Age associations and retinal structure-function relationships in companion dogs

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Background/Significance

The retina is part of the central nervous system (CNS) and is similarly vulnerable to functional impairment due to age-related neurologic decline. Investigation of age-related retinal structural and functional decline is straightforward and noninvasive compared with the brain. Study of retinal aging may provide an efficient way to longitudinally monitor the CNS effects of aging.

There are similarities between the retinal topography of the retina of dogs and humans (Fig. 1).[1,2] Dogs are a promising sentinel species in which to study risk factors for neurologic aging. Companion dogs are exposed to similar lifestyle and environmental risk factors as their cohabiting humans, and experience age-associated diseases within their relatively shorter lifespans.

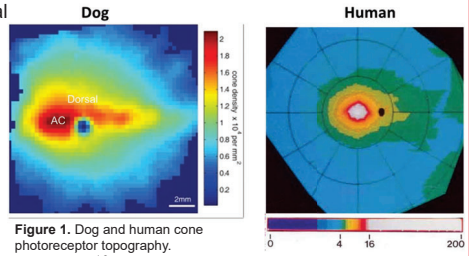

Figure 1. Dog and human cone photoreceptor topography. Adapted from[1,2]

Methods

Dogs underwent a clinical evaluation (n = 78):
- Optical coherence tomography (Heidelberg Spectralis HRA-OCT; Fig. 2A)[3]
- Light- and dark-adapted electroretinography (ERG; RetEval, LKC, Fig. 2B)[4]

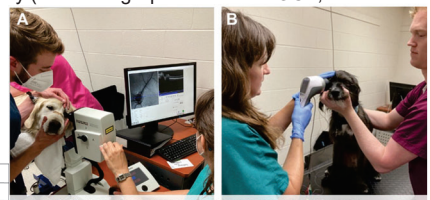

Figure 2. Companion dogs undergoing optical coherence tomography (A) and electroretinography (B).

Demographics (n = 78)

Age, median (IQR)	96 months (65 - 122)
Sex, %	53.8% female
Breed status, %	54.5% purebred
Weight, median (IQR)	25 kg (18 – 30.3)

Examples of ERG data from young & old dogs

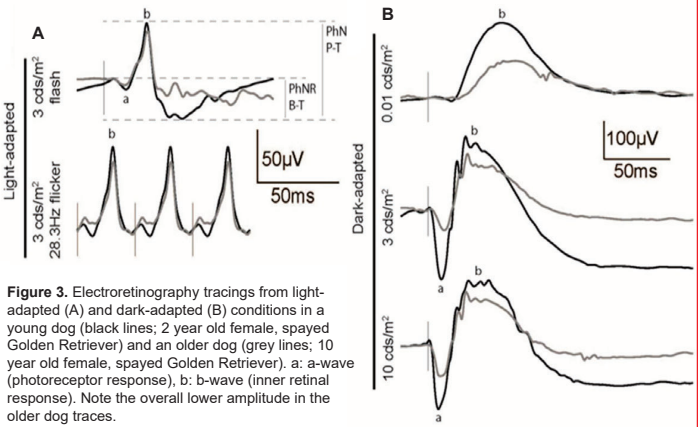

Figure 3. Electroretinography tracings from light-adapted (A) and dark-adapted (B) conditions in a young dog (black lines; 2 year old female, spayed Golden Retriever) and an older dog (grey lines; 10 year old female, spayed Golden Retriever). a: a-wave (photoreceptor response), b: b-wave (inner retinal response). Note the overall lower amplitude in the older dog traces.

Age negatively influences both retinal function and structure in dogs.

Inner retinal thickness is most associated with retinal function.

Acknowledgements
Aaron Kopydlowski, Leah Russell, Amelia Corona, Callie Rogers, Ryan Hopper, Patricia Kierski for assistance with dog examinations. Kyle Peterson for statistical support.

Funding
Morris Animal Foundation D23CA-510, NIH NEI K08EY028628, P30EY016665, NIA R01AG082907, DOVS Donor Funds, RPB grant to DOVS

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2. Curcio et al. *J Comp Neurol.* 1990 PMID: 2324310.
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Mowat Lab

Wisconsin Aging and Geriatric Dog Study

Examples of OCT data from young & old dogs

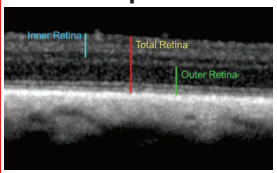


Figure 4. An optical coherence tomography scan illustrating layers measured: inner retina (blue), total retina (yellow) and outer retina (green). Scans were taken from the area dorsal to the optic nerve (dorsal) and area centralis (AC). Approximate regions are highlighted in Fig 1.

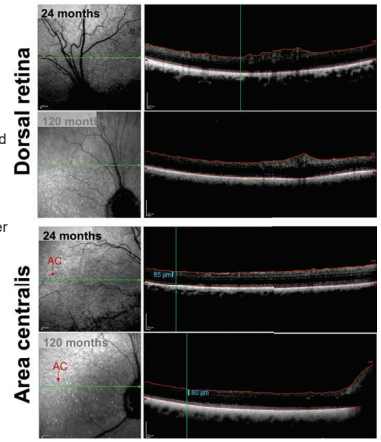
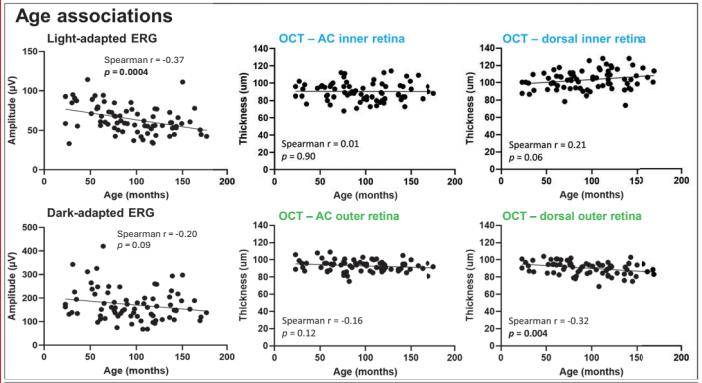
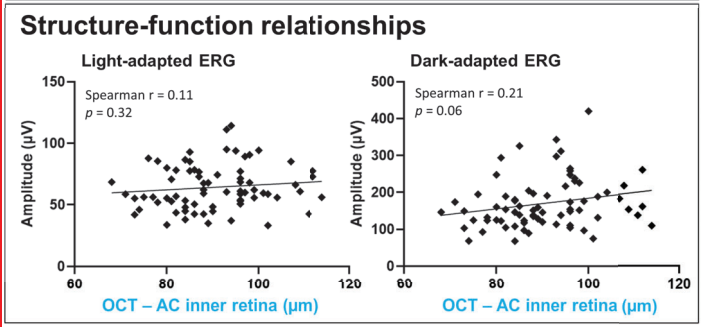


Figure 5. Example optical coherence tomography scans from dorsal retina (upper) and area centralis (lower) from younger (2 year old) and older (10 year old) female, spayed Golden Retriever dogs. Overall retinal thicknesses were relatively similar between the two ages, but the inner retina in the area centralis is notably thicker in the younger dog (highlighted in lower panel). Green lines on the images denote where sections were taken. The red line in cross sections denotes the internal limit of the retina.





Conclusions

Age was negatively associated with ERG amplitude. Age was also negatively associated with thickness of the outer retina, more so in the dorsal retina than the area centralis. There was a trend toward thickening of the inner retina with age. The greatest structure-function relationship was between dark-adapted ERG and inner retinal thickness.

Future Directions

- Determine whether there are age-related changes in retinal structure-function relationships.
- Define longitudinal changes in retinal structure and function and define risk factors for accelerated neurologic structural and functional decline in dogs, with relevance to humans.