The Equine Fundus

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KEYWORDS

• Fundus • Retina • Optic nerve head • Optic disc • Horse • Electroretinography • Ophthalmoscopy

KEY POINTS

- The equine retinal blood vessels are limited to the direct surrounding of the optic disc (paurangiotic retina), and extend a short distance into the nerve fiber layer.
- Choroidal blood vessels can be seen in lightly pigmented fundi, and should not be confused with retinal blood vessels or hemorrhage.
- The equine optic disc is elliptical, orange-pink in color, and located in the nontapetum fundus; it is positioned slightly ventrolateral to the posterior pole of the globe.
- Fundoscopy should be performed in dim light, to reduce glare from the corneal surface, and help with mydriasis. To view the optic disc the examiner should stand slightly in front of the horse and look slightly down.
- Due to their wider field of view, Panoptic and indirect ophthalmoscopy are the preferred methods for screening for fundic lesions, while the greater magnification of the direct ophthalmoscope should be utilized for close examination of lesions.

Fundus is an anatomic term referring to the portion of an organ opposite from its opening, and the fundus of the eye is the back portion of the posterior segment of the globe, including the optic nerve, the retina, and the choroid. Clinically, the fundus can be visualized by means of direct and indirect ophthalmoscopy. Understanding the normal anatomy and appearance of the equine fundus is crucial for differentiating normal variations from abnormalities when performing an examination of the fundus. This article reviews the normal anatomy and appearance of the equine fundus and discusses basic and advanced examination techniques. It also discusses common findings in the equine fundus and their interpretation.

ANATOMY OF THE EQUINE FUNDUS

Retina and Optic Disc

The equine neural retina consists of 10 layers and, similar to other vertebrates, forms a fundamental, vertical, synaptic chain from the photoreceptors (rods and cones) to bipolar cells, to ganglion cells (**Fig. 1**). The axons of the ganglion cells bundle together to

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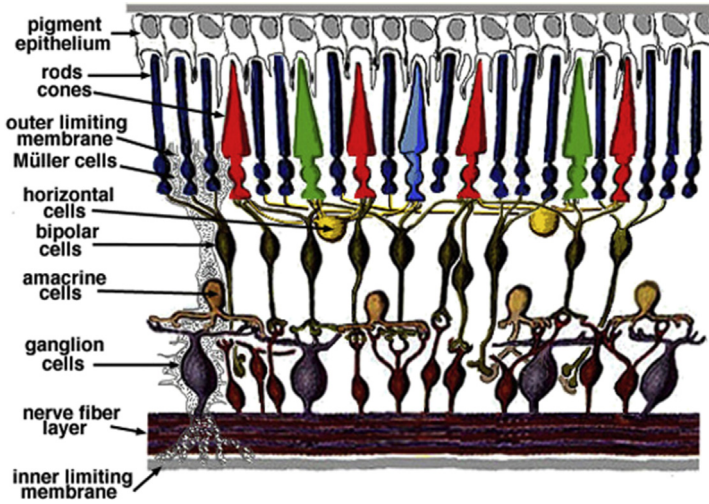

Fig. 1. A simple diagram of the organization of the retina. (*Reproduced from* Webvision. The organization of the retina and visual system. Available at: www.webvision.med.utah.edu; with permission.)

form the optic nerve. In addition to the vertical pathway, the horizontal and amacrine cells form lateral connections within the retina.[1] The horizontal cells synapse with photoreceptors and bipolar cells in the outer plexiform layer, while the amacrine cells synapse with bipolar and ganglion cells in the inner plexiform layer (**Fig. 1**). The horizontal and amacrine cells are inhibitory in nature, and are crucial for the processing of visual stimuli in the retina.

The complex conversion of light energy into electrical signal (ie, phototransduction) takes place in the photoreceptors. Rods are the predominate photoreceptors in the equine retina, with a ratio of about 20 rods for every cone.[2] Whereas rods provide achromatic, low-acuity, scotopic (dim light) vision, cones provide color, high-acuity, photopic (bright light) vision. Two areas in the equine retina contain a higher concentration of cone photoreceptors, and hence are responsible for higher visual acuity. The first is the visual streak, which is a narrow horizontal area located immediately dorsal and lateral to the optic disc (also known as the optic nerve head; ONH), and in parallel to the ventral border of the tapetum. The horizontal visual streak correlates with the horizontal shape of the equine pupil. The second is the area centralis, a circular region located at the lateral end of the visual streak and measures 2 to 5 mm in diameter.[3,4] These 2 areas also contain the highest ganglion cell density, further demonstrating the importance of the visual streak and area centralis for high visual acuity.[3,5] Owing to the lateral position of horses' eyes, the visual streak contributes to monocular vision, while the more laterally located area centralis contributes to forward, binocular vision.[1] Lesions in these 2 areas are likely to have greater impact on vision and visual acuity compared with other areas of the retina.

The retinal pigment epithelium (RPE) is the outermost layer of the retina, and is an intrinsic component of the blood–retinal barrier.[1] The RPE consists of a single layer of cells overlying the photoreceptors, and is firmly attached to the underlying choroid (**Fig. 1**). When retinal detachment occurs, the RPE is separated from the underlying photoreceptors. Because the RPE cells provide nutrition and metabolic support to the photoreceptors, and have an important role in phototransduction (ie, regeneration of the photoreceptors' photopigment), a separation between the RPE and photoreceptors