

Coats of the eyeball so

1- outer fibrous coat
3- Inner nervous coat

2- Middle vascular coat

1- Outer fibrous coat

Sclera

five-sixths of the outer fibrous

- dense fibrous tissue
- White.
- continuous
 - posteriorly with dura mater of optic nerve.
 - anteriorly with cornea at [corneo-scleral junction or limbus]
- it pierced by
 - optic N (posteriorly)
 - ciliary N + A + V
- Functions :-
 - 1- supports eye shape
 - 2- protect internal structures.
 - 3- attachment site with extrinsic eye muscle.

Cornea

one-sixth of the outer fibrous layer

- transparent
- contact posteriorly with aqueous humor.
- most sensitive tissues of body (has one of the richest sensory N).
- avascular, devoid lymphatic drainage
 - because B.V may cloud the cornea which :-
 - prevent it from refracting light properly
 - and may adversely affect vision.
- nourished by
 - aqueous humor
 - tears
 - capillaries at its edge (limbus).
- Nerve supply :- long ciliary N → from Vaso-oculomotor N.
- function :- refractive medium of eye.

2- middle vascular pigmented coat

Choroid

- brown vascular membrane deep to sclera
- component :-
 - areolar CT
 - highly vascularized
 - heavily pigmented (melanocytes).
- function :-
 - supplies nourishment to outer part of retina
 - pigment absorbs extraneous light.

Ciliary body

- ring-shaped
- continuous
 - posteriorly with choroid
 - anteriorly behind peripheral margin of iris.
- connected to lens by :- suspensory ligaments of lens (Zonular fibers)
- function :-
 - holds ligaments attach to the lens and change lens shape for far vision
 - epithelium secretes aqueous humor.
- components :-
 - * ciliary muscle
 - * ciliary processes. (covered with epithelium).

Iris

- Is a thin, contractile and pigmented smooth muscle with pupil (central aperture)
- suspended in the aqueous humor (between cornea + lens).
- and divide the space between lens + cornea into
 - anterior chamber + iris
 - ← both filled with aqueous humor.
 - posterior // between iris + lens.
- Periphery is attached to ciliary body
- component :-
 - 1- central pupil
 - 2- connective tissue stroma (contain melanocytes).

* ciliary processes :
secrete aqueous humor into posterior chamber



* ciliary muscle :
nerve supply : parasympathetic fibers
from inferior oculomotor N.

(celler synapsing in ciliary ganglion
↳ the postganglionic fibers pass forward to eyeball in the short ciliary nerves.)

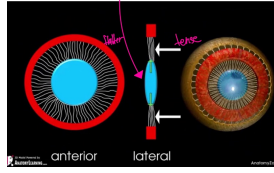
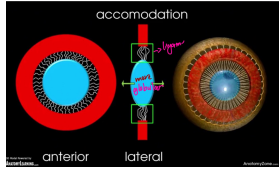
Action :- contraction of ciliary muscle
↳ - relieves the tension in suspensory ligament
- elastic lens becomes more convex
- this increases refractive power of lens.

Accommodation permits focusing on near and far objects by changing the curvature of the lens

Near vision far vision

To accommodate the eye for close objects, the ciliary muscle contracts so that the radiating fibers of the suspensory ligament are relaxed. This allows the elastic lens to assume a more globular shape.

When the ciliary muscle relaxes so that the radiating fibers of the suspensory ligament are taut, this allows the elastic lens to assume a flatter shape.



* In individuals with ↓ melanin pigment in stroma of iris
↳ light with a blue color is reflected back (short wavelengths) ←
[producing the blue color]

* ↑ melanin in stroma
↳ the iris color changes through shades of [green, gray and brown]

Blue eyes have low concentrations of melanin in the stroma of the iris, which lies in front of the dark epithelium. Longer wavelengths of light tend to be absorbed by the dark underlying epithelium, while shorter wavelengths are reflected and undergo Rayleigh scattering in the turbid medium of the stroma.

The Tyndall effect is scattering of light by particles in a colloid or particles in a fine suspension. It can be seen when the light passes through the colloid or turbid substances causing the light to scatter in multiple directions.



* albinism : no pigment + pink color of irises
blue ↳ reflection of incident light from blood vessels of stroma.



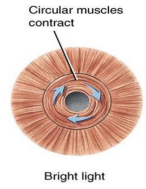
* function of iris :
1- controls pupil diameter + amount of light entering the eye
2- gives color by melanocytes

3 - muscle fiber of the iris (involuntary)

(3rd component of iris.)

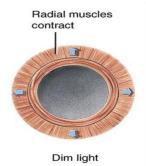
① The circular fibers form the sphincter pupillae
Nerve supply: is supplied by parasympathetic fibers from the oculomotor nerve. After synapsing in the ciliary ganglion, the postganglionic fibers pass forward to the eyeball in the short ciliary nerves.

Action:
The sphincter pupillae constricts the pupil in the presence of bright light and during accommodation



② The radial fibers form the dilator pupillae
Nerve supply: is supplied by sympathetic fibers, which pass forward to the eyeball in the long and short ciliary nerves.

Action:
The dilator pupillae dilates the pupil in the presence of light of low intensity or in the presence of excessive sympathetic activity such as occurs in fright

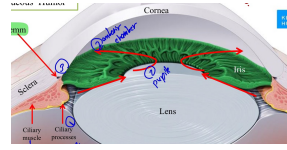


← حركاتهم
الغريزة

* production of aqueous humor + intra ocular pressure :

↳ clear fluid that fills the anterior + posterior chambers of eyeball

- 1- ciliary process : produces aqueous humor
- 2- posterior chamber : aqueous humor flows from this chamber through pupil → to anterior chamber
- 3- canal of schlemm : reabsorbs aqueous humor.



* clinical of glaucoma :

rise in intraocular pressure ↓ obstruction to draining aqueous humor ↳ optic neuropathy.

* the lens :

- (elastic + transparent)
- biconvex structure
- it situated { behind the iris, front of vitreous body.
- focuses light on the retina
- accommodation of eye : (for close object)
 - ciliary muscle contracts → suspensory ligament are relax
 - elastic lens assume a more globular shape. ↙

* We have (2) clinical conditions affecting the lens so

1- related to its elasticity (presbyopia) قسري نظر

advancing age → lens becomes denser + ↓ elastic ability to accommodate is lessened ↙
 * corrected by wearing glasses with (convex lenses)

2- related to its transparency (cataract)

older individuals → denaturation of crystallin (lens protein) lens become opaque or cloudy ↙

Cause Cataract { Excessive exposure of UV light (radiation) = trauma
 2nd effect in disease such as : diabetes mellitus + hypertension

3- inner nervous coat (Retina)

outer layer (pigmented)

- contact : with choroid
- compound : pigmented epithelial cells.
- function : 1- absorbs extraneous light (supplementing the choroid).
 2- provide vitamin A for photoreceptor cells.

inner layer (neural)

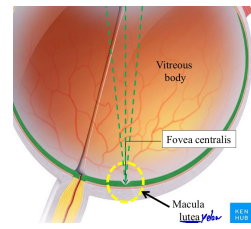
- contact : with vitreous body.
- component : 1- photoreceptors
 2- bipolar neurons. 3- ganglion cells
 4- supporting Muller cells.
- function : 1- Detects incoming light
 2- converted to nerve signals. rays
 3- transmitted to brain.

* at the center of posterior part of the retina

↳ is (macula lutea) → the area for the most distinct vision of the retina

↳ oval yellowish area

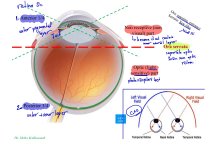
↳ It has a central depression (fovea centralis)



→ anterior part of retina
outer pigmented layer (not) / non receptive (non visual) part.

→ posterior " " " " " "
outer + inner layer. / optic (light sensitive) part.
(photo receptors base)

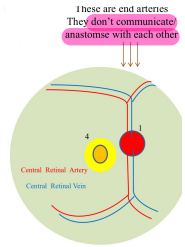
separate by
Ora serrata



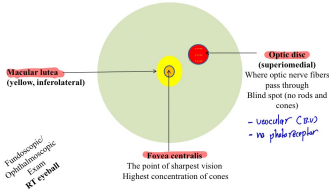
* optic disc :- 3mm to the medial side of the macula lutea, pierced by central artery of retina

↳ Where optic N leaves the retina.

referred to as blind spot :- because the absence of rods + cones → so it is insensitive to light.



* posterior view of retina (optic disc + Macula lutea) seen by → ophthalmoscopic (fundoscope) examination. (of right eye).



Macula lutea (4)	Optic disc (1)
Central depression: fovea centralis	Central depression: physiological cupping
Fovea centralis is the point of sharpest vision	Blind spot (no rods and cones)
Diffuse margins	Sharp margins
Lateral and slightly Inferior	Medial and slightly Superior
Avascular	Vascular (blood vessels entering/ leaving)

* contents of the Eyeball :-

1- aqueous humor

2- the lens

3- the vitreous body :- large gelatinous mass of transparent C.T, fills the eyeball behind the lens

↳ functions :- 1- magnifying power of the eye
2- supports the posterior surface of lens.
3- assists in holding the neural part of the retina against the pigmented part of retina.

* hyaloid canal : narrow channel that runs through the vitreous body (from optic disc to posterior surface of the lens.) it's filled by hyaloid artery in fetus and disappears before birth.

Detached retina :- detached inner layer from outer layer

- Eyeball (2) -

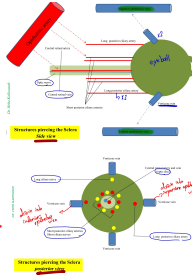
* Ocular blood supply :-

the arterial input.

* provide by several branches from ophthalmic artery, which derived from internal carotid.

These branches are:

- 1- central retinal artery
- 2- short posterior ciliary arteries (from 6-12) pierce the posterior part of sclera just around optic nerve.
- 3- long posterior ciliary arteries (2 in number) pierce the posterior part of sclera, at some little distance from optic nerve.
- 4- the anterior ciliary arteries derived from the muscular branches of the ophthalmic artery.



venous outflow

* vortex veins and central retinal veins.
↳ (mostly 4 in number) drain the ocular choroid.

↳ Which merge with the superior and inferior ophthalmic veins that drains into - cavernous sinus - pterygoid venous plexus - facial vein.

* inside choroid layer we have 80

choroidal vessels so

arise from long + short posterior ciliary arteries.

* the corresponding veins drain into vortex veins.

Choriocapillaris : is an extensive, anastomosing capillary system derived from the choroidal vessels.



* Histology of cornea :-



cornea : dense type of connective tissue sandwiched between 2 layers of epithelium

↳ human cornea is about 0.5 mm thick at center, increasing in the periphery

functions :-

- 1- transmission of light (as it is transparent)
- 2- Refraction of light for better focus (as it is curved)
- 3- plays a role in structural integrity of eyeball (as it's tough)
- 4- protection.

* The cornea can be reshaped by surgical procedures (LASIK)

* layers of cornea

1- Corneal covering epithelium

structure: stratified non keratinized squamous epithelium 5-6 cell layer → regenerates from stem cell at the edge (limbal stem cells)

functions: 1- absorbs nutrients and oxygen from tears and conveys it to the rest of cornea. / 2- contain free nerve ending. / 3- prevents foreign matter from entering the eye.

2- Anterior lamina. (Bowman's membrane).

structure: thick basement membrane between corneal covering epithelium and substantia propria.

functions: 1- supports corneal covering epithelium / 2- helping to protect against infection of the underlying stroma (filled)

3- Substantia Propria (corneal stroma.)

structure: The bulk tissue. Multiple lamellae of regularly arranged fine collagen fibrils and in between are fibrocytes (keratocytes).

is relatively dehydrated

→ are parallel and are superimposed like book pages (صفحة بصفحة)

- Around 250 collagen lamellae are arranged vertically and horizontally forming lattice.
- the fibrils are spaced apart by a ground substance → that is essentially a hydrated gel of proteoglycans.

function: the uniform arrangement of collagen fibrils → contributes to the transparency of this avascular tissue.

4- Posterior lamina (Descemet's membrane).

structure: thick basement membrane between substantia propria and corneal endothelium.

functions: supports the internal corneal endothelium.

5- corneal Endothelium.

structure: Monolayer of epithelial cells.

functions: 1- regulates composition of corneal stroma to maintain transparency / 2- maintains proper (fluid) balance

it (have water pumps) to regulates fluid and solute transport between aqueous humor and corneal stromal layer ← by

* layers (1+5) prevent excess fluid build up in stromal layer → stromal swelling → loss of transparency

clinical: in aging + more fluid → cornea becomes opaque

both are composed of dense fibrous CT

- sclera: (white) is opaque due to the irregularity of type I collagen fibers with different thicknesses.
- cornea: (transparent) near-uniform thickness and parallel arrangement of the corneal collagen fibrils.

* layers of retina so

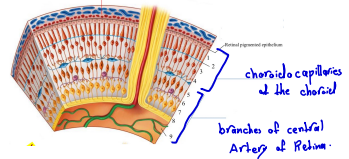
Inner Neural layer (9 layers)

- 1- The rods and cone layer \Rightarrow outer segments of the (rods) cells
- 2- The outer limiting layer
- 3- The outer nuclear \parallel \Rightarrow cell bodies of the (rods) cells.
- 4- The outer plexiform \Rightarrow axons of the (rods) cells + dendrites of bipolar cells.
- 5- The inner nuclear \Rightarrow nuclei of bipolar cells + amacrine + horizontal + Muller cells.
- 6- The inner plexiform \Rightarrow axons of bipolar cells + dendrites of ganglion cells.
- 7- The ganglionic layer \Rightarrow cell bodies of ganglion cells.
- 8- The nerve fiber \Rightarrow ganglionic cell axons (that converge at the optic disc \Rightarrow and form optic N.)
- 9- The inner limiting layer

Outer pigmented layer (Retinal pigment Epithelium)

- structure \Rightarrow consists of cuboidal or low columnar cells / surrounds the neural layer
 - functions \Rightarrow
 - 1- protects + nourishes retina.
 - 2- removes waste products.
 - 3- prevents new B.V growth into retinal layer
 - 4- absorbs light not absorbed by photoreceptor
- these actions prevent the scattering of the light + enhance clarity of vision.

Choriocapillary lamina of the choroid



Inner (5) retina layer supplied by \rightarrow branches of central Artery of Retina.

Outer (5) retina layer supplied by \rightarrow choriocapillaries (by simple diffusion).

plexiform \Rightarrow regions containing only axons + dendrites connected by synapses
 \hookrightarrow between (3) layers with cell nuclei.

* Cells of Neural Retina:

Main cells

- 1- photoreceptors (rods) cells.
- 2- Bipolar cells.
- 3- ganglion cells
 \hookrightarrow have long axons form optic nerve.

Cross-talking cells. (HA)

- * Horizontal cell
 - * Amacrine cell
- make specific connection with other neurons.

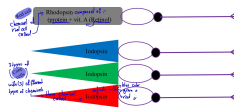
Glial cells.

* Muller cell \Rightarrow are retinal neuroglial cells

- processes span across the entire neural retina
- located in inner nuclear layer
- form \Rightarrow the outer limiting membrane the inner limiting membrane.

* photoreceptor within retina:-

- 1- Outer segment: contain photosensitive region (generation of the receptor potential).
 - 2- Inner segment
 - 3- Nucleus
 - 4- synaptic terminal.
- \hookrightarrow the rod and cone cells named for the shape of their outer segments.



rods:-

- black/white vision
- sensitive to dim light (night vision)
- more concentrated in the peripheral part of retina.
- more abundant
- \downarrow vitamin A \rightarrow night blindness.

Cones:-

- Color vision
- sensitive to bright light (Day vision).
- more concentrated in macula lutea (fovea centralis)
- less abundant
- three types
- color blindness.