Approach to ocular examination in small animals

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While a thorough ocular examination is clearly important in the diagnostic work-up of dogs and cats presenting with eye conditions, an assessment of the eyes should also be included in every routine health check in small animal practice. Eye examinations require basic equipment, good clinical observation and lots of practice. It is also important for clinicians to be familiar with the normal anatomy of the eye, so that abnormalities can be recognised and the significance of the findings appreciated. This article describes a step-by-step approach to examination of the eye in dogs and cats, and highlights the key diagnostic tests that should be carried out as part of this procedure.

Preparation

Basic instrumentation

Relatively basic and inexpensive equipment can be sufficient to diagnose many ocular conditions. The main requirements are a good focal light source and a method of magnification. Essential equipment (Fig 1) includes:

- A focal light source such as a pen-light/Finoff transilluminator/otoscope/direct ophthalmoscope;
- A means of magnification such as an otoscope/direct ophthalmoscope/2x to 4x loupes;
- A condensing 20 to 30 dioptre lens (eg, Volk, Heine, Nikon);
- Third eyelid forceps (eg, von Graefe forceps).

Additional instruments (available at referral centres, but also useful in practices with an interest in ophthalmology) include:

- Slit-lamp biomicroscope (eg, Kowa SL-15);
- Binocular indirect ophthalmoscope (eg, Keeler, Heine, Neitz);
- Monocular indirect ophthalmoscope (eg, panoramic ophthalmoscope; Welch Allyn);
- Tonometer (eg, Tono-Pen or TonoVet);
- Gonio lens (eg, Koepple or Barkan).

Disposables for diagnostic procedures

Disposable supplies (Fig 2) also required when carrying out an eye examination include:

- Cotton wool;
- Sterile saline;
- A mydriatic (1 per cent tropicamide such as Mydriacyl [Alcon] or Minims vials [Smith & Nephew]);
- Fluorescein dye (1 per cent sodium fluorescein, available as Fluroets sterile strips [Chauvin] or in Minims vials [Smith & Nephew]);
- A topical local anaesthetic (eg, 1 per cent proxymetacaine [Minims vials; Smith & Nephew]);
- Schirmer Tear Test (Intervet Schering-Plough), Sno Strips (Smith & Nephew) or Tearex Schirmer Strips (Dioptrix);
- Swabs for bacterial culture and virus isolation;
- Sterile disposable plastic or metal lacrimal cannulae.
Examination room
A full ocular examination involves carrying out various tests with the lights on and in the dark (to minimise reflections). It should therefore be possible to completely darken the examination room. Animals should be allowed a few minutes to acclimatise to the room. Small animals are best examined on a table, but large dogs may be examined sitting in a corner. The patient should be gently restrained, and ocular examination is usually tolerated well when approached calmly. An assistant is useful, or else owners should be shown how to gently restrain the animal with one arm over the body and the other hand resting under the chin. Some dogs may require a muzzle, but this does not hinder the ocular examination. Sedation should be avoided unless it is absolutely necessary, as it can cause enophthalmos, downward rotation of the globe, protrusion of the third eyelid, changes in pupil size or may alter the results of some tests (eg, the Schirmer tear test and intraocular pressure measurement), depending on the agent used.

Ophthalmic examination
Both eyes of any animal must be examined, even if only one has an obvious problem. The apparently normal eye may provide clues about the diagnosis as it may be at an earlier stage of the same condition. Systemic disease may cause secondary ocular signs, which may aid the diagnosis of the underlying condition. Conversely, an animal presenting with an eye complaint should undergo a full clinical examination in addition to an ocular examination, in case it represents an ocular manifestation of a systemic disease.

It may be helpful to record the findings of an examination on an ophthalmic examination chart, and the use of drawings will aid future monitoring. A good quality macro photograph is a useful way of recording the appearance of the eye. Almost all digital cameras have a macro function, which allows close-up focus. An eye model and drawings are really helpful for explaining the location and effect of the lesions within the eye to owners.

A step-by-step approach should be used to examine all parts of the eye in a specific order. By following such a routine, it is less likely that abnormalities will be missed. However, while the protocol should be kept relatively consistent, not every diagnostic test is required for each patient, and the choice of appropriate tests is made during the examination. Although there are many steps, with practice, a thorough eye examination can be carried out in less than 10 minutes. The recommended order of a thorough ocular examination is discussed below.

Lights on . . .
History
As with any aspect of veterinary medicine, accurate history taking is crucial. Information should be obtained about the animal’s breed, age, general health, current medications, travel history, vision, signs of ocular pain, duration and progression of the problem, changes in appearance and abnormalities of related and in-contact animals. Hereditary ocular disease is relatively common, and it is a good idea to have access to the list of breeds currently part of the BVA/KC/SDS Eye Scheme, which can be found on the British Veterinary Association’s website (www.bva.co.uk/canine_health_schemes/Eye_Scheme.aspx). Apart from hereditary disease, several breeds are predisposed to various ocular conditions. A list of these can be found in the appendices of many textbooks, and may help to diagnose certain conditions.

Distance examination
While the history is being obtained from owners, dogs and cats may be allowed free to explore the consultation room. During this time, the attitude of the patient in an unfamiliar environment should be observed to check their ability to navigate around obstacles and note any obvious abnormal gait or head position. The lighting level of the room may be temporarily reduced to see if this makes a difference to an animal’s behaviour. A maze test (Box 1) is a useful method of assessing vision in dogs (there is little point in performing the test in cats), and can be carried out at this stage or after the ocular examination.

Physical examination
With the animal placed on a table, a physical examination should be performed first in case other related or unrelated signs are present.

Gross general examination
A gross general examination should be carried out to check facial symmetry along with eye symmetry, size, movement and direction of gaze. The presence and nature of any ocular discharge should be noted. The animal should be observed for obvious signs of ocular pain, such as blepharospasm and epiphora. The ‘hands-off’ approach should be used initially to avoid disturbing the conformation of the eyelids, which could alter the appearance of entropion or ectropion, and stimulating changes such as increased tear production or changes in eyelid position. If a Schirmer tear test or bacteriological swabbing are being considered, this is an appropriate time to perform these.

Close inspection
Close inspection of the eye and adnexa should be carried out using a focal light source. It is best to examine the external eye first before assessing the internal aspect. The eyelids should anatomically fit well with the globe, and they should be checked for entropion or ectropion or macropalpebral fissures. The palpebral and bulbar conjunctiva should be assessed, and the presence and location of lacrimal punctate observed. The presence and position of the third eyelid should be noted, and if a more detailed inspection of the posterior aspect is required, it may be grasped withatraumatic forceps and carefully retracted from the globe. The episclera, sclera and limbus should be examined next, and the general appearance of the ocular surface noted to make sure there is a nice healthy tear film and to check for any obvious opacities or surface irregularities of the cornea. The anterior chamber should be clear, and neither excessively deep or shallow. The iris should be a normal colour and have a smooth round pupil margin. The lens should be observed behind the pupil, and may appear white or cloudy if there are cataracts.

Box 1: Maze test in dogs
A maze test involves placing obstacles of different sizes and colour around a room and asking the owner to call the dog from the other side of the room. This helps to easily assess a dog’s ability to navigate around the objects in the room. The test should be performed in photopic conditions (lights on) and repeated in scotopic conditions (low lighting) with a few obstacles moved to ensure the dog has not memorised the layout.
Neuro-ophthalmic examination

Ophthalmic disease such as blindness may have a neurological component, and a full neurological examination may be required based on the results and interpretation of a neuro-ophthalmic examination, which should include the following tests:

- **Palpebral reflex.** Observe the completeness of eyelid closure before and after stimulation of the medial and lateral canthus with touch, which normally elicits a complete blink. It is important to establish a normal blink response before judging the results of the menace response and dazzle reflex (see below), to ensure that the animal is capable of responding as expected. A normal result confirms an intact sensory pathway (trigeminal nerve) and motor pathway (facial nerve). An abnormal result (lack of a blink) indicates poor sensation or, more commonly, facial nerve paralysis;

- **Menace response.** This is assessed by making a threatening movement towards each eye in turn, taking care not to touch the patient or create a wind current. A normal response is a blink with aversion of the head, which confirms vision and an intact facial nerve. A negative menace response usually indicates blindness, although animals with cerebellar lesions and normal vision also have a negative menace response;

- **Dazzle reflex.** Shine a strong light into each eye in turn. This should elicit a normal involuntary avoidance response, which comprises a blink or partial blink and head aversion. The pathway for this reflex is not fully understood. A negative dazzle reflex is a poor prognostic indicator for vision. A positive result suggests function of the visual pathway from the eye to the rostral colliculus, so it is precortical and does not involve the visual cortex. This test is used to check for potential vision in cases with some opacity of the ocular media (eg, cataracts and hyphaema);

- **Pupillary light reflex (PLR).** Shine a bright light into the lateral aspect of each eye in turn. A normal response is constriction of the pupil being stimulated (direct response) along with slightly less constriction of the unstimulated pupil (consensual response). Knowledge of the neuroanatomical pathway of this reflex can help to pinpoint the location of a lesion in some cases. It is important to note that this response is not an assessment of vision as blind animals can have normal PLRs (eg, those with cataracts or occipital cortex lesions) and those with normal vision can have absent PLRs (eg, animals with iris atrophy). If the pupil does not constrict in response to light, it is possible that:
  - The light source is too weak;
  - The animal is very stressed, with excessive sympathetic nervous stimulation. In such cases, there will be bilateral mydriasis;
  - The iris is very thin leading to atrophy of the iris muscles, rendering them incapable of constricting the pupil. In such cases, there will be mydriasis and the iris stroma will appear tatty and contain holes, or will be ‘threadbare’ in areas (Fig 3);
  - There is extensive retinal, optic nerve or optic tract degeneration. If the lesion is unilateral, there will be anisocoria due to the affected eye having a more dilated pupil at rest. There is no direct and no consensual PLR in the normal eye. Stimulation of the unaffected eye causes a normal direct PLR, but there is no consensual PLR in the affected eye. If the lesion is bilateral, both pupils will be dilated at rest, and there will be no direct and no consensual PLR;
  - The oculomotor nerve (cranial nerve III) is not functioning. If this is a unilateral lesion, the pupil will be dilated at rest, while the other pupil will have slight miosis due to a constant consensual PLR. While there is no direct PLR, there is a normal consensual PLR, but the menace response is normal as lesions in the oculomotor nerve do not affect vision.

Conditions that cause miosis include uveitis and Horner’s syndrome. Despite the pre-existing constricted pupil, the affected iris should still constrict further following stimulation with a bright light, and there should be a normal consensual response in the unaffected eye.

**Lights off . . .**

**Distant direct ophthalmoscopy**

Distant direct ophthalmoscopy (Fig 4) is quick and simple to perform. The room should be darkened and the lens of the direct ophthalmoscope set to zero. The ophthalmoscope should be placed very close to the observer’s eye. The tapetal reflection should be...
obtained from about 50 cm away from the patient. The test takes mere seconds to perform, and several abnormalities can be picked up. These include:
- Anisocoria (pupils of unequal size);
- Absence of tapetal reflection (which suggests that an opacity, such as a cataract, is in the way);
- Distinction between nuclear sclerosis (Fig 5) and cataracts. Cataracts are opaque so it is not possible to see through them, while a normal tapetal reflection with an obvious concentric ring is obtained in the case of nuclear sclerosis;
- Focal opacities (eg, corneal pigmentation);
- Aphakic crescent. A moon-shaped crescent of tapetal hyper-reflectivity may be seen with lens luxation (Fig 6);
- Strabismus. Evaluation of the direction of the gaze will highlight any misalignment of the eyes.

Focal light source examination
The previous adnexal and ocular examination discussed above should be repeated, as some changes are easier to appreciate in the dark.

Examination with magnification
Using magnifying loupes, a direct ophthalmoscope set at 12 to 20 dioptres, an otoscope or, ideally, a slit-lamp biomicroscope, a more careful examination of the anterior segment of the eye should be carried out. Attention should be paid to fine detail such as distichia or ectopic cilia on the eyelids, and any abnormalities such opacities on the cornea or turbidity in the anterior chamber noted.

Examination of the fundus
The fundus should always be examined. It is important to become familiar with the normal fundus, as there are lots of normal variants between and within species. Variations occur because of differences in anatomy, colour and extent of the tapetum, pigmentation of the non-tapetal fundus, degree of myelination of the optic nerve head, location of the tapetal/non-tapetal junction with reference to the optic nerve head, and vascular pattern.

The fundus is best viewed after pharmacological dilation of the pupils using 1 per cent tropicamide drops, which takes 20 to 30 minutes to achieve full pharmacological dilation.

**Box 2: Direct ophthalmoscopy**

The lens dial should be set to zero, although observers who normally wear spectacles may remove them and use the lens dial to compensate for their degree of refractive error. The light level should be adjusted using the rheostat; it is best to use a low intensity light, which will disturb the patient less. The right eye should be used to examine the patient’s right eye, and the left eye to examine the patient’s left eye. The ophthalmoscope should be placed very close to the observer’s eye. The tapetal reflection is obtained from a short distance away to align the image, after which the observer and the instrument should move forward until the instrument is close to the animal’s cornea. The optic nerve head should be identified and examined, followed by the rest of the tapetal and non-tapetal fundus in quadrants. The green (red-free) light enhances contrast and therefore is useful for distinguishing between retinal pigment and retinal haemorrhage.
Atropine is not a suitable mydriatic for diagnostics as it takes longer to dilate the pupil, the effect lasts for much longer than is required, and it can raise the intraocular pressure. The fundus should be examined using direct or indirect ophthalmoscopy (Boxes 2, 3). Ideally, indirect ophthalmoscopy should be performed first. If lesions are seen or suspected using this technique, these can then be examined more closely with direct ophthalmoscopy. With direct ophthalmoscopy, the image obtained is upright, small and highly magnified. Conversely, the image obtained using indirect ophthalmoscopy is inverted and reversed, but is a larger image due to a larger field of view and less magnification. The latter technique takes a little longer to learn, but is very rewarding as the view obtained is easier to interpret.

**Diagnostic tests performed during the eye examination**

**Schirmer tear test**

The Schirmer tear test is indicated in every case with ocular discharge, conjunctivitis and keratitis, and is used to measure the quantity of tears produced in one minute. It is useful for diagnosing keratoconjunctivitis sicca and establishing whether an animal is producing excessive tears. The test is simple to perform, and should be carried out before other topical drops such as local anaesthetics are administered. The test uses special strips (e.g., Intervet Schering-Plough) that have a notch for easy placement, are calibrated with a millimetre scale and impregnated with a blue dye for easy visualisation of the result. The notched area should be bent over 90° before the strip packet is opened. The packet should then be opened from the opposite end, taking care to only handle the strip at this end, as oils from the fingers can absorb onto the strip and prevent the passage of tears down it. The animal’s lower eyelid should be gently pulled out slightly, and the notched section of the strip hooked onto the lateral aspect of the lower eyelid to contact the palpebral conjunctiva and the cornea. The strip should be left in position for 60 seconds and the distance travelled by the tears on the test strip recorded. If possible, quickly place a second strip into the other eye as well – this will speed up the test by recording the results in both eyes in one minute instead of two (Fig 7). During the test, it is useful to place a hand on the animal’s neck area to prevent it from raising its paws to rub out the strips.

Normal values for dogs are 15 to 25 mm/minute, while 10 to 15 mm/minute is borderline and 0 to 10 mm/minute is diagnostic for keratoconjunctivitis sicca. Cats have variable results, but a value of <10 mm wetting per minute is considered significant in the presence of ocular surface disease, such as ocular discharge, conjunctival hyperaemia or corneal opacities.

**Culture swabs**

Culture swabs moistened with sterile saline or viral culture transport medium can be carefully applied to the desired sampling site before the application of topical anaesthetics, which sometimes contain preservatives that may interfere with subsequent culture.
Corneal scraping
Corneal scraping should be carried out after the application of topical anaesthetics, using a Kimura spatula, cytobrush or, more commonly, the blunt end of a scalpel blade. The harvested cells should be spread onto a clean microscope slide, air dried and stained for cytology or submitted for analysis.

Fluorescein dye
Fluorescein is a water-soluble ophthalmic dye available in sterile single-use vials (1 or 2 per cent Minims Fluorescein; Chauvin) or as impregnated paper strips (Fluorets; Chauvin) that need to be moistened with a drop of saline or topical anaesthetic. Fluorescein staining is indicated for the examination of red or painful eyes, or if there is observable corneal disease. One drop of dye should be applied to each eye and any excess dye must then be flushed away from the eye – otherwise it pools in any irregularities on the corneal surface and can be confused with dye uptake. The dye is highly lipophobic and hydrophilic, and so will not penetrate an intact corneal epithelium with its lipid cell membranes. However, the corneal epithelium is breached in cases of corneal ulceration, leaving the stroma exposed, which will absorb and retain fluorescein (Figs 8). Descemet’s membrane does not take up fluorescein, so a clear area at the base of a deep defect in the cornea indicates a descemetocele. Observing fluorescein stain uptake is greatly enhanced by examination with a blue light. The stained cornea may be shown to owners, which can help them to understand their pet’s problem.

The dye may appear at the nares after five to 10 minutes of administration. This confirms the patency of the nasolacrimal duct and is called a positive Jones test (Fig 9). The absence of fluorescein dye at the nares is not diagnostic of a blocked nasolacrimal duct, as the dye may have drained into the pharynx.

Tonometry
Measurement of intraocular pressure (Fig 10) is very useful for the diagnosis of glaucoma (raised intraocular pressure, usually >25 mmHg), uveitis (lowered intraocular pressure, usually <10 mmHg) and for monitoring the response to treatment. Many first-opinion practices now have tonometers. Topical anaesthesia is required when using a Schiotz tonometer or Tono-Pen, but is not needed when using the rebound tonometer, TonoVet. Gentle patient handling is essential to avoid inducing a temporary increase in intraocular pressure as a result of jugular compression, which could lead to a false diagnosis of glaucoma. Intraocular pressure can be influenced by drugs (eg, raised with topical atropine and systemic ketamine, while the commonly used sedative medetomidine can have an unpredictable effect). Rapid referral is required if glaucoma is suspected.
**Gonioscopy**

Gonioscopy assesses the iridocorneal (drainage) angle and should be carried out before pupil dilation. The technique requires considerable practice and is normally only carried out at referral centres. A narrow angle or malformed pectinate ligament (pectinate ligament dysplasia) may be observed, and these anomalies are thought to contribute to the development of glaucoma.

**Imaging**

Imaging, such as ocular ultrasonography and radiography, are available in almost all practices. Ultrasound examination is a non-invasive and safe procedure that allows useful imaging of the eye and retrobulbar region, and can usually be carried out with gentle manual restraint without the need for sedation. After applying topical anaesthetic and coupling gel (eg, K-Y jelly; Johnson & Johnson), the probe may be directly applied to the cornea (Fig 11). Ultrasonography is indicated when there is an opacity in the transmitting media of the eye (ie, the cornea, aqueous humour, lens or vitreous). B-Scan ultrasonography is also useful for investigating intraocular masses and the extent of damage caused by ocular trauma, as well as the presence of ocular foreign bodies, cataracts, retinal detachment and retrobulbar space-occupying lesions. A 10 MHz probe provides good detail with high near-field axial resolution. As with all examination techniques, for accurate diagnosis, it is important to be familiar with the appearance of the normal eye.

Advanced diagnostic techniques such as computed tomography and magnetic resonance imaging (Fig 12) can be very useful in certain cases, such as those with neurological signs or tumours.

**Electroretinography**

Electroretinography may be performed at referral centres and is used to establish whether the retina is capable of responding to light. It is indicated in cases of sudden-onset blindness and is usually carried out before cataract surgery to confirm adequate retinal function.

**Summary**

Ocular examination can be very rewarding as the eye is readily examined and a definitive diagnosis is often possible. It is important to follow a consistent step-by-step approach to the examination to ensure that abnormalities are not missed. In cases where a diagnosis remains unclear, referral to a veterinary ophthalmologist should be considered (Box 4).

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**Box 4: When to refer**

**Conditions requiring urgent referral**
- Deep or melting corneal ulcers
- Perforating foreign bodies
- Deep corneal cat scratch injuries
- Sudden blindness
- Glaucoma
- Uveitis

**Conditions for which referral should be considered**
- Cataracts
- Severe eyelid problems
- Neoplasia of the orbit or globe
- Ocular pain with no apparent cause
- Feline sequestrum
- Superficial corneal ulcers unresponsive to treatment
- Conjunctivitis unresponsive to treatment
- Keratoconjunctivitis sicca unresponsive to treatment (for alternative treatments or parotid duct transposition)

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**Further reading**


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**Fig 11:** Ultrasound examination of the eye in an unsedated cat

**Fig 12a (above):** Six-year-old female Labrador retriever with right-sided exophthalmos and third eyelid protrusion. Ultrasound examination showed a solid mass but Tru-cut biopsy specimens were non-diagnostic.

**Fig 12b (below):** T1-weighted magnetic resonance scan from the same dog, showing a retrobulbar mass that is larger than the eye, which when measured using linear callipers (indicated by the transecting lines) was 30 x 42 mm on this view. The mass was subsequently diagnosed to be a histiocytic sarcoma
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