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CONTINUING EDUCATION

OPHTHALMOLOGY

The Aging Canine Eye: What to Look for and How to Intervene

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Aging dogs are predisposed to several ocular abnormalities ranging from benign changes to vision-threatening or painful diseases. Fortunately, most ocular diseases can be diagnosed through an examination alone or with the addition of a few simple diagnostic tests. This article discusses ocular diseases common in aging dogs and focuses on conditions that are more likely to become problematic for the patient. **BOX 1** contains recommended supplemental reading for further information about the specific conditions and treatments.

WHAT IS A “SENIOR” DOG?

According to the 2019 American Animal Hospital Association Canine Life Stage Guidelines, the mature adult stage of a dog's life begins at completion of physical and social maturation (most often 3 to 4 years old) and lasts until the final 25% of the individual's estimated lifespan is reached, while the senior stage is defined as the last 25% of the individual's estimated lifespan through end of life.¹ For example, if the estimated expected

lifespan of a Shih Tzu is 13 years, then it has entered its senior years by the age of 10. A Labrador retriever, which might have an estimated expected lifespan of 10 years, has entered its senior years by the age of 8.

It is recommended that a senior dog have at least semiannual examinations.¹ Senior visits are expected to take more time than a young adult or mature adult visit and should be allotted as such on appointment and fee schedules. The goal is to perform a thorough examination and appropriate health screening to detect abnormalities early, enhance quality of life, and promote longevity.² A thorough eye evaluation is therefore recommended at each senior dog's routine examination.

THE OCULAR EXAMINATION

Take a Complete History

A thorough and comprehensive history can gain insight into problems of which the owner may be unaware. Eye-related questions for apparently

KEEPING AN EYE ON THEIR VISION

Although the aging process is inevitable, we can help our senior canine patients with ocular abnormalities.

**BOX 1 Recommended Supplemental Reading**

- Best LJ, Hendrix DVH, Ward DA. Diagnosis & treatment of keratoconjunctivitis sicca in dogs. *Today's Vet Pract.* 2014;4(4):16-22. todaysveterinarypractice.com/ophthalmology/diagnosis-treatment-of-keratoconjunctivitis-sicca-in-dogs
- Dixon-Jimenez A, Rapport G, Brown SA. Systemic hypertension in dogs & cats. *Today's Vet Pract.* 2011;1(2):20-26. todaysveterinarypractice.com/cardiology/systemic-hypertension-in-dogs-cats/
- Foote BC. Diagnosis and treatment of eyelid tumors. *Today's Vet Pract.* 2022;12(1):64-71. todaysveterinarypractice.com/ophthalmology/eyelid-tumors-dogs-cats/
- Reinstein S. Acute glaucoma: a true emergency. *Today's Vet Pract.* 2018;8(2):38-46. todaysveterinarypractice.com/ophthalmology/acute-glaucoma-dogs-cats/

healthy senior dogs can include:

- Have you noticed any redness in the whites of the eyes, eye discharge, or rubbing at the eyes?
- Have you noticed any change in the color of the eyes?
- Have you noticed any changes in vision, including difficulty navigating stairs and curbs? Is there a difference in vision during full sunlight versus dim lighting or a dark room?
- Over what length of time have you noticed these changes?
- Have you tried any over-the-counter medications, and if so, what and for how long?

If there is an ocular presenting complaint, questions may be tailored to the individual problem.

Perform a Brief Ocular Examination

1. Observe the pet on the floor, off leash, prior to handling. Watch how the pet navigates the room as an unfamiliar environment.
2. Look at the patient's eyes at eye level (bring them up to you on an examination table or come down to them) and evaluate for symmetry in the ambient light. Test menace response and palpebral reflex.

3. Turn off the lights in the room and use a focal light source (e.g., penlight, Finoff transilluminator) for pupillary light reflexes. If the menace response is absent, be sure to test the dazzle reflex (blink response to bright light). These combined light reflexes assess retinal and central nervous system function even if the patient has something obscuring its vision that would cause an absent menace response, such as a cataract.
4. With light source in hand, use 2× to 4× magnification (e.g., an Optivisor; Donegan Optical Company, doneganoptical.com) to briefly examine the eyelid margins and cornea.
5. Stand an arm's distance away from the patient's head with a light source and look for a tapetal reflection (retroillumination).
6. Perform an undilated fundic examination, ideally with indirect ophthalmoscopy using a Pan Retinal 2.2 or 28D (Volk, volk.com) handheld lens and the light source; these lenses give a less magnified and wider field of view, allowing visualization of more of the fundus at a time in an undilated patient.
7. Based on the above results, any owner concerns, and the patient's signalment, determine the need for further diagnostic tests and/or a dilated ophthalmic examination (using 1% tropicamide solution).

DIAGNOSTIC PARAMETERS**Tear Production**

A gradual decrease in tear production is expected as dogs age. Schirmer tear test (STT) values of ≤ 10 mm/min are diagnostic for dry eye, while values of 11 to 14 mm/min are considered a "gray zone" and should be taken into consideration with the breed, ocular examination, and clinical signs. Values of 15 to 25 mm/min are considered normal. In one study, the mean STT decreased by 0.4 mm every year in aging dogs.³

In addition, dogs with endocrinopathies (e.g., diabetes mellitus, hyperadrenocorticism, hypothyroidism) are at higher risk of reduced tear production.⁴ This is especially of consequence to dogs that have always been on the low end of normal. Accordingly, performing the STT in routine senior examinations is advisable for any dog, but may be most important in small- to medium-breed dogs predisposed to dry eye, such as American cocker spaniels, English bulldogs, pugs, and Shih Tzus.⁵

Since tears are the main source of nutrition and immunity for the cornea, low tear production can have consequences for the ocular surface, including

conjunctivitis, bacterial overgrowth, corneal ulcers, corneal vessels (keratitis), and corneal pigmentation.⁶ Thus, low tear production should be taken seriously if diagnosed, especially if any (sometimes even subtle) clinical signs are noted. In a study specifically screening STT in senior dogs, 10% (10/98) of patients had a low STT (<15 mm/min); only 1 of these 10 dogs was clinical for decreased tear production.⁷

If a low STT value is obtained on a routine screening in an asymptomatic patient, repeating the test a few weeks later is advised to confirm a diagnosis before starting potentially lifelong treatment. Pending the repeat test, a topical lubricant will benefit the patient and not skew future results. If a patient remains borderline in the absence of clinical signs, a decision can be made on whether to start a lacrimostimulant medication or to continue to monitor (with use of just topical lubricant) based on the patient and client.

Intraocular Pressure

Intraocular pressure (IOP) also decreases with age in dogs.^{8,9} The normal IOP range varies slightly depending on the tonometer used but is generally considered to be 10 to 25 mm Hg in normal, young dogs. It is not unusual for senior dogs to have low IOPs (<7 mm Hg); however, in the absence of signs of anterior uveitis, this finding does not have clinical consequences for the animal's ocular health and no further monitoring or treatment is necessary.^{8,9}

Evaluation of IOP in asymptomatic senior dogs during routine examinations is not necessary unless the examiner wants to monitor IOP in breeds at risk for glaucoma. The age of onset for primary closed-angle glaucoma is most often mature adult to senior (4 to 10 years old), but glaucoma occasionally occurs in young adults.¹⁰

Unlike low IOP, a high IOP (>25 mm Hg) should be taken seriously, even in the absence of or with minimal clinical signs, as glaucoma can cause rapid vision loss.¹¹ However, a falsely elevated IOP of approximately 25 to 30 mm Hg is not uncommon in a clinical setting. Traction on the eyelids (especially lateral traction) or pressure on both jugular veins (tight collar or manual restraint) can significantly increase IOP values.¹² In the author's experience, other common causes for a falsely elevated IOP are a stressed/moving/uncooperative patient, forward movement of the rebound tonometer (e.g., Tonovet, tonovet.com) each time the examiner

pushes the button (i.e., failure to keep the hand steady), holding the probe of the rebound tonometer too far away from the cornea, and too much manual force when touching the footplate of an applanation tonometer (e.g., Tono-Pen Vet; Reichert, reichert.com) to the cornea. If a falsely elevated IOP is suspected, try addressing all the above variables and, if applicable, decreasing the patient's stress and anxiety with gabapentin or trazodone, as these drugs have been shown to not clinically alter the IOP.^{13,14}

EYELID TUMORS

Dogs are more predisposed to eyelid neoplasms as they age, particularly sebaceous gland adenomas and melanomas. However, approximately 90% of eyelid masses in dogs behave benignly.¹⁵ The decision to remove an eyelid mass depends on several factors, including (1) the size of the mass and speed of growth of the mass; (2) the location of the mass on the eyelid; (3) impairment of the normal blink process; (4) local irritation, including ulceration of the dermis, bleeding, corneal vascularization, or corneal ulceration; and (5) any unusual characteristics that indicate the mass could be malignant (e.g., of conjunctival origin).¹⁶

If the patient is bothered by the mass, the mass is growing rapidly, or there are concerns for malignancy, it is best to remove it. Debulking and cryotherapy or pentagonal resection with primary closure is most often sufficient to treat these tumors in dogs.¹⁷ Regardless of the likelihood of benign behavior, histopathology is always recommended if tissue is removed.

CORNEAL CHANGES

As dogs age, they become predisposed to several corneal pathologies, especially indolent ulcers, corneal degeneration, and corneal endothelial disease.

Ulcers

Indolent ulcers are superficial, noninfected corneal ulcers characterized by a loose epithelium refractory to healing. Most dogs that develop indolent ulcers are 7 to 10 years old.¹⁸ Indolent ulcers can be treated with routine ulcer management plus debridement of choice (e.g., diamond burr, grid keratotomy) with an approximately 70% to 90% success rate with the first debridement.^{18,19} Routine ulcer management should always include a broad-spectrum topical antibiotic (e.g., neomycin-bacitracin-polymyxin B), topical and/

or oral analgesia (e.g., atropine and/or gabapentin), and an Elizabethan collar.

Deposits

Crystalline corneal degeneration includes corneal calcium and/or lipid deposition concurrent with corneal inflammation.²⁰ These deposits can be spontaneous or secondary to systemic or ocular diseases (e.g., kidney disease, hyperadrenocortism, hypertriglyceridemia, dry eye, glaucoma) that can change the mineral composition, osmolality, or pH of the tears or metabolism of the epithelial cells.²⁰

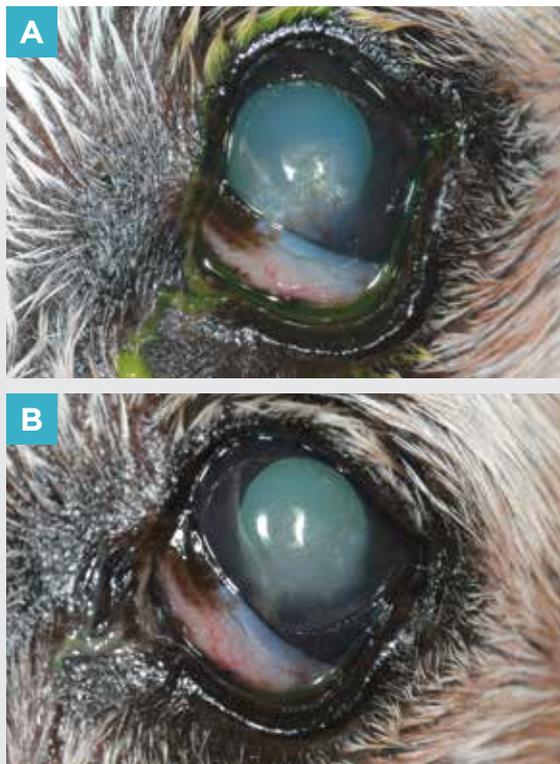


FIGURE 1. (A) Patient is a 15-year-old, medium-size, mixed-breed dog presented for epiphora and blepharospasm in both eyes. Multifocal coalescing, chalky white, superficial corneal opacities are visible in the axial and ventral cornea with associated moderate superficial vascularization and mild corneal edema (calcareous corneal degeneration). The patient was fluorescein positive with a small superficial ulcer. Debridement with a cotton-tipped applicator and a diamond burr was performed until the gritty corneal surface was smooth. The patient was prescribed a topical antibiotic (oxytetracycline-polymyxin B) and ethylenediaminetetraacetic acid (EDTA) 2% ophthalmic solution, both 3 times daily, along with an Elizabethan collar and analgesia. **(B)** Same patient, 2 weeks after the initial appointment. The calcium deposits are significantly improved, vasculature is reduced, and the corneal ulcer is healed. Topical antibiotic was discontinued and EDTA 2% was continued 3 times daily indefinitely.

The most common form of corneal degeneration and the most detrimental to older dogs is calcium deposition, also known as calcareous corneal degeneration.²¹ Calcium deposits cause secondary inflammation, vascularization, and disruption of the corneal epithelium, often leading to corneal ulcerations.^{20,21} The deposits range from sparse and lacy to dense white crystalline opacities, most often in the superficial axial cornea (**FIGURE 1A**).²⁰⁻²² The average age of affected dogs is 13 to 14 years.^{20,22}

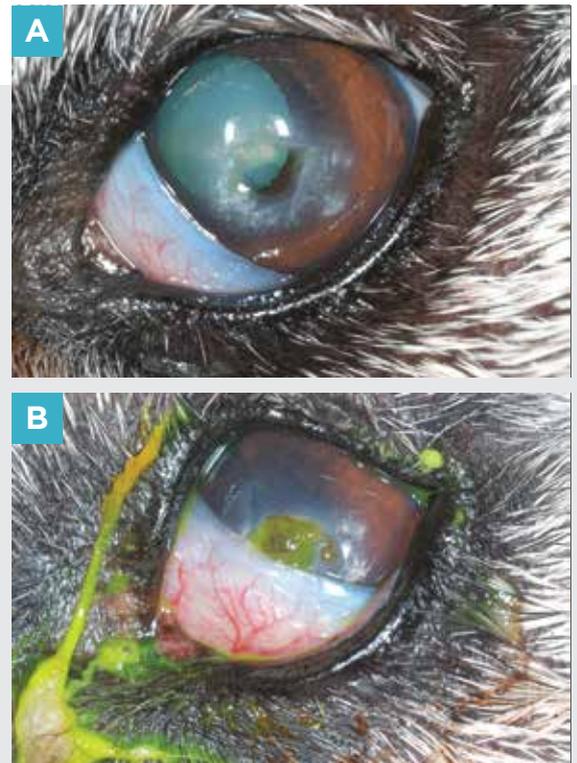


FIGURE 2. (A) Patient is a 14-year-old, medium-size, mixed-breed dog presented for blepharospasm. An axial descemetocele is present, with linear, lacy, white opacities throughout the stroma surrounding the ulcer (calcareous corneal degeneration). The patient was fluorescein positive along the dorsal wall of the descemetocele. Stabilization of the cornea with surgery was recommended but declined. There were no signs of corneal infection. Medical management with ofloxacin 4 times daily, ethylenediaminetetraacetic acid (EDTA) 3.75% 3 times daily, and oral analgesia was commenced. The descemetocele epithelialized within a week but never filled in the stroma, leaving the cornea fragile. EDTA was continued long term. **(B)** Same patient, 8 months later. A corneal perforation is plugged with fibrin (fluorescein positive) in the region of the descemetocele. The owner reported the patient sneezed and then became acutely painful in the eye. Again, surgical stabilization was offered but declined. Topical ofloxacin 4 times daily and atropine twice daily was started, as well as oral analgesia. EDTA solution was continued. Patient was lost to long-term follow-up, but if chronically painful, enucleation would have been recommended.

Calcium deposits warrant investigation into possible underlying causes with a history from the owner, bloodwork, and a thorough eye examination (STT, IOP, and fluorescein stain) but do not necessarily require treatment if they are mild and nonprogressive (not getting larger or denser) and there are no concurrent corneal ulcers.

Progressive deposits can be treated with topical application of ethylenediaminetetraacetic acid (EDTA) 1% to 4% compounded in artificial tears 2 to 4 times per day; secondary corneal ulcers should be treated with routine ulcer management.²¹ Diamond burr debridement has

been successfully used as a treatment modality in corneal ulcers associated with calcium deposits but should only be used for superficial ulcers (**FIGURE 1B**), not for ulcers associated with any stromal loss.²⁰

Corneal ulcers can sometimes be deep if calcium has sloughed on its own from the corneal stroma, leaving a fragile eye (**FIGURE 2A**). These deep, noninfected corneal ulcers are best treated with keratoplasty (corneal or conjunctival grafting surgery) if possible, as they pose a high risk for corneal perforation (**FIGURE 2B**).

Topical steroids may exacerbate both corneal calcium and corneal lipid and should be avoided if corneal deposits are observed.^{20,22}

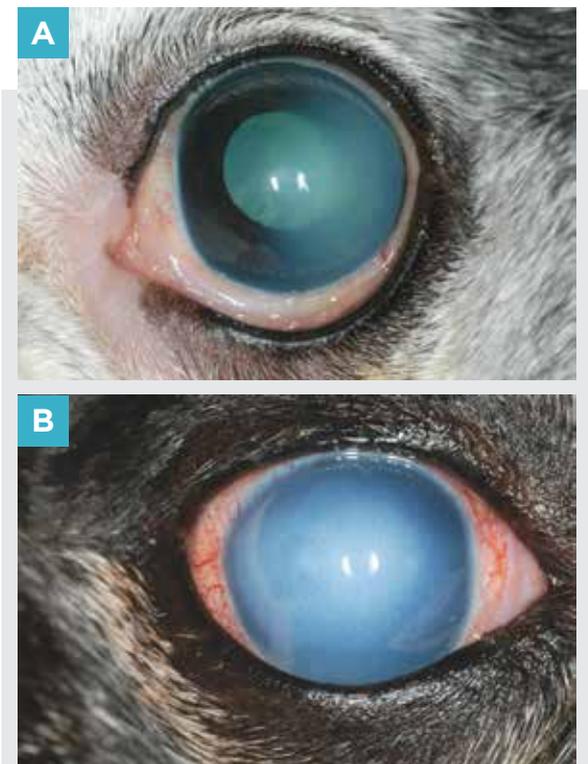


FIGURE 3. (A) Patient is a 10-year-old Boston terrier presented for worsening cloudiness in the left eye. Ocular examination showed mild temporal corneal edema in both eyes, with the left eye worse than the right. Intraocular pressure (IOP) and Schirmer tear test (STT) results were normal, and fluorescein stain was negative. No flare was present. Patient was diagnosed with corneal endothelial dystrophy and managed on 5% sodium chloride ophthalmic ointment 2 to 3 times per day indefinitely. **(B)** Patient is a 12-year-old Boston terrier with corneal endothelial dystrophy diagnosed 1.5 years prior and managed on 5% sodium chloride ophthalmic ointment 2 to 3 times daily. The disease has progressed over time, but at the time of this photo the patient was comfortable, had normal IOP and STT results, and was fluorescein negative, with secondary conjunctival hyperemia and moderate diffuse corneal edema. The pupil is still visible at this stage, and there are no active bullae.

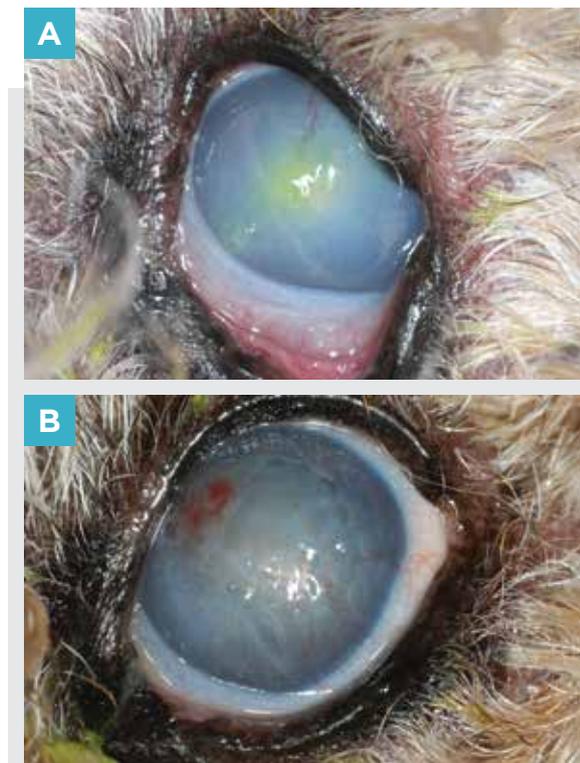


FIGURE 4. (A) Patient is a 15-year-old fox terrier presented for a nonhealing corneal ulcer of 1 month. Ocular examination showed severe corneal edema with multiple superficial bullae, a central superficial corneal ulcer, and associated vascularization. Medical management for the corneal ulcer was attempted with topical antibiotic (oxytetracycline-polymyxin B) 3 times daily, 5% sodium chloride ophthalmic ointment 4 times daily, atropine 2 times daily, and oral analgesia, as well as corneal diamond burr debridement twice. Owner elected thermokeratoplasty 3 months after original ulcer diagnosis. **(B)** Same patient, 3 weeks after thermokeratoplasty. The corneal ulcer has healed, but significant corneal scarring from the procedure is visible, as is secondary corneal vascularization and stromal hemorrhage from the chronicity of the ulcer.



Corneal Endothelial Dystrophy

Corneal endothelial dystrophy (CED) and senile corneal endothelial degeneration result in excessive corneal edema due to a primary loss of corneal endothelial cells, with affected dogs being a median age of 12 years.²³ Some breeds (e.g., Boston terrier, Chihuahua) are predisposed to CED, and it is likely a heritable condition.²³ The corneal edema appears as a blue-gray opacity and causes an increased thickness of the corneal stroma (mean of 1325 μm central corneal thickness versus 587 μm in normal dogs).²³ The edema starts temporally and is often asymmetric between eyes (**FIGURE 3A**), but over several months the condition progresses to bilateral diffuse edema (**FIGURE 3B**). Vision is impaired when the edema affects the whole cornea, and conjunctival hyperemia is common, though the condition is nonpainful by itself. Since this diagnosis is one of exclusion, other causes of progressive or diffuse corneal edema need be ruled out, including anterior uveitis, endotheliitis, glaucoma, and corneal ulceration.

When the edema becomes severe enough, bullae or blisters form and pop, leading to corneal ulcers (**FIGURE 4A**). These secondary corneal ulcers can be refractory to healing, but they are most often superficial and noninfected. Thus, they are treated routinely, but with the addition of topical hypertonic saline (5% NaCl) to pull fluid out of the superficial cornea.²³ Standard CED without corneal ulcers can also be managed with topical hypertonic saline ointment 3 to 6 times per day;²³⁻²⁵ anecdotally, this medication does



FIGURE 5. Patient is a 9-year-old Chihuahua 8 weeks after superficial keratectomy and conjunctival advanced hood flap was performed in the dorsal and ventral cornea for corneal endothelial dystrophy and severe corneal edema. The central corneal edema has decreased after the surgery.

not clear the cornea but reduces the chance of future bullae and corneal ulcers.

The predominant surgical intervention performed for advanced CED is a superficial keratectomy and conjunctival advanced hood flap (**FIGURE 5**).²⁵ Another, less complicated alternative if a refractory corneal ulcer is present is a thermokeratoplasty (**FIGURE 4B**), which heats the corneal stroma, causing contraction that leaves less room for fluid to accumulate in the cornea; however, this approach causes moderate corneal scarring.²⁶ The only definitive

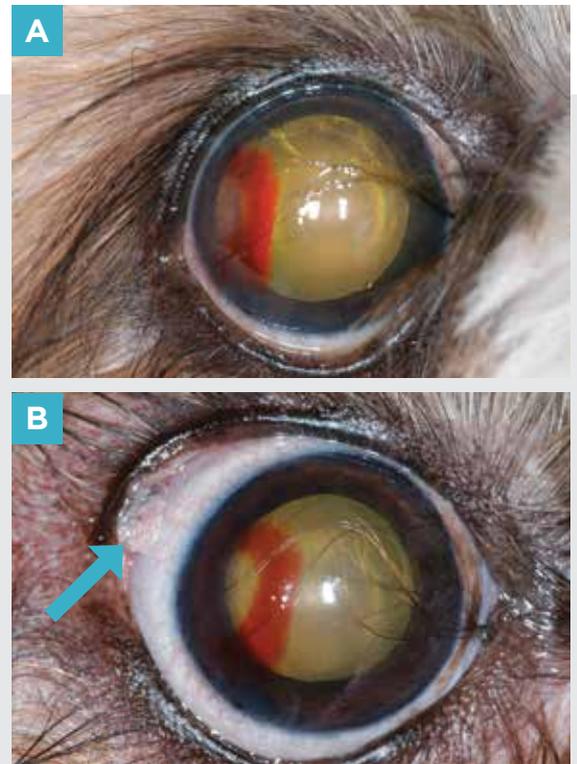


FIGURE 6. (A) Patient is a 12-year-old Shih Tzu presented for a red corneal opacity. There are focal superficial stromal corneal vessels temporarily with intrastromal hemorrhage at the tips of the vessels. Schirmer tear test and intraocular pressure results were normal; fluorescein stain was negative. The only other ocular abnormality was a conjunctival mass (suspected papilloma, not shown) on the upper palpebral conjunctiva in line with the keratitis, presumed to be the root of the corneal inflammation. Blood pressure and bloodwork were normal. Patient was diagnosed with intrastromal hemorrhage. To treat the focal keratitis, topical neomycin-dexamethasone-polymyxin B was prescribed twice daily for 1 month. (B) Same patient, 1 month after starting medical treatment. The conjunctival mass is visible in this photo (**arrow**). The blood vessels are resolved, but the hemorrhage remains. It takes several months for intrastromal hemorrhage to resolve. Medications were discontinued. Owner declined mass removal and patient was lost to follow-up, so it is unknown if the keratitis recurred.

treatment for CED in humans is replacement of the endothelial cells with an endothelial transplant (Descemet's stripping endothelial keratoplasty); this procedure is currently in the early stages of development for dogs.²⁷

Hemorrhage

Intracorneal stromal hemorrhage can be seen in senior dogs but is relatively uncommon. Stromal hemorrhage occurs when fragile corneal blood vessels leak blood into the stroma (**FIGURE 6A**). A recent study showed that the average age of patients diagnosed with this condition was 11.5 years, and 60% had systemic diseases, such as diabetes mellitus, hypothyroidism, hyperadrenocorticism, or hypertension, that could lead to fragile blood vessels.²⁸

If stromal hemorrhage is diagnosed, the recommendations include a full eye examination to determine the underlying cause for the corneal vascularization, as well as screening for systemic hypertension in all cases and endocrinopathies if other clinical signs warrant such testing. The hemorrhaged blood takes several weeks to months to clear (**FIGURE 6B**). Topical steroids can be used to resolve corneal blood vessels; the blood itself does not need to be treated. However, underlying causes (e.g., dry eye, systemic hypertension, endocrinopathies) do warrant treatment if discovered.



FIGURE 7. Patient is a 10-year-old Chihuahua presented for dilated pupils. Vision was normal. While pupillary light reflexes were present, they were incomplete, only constricting about 20% (pupil remained 80% dilated). In this photo, a single, long, thin strand of iris (**arrow**) spans the pupil from 4 to 7 o'clock, causing dyscoria, and the remainder of the pupil margin has some irregularity. The diagnosis was iris atrophy. Nuclear sclerosis is also present.

IRIS ATROPHY

Senile iris atrophy occurs in senior animals of all species but is most commonly noted in dogs. The atrophy occurs within the muscle and stroma and leads to an irregular pupillary margin, holes in the iris, and sluggishness or absence of pupillary reflexes (**FIGURE 7**).²⁹ Especially in the early stages, it causes a mild anisocoria because 1 side is more advanced. Senile iris atrophy is common in poodles, miniature schnauzers, and Chihuahuas, but can occur in any breed.²⁹ Patients may exhibit some mild photophobia in bright light due to inability to constrict properly, but typically this is considered a benign problem with no treatment or cure.²⁹ To rule out glaucoma, IOP should be measured when a dilated pupil with sluggish pupillary light reflex is observed, especially if other clinical signs exist.

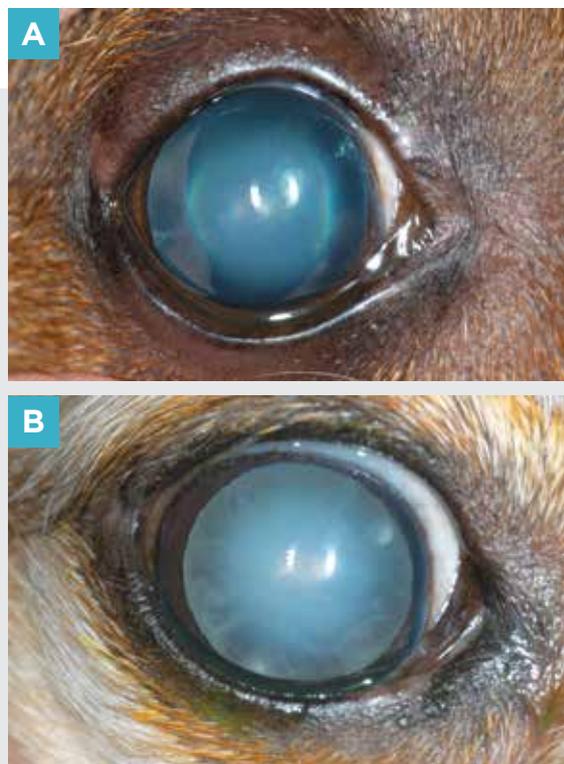


FIGURE 8. (A) Patient is a 13-year-old dachshund presented for possible cataracts and decreased depth perception. Nuclear sclerosis is visible with a gray opacity in the center of the lens. Dilution with tropicamide 1% revealed incipient senile peripheral cataracts. No treatment was necessary. **(B)** Patient is a 15-year-old Chihuahua-pug mix presented for decreased depth perception and decreased night vision. Dense nuclear sclerosis and immature senile cortical cataracts are visible with dilation (worse than seen in patient in A). A topical nonsteroidal anti-inflammatory drug was prescribed once daily to prevent lens-induced uveitis as the cataract matures.



LENS CHANGES

Lenticular changes are common in aging dogs. Nuclear sclerosis, an increased density and hardening of the lens nucleus associated with a progressively gray opacity in the center of the lens, is found in all dogs older than 7 years (**FIGURE 8A**).³⁰ Nuclear sclerosis is visible to the naked eye as cloudiness of the lens; thus, owners often present their dog for suspected cataract formation. In mild to moderate stages, the condition does not appear to clinically impede vision and does not obscure the retina for examination. However, in advanced stages, once a dog is approximately 12 years old, the density can be great enough to cause nearsightedness or a myopic shift (difficulty seeing objects far away) and visual acuity reduction,³¹ as well as distort the practitioner's examination of the retina.⁷ This change in vision is minimal enough that it does not warrant cataract surgery.

Senile cataracts develop most often in the periphery of the lens cortex and are slow to progress (over years). Senile cataracts are very common in dogs older than 10 years, and all dogs older than 13 years are expected to have some degree of cataractous changes.³² A dilated lenticular examination is important to differentiate nuclear sclerosis from cataracts, as well as to help stage and monitor cataracts in subsequent visits (**FIGURE 8B**).

Unfortunately, no validated medical options currently exist to decrease the progression of nuclear sclerosis or senile cataracts. Cataract surgery is an option if the patient's vision is affected, the dog is deemed an appropriate candidate for anesthesia, and the eyes have



FIGURE 9. Patient is a 13-year-old Shih Tzu diagnosed with incidental asteroid hyalosis (after presentation for a cataract in the other eye). Note the sparkly white to tan spherical opacities posterior to the lens through the dilated pupil.

adequate retinal function as determined by an electroretinogram (ERG).

VITREOUS CHANGES

Vitreous opacities called asteroid hyalosis (**FIGURE 9**) or sychysis scintillans are small, sparkly particles of calcium and phosphorus or lipid, respectively. These changes occur in aging dogs or secondary to a history of inflammation.³³ The opacities ("floaters") do not seem to influence vision in dogs. However, when advanced, their presence can make it more challenging to evaluate the fundus clearly. No diagnostic tests or treatment are needed when this finding is observed.

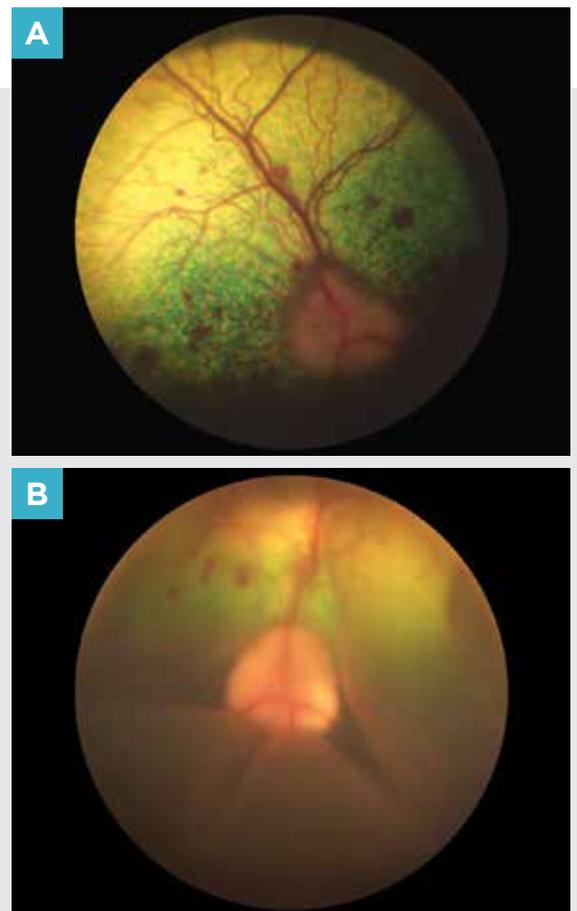


FIGURE 10. (A) Patient is a 12-year-old Maltese diagnosed with incidental multifocal retinal hemorrhages (petechiae) on routine fundic examination. Blood pressure was 210 mm Hg; treatment for systemic hypertension was commenced. The hemorrhages resolved about 1 month after the hypertension was controlled. (B) Patient is a 10-year-old, small, mixed-breed dog presented for blindness. Bilateral bullous retinal detachment with retinal hemorrhages was noted in both eyes. Blood pressure was 190 mm Hg and the patient was treated for systemic hypertension. No follow-up is available.

RETINAL CHANGES

Hypertension-Associated Lesions

Systemic hypertension leads to ocular lesions in at least 62% of dogs.³⁴ The retina and choroid are most commonly affected owing to the numerous small capillaries within the choroid susceptible to vascular ischemia, a condition known as hypertensive chorioretinopathy.³⁴ The most common manifestation of canine hypertensive chorioretinopathy is retinal

hemorrhage (ranging from petechiae to larger regions; **FIGURE 10**), but other sequelae include serous retinal detachments, subretinal edema, and tortuous retinal vessels.³⁴ Hyphema (blood in the anterior chamber), vitreal hemorrhages, and stromal hemorrhages are other, less common manifestations of ocular lesions secondary to systemic hypertension.^{28,34}

Acute onset of blindness or change in color of the eye may be the presenting complaint, but incidental ocular lesions from systemic hypertension can also be found during routine examination. Accordingly, systemic hypertension should be ruled out in dogs with any of the above-mentioned ocular lesions and clinical signs. Additionally, dilated indirect fundic examination is strongly encouraged for patients with known systemic hypertension or known systemic disorders that can lead to hypertension (e.g., renal disease, diabetes mellitus), or during routine examinations once the patient has reached senior age.²

Documentation of a systolic blood pressure greater than 160 mm Hg in a calm patient on 2 or more occasions is diagnostic for systemic hypertension; alternatively, the presence of target organ damage justifies diagnosis and initiation of treatment after a single measurement greater than 160 mm Hg.³⁵ The risk of ocular lesions substantially increases when the systolic blood pressure exceeds 180 mm Hg.³⁵ Looking for and treating an underlying cause are important for gaining control of elevated blood pressure, as most cases of canine systemic hypertension are secondary.³⁵ While the prognosis for return of vision is unknown in a dog with blindness due to hypertensive chorioretinitis, about 50% of cats that were blind at presentation regained some vision following successful treatment of systemic hypertension.³⁶ With treatment, the goal blood pressure is between 120 and 150 mm Hg, but any decrease in blood pressure decreases the risk of future target organ damage.^{35,37}

Retinal Degeneration

Senile retinal degeneration is observed in dogs, but it is little studied.³⁸ In retinal degeneration, the photoreceptors degenerate, leading first to impaired vision in dim lighting (i.e., nyctalopia) due to loss of rods, then reduction of daytime vision due to loss of cones as the disease progresses. Senile retinal degeneration is typically slow (over months to years) and should only clinically affect senior patients.

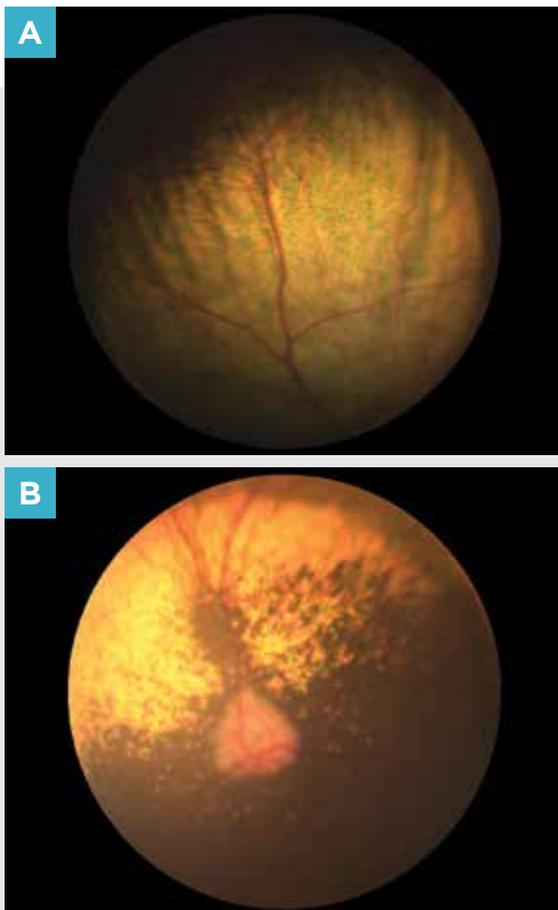


FIGURE 11. (A) Patient is an 11-year-old, small, mixed-breed dog presented for decreased vision at night, with normal vision during the day. Fundic examination showed retinal thinning in the periphery with linear furrowing (gray linear regions of altered reflectivity), but the vessels still appear appropriate for the breed. The diagnosis of suspected mild retinal degeneration was made. No further diagnostics (such as electroretinography [ERG]) or treatment (such as supplements) were pursued. **(B)** Patient is a 13-year-old long-haired dachshund presented for decreased vision during dim lighting (difficulty using the stairs at night). Fundic examination showed a pale optic nerve head, mild retinal vessel attenuation, and a normal tapetum. The patient was diagnosed with suspected mild senile retinal degeneration. ERG was declined. Supplements were pursued, but follow-up is not available.



When presented with clear recommendations, pet owners are 7 times more likely to follow through with recommendations.¹

To assess the patient's vision in light versus dark, perform a maze test. Turn the lights off in a darkened room (i.e., with no windows or with blinds covering windows) containing a few obstacles, such as cones, chairs, and/or trash cans. Place the dog on the floor with its nose in the corner, and watch it navigate the room (without making noise/calling its name). Then turn the light on and monitor for any change in confidence navigating or other changes in behavior. On neuro-ophthalmic examination, pupils may be slightly mydriatic in ambient light and slow to constrict but also may be unaffected. On dilated fundic examination, a pale optic nerve, decreased retinal vessel size (attenuation), and subtle peripheral hyperreflectivity with furrowing are observed (**FIGURE 11**). While examination and age should provide a diagnosis, an ERG can determine the ultimate quantitative retinal function. In one study of miniature poodles and Yorkshire terriers, ERG values were 15% to 30% lower in a group of older dogs (10 to 14 years) compared with a group of younger dogs (3 to 5 years).³⁹

Though the veterinary literature on medical treatments for retinal degeneration is sparse, dietary supplements, including lutein, zeaxanthin, β -carotene, and vitamins C and E, have been shown to have some protective effects against macular degeneration and cataracts in humans. A recent study showed that dietary supplementation with omega-3 fatty acids in normal puppies had positive benefits on visual acuity and that higher levels of serum DHA (docosahexaenoic acid) were correlated with higher ERG amplitudes.⁴⁰ Another recent study showed daily antioxidant supplementation (lutein 20 mg, zeaxanthin 5 mg, β -carotene 20 mg, astaxanthin 5 mg, vitamin C 180 mg, and vitamin E 336 mg) for 6 months increased ERG amplitude values in normal mature adult dogs compared with a control group in which ERG values declined slightly in the same 6-month period.⁴¹

While no studies have yet been performed on the above combinations of carotenoid and antioxidant supplementation in dogs affected by retinal degeneration, one study suggested that short-term omega-3 fatty acid supplementation had no effect on the DHA levels within the retina or on ERG amplitudes in dogs affected with progressive rod-cone degeneration (a specific inherited form of retinal degeneration).⁴² Although it is not expected that damage to the retina could ever be completely halted or reversed with supplements, targeted supplements may provide some benefit for ocular health in senior dogs.

RECOMMENDATIONS AND OWNER COMPLIANCE

While most of the above diagnoses can be detected or suspected on ocular examination, several require a few additional diagnostic tests and several require lifelong treatment or monitoring. Clear, up-front recommendations about why certain diagnostic tests and treatments are recommended and why some treatments are lifelong will greatly improve owner compliance. When presented with clear recommendations, pet owners are 7 times more likely to follow through with recommendations.¹ A shared decision also helps solidify these recommendations with the client. For example, after making recommendations, consider asking, "How does that plan sound to you?" or "What questions do you have about our recommendations?" This action of a shared decision results in increased owner satisfaction and compliance.¹ If any ocular condition is not improving with treatment as expected or a second opinion is desired, referral to a board-certified veterinary ophthalmologist is advised. **TVP**

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CONTINUING EDUCATION

The Aging Canine Eye: What to Look for and How to Intervene

TOPIC OVERVIEW

This article covers the most important steps in a screening ocular examination for senior dogs, discusses ocular diseases common in aging dogs with a focus on conditions that are more likely to become problematic over time for the patient, and gives guidance about diagnostic tests and treatments most appropriate for these conditions.

LEARNING OBJECTIVES

After reading this article, participants will know which steps of the ophthalmic examination should not be skipped in a senior dog and how to interpret specific ophthalmic diagnostic test results. Readers should also understand specific common ophthalmic conditions in senior dogs, including eyelid masses, iris atrophy, cataracts, nuclear sclerosis, and more.

This article has been submitted for **RACE approval for 1 hour of continuing education credit** and will be opened for enrollment upon approval. To receive credit, take the test at [vetfolio.com](https://www.vetfolio.com) by searching the name of the article or scanning the QR code below. Free registration is required.

Questions and answers online may differ from those below. Tests are valid for 3 years from the date of approval.



- Which approach is preferred for an undilated fundic examination?**

 - Indirect ophthalmoscopy with a 28D handheld lens
 - Indirect ophthalmoscopy with a 20D handheld lens
 - Indirect ophthalmoscopy with a 15D handheld lens
 - Direct ophthalmoscopy
- How are Schirmer tear test (STT) and intraocular pressure (IOP) expected to change as dogs get older?**

 - The STT increases and the IOP increases
 - The STT increases and the IOP decreases
 - The STT decreases and the IOP increases
 - The STT decreases and the IOP decreases
- A 12-year-old Shih Tzu with lagophthalmos and trichiasis has an STT performed at a routine examination with no clinical signs. The STT is 12 mm/min in the right eye and 13 mm/min in the left eye; last year, it was 16 mm/min in both eyes. The plan is to retest the dog in 1 to 4 weeks to see if this value is persistent or if it drops further. Which medication can be started in the meantime because it will not skew results when the STT is retested?**

 - Cyclosporine
 - Tacrolimus
 - Artificial tear gel
 - None; all will skew the results
- Which of the following is a recommended therapy for calcareous corneal degeneration?**

 - Hypertonic saline (5% sodium chloride) ointment
 - EDTA 2% compounded in artificial tears
 - Prednisolone acetate ophthalmic solution
 - Neomycin-dexamethasone-polymyxin B ophthalmic ointment
- A 10-year-old, male castrated Boston terrier presents at its routine examination with a diffuse, gray/blue haze to the cornea and mild conjunctival hyperemia. The owners report this haziness has progressed over the past few months, but they thought it was cataracts. The dog's vision is affected, as it appears hesitant to walk around the room and uses its nose to navigate a lot, but the menace response is positive. Aside from a thorough eye examination, what additional diagnostic tests need to be performed prior to suspecting a diagnosis of corneal endothelial dystrophy?**

 - STT and fluorescein stain
 - IOP and fluorescein stain
 - IOP and gonioscopy
 - IOP and electroretinography
- A 11-year-old female spayed Lhasa apso presents for an annual examination. The eye exam reveals a bright-red splotch approximately 6 mm in size on the peripheral cornea. What diagnostic tests are the most appropriate to recommend to the owner?**

 - STT, IOP, blood pressure, and routine bloodwork (complete blood count, chemistry, urinalysis)
 - STT, IOP, and fluorescein stain
 - Corneal biopsy
 - Blood pressure, routine bloodwork, and abdominal ultrasound



7. At what age is nuclear sclerosis expected to start in a dog, and what leads to this condition?

- 5 years; swelling of lens fibers in nucleus
- 7 years; increased density and hardening of nucleus
- 9 years; swelling of lens fibers in nucleus
- 11 years; increased density and hardening of nucleus

8. What is the most common ocular lesion from hypertensive chorioretinopathy in dogs?

- Retinal hemorrhages
- Subretinal edema
- Serous retinal detachment
- Hyphema

9. Which dogs should have a dilated indirect fundic examination at least once a year?

- Those with known systemic hypertension
- Those with known renal disease or endocrinopathy
- Those that have reached senior age
- All of the above

10. How can you detect early senile retinal degeneration in an examination room?

- Menace response
- Visual placing test at the edge of the exam table
- Maze test in a dim lit room
- Maze test in ambient light with the blinds open

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