

The Canine Optic Nerve

The optic nerve is commonly referred to as a cranial nerve. However, it is actually an outpocketing of the diencephalon. Both the brain and the optic nerve are encased within the meninges. The optic nerve acts as a pathway by which ganglion cell axons transverse from the retina to the brain (lateral geniculate nucleus, superior colliculus, hypothalamus, pretectum, etc).

The optic nerve head is the only part of the central nervous system that is easily accessible to direct visualization. Most optic nerve heads appear on the retina as an optic (neuro-retinal) disc that is slightly cupped near its center. The diameters of this disc's rim and cupped area can be measured, and are often expressed as a "cup-to-disc ratio." A normal canine eye's cup-to-disc ratio is about 1:3. An increase in intraocular pressure (IOP), as in a glaucomatous eye, will increase the cup-to-disc ratio by increasing the cupping. This increased ratio represents axonal loss (cell death) and can lead to subsequent loss of visual fields.

It is difficult to measure the exact size of an optic disc via direct or indirect ophthalmoscopy. In these techniques, the degree of disc magnification considerably varies with the distance to an observer. However, the relative size of an optic disc can be compared with the surrounding retinal vasculature. In optic nerve hypoplasia the disc will be shrunken compared to normal, and retinal venules will seem comparatively large. The canine hypoplastic optic disc is small, unmyelinated, and resembles that of a feline. Conversely, the disc will look larger than normal if it is swollen (optic neuritis) or the venules are attenuated (progressive retinal atrophy).

The canine optic nerve generally appears pink in color due to a mixture of fatty myelin and blood-filled capillaries. The degree of optic disc myelination varies between dogs, as does the background color (tapetum, non-tapetum) on which it is contrasted. The illumination (direct vs. indirect ophthalmoscopy) can also affect the color of the disc that is perceived. There is no standard shade of pink that implies a healthy canine optic disc. Diagnostically, extremely pale optic discs can imply atrophy. Increased redness of the optic disc can indicate capillary engorgement. The engorgement can be secondary to inflammation (papillitis or optic neuritis), or a passive response to optic nerve compression (venous stasis). The rim of the optic disc is normally clear and distinct. Any blurring along this margin may indicate peripapillary edema (associated with inflammation) (**Figure 1**).

In the dog, an IOP > 15 mmHg can result in a significant depression of the optic disc. Elevation of cerebral fluid pressure can cause an elevation of the optic disc. The elevation or depression of the disc is most readily evaluated via bifocal indirect ophthalmoscopy. However, there is a wide variation in the normal elevation (or depression) of the optic discs amongst dogs. An acute glaucoma spike in the dog is usually associated with changes in the appearance of the optic disc. The glaucomatous optic disc may redden and swell in response to vascular pressure, or it may show increased pallor due to compression of retinal venules. Days to weeks following an acute

glaucoma spike, the optic disc often darkens due to axonal atrophy. This darkened “pit” in the optic disc is also often associated with an increase in the cup-to-disc ratio.

Alternatively, a darkened pit within the optic disc can represent a coloboma (from the Greek word for mutilation). Optic nerve colobomas are typically described as pits or “excavations.” In collies, optic disc colobomas are often caused by the genetic malformation of the lamina cribrosa sclerae (collagen fibers that support the optic nerve). However, any optic disc coloboma should be evaluated by a veterinary ophthalmologist as it may lead to retinal detachment, glaucoma, and/or blindness.

This brief review cannot explain all the fine details of optic nerve morphology and related pathology. I hope it will be useful as a starting guide, and I suggest that you look at the optic nerves of as many patients as possible. Over time “abnormal” optic nerves should be readily recognizable. A veterinary ophthalmologist can also help in diagnosing and/or treating these optic nerve anomalies.

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Caption to Figure 1:

A hazy optic disc margin is seen in the left eye of a 2 year-old Pomeranian. The diagnosis was optic neuritis.