Current examination methods of the canine eye

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SUMMARY

The scope of the present paper is to give an overview of the current examination methods of the eye to practitioners who are involved in companion animal practice without being specialized in this field. The paper recommends a basic instrumentarium for ophthalmology practice that have been found to be useful by the authors. Further, practical approaches to ophthalmic examinations, as well as various examination methods used in the current ophthalmologic practice are discussed. A description of individual steps during ocular examination and a flowchart recommending the procedures are added in order to support systematic approach to case analysis.

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a) Focusing flash light or slit lamp provides oblique illumination for examination the anterior segment of the eye (conjunctiva, cornea, iris, anterior chamber, and lens)
b) Ophthalmic loupe, magnifying glass or binocular head loupe
c) Schiötz tonometer or other tonometer is a necessity for diagnosing uveitis and glaucoma
d) Set of lacrimal cannulae for examination a treatment of the nasolacrimal system
e) Cilia forceps for treatment of distichiasis
f) Small blunt forceps for lifting the third eyelid and for exploring the conjunctival sac for foreign bodies
g) Direct ophthalmoscope or biomicroscope for examination of the posterior segment of the eye (aqueous humour, fundus)
h) Schirmer test strips are inevitable for diagnosing keratoconjunctivitis sicca
i) Fluorescein test strips for diagnosing corneal defects
j) Rose bengal solution 0.5% or 1% for diagnosing keratoconjunctivitis sicca
k) Eye wash bottle to flush out discharge or stain from the eye
l) Tropicamide eye drops to dilate the pupil for lens and fundoscopic examination
m) Topical anaesthetic

As in any type of clinical examination, the detailed examination of the eye should be preceded by taking the medical history, such as client’s description of the clinical problem, previous illnesses or injuries, therapies, and any conditions potentially pertaining to the present problem. Numerous ophthalmic conditions may be age-related or occur in specific breeds and may be of hereditary origin. Knowledge of hereditary diseases and their breed predisposition, as well as information on animal’s pedigree are helpful. Client’s observations of the animal’s visual ability during the day and in the dark, as well as its ability to see moving and stationary objects may deliver useful hints to visual function of the patient.

Ophthalmic examination is usually preceded by general examination, because some systemic diseases may manifest ocular signs. A preliminary visual inspection of the globe and external ocular structures in day light or room light includes bilateral judgment of the visual axis and positions of the
globes, symmetry of the external ocular structures, position of the eyelids, size of the palpebral fissure, position of the membrana nictitans, presence of nystagmus, unequal pupils, blepharospasm, lagophthalmos, ocular or nasal discharge.

Adequate restraint is essential during the ophthalmic examination. The majority of patients can be examined without medication. Sedatives should be avoided whenever possible. If sedation is necessary, potential drug effects on intraocular pressure, miotic effects or protrusion of the nictitating membrane should be taken into consideration. In our clinic, we use medetomidine hydrochloride (Domitor) for sedation and atipamezol hydrochloride (Antisedan) as an antidote. Ketamine hydrochloride (11 mg/kg i.m.) can be used in intractable cats, atipamezol hydrochloride (Antisedan) as an antidote. Ketamine hydrochloride (11 mg/kg i.m.) can be used in intractable cats.

**Eye examination using a light source**

Closer eye examination should commence in a dimly lit room, in order to obtain information about pupil size of each eye and the transparency of individual ocular layers. The ocular adnexa, conjunctiva and cornea should be examined with direct and oblique illumination using focusing flash light or the direct light beam of the ophthalmoscope. Head light has proved to be practical, because it leaves both hands free and can be focused where you are looking. A magnifying glass (1.5-4 fold magnification) at a distance of 15-25 cm from the eye can also be recommended.

Symmetry of adnexa, eye-lids (entropion, ectropion) and eye-lid margins (trichiasis, distichiasis, chalazion), color and prominence of conjunctival and scleral vessels are evaluated. The cornea should be smooth, moist, transparent and free of vessels. It is examined for opacities, inflammation, pigmentation, degeneration, ulcerations, trauma or neoplasia. As cornea is sensitive to touch, it is recommended to instill topical anesthetic prior examination. Adequate restraint is essential during the ophthalmic examination. The majority of patients can be examined without medication. Sedatives should be avoided whenever possible. If sedation is necessary, potential drug effects on intraocular pressure, miotic effects or protrusion of the nictitating membrane should be taken into consideration. In our clinic, we use medetomidine hydrochloride (Domitor) for sedation and atipamezol hydrochloride (Antisedan) as an antidote. Ketamine hydrochloride (11 mg/kg i.m.) can be used in intractable cats, atipamezol hydrochloride (Antisedan) as an antidote. Ketamine hydrochloride (11 mg/kg i.m.) can be used in intractable cats.

**Staining techniques**

Fluorescein staining is one of the most common staining techniques, and indicated when there is evidence of corneal injury or other discontinuity of the corneal surface or in any painful eye with an unknown cause of pain. Corneal defects appear green, particularly when cobalt filter or Wood’s lamp (ultraviolet light) are used. Commercially available fluorescein strips are sterile and will not alter subsequent examinations. Fluorescein does not stain intact epithelium and does not penetrate through the epithelial barrier. Once the barrier is damaged, fluorescein penetrates into deeper corneal layers. The staining of the eye is transient and usually disappears within 45 minutes. Fluorescein is also used for assessment patency of the nasolacrimal duct (see later in the text).

Unlike fluorescein, rose bengal stains cells and their nuclei by staining red devitalized corneal and conjunctival cells. It is mainly used in for identification of corneal and conjunctival lesions associated with keratitis sicca. Rose bengal is used as 1% aqueous solution or as paper strips. One drop of a topical anesthetic should be instilled into the eye prior application of rose bengal in order to prevent irritation.

**Cytological, bacteriological and mycological examinations**

If conjunctival smears for cytology, bacteriology or mycology are requested, topical anesthetics should not be used, because they contain preservatives and may inhibit growth of bacteria or damage mucosal cells. For microscopic examinations, Giemsa staining is frequently used. Bacteriological culturing is recommended especially in chronic conjunctivitis. A sterile cotton swab moistened in sterile saline is used to transfer the smear material onto a sterile agar plate. Dry swabs can be used to mechanically debride an ulcer periphery, which is stained by fluorescein. Severe corneal ulcers, conjunctivitis resistant to treatment or eyes with chronic purulent discharge should be cultured for bacteria and fungi. A sterile metal spatula can be used for collecting samples for bacteriology or cytology.

**Schirmer tear test**

The test measures production of the aqueous portion of the tear film (Fig. 1). It is extremely helpful in diagnosing keratoconjunctivitis sicca. The Schirmer tear test (STT I) should be performed prior to using any medication or fluids. The test strips are sterile and will not negatively influence subsequent bacteriological or fungal examinations. This test is indicated in all patients with mucoid or purulent ocular discharge and/or chronic external ocular disorders. The test strip is placed behind everted lower eye-lid; approximately one third of distance from the medial canthus (use the correct side of the strip). The eye-lids are kept closed by examiner for one minute. After one minute, the strip is placed on the reading scale to obtain the STT value in millimeters. Values greater than 10 mm are considered...
to be physiological in dogs and cats, although some cats show „normal” values as low as 3 to 6 mm. Values between 5 and 10 mm are considered suspicious, and values below 5 mm are diagnostic for keratoconjunctivitis sicca. The test values have always to be interpreted in conjunction with the clinical signs.

**Ophthalmoscopy**

The most expeditious screening examination of the fundus can be achieved by using hand lenses (10-40 D) and head light (indirect ophthalmoscopy). For adequate visualization of the fundus, the pupil has to be adequately dilated. The examination needs to be done in a dark room. The lens is positioned 2.5 to 5 cm in front of the patient’s eye and the inspection is done at an arm’s length, moving the lens toward or away from the eye, until the entire lens is filled with the fundus image. The examiner sees an inverted picture. An advantage of this approach is a large field of view. The purchase costs, however, are quite high. Any lesion seen by indirect ophthalmoscopy should be evaluated by direct ophthalmoscopy.

Direct ophthalmoscopy is mainly used for examination of the ocular fundus (fundus is that part of the inner eye which includes the optic disc or papilla, the retinal vessels, tapetum lucidum and nigrum), even though it can also be used for other eye structures. For its relatively low purchase price, it is frequently used in general practice.

The direct ophthalmoscope has a focus wheel with lenses between + 40 dioptries (black) and – 25 dioptries (red). The most expeditious way of examination is to set the focus wheel at + 15 dioptries and using the large spot aperture. Working at the arm’s length from the patient, lesions anywhere in the cornea, anterior and posterior chambers, lens, or vitreous can be visualized. In the next step, the focus wheel is set to 0 and the examiner moves toward the patient until the fundus is clearly seen. At a distance of 2.5 to 5 cm from the eye, the focus wheel is used to obtain an optimal focus of the fundus. If a lesion is elevated from the fundus, more positive dioptries are needed to bring the lesion into focus and vice versa.

The appearance of the fundus of the dog is quite variable. The interpretation needs a certain level of experience and may be difficult for an untrained veterinarian. In view of numerous screening programs for hereditary eye diseases it is recommended to let the examinations be done by specially trained ophthalmologists in referral clinics.

**Patency of the nasolacrimal duct**

The lacrimal system is examined for excessive tearing or for hypofunction of tear secretion and for any swelling, redness or pain in the area of the medial canthus. When excessive tearing occurs, it has to be determined if the tearing is induced by partial or complete obstruction of the nasolacrimal system, by increased lacrimal secretion due to chronic ocular irritation as in distichiasis or trichiasis, or by a physiological increase in tear production as may occur with uveitis. The first diagnostic step is the test of patency of the nasolacrimal system. If dye is present, it can be concluded that the lacrimal excretory system is patent and epiphora is due to tear hyper secretion.

A drop of fluorescein solution is placed into the conjunctival sac. After two to five minutes, the nostrils are examined for presence or absence of fluorescein dye. If no stain is present in the nostrils, an obstruction of the excretory system can be assumed and irrigation of the nasolacrimal system in indicated. The irrigation is usually conducted under topical anesthesia. A curved nasolacrimal cannula (23-gauge in dogs and 25-gauge in cats) is routinely used. Flushing the nasolacrimal system is done in a restrained patient; sedation or anesthesia may occasionally be necessary, particularly in cats. The technique is as follows: Place the cannula on a syringe (1-2 ml) which is filled with water or saline solution. The cannula is gently inserted into the upper lacrimal punctum. The tip of the cannula tip should be directed medially and simultaneous movement of the syringe towards the dorsal midline of the patient’s head should direct the cannula into the lacrimal sac. As fluid comes out from the lower punctum, pressure on the lower punctum will force the fluid into the nasolacrimal duct. The fluid may come out of the nostrils or the patient swallows the fluid. If resistance is noted during irrigation, either the cannula is not in the lacrimal sac or an obstruction of the nasolacrimal duct is present. Further elucidation of the problem requests specific techniques, such as contrast radiography or cannulation of the whole nasolacrimal system.

**Intraocular pressure (Tonometry)**

Intraocular pressure (IOP) measurements are an inevitable part of eye examination whenever suspicions of glaucoma exist. It should be performed with the utmost care on eyes with corneal injuries or deep corneal ulcers. The most commonly used in general practice is the Schiötz tonometer. It is not very accurate, but it is sufficient enough for estimations of the IOP. After topical anesthesia, the corneal footplate of the device is applied to the cornea in a perpendicular manner and several readings are done, using 5 or 7.5 g weights. A table for conversion (delivered with the device) helps to determine the values in mm Hg. Ocular pressure values of 10 to 30 mm Hg are considered to be physiological in dogs, values of 14 to 26 mm Hg are considered to be physiological in cats. In the meantime,
newer devices are available on the veterinary market, such as TonoPen (Mentor Ltd.) or Tonovet (Tiolat Ltd.). They are easier to operate (Fig. 2), deliver more accurate results, but they are more expensive than the Schiötz tonometer. It should be kept in mind that the intraocular pressure increases in severely restrained patients (occlusion of the jugular veins) and that some drugs can also influence intraocular pressure (decrease by sedatives, increased by ketamine). Intraocular inflammatory processes, such as anterior uveitis decrease intraocular pressure.

**Gonioscopy**

Gonioscopy enables direct observation of the iridocorneal angle (pectinate ligament and drainage angle between iris and cornea) in the anterior chamber, by use of gonioscopic lenses (Franklin, Koepppe or Barkan). Besides detection of foreign bodies, tumors or exudate in the iridocorneal angle, this examination is crucial for reliable diagnose in patients with suspected glaucoma. Routine examinations are conducted in dog breeds with frequent incidences of glaucoma due to goniodysgenesis, such as the basset hound.

The examination is conducted under topical anesthesia and firm restraint. Sedation is required in some animals. The goniolens is carefully positioned on the cornea, and the lens-cornea interspace is filled with 1% methylcellulose (Franklin and Koepppe lens, saline with the Barkan lens). The iridocorneal angle is examined with respect to width, status of the pectinate ligament, inner and outer pigment zones, and the outer trabecular meshwork. The clinical classification of glaucomas (open angle, closed angle) and the decision to use medical or surgical treatment are based on gonioscopic findings.

**Slit lamp**

The slit lamp provides oblique illumination for examination the anterior segment of the eye, mainly of the cornea and lens. It offers advantages in detecting minute corneal opacities and exact localization of lens changes. Commonly used is a binocular slit lamp biomicroscope with options of adjustable 5-40 times magnification and a cobalt filter for highlighting changes in the fluorescein test. Its relatively high purchase price may be a limiting factor for general practice.

The lens can also be examined by direct ophthalmoscopy (slit beam aperture) in direct and oblique illumination for the presence of pigments, adhesions, opacities, or position of the lens (subluxation or luxation).

**Electroretinography**

Electroretinography (ERG) records electric potentials that arise in the retina after light stimulation at different light intensities, wave lengths, and exposure duration. The electroretinogram represents the composite activity of millions of retinal cells, extending from the pigment epithelium to the inner nuclear layer. It is used for studies of the retinal function (not visual function) and detection of early stages of the progressive retinal degeneration (the PRAs), before retinal changes can be seen by ophthalmoscopy. ERG is routinely used in genetic screening programmes for hereditary eye diseases, before extraction of hypermature lens cataracts, and in diagnosis of sudden acquired retinal degeneration (SARD) and the PRAs. ERG equipment is financially quite pretentious and interpretation of the records requires high level of experience. Specialized clinics use this method with increasing frequency. The European Society of Veterinary Ophthalmology makes efforts to standardize the ERG technique and to work out a global ERG protocol. Current recommendations are described in another paper in this issue of the EJCAP and can also be found in: Narfström K, Ekesten B, Rosolen SG, Spiess BM, Pericot CL, Ofri R - Committee for a Harmonized ERG Protocol, European College of Veterinary Ophthalmology. Guidelines for clinical electroretinography in the dog. Documenta Ophthalmologica, 2002, 105, 83-92.

**Radiographic procedures (X-ray)**

Orbital radiography enables identification of changes in the orbit and paranasal cavities. It is an essential method in traumatology.

**Dacryorhinocystography**

Dacryorhinocystography is a radiographic examination of the nasolacrimal duct using a contrast medium for localization of a possible obstruction.

**Computer Tomography and Magnetic Resonance Image**

CT and MRI offer a wide scale of diagnostic possibilities particularly in diseases of the orbit (Fig. 3).

**Ultrasonography**

Ultrasonography (USG) utilizes beams of acoustic energy and their echoes that localize and quantitate tissues of various densities within the eye and orbit (Fig. 4, 5). The indications for diagnostic
USG include localization of retinal detachments, intraocular and intraorbital tumors, and foreign bodies. This method is particularly useful in eyes with an opaque cornea. Devices with sector scanners of 7.5 or 10 mHz are recommended.

**Paracentesis**
Paracentesis of the anterior chamber may be indicated in uveitis of potential mycotic aetiology. Paracentesis of the vitreous humor (hyalocentesis) is indicated for the diagnosis of severe inflammatory processes in the posterior segment. These methods are used relatively rarely, even in referral clinics.

**Corneal Computer Topography**
Computer topography (keratoscopy) is used to exclude astigmatism. This method examines corneal curvature by means of concentric light beams (Placid rings). Final picture (distance between rings) is analyzed by a computer. This technique has been used in the development of contact lenses. Studies have shown that the corneal curvature in middle and small dog breeds is larger than in large dog breeds.

The sequence of examinations is quite essential, in order to proceed in a systematic manner and because some diagnostic procedures may adversely affect procedures that follow later. The following examination procedure is recommended:

**Tab. 1: Flowchart for ophthalmic examination.**

![Recommended procedure of the eye examination](image_url)
Assessment of visual function in pets presents a difficult problem. A common clinical test to assess vision is the „menace reaction“ conducted by passing the hand in front of the animal’s eyes to induce blink reflex or the „cotton ball test“ conducted by dropping a piece of cotton in front of the dog’s eye; animal’s response is evaluated. Occasionally, dogs and cats do not show any response with these tests. The response of the pupil can also be used as a sign of visual competence. Further method of assessment of the visual system is the maze test. The light intensity in the examining room can be varied, and alternate patching of the eyes may be helpful. Frequently, valuable information is obtained from the owner’s observations.

Information obtained by individual examination steps should be recorded in patient’s health record, which can be passed on to an ophthalmologist or as a part of the patient data sheet. A specific form for ophthalmologic examinations can be obtained from the European Society of Veterinary Ophthalmology.

Suggested reading