Retina Histology

SUMMARY

ANATOMICAL ORIENTATION

• The vitreous chamber lies internal to the retina.

• The choroid lies external to the retina.

THE TEN LAYERS

1. The pigmented layer

• Retinal retinal pigmented epithelium (commonly abbreviated RPE).

- It is involved in photoreceptor metabolism and that it comprises which captures light not picked up by the photoreceptors.

2. The photoreceptor cell layer of rods and cones

• Photoreceptor cells:

- Involved in light capture and PHOTOTRANSDUCTION; the phototransduction cascade occurs here, which transforms light into neural signal. The photoreceptor cell segments are metabolically dependent upon the pigmented epithelium for photoreceptor regeneration and waste disposal.

• Divisions

- Outer segment

- Inner segment.

3. External limiting membrane

4. Outer nuclear layer

• Photoreceptor cell bodies.

- Cones have a large outer, conical segment; they provide high-resolution color vision.

- Rods have a small, narrow cylindrical outer segment; they provide low-resolution dim-light ("night") vision. Rods outnumber cones by roughly 15:1.

Central vs Peripheral Vision

• Cones predominate in central vision (within the fovea)

• Rods predominate in peripheral vision (outside of the macula).

5. Outer plexiform layer

• It comprises a thin synaptic zone; we'll draw these synapses momentarily.

6. Inner nuclear layer

• It comprises retinal interneuronal cell bodies.

This layer specifically comprises:

• BIPOLAR CELLS, which, as we see have two poles, so they can pass forward electrical signal from the photoreceptor cells to the ganglion cells (drawn soon).

• HORIZONTAL and AMACRINE CELLS, which enhance visual contrast.

Visual Contrast vs Illumination for Visual Perception

• It is well recognized that the visual system relies more on visual contrast than the overall level of illumination for visual perception. The visual system attends to the borders between light and dark areas or color differences more so than light intensity.

- As long as we can read the page of a book comfortably, we perceive the words on it just the same in varying levels of illumination; it is the contrast of the ink from the page that makes the largest impression in our mind.

• MÜLLER GLIAL CELLS extend across the retina: their proximal endings form the inner limiting membrane (as we'll soon see) and their distal processes help form the external limiting membrane.

7. Inner plexiform layer

• It comprises a thick synaptic zone.

8. Ganglion cell layer

• It comprises ganglion cell bodies.

- The ganglion cell dendrites help form the inner plexiform layer, and the axons form the nerve fiber layer.

9. Nerve fiber layer

• It comprises axons of the ganglion cells, which are unmyelinated.

10. Inner limiting membrane

• It forms from the basal lamina of Müller glial cells.

CONSOLIDATION OF LIGHT CAPTURE & PROCESSING

• Light passes through the retina and is captured by the photoreceptor cell segments where the phototransduction cascade occurs, which converts light to neural signal.

• Neural signal signal is passed back through the retina: to the photoreceptor nuclei to the bipolar cells, the ganglion cells, and our along the ganglion cell axons (the nerve fiber layer), which are unmyelinated so as to NOT impeded the light from passing through the retina to the photoreceptor cell layer.

THE 10 LAYERS OF THE RETINA

From outside to inside:

• Sclera

• Choroid

• The pigmented epithelium

• Photoreceptor cell layer of rods and cones

• External limiting membrane

• Outer nuclear layer

• Outer plexiform layer

• Inner nuclear layer

• Inner plexiform layer

• Ganglion cell layer

• Nerve fiber layer

• Inner limiting membrane

Clinical Correlation: Retinal Pathologies

FULL-LENGTH TEXT

• Here, we'll address the histology of the retina, which captures light and turns it into electrical signal.

To begin, let's orient ourselves.

• Indicate the inner-lying vitreous chamber; it lies internal to the retina.

• Then, indicate the outer-lying choroid; it lies external to the retina.

Now, let's draw the ten layers.

• First, draw a row of retinal retinal pigmented epithelium (commonly abbreviated RPE).

- The pigmented layer.

- Indicate that it is involved in photoreceptor metabolism and that it comprises which captures light not picked up by the photoreceptors.

• Next, draw a series of photoreceptor cells.

- Specify the photoreceptor cell layer of rods and cones

- Indicate that it is involved in light capture and phototransduction; the phototransduction cascade occurs here, which transforms light into neural signal.

- The photoreceptor cell segments are metabolically dependent upon the pigmented epithelium for photoreceptor regeneration and waste disposal.

- Indicate that this layer divides into an outer segment and an inner segment.

Soon we will address the difference between rods and cones.

• External limiting membrane

• Outer nuclear layer

- Indicate that it comprises photoreceptor cell bodies.

• Label a cone nucleus for a photoreceptor cell with a large outer, conical segment; they provide high-resolution color vision.

• Label a rod nucleus for a photoreceptor cell with a small, narrow cylindrical outer segment; they provide low-resolution dim-light ("night") vision.

• In addition to their difference in shape, these photoreceptor cells also differ in pigment types (opsins).

In our diagram are there more rods or cones?

- We draw more rods than cones, here, to reflect that rods outnumber cones by roughly 15:1.

• Cones predominate in central vision (within the fovea), whereas rods predominate in peripheral vision (outside of the macula).

• Outer plexiform layer

- Write that it comprises a thin synaptic zone; we'll draw these synapses momentarily.

• Inner nuclear layer

- We'll see that it comprises retinal interneuronal cell bodies.

• Indicate that this layer specifically comprises:

- Bipolar cells, which, as we see have two poles, so they can pass forward electrical signal from the photoreceptor cells to the ganglion cells (drawn soon).

- Horizontal and amacrine cells, which enhance visual contrast. It is well recognized that the visual system relies more on visual contrast than the overall level of illumination for visual perception. The visual system attends to the borders between light and dark areas or color differences more so than light intensity. As long as we can read the page of a book comfortably, we perceive the words on it just the same in varying levels of illumination; it is the contrast of the ink from the page that makes the largest impression in our mind.

- Lastly, show a representative Müller glial cells extend across the retina: their proximal endings form the inner limiting membrane (as we'll soon see) and their distal processes help form the external limiting membrane.

• Inner plexiform layer

- Write that it comprises a thick synaptic zone.

• Ganglion cell layer

- Indicate that it comprises ganglion cell bodies.

- Label a ganglion cell body and show the ganglion cell dendrites, which help form the inner plexiform layer, and the axons, which as we'll see in a moment, form the nerve fiber layer.

• Nerve fiber layer

- Indicate that it comprises axons of the ganglion cells, which are unmyelinated.

• Inner limiting membrane

- Indicate that it forms from the basal lamina of Müller glial cells.

• Finally, to consolidate our understanding of this material, show that:

- Light passes through the retina and is captured by the photoreceptor cell segments where the phototransduction cascade occurs, which converts light to neural signal.

• Show that neural signal signal is passed back through the retina: to the photoreceptor nuclei to the bipolar cells, the ganglion cells, and our along the ganglion cell axons (the nerve fiber layer), which are unmyelinated so as to NOT impeded the light from passing through the retina to the photoreceptor cell layer.

Next, let's introduce a histological slide of the retina.

• We show a small, zoomed-out view

• And a large, magnified view.

• For contextual purposes, label the following:

- The inner limiting membrane.

- The sclera.

- The vascularized choroid.

Now, let's walk through a magnified view of this slide and label the 10 layers of the retina.

• From outside to inside, label the:

- Sclera

- Choroid

- The pigmented epithelium

- Photoreceptor cell layer of rods and cones

- External limiting membrane

- Outer nuclear layer

- Outer plexiform layer

- Inner nuclear layer

- Inner plexiform layer

- Ganglion cell layer

- Nerve fiber layer

- Inner limiting membrane