



Ophthalmology Clinical Guidelines For Independent Vet Care

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I.Ophthalmic examination

Equipment

The equipment available for examination of the eye may vary from situation. With care, the eye can be examined with relatively simple equipment and tests. A logical approach should be taken that is repeated each time an eye is examined.

Should a situation arise where equipment is required but is not available, arrangements should be made for these test to be performed. An example would be tonometry, or slit lamp examination. Similarly, in a routine veterinary consultation, there may be time or other constraints preventing a full ocular examination, if a full ophthalmic examination is required arrangements should be made, for example hospitalisation or repeat consultation.

Routine photography of eye cases is encouraged. With practice smartphones can take more than adequate especially if used with macro-lenses that be purchased very cheaply on the internet.

Suggested equipment for routine veterinary work would include:

- A room capable of being darkened
- A bright focal light source, for example a Finhoff transilluminator
- Ophthalmoscope
- Lens for indirect ophthalmoscopy (20 dioptre or Volk Pan Retinal are the most commonly used)
- Schirmer Tear Test Strips
- Ophthalmic stains and drugs, Fluorescein, Local anaesthetic (Proxymetacaine advised), Tropicamide, Phenylephrine, (Rose Bengal).
- Cotton buds – for example to allow manipulation of the third eyelid
- Smartphone or other camera to record images or facilitate seeking advice in the case of doubt
- Tonometer – not universally available but does facilitate the diagnosis and monitoring common and sight threatening diseases such as uveitis and glaucoma. Their use is actively encouraged. There are different tonometers available for veterinary use and seeking advice on their relative pros and cons is encouraged if required

To complete a full examination of the adnexa and eye in all cases further equipment is required, however investment in this equipment, both financially and in experience is needed and maybe reserved for those with a special interest in ophthalmic examination. Such equipment would include:

- Handheld slit-lamp biomicroscope
- Indirect ophthalmoscope
- Gonioscopy lens – Barkan or Koepe most commonly used

Further equipment is likely to only prove useful in a specialist environment, for example:

- Electro-retinography
- Specialist light sources for chromatic PLR assessment

Routine Examinations

With practice certain techniques are quick to perform and provide a high yield of diagnostic information and should be included in a routine clinical examination, for example at vaccination.

These include:

- Assessment of the blink reflexes, at both the medial and lateral canthus
- Menace response
- Dazzle reflex and pupillary light response with a bright light. Examination of the eye with the light source variably angled using the naked eye can be extremely useful
- Distant direct ophthalmoscopy – a very useful tool for assessing pupil size, identification and localisation of visual axis opacity (not just cataract) and fundic reflex
- Close direct ophthalmoscopy can be used not just to examine the fundus but by using the available lens can be used to help examine most intraocular structures.
- An otoscope head can be used to examine the adnexa under magnification
- Indirect ophthalmoscopy – for example subtle fundic changes can often be the first sign of systemic hypertension

Further examination should be performed if indicated any findings from above.

Suggested Protocol for Full Ophthalmic Examination

- Ensure a full clinical history, not just regarding the current problem. For example previous systemic disease, travel history, previous symptoms, information about close relatives.
- Remember to ask about vision at varying light intensities
- systematically work 'from in to out', examining the eye from the eyelid and orbit inwards, finishing with examination of the fundus.
- Always follow the same routine when examining the eye

Split the examination into two main parts, lights on and then lights off.

Lights-On Examination

Examination from a distance

- General observation of the animal's demeanour and appearance
- Head position for example the presence of a head tilt.
- Check for eye movements both normal (Eg oculocephalic reflex) and abnormal (Eg nystagmus)
- Check the eye position
- Examination from above to assess for exophthalmos and buphthalmos.
- Assess facial symmetry
- Assess the appearance of the lids – Eg TEL protrusion, blepharospasm, entropion, ectropion, obvious discharge

- Assess for the presence of a blink and the blink rate

Assessment of vision

- Menace response - a learned response therefore absent in very young animals. Care is required to avoid creating air currents.
- Obstacle course – the ability to navigate an obstacle course with either eye covered, these were repeated in varying lighting conditions
- Visual tracking of for example of a falling cotton wool ball or a treat
- Placing reflexes – useful in the cat
- Dazzle reflex
- Pupillary light reflexes (PLRs) direct and consensual, use the swinging flash light test (this maybe easier performed with the lights off). Remember the PLR is not a test of vision, it can be absent in visual eyes

Physical examination

- Palpate the surrounding tissues and retropulse the eye through the upper lid to assess for possible orbital space occupying lesions.
- Open the jaw and note any pain examine the teeth.
- Check for ocular discharge
- Assess the eyelids for obvious changes such as swelling, abnormal masses
- Assess the nictitating membrane, position and appearance.
- Evert the eyelids and examine conjunctiva - any signs of for example, inflammation, haemorrhage, chemosis. A scale for scoring hyperaemia can be useful.
- Sclera and episclera – are they a normal colour and appearance and is the vasculature normal
- Apply gentle pressure at the medial canthus to assess if nasolacrimal discharge is present.
- Assess the palpebral reflex both medially and laterally.
- Consider assessing corneal reflex
- Perform a Schirmer Tear Test (STT), assuming safe to do so (Eg there is no concern about corneal rupture). Remember to perform prior to application of any drugs.
- Perform tonometry, again assuming safe to do so
- In cases with blepharospasm application of topical anaesthetic may aide examination. Proxymetacaine is recommended by the authors.

Lights-Off Examination

Focal light source examination

- For example, using a Finhoff transilluminator
- screen for obvious abnormalities such as an anteriorly luxated lens
- assess cornea for opacity and abnormal appearance, illuminate from different angles
- check the corneal reflection – Normal reflection requires healthy pre-corneal tear film, epithelium and anterior stroma

- Assess the iris for symmetry, colour, shape and obvious anisocoria.
- Check for obvious aqueous flare
- Check the dazzle reflex and direct and consensual PLRs. Perform a swinging flash light test.

Distant direct ophthalmoscopy

- An extremely useful and simple test, often under utilised
- Opacities on the visual axis are highlighted against the tapetal reflex. These opacities can be anywhere from the tear film to the vitreous
- Assess the fundic reflex for symmetry (Eg retinal detachment will lead to a dull tapetal reflection, unilateral cataract)
- Assess the pupil size, if both eyes are examined at the same time anisocoria can be detected
- Parallax can be used to aide position focal opacities
- A useful tool to differential nuclear sclerosis from cataract

Slit lamp biomicroscopy

- Allows detailed, magnified examination of the adnexa and anterior segment
- Requires practice to master
- Allows for the assessment of the depth of lesions
- A logical approach is required, work from in to out, examine the:
 - Eyelids – noting abnormal hairs, margin defects, assess the nasolacrimal duct/s.
 - Nictitating membrane
 - Conjunctivae, sclera and episclera, assess the depth of any abnormal vessels – differentiate conjunctival from deeper vasculature
 - Cornea, use the slit to assess the depth of any lesion, utilise internal reflection to highlight stromal opacities. Purkinje images may help localise lesions.
 - Anterior chamber – slit beam examination was used to highlight any aqueous flare, cells or vitreal prolapse. Assess the depth of the anterior chamber.
 - Iris – check for masses, colour or texture changes, check iris structure, synechiae, ectropion uvulae
 - Lens – the slit beam used to identify the position of any lens opacity, check the anterior lens capsule for iris rest and synechiae.
 - Anterior vitreous, note opacities and signs of vitreal degeneration

Indirect ophthalmoscopy

- Useful to survey the fundus for lesions prior to direct ophthalmoscopy
- Mydriasis with tropicamide (unless contraindicated) should be used

Close direct ophthalmoscopy

- Remember to allow for your own refractive error if you have one
- If you select the lens that allows an object more than 6 metres away (infinity) to be in focus, this should be the lens you require to focus on the fundus in a normal emmetropic eye
- Examine the fundus in a systematic fashion in quadrants using the optic disc as a reference point

- The anterior structures were then examined by progressing through the positive lenses on the ophthalmoscope. This is easily performed following fundoscopy without moving away from the animal

Additional tests

Fluorescein should be performed to identify ulcers and assess the tear film break up time (see below)

Mydriasis with topical tropicamide 0.5% should be used to allow full posterior segment and lens, except in cases where intraocular pressure was elevated.

Phenylephrine is useful to blanch conjunctival blood vessels to help with the assessment of the depth of abnormal vasculature and in the assessment of Horner's syndrome cases.

Rose Bengal, stains devitalised tissue and is of use in keratoconjunctivitis sicca cases and in cats with suspected herpes keratitis. It is however irritant. Lissamine Green is less frequently used but maybe a better tolerated alternative.

Fluorescein

Fluorescein is not only useful for identification of ulcers. Other ocular uses include:

- Staining of damaged conjunctiva
- Seidel Test to identify aqueous leakage
- Tear Film Break-up Time (normal is 20 seconds or above, abnormal is below 5 seconds)
- Jones test to demonstrate naso-lacrimal patency
- Assessment of the epithelium at the edge of ulcers, can help identify under-running and also be used to monitor the epithelisation of healing ulcers

The use of single use pipettes (Minims) is preferred, fluorescein impregnated paper strips can lead to false findings when touched on the cornea. Use a blue light (a Woode's lamp may be useful) to accentuate staining.

Do not store and re-use opened pipettes, Pseudomonas can grow in these.

Rinse following application to avoid pooling of stain in epithelised ulcer facets.

Descemet's membrane does not stain

Corneal and conjunctival cytology sampling technique

- Use kumar spatula, cytobrush or the blunt end of a scalpel blade.
- Smear on to slide to get monolayer. Should see epithelial cells if a good sample.

- Bacteriology samples should be taken at the same time where bacterial infection of the cornea is suspected. Primary bacterial conjunctivitis is rare.

Check for:

- Bacteria – are they rods or cocci?
- Inclusion bodies -viral keratitis
- Fungal hyphae - one is diagnostic
- Lymphocytes, plasma cells (immune mediated keratopathy/conjunctivitis)
- PMN's (bacterial or fungal infection),
- Eosinophils (eosinophilic or parasitic keratitis).

Conjunctival biopsy technique

- Can often be performed in the conscious animal
- Apply topical local anaesthetic – multiple application +/- soaked cotton tip
- Samples are best taken from the ventral conjunctival fornix
- With fine toothed forceps grasp a fold of conjunctiva
- Cut a strip of conjunctiva from the ventral fornix rather than a snip
- Specialist stain (PAS) is required to assess goblet cell numbers
- Phenylephrine can be applied to limit haemorrhage

II. Digital photography

- Photography is an excellent way of recording lesions and enables sharing of knowledge and easy seeking of advice. Photography of all cases is to be encouraged.
- Modern digital cameras allow excellent quality macro photography with little practice or financial outlay. The use of flash allows critical evaluation of structures posterior to the pupil as well as the use of retro-illumination to highlight subtle corneal lesions.
- www.theeyephone.com for more help.

Which Camera?

Digital SLRs

Advantages

- Rapid focussing
- Minimal delay between shots
- Burst mode useful for moving patients
- Good quality lenses improve image quality
- Availability of dedicated macro lenses

- Standard macro capability of most included lenses often sufficient

Disadvantages

- Cost, size and fragility
- Built in flashes further from cameras “visual axis” thus often require more distant position to obtain good tapetal reflex

Compact digital cameras

Advantages

- Cost
- Often more robust,
- pocket sized
- Flash often much closer to optical axis allowing macro photography with tapetal reflection
- Ease of use

Disadvantages

- Slow to focus, slow to ready for next shot – however newer compacts better than ever before.
- Some noisy to focus which can reduce compliance when used at closest position - Not all have ability to select spot focus

Camera phones

Advantages

- Always with you
- Increasingly impressive camera technologies
- Allows rapid telemedicine referrals
- Flash often very close to lens and therefore allows use as a direct ophthalmoscope *where able to have camera LED continuously illuminated* allowing distant direct views and close direct fundic views Video function often readily available
Accessible for owners for use in monitoring where appropriate

Disadvantages

- Macro photography may be limited without use of additional lenses, these are cheap and readily available
- LEDs often very bright requiring adjunctive methods to reduce illumination intensity.

Features and settings required when choosing a camera

- Macro setting
- P (programme) setting – allows more control over cameras functions
- Spot or centre focussing selectable

- Force flash always on
- Disable red eye reduction facility
- Rapid, quiet focussing
- Shortest delay between photo's
- Burst mode useful on digital SLRs (rarely fast enough on compacts to be of use)
- Good quality memory card with rapid write speed
- Long battery life and / or option to use readily available batteries (eg AA)

Tips for taking ophthalmic photographs:

Flash, Flower and Focus

Flash:

Force flash always on, turn red eye reduction off

Flower:

- Macro setting on – look for the flower symbol.
- Zoom off (select widest angle lens allows)

Focus:

- Allow camera to focus lock before photograph taken, usually half depress button and wait until an audible signal or focussing grid or spot changes colour to confirm focussed.
- Practice- ensure comfortable with minimum focus distance by using e.g. text
- Spot or centre focussing selected (without cameras tend to focus on the eyelids)
- If autofocus focuses on corneal reflection then focus at lateral canthus, obtain focus lock before moving back to axial view of the eye to obtain focus at level of iris.

Other tips

- Try and reduce shutter speed to minimum by increasing ISO although note at some very high ISO settings image quality may reduce. This is rarely required if flash on
- Clean discharge and remove hairs from cornea
- Avoid holding lids open if possible as will obtain corneal reflection of hand and distort lid anatomy
- Avoid wearing white or red clothes as these will often cause striking corneal reflections.

Fundus photography

Fundus photographs are possible using a compact or DLR with an indirect lens, practice, patience and a dilated pupil. A light source can be secured to the lens of a digital SLR (e.g. pen torch and rubber band) or with a compact a head torch can aid in correct positioning.

Some smart phone cameras lend themselves to fundic photography eg iPhone 4S

Further information www.theeyephone.com has more information on using the smart phone to image the eye.

III. General principles of ophthalmic surgery

Surgical preparation of the eye

- Be aware that aggressive clipping of facial hair will cause micro-abrasions increasing the change of self-trauma and post-operative infection. Consider the use of scissors
- Prevent hair from entering the eye by applying carbomer gel to the eye and lids prior to trimming
- Surgical scrubs should not be used close to the eye or on the cornea
- Povidine iodine **solution** should be used not scrub
- 1:20 solution can be used on the eyelids
- 1:50 solution should be used where there is contact with the cornea
- Dilute accurately using sterile saline
- Clean for three minutes prior to surgery, consider the use of a timer
- Ensure the conjunctival fornices and under the third eyelid are cleaned, use a 5ml syringe to flush
- Should rupture of the globe be suspected consider preparing the cornea and conjunctival sac with sterile saline

Iatrogenic kerato-conjunctivitis sicca during anaesthesia

- STT can be affected for 24 hours after anaesthesia/sedation- effect more prolonged following long periods of anaesthesia
- During all anaesthetics lubricate cornea, a hyaluronate based preparation is preferable in the author opinion. Repeat lubrication during the anaesthetic
- Consider carefully taping the eyes shut during long anaesthesia
- Consider pre and post-operative lubrication in at risk dogs such as brachycephalic breeds

Atropine usage

- When used both systemically and topically, there can be an effect on the Schirmer Tear Test (STT)
- Remember when using for the treatment of uveitis associated with ulceration – these cases may have defective tear films, consider the use of lubricants (hyaluronate based products are preferred by the authors)
- Check STT prior to use in ulcerative keratitis if this is safe. Remember the discomfort of ulceration may elevate the STT in ulcerated eyes, compare readings between eyes
- use of frequent tropicamide may be safer, tropicamide is a poor cycloplegic
- Cyclopentolate may have less effect in the STT and also is a cycloplegic
- Atropine use can precipitate a glaucoma crisis, use with caution if glaucoma is a concern, for example in dogs with known goniodysgenesis

Monitoring of anaesthesia

- During ophthalmic surgery the head is not accessible for many of the routine anaesthetic monitoring signs

- Ensure consideration is given to enable adequate monitoring is possible, for example use of an oesophageal stethoscope, placement of pulse oximetry probes at alternative sites to the tongue. Consider the use of additional monitoring techniques

Illumination and magnification

- Ophthalmic surgery including lid surgery is delicate requiring good illumination and often magnification
- Consider the use of surgical loupes with head mounted illumination, alternatives include the use of an operating microscope. The sue of magnification requires practice which should be gained in a wet-lab situation

Correct use of instruments and suture

- Use appropriate instrumentation, fine instrumentation is required for fine surgery. Do not 'make do' with instruments designed for other procedures. Seek advice if you are unsure.
- Treat ophthalmic surgical instruments with care, they are rapidly blunted and damaged. Clean instruments carefully with appropriate cleaners. Avoid scrubbing. Package and store them before and after sterilisation
- Choose appropriate suture, for the eyelid 6/0 suture is appropriate
- Curved needles do not do pass in in straight lines. Let the needle guide you. No force required.
- Grip the needle correctly in the centre, never at the tip or end
- Rotate your wrist not your arm
- Place sutures accurately and evenly
- lock knots properly at the tension you require
- A figure of 8 suture should be used at the eyelid margin
- Always ensure knots do not abrade cornea

Rational use of antibiotics in ophthalmology

- Be aware of and apply BSAVA/Samsoc PROTECT guidelines
- Antibiotic resistance can occur rapidly and commonly
- Consider whether antibiotics are necessary? – are you performing a clean surgery? Are you using prophylactically or therapeutically?
- use cytology early and regularly.
- Consider whether bacteriostatic or bacteriocidal drugs are most appropriate
- Culture and sensitivity should be performed if bacterial infection is suspected
- Don't forget topical drugs are often epithelio-toxic Especially gentamicin
- Conjunctivitis is rarely a primary bacterial disease
- Avoid the temptation to change topical antibiotics when symptoms do not result, reassess for underlying causes

- There are no primary bacterial pathogens of the canine, feline or rabbit cornea (cattle for example have *Moraxella Bovis*), antibiotic use *uncomplicated* corneal ulcers is to prevent secondary infection.

Drug	Spectrum	Cidal/Static?	Notes
Ofloxacin	Broad	Cidal	Well tolerated, resistance emerging, 2 nd line drug
Fusidic acid	Narrow, G+ve	Static (Cidal at increase fq)	Licensed, low fq application SD-BD, may be irritant at higher fq
Gentamicin	Narrow, G-ve with some G+ cover, good activity vs <i>Pseudomonas</i>	Cidal	Licensed, Epitheliotoxic, <i>Pseudomonas</i> resistance emerges readily
Chloramphenicol	Broad but limited vs <i>Pseudomonas</i>	Static	Well tolerated, available in ointment and drops.
Doxycycline	Broad	Static	Given systemically excreted in tear film, metal chelator may have antiprotease activity. Probable immunomodulation.
Cephalexin	G+ and some G- activity.	Static at low dose cidal at higher doses	Given systemically. Good soft tissue penetration

IV. Eyelid surgery

Follow general principles described previously

Eyelid Laceration Repair

- Do not amputate any tissue – this is very vascular tissue and even sick looking tissue can recover. Removal of lid tissue may result in exposure keratitis.
- Sample wound edge for cytological examination to guide selection of appropriate antibiotics.
- Thorough flushing of the affected area with saline and a dilute povidone-iodine (2%) solution should be performed prior to closure
- Use 5-0 to 6-0 absorbable suture (always use the smallest available).
- Start with closing the eye lid margin using a figure of 8 suture
- Close remainder of wound in 2 layers: a deep layer just beneath but not passing through the conjunctival material in a simple interrupted or simple continuous pattern starting at the eyelid margin and a superficial layer through the skin with 4-0 to 6-0 non-absorbable suture material in a simple interrupted pattern. Sutures are usually left in place for 7 to 10 days
- Lacerations of the eyelids near the medial canthus may involve the nasolacrimal apparatus and affect tear drainage. The integrity of the duct should be tested by examination of the punctae, passage of fluorescein to the nose and nasolacrimal flush if required.
- Silicone tubing or monofilament sutures can be secured temporarily in to the proximal nasolacrimal duct used to maintain patency of canaliculi following surgical repair

Eyelid Tumour Removal/Eyelid Shortening

- A 'house shaped' excision is preferable to a wedge to allow better apposition of the tarsal plate at repair
- Should more than 1/3rd of the eyelid margin require excision then more complex repair may be required
- Should the nasolacrimal system be involved in the excision, a more complex repair may be required
- Use 5-0 to 6-0 absorbable suture (always use the smallest available).
- Start with closing the eye lid margin using a figure of 8 suture
- Close remainder of wound in 2 layers: a deep layer just beneath but not passing through the conjunctival material in a simple interrupted or simple continuous pattern starting at the eyelid margin and a superficial layer through the skin with 4-0 to 6-0 non-absorbable suture material in a simple interrupted pattern. Sutures are usually left in place for 7 to 10 days
- Always send excised abnormal tissue for histology

Modified Hotz-Celsus Procedure

- Often combined with other procedures to get best result, for example eyelid shortening in cases of eyelid overlength. As with many ophthalmic disorders consider the underlying cause of the problem
- The aim of surgical correction of entropion should be slight under-correction.
- Advise clients that more than one surgery may be needed to fully correct the problem – it is easier to take more tissue away at a later date than it is to put it back.
- Aim to remove a crescent-shaped piece of skin whose proximal edge is parallel to the lid margin.
- The initial incision is made with a number 15 scalpel blade 3-5 mm from the eyelid margin; its length depends on the amount of affected eyelid margin.
- Ensure there is sufficient marginal skin to allow suturing with no risk of the sutures rubbing the cornea.
- A second elliptic incision made parallel to the first joins the two ends of the first incision. The width of the piece of tissue to be excised should have been previously determined while examining the eye with local anaesthetic applied in the non-sedated patient to determine how much eversion is required.
- The skin is undermined and excised with scissors. The defect is then closed using 4-0 to 6-0 non-absorbable suture material in a simple interrupted pattern rolling the knot away from the lid margin.

V. Third Eyelid Surgery

Third Eyelid (TE) Flaps

- TE flaps provide physical support to a weakened cornea, potentially reduce contamination of the surface of injured corneas, and minimize tear evaporation from the exposed corneas of exophthalmic globes.
- TE flaps do not allow visualisation of the cornea.
- TE flaps do not allow topical medication of the cornea.
- TE flaps do not provide plasma-derived antiproteases to melting ulcers and are not a source of collagen to replace missing corneal tissue.
- They may be indicated in superficial non-healing and non-infected corneal ulcers where compliance with topical medication is poor, in ulcers caused by facial nerve paralysis, to reinforce a corneal graft and to protect a fragile cornea during transport to a specialist centre.
- TE flaps are contraindicated for melting corneal ulcers in all species because they do not provide a blood supply or fibrovascular tissues to the ulcer. In addition, they may make it impossible to observe the progression of the disease visually, impede the penetration of topical medications to the cornea, and cause the retention of inflammatory exudates adjacent to the corneal lesion.
- General anaesthesia is recommended for performing a TE flap

- The author's preferred method is to secure the third eye lid to the dorsolateral bulbar conjunctiva using 2-3 mattress or cruciate sutures using a 6-0 multifilament absorbable suture.
- Formation of a TE flap with attachment to the upper eyelid may be performed by placing horizontal mattress sutures through stents high in the upper eyelid via the dorsal fornix of the desired location. Direct the needle (4-0 suture) through the anterior face of the TE approximately 3 mm from the leading edge and then again through the fornix to the skin adjacent to the first bite. These sutures should pass through the cartilage but not be full thickness in the TE. While this technique allows the TEF to be untied and replaced, in practice this is poorly tolerated both by the patient and the fragile upper lid skin.

Prolapsed Nictitans Gland Surgery (Cherry eye)

- The nictitans gland must **NEVER** be excised
- Multiple replacement procedures have been described however the author's preference is for a microsurgical pocket technique, closed with a double layer of continuous sutures – this technique carries a very high (>95%) success rate.
- The pocket technique should always be performed with magnification using appropriate suture (6-0 multifilament polyglycolic acid) and instrumentation – contact the eye clinic for advice if required..
- Ensure all sutures are knotted on the outer surface of the third eye lid.
- Check for any concurrent scrolling of the third eyelid cartilage
- Warn owners that recurrence is possible following surgery if not performed microsurgically.
- Monitor for corneal ulceration following surgery,
- Ongoing monitoring the STT is advised following surgery

VI. Corneal Ulceration

Introduction

- The corneal stroma is slow to heal. Vascularisation speeds healing but increases scarring.
- The corneal epithelium is quick to heal. Ensuring a healthy tear film which is able to be distributed normally is essential.
- Infections may occur following any break in epithelium– and include a wide range of pathogens determined by environment and time of year.
- progression to complicated corneal disease can occur rapidly – particularly in the brachycephalic patient.
- Always try to identify and correct any underlying cause such as tear deficiencies or eyelid abnormalities

Classification of corneal ulcers

It is helpful to classify corneal ulcers into superficial uncomplicated or complicated. This is the key to avoiding progression and complications.

Superficial uncomplicated ulceration:

- No cellular infiltrates.
- Well adhered epithelial edge.
- Culture negative.
- Cytology pathogen free.
- No foreign body.
- No uveitis (NB reflex miosis associated with painful corneal lesions is not a true uveitis)
- Healing is RAPID – 3-7days once cause eliminated. Compare to a skin blister.

Complicated corneal ulceration:

- Infected stromal ulcers – stromal abscess
- Deep stromal ulcers
- Melting corneal ulcers
- Indolent ulceration – some will progress to corneal sequestrum (especially cats)

Suspect an ulcer complicated if:

- Not healed or showing significant healing in 3-7 days
- corneal neovascularisation (not a normal part of epithelial repair process.)
- significant corneal oedema,
- yellow – white cellular infiltration,
- evidence of keratomalacia (melting)
- mechanical obstruction to healing (foreign body, entrapped pathogens or necrotic tissue),
- abnormal corneal healing mechanisms (indolent ulcer),
- infected (bacteria, fungi or viruses),
- secondary uveitis
- in danger of perforation or has perforated.

If there is any doubt about the best management of a corneal ulcer, particularly a complicated one, expert advice should be sought as soon as possible.

Treatment of uncomplicated corneal ulceration

- Identification of cause main aim. *Ulcers heal unaided once cause removed.*
- Prevention of secondary infection and progression to melting with broad spectrum antibacterials advised - Chloramphenicol good first choice.

- Avoid the temptation to change topical antibiotics when an ulcer does not heal. *Antibiotics do not cause ulcers to heal and in most cases their use will slow epithelial growth, changing topical antibiotic is unlikely to result in an ulcer healing.*
- There are no primary bacterial pathogens of the canine, feline or rabbit cornea, their use in uncomplicated corneal ulcers in our patients is to prevent secondary infection.
- Use tropicamide or cyclopentolate to relieve miosis often associated with corneal lesions.
- Prevention self-trauma – E collar, systemic analgesia
- Consider use of bandage contact lens for pain control in large lesions.
- NEVER use topical steroids. Topical non-steroidal drugs are also epitheliotoxic and should be used with caution – note that topical NSAIDs are not analgesic. They are not indicated in ulcerative keratitis unless there is a concurrent anterior uveitis when they can be used with caution.
- Vascularisation is not a sign of healing in uncomplicated ulceration

Management of complicated ulcers

- Advice should be sought on the management of complicated corneal ulcers **early** in the disease process if there is any doubt on the most appropriate treatment
- All complicated ulcers should be cultured (with **appropriate** antibiotic sensitivity) and samples submitted for cytological examination
- Progressive ulcers or impending perforation - corneal surgery may be required
- Do not prolong medical treatment if progress is not being made in the hope of avoiding surgery, seek advice.
- Descematocele's are surgical emergencies
- Melting ulcers are medical emergencies
- Once eye perforated prognosis declines dramatically however it is rare to enucleate ruptured eyes in specialist ophthalmology units as multiple methods of corneal reconstructive surgery are now available thus advice should always be sought from an ophthalmologist before progressing to enucleation or euthanasia.
- Corneal surgery should only be performed in a setting where there is suitable equipment, instrumentation and experience.

Indolent ulcer treatment

Identification of cause **imperative**. Broadly divide indolent ulcers into :

1. SCCED (Spontaneous Chronic Corneal Epithelial Defect, previously known as the “Boxer ulcer”) Treatment – conservative treatment often successful in early cases, surgical treatment required in long standing cases. This is the “only” indication for the anterior grid keratotomy however note that this is NOT now advised as a first line treatment due to other lower risk treatment options – notably diamond burr debridement and the anterior punctate keratotomy.

2. Recurrent corneal trauma (foreign bodies, trichiasis) Treatment = removal of cause and conservative treatment. Surgery rarely required.
3. Iatrogenic e.g. steroids, long term topical antibacterials (preservatives and direct epitheliotoxic effects of drugs, ointments may also compromise epithelial growth) and rubbing sutures.
 - Client education important when suspect an ulcer is indolent.
 - Surgical treatment of indolent ulcers is rarely required except in cases of SCCED.
 - Surgical treatment is CONTRA-INDICATED unless the cause of the indolent ulcer has been established and where possible corrected.
 - Never use a surgical technique if the cause of the ulcer is uncertain

Main aims of management:

- Identify the cause of the ulcer and remove
- Provide appropriate antibacterial cover.
- Remove non-adherent epithelium (debridement – sterile cotton bud, normal epithelium will not debride)

Conservative management:

- Improve epithelial environment (steroids contra-indicated, gels and aqueous solutions preferable to ointments, serum to provide growth factors) particularly in brachycephalics and compromised corneas (e.g. KCS).
- If uncertain as to corneal stromal health then perform cytology at an early stage- beware neutrophils which may indicate early keratomalacia, bacteria should not be present.
- Reduce friction (bandage contact lens, partial tarsorrhaphies, caution with third eye lid flaps).

Surgical management:

- Where conservative treatment fails then surgical treatment to encourage epithelial attachment may be required (Diamond Burr debridement, anterior stromal punctures, anterior stromal grid keratotomy, superficial keratectomy).

Management of melting corneal ulcers (keratomalacia)

- Identify any underlying cause and treat if appropriate (Eg tear film disease, eyelid abnormalities)
- Avoid aggressive restraint, iatrogenic globe rupture is possible on handling
- Take care on blood sample/autogenous serum collection, collect from the contra-lateral jugular vein to try to avoid increasing the intraocular pressure of the affected eye
- Consider having frozen serum in the practice for patients where gentle serum collection is not possible (cross species use is possible, consider FeLV/FIV risk)
- Take corneal cytology and culture sample prior to treatment

- Examine corneal cytology samples in-house initially, identify the morphology of any bacteria to guide anti-microbial selection. Rods are more likely to be gram negative (potentially Pseudomonas), Cocci are more likely to be gram positive). Examine for fungal hyphae.
- Consider hospitalisation in a 24-hour care environment if appropriate to monitor and ensure compliance. If this is not possible owners should be encouraged to ensure drops are given overnight if practical
- Treat aggressively from the start with:
 - Broad spectrum antibiotic based on cytology and then culture
 - Autogenous serum, other anti-collagenases such as EDTA may be used, serum is the author's preference
 - Lubricants, hyaluronate lubricants are preferred, these compliment other treatments and should be used as an adjunct rather than a sole therapy
 - NSAIDS systemically if appropriate
 - Doxycycline may have an anti-collagenase effect
 - Further analgesia/sedation may be required if painful
- Monitor the response to therapy closely surgical intervention such as keratectomy and grafting may be required. Seek advice early in the disease process.

VII. Enucleation

Retrobulbar block

Significant risks are associated with this technique including retrobulbar bleeding, globe rupture and injection of local anaesthetic into the blood stream or the CSF leading to sudden cardiac or respiratory arrest. This technique is not recommended in inexperienced hands.

A pre-curved fine gauge $\frac{3}{4}$ " needle (23g or smaller) is passed either sub-conjunctivally or through the eye lid aiming to run the needle close to the globe prior to slow injection of local anaesthetic in the immediate retrobulbar space. Care should be taken to draw back prior to injection. An entry point dorsolateral to the globe is preferred.

This technique can provide excellent postoperative analgesia however careful and considerate dissection and the use of a retrobulbar splash block prior to closure can also provide excellent analgesia also.

Enucleation techniques

- Two approaches are described, the transpalpebral and subconjunctival techniques.
- Be aware that several microsurgical enucleation techniques may be available at your local ophthalmology clinic which offer increased cosmesis and post-operative facial sensation – make sure you know what they can offer.

Trans-palpebral enucleation technique

Where conjunctival sac pathology, corneal and or globe infection or neoplasia is suspected this technique is preferred as it allows the conjunctival sac and globe to be removed as one structure limiting orbital contamination.

Sub-conjunctival enucleation technique

Globe is removed prior to the lids and the conjunctival sac. Haemorrhage following globe removal can make identification of the conjunctival sac more difficult and great care needs to be taken to ensure all conjunctiva is removed.

Regardless of technique the aims should be to:

- Use appropriate instruments
- Use clean kit to close when infection or neoplasia suspected
- Surgically prepare both the skin and the ocular surfaces (including the conjunctival fornixes)
- Remove all conjunctival tissue
- Stay as close to the globe and the conjunctival sac as possible
- Remove the minimum amount of tissue
- Identify and section the extra-ocular muscles at their insertion
- Maintain the globe's integrity
- Avoid tractional forces on globe prior to section of optic nerve head (especially in cats)
- Avoid clamping optic nerve (especially in cats)
- Section the optic nerve leaving a small section attached to the globe
- Ensure the orbit is not contaminated during surgery. Irrigate with warm saline prior to closure
- Ensure adequate analgesia (consider retrobulbar splash block post enucleation or retrobulbar block prior to enucleation)
- Always send for histology or retain so that can
- Close the orbital opening using the remnants of the orbital ligament. (consider the use of a non-absorbable suture to limit orbital sinking)
- Close the skin wound so that primary intention healing occurs
- Consider the use of a short term postoperative stent to reduce post-operative swelling and epistaxis

VIII. Kerato-conjunctivitis Sicca (KCS) – 'Dry Eye'

Dogs

- A common disease often under diagnosed
- Breed predispositions exist for example West Highland White Terrier, Cavalier King Charles Spaniel
- Most cases have an immune mediated aetiology other causes occur, for example drug reaction, iatrogenic following anaesthesia. A full clinical examination should be performed.
- There has been an association to endocrinopathies (hypothyroidism, diabetes mellitus, hyperadrenocorticism), consideration should be given to these diseases

- Generalised systemic illness may lead to a temporary reduction in the STT
- All cases of conjunctivitis or unexplained keratitis should have a STT performed as a screen
 - A reading below 10mm/min should be considered diagnostic
 - A reading between 10 and 15 mm/min should be monitored or interpreted with the other findings of the ophthalmic examination
 - A reading of 15mm/min or more should be considered normal but in a painful eye lacrimation may be masking an otherwise low STT
 - Elevated STT reading may be an indication of ocular pain or irritation
- Evaluate the quality of the tear film for example the presence of mucoid strands
- Perform a fluorescein tear film break up time
- Early treatment gives the best long-term outcome, carefully counsel owners on the need for ongoing treatment and monitor
- Response to therapy can be slow

Therapy includes

- 0.2% Ciclosporin ointment – use twice daily and continued twice daily.
- Use concurrent lubricants, hyaluronate based products are the author's preference
- Educate the owners on sensible use of lubricants (for example extra application prior to periods of increased exposure on a windy day or a beach)
- Do not use long term antibiotic therapy

Options for refractory cases include

- Tacrolimus ointment – off licence use
- Parotid duct transposition – this procedure does not negate the need for eye drops and can carry a significant post-operative care burden. Careful client counselling regarding potential sequelae and complications is required. Should be performed only in a setting with adequate facilities and experience.

Cats

- The STT is more variable in the cat, look for symmetry in the readings gained from each eye
- Is not usually an immune mediated disease, therefore ciclosporin and other immunomodulants are less important in therapy, although they may have a place
- Often a sequela of Feline Herpes Infection

IX. Ophthalmic Emergencies

The following should be considered ophthalmic emergencies and should be given prompt treatment and early advice, or referral, should be sought.

- Globe proptosis
- Corneal foreign body
- Melting corneal ulcers
- Deep stromal corneal ulcers including descemetocoeles
- Acute uveitis
- Acute glaucoma

- Sudden onset ocular discomfort
- Sudden loss of vision
- Lens luxation
- Penetrating ocular injury (for example a cat scratch)
- Diabetic or other sudden onset cataracts

X. Globe prolapse

- Prompt treatment is essential to limit Wallerian degeneration of the optic nerve
- Assess vision by use of the direct and consensual pupillary light reflex, menace response and dazzle reflex. Loss of these indicate a poor prognosis
- Assess the vision in the fellow eye, traction injury to the contra-lateral optic nerve across the optic chiasm can occur
- Ensure the cornea remains lubricated whilst awaiting treatment
- Manipulate into place under general anaesthesia
- The palpebral fissure may require enlarging with a lateral canthotomy to facilitate replacement. Repair the canthotomy in 2 layers using a figure of 8 suture at the lid margin
- Perform a temporary tarsorrhaphy following replacing the globe, the author's preference is to use multiple single interrupted sutures of 6/0 material with the needle passing through the Meibomian gland openings of the lid margin to avoid a 'cheese wiring' effect
- The medial rectus muscle is the shortest and most easily damaged. Warn that a lateral strabismus is common following replacement.
- Monitor the cornea closely, exposure and a loss of corneal sensation may lead to severe corneal ulceration
- Check for other injuries, in the dog the injury often occurs during a dog fight, appropriate antibiotic cover should be considered. The cat has a deep orbit and proptosis usually only occurs as part of a significant trauma, orbital and other skull fractures are often present.
- If there is significant swelling the use of systemic steroids should be considered
- Appropriate analgesia should be provided

XI Glaucoma

- Glaucoma is a complex neurodegenerative disease, high intraocular pressure being one of the symptoms.
- Management can be complex and often disappointing
- Glaucoma is not only blinding but is painful
- Early advice or referral is strongly advised
- Should glaucoma be suspected and a tonometer not be available, **immediate** alternative arrangements should be made for tonometry to be performed
- Glaucoma can either be primary (either open or closed angle) or secondary to other intraocular disease. Identification of which sort of glaucoma is present should be established
- Gonioscopy should be performed

- If the eye is blind and painful, with a hopeless visual prognosis enucleation should be recommended. Exceptionally chemical ablation of the ciliary body or evisceration and intra-scleral silicone implants may be appropriate.
- All enucleated eyes should be sent for histology by a pathologist competent in ocular histopathology.
- If the eye has visual potential therapy should be offered
- Options for treatment are medical or surgical
 - Medical management involves the use of carbonic anhydrase inhibitors, Beta blockers, prostaglandin analogues and alpha 2 agonists
 - Neuroprotectants and anti-inflammatories may be appropriate
 - A full understanding of the drugs, their modes of action and their use should be gained before using them, seek advice if there is doubt
 - Aqueocentesis in the acute situation may be required
 - Surgical management options include anterior chamber shunt procedures and ciliary destructive procedures, usually by endoscopic photocoagulation
 - Surgical options are complex and careful counselling is required, they should only be attempted in settings with appropriate facilities and experience
- Appropriate management and monitoring of the second eye should be undertaken. Often glaucoma is a bilateral disease and careful client counselling is required