

Adapting the RETeval™ ERG device into a veterinary tool (RETevet™)

INTRODUCTION

There are approximately 75 million dogs in the United States. Fully 45% of all U.S. households have at least one dog as a pet. Many pet owners view their dogs as cherished family members and are very willing to spend considerable sums of money to prolong both the quality and length of their pet's life. This provides a recurring and lasting source of income for veterinary health providers. There are approximately 100,000 veterinarians practicing in 60,000 clinics. The prevalence of dogs, veterinarians, clinics, and households with pets is similar in the European Union.

The formation of cataracts is a very common ophthalmic condition in dogs. A cataract is a clouding of the ocular lens impairing their vision, especially in the dark. In dogs, cataract formation is primarily an age-related ophthalmic disease, affecting 50% of dogs older than 9.4 years regardless of a breed (Williams, Heath, and Wallis, 2004). However, certain breeds, such as the American Cocker Spaniel and the Miniature Poodle develop genetically triggered cataracts earlier in their life. Diabetes, eye trauma, glaucoma, drug toxicity, and dietary deficiency are also cited as causes of cataract formation. Overall statistics show 2-12% cataract prevalence across all the dog breeds and regardless of age (Gelatt and MacKay, 2005).

In order to provide these canine patients with quality treatment, veterinarians often use methods and equipment designed for humans. The extracapsular phacoemulsification followed by intraocular lens implantation is the most suitable way to treat immature and mature cataracts in dogs (reference). In order to optimize the probability of success in restoring post cataract surgery vision and owner happiness, all clinics strongly recommend performing an assessment of retinal function prior to the cataract surgery (reference).

The full-field electroretinogram (ERG) is a diagnostic test that measures the electrical activity of the retina in response to a light stimulus (flash). Rod-driven responses are obtained after a dark adaptation period, with no background light, and using dim flashes. Cone-driven responses are obtained after a period of light adaptation, with a constant background light and high intensity flashes. Typical ERG protocols combine these conditions into steps ultimately providing an objective information about the status of retinal function.

Obtaining full-field dark and light adapted ERGs as a pre-test to the cataract surgery verifies if the retina behind the lens is functioning properly. Near normal ERG results suggest that the removal of the cataract will improve overall vision. If the retinal function is substantially decreased, cataract surgery might not contribute to the improvement of useful sight, possibly due to additional ocular disease.

Canine electroretinograms are traditionally recorded using one of few commercial stationary equipment options available on the market. The RETeval is a recently introduced portable ERG/VEP device that is FDA-approved and available on the international market to assess visual function in humans. In this report, we adapt the RETeval device to be a fast, easy, and portable veterinary tool helpful in assessing retinal function before performing cataract surgery in dogs.

MATERIAL AND METHODS



All the data collected in this study were obtained in Texas Veterinary Ophthalmology, a board-certified specialty practice providing eye care to animals of the greater Fort Worth, TX area. Dr. Brian Cichocki performed all the ERGs and cataract surgeries.

Subjects

- 17 dogs (10 female) evaluated for cataract surgery
- Small, pure, and mixed breeds
- 9.5 ± 3.0 years old (mean ± SD)
- All neutered or spayed
- 4 dogs with normal vision served as controls (two 4 y/o dachshunds, F and M, 3 y/o Amstaff, M, 1 y/o standard poodle, M)

Methods

- Pupils dilated with 1% Tropicamide
- ERG-Jet corneal electrode (active), platinum subdermal needle electrodes, reference at the base of the ear and ground in the middle of the back
- 20-30 min of dark adaptation

Cataract surgery

Phacoemulsification using Centurion (Alcon) with or without lens (Cara) implantation was performed according to the TXVO standard operating procedure

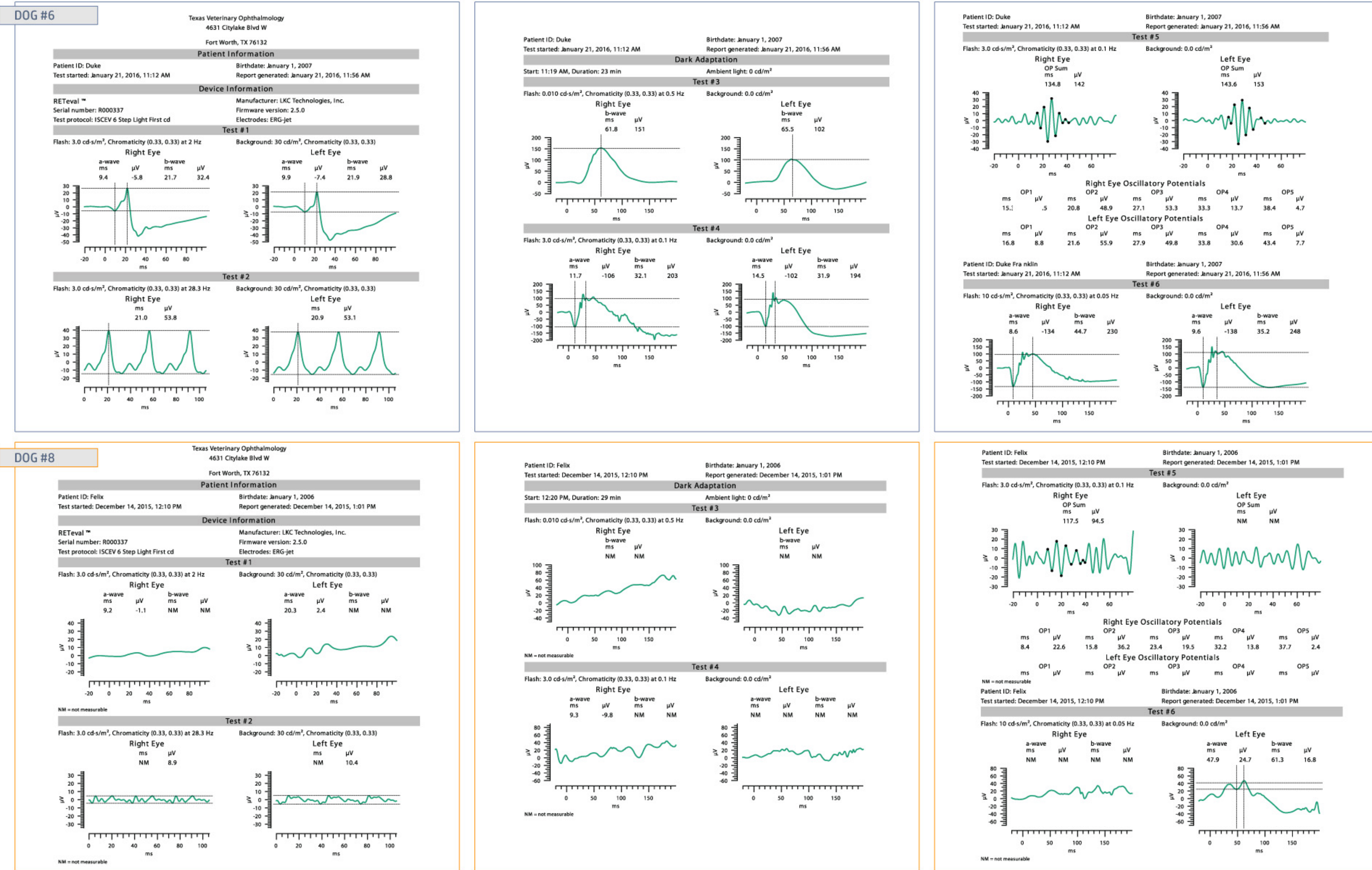
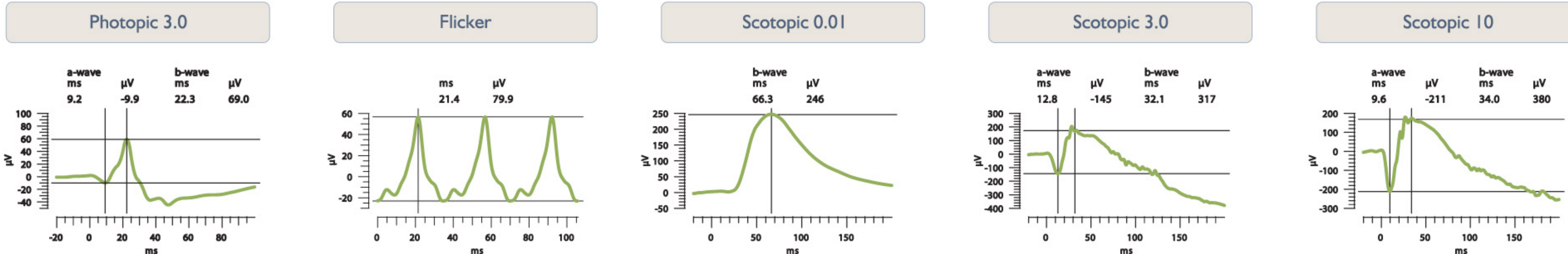
RESULTS

Table 1: Ocular findings and retinal function of cataract surgery candidates

Dog ID	Dog description	Ocular findings	ERG results and interpretation	Cataract surgery candidate?
1	Maltese, 15 y/o, spayed, F	OU: hypermature cataracts; OD: secondary glaucoma, severe anterior segment abnormalities secondary to chronic, uncontrolled phacolytic uveitis	ERG performed in OS only: flat photopic and scotopic ERGs	NO
2	Dachshund, 13 y/o, neutered, M	OD: unremarkable, funduscopically normal OS: complete cataract, suspected chronic inflammation	OS: severely decreased photopic and scotopic ERGs; OD: photopic ERG decreased suggesting a systemic component	NO
3	Pomeranian, 7 y/o, neutered, M	OD: funduscopically normal, early immature cataract; OS: retina could not be visualized, late immature cataract	OU ERGs performed: OD 30% > OS The complete set of readings was obtained from OS to compensate for the lack or fundus visualization	YES
4	Wheaten Terrier, 8 y/o, neutered, M	OD: hypermature cataract, subluxation previous glaucoma, OS: early hypermature cataract	OS: Photopic and scotopic rod ERGs decreased by around 50%	YES
5	Mixed Breed, 7 y/o, spayed, F	OD: hypermature cataract; OS: immature cataract	OU ERGs performed: Scotopic mixed OS 20% < OD	YES
6	Toy Poodle, 10 y/o, neutered, M	OD: immature cataract, ~80% of lens volume is cataractous OS: late immature cataract, scant areas of muted tapetal glow through peripheral cortex	OU ERGs performed: Scotopic, rod OS 30% < OD	YES
7	Maltese 6 y/o, spayed, F	OU: late immature cataracts, approximately 90% of lens volumes is opacified	OU ERGs performed: Photopic and Scotopic OD 30% < OS	YES
8	Chihuahua 10 y/o, neutered, M	OU: hypermature cataracts, anterior capsular pigment; mild brunescence; suspected progressive retinal atrophy	OU ERGs performed: OU residual or flat ERG	NO
9	Mixed Breed 10 y/o, spayed, F	OU: mature cataracts, mild brunescence	OU ERGs performed: OU residual or flat ERG	NO
10	Toy Poodle 13 y/o, spayed, F	OU: hypermature cataracts, OS: subluxation	OU ERGs performed: Scotopic OS 35% < OD	YES
11	Puggle (Pug/Beagle cross) 7 y/o, spayed, F	OU: mature cataracts, mild intraocular inflammation, diabetes	OU ERGs performed: OU residual or flat ERG	NO
12	Pug 10 y/o, spayed, F	OU: nuclear sclerosis, vitreous degeneration Presented for evaluation of acute amaurosis	OU ERGs performed: OU residual or flat ERG, SARDS confirmed	NO
13	Bichon Frise 12 y/o, spayed, F	OD: nuclear sclerosis; incipient cortical opacities; limited view; geographic retinal atrophy; choroidal furrowing; tapetal hyperreflectivity; vascular attenuation OS: hypermature cataract, fundus not visualized	OU ERGs performed: OU flicker and scotopic high flash: residual ERGs, photopic and scotopic rod and mixed: flat ERGs	NO
14	Toy Poodle 4 y/o, neutered, M	OD: hypermature cataract, OS: immature cataract	OU ERGs performed: OD, all ERGs decreased by 50%; OS, all ERGs close to normal. Partial superior retinal detachment diagnosed via B-scan	YES
15	Shih Tzu 7 y/o, spayed, F	OD: hypermature cataract; OS: immature cataract, OU: dry eye; vitreal degeneration	OU ERGs performed: OU ERGs decreased by 80-90 %, suspected progressive retinal atrophy	NO
16	Dachshund. 13 y/o, spayed, F	OU: 1-2+ nuclear sclerosis; incipient anterior cortical cataract hemorrhage(s) ventrotemporal at tapetal-nontapetal junction (OS>OD). Presented for evaluation of acute amaurosis	OU ERGs performed: OU residual or flat ERG, SARDS confirmed	NO
17	Mixed Breed 9 y/o, neutered, M	OU: immature diabetic cataracts, no other abnormal findings	OU ERGs performed: Photopic OD 40%<OS	YES

Table 2: Normal dog ERG measurements

	PHOTOPIC			SCOTOPIC					
	3.0		flicker	0.01		3.0		10.0	
	a-wave	b-wave		b-wave	a-wave	b-wave	a-wave	b-wave	
Amplitude (µV)	3-13	25-75	19-80		50-250	60-150	150-320	100-220	200-400
Implicit time (ms)	8.5-13	20-24	20-22		50-70	11-16	29-33	8.0-12	29-45



DISCUSSION

- Due to the positive outcome of their electroretinograms 8 out of 17 dogs (47%) were deemed to be suitable candidates for the cataract surgery
- ERG amplitudes greater than the minimum reference range or at least half that of an unaffected eye and normal implicit times were considered a good prognosis for sight restoration after the phacoemulsification and lens replacement
- The ERG results were also useful in:
 - Establishing the retinal status in case the retina cannot be visualized due to the dense cataract
 - Establishing and/or confirming the Sudden Acquired Retinal Degeneration Syndrome (SARDS) diagnosis
 - Detecting an unexpected retinal detachment and deciding on the treatment
- Normal dog ERGs confirmed the measurements obtained from the non or less affected eyes of the phacoemulsification candidates were within the normal values
- Amplitudes of the normal ERGs vary significantly more than the implicit times
- In a busy veterinary practice ERG results are evaluated for:
 - Morphology of the waveforms
 - Implicit times and amplitudes within the normal ranges
 - Consistency with other ocular findings

CONCLUSION

- ERG is an essential pre-surgical evaluation tool able to efficiently discriminating between suitable and unsuitable cataract surgery candidates
- RETeval is easily adaptable to be used in veterinary settings to measure dog retinal function
- ERG recordings in dogs can be successfully obtained without any anesthesia or sedation using RETeval
- Results obtained with RETeval were crucial in establishing diagnosis and further treatment of the animal