

*Original Research***Ocular Ultrasonographic Biometry of Dogs Bred in India**

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Abstract

The present study was conducted on 135 dogs of age ranging from four months to fifteen years of either sex referred to the department. In all animals, corneal anesthesia was achieved by instilling Proparacaine HCl 0.5% directly on the cornea. Ultrasonographic scanning of eyes was done in sternal recumbency using e-saote My Lab Five VET with linear transducer (7.5-18 MHz) by transcorneal (n=129) and transpalpebral (n=6) approaches. During USG examination, anterior chamber depth, antero-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length were studied according to age, breed, sex, left and right eye. Different parameters of eye significantly increased in dogs above five years as compared to below one year age group. Significantly longer anterior chamber depth, vitreous depth and axial length measurement were observed in male dogs compared to females. Vitreous depth of Pug and Boxer showed significant difference as compared to Labrador retriever. Axial length in Dalmatian differed significantly than German shepherd and Labrador retriever. No significant difference was observed in all the parameters between left and right eyes.

Key words: Biometry, Normal Eye, Ultrasonography

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Introduction

Dogs are dichromats and visual system has evolved to aid proficient hunting. The eyes of different breeds of dogs have different shapes, dimensions and retinal configurations (Coppinger, 2001). Ultrasonography is a safe, non-invasive method to evaluate the intraocular and retrobulbar tissue of opaque eyes (Nyland and Mattoon, 1995). It allows evaluation of structures such as the cornea, the anterior chamber, the iris, the ciliary body, the lens, the vitreous chamber and the posterior section of the bulbar wall (Nautrup and Tobias, 2007).

Ocular ultrasonographic biometry is one of methods to measure the axial dimensions of the eye and determine the position of intraocular components. Biometry of the eye has been useful for the assessment of certain pathological abnormalities such as microphthalmia, pseudoexophthalmia (unilateral axial myopia), scleral ectasia and congenital glaucoma (Brandao, 2007; Potter, 2009). In veterinary medicine ocular biometry has potential application in establishing lens power, and estimating prosthetic globe size after enucleation (Gilger *et al.*, 1998). Ocular dimensions varied considerably and depended on species, age and sex. Axial ocular length was significantly longer in human males than in females (Nyland and Mattoon, 1995). The lens thickness was increased and anterior chamber depth was decreased with aging in both sexes in human (Lim *et al.*, 1992). This was also found in the dog (Ekesten, 1994).

The aim of the present study was to ultrasonographically measure and evaluate *in vivo* the structures of the eye (anterior chamber depth, antero-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length) in dogs commonly bred in India.

Materials and Methods

The present study was conducted on 135 dogs of age ranging from four months to fifteen years of either sex referred to the department. In all animals, corneal anesthesia was achieved by instilling Proparacaine HCl 0.5% directly on the cornea. Manual restraint was sufficient for ophthalmic ultrasonographic examination. Dogs were scanned in sternal recumbency or sitting position. Ultrasonographic evaluation of eyes was done using *e-saote My Lab Five VET* with linear transducer (7.5-18 MHz) by transcorneal (n=129) and transpalpebral (n=6) approaches. To avoid air trapping between the transducer and the patient, the palpebral hair was thoroughly wetted before the acoustic gel was applied when transpalpebral approaches used. Each eye was scanned in horizontal and vertical planes through the visual axis for a complete examination (Fig. 1 and 2). The view was optimized through minor adjustments in transducer angle to obtain an optimal image. Images of the right and left eyes were taken and then compared for asymmetry. Biometry of the eyes was done and compared among the different age group, breed, sex, left and right eyes. After examination, each eyelid was gently flushed with sterile saline to remove coupling gel and associated debris.



Fig.1: Placement of linear transducer (7.5-18 MHz) by transcorneal technique in horizontal plane



Fig. 2: Placement of linear transducer (7.5-18 MHz) by transcorneal technique in vertical plane

Normal ultrasonographic appearance of the eye was described and biometry of intraocular structures including anterior chamber depth, anterior-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length were measured. The measurements were achieved on sonograms of the horizontal planes. The means and standard error (Mean $\pm$ SE) for each set of measurements were calculated. A statistical comparison of different age group was also done using one way ANOVA.

Results and Discussion

In the present study, ultrasonographic ophthalmic examination was conducted on 135 dogs of either sex. Corneal anesthesia was achieved by instilling 1 to 2 drops of Proparacaine HCl 0.5% directly on cornea in all the cases which facilitated ultrasonographic examination of eye. Similar anaesthetic regimen was also adopted by earlier workers (Woerd *et al.*, 1993). Ocular ultrasonography was performed in sternal recumbency or sitting position after manual restraining by transcorneal (n=129) and transpalpebral approaches (n=6) as per the standard technique (Spaulding, 2008). Transcorneal technique was superior to transpalpebral technique but contraindicated in cases of corneal damage (Hallowell and Potter, 2011).

On ocular ultrasonographic examination, anterior chamber, posterior chamber and vitreous body were visualized as anechoic, with few reflectors. The anterior chamber was distended with the anechoic aqueous humor, while posterior chamber was located between the posterior aspect of the lens and the ciliary body. The iris was continuous at the equilateral plane in the periphery of the globe to the ciliary body. The internal appearance of the normal lens was anechoic, while curvilinear interfaces appeared at the anterior and posterior margins of the lens, when scanned perpendicularly. The lateral and posterior boundaries of the vitreous body were seen as an echogenic line of modest thickness, extending from the iris plane posteriorly to the optic nerve. This echogenic line consisted of three layers i.e. the outermost

sclera, which has the choroid applied to its inner surface and internal aspect of the choroid was retina. In retrobulbar space the extrinsic ocular muscle, the optic nerve, arteries, veins, and periorbital fat were visualized. The optic nerve was seen as thin linear hypoechoic structure outlined by adjacent hyperechoic fat (Fig. 3 and 4).

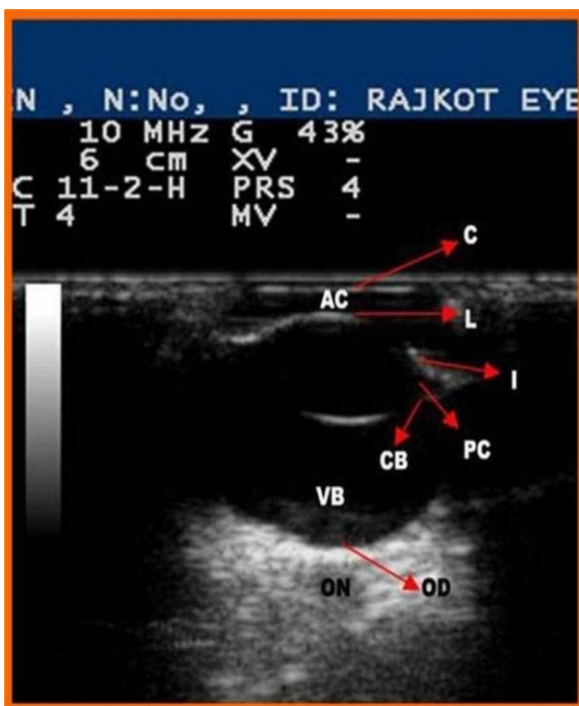


Fig. 3: Normal Sonoanatomy of canine eye (AC: Anterior chamber; PC: Posterior chamber; VB: Vitreous body; C: Cornea; I: Iris; CB: Ciliary body; L: Lens; OD: Optic disc; ON: Optic nerve)



Fig. 4: USG image showing normal optic disc (bold arrow) and optic nerve (arrows) as thin linear hypoechoic structure outlined by adjacent hyperechoic fat.

The biometry of intraocular structures including anterior chamber depth, anterior-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length were also measured (Fig. 5). In B-mode ocular ultrasonography, four major echoes i.e. cornea, anterior lens capsule, posterior lens capsule and retina-choroid sclera complex were easily seen. The cornea was represented as a curved hyperechoic interface immediately under the eyelid. Anterior chamber of the eye, lens cortex and nucleus and the vitreous were anechoic. In some of the images, the optic nerve appeared as a hypoechoic structure posterior to the optic disc in the retrobulbar region. Other echoic structures including ciliary body, iris and optic disc could also be distinguished. Anterior chamber depth, antero-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length increased in groups II, III and IV as compared to group I. Similar to our findings, the lens thickness, vitreous thickness and sagittal eyeball axis increased

with age (Paunksnis *et al.*, 2001) and also with aging in both sexes of dogs (Ekestén 1994; Schiffer and Rantanen, 1982).

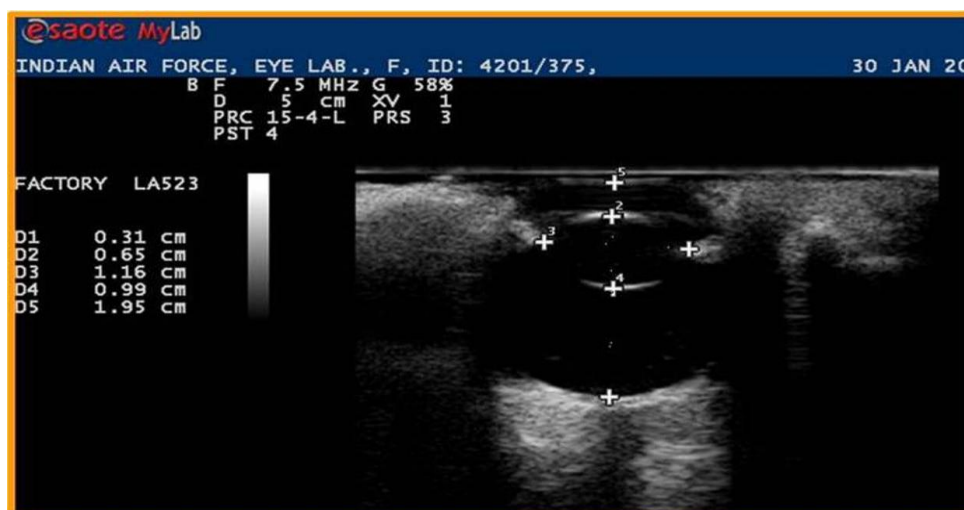


Fig. 5: Ultrasonographic technique for measuring the ocular biometry in dog (D1: Anterior chamber depth; D2: Anterio-posterior depth of the lens; D3: Latero-medial diameter of the lens; D4: Vitreous depth; D5: Axial length)

Out of 135 cases, 13 cases were of 0-1year (Group-I), 30 of 1-5 years (Group-II), 53 of 5-10 years (Group-III), 39 of 10-15 years (Group-IV) age group. Anterior chamber depth, anterio-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length increased in groups II, III and IV as compared to group I (Table 1 and 2).

Table 1: Measurements of left eye parameters (mm) of different age groups (mean±SE)

Group	Anterior chamber depth	Anterio-posterior depth of lens	Latero-medial diameter of lens	Vitreous depth	Axial length
I (0-1 yrs) (n=13)	2.05 ± 0.14 ^a	4.13 ± 0.17 ^a	9.07 ± 0.30 ^a	7.94 ± 0.60 ^a	14.35 ± 0.56 ^a
II (1-5 yrs) (n=30)	3.23 ± 0.10 ^b	5.62 ± 0.22 ^b	10.82 ± 0.41 ^b	8.82 ± 0.25 ^b	17.92 ± 0.34 ^b
III (5-10 yrs) (n=53)	2.93 ± 0.09 ^b	6.40 ± 0.13 ^{bc}	12.11 ± 0.22 ^{bc}	8.97 ± 0.17 ^b	18.34 ± 0.21 ^b
IV (10-15 yrs) (n=39)	3.03 ± 0.15 ^b	6.05 ± 0.14 ^c	11.45 ± 0.24 ^c	9.15 ± 0.15 ^b	18.24 ± 0.22 ^b

Superscript (a, b and c) indicates significant difference at 0.05 level

Table 2: Measurements of the right eye parameters (mm) of different age groups (mean ± SE)

Group	Anterior chamber depth	Anterio-posterior depth of lens	Latero-medial diameter of lens	Vitreous depth	Axial length
I (0-1 yrs) (n=13)	2.25 ± 0.09 ^a	4.21 ± 0.18 ^a	9.13 ± 0.28 ^a	7.87 ± 0.44 ^a	14.48 ± 0.46 ^a
II (1-5 yrs) (n=30)	3.20 ± 0.10 ^b	5.58 ± 0.24 ^b	10.53 ± 0.34 ^b	9.02 ± 0.24 ^b	18.06 ± 0.31 ^b
III (5-10 yrs) (n=53)	3.06 ± 0.11 ^b	6.35 ± 0.13 ^{bc}	12.20 ± 0.25 ^{bc}	9.17 ± 0.19 ^b	18.44 ± 0.28 ^b
IV (10-15 yrs) (n=39)	2.95 ± 0.15 ^b	6.04 ± 0.15 ^c	11.59 ± 0.23 ^c	9.01 ± 0.16 ^c	17.90 ± 0.28 ^b

Superscript (a, b and c) indicates significant difference at 0.05 level.

Breed wise distribution revealed 80 Pomeranian, 18 Labrador retriever, 15 German shepherd, 7 Beagle, 4 each of Dalmatian and Golden retrievers, 3 Doberman pinsher, 2 Lhasa apso, 1 each of Boxer and Pug. The Mean $\pm$ SE values of ophthalmic parameters studied of different breeds were non-significant ($P>0.05$) for measurements of anterior chamber depth and latero-medial diameter of the lens. However, antero-posterior depth of the lens differed significantly ($p<0.05$) in Dalmatian and German shepherd breeds of dogs, whereas, vitreous depth in pug and boxer showed significant difference than Labrador retriever. Anterior chamber depth, vitreous depth and axial length were significantly ($P>0.05$) longer in male dogs as compared to females (Schiffer and Rantanen, 1982), whereas antero-posterior depth of the lens and latero-medial diameter of the lens were non-significantly ($P<0.05$) different, as also reported earlier (Cottrill *et al.*, 1989; Silva *et al.*, 2010; Patil *et al.*, 2011). Axial length in Dalmatian differed significantly than German shepherd and Labrador retriever (Table 3). There was no significant difference in other parameter of left and right eyes. Similar observations were made by earlier workers (Paunksnis *et al.*, 2001; Cottrill *et al.*, 1989; Silva *et al.*, 2010).

Table 3: Measurements of eye parameters (mm) of different breeds (mean $\pm$ SE)

Breed	Anterior chamber depth	Antero-posterior depth of lens	Latero-medial diameter of lens	Vitreous depth	Axial length
Pomeranian (n=80)	2.77 $\pm$ 0.06 ^a	5.84 $\pm$ 0.09 ^{ab}	11.09 $\pm$ 0.14 ^a	8.67 $\pm$ 0.09 ^{ab}	17.29 $\pm$ 0.15 ^{ab}
Labrador retriever (n=18)	3.34 $\pm$ 0.10 ^a	6.11 $\pm$ 0.24 ^{ab}	12.53 $\pm$ 0.46 ^a	10.18 $\pm$ 0.25 ^b	19.65 $\pm$ 0.30 ^b
German Shepherd (n=15)	3.64 $\pm$ 0.24 ^a	6.00 $\pm$ 0.50 ^{ab}	10.87 $\pm$ 0.71 ^a	9.92 $\pm$ 0.38 ^{ab}	19.52 $\pm$ 0.23 ^b
Doberman (n=3)	2.93 $\pm$ 0.31 ^a	5.52 $\pm$ 0.65 ^{ab}	11.67 $\pm$ 0.93 ^a	8.52 $\pm$ 0.42 ^{ab}	17.03 $\pm$ 0.81 ^{ab}
Beagle (n=7)	3.06 $\pm$ 0.06 ^a	5.96 $\pm$ 0.27 ^{ab}	10.96 $\pm$ 0.32 ^a	9.55 $\pm$ 0.35 ^{ab}	18.55 $\pm$ 0.36 ^{ab}
Dalmatian (n=4)	3.56 $\pm$ 0.19 ^a	5.23 $\pm$ 0.28 ^a	11.13 $\pm$ 0.48 ^a	9.59 $\pm$ 0.46 ^{ab}	18.88 $\pm$ 0.60 ^a
Golden retriever (n=4)	3.56 $\pm$ 0.19 ^a	5.23 $\pm$ 0.28 ^a	11.13 $\pm$ 0.48 ^a	9.59 $\pm$ 0.46 ^{ab}	18.88 $\pm$ 0.60 ^{ab}
Lhasaapso (n=2)	2.95 $\pm$ 0.28 ^a	7.27 $\pm$ 0.47 ^{ab}	11.95 $\pm$ 0.71 ^a	8.67 $\pm$ 0.12 ^{ab}	18.95 $\pm$ 0.66 ^{ab}
Boxer (n=1)	3.25 $\pm$ 0.06 ^a	6.45 $\pm$ 0.29 ^{ab}	11.35 $\pm$ 0.61 ^a	7.95 $\pm$ 0.25 ^a	17.75 $\pm$ 0.13 ^{ab}
Pug (n=1)	2.97 $\pm$ 0.34 ^a	5.69 $\pm$ 0.42 ^{ab}	11.04 $\pm$ 0.61 ^a	7.92 $\pm$ 0.42 ^a	16.62 $\pm$ 1.1 ^{ab}

Superscript (a and b) indicates significant difference at 0.05 level.

Out of 135 cases, 77 cases of male and 58 of female were ultrasonographically examined and echobiometry was performed. In the present study, anterior chamber depth, vitreous depth and axial length were significantly ($P>0.05$) longer in male dogs as compared to females (Table 4).

Table 4: Measurements of eye parameters (mm) in male and female dogs (mean $\pm$ SE)

Group no.	Anterior chamber depth	Antero-posterior depth of the lens	Latero-medial diameter of the lens	Vitreous depth	Axial length
Male (n=77)	3.18 $\pm$ 0.06 ^a	5.86 $\pm$ 0.09 ^a	11.46 $\pm$ 0.16 ^a	9.18 $\pm$ 0.10 ^a	18.24 $\pm$ 0.15 ^a
Female (n=58)	2.67 $\pm$ 0.06 ^b	5.89 $\pm$ 0.12 ^a	11.12 $\pm$ 0.18 ^a	8.56 $\pm$ 0.13 ^b	17.20 $\pm$ 0.21 ^b

Superscript (a and b) indicates significant difference at 0.05 level.

Echobiometry was performed in left and right eye of all 135 cases. There was no significant difference in any parameter of left and right eyes (Table 5).

Table 5: Measurements of the eye parameters (mm) in left and right eyes (mean±SE)

	Anterior chamber depth	Anterio-posterior depth of the lens	Latero-medial diameter of the lens	Vitreous depth	Axial length
Left eye (n=135)	2.92± 0.067	5.92±0.10	11.33± 0.17	8.85± 0.12	17.78± 0.17
Right eye (n=135)	2.98± 0.07	5.86 ± 0.10	11.31± 0.17	8.96± 0.11	17.79±0.19

Conclusion

Ultrasonography is a safe and non-invasive method for the diagnosis of ocular disorders as complementary to routine ophthalmic examinations. In dogs, anterior chamber depth, antero-posterior depth of the lens, latero-medial diameter of the lens, vitreous depth and axial length increased with age. The measurements of male dog ophthalmic parameters were significantly longer for anterior chamber depth, vitreous depth and axial length than in female dogs.

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