OPHTHALMOLOGY

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MICHIGAN VETERINARY SPECIALISTS
PRESENTS:

EVALUATION OF THE OCULAR FUNDUS

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Revised November 2010

CHAPTER 1

Introduction

Welcome to the Michigan Veterinary Specialists presentation on Evaluation of the Ocular Fundus. This manual is meant to provide you with all the techniques you will need to perform a good ophthalmic examination on your patients and perform basic ophthalmic procedures.

The ocular fundus is the inside, posterior surface of the eye which is visible with an ophthalmoscope. Due to accessibility and tremendous variation, this is one of the most difficult parts of the eye to examine. This course will cover evaluation and interpretation of the ocular fundus. Ophthalmoscopic technique and dilating agents will be reviewed. The components that make up the ocular fundus will be discussed and there will be a strong emphasis on variation of normal. We will also discuss how to interpret changes that are observed in the fundus. Finally, comparative anatomy of the ocular fundus will be discussed.

As with anything, the more you do it, the better you will be at it, so try to examine the fundus on all of your ophthalmology cases. As always, if you run into a problem, give us a call and we'll be happy to help you out.

CHAPTER 2

Ophthalmoscopic Technique

2.1 General Comments

Ophthalmoscopy allows visualization of the ocular fundus. This includes components of the optic nerve head, retinal blood vessels, retina, tapetum, choroid, and occasionally sclera. Installation of mydriatic agents will aid visualization of these structures. The use of direct ophthalmoscopy, indirect ophthalmoscopy, as well as mydriatics will be discussed here.

2.2 Mydriatic Agents

The most common mydriatic used diagnostically in veterinary ophthalmology is 1% tropicamide. This drug is fast acting, achieving maximal mydriasis within 30 min. of administration. It also has a relatively short duration of action, typically lasting 8-12 hours. It is safe and effective in all the domestic species. Other common mydriatics are limited due to longer time to maximal mydriasis or extended duration. These drugs will not produce mydriasis in birds as they possess skeletal muscle in their iris. Topical vecuronium may provide mydriasis in kestrel-sized or larger birds.

2.3 Direct Ophthalmoscopy

There are many different models of direct ophthalmoscopes available. They all contain a light source and a series of lenses that are changed using a dial. The numbers on this dial are the diopter power of the lens you have selected. Red numbers are negative diopter lenses which will increase your focus into the eye and positive diopter lenses which will decrease your focus into the eye have green or black numbers. Most models will have another dial which modifies the light source. Common modifications include large and small spot sizes, slit light, graticule, red-free filter, and cobalt blue filter.

Direct ophthalmoscopy must be performed with the observer in close proximity to the eye (2-3 cm). The animals left eye should be observed with your left eye and the right eye should be examined with your right eye (Fig.1). This will distance you as much as possible from your patients mouth. For most people, the retina will be in focus with a diopter setting of 0 to -4. Direct ophthalmoscopy provides high magnification (~17 times in the dog and ~19 times in the cat). Due to this degree of magnification, only a small amount of the fundus can be visualized at a time. Begin by observing the optic nerve head and then systematically cover the quadrants of the fundus.

The advantage of the direct ophthalmoscope is the amount of magnification you are able to achieve. The equipment is also relatively inexpensive. Unfortunately, the high magnification comes with the drawback of a very small field of view. There is also no stereopsis, however, by changing the diopter power of the lens you are using you can determine how depressed or raised a lesion is. Another disadvantage to this system is the proximity of your face to the patient's mouth when performing this procedure.

2.4 Indirect Ophthalmoscopy

Binocular indirect ophthalmoscopy is performed with a binocular indirect ophthalmoscope or BIO. There are several different makes of BIO's available. Although they vary in their position, they have the same basic controls. The eyepieces adjust for the interpupillary distance. There is a lever that changes the spot size of the light, and there is a lever that changes the light color. It varies through white, cobalt blue, and green (no red filter). Some have a yellow filter to decrease retinal damage.

Binocular indirect ophthalmoscopy also utilizes a hand held lens. These lenses typically vary in diopter power from 14-40 D. Magnification with indirect ophthalmoscopy varies with lens power and species but typically ranges from 3-5 times. The higher the diopter power of your lens, the less magnification you will have and the wider field of view you will have. It is often easiest for the beginner to start off with a 28 or 30 D lens. Another important point is that everything you see with this procedure will be upside-down and backwards. You will need to reverse this in your head to understand what you're seeing.

Binocular indirect ophthalmoscopy is performed with the patient at arms length. One hand should be used to hold the muzzle and the other should hold the lens. After looking at the patient with the headset and getting a fundic reflection, the lens should be placed in the light beam path 2-4 cm in front of the eye (Fig.2). The lens should be moved toward or away from the eye in order to obtain a full view of the fundus. It is important to keep the lens perpendicular to a ray between the observer's eye and the patient's eye. You should then move your body and the dogs head to examine all areas of the fundus.

Advantages of binocular indirect ophthalmoscopy include a much wider field of view than can be obtained with direct ophthalmoscopy. This method also provides stereopsis so that lesions can be visualized three-dimensionally. You are also in a safer position from the animal's mouth. The main disadvantages of the procedure are that it is initially harder to learn and the equipment is more expensive.

Welch-Allyn manufactures a Pan-Optic monocular indirect ophthamoscope. This scope has the advantage of being simple to use as well as a view of the fundus that is 5 times larger than a direct ophthalmoscope. The scope hooks onto a standard Welch-Allen battery pack hand set. It will work best if the Lithium-Ion battery source is used. The aperature setting should be on the standard setting, and you should focus on an object 10-15 ft away. After focusing, the eye cup should be placed against the animal's brow and you can observe the fundus through the observer aperature.

CHAPTER 3

Components of the Ocular Fundus

3.1 General Comments

The ocular fundus is a composite view of all of the structures that make up the back of the eye. All of these structures can be visualized to varying degrees when viewing the normal fundus. In order to understand pathology of the fundus, it is important to understand the normal layers and how normal variation and pathology can affect how they appear. These layers are shown in Fig. 3.

3.2 Sclera

The sclera is the outer fibrous shell of the eye. It is continuous with the cornea at the front of the eye. Unlike the cornea, the sclera is not clear. The sclera appears white due to varying size and irregular arrangement of the collagen fibrils. The sclera is not readily visible in a normally pigmented fundus. It can be readily visualized in a variation of normal called subalbinism and in some pathologic conditions.

There are several larger blood vessels that pass through the sclera that may be visible in subalbinotic animals. The vortex veins drain blood from the eye and can sometimes be visualized out at the equator. The long posterior ciliary arteries supply blood to the front portion of the eye and may sometimes be seen running at the 3 and 9 o'clock positions in subalbinotic animals. These vessels usually appear as darker shadows in the sclera.

3.3 Choroid

The choroid is the posterior portion of the uvea, or vascular coat of the eye. This is a highly vascular structure that is usually heavily pigmented in the typical eye. This layer sits just interior to the sclera. The choroid provides the blood supply to the outer layers of the retina. The choroidal vessels can be visualized if the structure is not heavily pigmented. These vessels usually spread out in a radiating fashion. Choroidal vessels usually appear orange to orange-red in color when they are visible.

3.4 Tapetum Lucidum

The tapetum lucidum is a reflective structure that is found in the innermost layer of the choroid called the choriocapillaris. Usually this structure covers the dorsal half of the fundus, separating the fundus into tapetal and nontapetal sections. It is generally larger in cats than it is in dogs.

The tapetum lies deep to the retina and functions to reflect light back toward the retina that has not been absorbed, giving the retinal photoreceptors a second chance to pick up the photons. This allows for better night vision at the expense of mild light scatter and decreased visual acuity.

In the dog, tapetal color usually varies from blue to green to yellow. The variation has to do with the thickness of the tapetum and the degree of pigmentation. In puppies, while the tapetum is developing, the tapetum is purple-blue in coloration. In cats the tapetum is quite thick and is usually yellow in color although it often turns green around the edges where it becomes thinner.

3.5 Retinal Pigment Epithelium

There are 10 layers that make up the retina; nine layers that make up the neurosensory retina and the retinal pigment epithelium (RPE). The RPE is the outermost layer and is critical to the health of the photoreceptors in the neurosensory retina. In the normal situation, the RPE is 1 cell layer thick. It is pigmented in the area of the nontapetal fundus and non-pigmented over the area of the tapetum.

In pathologic conditions, the RPE may undergo change. When there is a retinal detachment, the neurosensory retina separates from the underlying RPE. The RPE cells then undergo hypertrophy and may become hyperplastic. Other pathologic conditions may cause clumping of the RPE cells and the RPE over the tapetum may become pigmented.

3.6 Neurosensory Retina

As stated previously, the neurosensory retina consists of 9 layers. Although it is not important to memorize all these layers, an understanding of the structure is useful to understand the appearance of retinal hemorrhages at different depths which will be discussed later. In general, the photoreceptors are in the outermost layer adjacent to the RPE. Next there is a series of cells which connect the photoreceptors to the ganglion cells. The ganglion cells then send off their axons. These axons form the nerve fiber layer and then coalesce to form the optic nerve. The visible retinal blood vessels are found in the nerve fiber layer or just interior under the internal limiting membrane. The neurosensory retina is continuous with inner non-pigmented epithelium of the ciliary body at the ora ciliaris retinae. The retina appears as a translucent veil-like structure when detached. Degenerative or inflammatory diseases often result in thinning of the retina. Edema results in thickening and more opacity of the retina. Abnormal formation of the retina may result in linear folds.

3.7 Optic Disc

The axons of the ganglion cells forming the nerve fiber layer all converge and exit the sclera at a sieve-like area called the lamina cribrosa. This point at which they converge is the optic disc or optic nerve head. In the dog, the optic disc is usually found at the border of the tapetal and nontapetal fundus. In the cat it is usually completely within the tapetal fundus. This is not a difference in where the optic nerve leaves the eye, but a difference in the size of the tapetum between the two species.

Dogs and cats have several other differences in the appearance of the optic nerves. In dogs, the optic nerve head is usually myelinated to varying degrees. This makes it larger, lighter in color, and it may be raised and irregular in shape. In cats, the optic nerve head is not myelinated making it smaller, rounder, and darker than dogs. Also, in dogs, the retinal venuoles make a partial to complete anastamosis on top of the optic nerve head and the arterioles come from the periphery of the disc. In cats, all the vessels arise from the periphery of the disc.

3.8 Retinal Vasculature

There are four types of retinal vascular patterns (Fig.4). All non-mammalian species and some of the primitive mammals have an anangiotic pattern in which there are no retinal blood vessels. Horses and guinea pigs have a paurangiotic pattern in which blood vessels extend 1 or 2 disc diameters from the optic disc and then fade out. Lagamorphs have a merangiotic pattern in which the retinal vessels extend temporally and nasally, and most of our domestic species have a holangiotic pattern in which the vessels extend over the entire fundus. Dogs and cats both have a holangiotic retinal vascular pattern. Dogs typically have 3-4 venules that make a complete or partial anastamosis on the optic disc and 15-20 smaller arterioles that extend from the edge of the disc. Cats typically have 3 major pairs of venules and arterioles that extend from the edge of the optic disc.

CHAPTER

4

Variations of Normal

4.1 General

The hardest thing about interpretation of the ocular fundus is knowing what is normal. There is a tremendous amount of normal variation in the ocular fundus and one must examine many animals to truly understand what normal is. Until variations of normal are understood, determination of pathologic changes is impossible. This chapter will try to identify the common variations of normal, but in order to truly understand, these variations must be observed.

4.2 Degree of Pigmentation

The degree of pigmentation of the ocular fundus is highly correlated with coat and iris color. Dogs with a color dilute gene such as chocolate Labrador Retreivers, merle colored dogs, and dogs with blue irides often have some degree of hypopigmentation called subalbinism (Fig. 5.). This results in the ability to visualize the orange, radiating choroidal vessels beneath the retinal pigment epithelium, and in many cases the sclera as well. It is common for this to be misinterpreted as pathology. It must be distinguished from pathologic hypopigmentation such as what might be seen with choroidal hypoplasia which is the main sign of collie eye anomaly. In this pathologic change, there is more irregularity of the choroidal vessels and large bare areas of sclera may be visualized.

4.3 Variations in the Tapetum Lucidum

There is a significant amount of normal variation in the size, color, and appearance of the tapetum. Color in the dog is once again highly correlated with coat and iris color. The tapetum comes in color variations of blue, orange, yellow, and green (Fig.6). The tapetum may be hypoplastic or totally absent, especially in subalbinotic animals. The border of the tapetal/nontapetal fundus may be straight or irregular. It is also common for the nasal tapetum to be more irregular and have more pigmentation.

4.4 Variation in the Optic Nerve Head

The shape and appearance of the optic nerve head in the dog is quite variable (Fig.7). Most of this variability is due to the amount of myelination of the disc. Heavily myelinated discs may protrude although you should still be able to visualize an optic pit which helps distinguish this from papilledema (swelling of the optic disc). They may also be irregular in shape, oftentimes being triangular in appearance. Dogs with poorly myelinated optic discs may be somewhat depressed. They may also have a ring of tapetal hyperreflectivity around them called peripapillary conus. This can be difficult to distinguish from pathologic peripapillary hyperreflectivity due to retinal degenerations or glaucomatous changes.

The optic disc of the cat is not usually myelinated and is typically smaller, darker, and slightly depressed. In some older cats, we will see some aberrant myelination of the nerve fiber layer extending from the optic disc.

4.5 Variation in the Retinal Vasculature

Dogs may vary in the number of retinal venules as well as the degree to which these venules anastamose on the optic disc. Cats may also vary in number, although there are usually three. The caliber of the vessels is often slighter in small breed dogs, especially as they get older, than larger breed dogs. Subalbinism may make it more difficult to evaluate the retinal vessels. There is some degree of variation in the degree of vessel tortuosity as well. Truly tortuous vessels are often associated with pathologic conditions such as collie eye anomaly, hypertension, and hyperviscosity syndrome. One very common error is to find normal vessels to be tortuous when viewed with a direct ophthalmoscope. Vessels commonly appear more tortuous with this technique due to the high magnification.

CHAPTER 5

Interpretation of Fundus Changes

5.1 General Comments

Once one has determined that there is a pathologic change in the retina, it must be determined what that change is due to. There are some important ways to break down and interoperate the lesion to help make sense of it. Whenever a change in the fundus is noted, the first question to ask is if something has been added to the picture or if something has been taken away. This is where a good understanding of the layers that make up the fundus comes into play.

5.2 Loss of Fundus Layers

Loss of layers of the fundus allows a clearer view of the layers beneath them. We are fortunate in most of our domestic animals to have a tapetum that can help us in this determination. In animals that lack a tapetum as a variation of normal, these changes can be much more difficult to interpret.

5.2.1 Vascular Attenuation

Decrease in the size and amount of the retinal vasculature is a common change in degenerations of the retina (Fig. 8). This is most easily visualized in the tapetal fundus, and is most difficult in animals that are subalbinotic. Vascular attenuation is usually secondary to loss of demand for blood supply due to loss of retinal tissue.

5.2.2 Retinal Thinning

Retinal thinning is also easier to visualize over the tapetum. As the translucent retina becomes thinner, the tapetum becomes more visible resulting in tapetal hyperreflectivity (Fig. 9). It is important to remember that depending on how the light is being reflected of the tapetum, it can also appear hyporeflective. Changing the incidence of the light beam will then result in hyperreflectivity. Retinal thinning is the result of retinal degenerative processes and scarring. This can result in retinal holes or tears. There may also be loss of pigmentation in the retinal pigment epithelium.

5.2.3 Retinal Disinsertion

Sometimes the retina will detach and then break at its peripheral attachment at the ora ciliaris retinae. This results in the retinal falling down and hanging over the optic nerve head and nontapetal fundus (Fig.10). This is a problem seen most frequently in the Shih Tzu breed. The tapetum will appear very hyperreflective and no vessels can be seen over this portion of the fundus. In addition, the optic disc and part of the nontapetal fundus will be obscured by the folded over retina.

5.2.4 Choroidal Hypoplasia

This is the main lesion in collie eye anomaly. It is usually seen adjacent to the optic disc temporally (Fig.11). Sclera can be visualized through the hypoplastic choroid and the choroidal vessels are usually irregular. It is often accompanied by retinal vascular tortuosity.

5.2.5 Loss of Optic Disc

The optic nerve head may be congenitally small as with optic nerve hypoplasia or micropapilla (Fig.12). The distinction between these two disorders is clinical in that micropapilla is less severe and does not result in recognizable visual deficits. It may also degenerate due to chronic inflammation as with optic neuritis. The optic nerve may become cupped secondary to glaucomatous change. Colobomas may also affect the optic disc (Fig.13). A coloboma is an area of a structure that is missing. In the optic nerve, this may be a small hole or the entire optic disc may appear to be missing.

5.3 Additions to Fundus Layers

When there are additions to the fundus layers, the underlying layers are obscured. Blood, pigment, inflammatory cells, and fluid can all be added to obscure underlying layers.

5.3.1 Retinal Hemorrhages

Retinal hemorrhages may occur due to inflammatory disorders, systemic hypertension, hyperviscosity syndrome, and other retinopathies. These may be associated with vascular tortuosity as well. The depth of retinal hemorrhages can be determined by their appearance (Fig.14). Subretinal hemorrhages tend to be large accumulations of blood and are usually dark in coloration. Deep intraretinal hemorrhages tend to be what are referred to as “dot and blot” hemorrhages due to their containment within the photoreceptor and intermediate retinal cells. Superficial retinal hemorrhages tend to be flame-shaped as they spread out in the nerve fiber layer. Preretinal hemorrhages tend to settle ventrally between the retina and vitreous forming keel-shaped hemorrhages.

5.3.2 Pigmentary Changes

Chorioretinal scars often involve the proliferation of RPE cells. Non-pigmented RPE cells in the tapetal fundus may develop pigment. These areas are typically surrounded by areas of tapetal hyperreflectivity where the retina has thinned (Fig. 15). They may result as post-inflammatory changes or geographic retinal dysplasia.

Another form of pigmentary change would be a choroidal melanoma. These heavily pigmented, raised lesions are usually found as incidental findings. They are not as malignant as choroidal melanomas are in humans and often only require monitoring.

5.3.3 Inflammatory Cells

Active chorioretinitis lesions are usually raised, hazy areas, often along retinal vessels. In the tapetal fundus they are often tan to brown in coloration and in the nontapetal fundus they are usually white (Fig. 16). Retinal hemorrhages may accompany these lesions.

5.3.4 Bullous Retinal Detachment

When bullous retinal detachments occur, the tapetum is obscured by the veil-like retina. Another sign that the retina is detached is the ability to see the retina without an ophthalmoscope (Fig.17). These are usually inflammatory in nature or secondary to systemic hypertension.

5.3.5 Swelling of the Optic Disc

Swelling of the optic nerve head without inflammation or vision loss is called papilledema. This may be caused by increased intracranial pressure. The optic disc may also become swollen with optic neuritis. In this case, the swelling is typically accompanied by hyperemia, peripapillary edema or detachment, and often hemorrhage (Fig.18).

CHAPTER 6

Comparative Fundus Anatomy

6.1 Canine (Fig.19)

The typical dog fundus has a tapetum that covers roughly the upper half of the fundus. The tapetal color may be blue, green, orange, or yellow. The amount of pigment is variable and is usually less in color dilute or merle animals or those with blue irides. The optic nerve head is located at the tapetal/nontapetal junction, is myelinated, and may vary in shape. The vascular pattern is holangiotic with 3-4 venules that anastamose on the optic disc and 15 to 20 arterioles that arise from the periphery of the disc.

6.2 Feline (Fig.20)

The typical cat fundus has a large, yellow tapetum that covers more area than in the dog. The amount of pigmentation will also vary with coat and iris color. The optic nerve head is located completely within the tapetal fundus and is smaller, rounder, and darker than the canine optic nerve head due to the lack of myelination. The vascular pattern is holangiotic with 3 sets of venules and arterioles that arise from the periphery of the optic disc.

6.3 Equine

The typical horse fundus has a tapetum that is blue in color. Streaks of subalbinism can be seen in some horses that change the tapetal color to green or yellow and allow visualization of choroidal vessels. The optic disc is horizontally oval in appearance and is located completely within the nontapetal fundus. The vascular pattern is paurangiotic with 50-80 small venules and arterioles arising from the edge of the disc and fading out after a short distance.

6.4 Food Animals

Sheep and Cows tend to be fairly similar. They have a tapetum over the dorsal fundus, holangiotic retinal vascular patterns with 3-4 major venules with matched arterioles, and an optic disc mostly within the nontapetal fundus. The optic disc in the cow is more of a horizontal oval and in the sheep it is kidney shaped. Goats tend to have a rounder optic nerve head and more numerous venules but are otherwise similar. Pigs are more similar to humans in that they have a central retinal artery and vein that runs up through the optic nerve, they lack a tapetum, and they have a slightly horizontal oval optic disc. The retinal vessels of food animal species are found just beneath the internal limiting membrane and appear to stick into the vitreous.

6.5 Camelids

Camelids lack a tapetum. The pigmentation depends on coat color, however they are often heavily pigmented and the optic nerve may have pigment on it. They usually have a prominent Bergmeister's papilla, which is the posterior remnant of the hyaloid artery. The vascular pattern is holangiotic and is similar to other ruminants.

6.6 Rabbits, Rats, and Mice

Rabbits have a horizontal oval optic disc with a deeply cupped appearance. Myelin rays extend nasally and temporally from the optic disc with the merangiotic vascular pattern. Rats and mice have holangiotic vascular patterns with vessels that extend in a spoke-like pattern from a round optic disc. All these species lack a tapetum and the amount of pigmentation depends on coat color.

6.7 Non-Human Primates

Non-human primates lack a tapetum. They have a vertical oval optic disc with 4 pairs of venules and arterioles extending from it. A macula and fovea can be found temporal and slightly dorsal to the optic disc. The amount of pigment depends on coat and iris color.

6.8 Birds

Birds have an anangiotic retina. The optic nerve is obscured by a pleated structure that extends into the vitreous called the pecten. Depending on the species, there may be 0, 1, or 2 foveas. These are areas of high vision. The amount of pigmentation depends on the individual and birds lack a tapetum.

6.9 Reptiles and Amphibians

Reptiles and amphibians have anangiotic retinal vascular patterns. Some do, however, have a preretinal vascular system. There is a large amount of variation. Some species have a tapetum. Some species have a structure similar to the pecten of birds that extends from the optic disc called a conus papillaris.

CHAPTER

7

Figures And Illustrations

Fig. 1: The correct use of the direct ophthalmoscope. The observer should be 2-3 cm from the patient. The left eye of the observer should be used to examine the left eye of the patient and vice versa.

Fig. 2: The correct use of the indirect ophthalmoscope. The patient is at arms length with the lens held perpendicular 2-4 cm in front of the patient's eye.

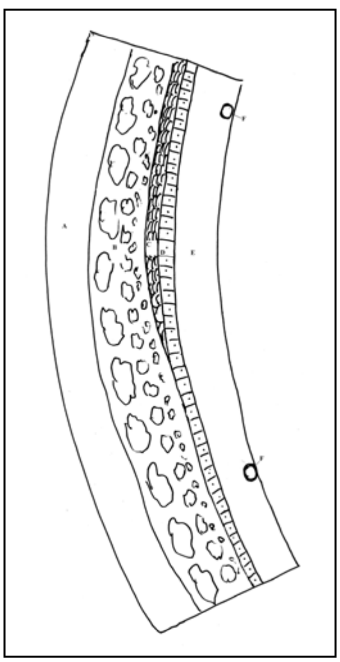


Fig. 3: Illustration of the layers of the ocular fundus. They are from outside to inside A. Sclera B. Choroid C. Tapetum D. Retinal Pigment Epithelium E. Neurosensory Retina and F. Retinal Vasculature.

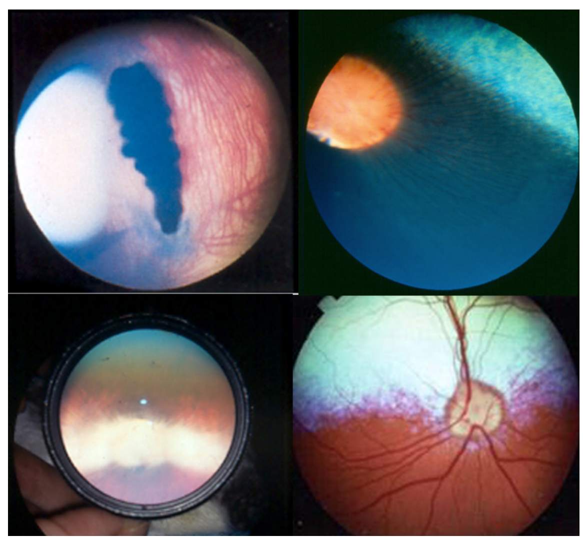


Fig. 4: Examples of the four types of retinal vascular patterns. The anangiotic vascular pattern of a bird; The paurangiotic vascular pattern of a horse; The merangiotic vascular pattern of a rabbit; The holangiotic vascular pattern of a dog.

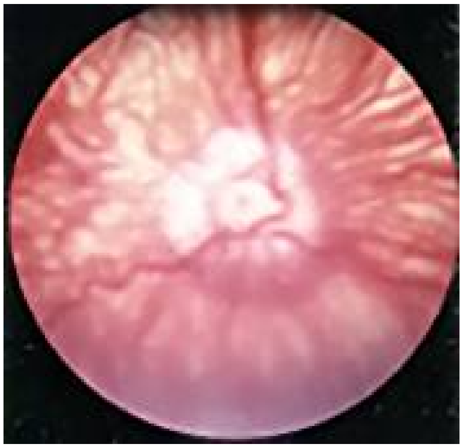


Fig. 5: The appearance of a subalbinotic canine fundus. This dog also lacks a tapetum.

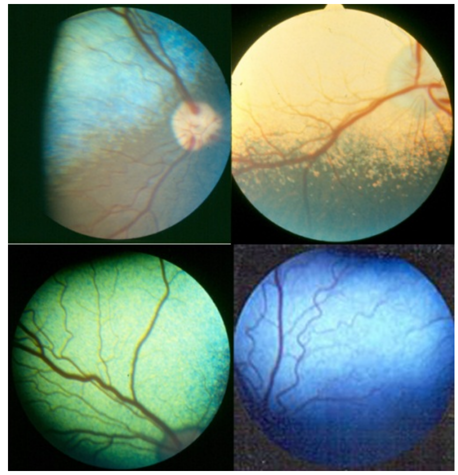


Fig. 6: The normal color variation of the canine tapetum lucidum.

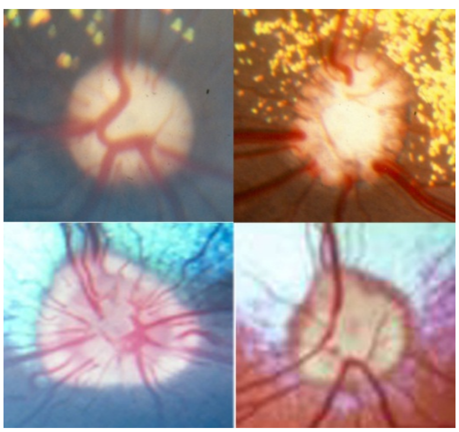


Fig. 7: Variation in the shape of the canine optic nerve head.

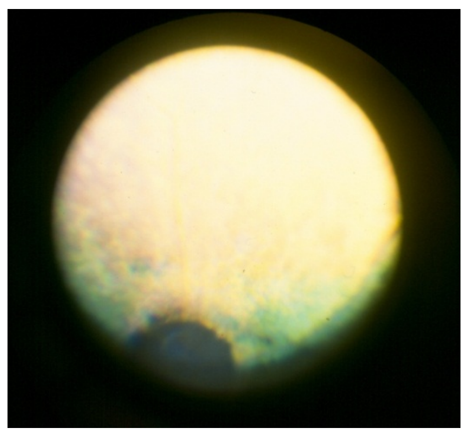


Fig. 8: Severe vascular attenuation in a dog with progressive retinal atrophy. The tapetum is hyperreflective.

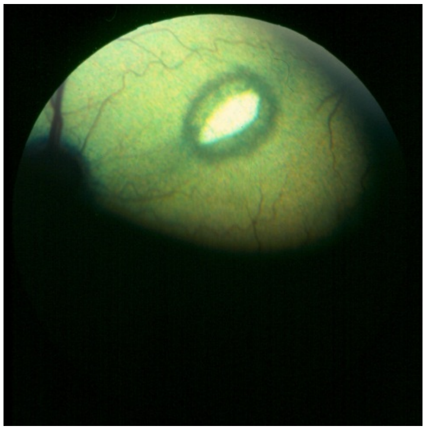


Fig. 9: Tapetal hyperreflectivity in a cat with central retinal degeneration.

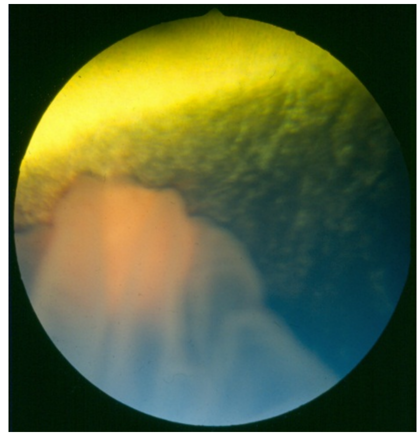


Fig. 10: Retinal detachment with disinsertion in a dog.

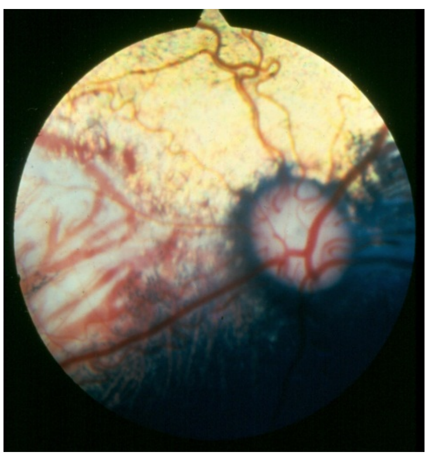


Fig. 11: An area of choroidal hypoplasia temporal to the optic disc in a collie with collie eye anomaly. The sclera can be seen through the abnormal choroid.

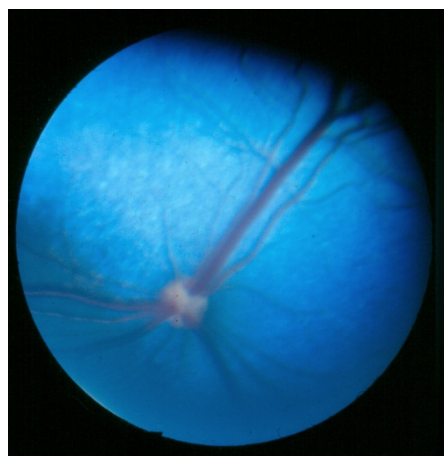
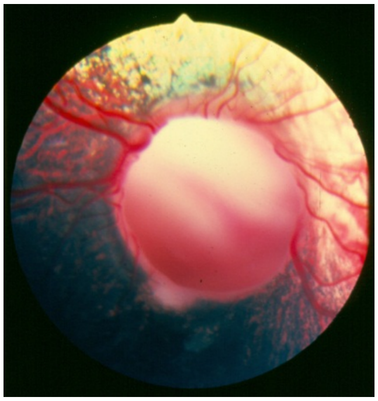


Fig. 12: Optic nerve hypoplasia in a puppy.



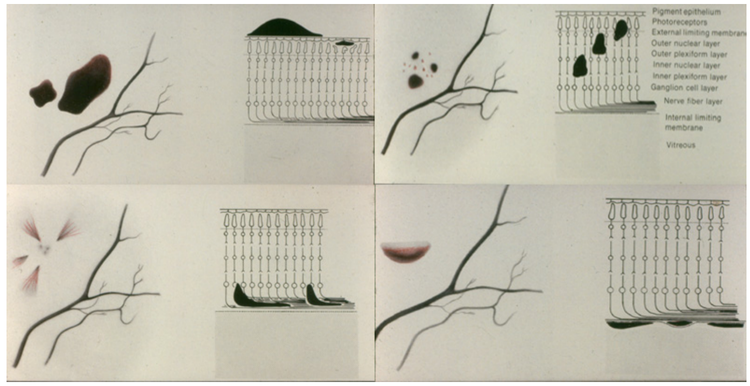
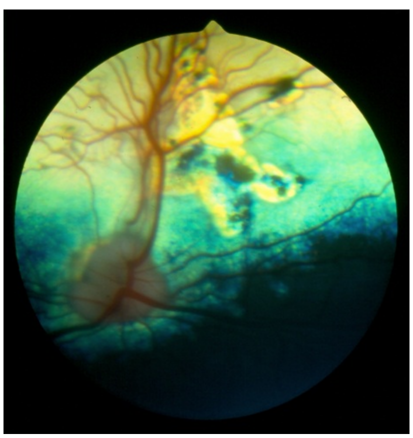


Fig. 13: A large optic nerve coloboma in a dog.

Fig. 14: Schematic showing appearance of subretinal hemorrhages, deep intraretinal “dot & blot” hemorrhages, superficial retinal “flame” hemorrhages, and preretinal “keel boat” hemorrhages.



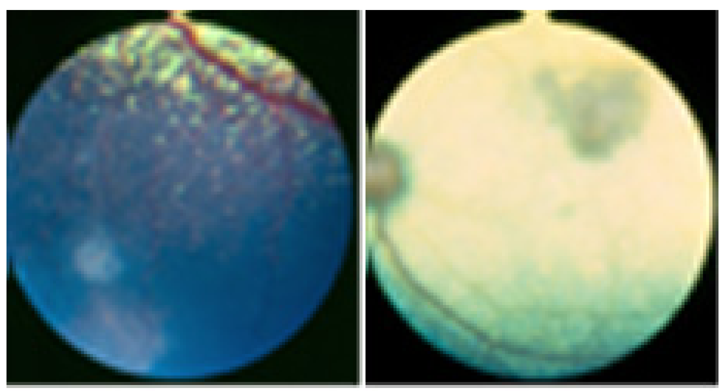


Fig. 15: A chorioretinal scar with RPE proliferation and retinal thinning. This is geographic retinal dysplasia.

Fig. 16: The appearance of active chorioretinitis in the nontapetal and tapetal fundus.

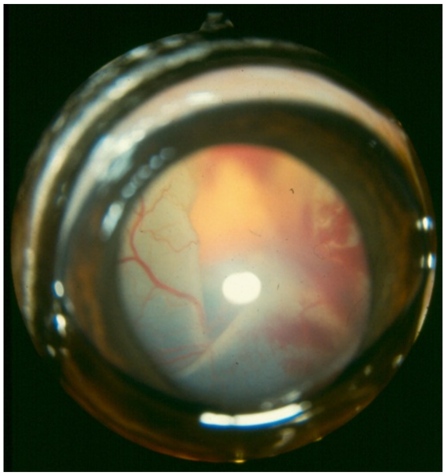


Fig. 17: Retinal detachment in the dog. The retina is visible without an ophthalmoscope. Retinal hemorrhages can also be visualized.

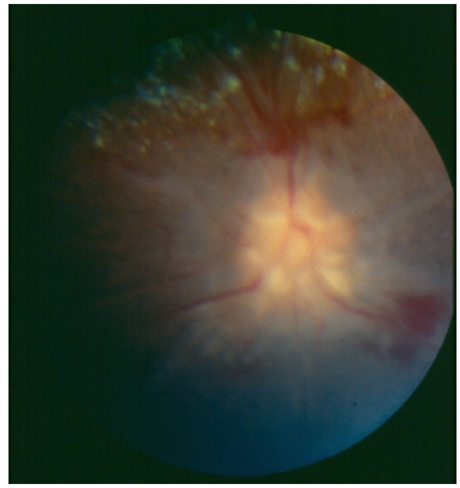


Fig. 18: Optic neuritis in the dog. The optic nerve is swollen. Peripapillary retinal elevation and retinal hemorrhage can be observed.

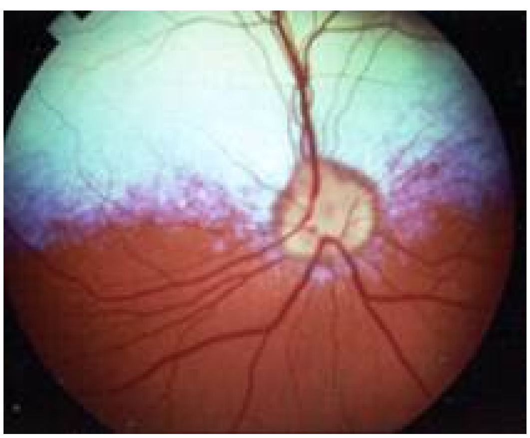


Fig. 19: Appearance of the normal canine fundus.

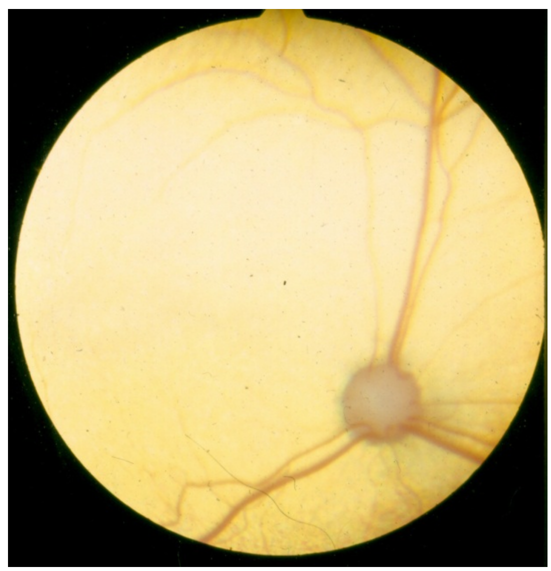


Fig. 20: Appearance of the normal feline fundus.