Ophthalmology and Unusual Pet Practice: What do I need and how to use it?

Ruediger Korbel
Clinic for Birds, Reptiles, Amphibians and Ornamental Fish
University Ludwig-Maximilian Munich
Sonnenstrasse 18, D-85764 Oberschleissheim, Germany

Summary

Certain avian and reptile specific capacities – like orientation, flying, catching prey – are closely bound to fully functional vision underlining the importance of avian ophthalmology. In addition, ocular lesions in birds and reptiles are an expression of systemic disorders more than in mammals and therefore represent an important diagnostic criterion. After a short review on anatomical and physiological peculiarities, commonly and newly developed routine ophthalmological examination procedures will be described. In principle avian and reptile ophthalmology uses techniques commonly used in mammalian ophthalmology, but miniaturized.

INTRODUCTION

In many birds and reptiles the eye is the most important sensory organ. The capacities of the avian and reptile eye are an adaptation to the specific way of life and habitats as well as physical activities that are closely bound to perfectly functioning vision (e.g. flying). Even partial impairment of vision that can be caused by any one of many known eye diseases, always has far-reaching consequences because compensation by other senses (including olfactory and acoustic sensory perceptions) is usually insufficient, if possible at all. Hence ornitho-ophthalmology occupies an important position in avian medicine (Murphy, 1987; Korbel, 2000; Kern, 2007; Korbel and Bohnet, 2007; Korbel and Weise, 2007).

OPHTHALMOLOGICAL EQUIPMENT AND EXAMINATION PROCEDURE

Minimum requirement for basic and general purposes

- Focused light source with magnification lens ("Finoff transilluminator")
- Instrumentation for manipulation of the eye lids (Graefe hook)
- Lacrimal cannula (Anel)
- Topical anaesthetics: Proxametacain, Oxybuprocain (duration of action approx. 7- 8 min), or Lidocain (duration of action approximately . 17 minutes)

Advanced Equipment

- Slit lamp (magnification x 5 – x 15, better x 20)
- Monocular direct ophthalmoscope with 15 D lens or even better
- Head band ophthalmoscope with 30 and 78 D lens (additional aspherical 40, 60, 78, 90 D)

General examination procedure - Adnexal structures and anterior eye segment

- Without restraint
  - Assessment of visus via food intake, reluctance to fly, orientation
- With restraint
  - Examination of the ear opening
  - Pupillary reflex
  - Examination of the anterior eye chamber with lateral illumination
  - Examination of the anterior eye chamber with lateral transillumination
  - Examination of the anterior eye chamber with retroillumination

Equipment and procedure for specific examinations

- Slit lamp biomicrography
- Gonioscopy (Lovac lens), examination of the angulus iridocornealis with the pectinate ligamentum. Aetiological assessment of primary/secondary glaucoma status.
- Tonometry. Estimation of the intraocular pressure (IOP). Use electronic short time acting tonometer or Schioetz - Tonometer in raptors. Standard reference values measured with an electronic tonometer calibrated for avian eyes, range from 9 to 22 mg Hg and are available for 42 species from 7 orders. Standard reference values for psittacines range from 12-15 mm HGg for nocturnal birds from 9-12 mm Hg, for various poultry species intraocular IOP values are as high as 22 mm Hg, for reptile species 10-18 mm Hg. Minimum corneal diameter for reliable value is 9 mm. Reference values for newly developed tonometers (Tonovet^{R} and Tonolab^{R}) will be available soon.
- Schirmer-Tear-Test. Test for the estimation of the lacrimal function (no scientific based data for reptiles available). Use standardised filter strips of 2, 3 and 5 mm width. Standard reference values using filter strips of various width for 42 species from seven/ orders showing a wide range of interspecific variations are available. Strigiformes show conspicuously low values.
- Electroretinography. Measurement of retinal function by recording electrical potentials after light stimulation. This technique gives no information about the visus, only on retinal function. Basic principles of electroretinography for routine examination have been established. Indications are retinal disorders and diotric apparatus opacities.
- Laboratory examinations include bacteriological examination of the conjunctival flora. Physiological bacterial flora contains gram positive bacterias, while gram negative bacterias are an indicator for pathological conditions. Standard reference values have been worked out for 42 different bird species from eight orders.

Mydriasis and air sac perfusion technique for birds

Induction of mydriasis is indispensable for the examination of the posterior eye segment (ophthalmoscopy). A major difference between the mammalian and the avian eye however is that the commonly used mydriatics of atropine and tropicamide have little effect in the avian patient due to a striated rather than smooth intraocular musculature. Therefore the iris is partly under voluntary control. It is essential to have a dilated pupil (mydriasis) to perform an ophthalmoscopy, i. e. examination of the posterior eye segment including the vitreous, the fundus and the pecten oculi. Therefor neuromuscular blocking agents such as d-Tubocurarine (3%; 0,01 - 0,03 ml; 1) may be used. As the drug penetrates the cornea insufficiently it has to be administered directly into the anterior

chamber by paracentesis using a 27-30 gauge needle. This technique includes substantial risk for injuries of intraocular structures causing i. a. hyphaema, increasing intraocular pressure (IOP), transmission of conjunctival flora with consecutive uveitis and systemic side effects if larger dosis than recommended are used. Therefore it is recommended to use this technique just for therapeutical reasons (prevention of posterior of anterior synechia resulting from uveitis and consecutive miosis).

An alternative for routine induction of a mydriasis as well as for intraocular surgery and surgery in the head area is the air sac perfusion anaesthesia. In principle APA consists of a retrograde perfusion of the lung-airsac-system through a perfusion catheter via the left caudal thoracic airsac. As a carrier gas 0,3 l/min/kg BW of O2 is used. Effect of nitrous oxide application are a low potentiation of isoflurane of approximately 11 % and thus improvement of the circulatory situation and release of the surgeon from isoflurane waste gases. Higher perfusion rates than recommended result in respiratory alkalosis due to a CO2-wash-out-effect causing severe cardiac arrhythmias. Isoflurane maintenance concentrations vary - dependent of different bird species - between 1,0 Vol. % to 2,4 Vol. % (*Columba livia* Gmel., 1789). Pulsoximetry is indispensable as APA causes a reversible apnoe due to reduced CO2 partial pressure causing a missing stimulation of the respiratory centre. Advantages of APA, a long period anaesthesia, which is used for routine ophthalmoscopy, electroretinography and head surgery in birds, are free surgical access to the head for intraocular surgery, stable or decreasing intraocular pressure and reversible apnoea with an absolute immobilisation of the patient. Achievement of mydriasis for ophthalmoscopy may be optimized by systemic administration of 0,2 mg/kg BW of the muscle relaxant Vecuronium which allows a complete mydriasis and areflexia with a lag period of approx. 26 sec. and a duration of 25 6 min. in pigeons (*Columba livia* Gmel., 1789) and a reduction of isoflurane consumption of approximately 25 % at the same time. This technique allows examination even of the very lens periphery with the annular pad and the extreme fundus periphery.

APA - PRINCIPLES

- Anaesthesia induced mydriasis and free surgical access to the head area
- Perfusion of lung-airsac-system with oxygen-(nitrous oxide)-isoflurane or sevoflurane mixture
- Retrograde perfusion via left caudal thoracic air sac using a specific air sac catheter
- Induction of a reversible apnoea due to lowering of the CO_2-partial pressure with subphysiological values (below 48 mm Hg; no stimulation of respiratory center)
- Modified anaesthetic machine with low flow flowmeter (0.01-0.5 l/min)

APA – Performance

- Carrier gas O_2
- Induction: Head chamber
- Maintanance: Air sac catheter
- Isoflurane concentration: 1.0 - 2.7 Vol.%
- Monitoring: Pulse oximetry (!, no respiratory movements), reflex score, blood gases, body temperature

APA – Advantages

- Routine method for ophthalmology and head surgery
- Benefits of inhalation anaesthesia and long period anaesthesia
- Free surgical access to the head
- Stable or decreasing intraocular pressure (IOP)

- Reversible apnoea – absolute immobilisation of the patient
- Achievement of mydriasis for ophthalmology

OPHTHALMOSCOPY IN BIRDS AND REPTILES

Ophthalmoscopy, a technique to examine the fundus oculi (a clinical term, describing ocular structures, which are situated behind the lens) using a focused light beam reflected from the fundus, can be carried out by both monocular and binocular and direct or indirect ophthalmoscopy in combination with double aspherical ophthalmoscopic lenses (at 30, 40, 60, 78 and 90 diopters (D, Volk Bio II) refractive power. In all cases indirect binocular ophthalmoscopy using a head ophthalmoscope is advisable. A 30 D lens is used in birds with larger pupil diameters (nocturnal and diurnal raptors), ophthalmoscopy of most reptile species, pigeons and larger psittacine birds requires an 78 D lens, those in avian and reptile species with a pupillary diameter smaller than 4-5 mm the use of a 90 D lens. Alternatively, monocular indirect ophthalmoscopy (such as an panoptic monocular ophthalmoscopy by Welch Allyn® may easily performed in all reptiles and birds, especially in smaller species. It should be pointed out that within a long term survey including more than 32% of traumatised birds showed haemorrhages in the vitreous body originating from lesions of the pecten oculi. Thus ophthalmoscopy is obligatory in traumatised birds.

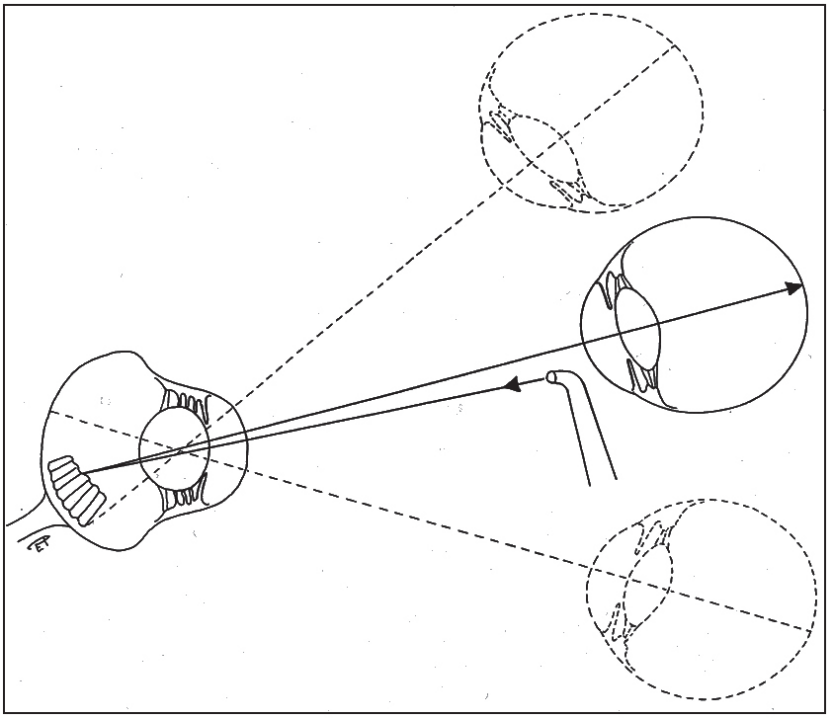

Fig. 1: Optical principles of the (monocular direct) ophthalmoscopical examination of avian eyes. Per definition "ophthalmoscopy" is the examination of ocular structures situated behind the lens, using a focused light beam directed through the pupil and performing the examination using light, reflected from the fundus oculi. As a rule, a nearly coaxial direction of the light beam directed through the (dilated) pupil (Mydriasis) of the patients eye (left) on the one hand and the reflected light beam from the patients fundus to the examiner's eye (right; viewing axis) on the other hand is indispensable in order to project an image on the examiner's retina (taken from Korbel and Bohnet, 2007).

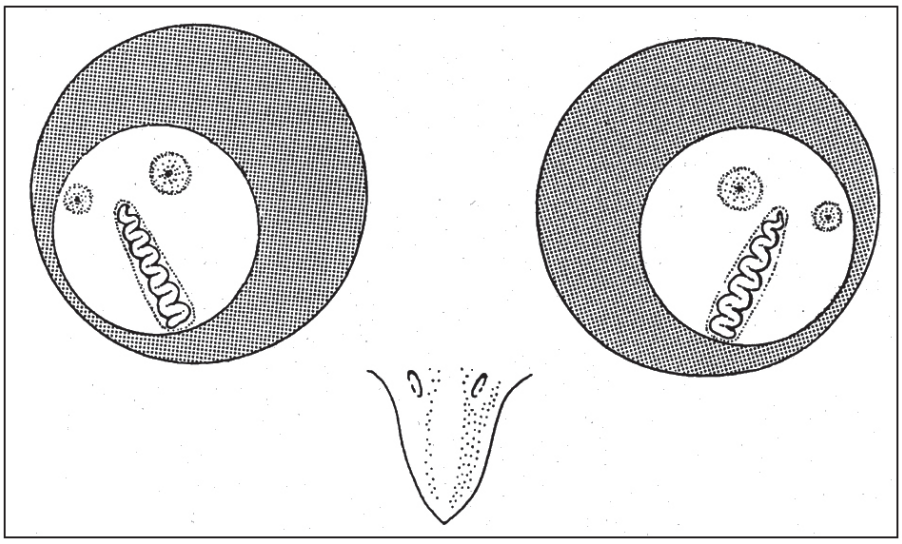

Figure 2: Topograpical landmarks within the avian fundus with the pecten oculi respectively conus papillaris in reptiles and the central and temporal fovea. Accesible viewing field (bright area) using monocular direct ophthalmoscopy (taken from Korbel and Bohnet, 2007).

REFERENCES

Kern TJ. 2007. Exotic animal ophthalmology. In: Gelatt K. N. (ed): Veterinary Ophthalmology, Vol. 2.; Ames, Iowa, USA pp. 1370-1405.

Korbel RT. 2000. Disorders of the posterior eye segment in raptors – examination procedures and findings. Raptor Biomedicine III. Lake Worth/FL: Zool Education Network pp 179-194.

Korbel R. 2011. Gonioscopy in birds. Proceedings of the 11th AAV Conference, Madrid pp 218-224.

Korbel R. T., Bohnet N. 2007. Ophthalmological examination of the avian eye – an interactive CD-ROM. Munich, Germany.

Korbel R. T., Weise H. 2007. Light related influences on various body parameters in broiler chicks. Proceedings of the Annual Conference of the Association of Avian Veterinarians, Providence, Rhode Island, USA. pp. 278-282.

Korbel R. T, Reese S, Liebich HG. Sehorgan. 2008. Bildgebende Verfahren. Klinischer Untersuchungsgang. In: König HE, Korbel R, Liebich HG. Anatomie der Vögel - Klinische Aspekte und Propädeutik Zier-, Greif-, Zoo- und Wildvögel sowie Wirtschaftsgeflügel. Stuttgart, New York: Schattauer pp 229-256, 277-284, 285-290.

Korbel R, Rinder M. 2011. Ophthalmological findings in birds affected with PDD. Proceed 11th AAV Conference, Madrid pp 215.

Liepert A, Dorobek K, Hufen H, Korbel R. 2011. Application of 3D Ultrasonography in clinical avian ophthalmology. Proceed 11th AAV Conference, Madrid pp 212-213.

Lierz M, Korbel R. 2012. Anaesthesia and analgesia in birds. Journal of Exotic Pet Medicine 21, 44-58.

Murphy CJ. 1987. Raptor ophthalmology. Compendium on Continuing Education for the Practicing Veterinarian 9, 241-260.

Reese S, Korbel R, Liebich HG. 2009. Auge. IIn: Anatomie der Vögel – Zier-, Wild- Greif- und Zoovögel sowie Wirtschaftsgeflügel – Lehrbuch und Atlas für Studium und Praxis. 2. Aufl. König H, Korbel R, Liebich HG (Hrsg). Stuttgart, New York: Schattauer pp 229-251.