THE EYEBALL:
It can be divided into the fibrous (cornea & sclera), vascular (uvea; choroid posteriorly and the ciliary body and iris anteriorly) and inner layers (retina).

Fibrous Layer (cornea & sclera)
- It is the outermost layer.
- It is a tough outer coat which is transparent anteriorly (the cornea) and opaque posteriorly (the sclera). The junction between them is called the limbus.
- The extraocular muscles attach to the outer sclera while the optic nerve leaves the globe posteriorly.
- Their main functions are to provide shape to the eye and support the deeper structures.
A. The cornea

- The cornea is transparent and positioned centrally at the front of the eye. Light entering the eye is refracted by the cornea.
- The cornea is 0.5 mm thick and comprises:
  1. The epithelium, an anterior non-keratinized squamous layer, thickened peripherally at the limbus where it is continuous with the conjunctiva. The limbus houses the germinative stem cells of the corneal epithelium.
  2. An underlying stroma of collagen fibrils, ground substance and fibroblasts.
- The regular packing, small diameter and narrow separation of the collagen fibrils account for corneal transparency. This orderly architecture is maintained by regulating stromal hydration.
  3. The endothelium, a monolayer of non-regenerating cells which actively pump ions and water from the stroma, controlling corneal hydration and hence transparency.

  - The difference between the regenerative capacity of the epithelium and endothelium is important. Damage to the epithelial layer, by an abrasion for example, is rapidly repaired by cell spreading and proliferation. Endothelial damage, by disease or surgery, is repaired by cell spreading alone, with a loss of cell density. A point is reached when loss of its barrier and pumping functions leads to over-hydration (oedema), disruption of the regular packing of its stromal collagen and corneal clouding.
    - Note: the epithelial layer prevents the infection because it forms barrier except: gonococcus and pseudomonas. *

- Functions of the cornea
  1. It protects the internal ocular structures.
  2. Together with the lens, it refracts and focuses light onto the retina.
- The junction between the ambient air and the curved surface of the cornea, covered by its optically smooth tear film, forms a powerful refractive interface.
  - Note: corneal refraction is 40 degrees & Lens refraction is 20 degrees. *
- The nutrition of the cornea is supplied almost entirely by the aqueous humour, which circulates through the anterior chamber and bathes the
posterior surface of the cornea. The aqueous also supplies oxygen to the posterior stroma, while the anterior stroma receives its oxygen from the ambient air. The oxygen supply to the anterior cornea is reduced but still sufficient during lid closure, but a too-tightly fitting contact lens may deprive the anterior cornea of oxygen and cause corneal, especially epithelial, oedema.

B. The tear film:

When the eyes are open, the exposed ocular surface (the cornea and exposed wedges of bulbar conjunctiva) are covered by a tear film, 3 μm thick.

- This comprises three layers:
  1. a mucin gel layer produced by the conjunctival goblet cells, in contact with the ocular surface;
  2. an aqueous layer produced by the lacrimal gland;
  3. a surface oil layer produced by the meibomian glands and delivered to the lid margins.

- Functions of the tear film:
  1. It provides a smooth air/tear interface for distortion-free refraction of light at the cornea.
  2. It transmits oxygen to the avascular cornea.
  3. It removes debris and foreign particles from the ocular surface through the flow of tears.
  4. It has antibacterial properties through the action of lysozyme, lactoferrin, defensins and the immunoglobulins, particularly secretory IgA.

- The tear film is replenished with each blink.
  - Note: The mucin layer is important in prevention of the evaporation of the fluid. *

- Anterior and Posterior Chambers
They are two fluid filled areas in the eye. The *anterior chamber* is located between the cornea anteriorly and the iris and central lens posteriorly, whose periphery is the **iridocorneal angle or drainage angle**. The *posterior chamber* between the iris and ciliary processes. The chambers are filled with aqueous humor – a clear plasma-like fluid that nourishes and protects the eye. The aqueous humor is produced constantly, and drains via the trabecular meshwork.

- **The iridocorneal angle or drainage angle** is lined by a meshwork of cells and the collagen beams called the trabecular meshwork through which aqueous drains into Schlemm’s canal and thence into the venous system via the aqueous veins. This is the basis of aqueous drainage.
- Schlemm’s canal is a circular lymphatic-like vessel in the eye that collects aqueous humor from the anterior chamber and delivers it into the episcleral blood vessels via aqueous veins. (drainage point)

C. The sclera:
- The sclera comprises the majority of the fibrous layer (approximately 85%). It provides attachment to the extraocular muscles – these muscles are responsible for the movement of the eye. It is visible as the white part of the eye.
- The sclera is formed from interwoven collagen fibrils of different widths lying within a ground substance and maintained by fibroblasts.
- It is of variable thickness.

D. Conjunctiva:
- Anteriorly, the **bulbar conjunctiva** of the globe is reflected from the sclera into the *fornices* and thence onto the posterior surface of the lids where it forms the *tarsal (palpebral) conjunctiva*. A connective tissue layer (*Tenon’s capsule*) separates the conjunctiva from the sclera and is prolonged backwards as a sheath around the rectus muscles.
2. Vascular Layer

A rich vascular coat (the **uvea**) lies underneath the fibrous layer, forms the **choroid** posteriorly and the **ciliary body and iris** anteriorly.

**A. The choroid:**
- The choroid is formed of arterioles, venules and a dense, fenestrated capillary network.
- It is loosely attached to the sclera.
- It has a remarkably high blood flow.
- It nourishes the deep, outer layers of the retina and may have a role in its temperature homeostasis.
- It lines the retina, to which it is firmly attached and nourishes its outer two-thirds. Its basement membrane, together with that of the **retinal pigment epithelium (RPE)**, forms the **acellular Bruch’s membrane**, which acts as a diffusion barrier between the choroid and the retina.
  ✓ Note: The inner one third supplied by the central retinal artery and it’s an end artery. *

![Figure 1.6](image.png) The relationship between the choroid, RPE and retina.

**B. The ciliary body**

The ciliary body is subdivided into three parts:

1- the ciliary muscle;
2- the ciliary processes (fluid secretion site).
3- the pars plana (avascular stroma used as incision site in eye’s surgeries).

➢ **The ciliary muscle**
  o This comprises smooth muscle arranged in a ring overlying the ciliary processes.
  o It is innervated by the parasympathetic system via the third cranial nerve.
  o It is responsible for changes in lens thickness and curvature during accommodation.

C. **The iris**
  o The smooth dilator muscle extends from the iris periphery towards the sphincter. It is innervated by the sympathetic system.
  o The sphincter muscle is innervated by the parasympathetic system.

➢ **The lens**

The lens is the second major refractive element of the eye; the cornea, with its tear film, is the first.
  o It grows throughout life.
  o It is supported by zonular fibers (suspensory ligaments) running between the ciliary body and the lens capsule.
  o The zonular fibers transmit changes in the ciliary muscle allowing the lens to change its shape and refractive power (accommodation).

✓ **Note:** When the eye is focused for distance, tension in the zonule maintains a flattened profile of the lens.

➢ **The retina**

The retina itself is composed of two cellular layers:
  1. Pigmented layer – the outer layer of the retina. It is attached to the choroid layer and acts to support the neural layer. It continues around the whole inner surface of the eye.
2. Neural layer – the innermost layer of the retina. It consists of photoreceptors; the light detecting cells of the retina (rods and cones).

💡 The vitreous humour
- The vitreous is a clear gel occupying two-thirds of the globe.
- Its body lies between the lens and retina.
- It is 98% water. The remainder is gel-forming hyaluronic acid traversed by a fine collagen network (Note: it has an important role in the attachment and prevent the floating of the fiber in the vitreous body and so it prevents the formation of Floaters).
- There are few cells.
- It has a nutritive and supportive role.

✓ Note:
The internal carotid gives the first branches >> ophthalmic artery >> any emboli may occlude one of its branches:
- Ciliary: if affect the choroid: may asymptomatic / the optic nerve: optic neuropathy
- Retinal: central artery occlusion
- Muscular: paralysis*

*All notes are copied from Hiba Bilal’s PowerPoint.