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**COURSE TITLE: NEUROHISTOLOGY**

**1. HISTOLOGICAL IMPORTANCE OF THE EYE IN RELATION TO THEIR CELLULAR FUNCTION.**

 The eyes are a complex and highly developed photosensitive organ that permits an accurate analysis of the form, light intensity, and color reflected from objects. Broadly, from an anatomical perspective, the eye can be viewed as a series of overlapping layers of tissue. Each eye is composed of three concentric layers: an external layer that consists of the sclera and the cornea; a middle layer also called the vascular layer consisting of the choroid, ciliary body, and iris; and an inner layer consisting of the lens, vitreous and the retina.

**A. External layer**

**SCLERA**: the sclera consists of tough, dense connective tissue made up mainly of flat collagen bundles intersecting in various directions while remaining parallel to the surface of the organ, a moderate amount of ground substance, and a few fibroblasts.

The four layers of the sclera from external to internal are episclera, stroma, lamina fusca, and endothelium.

The external surface of the sclera, the episclera, is connected by a loose system of thin collagen fibres to a dense layer of connective tissue called Tenon’s capsule. At the corneoscleral junction, also known as the limbus, the Tenon capsule contacts stroma of the conjunctiva.

The exposed front surface of the eye, including the cornea, is also covered by a thin, non-keratinized stratified squamous epithelium.

**CORNEA(transparent front layer of the eye)**: Consists of type I collagen fibers oriented in a uniform parallel direction to maintain transparency. It consists of five layers: epithelium (non-keratinized, stratified squamous epithelium), bowman layer, stroma (also called substantia propria), Descemet’s membrane, corneal endothelium.

The Bowman’s membrane: consists of collagen fibers crossing at random, a condensation of the intercellular substance, and no cells. Bowman’s membrane contributes greatly to the stability and strength of the cornea.

The strom: a is formed by many layers of parallel collagen bundles cross at approximately right angles to each other.

Descemet’s membrane: is a thick homogenous structure composed of the collagenous filaments organised in a three-dimensional network.

Corneal endothelium: a one cell thick layer made of either simple squamous or cuboidal cells. Cells in this region do not regenerate and have pumps that maintain fluid balance and prevent swelling of the stroma. When corneal endothelial cells are lost, neighbouring cells stretch to attempt to compensate these losses.

**B- MIDDLE LAYER**: The middle layer of the eye consists of three parts: choroid, ciliary body and iris, known collectively as the uveal tract.

**The ciliary body** contains ciliary muscles that are composed of smooth muscle. Contraction and relaxation of the ciliary muscles change the tension of the zonular fibre, or suspensory ligaments of the lens. This allows the lens to change shape, a process known as accommodation.

The ciliary processes are folds of connective tissue that are covered by two layers of epithelium. There is also a complex vasculature that cannot be seen easily. Fluid from these vessels is processed and transported by the epithelial cells to the posterior chamber as aqueous humor. The epithelial cells constitute the blood-aqueous barrier.

**The Iris**: its anterior surface contains loose variably pigmented stroma. It is open to the circulating aqueous humor within the anterior chamber.

Two layers of heavily pigmented epithelium cover the posterior surface of the iris.

The sphincter pupillae and dilator pupillae muscles connect to the stroma. The pigmented layer of cells blocks rays of light that move through the pupil to reach the retina.

The angle formed by the iris and cornea contains connective tissue with endothelial channels called the trabecular meshwork, which drains aqueous humor in the anterior chamber into the venous canal of Schlemm. From here, fluid drains into the episcleral veins.

**Choroid**: Consists of a dense network of blood vessels supplying nourishment to structures of the eye, housed in loose connective tissue.

The choriocapillary layer is located in the innermost part of the choroid and supplies the retina.

The Bruch membrane is an extracellular matrix layer situated between the retina and choroid and has significance in age related macular degeneration, where an accumulation of lipid deposits prevent diffusion of nutrients to the retina.

**Innermost layer**: Lens, Vitreous, Retina.

**Lens**: separates the aqueous and vitreous chambers. It consists of an outer capsule, a middle layer called cortex, and an inner layer called the nucleus.

The capsule is the basement membrane of the lens epithelium which lies below. New lens cells differentiate from the lens epithelium and are incorporated peripherally, pushing older lens cells towards the middle.

**Vitreous**: a jelly-like space made of type II collagen separating the retina and the lens.

**Retina**: nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials.

**2. LAYERS OF THE RETINA.**

I. The pigmented layer: retinal pigmented epithelium (commonly abbreviated RPE). It is involved in photoreceptor metabolism and that it comprises which captures light not picked up by photoreceptors.it is made up of cuboidal cells containing melanin which absorbs light. These cells also establish a blood-retina barrier through tight junctions.

“Rod and cone cells”: the layer of cells with photoreceptors and glial cells. Rods are located peripherally and are more sensitive to light and motion than cones. Cones have higher visual acuity and specificity for color vision.

 ● Outer limiting membrane: a layer of Muller cells and rod/cone junctions which serves to separate the photosensitive regions of the retina from the areas that transmit the electrical signals.

 ● Outer nuclear layer: this layer consists of nuclei of rod and cone cells.

 ● Outer plexiform layer: this layer contains synaptic processes of rod and cone cells

 ● Inner nuclear layer: this layer contains the cell body of glial, amacrine, bipolar, and horizontal cells.

 ● Inner plexifrorm layer: This layer relays information from cells of the inner nuclear layer. Thus, this layer has axons of amacrine, bipolar, and glial cells and dendrites of retinal ganglion cells.

 ● Ganglion cell layer: This layer contains nuclei of retinal ganglion cells.

 ● Nerve fiber layer: this layer contains axons of retinal ganglion cells and the astroglia which support them. Collectively, these axons constitute the optic nerve.

 ● Internal limiting membrane: a thin layer of Muller glial cells and basement membrane which demarcates the vitreous anteriorly from the retina posteriorly.