DO YOU SEE WHAT I SEE? OPHTHALMIC EXAM BASICS

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Ophthalmic History

Obtaining a thorough history is crucial in the management of any case and specific questions should be posed for an ophthalmic case. Generally, the first step is identification of the presenting complaint and predominant ocular clinical signs that incited the office visit. Often owners will report squinting, tearing, swelling, or redness as the main cause(s) for concern. Many ocular conditions also cause discharge from the eye – if this is present, it’s helpful to classify the discharge to help narrow our list of differentials. Mucoid and mucopurulent discharge are most common, and generally indicate surface eye disease such as eyelid, conjunctival, or corneal disease. In addition, owners should be questioned about changes in vision, even if that isn’t part of the presenting complaint. Often times our pet owners aren’t sure if their pet can see normally, however once they are specifically questioned about their pet’s navigation ability in various light conditions, stairs, or unfamiliar environment, for example, they may identify a vision issue. The duration of the clinical signs and the progression should be discussed, including any response to medications that have been used. Lastly, it is very important to discuss the overall health of the pet, including any known concurrent disease, routine medications, and systemic clinical signs like weight loss or vomiting.

The Initial Examination

The first step in the eye exam should be looking at the patient from a distance, with minimal head restraint. This should be accomplished prior to placing the pet on the exam table to avoid inducing squinting, head shyness, or even excessive tearing. Specifically, the distance exam should focus on pupil sizes and symmetry, facial symmetry, and the position and size of the globe itself. In addition, the position of the nictitating membrane (3rd eyelid) should be noted.

Neuro-Ophthalmic Examination

A neuro-ophthalmic exam should be performed on every case. Vision is assessed most often using the menace response. Cats or patients with high sympathetic tone may respond better to dropping a cotton ball near them, causing them to shift their gaze towards the dropped object. Occasionally, a maze test is used to help identify subtle visual changes or exaggerate the effects of various lighting conditions. For animals younger than 4 months of age who have not developed a full menace response, visual placing or a visual cliff test can be used to assess vision. The cranial nerves associated with the eye should be tested in a systemic fashion. The pupillary light reflex assesses the function of the retina to perceive light, followed by the optic nerve (CN II) as the afferent arm and the oculomotor nerve (CN III) supplies the effect fibers. The palpebral reflex is performed by tapping both the medial and lateral aspects of the eyelids – sensory fibers travel in the trigeminal nerve (CN V) and elicit a blink via motor fibers in the facial nerve (CN VII). The dazzle reflex is a subcortical reflex, and thus is not truly indicative
of vision. When a bright light is shone into the eye, the stimulus travels via the retina to the optic nerve, and then projects onto the midbrain and a blink reflex is mediated by the facial nerve. This reflex is most helpful in patients with mature cataracts or elevated intraocular pressure, when the menace response cannot properly determine the visual potential.

**Ophthalmic Minimum Data Base**

Performing a Shirmer Tear Test (STT), fluorescein staining, and measurement of the intraocular pressure should be considered in almost every eye case, as the clinical signs dictate. A STT should be performed prior to any significant manipulations of the eye, and before any drops are instilled. While dogs have a very reliable normal value of >15 mm of wetting per minute, cats may not tear reflexively due to high sympathetic tone. Instillation of fluorescein and examination with a cobalt blue filter is the only way to determine the presence and extent of a corneal ulcer. Tonometry is usually performed using a TonoPen® or TonoVet®. The Schiotz tonometer is considered outdated, difficult to use, and rarely accurate. It is important to realize that these are estimations of intraocular pressure, and the results should be interpreted in light of the clinical signs and ocular exam findings.

**Examination Basics and Equipment**

It is very important to be systematic when performing an ocular exam. It is easy to become distracted by the large corneal ulcer and overlook the eyelid mass, for example. A checklist or exam form is helpful to ensure that each structure is examined for abnormalities. Most often, the exam is performed starting with the adnexal structures (eyelids, 3rd eyelid, conjunctiva), progress to the surface structures (sclera, cornea), and then continues from the front of the eye to the back (anterior chamber, iris, lens, vitreous, retina). Drawing or writing detailed descriptions of all abnormalities is recommended so these may be readily compared to follow-up examinations.

A thorough eye exam can be performed using basic equipment, including a focal light source and magnification (such as head loupes or a direct ophthalmoscope). An indirect lens for fundic examination has benefits (to be discussed later), but is not considered a necessity. A transilluminator provides a bright, focused light source that can be used for distance examination and PLR and dazzle testing. Coupled with a source of magnification such as head loupes, the adnexal structures can be examined with this light source. The direct ophthalmoscope provides a source of light with magnification and focusing ability. This instrument is used to examine both the ocular surface and the internal ocular structures. Most direct ophthalmoscopes have 5 apertures that area adjusted using the rolling dial on the front of the attachment. The macular (small circle) aperture is used to illuminate a small, focused beam of light through the anterior chamber to detect opacities such as aqueous flare or blood. The large circle is the most often used to examine the vast majority of the ocular structures. The dial on the side of the attachment changes the diopter strength of the lens, which focuses the light at different depths within the eye. Green numbers are positive and red numbers are negative, and are displayed on the front or side of the attachment. In general, the cornea is in focus at +20D, the anterior lens at +12D, the posterior lens at +8D, and the optic nerve at 0D. Location of lesions within the ocular chambers can be determined by rolling the focusing dial up and down to note the relationship of the lesion to these known focusing depths. The slit aperture provides an optical section and can be used to detect curvature changes, depth of lesions, or the distance between 2 structures (see Methods of...
Illumination. The intermediate circle, glaucoma (haptic), and semi-circle apertures are not useful in veterinary medicine. Finally, the indirect attachment has a colored light filter – either red-free (green in color) or cobalt blue. The cobalt blue filter is used for visualization of fluorescein staining. The red-free filter, which differentiates between pigmentary changes and hemorrhage, is commonly used in human ophthalmology but is less useful for veterinary patients.

Methods of Illumination
There are various methods of illumination that can be used to determine the density and location of structures or lesions. Direct illumination is achieved when the light source is shone directly upon the structure of interest, and can be done in a diffuse or focal manner. Diffuse direct illumination is performed by shining the light from a distance and illuminates a larger area with an unfocused light beam. This technique is useful for examination of the adnexal structures, ocular surface, lens, and the iris. A structure that is dense in nature (like a cataract) will appear white with direct illumination, as all of the light beams are reflected back at the examiner. Focal direct illumination is accomplished by bringing the light source into close proximity to the structure of interest in a dark room. This technique is used to detect the presence of cloudy ocular media (aqueous flare) and, when viewed or shone at a tangential angle, can highlight cystic structures and emphasize texture. Light will transmit through a cystic structure, which would have otherwise appeared solid when illuminated diffusely. A slit beam can also be used to perform direct focal illumination and highlight topographical alterations. This technique is particularly helpful when determining the depth of a corneal ulcer, for example. In addition, distance estimation can be accomplished by examining the reflection off of 2 superimposed structures. Retroillumination takes advantage of the tapetal reflection in the majority of veterinary patients. By shining the light onto the tapetum, the structure of interest is “back-lit.” A dense cataract will block this light, and appear dark, whereas a cystic or thinned lesion (such as iris atrophy) will allow light to pass through.

Fundic Examination
The retina can be examined in both direct and indirect methods. Direct ophthalmoscopy is achieved by setting the diopters of the ophthalmoscope around 0D. The advantages of this technique image are that is provides a highly magnified image that is upright (real), does not require full pupillary dilation, and is accomplished with minimally expensive equipment. The disadvantages are the required proximity to the patient, and the field of view is quite small thus requiring extensive examination to visualize the entire retina. Indirect ophthalmoscopy provides a much less magnified view (depending upon the dioptic strength of the lens used) but the field of view is subsequently greater. The disadvantages are that the image produced is inverted and upside down, and also the need for specialized indirect lenses.

Ophthalmic Examination

Basic Ophthalmic Disease Principles
Often, the most challenging part of the eye exam is not performing it, but rather interpreting the changes seen on the exam, determining the underlying cause(s) and the sequence of events. However, it should be noted that the ocular structures undergo a limited number of disease
processes, including inflammation / infection, bleeding, degeneration, and tumor formation. Once a structure is identified as being abnormal, it should be categorized into the suspected basic disease process and then a diagnosis is more easily reached. As mentioned, many ocular conditions can lead to secondary disease processes, and it can be challenging to determine the initial cause. For example, cataracts can cause inflammation within the eye (uveitis), however uveitis can also lead to cataract formation. In certain circumstances it is not possible to tease out the primary disease, however treatment of each condition is still warranted. The ocular media should be clear, and allow visualization of each structure from the cornea to the retina. Disease often causes opacity, and thus will block visualization of the structures posterior to the opacity. Knowing the normal ocular anatomy and determining which structures can and cannot be visualized can localize the location of the abnormality localized at minimum.

Eyelid Exam

The haired skin of the eyelids may be affected by both primary ocular disease and primary dermatological disease. The eyelid skin should be examined for signs of inflammation such as hyperemia, swelling, or alopecia. Chronicity can produce hyperpigmentation and lichenification of the eyelid skin. The eyelid margins should be examined for evidence of poor conformation (entropion, ectropion), defects or masses, and inflammation of the meibomian glands. However, they should also be closely inspected with magnification for the presence of aberrant cilia, including distichia and ectopic cilia.

3rd Eyelid Exam

The first step in examination of the 3rd eyelid, or nictitating membrane, should be to note its resting location. The normal 3rd eyelid is visible to varying degrees depending upon the species and breed of the patient. For example, a domestic cat will have a much less visible normal 3rd eyelid than a Bloodhound. The 3rd eyelid can be manually prolapsed to determine the mobility and permit examination of the surface by gently retropulsing the globe. Prolapse or elevation of the 3rd eyelid is a commonly noted clinical sign, and can be seen with painful ocular conditions or neurologic conditions that affect the sympathetic tone to the eye, such as Horner’s syndrome. On the contrary, exophthalmos or buphthalmos should reduce the visibility of the 3rd eyelid. Importantly, a patient that is noted to have exophthalmos and a prolapsed 3rd eyelid will almost always have pathology in the orbit (abscess, mass), leading to anterior displacement of both of these structures. The 3rd eyelid should be inspected for hyperemia, which is common in many surface inflammatory conditions (conjunctivitis, dry eye). Allergic disease can lead to follicle formation on the posterior aspect of the 3rd eyelid, which appears as small clusters of clear bubbles. The posterior 3rd eyelid can be examined after instillation of topical anesthesia and gentle manipulation with a cotton swab or atraumatic forceps. The 3rd eyelid possesses a T-shaped cartilage piece, which maintains its shape. Bends to the shaft or tips of this cartilage piece will induce folds or curves to the 3rd eyelid, and are most common in larger breed dogs. Prolapse of the gland of the 3rd eyelid, known as cherry eye, is a very common abnormality. Inherent weakness in the gland’s attachment leads to prolapse of the gland over the leading edge of the 3rd eyelid. This appears as a smooth, red mass in the medial canthus, most often in dogs less than 1 year of age. Finally, the 3rd eyelid should be inspected for the presence of masses, as both benign and malignant tumors can grow from the conjunctival lining or the gland.
**Conjunctiva and Sclera Exam**

The conjunctiva and sclera are quite vascular, reactive tissues. Inflammation, bleeding, and tumor formation and the most common basic disease processes these tissues undergo, which can be a primary condition or secondary to other underlying ocular diseases. The bulbar conjunctiva should be examined separately from the palpebral conjunctiva as often times one is affected to a greater degree than the other. Conjunctival inflammation is most often seen as a diffuse increase in the vascularity of the tissue, often appearing as a pink hue. Conjunctival edema, also known as chemosis, will appear puffy and swollen, and is more common on the palpebral conjunctiva. Scleral inflammation can be focal or diffuse, and appears as pronounced vascular engorgement of the larger, straighter episcleral veins. Hemorrhage of these structures should be differentiated from hyperemia, and can be seen following blunt trauma, choking episodes, or with coagulopathies. Subconjunctival hemorrhage appears as a diffusely red membrane, without the ability to visualize individual blood vessels. Masses may be present on the palpebral or bulbar conjunctiva, or associated with the deeper sclera. Cysts, benign papillomas, as well as benign and malignant epithelial tumors can form on these tissues.

**Cornea Exam**

The cornea is probably the one ocular structure that can have the most varied appearance in disease. While this can be a daunting structure to examine, changes to the cornea can be simplified for ease of classification into 3 changes in color: haze, red, and brown.

Haze to the cornea is quite common, and is caused by edema, infiltrate, scarring, or corneal deposits. Corneal edema can be focal or diffuse, and presents in varying degrees of severity depending upon the underlying cause. Focal corneal edema is most often secondary to epithelial disruption, such as corneal ulceration. Diffuse corneal edema occurs secondary to endothelial disease, such as with glaucoma, uveitis, or endothelial degeneration. Dense corneal edema appears as a sky blue haze, and can prevent thorough examination of the internal structures. Corneal infiltration with leukocytes and/or bacteria will produce a haze. This haze is denser than edema, and can appear white or creamy. Infiltrate is usually focal or multifocal, and often incites a vascular response. Corneal scarring after injury or ulceration will appear white or hazy, and can be present at variable depths within the cornea. Deposition of lipid, cholesterol, or mineral within the cornea produces haze that is often sparkly or crystalline in appearance.

A red color change to the cornea is most often produced by the ingrowth of blood vessels, but can also be from the formation for granulation tissue or a blood clot associated with a ruptured corneal ulcer. Vascularization of the cornea is a helpful exam finding in that it is most pronounced or progresses towards the primary disease. Focal corneal disease, such as a corneal ulcer, will incite long, branching blood vessels to grow towards the ulcer. More severe corneal disease or intraocular disease, such as uveitis, will produce a dense brush border of vessels to grow from the limbus towards the central cornea. This is called “ciliary flush” as is indicative of more severe pathology within the eye. Granulation tissue will form on the cornea to variable degrees during healing of ulceration, often associated with chronicity or persistent trauma (chronic entropion, for example), and appears as a bright red, slightly elevated lesion. A deep corneal ulcer that ruptures can also present as a red color change. As the ulceration progresses, fibrin, leukocytes, and red blood cells leak from the uvea into the anterior chamber of the eye. Once a perforation develops, a red clot will fill the defect with variable degrees of iris involvement. This clot will appear as a focal, red lump present within the center of a deep corneal defect.
A brown color change to the cornea can be pigmentation, sequestrum formation, iris prolapse, or foreign material. Corneal pigmentation is very common in dogs secondary to chronic surface diseases such as dry eye or Pannus, and appears as splotchy to wispy brown areas with variable density. A triangular shaped wisp of corneal pigmentation in the medial cornea is exceedingly common in Pugs. In cats, a brown color change to the eye is more often a corneal sequestrum. Corneal sequetra are foci of dead corneal tissue that can appear auburn, brown, or black. Corneal ulceration is common surrounding sequestra, and vascularization is present to varying degrees. If penetrating trauma occurs to the cornea acutely, the iris will often fill the defect as a fibrin and blood clot has not had time to form. An iris prolapse appears as an elevated, dark brown to black tissue in the center of a corneal defect. Finally, many corneal foreign bodies are brown given that they are usually organic debris from the environment (shards of wood, leaves, sand).

Corneal ulceration is a very common condition and also has a significantly variable appearance. In addition to the ulcer, the cornea may have edema, vascularization or granulation, and even pigmentation. After instillation and rinsing of fluorescein stain, the corneal ulcer is examined using a cobalt blue light. Corneal ulcers should be described based upon their location, size, shape and depth. Superficial corneal ulcers involve the epithelial cell layer and may extend to the anterior 1/3 – 1/2 of the corneal stroma. Deep corneal ulcers extend beyond 1/2 of the stromal thickness, and descemetoceles result when the ulceration has extended to the level of Descemet’s membrane. Ruptured corneal ulcers are often filled with fibrin, blood, or iris tissue. Based on the appearance of the ulcer, it should be classified as infected or not. Infection of a corneal ulcer will produce more pronounced discomfort, moderate to severe edema, reflex uveitis, and possibly corneal melt, which appears as a mushy, creamy cornea. An attempt should be made to identify and underlying cause of the ulcer by using the location and appearance of the ulcer in conjunction with examination of the adjacent structures.

**Anterior Chamber Exam**

The main abnormalities that can be noted in the anterior chamber are alterations in the clarity, the presence of tumors or cysts, or changes in depth due to lens luxations. Aqueous humor is optically clear, however inflammation of the uvea will lead to leakage of protein, fibrin, and blood cells, known as aqueous flare, which leads to a decrease in the clarity. Frank hemorrhage into the anterior chamber, known as hyphema, will appear as a diffuse red haze initially, but usually settles in the ventral anterior chamber. Hypopyon, or pus in the anterior chamber, appears as a yellow or creamy layer settled in the ventral anterior chamber. Tumors present in the anterior chamber most often originate from the iris or ciliary body, but can bulge into and obliterate the anterior chamber. Uveal cysts are round, pigmented structures that can be free-floating, but are often present in the ventral anterior chamber. The depth of the anterior chamber is maintained by the normal lens position upon which the iris rests. Changes in the position of the lens with alter the depth of the anterior chamber. Posterior lens luxations will cause the iris to be less curved and appear to have fallen deeper within the eye, whereas an anterior lens luxation will create a shallow appearance to the anterior chamber and may obscure the view of the iris if the luxated lens is cataractous.

**Iris and Pupil Exam**

The main pathologic change to the iris involves a color change. Iris atrophy, while not necessarily pathologic, is exceedingly common, and appears as a feathered or “moth-eaten”
pupillary margin. Inflammation of the iris will produce hyperemia, although this is difficult to appreciate in animals with darkly pigmented irides. However, in cats or blue-eyed dogs, iris hyperemia, also know as rubeosis irides, is readily apparent. Swelling or a thickened appearance to the iris is also common with inflammation. Brown discoloration to the iris can be seen with chronic inflammation, tumor (melanoma) formation, or iris melanosis (in cats). Tumor formation within the iris will distort the tissue, often resulting in elevations, bulges, or dyscoria, or an abnormally shaped pupil. Synechia is an adhesion of the iris to either the lens (posterior synechia) or the cornea (anterior synechia). Posterior synechia is seen commonly following intraocular inflammation, and will result in dyscoria and / or pigment splotches on the anterior lens capsule.

**Lens Exam**
The vast majority of lens pathology involves changes in the clarity. Nuclear sclerosis will appear as a round, opalescent appearance to the center of the lens. This change should not affect the ability to examine the retina to a significant degree (although it may appear hazy). Cataract formation is the most common change to the lens. Cataracts have a widely variable appearance based upon their location, stage, and underlying cause. Cataracts can form on the anterior or posterior lens capsule, the anterior or posterior lens cortex, or the nucleus. They can range in appearance from a dot or line, wedge-shaped, triangular, or can completely opacify the lens. As discussed above, the lens may also undergo changes in its position, becoming either anteriorally or posteriorally luxated. Lens subluxation can occur when only a portion of the lens zonules become broken, and the lens may tip or tilt and can cause asymmetric changes in the anterior chamber depth. Pigment or blood may be deposited on the anterior lens capsule following inflammation or trauma.

**Vitreous Exam**
The normal vitreous is optically clear, with the predominant change being an alteration to this clarity. Vitreal degeneration is a fairly common age-related change, and results in the formation of small crystalline floaters that have a “snow globe” appearance (known as asteroid hyalosis) or opaque vitreal strands (termed syneresis). Inflammation in the posterior segment of the eye can result in clouding of the vitreous as fibrin or white blood cells infiltrate from the posterior uvea or retina. Finally, bleeding into the vitreous, appearing as a diffuse red haze precluding visualization of the retina, is seen following blunt ocular trauma or retinal detachment.

**Retina Exam**
The most important aspect of fundic examination is to be able to recognize normal variations. The color and presence of the tapetum and retinal pigment varies with coat and eye color, as well as with age, and the appearance of the optic nerve varies with species and breed. For example, dogs with light hair coats or blue eyes will also lack pigment in their fundus, allowing visualization of the choroidal vessels. Young dogs and cats (<4 months of age) will have a blue tapetum, which matures to the more common green color, however tan colored dogs, such as Cocker Spaniels will often have an orange tapetum. The optic nerve of most dogs is highly myelinated (white) and often triangular in shape. The retinal blood vessels should pass onto the surface of the optic nerve head, often forming a C-shaped anastomosis. Cats, on the other hand, have poorly myelinated optic nerves that appear dark, small, and round. Retinal blood vessels
appear to originate from the periphery of the nerve head. These normal variations can be misinterpreted as lesions or abnormalities to the untrained eye.

Fundic pathology can involve the retina, the tapetum, the choroid, and the optic nerve head. Basic processes of inflammation, degeneration, detachments and bleeding are the most common. Retinal and choroidal inflammation will result in a fuzzy appearance that often times produces a dull area to the tapetal reflection and an engorged or tortuous appearance to the retinal vessels. Often, multifocal circular or wedge-shaped lesions develop. Small focal retinal detachments (bullae), often seen with systemic hypertension, appear as diffuse grey lesions in the tapetum. Examination of these lesions at high magnification will demonstrate elevation of the blood vessels as they travel over these focal elevations. Retinal hemorrhages can vary in their appearance from small dots to larger splotches depending upon the underlying cause and severity. Retinal detachments are classified broadly as bullous or rhegmatogenous. A bullous retinal detachment appears as a fluid bubble under the retina causing elevation of the retina into the vitreous. The vessels will have an abnormal course and appear out of focus. A rhegmatogenous detachment occurs when the retina tears from its peripheral attachment and falls over the optic nerve, which appears as a hazy “curtain” of tissue that may billow in the vitreous. Degeneration of the retina results in a thinning of this tissue leading to tapetal hyperreflectivity as well as a decrease in the size and distribution of the retinal blood vessels. Inflammation is the primary abnormality seen in the optic nerve head. The tissue will appear puffy or swollen and hyperemic, and the vessels may appear to “fall off” the edge of the optic nerve head. The surrounding retina may be hazy or slightly detached, and hemorrhages on or adjacent to the optic nerve head are not uncommon. Patients with inflammation of the optic nerve head are almost always significantly visually compromised.