GENERAL HISTOLOGY

G. Histology

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Eye

The eyes, housed in the bony orbits, are the photosensitive organs responsible for vision. Each eye is composed of three concentric tunics or layers:

1) A tough external fibrous layer consisting of the sclera and the transparent cornea.

2) A middle vascular layer that includes the choroid, ciliary body, and iris.

3) An inner sensory layer, the retina, which communicates with the cerebrum through the posterior optic nerve.

1- Fibrous Layer

This layer includes two major regions, the posterior sclera and anterior cornea, joined at the limbus.

A) Sclera

The sclera (the white of the eye) is an opaque, relatively avascular. The white posterior five-sixths of this layer is the sclera, which encloses a portion of the eyeball. The sclera consists mainly of dense connective tissue, with flat bundles of type I collagen parallel to the organ surface but intersecting in various directions; microvasculature is present near the outer surface.

B) Cornea

In contrast to the sclera, the anterior one-sixth of the eye—the cornea—is transparent and completely avascular. A section of the cornea shows five distinct layers:

1. An external stratified squamous epithelium is non-keratinized.
2. An anterior limiting membrane (Bowman's membrane), which is the basement membrane of the external stratified epithelium.
3. The thick stroma; or substantia propria, makes up 90% of the cornea's thickness and consists of approximately 60 layers of parallel collagen bundles.
4. A posterior limiting membrane (Descemet's membrane).
5. An inner simple squamous endothelium.

C) Limbus

Encircling the cornea is the limbus, a transitional area where the transparent cornea merges with the opaque sclera. Here Bowman's membrane ends and the surface epithelium becomes more stratified as the conjunctiva that covers the anterior part of the sclera (and lines the eyelids).

2) Vascular Layer

The eye's more vascular middle layer, known as the Uvea, consists of three parts, from posterior to anterior: the choroid, the ciliary body, and the iris.

A) Choroid

Located in the posterior two-thirds of the eye, the choroid consists of loose, well vascularized connective tissue and contains numerous melanocytes. Two layers make up the choroid:

1. The inner choroido-capillary lamina has a rich microvasculature important for nutrition of the outer retinal layers.

2. Bruch's membrane, a thin extracellular sheet, is composed of collagen and elastic fibers surrounding the adjacent microvasculature and basal lamina of the retina's pigmented layer.

B) Ciliary Body

The ciliary body, the anterior expansion of the uvea that encircles the lens, lies posterior to the limbus. Like the choroid, most of the ciliary body rests on the sclera. Important structures associated with the ciliary body include the following:

- Ciliary muscle makes up most of the ciliary body's stroma and consists of three groups of smooth muscle fibers.

- Ciliary processes are a radially arranged series of about 75 ridges extending from the inner highly vascular region of the ciliary body.

Aqueous humor

Aqueous humor is a continuously flowing liquid that carries metabolites to and from cells and helps maintain an optimal microenvironment within the anterior cavity of the eye, it is secreted from ciliary processes into the posterior chamber of the anterior cavity, flows into the anterior chamber

through the pupil, and drains into the scleral venous sinus (canal of Schlemm).

Ciliary zonule

Ciliary zonule is a system of many radially oriented fibers composed largely of fibrillin-1 and 2 produced by the nonpigmented epithelial cells on the ciliary processes.

C) Iris

The iris is the most anterior extension of the middle uveal layer which covers part of the lens, leaving a round central pupil.

The anterior surface of the iris, exposed to aqueous humor in the anterior chamber, consists of a dense layer of fibroblasts and melanocytes with interdigitating processes and is unusual for its lack of an epithelial covering.

The posterior surface of the iris has a two-layered epithelium continuous with that covering the ciliary processes, but very heavily filled with melanin.

Eye color is blue only if few melanocytes are present.

Increasing amounts of pigment impart darker colors to the eye, the iris color changes through various shades of green, gray, and brown. Individuals with albinism have almost no pigment and the pink color of their irises is due to the reflection of incident light from the blood vessels of the stroma.

Lens

The lens is a transparent biconvex structure suspended immediately behind the iris, which focuses light on the retina. The lens is a unique avascular tissue and is highly elastic, a property that normally decreases with age.

3) Sensory layer

A. Retina

The retina is the innermost of the three tunicae of the eye and is responsible for photoreception. It is interposed between the choroid and the vitreous humor.

Accessory Structures of the Eye

a) Conjunctiva (transparent mucous membrane)

The conjunctiva lines the eyelids and is reflected onto the anterior portion of the eyeball to the cornea, where it becomes continuous with the corneal epithelium. It is a stratified columnar epithelium possessing many goblet cells. It is separated by a basal lamina from an underlying lamina propria of loose connective tissue.

b) Eyelids

The eyelids are lined internally by conjunctiva and externally by skin that is elastic and covers a supportive framework of tarsal plates. Eyelids contain highly modified sebaceous glands (meibomian glands), smaller modified sebaceous glands (glands of Zeis), and sweat glands (glands of Moll).

c) Lacrimal apparatus

1. Lacrimal gland

The lacrimal gland is a compound tubuloalveolar gland with secretory units that are surrounded by an incomplete layer of myoepithelial cells.

2. Lacrimal fluid (tears) is mostly water, and contains lysozyme, an antibacterial enzyme. Tears drain from the lacrimal gland via 6 to 12 ducts into the conjunctival fornix, from which the tears flow over the cornea and conjunctiva, keeping them moist. Tears then enter the lacrimal puncta, leading to the lacrimal canaliculi.

3. Lacrimal canaliculi are lined by a stratified squamous epithelium and unite to form a common canaliculus, which empties into the lacrimal sac. The lacrimal sac is lined by a pseudostratified ciliated columnar epithelium. The nasolacrimal duct is the inferior continuation of the lacrimal sac and is also lined by a pseudostratified ciliated columnar epithelium. The duct empties into the floor of the nasal cavity.

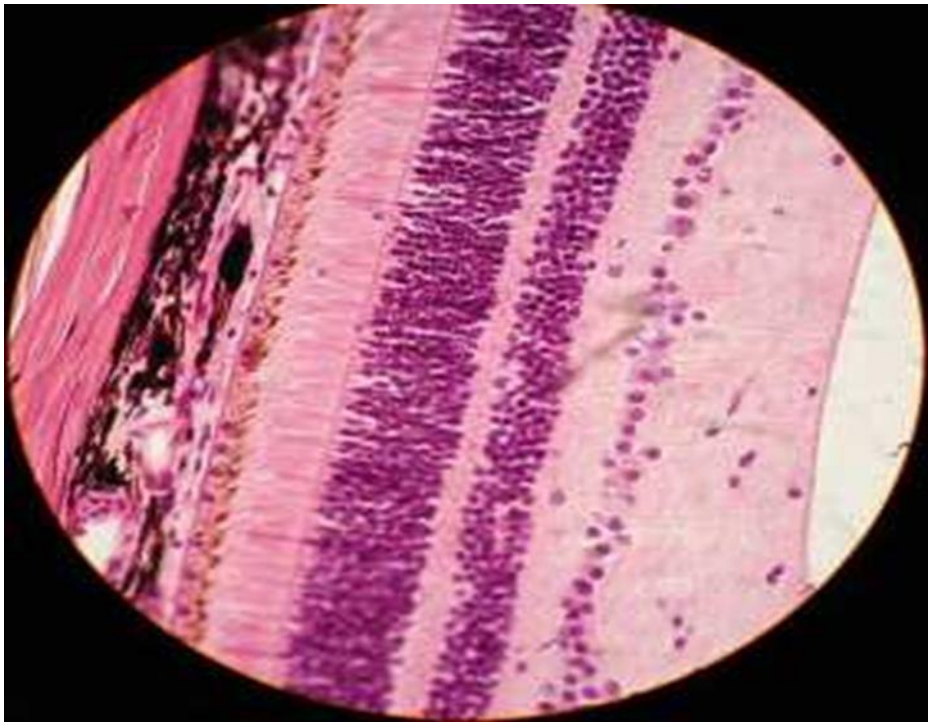


Figure1: Deep to superficial tissues (left to right):

pigment cells rods (finer

and longer) cones (thicker

and shorter) outer limiting

membrane

nuclei of cones (closer to choroid)

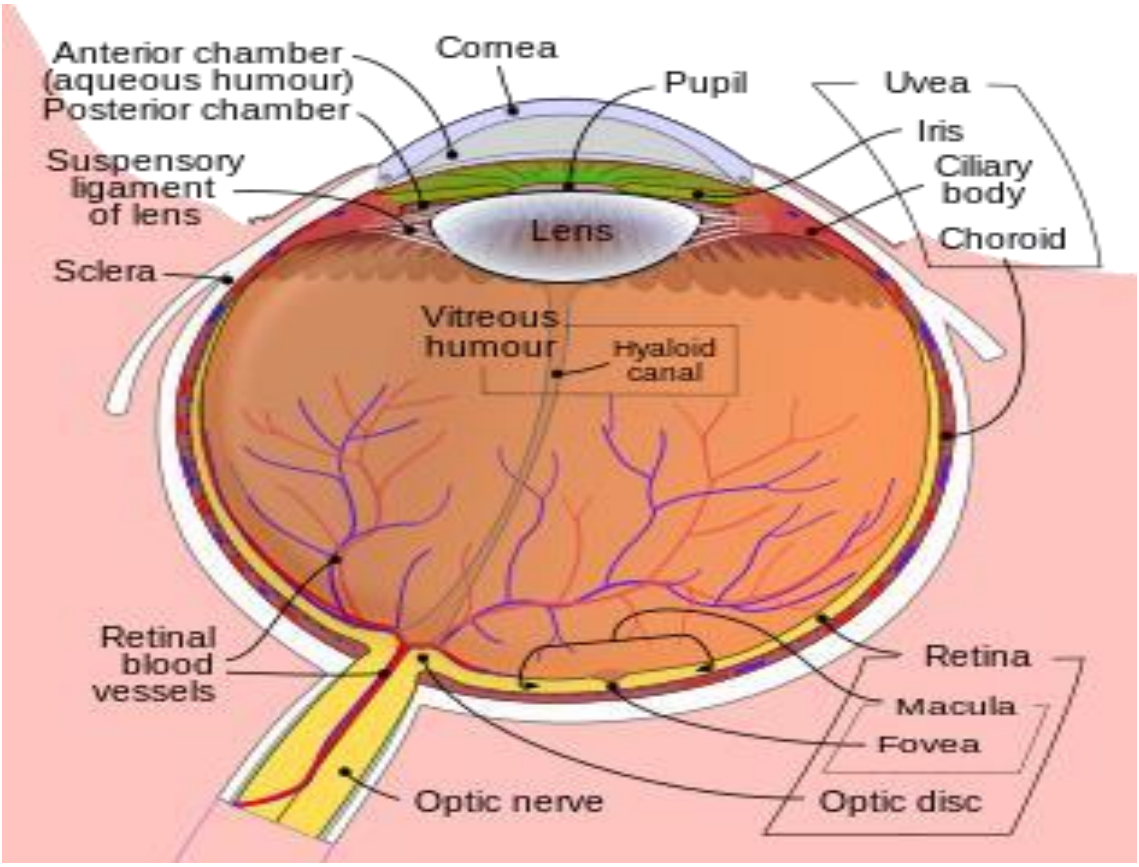
nuclei of rods (further from choroid)

nuclei of: horizontal cells (closest to

receptors) bipolar cells

amacrine cells (closest to ganglion)

ganglion cell bodies Mullers fibers (vertical fr ganglion cells


Anterior chamber
(aqueous humour)
Posterior chamber
Cornea
Pupil
Uvea
Iris
Ciliary
body
Choroid
Suspensory
ligament
of lens
Lens
Sclera
Vitreous
humour
Hyaloid
canal
Retinal
blood
vessels
Retina
Macula
Fovea
Optic nerve
Optic disc