

only the nerve fiber layer (NFL) continues to become the optic nerve, making a 90° turn posteriorly as it becomes the optic nerve head (optic disc). See BCSC Section 2, *Fundamentals and Principles of Ophthalmology*, and Section 12, *Retina and Vitreous*, for additional information on the anatomy of the retina and RPE.

Neurosensory Retina

The neurosensory retina has 9 distinct histologic layers (Fig 11-1). An additional layer, the middle limiting membrane (MLM), has been described, but it is not a distinct layer on routine histologic sections of the neurosensory retina. On optical coherence tomography (OCT), the photoreceptor inner segment layer appears as several layers because of its innate optical properties: the myoid zone (MZ), which is just external to the external limiting membrane; the ellipsoid zone (EZ), which is closest to the outer segments; and the interdigitation zone (IZ), which is between the outer segments and the RPE (Fig 11-2). The myoid zone contains ribosomes, endoplasmic reticulum, and Golgi bodies, whereas the ellipsoid zone is densely packed with mitochondria of the photoreceptors. In histologic cross sections of the neurosensory retina, the retinal fibers and synaptic processes are arranged perpendicular to the retinal surface, with the exception of the NFL, where

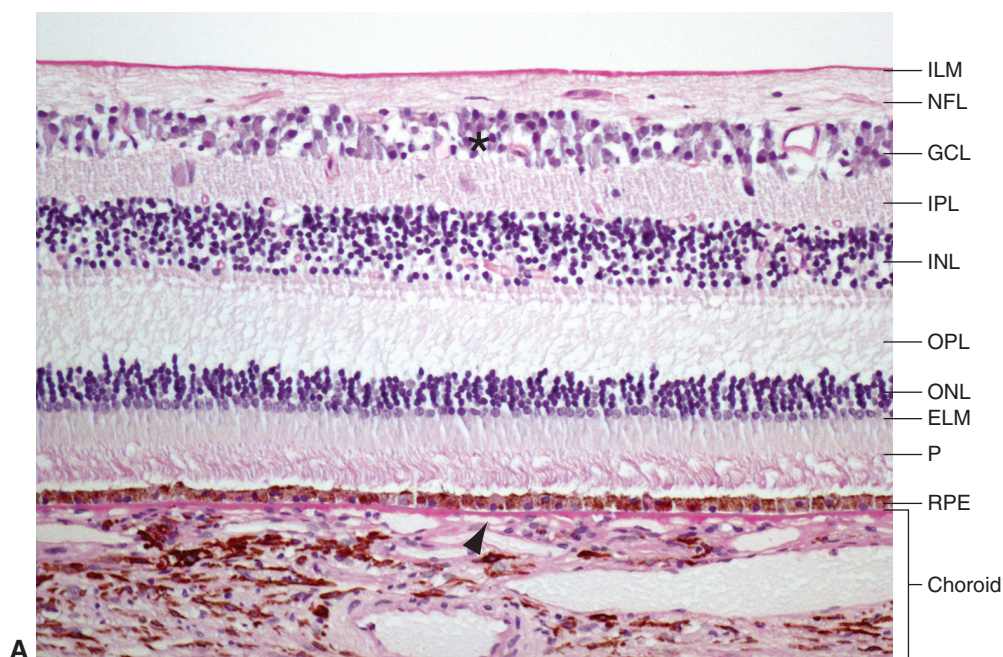


Figure 11-1 Photomicrographs illustrating retinal organization and how it differs depending on location. **A**, Macula, from vitreous (*top of photo*) to choroid (*bottom*): ILM=internal limiting membrane; NFL=nerve fiber layer; GCL=ganglion cell layer (*asterisk*); IPL=inner plexiform layer; INL=inner nuclear layer; OPL=outer plexiform layer; ONL=outer nuclear layer; ELM=external limiting membrane; P=photoreceptors (inner/outer segments) of rods and cones; RPE=retinal pigment epithelium; Bruch membrane (*arrowhead*).

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the axons run parallel to the retinal surface and converge at the optic nerve head. Consequently, deposits and hemorrhages in the deep retinal layers have a round appearance clinically as they displace the perpendicularly arranged fibers, whereas those in the NFL have a feathery or splinter-shaped appearance (Video 11-1).



VIDEO 11-1 Appearance of blood in various retinal layers.

Developed by Vivian Lee, MD.

Go to www.aao.org/bcscvideo_section04 to access all videos in Section 4.



The morphology of the retina varies depending on the region. For example, histologically, the *macula* is the area of the retina where the ganglion cell layer (GCL) is thicker than a single cell (see Fig 11-1A). Clinically, this area corresponds approximately with the area of the retina bounded by the inferior and superior major temporal vascular arcades. The center of the macula is further subdivided into the *fovea*, the central 1.5 mm of the macula, and the *foveola*, a small pit in the center of the fovea. The foveola contains only cone photoreceptor cells; ganglion cells, other nucleated cells (including Müller cells), and blood vessels are not present (see Fig 11-1E). The concentration of cones is greater in the macula than in the peripheral retina, and only cones are present in the fovea.

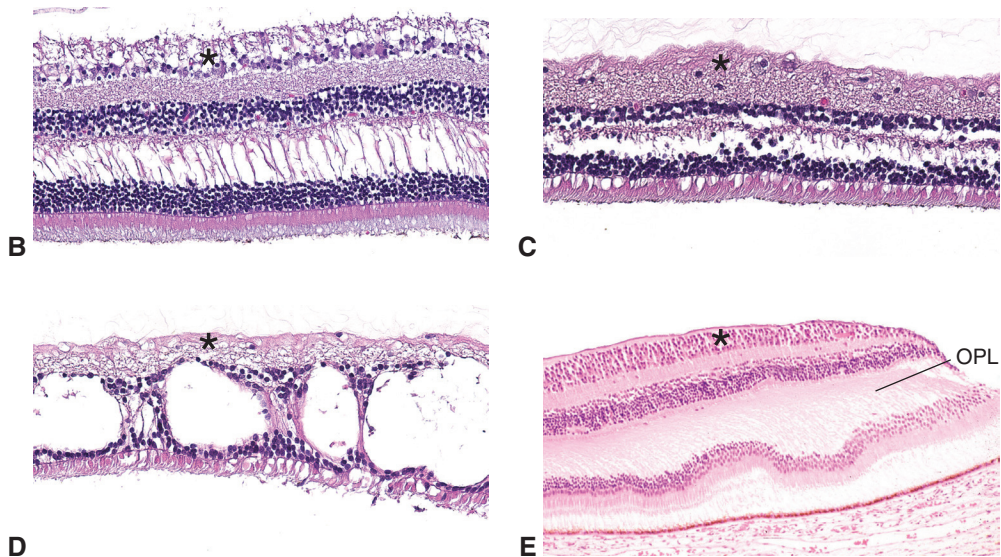


Figure 11-1 (continued) **B**, Retina peripheral to the major vascular arcades and posterior to the equator (near-peripheral retina). The *asterisk* denotes the GCL. **C**, Retina in the equatorial region. The *asterisk* denotes the GCL. **D**, Far-peripheral retina near the ora serrata. Note the reduced density of the GCL (*asterisk*) and overall thinning of the inner retinal layers. **E**, In the region of the foveola, the inner cellular layers taper off (*right side of photo*), with increased density of pigment in the RPE. The incident light falls directly on the photoreceptor outer segments, reducing the potential for distortion of light by overlying tissue elements. Note the multilayered GCL (*asterisk*), typical of the macula. The OPL fibers travel obliquely in the fovea (Henle fiber layer), and the photoreceptor layer in the fovea consists only of cones. (Part A courtesy of Robert H. Rosa Jr, MD; parts B–D courtesy of Vivian Lee, MD; part E courtesy of Nasreen A. Syed, MD.)