There is no doubt that it can be difficult to perform a complete ophthalmic exam in a busy general practice environment. It’s easy to feel overwhelmed initially when faced with a patient with an ocular problem. The goal of this article is to outline the basic steps and procedures involved in a thorough ophthalmic exam and to help the clinician feel comfortable with the overall process.

Ophthalmology is a unique area of veterinary medicine for several reasons. First, we are able to directly observe all the structures of the eye (Figure 1, page 23), so that the examination can be conducted almost entirely visually. In fact, with equipment available to most general practitioners (e.g., a direct ophthalmoscope and 20-diopter [D] indirect lens) you can visualize lesions that are as small as 30 to 90 microns in diameter. And while you may find lesions that are initially confusing, the most important step is documenting abnormalities. There is no doubt that when starting out in veterinary ophthalmology (as with many aspects of veterinary medicine), you miss more by not looking than not knowing.

The second aspect of ophthalmology that can be challenging is the speed with which changes in the eye can take place. Ophthalmic problems do not lend themselves to casual examination or ‘trial and error’ therapy. This is because many conditions (such as infected corneal ulcers, glaucoma and uveitis) can progress rapidly, leading to continued pain and ultimately blindness. It is for this reason that a complete ophthalmic examination is so crucial for all patients that present with an ocular complaint.

Third, it is always important to maintain an index of suspicion for systemic disease when evaluating the ophthalmic patient. Many Pets are presented to the veterinarian when the owner notes changes in the eyes; however, this may be a sign of an underlying systemic disease process that only became obvious to the owner when the ophthalmic signs manifested. It is not unusual for an ophthalmic examination to ultimately lead to a diagnosis of feline immunodeficiency virus or feline leukemia virus infection, toxoplasmosis, hypertension or lymphoma in a Pet that otherwise might not have been presented to the veterinarian.
As a general practitioner, it is crucial during an ophthalmic exam not to miss the signs that can lead you to these systemic disease diagnoses.

**Ophthalmic exam setting**

The ophthalmic examination setting is important and can make it much easier to perform your job as a clinician. It should take place in a quiet area where the amount of light can be controlled. If the exam room has a window to a lighted hallway or treatment area, usually you can simply shut the lights off and have enough light from the adjacent area to perform the exam. If this isn’t the case, there is usually an alternative means of creating low levels of light, such as a radiograph view-box or computer monitor. Proper restraint is also crucial, and it is important to have a PetNurse or assistant (not the owner) help you restrain and manipulate the patient for the exam. Sedation is rarely required for a thorough ophthalmic exam, and can make the exam more difficult due to side effects such as elevation of the nictitans or altered globe position. A bright light source such as a handheld or wall mounted transilluminator is required for the exam; a pen-light does not produce enough focused light to complete a proper exam. Lastly, a magnification source is important for the exam. An inexpensive plastic head loupe works well for this.

**Examination sequence**

The ophthalmic exam should be performed
in a consistent and organized manner so that a routine can be developed. In addition, it is important to remember that the order of testing is important because some tests or observations should be performed before others. For example, Schirmer tear testing should be performed before instilling topical anesthetic, and intraocular pressure measurement and pupillary light response should be evaluated before inducing mydriasis.

Before beginning the examination, it is important to evaluate the Pet from a few feet away, while using minimal restraint. Closely evaluate the patient for facial symmetry, paying close attention to globe and lid position. Evaluate the Pet from different angles, because from a single vantage point it can be difficult to detect subtle changes such as mild exophthalmos. In addition, take note of any altered head position, blepharospasm, lid abnormalities or accumulated discharge around the eyes.

**Retroillumination**

In a dark room, use a strong light source (such as a transilluminator) and hold it close to your eye with the light directed at the Pet, who should be restrained by an assistant. When the light enters the pupils, a tapetal reflection will be noted, appearing as a yellow to greenish glow. This is called retroillumination, which is a simple and useful technique to evaluate the size, shape and symmetry of the pupils (Figure 2). In addition, any opacities in the clear media of the eye (such as the cornea, lens and vitreous body) will interfere with reflection of light from the tapetum, standing out as darker areas against the bright background and making them easier to visualize.

**Evaluation of vision and pupillary light response**

Now that the general observations have been completed, it is time to approach the patient and begin a more detailed examination. In order to evaluate vision, it is important to see the Pet move around the exam room in both normal lighting and dim lighting. Called the maze test, this allows you to gain important information about the Pet’s vision and neurologic status.

The Pet should then be placed on the examination table for evaluation of the menace response. When performing this test, the goal is to make a threatening gesture with your hand towards the eye being evaluated, while the contralateral eye is covered. To elicit a response based purely on visual stimulus, the clinician must be very careful not to make any noise or create air currents that would cause the Pet to react. The menace response evaluates cranial nerves II and VII; a Pet with a normal menace response will blink in response to the oncoming threat of your hand. Before evaluating the menace response...
response, it is best to evaluate the palpebral response by gently tapping the medial canthus to ensure that a normal blink response is present and that the menace response can be correctly interpreted.

Last, you can perform the tracking evaluation by dropping a cotton ball or gauze sponge in front of the Pet to see if it follows. However, some Pets, especially cats, may lose interest after several tries, which makes interpretation of the tracking test difficult.

Having already evaluated pupil symmetry, size and shape using retroillumination, the next step is to evaluate pupillary light response using a bright light source. It is important to evaluate both direct and consensual pupillary light response, especially when an abnormality in the direct response is noted. If any anisocoria (asymmetry in pupil size) is noted (Figure 3), it is crucial to evaluate the abnormality in both bright and dim light to determine which pupil is abnormal. For example, a dog with a cranial nerve III lesion causing a dilated right pupil may be difficult to diagnose in dim light, as both pupils would be dilated. However, in a brightly lit room, the normal pupil constricts, while the affected pupil does not.

Always pay attention to the shape of the pupils as well, especially if abnormalities in pupillary light response are noted. Iris sphincter atrophy and posterior synechia (Figure 4, page 26) are two examples of conditions that could lead to abnormal pupillary light response, as well as dyscoria (abnormally shaped pupils). Any time abnormalities in vision, pupillary light response or pupil symmetry are noted, a neurologic exam should be performed as well.

**Eyelid**

Next, evaluate the eyelids for abnormal hairs such as ectopic cilia and distichia, as well as masses and anatomic abnormalities such as entropion, ectropion and lagophthalmos. When evaluating for entropion, it is important to remember that superficial ocular discomfort can create a spastic component to the entropion. For this reason, it is useful to observe the Pet both before and after instilling topical anesthetic. Then, evaluate the conjunctiva, noting any hyperemia or chemosis, as well as follicle formation or accumulation of discharge in the lower conjunctival fornix.

**Cornea**

To examine the cornea, use a combination of retroillumination (previously discussed) as well as direct illumination to closely assess it for surface abnormalities and opacities such as stromal infiltrates, edema, vascularization and pigmentation. It is important to critically evaluate the location of any lesions you find, as this can often help to determine the underlying cause of the
problem. For example, a corneal ulcer with marked keratitis in the ventromedial quadrant of the cornea should make the clinician more suspicious of a potential foreign body behind the nictitans.

Anterior chamber

After evaluating the ocular adnexa and surface of the eye, it is time to begin evaluating the intraocular structures. The anterior chamber should be evaluated for clarity and the presence of any masses. Anterior uveitis is caused by a breakdown in the blood-aqueous barrier, and results in the influx of protein and cells into the anterior chamber. By directing a focal light source into the anterior chamber and evaluating the light beam with magnification, you can see light scatter from the protein and cells; this is called the Tyndall effect, and it is what causes the visible appearance of flare. As a phenomenon, flare is similar to our ability to see beams of light traveling through a dust-filled room; anterior chambers filled with protein and cells will scatter some of the light that passes through them and manifest as flare.

In addition to the contents of the anterior chamber, it is also crucial to note the depth of the anterior chamber. This can be affected by lens position; the chamber will be shallow if the lens has luxated anteriorly or there is a swollen (intumescent) cataract, while the chamber will be deeper if the lens is luxated posteriorly. Chamber depth can also be affected by iris bombe or masses behind the iris. The iris should be evaluated for color, thickness and texture, and the two sides should be critically compared. In addition, the shape, size and position of the pupils should be evaluated.

Lens

As we discussed with the cornea, the lens is best evaluated through a combination of direct observation and retroillumination, which will help to document any opacities.
within the lens (cataracts). Sometimes it can be difficult to determine the position of an opacity within the lens, and in these cases observing parallax can help. Parallax is the apparent motion of an object against a background because of a perspective shift. With a focal light source, the observer can move from right to left while observing a lesion, and the degree and direction that the lesion ‘shifts’ can give important information as to the depth and position of the lesion within the lens (Figure 5, page 28). Clients often report that their Pets are developing cataracts when in reality they are noting nuclear sclerosis. It is important to differentiate the two, and explain that nuclear sclerosis is a normal aging change, and not an abnormal finding. Retroillumination is an excellent way to differentiate cataracts from nuclear sclerosis; cataracts will interfere with retroillumination, blocking the tapetal reflection, while nuclear sclerosis will not.

Evaluate the lens position to rule out lens luxations or subluxations. In some cases these changes can be difficult to recognize because not all cases of lens luxation involve the obvious anterior lens luxation. Lens instability is often indicated by subtle movements of the iris or lens—termed iridodonesis and phacodonesis, respectively. This appears clinically as mild iris or lens wiggle as the Pet moves its head.

**Vitreous body**
The vitreous body is normally a clear, semi-solid fluid posterior to the lens and is most easily evaluated after mydriasis. The vitreous body should be evaluated for any opacity such as aggregates of white blood cells, protein and blood, as well as noninflammatory changes such as asteroid hyalosis. Liquefaction of the vitreous body can be caused by degenerative changes and will cause a swirling movement that is visible on examination (syneresis). When complete bullous retinal detachment is present, it is often noted at this stage of examination as a billowing membrane just behind the lens in the anterior vitreous body.

**Culture and sensitivity testing**
After the initial examination and before performing the additional diagnostic testing discussed below, culture and sensitivity testing should be performed if indicated. Topical anesthetics are bactericidal, so cultures should be collected before their use when possible. A standard or microtipped culturette can be used to collect samples for culture. Culture and sensitivity testing is most useful for suspected septic corneal ulcers. Culture and sensitivity testing is less useful in routine cases of conjunctivitis, because the results are rarely helpful and contamination and growth of normal flora is common. Wipe away any accumulated discharge and gently swab the culturette on the lesion in question. When culturing the cornea, contact should be made with the cornea only, avoiding the conjunctiva. Most laboratories offer a topical sensitivity panel as well as a systemic sensitivity panel. The topical sensitivity panel should be requested for surface ocular cultures, as the sensitivity results will include data on common topical antibiotic preparations.
Importance of thorough diagnostic testing

The three most important tests to perform during an ophthalmic exam are the Schirmer tear test, fluorescein staining and intraocular pressure measurement. It is my opinion that when you are seeing any new case with an ophthalmic complaint, all three of these tests should be performed. There is no way to rule out a corneal ulcer or keratoconjunctivitis sicca just by looking; you need to have a minimum database. With regard to tonometry, it is crucial to obtain an accurate intraocular pressure in all cases, even if glaucoma is not suspected. Many cases of anterior uveitis have been detected through decreased intraocular pressure when other signs of uveitis were minimal and easily overlooked. In addition, subtle intraocular pressure elevations in the range of 26 to 40 mm Hg can easily be missed. This is especially true in cats, which don’t always demonstrate the more obvious clinical signs of elevated intraocular pressure such as corneal edema, often noted in dogs.

Schirmer tear test

The Schirmer tear test is the first diagnostic test to be performed during the exam, and it should be done before instilling any medications, eye wash or topical anesthetic in the eye. The Schirmer tear test I is usually performed, and it measures basal tearing as well as reflex tearing due to irritation from the test strip itself. Normal Schirmer tear test values for the dog are 20 ± 5 mm/min. It is important to realize that Schirmer tear test readings in the cat can be extremely variable, so low values without clinical signs
must be interpreted with caution. The most convenient strips come in individual plastic packages and have a printed millimeter scale as well as a color bar that moves with the leading edge of the tear film as it progresses up the strip, making interpretation rapid and simple. The end of the strips should be bent at a 90-degree angle at the pre-cut notch while the strips are still in the package. It is best to avoid touching the strips because the oil from your skin can affect the test results. Then, gently pull the lower lid down and place the strip in the middle lower conjunctival fornix. If there is any problem keeping the strip in place, exert gentle tension at the lateral canthus to help the strip stay securely in place. The strip should be left in place for a full minute and the results recorded.

**Intraocular pressure measurement**

Measurement of intraocular pressure is the next diagnostic test performed. The Schiotz tonometer is an older and inexpensive method of measuring intraocular pressure, and can produce accurate results in the dog and cat when used appropriately. It can be difficult to perform measurements with uncooperative patients, however, and many clinicians become frustrated with this instrument. Applanation tonometers—e.g., the Tono-Pen®—solve many of the problems found with the Schiotz; these devices allow the Pet’s head to be held in a more natural, horizontal position and produce accurate results in many species (e.g., birds and ferrets), for which the Schiotz would not be appropriate.

Despite the convenience of applanation tonometry, it can still be challenging to use initially—here are some helpful tips for getting consistent, reliable results. A drop of topical anesthetic, such as proparacaine, should be instilled in the eye. A new disposable cover should be placed over the end of the tonometer. The rubber membrane should fit snugly and be in contact with the metal tip of the instrument without wrinkles or creases, but should not be so tight that the membrane is tightly stretched over the tip. It is helpful to calibrate the instrument before use, according to the instruction manual provided.

The most important aspect of obtaining accurate and reproducible intraocular pressure measurements is proper restraint of the Pet; improper technique can lead to falsely elevated readings (especially in brachycephalic breeds). The dog should be gently restrained by the veterinary nurse or assistant and the head held gently, without excessive pressure on the neck.

When the Pet is properly restrained, gently spread the Pet’s eyelids open, making sure to put pressure only over the skull and never on the globe itself. To obtain readings, the central cornea should be gently touched with the tip of the tonometer. When beginning to use the instrument, it is common for clinicians to tap the cornea too aggressively, making it difficult to obtain accurate readings. In fact, very little pressure is required and unless intraocular pressure is very low, the cornea should not visibly indent during pressure measurement.

It is also important to understand that when measurements are obtained, the flat
tip of the tonometer should remain parallel with the surface of the axial cornea as contact is made. If the tonometer tip is at an angle when making contact with the cornea (so the edges of the tip touch the cornea before the center of the tip does), valid readings can be difficult to obtain.

When an individual reading is obtained by the instrument, a beep will sound. When an adequate number of valid readings are collected, a longer tone will sound, indicating that the test is complete. The instrument display will show a numerical value (intraocular pressure in mm Hg) as well as a line over the value for the coefficient of variance (from 5 percent to 20 percent). The line should be over the 5 percent value; if it is not, then the test should be repeated.

In general, the normal intraocular pressure is 15 to 25 mm Hg in the dog and cat, although this varies somewhat depending on the method of measurement. For example, the Tono-Pen shows a slight extension of the lower range of normal. In one study evaluating the use of The Tono-Pen in the dog, the mean intraocular pressure was found to be 19 +/- 6 mm Hg.1

If you obtain elevated readings without concurrent suspicious clinical signs, it is important to take the time to repeat the procedure. Improper restraint or a struggling Pet can easily result in falsely elevated readings of 35 to 40 mm Hg.

Always be in the habit of measuring intraocular pressure before you dilate the pupils for your ophthalmic exam. As a mydriatic and cycloplegic, tropicamide has the potential to precipitate glaucoma; normal intraocular pressure measurements should be obtained prior to administering this medication. In addition, tropicamide can also cause a transient elevation in intraocular pressure, making accurate measurement of intraocular pressure difficult. After intraocular pressure measurement, tropicamide can be instilled to dilate the pupils (which normally takes 15 to 20 minutes), making a comprehensive evaluation of the posterior segment much easier for both the clinician and the Pet (see Direct ophthalmoscopy, page 31).

Fluorescein staining
Fluorescein staining is an important diagnostic tool in detecting corneal ulceration. The fluorescein dye will not penetrate the normal lipophilic corneal epithelium and in a normal cornea will be completely irrigated with eyewash after instillation. When a defect in the surface epithelium is present, the dye will be retained by the hydrophilic stroma and easily visualized with traditional illumination or preferably with a cobalt blue light available on most direct ophthalmoscopes.

The most commonly available form of fluorescein dye is a dry, impregnated paper strip. First, the strip should be removed from the sterile packaging and moistened with a few drops of eye wash. Then, hold the palpebral fissure open and place the strip over the eye, allowing a drop of dye to fall onto the corneal surface. Alternatively, you can touch the moistened strip to the bulbar conjunctiva as a means of instilling the fluorescein dye. However, take care not to touch the cornea during this procedure. Although inadvertently touching the cornea will not cause damage, it can lead to a focal area of
stain uptake that can be difficult to interpret and result in the inaccurate diagnosis of a corneal ulcer.

After instilling the fluorescein, irrigate the ocular surface with eyewash to remove excess dye. It is important to irrigate adequately to remove all excess dye as well as mucous threads that can adhere to the cornea and make interpretation difficult. In Pets with previous stromal ulcers that have healed and formed small depressions in the cornea (corneal facets), it is common for surface tension to cause the stain to pool within these depressions, resembling a corneal ulcer. Adequate irrigation will help to prevent these false positive results; even with copious irrigation, fluorescein cannot be rinsed away from a true corneal ulcer bed.

There are additional uses for topical fluorescein dye besides the diagnosis of corneal ulcers. When evaluating a deep stromal corneal ulcer, laceration or descemetocele that may have perforated, the Seidel test can be performed to evaluate for aqueous humor leakage. In this test, the fluorescein strip is very lightly moistened and the concentrated dye on the strip is used to gently ‘paint’ the lesion. The dye will be a deep orange color in this concentrated form, and if there is active leakage of aqueous fluid it is diluting the dye. The Jones test involves evaluating the external nares after instilling the fluorescein dye. The appearance of dye at the nares within a few minutes confirms patency of the nasolacrimal system. It is important to note, however, that a lack of fluorescein dye at the external nares does not necessarily imply that there is an obstruction or abnormality present, and can occur in normal Pets.

**Obtaining cytologic samples**

It is often useful to obtain cytologic samples of corneal and conjunctival lesions. An excellent tool for this is the Kimura platinum spatula, which is a fine, malleable spatula that allows simple sample collection from the cornea and conjunctiva. Since this tool is not frequently available in general practice, the dull handle end of a #15 scalpel blade also works well. Simply remove a blade from its sterile foil packaging, and slip the blade end back into the foil, exposing the opposite end of the blade. This provides a sterile atraumatic instrument for cytologic sampling. Obtaining samples is relatively straightforward. With a PetNurse or assistant restraining the patient, conjunctival cytology can be obtained by gentle retropulsion of the globe, which will elevate the nictitans and allow easy access to the conjunctiva of the nictitans as well as the palpebra. When performing a corneal scraping, your hand should rest gently on the patient’s head or nose. This ensures that if the patient moves during sampling, the instrument and hand will move with the patient’s head, avoiding iatrogenic trauma to the cornea or conjunctiva.

**Direct ophthalmoscopy**

With the pupils fully dilated, it is now time to more closely evaluate the posterior segment. The most common tool utilized to perform a fundic ophthalmic exam in general practice is the direct ophthalmoscope. The direct ophthalmoscope should be set at a 0-D setting on the rotating scale, and the instrument should be placed against your brow. From approximately arm’s length, focus on the eye to detect the tapetal reflection as previously discussed. Then move in towards the patient until you are at a distance of about an inch. Due
to the conformation of most of the Pets that we examine, it is best to use your right eye to look at the Pet’s right eye, and left eye for the Pet’s left eye (this helps to avoid the muzzle). It is usually easiest to visualize the optic nerve head initially, and then perform the rest of the fundic evaluation. If you lose your sense of orientation during the exam, you can always use the optic nerve head as well as tapetal and non-tapetal zones as frames of reference.

It should always be stressed that safety is paramount when performing this test, because of the clinician’s proximity to the Pet as well as the dominant nature of the procedure; if there is any doubt as to how the Pet will react, a muzzle should be used.

Indirect ophthalmoscopy
Although most practices have a direct ophthalmoscope, this technique can be a difficult and sometimes frustrating method for evaluating the fundi if the patient is uncooperative. This can be attributed to the high magnification (17x in the dog) and small field of view. Because of these obstacles, indirect ophthalmoscopy can be a useful alternative.

A transilluminator and a hand-held lens are the most important items for monocular indirect ophthalmoscopy. The most practical size lens for general practice use is a 20-D lens. With a 20-D lens in the dog, magnification will vary from about 2x to 4x, giving the observer a larger field of view due to the decreased magnification. Because of this, it will be easier to scan the fundus, and subtle movements of the Pet’s eye and head will cause less distortion and disorientation.

To start, direct the light at the eye being examined and observe the tapetal reflection. The lens should be placed in front of the eye in the path of the light, and a fundic image should be visible. If the image does not fill the entire lens, the lens can be slightly moved back and forth until the image is perfect. At that point, you should be able to systematically observe the entire fundus. Remember, the image you are seeing is upside down and reversed, and this must be taken into account when recording findings.

While it initially seems more cumbersome, and has a steeper learning curve, indirect ophthalmoscopy allows a more rapid and complete fundic exam than the direct technique, and is ultimately easier to perform. Direct ophthalmoscopy can always be used when a lesion is noted, for a more magnified view of the area in question.

The complete exam
For many veterinarians who lack experience in ophthalmology, the thought of performing a full ophthalmic exam can be overwhelming. However, with minimal equipment, a bit of practice and some patience, it isn’t difficult to gain confidence and add these techniques to your skill set.

References: