NOTE *Internal Medicine*

Evaluation of Refractive Value by Skiascopy in Healthy Beagles

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ABSTRACT. We examined the refractive value in healthy Beagles by skiascopy. The mean refractive value of 54 eyes of 27 Beagles was 0.08 ± 0.87 (mean ± SD) diopters (D). The numbers of eyes defined as having emmetropia, myopia and hyperopia were 34, 8 and 12, respectively. Anisometropia was detected in 4 dogs. The mean refractive values in the 3–6-year-old and 8–9-year-old groups were 0.26 ± 0.84 and –0.29 ± 0.82 D, respectively, with a significant difference between the two groups (P<0.05).

KEY WORDS: beagle, refractive state, refractive value, skiascopy.

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Refraction in an eye is the change in direction of light when light passes from the ophthalmic medium, mainly the cornea and crystalline lens, toward the retina [19]. The refractive value indicates the degree of the defocusing of light on the retina. The refractive state is classified as emmetropia, myopia and hyperopia. In an emmetropic eye, light from objects is focused on the retina. In myopic and hyperopic eyes, light is focused in front or behind the retina, respectively [19]. Anisometropia is the condition of an unequal refractive value between the 2 eyes of one subject. Though the detailed definition is obscure, a difference of ≥ 2.0 diopters (D) is considered to indicate anisometropia in human medicine [11], and it has previously been reported that a difference of 1.0 D indicates anisometoropia in veterinary medicine [12].

Objective refractometry is broadly divided into two methods, using an auto refractometer or a skiascope. In veterinary ophthalmology, determination of the refractive value by skiascopy has been documented in various animal species, such as the dog, cat, horse and bird [2–7, 12, 14–19, 22]. In dogs, there are reports of differences in refractive value by breed [2, 12, 17], shape of the cranium [5, 19], or age [12, 16, 19]. However, interestingly, there are no reports of refraction in Beagles, which are widely used as an experimental animal [10]. In this study, we performed skiascopy in laboratory Beagles, and evaluated the refractive value and state.

Fifty-four eyes of 27 Beagles (15 male and 12 female) were assessed. The mean age of the dogs was 5.7 years old, and 5 were 3 years old, 4 were 4 years old, 7 were 5 years old, 2 were 6 years old, 6 were 8 years old, and 3 were 9 years old. All dogs were in good health clinically. Ophthalmic examinations, including pupillary light reflex, menace response, Schirmer tear test, tonometry (Tono-Pen XL applanation tonometer, Medtronic Solan, Jacksonville, FL, U.S.A.), slit-lamp biomicroscopy (SL-D7, Topcon, Tokyo, Japan) to evaluate the anterior segment and funduscopy (TRC-50IX, Topcon), were performed before the study. Neurological or ophthalmic disease was not observed in any subjects. This study was conducted according to the guidelines of the experimental animal research committee of Rakuno Gakuen University.

Skiascopy was performed using a streak retinoscope (RX-3A, Neitz, Tokyo, Japan) and skiascopy bar with trial lenses (HE 111, Handaya, Tokyo, Japan) 30 min after administration of 1% cyclopentolate hydrochloride (Cyplezin, Santen, Tokyo, Japan). The distance between the examiner and the dog's eye was 50 cm. The incoming light projected into the pupil was moved left to right, and the movement of the reflected light from the fundus was judged to be with motion, against motion or neutral. The refractive value of the trial lens required for neutralization was investigated at the time of examination with motion or against motion. The refractive value of the dog's eye was obtained by subtracting 2 D from the power of the neutralizing lens.

The refractive error of the subjects' eyes was classified according to the previous report by Kubai [12]. Eyes were defined as emmetropic when the refractive value was between –0.5 and 0.5 D. Eyes were defined as myopic when the refractive value was < –0.5 D and were defined as hyperopic when the refractive value was > 0.5 D. When a difference of ≥1.0 D was detected between two eyes in the same dog, anisometropia was diagnosed.

The subjects were divided into 2 groups to investigate the difference in refractive value between 3–6-year-old (n=18) and 8–9-year-old groups (n=9). The statistical normality of the distribution of the refractive value was evaluated with the D'Agostino-Pearson normality test. The difference in refractive value between the 3–6-year-old and 8–9-year-old groups was analyzed by the Mann-Whitney U test without corrections. The statistical significance of differences was determined with a P-value (P) of less than 0.05 as the minimum acceptable level of significance. All statistical methods were performed using the GraphPad Prism 5 software (GraphPad Software Inc., La Jolla, CA, U.S.A.) for Windows.

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A histogram of the refractive values of all 54 eyes in the 27 dogs is shown in Fig. 1. The refractive value for all the subjects was 0.08 ± 0.87 (mean ± SD) D, and the average refractive state indicated emmetropia. The range of the refractive value was –2.0 to 2.0 D, and the histogram showed a normal distribution statistically (P>0.34). In all dogs, the difference in refractive value between the left and right eye was 0.36 ± 0.51 D (range: 0 to 1.75 D). Anisometropia was found in 4 dogs (14.8%), and the average difference between the left and right eye was 1.25 ± 0.35 D (range: 1.0 to 1.75 D).

The refractive values in 3–6-year-old and 8–9-year-old groups were 0.26 ± 0.84 D (range: –2.0 to 2.0 D) and –0.29 ± 0.82 D (range: –2.0 to 1.0 D), respectively, and the average refractive state was emmetropia in both groups (Table 1). The refractive value in the 3–6-year-old group was significantly lower than that in the 8–9-year-old group (P<0.05).

In this study, the refractive state of the Beagles showed a high rate of emmetropia. Differences in refractive state according to breeding environment or shape of the cranium have been reported; the refractive value of indoor dogs was –0.64 D, and that of mesaticephalic breeds was –0.62 D, both being slightly myopic [5]. In this study, we examined laboratory Beagles, which are classified as a mesaticephalic breed, and their breeding environment was an indoor dog kennel; our results differed from the tendency shown in previous studies [12, 23]. Kubai *et al*. studied the difference in refractive state by breed; the Rottweiler, Collie and Toy Poodle were myopic, whereas the Australian Shepherd, Alaskan Malamute and Bouvier des Flandres were hyperopic [12]. In humans, it has been shown that genetic elements play a role in the development of ametropia [23]. There are large differences between breeds of dog, although it seems that ametropia is related to inheritance, and further study is required.

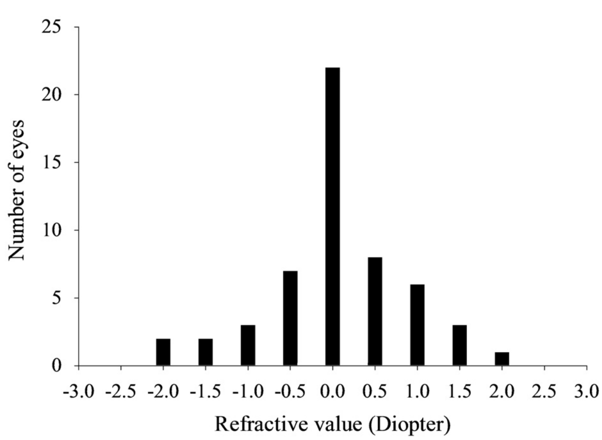

Fig. 1. Distribution of the refractive values of the 54 eyes in the 27 normal Beagles.

In this study, anisometropia was detected in 4 subjects (14.8%). In a previous study, anisometropia was detected in 6% of 1,440 dogs of various breeds, and in 9% of German Shepherds, the largest breed [12]. We diagnosed anisometropia as a difference of ≥1.0 D between the left and right eye in the same dog. Although this diagnosis was similar to that in a previous report [12], a higher rate of anisometropia was diagnosed in this study. There is no report about refractive error in Beagles. Though this study was performed with a Beagle group from only one laboratory, it seems that this result might be a trait of Beagles. In humans, anisometropia is defined as a ≥2.0 D difference between two eyes [11]; if this condition is also defined as anisometropia in dogs, there were no anisometropic dogs in this study.

The refractive state of Beagles showed a trend toward myopia in the 8–9-year-old group, compared with the 3–6-years-old group. The same association between myopia and age has been detected in dogs [12] and humans [13, 20]. In humans, since the thickness of the lens nucleus increases with nuclear sclerosis, which is an age-related change, so the refractive power of the lens increases, and as a result, the refractive state tends toward myopia with ageing [1, 8, 9]. In dogs, nuclear sclerosis becomes evident at approximately 6 years old or older [21]. In this study, nuclear sclerosis in the subjects in the 8–9-year-old group might have caused the tendency of the refractive state toward myopia in the Beagles. The axial length of the canine eye normally ranged from 20–24 mm and has been considered one of the logical factors affecting the value of refractive power of the eye logically. Murphy *et al*. reported that canine eye size had no relation with refractive value [16]. Ophthalmic examination was performed for all subjects before the present study. Because of no ophthalmic diseases were observed, it was speculated that the axial length of our subjects' eyes would show a normal value, though the length were not measured. Therefore, it seemed that the change of refraction in the 8–9-year-old group was caused by the changes of the crystalline lens with age.

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Table 1. Refractive values in the 3–6-year-old and 8–9-year-old groups

Group	All subjects	3–6-year-old	8–9-year-old
Number of eyes	54	36	18
Refractive value*	0.08 ± 0.87 D	0.26 ± 0.84 D	–0.29 ± 0.82 D

Values are indicated as means ± SD.
* Significant difference between the adult and aged groups (P<0.05).

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