BASICS OF OCULAR EXAMINATION AND DIAGNOSTICS

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The eye is a beautiful window into the body and therefore an ophthalmic examination can provide invaluable information on systemic as well as ocular disease, augmenting the general physical examination.

Making a correct diagnosis is fundamental to the subsequent treatment, and the prognosis of any ophthalmic patient . In some patients the diagnosis may be obvious from a simple ophthalmic examination, especially as the eye lends itself to visual assessment so brilliantly. In other patients, further diagnostic techniques and/or tests may be required.

It is stating the obvious that the signalment and history are key pieces of information when making a diagnosis. Certain ocular disorders are more likely to occur in animals of a particular species and/or at certain ages. The duration of a condition, its speed of onset, whether it has been bilateral at any stage, the presence of any associated systemic signs, and any response to therapy are important clues. For many (most) zoological species husbandry and nutrition history is of critical importance, particularly with respect to pet-owned exotic species.

Observe from a distance

If possible, assess the appearance of the head, periocular regions, position of the lids and globes as well as the globe and pupil sizes in ambient light before approaching the patient. In many exotic species (particularly birds and reptiles, but also in equidae and ruminants) it is important to assess the appearance of the skull over the sinuses as the close proximity of the sinuses to the orbit can lead to primary sinus disease causing secondary orbital/ocular disease.

Neuro-ophthalmological assessment

Assess Vision

In veterinary ophthalmology generally only very crude assessments of vision can be made

- **Menace response** – this is tested by making a 'menacing gesture' towards each eye in turn, with the other covered (not always feasible in zoo species). Take care to minimise air turbulence, which may give a false positive result. In domesticated species (altricial) the response is learned and is absent in young animals (less than 10-12 weeks old) and also may be overcome by fear. It tends to be unreliable in birds, reptiles, and a number of other species (e.g. some feline species). More reliable is '**avoidance behaviour**' in these animals – moving the head or the whole body away from the perceived threat.
- **Tracking/fixation responses** – use a cotton wool ball or a moving spot of light. Food items may be more interesting but might make a noise and have a smell, which can lead to false-positive results.
- **Dazzle reflex** – a very bright light shone in each eye in turn should result in a reflex blink in both eyes. The reflex is sub-cortical (i.e. not involving the visual cortex), so cases with blindness of central origin may still exhibit a dazzle response. Animals that do not blink (e.g. snakes) will obviously not have this reflex!
- In many zoological species vision is often best assessed by careful observation of the animal's behaviour in their enclosures, although improvised **maze tests** can be fashioned within an enclosure for some species. Sometimes a change in layout of objects in an enclosure will highlight visual deficits in an animal that was previously 'coping' due to familiarity with their environment ('spatial mapping').

Pupillary Light Reflex (PLR)

- The PLR (which should ideally be assessed in a darkened room) has two components – direct and consensual. A bright light shone into one eye causes both pupils to constrict (positive direct and consensual response). The optic nerve (CN II) comprises the afferent arm, whilst the parasympathetic fibres, which run with the oculomotor nerve (CN III), comprise the efferent

arm. Parasympathetic stimulation leads pupilloconstriction due to contraction of the iris sphincter muscle and relaxation of the dilator muscle. The consensual response is the result of decussation of nerve fibres at the optic chiasm and/or the pretectal area.

- The non-autonomic innervation of the iris and presence of striated iris musculature in birds and reptiles mean that the PLR is unreliable in these animals and parasympatholytics will not result in mydriasis for posterior segment examination respectively.
- *A positive PLR does not necessarily indicate the presence of vision and a negative one does not necessarily indicate blindness.*

Palpebral and Corneal Reflexes

- These reflexes test sensory (trigeminal CN V) innervation to the periocular skin, eyelids and cornea. Touching these structures results in a blink (facial CN VII) and globe retraction (abducens CN VI) due to retractor bulbi activity (in those animals that can blink and/or have a retractor bulbi muscle). Animals requiring general anaesthesia for examination (e.g. many zoo species) cannot be tested for these reflexes.

Vestibulo-Ocular Reflex (VOR)

- Normal saccadic ocular movements should result when the patient's head is moved from side to side, and up and down (the so-called 'doll's head reflex' or vestibulo-ocular reflex (VOR)). Extra-ocular muscle paralysis may impair globe movements in different directions dependent upon which nerve/muscle group is involved, and vestibular disease may alter the afferent arm of this reflex.

The ophthalmic examination

Examination in Ambient Light with the naked eye

Two parts: a hands-off and a hands-on assessment:

Hands off:

- Globe size, position and movement should be assessed – the head should be moved around to check that both eyes move freely in reflex compensation for head movement
- Eyelid position, conformation and apposition to the globes should be appreciated as well as the blink rate and degree of eyelid opening

Hands on:

- areas around the globes should be palpated and the globes should be retropulsed to check for resistance and also to expose the third eyelids for inspection
- cornea, sclera and overlying structures, anterior chamber and iris /pupil should be briefly assessed (which may require holding eyelids open).

Examination in Dim Light / Darkness with Magnification

- Focal illumination and magnification are required at this stage:
  - a pen torch (Maglite©) or Finhoff transilluminator used with loupes
  - a direct ophthalmoscope with a halogen bulb
  - ideally, a slit-lamp biomicroscope.
- A systematic approach should be adopted & I prefer to work from the 'outside to inside'
  - examine the eyelid margins, conjunctiva, third eyelid and ocular coats in detail, noting colour, vascularity, lustre, opacities, swellings etc
  - note the depth and transparency of the anterior chamber
  - examine the iris – colour, stability, mobility, shape of pupil, contour
  - assess the lens position, stability, presence of opacities (ideally again 20 minutes later after mydriasis with tropicamide (Mydriacyl®), atropine or curariform drug as required for the species concerned (N.B. general anaesthesia is often sufficient to cause mydriasis in birds without the need for topical or intracameral drugs which are not without risk)
  - examine the anterior vitreous.

Slit lamp examination

The slit lamp is a combination of magnification (biomicroscope 10x and 16x objectives) with a bright light source, allowing the detailed and binocular examination of the surface and anterior ocular structures. The light beam of the slit lamp can be modified from a broad, round beam into a thin slit of light, and the angle of incidence of the beam can be varied allowing (normally) transparent anterior ocular media (cornea, anterior chamber, lens and anterior vitreous) to be sectioned and examined in great detail. It is an expensive piece of equipment (~£4000) so is not available in many general practices.

Full Beam

Using a full beam on the slit lamp with direct illumination is the equivalent to using a pen torch but with magnification. It gives a generalised view of the adnexal and anterior segment structures, and as the angle of the incident light can be varied (and different from the examiners view) enhanced detection of three-dimensional structures (the greater the angle, the larger shadow created by a 3D structure) is possible.

Slit Beam

The slit beam is used to provide more focal illumination and to give an optical section through the structures of the eye. This allows smaller areas to be concentrated upon in detail and also gives an indication as to the depth of lesions within transparent structures such as the lens or cornea. This technique is also useful for the detection of aqueous flare, as any protein within the normally optically clear aqueous will show as a 'smokiness' within the slit beam (the Tyndall effect), and also to see cells within the aqueous – both of these findings can be very helpful when assessing the integrity of the blood/aqueous barrier e.g. for the diagnosis and monitoring of uveitis.

Retro-Illumination & Trans-Illumination

It can be very useful when performing slit beam examination of the eye to observe structures slightly to one side of the slit. These structures are being illuminated by light reflected back from intraocular structures such as the iris or the fundus. Often very subtle abnormalities (e.g. ghost vessels within the cornea, lens vacuoles) can be seen more readily using this technique.

In addition, it is useful for assessing the thickness of structures such as the iris, or the wall of a potentially cystic lesion. An atrophic iris (e.g. senile iris atrophy) will be more readily transilluminated with light reflected back from the fundus (including tapetum if present).

Examination in Darkness – Direct and Indirect Ophthalmoscopy

Full examination of the posterior segment requires dilation of the pupils. Direct and indirect ophthalmoscopy are the two main types of examination techniques available.

Direct ophthalmoscopy is the more commonly used technique in veterinary medicine and has two components:

i) Distant direct ophthalmoscopy

- the ophthalmoscope lens is set at 0 (unless you have removed spectacles – set to your prescription) and the patient is viewed at arm's length
- the position of the visual axes and pupil size/symmetry can be readily assessed
- any opacity in the ocular media is seen as a black area viewed against the reflection of light from the fundus (the "fundic reflex" the colour of which depends upon presence or absence of a tapetum and the colour of the tapetum)
- it is especially useful for highlighting cataracts, and parallax may help to localise the position of the opacity
- true cataract can be differentiated from nuclear sclerosis (which shows as concentric rings of altered refraction rather than black opacity).

ii) Close direct ophthalmoscopy

- The viewer's eye is brought as close as possible to the ophthalmoscope (it is designed to fit into a human socket)

- The light intensity should be as low as possible
  - To make the patient comfortable and improve the chances of 'getting a good look'
  - To improve the image quality if the tapetum (if present) is highly reflective
- Lean in so the ophthalmoscope is positioned 2 to 3 cm from the patient's eye with the lens setting on zero (unless you have removed spectacles – set to your prescription) - you are looking through a keyhole so the closer you are to the keyhole the more you will see
- You will see an upright, non-stereoscopic highly magnified view of the fundus
- The major disadvantage is that only a small area of fundus is revealed
- The ophthalmoscope should therefore be moved around to view different areas of the fundus – and it is best to do this in a routine manner to avoid missing areas.
- Assess the appearance of the/any retinal vasculature, optic nerve head, tapetal fundus, non-tapetal fundus and choroidal vasculature
- The different dioptre lenses (on the lens wheel) allow the viewer to focus at different depths within the eye: vitreous approx. +4, lens approx. +10, aqueous and cornea approx. +20-29
- BUT, a slit lamp offers a much better way of examining anterior segment structures

Indirect ophthalmoscopy gives a less magnified image than close direct ophthalmoscopy but reveals more of the fundus in one view. The technique takes practice, it is well worth persevering and will eventually 'click'. It is useful for giving an overview of the fundus and is best used before a more detailed direct ophthalmoscopic examination.

- A simple inexpensive version of indirect ophthalmoscopy can be performed using a pen-torch held by the side of the viewer's head and a lens held in the other hand – an assistant is needed to hold the patient's head still
- The condensing lenses form a virtual image which is inverted, reversed and magnified
- 20 or 30 dioptre lenses are commonly used - higher dioptre lenses afford less magnification but a wider field of view. 30D or the 'pan-retinal' 2.2 lenses give a wider view with less magnification. Higher dioptre lenses, such as 90D, are required for small eyes (e.g. mouse, rat etc). Cheap plastic 20D lenses can be purchased for approx £20, the nicer Volk© lenses are a few hundred pounds once you've mastered your technique.
- The lens is held about 2 to 5 cm from the patient's eye and the observer stands at arm's length with a pen torch held at the side of the head near the viewing eye, so that the viewer, light, lens and patient are in line. The lens needs to be held parallel to the fundus. It is easiest to get a tapetal/fundic reflex and then bring the lens into place, and if you lose the image just repeat this.
- A head mounted binocular indirect ophthalmoscope is expensive (~£1500-1800 depending on the system) but makes the technique easier as a hand is free to hold the patient's head, and being binocular has the significant advantage of stereopsis.

Schirmer Tear Test (STT)

- This test should be performed on **any** conjunctivitis/keratitis case not associated with obvious epiphora
- It should be carried out before any drops or stains are instilled in the eye
- The notched end of the strip is bent over (within the plastic so lipids from your skin are not transferred onto the strip – changing its absorption pattern) and placed in the lower conjunctival sac for 1 minute. The distance travelled by the tears is measured
- In dogs a single reading of <15 mm is suspicious of tear underproduction, while <10 mm is diagnostic when associated with changes consistent with *keratoconjunctivitis sicca*. Cats' normal STT are >10mm/wetting but can be much more variable (especially affected by stress). Values <5mm in conjunction with clinical signs are diagnostic for KCS. Horses normal STTs are 24+/-5mm/min.
- Rabbits normal STT is 5+/-3mm/min. Guinea pigs have normal readings of 2-7mm/minute (more than 70% are 3-4mm/min).

- Small eyes will have much lower readings, and in some eyes using a STT strip is simply not feasible. **Phenol red thread testing (PRTT)** is an alternative – small thread placed into eye and pH of tears causes change of thread colour from red to yellow-orange over a period of 15 seconds. Very useful in birds (e.g. Amazon parrots PRTT normal range 12.5+/-5mm/15secs).
- It is important to remember that anaesthetic agents will reduce tear production. Ketamine and ACP, halothane as well as glycopyrrolate and atropine can markedly reduce tear production.

Topical anaesthesia

A topical anaesthetic such as proxymetacaine may be required e.g. when looking for foreign bodies behind the third eyelid or measuring intraocular pressure – this should be applied after performing a Schirmer tear test. Previously it was advised to take microbiology swabs prior to applying topical anaesthesia as preservatives present were thought to reduce bacterial/viral/fungal cultures but this has been more recently disproved.

Ophthalmic stains

Fluorescein is a hydrophilic, lipophobic xanthene derivative which appears green in the tear film. It has an affinity for the corneal stroma, but not the corneal epithelium. Fluorescein demonstrates the loss of epithelium e.g. with ulcers or abrasions. It is best viewed with cobalt blue light (available in some ophthalmic instruments) or under a Wood's lamp as this wavelength excites the fluorescein and makes it more obvious. Use only impregnated strips or once only droppers (the multi-use solution can become contaminated – *Pseudomonas* colonisation has been reported in the literature)

- Wet the strip first then apply it to the **conjunctiva** (application to the cornea can give false positive result)
- Flush excess stain away as false positive results may be obtained if epithelialised irregularities in the corneal surface fill with stain, and given sufficient time and concentration of fluorescein, even a healthy cornea will eventually take up stain.
- N.B. **Descemet's membrane does not stain** – a non-stained central area may indicate impending perforation of the globe!

Fluorescein passage (Jones' test) – this is used to give an indication of duct patency. Usually it takes less than 5 minutes for fluorescein placed in the conjunctival sac to appear at the nostrils. The time taken is influenced by several factors:

- Volume of tears
- Length and diameter of the duct
- Function of the lacrimal 'pump' of nasolacrimal system (largely activated by eyelid blinks)
- Presence of any obstructions.

The detection of fluorescein is enhanced with cobalt blue or U-V light. A negative result is often obtained in brachycephalic dogs, possibly as a result of a more caudal nasal punctum being present – fluorescein may then be detected in the nasopharynx. Some species lack a nasolacrimal duct – e.g. amphibians, chelonians, whilst others drain to the roof of the mouth e.g. reptiles. A negative result does not confirm a blockage of the nasolacrimal duct, it is merely consistent with it. If a negative result is obtained, further investigation is required.

Rose bengal. This is a pink-red stain used to demonstrate dead or devitalised tissue. It can be very irritating to the patient. It can be useful for highlighting small dendritic ulcers, which are sometimes seen in feline herpetic keratitis, as well as viral or fungal keratitis in equidae. This stain is however rarely required in practice.

Conjunctival Swabs / Scrapes / Biopsy

Cytological analysis can provide rapid and helpful information for diagnosis and determination of appropriate antimicrobial therapy in many corneal and conjunctival diseases.

Extreme care must be taken if a deep ulcer (or descemetocoele) is present as heavy restraint or inadvertent trauma to the ulcer base may cause corneal perforation.

A cytobrush is ideal and will provide better cytological capture than a cotton-tipped swab, and tends to keep cell morphology intact. The cytobrush should be gently rolled on to the area of interest and then rolled against a clean dry microscope grass slide. The sample is then air-dried and Diff Quik© or Gram staining then light microscopy can be performed.

Scrapes are performed after the application of topical anaesthetic and the wrong end of a scalpel blade (or a Kimura spatula) can be used for these. Corneal scrapes using the back end of a scalpel blade will leave a corneal erosion/ulcer in most cases. Scrapes may be useful for directing antibiotic therapy and gaining clues regarding aetiology in some conjunctivitis cases. Can be especially useful in proliferative keratoconjunctivitis in cats, eosinophilic conjunctivitis/keratitis in horses, adnexal squamous cell carcinoma or if lymphoma (e.g. infiltrating the conjunctiva or third eyelid) is suspected. Bacterial or fungal culture may be more sensitive than cytology for identifying causative agents but the immediacy (and cheapness) of cytology results allows prompt and focussed therapy.

Impression smears using a clean dry microscope slide pressed gently but firmly against the abnormal area may provide valuable information on microbial involvement in adnexal disease (e.g. blepharitis, superficial pyoderma, adnexal squamous cell carcinoma).

Aerobic and anaerobic bacterial culture should be taken from purulent conjunctival or corneal lesions, or where the condition is not responding to treatment. Bacterial or fungal culture samples are best collected using a moistened (with sterile saline – this will enhance microbial capture) cotton-tipped swab against the tissue of interest before placing in the appropriate medium. If collecting samples for viral infectious organisms, a cytobrush can be superior to a cotton-tipped swab as viruses are usually captured intracellularly. The cytobrush can be placed directly into virus transport medium (for virus isolation) or into a plain tube (for PCR).

Biopsy is useful in some problematic cases. For conjunctivitis, the lower fornix is often the best site as this has the highest concentration of goblet cells. After repeated topical local anaesthetic, including by application to a cotton-tipped swab and holding onto the conjunctiva to sample, a small snip is taken, placed on card to prevent curling, and the sample is then placed in 10% formalin. Unfortunately, many cases reveal a non-specific lymphoplasmacytic conjunctivitis that is not enormously helpful, so this is best reserved for cases where discrete lesions or masses are present. Biopsies may be useful in cases of unusual corneal lesions, epibulbar masses and, occasionally, iris masses. These will require general anaesthesia and surgical magnification (loupes as a minimum). Corneal and scleral biopsies may be excisional in some instances.

Tonometry

Tonometry is the measurement of intraocular pressure (IOP). It is essential when handling cases of suspected glaucoma. Tonometry is also useful when monitoring uveitis cases – these can develop glaucoma as a complication, and the intraocular pressure also reduces in many cases of uncomplicated uveitis.

Schiøtz tonometer. This is an indentation tonometer and inexpensive. The patient's head is positioned vertically (nose to ceiling) and the Schiotz footplate is placed on the anaesthetised cornea. Multiple readings are taken to obtain an average / fairly consistent reading. Different weights may need to be added to neck of the plunger if the IOP is elevated. The IOP is read from a conversion chart. There are drawbacks to the technique; it is not entirely accurate and should not be used after intraocular surgery or diseased corneas. Corneal oedema also artificially lowers the IOP reading.

Applanation tonometry using e.g. the "Tonopen" (Carleton Optical) tonometer is one of the methods of choice. The technique measures the force required to flatten a given, small area of the corneal surface. It is fairly accurate for use in small animals and the patient can be examined in a normal sitting position (head horizontal). The equipment is expensive (~£1600) and a tonopen cover must be used on the tip **at all times** as service/repair is often only just short of the purchase price. Topical anaesthesia is usually required and it is important not to press on the globe through the eyelids (easy to do in horses and cattle when restraining) as an artificially increased reading will be obtained. Increased

systolic blood pressure (fear, stress) or pressure on the jugular veins and carotid arteries may also result in an increased reading. General anaesthesia may reduce IOP readings (usually by reducing systolic BP).

Rebound tonometry (e.g "TonoVet" – Tiolat) is a technique in which a small probe is fired from an instrument held close to the eye and perpendicular to the un-anaesthetised cornea (needs to be in a horizontal (or near horizontal) plane. The deceleration of the probe as it returns into the instrument is proportional to the intraocular pressure. The technique is reasonably accurate, in fact is more accurate in cats, but so far has only been calibrated for the dog/cat and horse (2 settings). As the probe is small it is ideal for use in small eyes and does not require topical anaesthesia.

Gonioscopy

A contact lens (commonly either the Barkan Lo-Vac or a Koeppe lens) is placed on the cornea. This alters the refractive index at the corneal surface and allows inspection of the drainage apparatus. This technique is important in the diagnosis and management of glaucoma especially where primary (inherited) glaucoma is suspected. It is also useful in the investigation of neoplastic, inflammatory and pigmentary disorders that may affect the drainage structures. The technique is challenging to perform with accuracy and requires practice. It is not necessary in all species as in some the drainage angle is visible directly (e.g. horses where the lateral and medial drainage angle can be observed directly, many birds, cats).

Fine Needle Aspirate Biopsy (FNAB)

This can be a very informative technique. A 5 ml syringe and an appropriate length fine-gauge needle are required. Remember to stop applying negative pressure whilst withdrawing the needle from the lesion. Indications for FNAB include exophthalmos (the approach can be transconjunctival or from behind the caudal molar tooth – CARE – do not perforate the globe), periocular dermal and some conjunctival masses. Avoid aqueo- and vitreo-centesis except where vision is under major threat or if the health of the patient takes precedence over that of the eye, e.g. in panophthalmitis. In the vast majority of cases FNAB will need to be performed under general anaesthesia. Samples may be submitted for culture / sensitivity and cytology. Ultrasound guidance can be invaluable in achieving a diagnostic sample and avoiding other major structures (e.g. in orbital disease).

Imaging Techniques

Radiography

Radiography is indicated in some cases of orbital disease e.g. trauma, neoplasia, osteomyelitis. It may also be useful if an intraocular foreign body, e.g. an airgun pellet, is suspected. Identification of the position of the globe may be enhanced by the use of a metal ring at the limbus.

Contrast studies may sometimes be indicated, most notably dacryocystorhinography – the injection of positive contrast in the nasolacrimal duct to outline abnormalities, especially useful in rabbits. Use an iodine-based preparation.

Radiography, e.g. of the chest and abdomen, should also be employed when investigating cases with possible systemic disease, such as neoplasia or infection.

Ultrasonography

Ultrasonography is useful for:

a) investigating orbital disease e.g. in cases of exophthalmos, enophthalmos, strabismus etc
b) assessing the status of intraocular structures (e.g. lens position, possible intraocular masses / foreign bodies, presence of vitreal abnormalities and retinal detachments) especially where opacities preclude direct visualisation
c) measurement of globe size (e.g. in cases of hydrophthalmos (stretched globe) secondary to glaucoma or microphthalmia (congenitally small eye) as part of a multiple ocular defect syndrome).

Various units are available. The main requirements are B-mode (A-mode may be useful for biometry), a sector (rather than linear) scanner and a probe of at least 7.5 MHz – ideally 10 to 20 MHz to enhance image quality. Larger eyes require lower frequency probes (e.g. horse, elephant etc) whereas smaller eyes require higher frequencies +/- stand-offs. Ultrasonography can be performed in most domesticated patients (dog, cat, horse) either fully conscious or using light sedation, but will require anaesthesia in most zoo/wild species (with possible exception of trained elephants). A topical anaesthetic is applied and viscous coupling gel is required to act as a small stand-off, allowing imaging of the anterior segment structures. Do not press the probe onto the eye but simply contact it to the coupling gel to get the best images. Ocular ultrasound of the elephant using running water as a coupling gel has also been published.

High-resolution ultrasound (HRU) (20-50MHz) and ultra-high resolution ultrasound biomicroscopy (UBM) (50-100MHz) have been used with excellent results for imaging the eye. HRU probes are available for a number of ultrasound machines and can be used in a similar fashion to that described above. UBM provides resolution of structures as small as 50um but only has a penetration of 4-5mm. In larger eyes these will give high-resolution images of the anterior segment only, but can allow distinction of corneal lesion depth (e.g. sequestrum) or information on structures that we cannot visualise (e.g. drainage apparatus beyond the pectinate ligament – trabecular and uveoscleral meshworks). With UBM, the probe tip is placed in a water bath of methylcellulose and saline filled eye-cup, and patient positioning is critical for obtaining a good quality image, so anaesthesia or heavy sedation is required. The expense of an UBM machine (~£60,000) limits the use of this modality.

More recent studies using an intravenous contrast agent (composed of 'microbubbles') have been used with brilliant results to identify vascularised structures within the eye. Vascularised structures will be highlighted by the flow of these bubbles (seen as hyperchoic signals) immediately after injection of the contrast agent. With respect to the eye, this has been especially helpful in distinguishing between posterior vitreal detachment and retinal detachment, vascularisation of ocular tumours (prior to planned biopsy) and persistent foetal vasculature (e.g. hyaloid artery) prior to planned cataract surgery.

CT / MRI Scanning

The use of computerised tomography (CT) and magnetic resonance imaging (MRI) is becoming much more commonplace. MRI is the technique of choice for imaging orbital disease and is invaluable when looking for optic nerve or CNS-related causes of blindness i.e. soft tissue lesions. CT is of particular use when imaging the nose and para-nasal sinuses i.e. bony lesions, which may be involved in some patients with peri-ocular and ocular disease.

Electroretinography (ERG) & Visual Evoked Potentials (VEPs)

An ERG involves measurement of retinal generated electrical activity in response to light stimuli. The technique is usually performed on an anaesthetised patient using standardised conditions (dark and light adaptation for set periods) and recording equipment when documenting retinal degenerations or functional defects. Clinically however, it can be useful for crudely assessing retinal function in the presence of clouded ocular media (e.g. cataract) prior to surgery, to rule out retinal degeneration that would make the surgery pointless. Under these circumstances a response to a bright white light flash/flashes is measured. More sophisticated measurements using light of varying intensity, wavelength and flashing flicker frequency are more often used in research environments.

VEPs represent the electrical activity generated in the visual cortex during light stimulation of the visual pathways. Reliability / reproducibility can be a problem with the technique and anaesthesia is required. Largely this is reserved for experimental studies and investigations of visual deficits in humans.

DNA Tests

An increasing number of inherited ocular conditions can be investigated by use of DNA testing. The genotype of patients with respect to numerous retinal diseases (such as choroidal hypoplasia in collie eye anomaly (CEA), and various forms of progressive retinal atrophy (PRA)) and some forms of cataract, as well as lens luxation, can currently be tested using PCR. Testing is performed on patient DNA obtained from either blood (5mls EDTA) or cheek swabs (cytobrush). The

tests are applicable only to specific conditions in specific breeds of dog so far, but given the incidence of potentially primary diseases in zoo/wild species (e.g. lens luxation in pinnipeds) this is an area of potential research/discoveries.

DNA testing is especially valuable for use in animals for potential use within breeding programs. Testing can identify affected individuals before breeding age and potentially before signs have developed in certain conditions. In autosomal recessive conditions (which most ocular conditions have so far proven to be) it also has the potential to allow the identification of affected, carrier and clear animals such that no animal is excluded from breeding provided their mate is appropriately chosen.

For current information on which tests are available, go to:
Optigen in USA at www.optigen.com and the Animal Health Trust in Newmarket at www.aht.org.uk. The AHT will also investigate 'non-commercial' disease (not just tests for mass markets), so collaborative work with your organisation(s) is open to you all. As always, we try to gain funding for research projects prior to undertaking expensive work but please feel free to approach us and we can identify suitable grant-giving bodies to target for any research.

Enucleation / Histopathology

Indications for enucleation include intractable pain, irreversible blindness with discomfort, and suspected neoplasia. It is essential to store any enucleated globe in formalin, even if histopathology costs cannot be justified immediately, as a vital resource to call on later. Histopathology of enucleated globes can be a very useful aid wherever the diagnosis is in any doubt, and I have received an unexpected result on cases where the globe was routinely submitted. So much in zoo and wild animal species is not fully described that, from a research point of view, an enucleated globe is a gold mine!

In summary, undertaking a methodical ophthalmic examination will help you unearth invaluable information about the eye and systemic disease. Practice is enormously helpful and recognising the normal appearance cannot be underestimated.