

Ophthalmic Findings in 547 Korean Sapsaree Dogs

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(Accepted: November 17, 2008)

Abstract : This study was performed to investigate the ophthalmic findings of the Korean traditional 'Sapsaree' dogs, and to provide ophthalmic references. Five hundred forty-seven Sapsaree dogs were randomly chosen without any criteria preference. Ophthalmic examination was performed bilaterally using ocular equipments, including slit-lamp biomicroscope, tonometer, direct and indirect ophthalmoscope. The obtained data for ophthalmic findings were analysis by the multivariate linear regression model to identify effects of sex, age and hair coat type. For congenital conditions, the incidence of persistent pupillary membrane (PPM) was the most common defect and there was present 8.8 % whereas for acquired ophthalmic diseases, cataract was the most commonly observed (3.7 %) in Sapsaree dog. Other frequent ocular finding included persistent hyaloid vessel remnant (PHVR, 6.2 %) in congenital conditions, and postinflammatory retinal degeneration (PIRD, 3.1 %) and corneal dystrophy (2.4 %) in acquired ophthalmic diseases. Only one significant effect was age of the Sapsaree for PIRD (P=0.040). There are no any significant effect for sex and hair coat types. This study will provide useful guidelines to clinicians and breeders for the basic ophthalmic information on this breed.

Key words : dog, Korea, ophthalmic finding, persistent pupillary membrane, Sapsaree

Introduction

The dog, *Canis familiaris*, is one of the oldest domestic animals and it is originally domesticated in the pre-agricultural age between 14,000 and 12,000 years ago. There are currently more than 400 breeds of dogs with various morphological and behavioral traits in the world, and most countries have their traditional dogs (7,14). In Korea, the Jindo dog and the Sapsaree are registered as Korean native dog breeds. The Sapsaree was declared the national monument No. 368 by the Korea Ministry of Culture in 1992 (10). Sapsaree is a medium sized dog; the mean height is about 55 centimeters and the mean weight is about 22.5 kilograms (10). There are five types of the Sapsaree as classified by the hair coat color: the blue, chestnut, yellow, yellow-white, and white Sapsaree (9).

The prevalence and character of ophthalmic disorders have been reported for purebred dogs. The information about ophthalmic disorders concerning inherited, especially congenital defects has been used for controlled breeding in breeder and ophthalmic disorders have been decreased in many purebred dogs by these efforts. Also, this ophthalmic information has been used for veterinary clinician as reference of practice and for scientist as animal modeling or genetic study.

Only gene characteristics (11,14,15) were usually studied for the Sapsaree and they had provided the information about the genomic characters of the Sapsaree and they elucidated the relationship between the Sapsaree and other East-Asian dogs. However, there have been no clinical references and there have not been studies on ophthalmic diseases for the Sapsaree.

The main purpose of this study was to investigate the ophthalmic findings of the Sapsaree, including the congenital conditions and acquired ophthalmic diseases. This study will provide ophthalmic reference for breeders, clinicians and scientists to preserve proper pedigree, consult basic data for treatment on breed of Sapsaree and basic information for utilizing this breed in genetic or other ophthalmic researches.

Materials and Methods

Five hundred forty-seven Sapsaree dogs that were clinically healthy and registered with the Korean Sapsaree association were chosen regardless of their sex or hair coat color (Fig 1). All dogs had fully developed eyes and the mean age was 2.3 ± 2.1 years (range: 6 months ~ 9 years). The age and sex distributions according to the hair coat color are presented in Table 1. All procedures were performed in compliance with the ARVO statement for the use of animals in ophthalmic and vision research.

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Fig 1. Appearance and haircoat type of the Sapsaree; A: Blue type; B: Chestnut type; C: Yellow type; D: Yellow-White type; E: White type (Photography courtesy by Korean Sapsaree Association).

Table 1. Age and sex distributions in this study according to the haircoat color of the Sapsaree

Age (year)	Haircoat color					Total
	Yellow	Blue	White	Yellow-white	Chestnut	
<1	87*	65	17	4	13	186
1~3	89	93	14	11	2	209
3~6	52	58	5	3	-	118
6~9	12	20	1	-	1	34
Male	103	113	13	4	6	239
Female	137	123	24	14	10	308
Total	240	236	37	18	16	547

* No. of dogs.

The sex, age, and hair coat color of the Sapsaree dogs were recorded before examination, and all the ophthalmic examinations were performed in a semi-darkened room. The adnexa, anterior and posterior ocular segment of both eyes were examined with a portable handheld slit-lamp biomicroscope (Kowa SL-14[®], Kowa, Tokyo, Japan), tonometer (Tonopen[®]XL, Mentor, Norwell, USA), a direct ophthalmoscope (Heine Beta 200S[®], Heine, Herrsching, Germany) and an indirect ophthalmoscope (Vantage[®], Keeler, Berkshire, UK). For posterior segment examination, the dogs were applied pharmacological mydriatics: 1% tropicamide (Mydriacyl[®], Alcon, Puurs, Belgium). After ophthalmic examination, some affected eyes were taken photographs using the fundus camera (Genesis[®], Kowa, Tokyo, Japan).

Some of the ophthalmic findings, such as retinal dysplasia, eyelid melanoma and tarsal gland adenoma, affected eye or eyelid were prepared for pathological examination. The specimen was fixed with Davidson's fixative, and the paraf-

fin sections were stained with hematoxylin and eosin (HE) for microscopic observation.

The ophthalmic disorder which found this study was divided to congenital conditions and acquired diseases. If two more disorders present in one eye, the disorders were classified by caused disorder. If these disorders were not cause and effect relationships, we regarded it as respective disorders.

The obtained data were analyzed by statistical package (SPSS 12.0 for Windows, SPSS Inc., Chicago, IL, USA). The multivariate linear regression model was performed for more frequent (over 3%) ophthalmic findings to identify effects of independent variables: sex (male, female), age (young: <1year, young adult: 1~3 years old, mid adult: 4~6 years old, older: ≥7 years old), hair coat type (blue, chestnut, yellow, yellow-white, white) and Linear-by-linear association testing (X^2 testing) was used for post-hoc test with a correlation between prevalence of ophthalmic findings and age. *P* values of <0.05 were considered statistically significant.

Results

Five hundred forty-seven Sapsaree dogs were examined to investigate their ophthalmic findings (Table 2).

For the congenital conditions, the persistent pupillary membrane (PPM, Fig 2) was the most prevalent ocular finding; it was identified 48 dogs (8.8%). Persistent hyaloids vessel remnant (PHVR) was present in 34 dogs (6.2%, Fig 3). Other less common congenital conditions, persistent hyperplastic primary vitreous (PHPV, 1.1%, Fig 4) and retinal dysplasia (RD, 0.9%, Fig 5 & 19) and the prominence of lens suture line (0.5%, Fig 6) were also found.

For the acquired ophthalmic diseases, cataract was predominantly found in 21 dogs (3.7%); seventeen dogs were affected with cortical cataract (3.0%, Fig 7), 3 dogs were diagnosed with nuclear cataract (0.5%, Fig 8) and only one dog was affected with total cataract (0.2%, Fig 9). Post-inflammatory retinal degeneration (PIRD, Fig 10) was occurred in 17 dogs (3.1%), and corneal dystrophy (Fig 11) was seen in 13 dogs (2.4%). Other less common acquired ophthalmic diseases were keratitis (0.9%, Fig 12), entropion (0.5%, Fig 13), eyelid laceration (0.4%, Fig 14), tarsal gland adenoma (0.4%, Fig 15 & 20), conjunctivitis (0.2%, Fig 16), eyelid melanoma (0.2%, Fig 17 & 21), and iris freckle (0.2%, Fig 18). Overall, ocular congenital conditions were

Table 2. The distribution of ophthalmic findings in the Sapsaree

Ocular findings	Total (n=547)
Congenital conditions	
Persistent pupillary membranes	48 (8.8) *
Persistent hyaloid vessel remnant	34 (6.2)
Persistent hyperplastic primary vitreous	6 (1.1)
Retinal dysplasia	5 (0.9)
Prominence of lens sutures	3 (0.5)
Subtotal	96(17.6)
Acquired diseases	
Cataract	21 (3.7)
Cortical	17 (3.0)
Nuclear	3 (0.5)
Total	1 (0.2)
Postinflammatory retinal degeneration	17 (3.1)
Corneal dystrophy	13 (2.4)
Keratitis	5 (0.9)
Entropion	3 (0.5)
Eyelid laceration	2 (0.4)
Tarsal gland adenoma	2 (0.4)
Conjunctivitis	1 (0.2)
Eyelid melanoma	1 (0.2)
Iris freckle	1 (0.2)
Subtotal	66(12.0)

* No. of dogs (percentage of dogs).

presented in 96 cases and the prevalence of that was 17.6%. Whereas, acquired ophthalmic diseases were found in 66 cases and the prevalence of that was 12.0% in Sapsaree dogs.

The significance of the fixed systemic effects was shown in Table 3. Only one significant effect was age of the Sapsaree for PIRD ($P=0.04$) as they got older (Table 3). There were no any significant effects for sex and hair coat types in ocular findings.

Discussion

This study would be the first report of clinical ophthalmic reference for Sapsaree dog, which has been widely breeding in Korea.

In congenital conditions, the PPM was present at a frequency of 8.8%, which was greater than any other ophthalmic findings. PPM is the remnant of the pupillary membrane, which is a sheet of mesoderm carrying a network of anastomosing blood vessels, and its atrophy starts in fetal life; it is not common for it to remain thorough adult life (3). Some severe forms of PPM causes diffuse corneal opacities and cataract formation, but others do not cause any pathogenic defect (12). In some previous report of this disease, the greatest incidence occurred in the Basenji (22): the incidence rate from 2000 to 2004 for this breed of dog was 47.3% (1) and it appears to be an inherited disease. Because of inheritance, using an affected dog for breeding is not recommended (22). However, determining the inheritance pattern or any genetic study of the Sapsaree has not been performed and a future study on this needs to be done. The effect of sex was reported in the Tibetan terrier that the males had greater prevalent of this disease and it might be concerning inheritance (13). However, we could not find any significant difference between male and female in Sapsaree dogs.

Persistent hyaloid vessel remnant (PHVR) is what remains of the prenatal vitreal vascular system. The genesis of this is incomplete regression after birth and the condition is not considered pathogenic (5) and it does not affect the sight (23). It is also common in the Australian Shepherd and prevalence of this breed reported 5.82% (17). In this study, PHVR appeared high frequency at 6.2% for the Sapsaree. For the distribution based on age, the incidence of persistent hyaloid vessel remnant decreased with aging for the Beagle (5) and

Table 3. Significance of systematic fixed effects for ophthalmic findings using a mixed model analysis

Source of variation	DF	PHVR	Cataract	PIRD
Sex	1	0.850	0.321	0.887
Age	3	0.110	0.261	0.040*
Hair coat type	4	0.899	0.941	0.999

* Positive corrections were found with $P > 0.01$ based on Linear-by-linear association test. DF: degree of freedom; PHVR: persistent hyaloid vessel remnant; PIRD: post-inflammatory retinal degeneration.

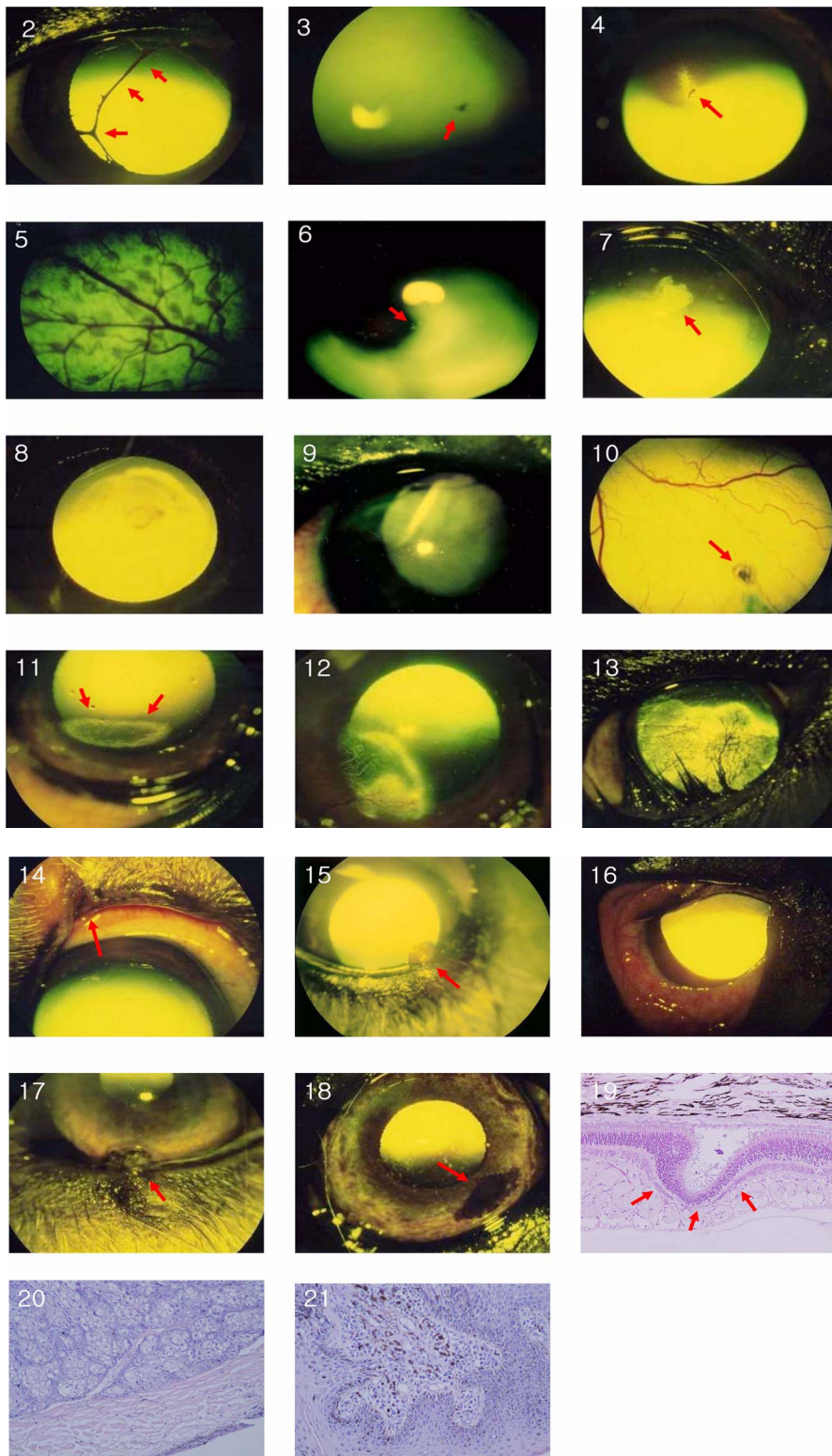


Fig 2~21. (2) Persistent pupillary membrane (arrows). (3) Persistent hyaloid vessel remnant (arrow). (4) Persistent hyperplastic primary vitreous with focal cataract (arrow). (5) Retinal dysplasia. (6) Prominence of lens suture line (arrow). (7) cortical cataract (arrow). (8) Nuclear cataract. (9) Total cataract. (10) Postinflammatory retinal degeneration (arrow). (11) Corneal dystrophy (arrows). (12) Keratitis. (13) Eyelid entropion with keratitis. (14) Eyelid laceration. (15) Tarsal gland adenoma. (16) Conjunctivitis. (17) Eyelid melanoma. (18) Iris freckle. (19) Histopathological finding of retinal dysplasia (arrows). H&E stain, $\times 200$. (20) Histopathological finding of tarsal gland adenoma. H&E stain, $\times 200$. (21) Histopathological finding of eyelid melanoma. H&E stain, $\times 200$.

Jindo dog (23). In the survey of the Jindo dog, the persistent hyaloid vessel remnant was found to generally regress after birth (23). However, it was found that there was no any effect of age statistically for PHVR in Sapsaree dogs.

Cataract was most common disease for acquired ophthalmic disease in Sapsaree dogs. The breeds with high cataract prevalence include: Smooth Fox Terrier (11.70%), Havanese (11.57%), Bichon Frise (11.45%) and Boston Terrier (11.11%) in North America (8). In this study, the prevalence of cataract was only 3.7% in the Sapsaree and the prevalence of this disease was comparatively low compared to that of other breeds.

There are various origins of the cataract in dogs (8). In the Sapsaree, the shapes and resulting conditions were irregular for most of cataracts. Without only one cataract, which accompanied with PPM, there were not any specific appearance and any concerning congenital defects. Most cataracts might be acquired cataract rather than being inherited in the Sapsaree.

Increasing age probably contributed to the development of cataract (25). However, there were no correlation between age and cataract in the Sapsaree. It was suggested that other factors might be more effective to develop cataract than aging in the Sapsaree such as excessive ultraviolet light exposure (20), nutritional deficiencies (16,21,24) and metabolic diseases as like diabetes mellitus (4,6).

The prevalence of cataract between males and females was reported almost the same on the evaluation of the all breeds (8). However, the American Cocker Spaniel demonstrated a trend that the female had more prevalent cataract than the males, whereas a higher number of males than females present with cataract for the Australian Terrier, the Japanese Chin and the Bearded Collie in North America (8). In this study, the effect of sex for cataract in the Sapsaree was not found.

Postinflammatory retinal degeneration (PIRD) is usually the sequela of chorioretinitis; it causes atrophy of the retina and hyperreflectivity. It is more commonly found in older dogs than young puppies (2). Similarly, it was revealed that this disease was strong positive correlation with aging. The causes for chorioretinitis are unclear except secondary infection, including virus infection (18), toxoplasmosis (19), cryptococcosis (26), blastomycosis (7) and other systemic diseases (2).

This study was first investigation of clinical ophthalmic findings for the Sapsaree. Though this study did not elucidate the relationship between genetic and ophthalmic diseases in the Sapsaree, it might be contributed to eliminate the inherited ophthalmic diseases and be useful for reference in clinics.

Acknowledgments

This study was supported by grant No.KRD-2006-E00153 from the Korea Research Foundation Grant by Korean Gov-

ernment (MOEHRD) and BK21 program for Veterinary Science and through Research Institute for Veterinary Science (RIVS), College of Veterinary Medicine, Seoul National University, Korea. Also, the authors deeply appreciated to the staffs of the Korean Sapsaree Association for their assistance with data collection, and for their handling of Sapsarees.

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