortex

- Eyes are the sense organs for vision.

Functional anatomy of eyeball

- Eyeballs are present in orbital cavity.

- Eyeball has three layers.
- 1.Outer fibrous layer-sclera and cornea.
- 2.Middle vascular layer-choroid , ciliary body and iris.
- 3.Inner nervous layer-retina.


Human eye anatomy
Sclera
Posterior chamber
Choroid
Anterior chamber
Retina
Cornea
Macula/
Fovea
centralis
Pupil
Lens
Vitreous chamber
Iris
Lacrimal fluid
Suspensory
Ligament
Optic nerve
Limbus
Cilliary muscle
Blind spot
(optic disc area)
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Outer layer

- It protects intra ocular contents
- It provides shape to the eye ball.

Sclera

- Posterior 5/6 part is opaque and white in colour .
- It is pierced by nerves and vessels entering the eye.

Cornea

- Anterior 1/6 part is transparent and avascular.
- Light enters the eye through it .
- Maximum degree of refraction occurs at air-corneal junction
- It has rich supply of nerve endings.
- Cornea is avascular and it gets nutrition mainly from aqueous humor .

- The junction of cornea with sclera is called limbus .

Middle layer

CHOROID

- Highly vascular and pigmented.
- Nourishes structures of eyeball.

CILIARY BODY

- It is present between choroid and iris.
- It has 2 parts - ciliary muscles
  - ciliary processes

Ciliary muscle :-

- They are the infoldings at the tip of ciliary body.
- From this suspensory ligaments arise which can hold the lens in its position.

Ciliary processes

- They secrete aqueous humor.

FUNCTIONS OF CILIARY BODY

- Secretes aqueous humor.
- Role in accomodation.
- Hold the lens in its position.
- **IRIS**

It is pigmented and opaque muscular structure .

- Gives colour to the eye.
- Thin circular diaphragm placed in front of the lens .
- It has a central opening known as pupil .
- Through pupil light enters the eye

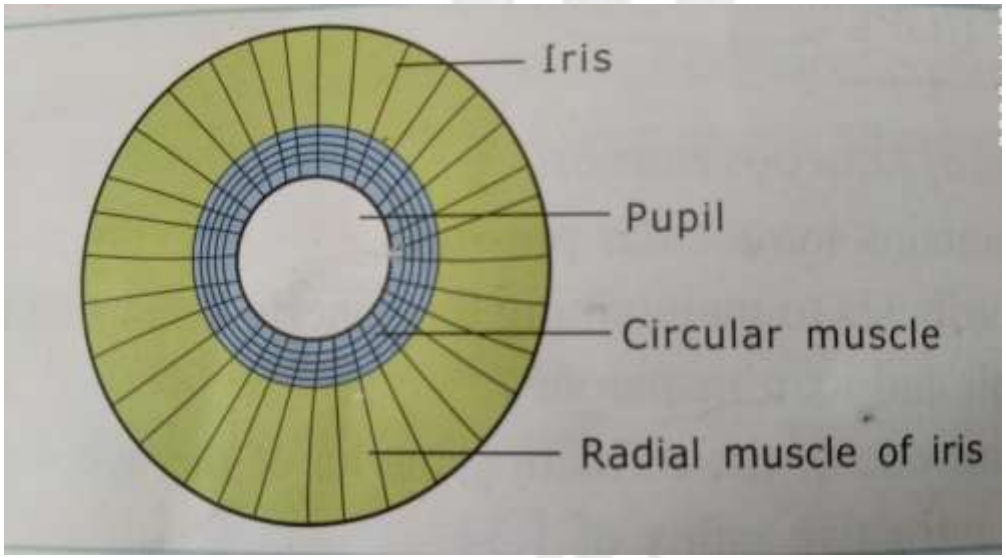
Iris has 2 muscles sphincter pupillae and dilator pupillae.

SPHINCTER PUPILLAE

- Formed by **circular** muscle fibres
- Their contraction cause pupillary constriction

DILATOR PUPILLAE

- Formed by **radial** muscle fibres.
- Their contraction cause pupillary dilation



Functions of IRIS

- Gives colour to the eye.
- Regulates the amount of light entering the eye.
- It prevents spherical and chromatic aberration
- It increases the depth of focus by constriction of pupil .

Retina

- It is the innermost layer and it contains rods and cones.
- It has 10 layers

1. Layer of pigment
2. Layer of rods and cones
3. Outer limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion cell layer
9. Layer of optic nerve fibres
10. Inner limiting membrane

Fundus

- The posterior part of the interior of the eyeball.
- It can be viewed through pupil with the help of ophthalmoscope .

- It is **the only region in the body where arterioles are readily visible.**

- Fundus examination is useful in the diagnosis of ocular diseases retinitis pigmentosa, papiledema etc and also in detecting diabetes mellitus , hypertension etc.
- It has 2 structures :- optic disc and macula lutea

Optic disc

- It is small area near the posterior pole of the eyeball.
- Rods and cones are absent. Therefore it is insensitive to light. So vision is not possible …blind spot

- It is the point at which optic nerve leaves the eyeball and blood vessels are entering the eyeball.

Macula lutea

- It is a yellowish area present on retina lateral to the optic disc. Yellow spot ⟹
- Yellow colour is due to the presence of carotenoid pigment xanthophyll.
- Its centre is known as fovea centralis

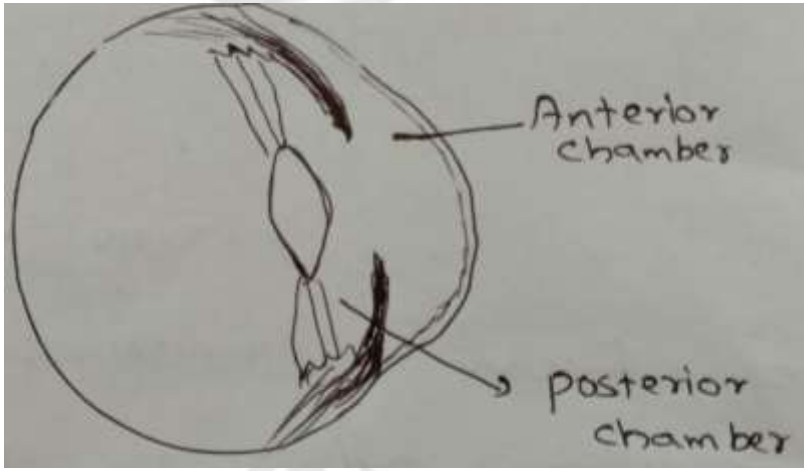
Fovea centralis

- It is the most sensitive part of retina.
- Rod free area , only cones are present .
- Visual acuity is maximum.
- No blood vessels are seen .
- Light rays passing through visual axis will fall on fovea centralis.

- **Foveal vision** ….when we look at an object , both eyeballs are directed towards that object and light rays from that falls firectly on fovea, then image will be clear ---foveal vision

Chambers of eye

- space in front of the lens is divided into 2 chambers by iris :- anterior chamber and posterior chamber
- **Ante.chamber**– space b/w iris & cornea.
- **Post.chamber** – space b/w iris & lens
- Both chambers are filled with aqueous humor and can communicate through pupil.



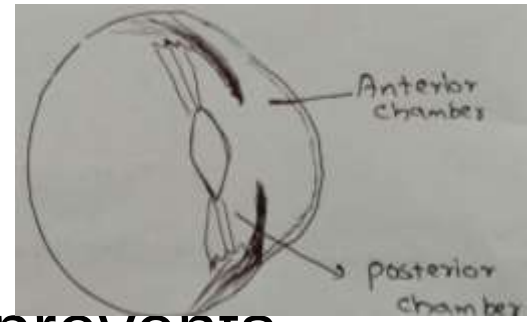
Intra ocular fluids

1. Vitreous humor
2. Aqueous humor

Vitreous humor

- It is a clear gelatinous fluid present between lens and retina.
- Components……

water , collagen fibrils ,protein- vetrein and hyaluronic acid.



FUNCTIONS

- Prevents collapse of the eyeball
- Semisolid support to retina and prevents detachment of retina
- Helps in maintaining normal intraocular pressure.
- Keeps intraocular structures in position and thus helps in image formation.

Aqueous humour

- It is a thin clear fluid present in the anterior and posterior chambers of eye.
- Refractive index = 1.34
- Specific gravity = 1.002 – 1.004
- Viscosity = 1.029
- pH =7.1 – 7.3
- Rate of formation =2 - 3µl/min

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- **Composition of aqueous humor**

- High content of Vitamin C.
- High concentration of NaCl .
- Low in glucose , but high lactic acid content.
- High amount of hyaluronic acid.

Formation of Aqueous humor

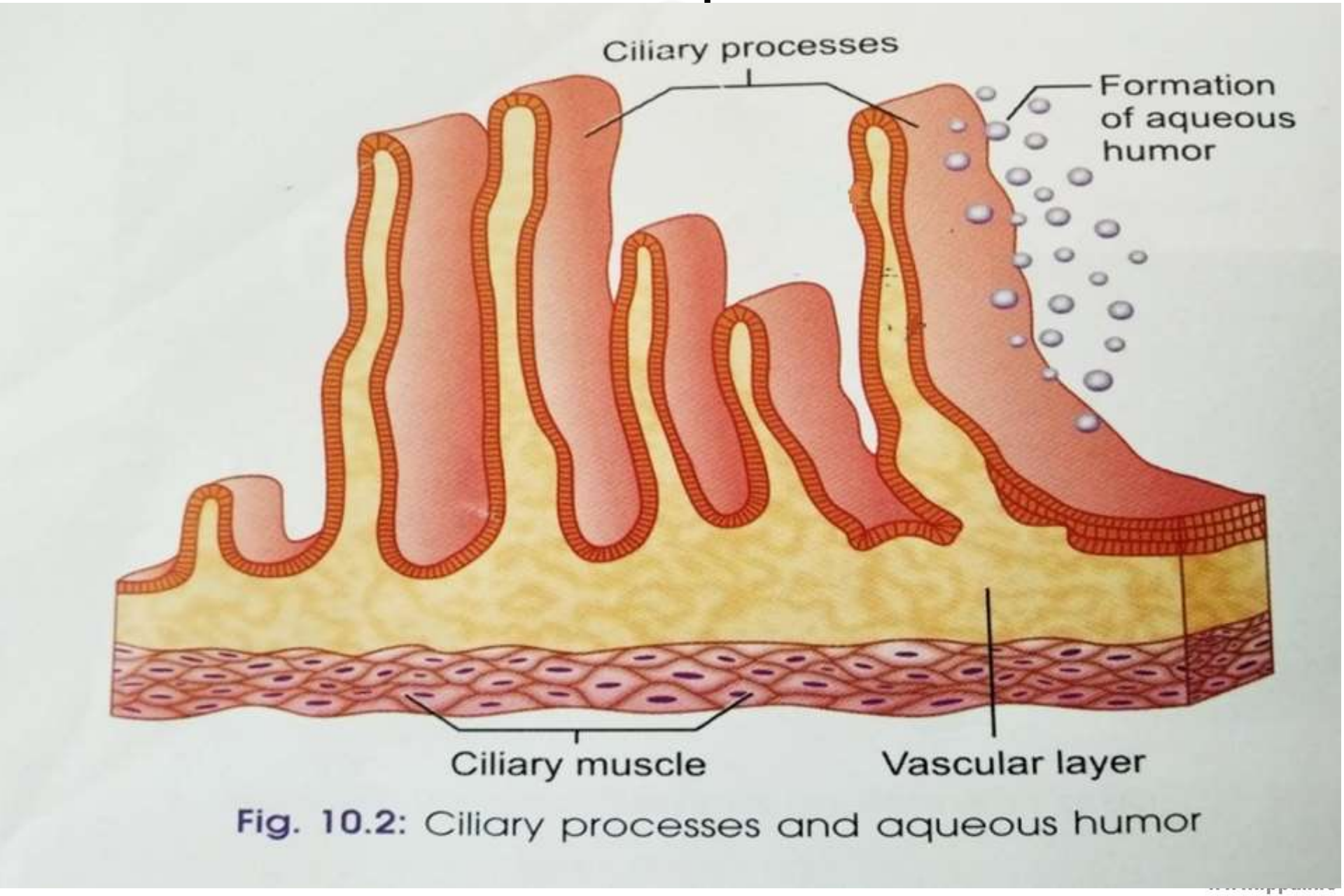


Fig. 10.2: Ciliary processes and aqueous humor

AH formation

- A H is secreted from ciliary processes .

- The surface of ciliary processes are covered by highly secretory epithelial cells, they produce **AH -**below this – a highly vascular area.

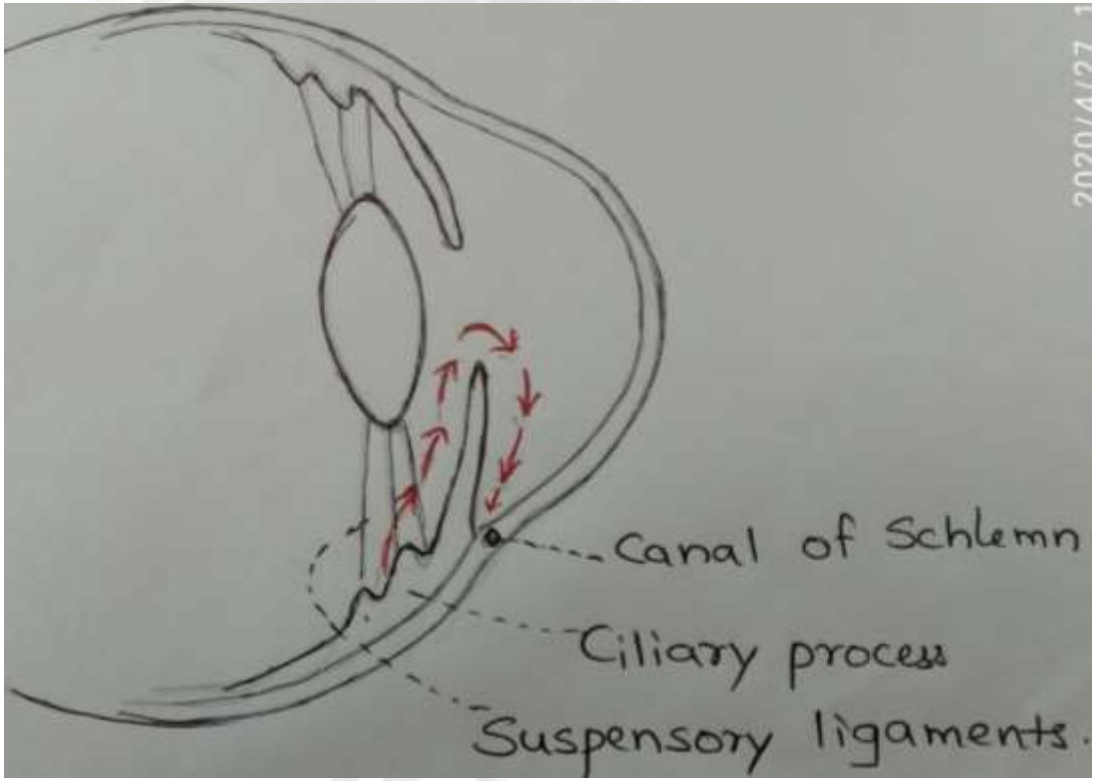
- **Secretion-** begins with active transport of Na+ into the spaces b/w epithelial cells.
- Na+ pull Cl-and HCO3- ions along with them to maintain electrical neutrality

-Then all these ions together cause osmosis of water from underlying capillaries into the above space.

- glucose,amino acid,ascorbic acid etc are transported actively or by facilitated diffusion into the above soln.

- The resulting fluid is AH

- **Circulation of aqueous humor**
- Formation in ciliary processes-→through spaces b/w suspensory ligaments→ posterior chamber-through pupil-→anterior chamber -→limbus-→ trabeculae-→canal of schlemn→venous system



- Rate of synthesis should balance rate of drainage , if any block or imbalance – IOP will increase

- **Functions of AH**
- Maintains the shape of eyeball.
- Maintains IOP .
- Provides nutrition to the lens and cornea.
- Removes metabolic products from lens and cornea.

Intra ocular pressure

- Pressure exerted by AH
- Normal IOP 10-20 mmHg

- Rate of production and rate of drainage of AH should balance to maintain normal IOP
- If any imbalance , then IOP increases.

- Tonometer use to measure IOP

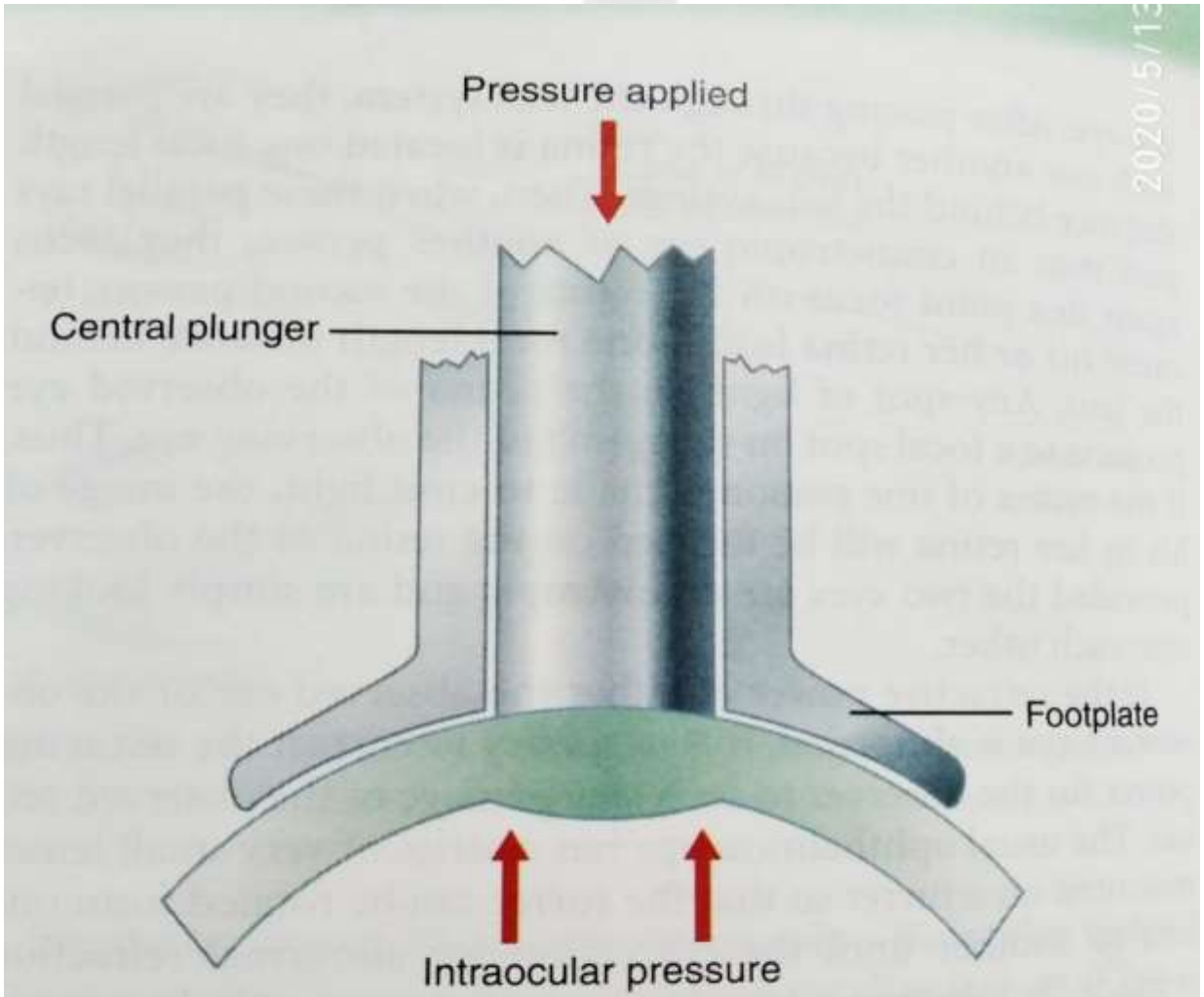


Figure 108-21 Principles of the tonometer.

Tonometer

- To measure IOP

- Anasthetise cornea by local anasthesia
- Place footplate of tonometer on cornea
- Apply pressure –part of cornea displace downward
- Displacement is calibrated in terms of IOP

- In glaucoma IOP increases upto 60-70 mm Hg

Glaucoma

Glaucoma is a condition of increased IOP due to the accumulation of AH

- If any block in trabecular spaces & canal of schlemn , A H accumulates in both chambers.
- it will push lens backward into vitreous body.
- Vitreous body compress blood vessels and neurons of retina.
- Destruction of neurons and degeneration of optic disc
- Blindness .

Glaucoma - types

1. **open angle glaucoma**

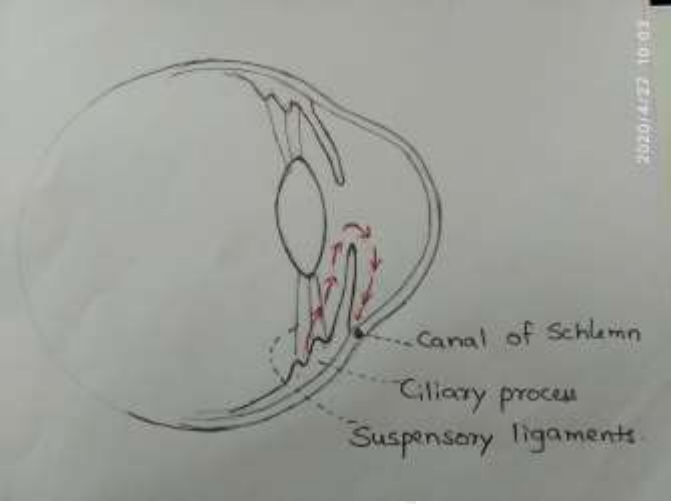
-- due to increased resistance of trabeculae to aqueous flow

2. **angle closure glaucoma**

-- forward movement of iris - closes (narrows) the iridocorneal angle.

Treatment

- -- carbonic anhydrase inhibitor (Diamox) decrease production of AH
- -- surgical removal of block to the drainage of AH



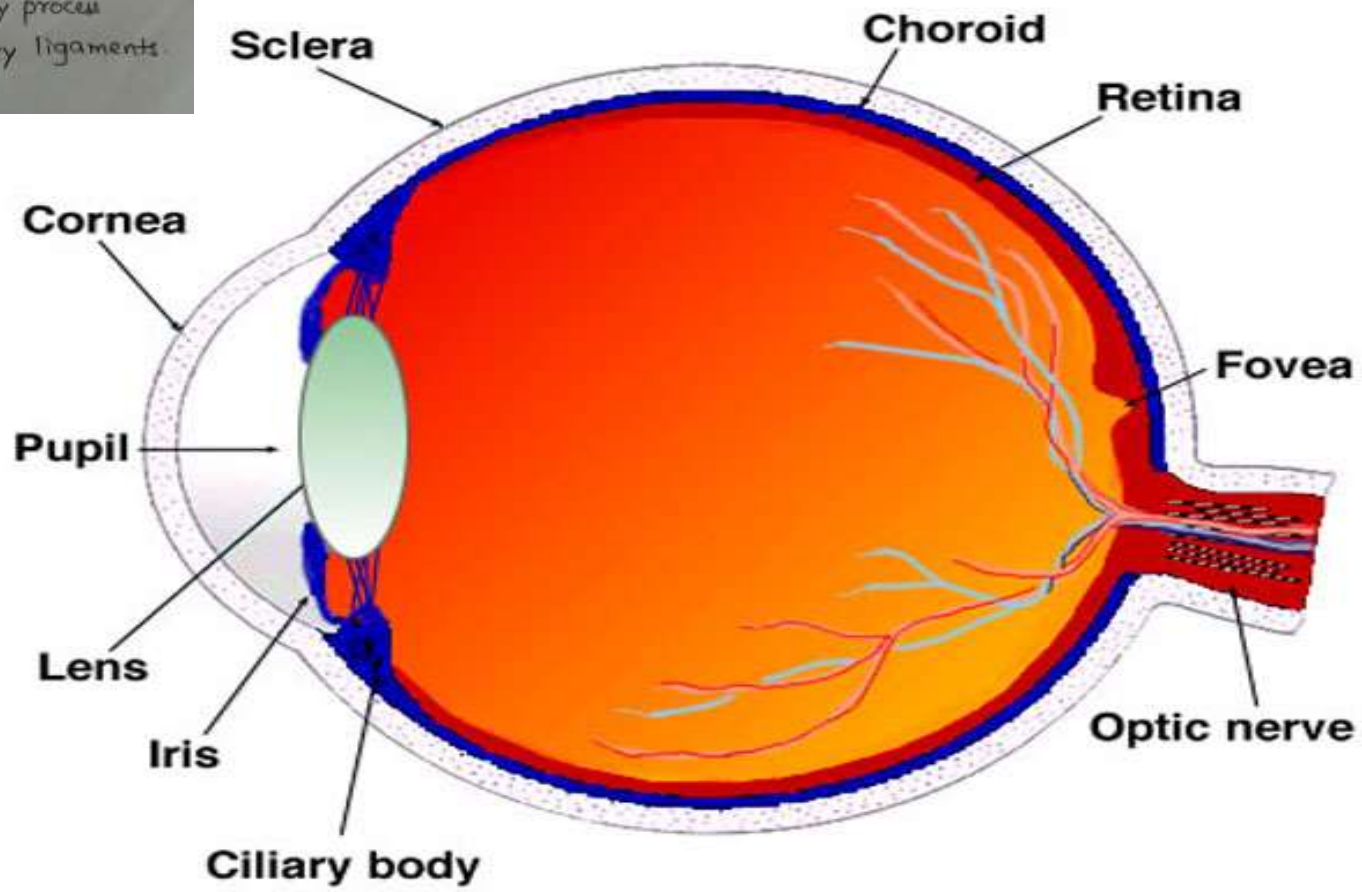


Fig. 6. Vertical sagittal section of the adult human eye.

Lens

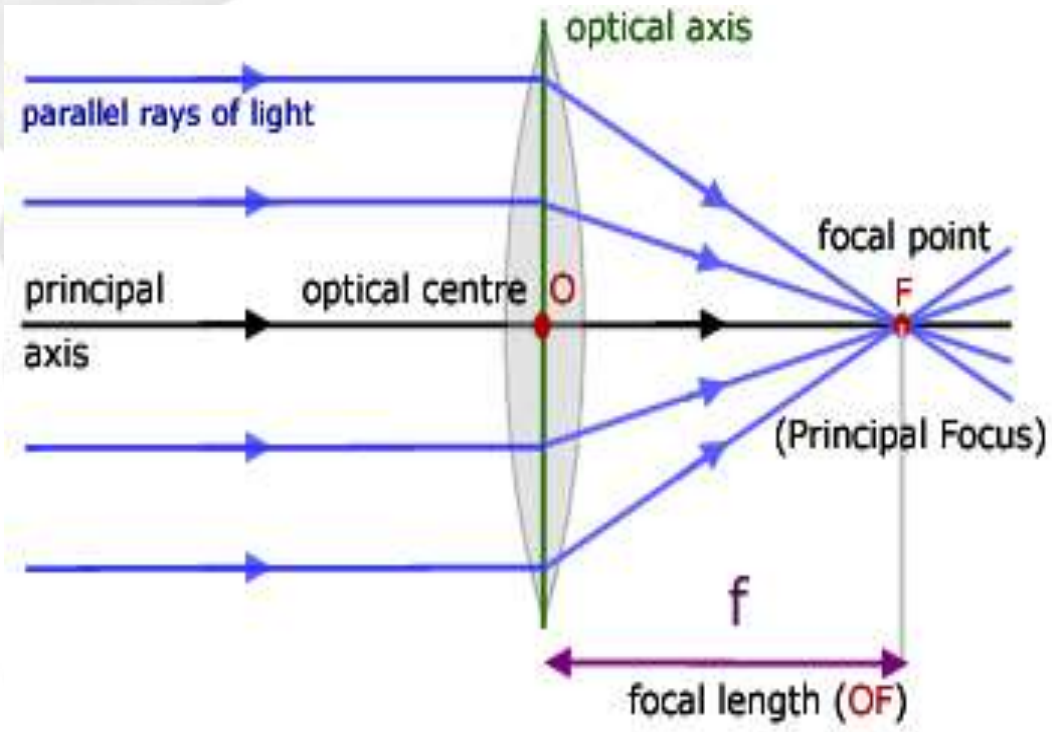
- Lens is a biconvex, transparent, avascular body enclosed in an elastic capsule.

- It is held in position by suspensory ligaments
- Receives nutrition from AH
- Made up of collagen fibrils –they arrange in layers like onion
- During life there is constant replacement of layers
- By contraction of ciliary muscles curvature of lens can change.

- Cataract is a condition of opacity of lens

Principles of optics

- Refraction
- Lens 3 types- convex, concave, cylindrical
- Optic centre or nodal point
- Principal axis
- Focus , focal length
- Power of a lens.
- p=1/f , dioptre



Accomodation

- The ability of the eye to focus an object at varying distances
- For far vision lens should be flat and for near vision lens should be curved.

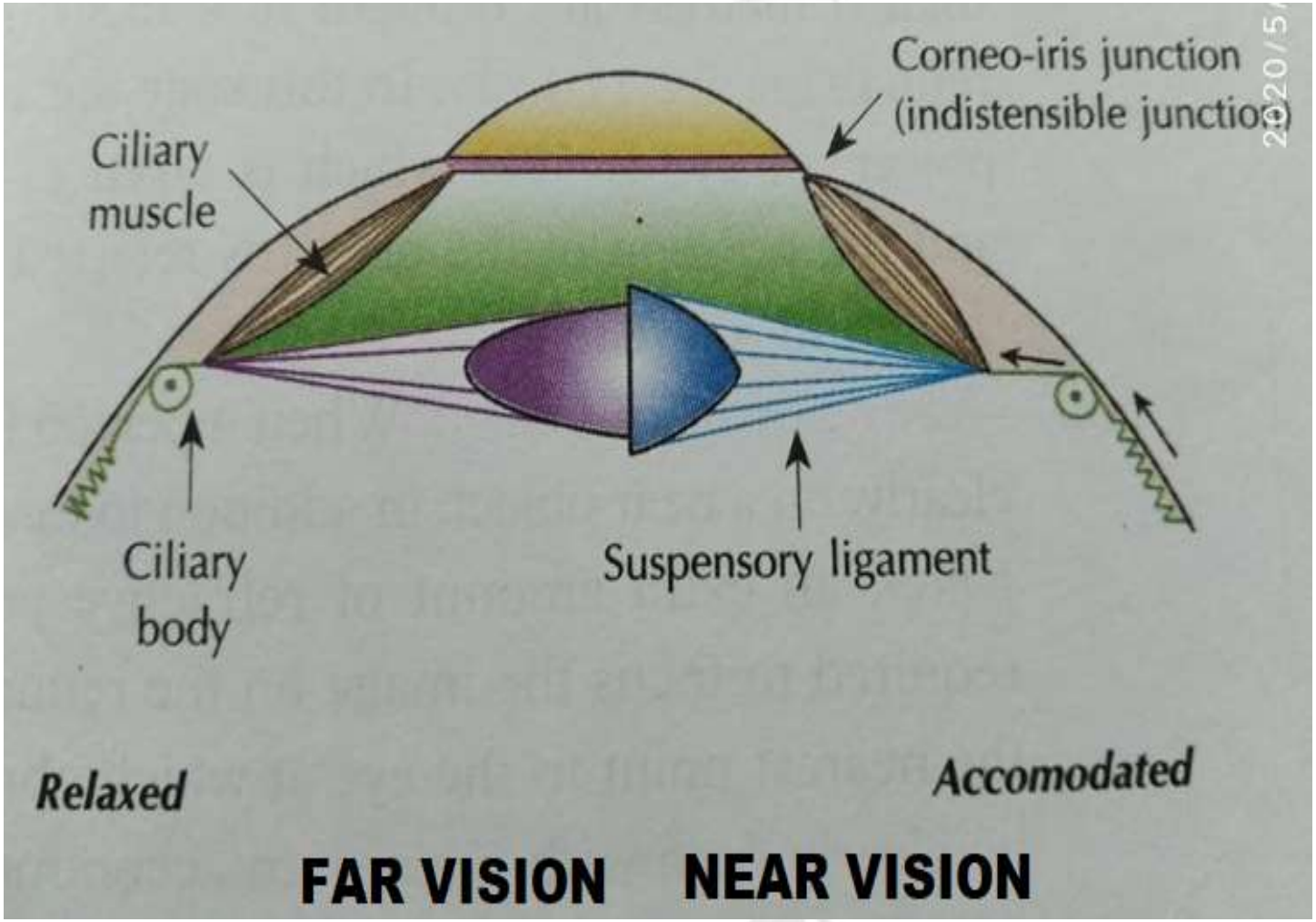
Mechanism of accomodation

- For near vision , ciliary muscle contracts, it pulls ciliary body forwards & inwards towards the lens & suspensory ligaments relax and tension on lens decreases.

  -Therefore curvature of lens increases

- For far vision- ciliary muscles relax & it pulls ciliary body backward and outward. So suspensory ligaments stretch – lens attains flat shape

Mechanism of accomodation



Near vision

Ciliary muscle- contracts

Susp. Ligaments- loose

-tension on lens decreases

Lens –curvature -increases

Far vision

- Cili muscl –relaxes
- Susp liga-stretch

tension increases

Lens--flat

- Near point– nearest point from the eye at which an object can be seen clearly with maximum accommodation

- Far point---- is the farthest point from the eye at which an object can be seen clearly without any accommodation

For a normal eye-it is at infinity.

- Range of accommodation--- distance between far point and near point

Presbyopia

- Power of accommodation decreases .
- As age advances, due to denaturation of lens proteins – lens becomes thick and hard, flexibility of lens decreases,

  lens cannot increase its curvature.
- Person cannot see nearby objects
- Near point recedes
- Correction by bifocal lens