# Avian Ophthalmology in an Egg Shell - Part 1

**Anne Gemensky Metzler, DVM, MS, DACVO**
**Clinical Assistant Professor**
**The Ohio State University**

## Avian Ophthalmology References

- Pet Birds
  - Willis AM and Wilkie DA. Avian Ophthalmology Part 1: Anatomy, examination and diagnostic techniques. *J Avian Med Surg* 1999;13(3)160-166. Part 2: Review of ophthalmic diseases. 1999;13(4):245-251.
  - Karpinski LG. Ophthalmology. In: Harrison & Harrison, eds. Clinical Avian Med and Surg. WB Saunders, 1986: 278-281.
- Raptors
  - Murphy CJ. Raptor ophthalmology. *Comp Cont Educ* 1987;9(3):241-260.

## Anatomy & Physiology
## Bird's eye view …

- "A bird is a wing guided by an eye."
  - Rochon-Duvigneaud: *Les Yeux et La Vision Des Vertebrates*
- How do birds see?
- Unique anatomy
- Examination
- Avian diseases
- Avian surgery

## Bird's eye view…

- Color vision (tetrachromatic)
- Dim and bright light vision
- Pattern recognition
- Excellent visual acuity
- Spatial frequency of 160 frames/sec
  - High resolving power for detection of motion

## Bird's eye view …

- Visual acuity/ability to resolve differs by species/behavior
- Raptors: can resolve small objects/rapid motion
  - Falcon: high visual acuity during 150 mph swoop, but only in dorsal retina
- Raptor acuity = 2.5X greater than human!

## Bird's eye view…

- Diving birds: have ability for high accommodation w/ sudden change in refractive index under water
- Poultry: less visual acuity
  - "Lower visual field myopia" allows chickens to keep ground in focus during other tasks
- Some birds see UV radiation or polarization of light

## Avian Globe - Size

- Occupy greater cranial volume than other vertebrates
- Often ≥ 50% of cranial volume vs. ≤ 5% in human
- Ostrich
  - Largest globe of land animals (50 mm)

## Globe - Size

- Globes so large, nearly touch at midline of skull

- BIG EYES, SMALL BRAIN!!!

## Globe - Shape

- Diving, small raptors, pets - flat
- Lrg. diurnal - globular
- Owls - tubular

## Globe - Position

- Varies with type of bird
- Raptors: more forward/increased binoc. vision & acuity
- Pet birds/poultry: more lateral/decreased binoc. vision & acuity

## Eyelids/Conjunctiva

- Very thin, delicate
- Few feathers (filoplumes)
- No meibomian glands
- 2 puncta -- NL duct -- nasal cavity
- Conjunctiva similar to other species

## Nictitans

- Drawn from **dorsonasal** aspect over cornea
- Pyramidalis m.
- Quadratus m.
- Innerv. by CN 6
- Rapid, voluntary mmt.

## Nictitans/Orbital Glands

- Blinks more often than eyelids
- Can be transparent
- No GNM proper
- LG inferotemporal to globe
- Harderian gland post. to sclera near NM

## Cornea

- Thinner than mammals
- Has Bowman's mb
- Tear film viscous

## Cornea-Accommodation

- Crampton's musc. contraction flattens cornea to aid accommodation

## Sclera

- Scleral ossicles:
  -10-18 bony plates
  -Anterior location
  -Origin of ciliary m.
  -Improve accommodative ability
- Cartilagenous plates
  -Post. to ossicles
- Os nervi optici

## Iris

- Lipochrome pigments
- Color varies w/ species, age, sex

## Iridal Musculature-Constrictor

- Striated muscle
  *1degree constrictor
  *voluntary control
  *rapid response
- Smooth muscle
- Myoepithelium

## Iridal Musculature-Dilator

- Myoepithelium
  *1degree dilator muscle
  *Lines posterior side of iris
- Striated muscle

## Pupil Responses

- Due to 100% ON decussation, consensual PLR is questionable
- May obtain false consensual PLR by stimulation of contralat. eye through thin intraorbital bony septum
- Birds can voluntarily dilate or constrict pupil, although more likely to constrict in the face of light

## Pupil Dilation - RX

- Parasympatholytics - only partial effect
- **Vecuronium 0.8 mg/ml
  - 1-2 drops topically q 2 min x 2 treatments
  - Most consistent, best mydriasis, least side effects
  - Poss. mild/transient side effects in Amazon parrots
- Pancuronium
  - Inconsistent effect
  - Severe side effects (+/- death) in cockatoos

## Pupil Dilation - RX

- D-tubocurarine topically
  - 3 mg/ml in 2% benzalkonium 3-4X in 20 min.
  - Not effective in all species
  - Can also be given intracamerally w/o the benzalkonium for more consistent effect
- Alcuronium
  - Effective, but side effects=eyelid, neck, limb paralysis

## Ciliary Body

- Supports lens
- Ciliary processes contact lens capsule
- Accommodation
  - Amt. varies by species/function
- Produces aqueous

# Lens/Accomodation

- Very pliable
- Annular pad
  - Equatorial radial fibers
  - Largest in birds w/ largest accom. range
- Capable of large change in diopters/power
  - Esp. raptors

# Lens/Accomodation

- Brucke's & Crampton's muscles
- Contraction of these ciliary muscles leads to flattening of lens leads to increased lens power

# Pecten

- Pleated, pigmented structure over ONH protruding into vitreous
- **Functions:**
  -Aqueous production
  -Thermoregulation
  -Navigation
  -pH, oxygenation

# Choroid

- No tapetum
- Highly vascular
- Supplies the retina

# Retina

- Avascular
- High density of rods and cones
- Oil droplets in cones
- Well-developed color vision
- 1:1 ratio of RGC's to photoreceptors
- Excellent visual acuity

# Retina - Fovea

- Cone-rich, rod-free pit
- Dorsotemp. to pecten
- **Functions**:
  -High resolution
  -Binoc. fixation
  -Depth perception
  -Color perception

## Retina - Fovea

- Most domestic species are afoveate
- Some are monofoveate (owl)
- Some are bifoveate (diurnal raptors, hummingbirds, passerines)

## Retina - Fovea

- Bifoveate Theory:
  -Temporal fovea for binoc. vision
  -More medial one for monoc. vision
- H/P: area of thinning of retina

## Optic nerve

- ONH covered by the pecten
- 100% decussation

## Orbit/Extraocular Muscles

- Tight fit of globe/orbit
- EOM thin/poorly developed
- Posterior aspects of globes nearly touch
- Ventrolat plexus

## Orbit/Paranasal Sinuses

- Thin bony septum b/t orbits
- Sinuses intimately associated with orbits
- Sinus disease can cause ocular signs

# EXAM / DIAGNOSTICS

## Examination & Diagnostics

- Systematic approach in any species
- Vision, pupil symmetry, cranial nerves
- Orbit (exophthalmus, enophthalmus?)
- Adnexa (feathers, lids, conjunctiva, NM)
- Anterior segment (cornea, AC, iris, lens)
- Posterior segment (vitreous, pecten, retina)
- Sinuses / General physical exam

## Tear Production

- Cut Schirmer Tear Test strip lengthwise to reduce width from 6 mm to 4 mm (fit better in fornix)
- **Normals for Psitticines**:
  -Large (i.e. African Gray) = 8 +/- 1.5 mm
  -Small (i.e. Conure) = 4 +/- 1.0 mm

## Examination & Diagnostics

- Culture & sensitivity and cytology:
  -Conjunctivitis or keratitis
  -Calgiswab (smaller than culturettes)
  -Cytology brush

## Conjunctival Flora

- **Psittacines**:
  -Bacterial cultures (+) in 83%
  -Fungal cultures (+) in 14%
  -*Staph* and *Corynebacterium* sp. (Gram +)
- **Non-psittacines**:
  -Mixed bacterial population more common
- **Struthioniformes and Anseriformes**:
  -Gram (-) bacteria found more often

## Intraocular Pressure (IOP)

- Reproducible readings on corneas ≥ 9 mm
- Apply 1 drop topical anesthetic
- Use Tonopen®
- **Normals: 9 - 16 mmHg**

## Examination & Diagnostics

- Anterior segment
  - Small eyes--**handheld slitlamp** or other mag. device
- Posterior segment
  - Small eyes--difficult to pharmacologically dilate
- **Direct ophthalmoscope**
  - Mag: GHO=10X, Pigeon=32X, Budgie=70-80X
- ****Indirect ophthalmoscopy--tricky!**
  - 90 D lens (fits small pupil, little mag., panoramic)

## Examination & Diagnostics

- Evaluate for periorbital swelling as evidence of sinusitis/sinus abscess
- Discharge from nostrils on cere
- Skull rads, CT scan, MRI

## Questions???????