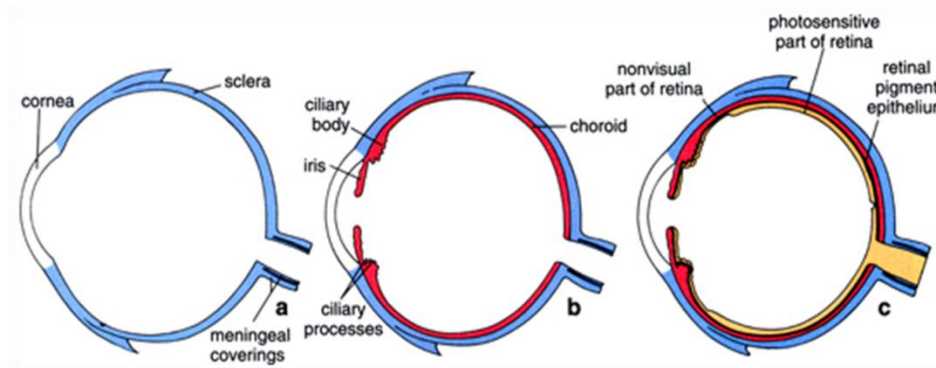


The EYE

Is a complex and highly specialized organ for perception of form, light, and color. The eyes are located in the protective cavities within the skull called orbits.

Each eye consists of 3 concentric layers:

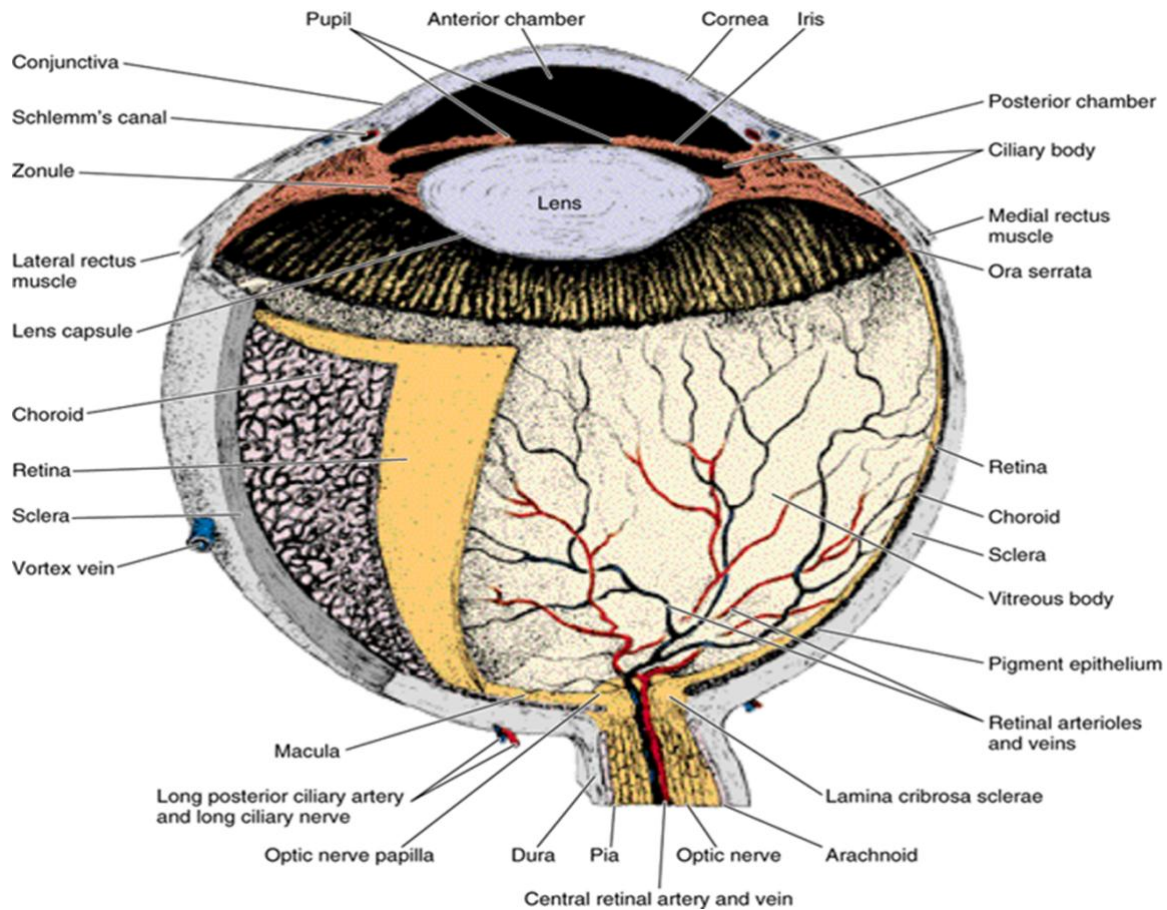
1. external layer consist of sclera posteriorly and cornea anteriorly
2. middle layer consist of choroids, ciliary body & ciliary processes
3. inner layer of nerve tissues called retina.



Each eye consist of 3 compartments:

1. ant. Chamber: space between the cornea ant. & iris post.
2. post. Chamber: limited ant. by iris
lat. by ciliary processes
post. by lens & zonal fibers of the lens
3. vitreous space: lies behind the lens & its zonal fibers and it is surrounded by the retina.

Both ant. & post. chambers are filled with a protein-rich fluid called aqueous humor while the vitreous space is filled with gelatinous substance called vitreous body.



I. External layer of the eye (Tunica fibrosa):

Consist of two parts:

- Sclera & Cornea ant. 1/6th it is colorless & transparent.

❖ Sclera:

post. 5/6th it is opaque white layer. Consist of tough dense C.T. formed mainly of flat collagen bundles oriented in different directions with a moderate amount of ground substance. The cells of the sclera are few fibroblasts which contain pigment near the corneo-scleral junction and near the exit of the optic nerve. The muscles of the eye are attached to the sclera & control its movement.

The sclera is composed of 3 layers:

- 1) Episclera: is the external layer of loose C.T. running adjacent to the periorbital fat. The episclera is connected to a dense layer of C.T. (Tenon's capsule) by a thin bundles of collagen fibers, between the tenon's capsule & the sclera is a space called tenon's space & because of the presence of this space the eyeball can make rotatory movements.
- 2) Middle layer (stroma): consist of bundles of collagen fibers
- 3) Inner layer of the sclera which is adjacent to the choroid and called suprachoroidal lamina it is thin layer rich in melanocytes, fibroblasts & elastic fibers.

Lamina fibrosa :

The part of the sclera at the exit of the fibers of optic nerve appear to be reduced in thickness and show perforations through which fibers of the optic nerve pass outwards, it constitute a weak spot so any rise in the intra ocular pressure such as in glaucoma cause bulging of the sclera out words.

The sclera is relatively avascular & ant. it blends with the cornea in a transition zone called limbus.

Cornea

Is the ant. 1/6th of the tunica fibrosa it is colorless & transparent, a transverse section of the cornea shows that it consist of five layers:

- 1) Corneal epithelium: non-keratinized stratified squamous epithelium consist of 5-6 layers with numerous mitotic figures at the basal layer indicate its regenerative capacity. Numerous free nerve endings terminate in this epithelium which is part of the blink reflex.
- 2) Bowman's membrane: thick homogenous layer lies beneath the corneal epithelium, it consist of collagen fibers with condensation of intercellular

substance and no cells. This membrane contribute greatly to the stability & strength of the cornea.

- 3) Corneal stroma: is the main layer formed of many layers of parallel collagen bundles, between these fibers few fibroblast cells (keratocytes) are found, the cornea is avascular & this feature together with the paucity of cells render the cornea transparent to transmit light.
- 4) Decemet's membrane: it is hyaline homogenous layer on the post. aspect of corneal stroma composed of thin collagen fibers.
- 5) Corneal endothelium: single layer of simple squamous cells which line the inner surface of the cornea, these cells have organelles characteristic of cells engaged in the process of active transport & protein synthesis so these cells are responsible for:
 - a. Synthesis & maintenance of Decemet's membrane.
 - b. Maintaining the transparency of the cornea (together with the corneal epithelium) both layers pumps fluid from the corneal stroma to the outside keeping the stroma in a dehydrated state which is very important factor in the transparency of the cornea. Excessive hydration of the stroma will result in a state of opacification of the cornea.

The cornea is avascular and receive its nutrition by diffusion from nearby vessels & from fluid in the ant. chamber of the eye.

Corneo-scleral junction: (limbus)

Is the area of transition from the transparent collagen bundles of the cornea to the white opaque fibers of the sclera this area is highly vascularised so it consist of highly communicating channels lined with endothelial cells, these channels unite to form the Canal of sclemm which will drain the fluid in the ant. chamber of the eye (aqueous humor). Sclemm's canal communicate externally with the venous system.

Any block in this drainage pathway will lead to increase intraocular pressure leading to glaucoma. Normal intraocular pressure is 24 mmHg (similar to CSF).

Middle layer (vascular layer, uvea):

Uvea is the intermediate layer in the eye between the sclera & retina, it contains blood vessels, nerves, supportive cells, contractile cells & melanocytes. It is divided into 3 areas: choroids, ciliary body & iris (uveal tract).

■ 1- Choroid

- extends from the ora serrata to the optic nerve. It is highly vascularized coat, between its blood vessels there is loose C.T. which is rich in fibroblasts, macrophages & melanocytes.
- The inner layer of the choroids is richer in blood vessels & called choriocapillary layer it has an important function in nutrition of the retina
- Choriocapillary layer is separated from the retina by a thin hyaline membrane called Bruch's membrane. The choroids is bound to the sclera by the suprachoroidal lamina which is a loose C.T. rich in melanocytes.

2- Ciliary body & Ciliary processes:

Is the ant. expansion of the choroids at the level of the lens, it extend from the base of the iris to the ora serrata where it is continuous with the choroid. In transverse section the ciliary body is triangular in shape, composed of vascular stroma, smooth muscles & melanocytes. Its inner surface is lined by a double layer of columnar epithelium, the basal cells are pigmented while the superficial cells are not (this epithelium is regarded as a continuation of the non-nervous part of the retina).

- Ciliary processes are ridge like extensions of the ciliary body with a core of loose C.T. & numerous fenestrated capillaries. from these processes emerge fibers called zonule fibers that will insert into the lens. Ciliary processes are

covered by the same cells covering the ciliary body and they are responsible for formation of aqueous humor.

■ 3- Iris:

- Is the ant. continuation of the choroids it lies in front of the lens leaving a hole in the center called pupil,
- the iris consists of a vascular core with pigmented cells and iridial muscles.
- It is lined by double layer of columnar pigmented cells posteriorly, while ant. it is covered by simple squamous epithelium which represents the continuation of the post. epithelial layer of the cornea.

The iridial muscles

1-Constrictor pupilli muscle: lies internally, circularly arranged, supplied by parasympathetic fibers. It causes constriction of the pupil.

2-Dilator pupilli muscle: radially arranged, lies externally supplied by sympathetic fibers and their contraction leads to dilatation of the pupil.

Inner layer (Retina)

Is the inner most layer of the eye & considered as a photosensitive nervous layer. It extends from the optic disc to the ora serrata which limits the beginning of the non-nervous part. When the retina is examined by ophthalmoscope it appears red in color due to reflection of light from the vascular choroids layer. At the center of the retina lies the *yellowish spot (macula)* which contains a central depression called *fovea centralis* this is the area of higher visual acuity in the eye. Medial to the macula we have the *optic disc (blind spot)* where the fibers of optic nerve leave the eye.

The retina consist of many types of cells:

- 1) Pigment cells: large hexagonal cells contain pigments, send processes (large microvilli) that extend between the rods & cones, each pigment cell cover 9-10 rods & cone, these cells lies on the bruch's membrane.
- 2) Photoreceptor cells of rods & cones: rods are more numerous then cones (rods are 110-115 million while cones are 6-7 millions) nuclei of rods lie in the inner part of the outer nuclear layer, cones are concerned with color vision and bright light vision while rods are concerned with low light vision.
- 3) Supportive cells (muller's cells & astrocytes): the muller cells are tall supporting cells extend from the base of the photoreceptor cells up to the retinal surface, they link to each others by processes forming the outer limiting membrane. Astrocytes found throughout the retina and there prosesses form a scaffold for other nerve cells.
- 4) Nerve cells: are bipolar cells, horizontal cells, amacrine cells. They interconnect with each others and with the photoreceptor cells to finally transmit signals to the optic nerve.

The retina is formed of 10 layers from out side to inside:

- 1) Pigment cell layer
- 2) Photoreceptor cell layer
- 3) External limiting membrane
- 4) Outer nuclear layer
- 5) Outer plexiform layer
- 6) Inner nuclear layer: nuclei of bipolar, horizontal, amacrine & muller cells
- 7) Inner plexiform layer
- 8) Ganglion cell layer: a row of ganglion cells which have large nuclei and prominent nucleoli

- 9) Nerve fiber layer: the axons of ganglion cells in their way to the optic nerve.
- 10) Inner limiting membrane: a barely visible membrane between the vitreous and retina.