

## Assessment of eye disorders in brachycephalic cat breeds - a retrospective study of 328 cases (2018-2022)

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**DEMIR, A.: Assessment of eye disorders in brachycephalic cat breeds - a retrospective study of 328 cases (2018-2022). Vet. arhiv 94, 237-254, 2024.**

### ABSTRACT

Excess selective breeding that causes significant changes in the facial structure of brachiocephalic breeds has resulted in potential ophthalmological disorders that put their vision at risk. This study aims to assess the prevalence of ophthalmological disorders in seven cat breeds referred to the Ophthalmology Clinic of the Veterinary Teaching Hospital between January 2018 and January 2022. The medical records of all patients that underwent a complete ophthalmological examination, including patient signalment, clinical signs, routine and complementary ophthalmological test results, diagnosis, frequency, and the dates of visits were closely monitored, and the data were summarized in Microsoft Office Excel 2010®. The mean age at the initial referral was 4.65 years (ranging from 2 months to 14 years). The most prevalent breeds were Persians, British Shorthairs, and Scottish Folds, in descending order, at 35.9% (n=118/328), 27.1% (n=89/328), and 16.1% (n=53/328), respectively. Entropion, conjunctivitis, and corneal necrosis were the most common disorders, each of which was detected in  $\geq 100$  cats. The lesions' anatomic localization-wise distribution most frequently involved, in descending order, the conjunctiva, cornea, and eyelid at 42.57% (n=321/754), 25.86% (n=195/754), and 22.14% (n=161/754), respectively. In conclusion, the study aimed to instruct the pet owners and breeders concerning understanding the potential severity of health issues in brachycephalic pet animals, and will undoubtedly contribute to veterinary practitioners' clinical approach to various eye conditions by determining the most commonly encountered eye disorders in these breeds.

**Key words:** brachycephalic breeds; entropion; cat; conjunctivitis; corneal necrosis

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### Introduction

Particular selective breeding procedures applied over the last three decades, aimed at producing a more appealing appearance with morpho-anatomical changes in skull conformation, disproportionate to the body, such as a large round head, a shortened flat face, a broad forehead with large eyes, generating a newborn-like appearance in brachycephalic cat

breeds have increased the popularity of these breeds (GLAZE, 2005; ESSON, 2015; GRAHAM, 2017). However, this facial conformation generates several potential health and welfare issues, including ophthalmological complications, even though it is considered "adorable" (GLAZE, 2005; ESSON, 2015; GRAHAM, 2017). The brachycephalic

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morphology manifested by a large round head, a large cranium, a flattened nose due to excessive skin folds, and creating a “split” between the eyes at the junction of the nasal and frontal bones, leads to several primary eyelid abnormalities, including macroblepharon, lagophthalmos, medial entropion, and trichiasis, and other ocular structures, such as the conjunctiva and cornea, are secondarily affected, inducing brachycephalic ocular syndrome (BOS) (MAGGS et al., 2008; ESSON, 2015; SCHMIDT et al., 2017).

The brachycephalic breeds’ characteristic facial and orbital conformation occurs due to their rounded cranium, morphologically generating exophthalmos. Huge eyes and macropalpebral fissures lead to insufficient ocular closure and lubrication, potentially endangering ocular surface health. The reduced corneal sensation renders the eyes susceptible to chronic exposure-related conditions. Excessive nasal skin folds and long nasal hairs cause frictional trauma, leading to several ocular surface disorders, including chronic conjunctivitis, exposure keratopathy, corneal erosion, corneal sequestrum, corneal ulcers, and corneal perforation. Furthermore, various either known or suspected ocular diseases not involved in BOS, such as distichiasis, corneal dystrophy, the prolapsed nictitating gland and everted cartilage, congenital and progressive cataracts, lens luxation, and glaucoma, are listed among the ocular disorders of the brachycephalic cat breeds (NASISSE et al. 1993; NARFSTROM, 1999; COSTA et al. 2021).

Selectively breeding of animals to develop extremist morpho-anatomical features such as brachycephaly, potentially threatening animal health and welfare, has recently become a matter of debate. It is considered crucial to initially recognize the brachycephalic cat breeds’ phenotype-related health issues, and precisely monitor and describe the clinical characteristics of the cats with these disorders. More awareness is required concerning the significance of regular ophthalmological examinations enabling early diagnosis of primary ocular diseases, and developing a prophylactic approach strategy in these cat breeds. This study is the first to provide prospective insight into

the brachycephalic cat breeds’ ocular health and characterize more comprehensively their ocular disease complex through investigating in detail the patients’ signalment (age, breed, and gender), clinical signs, and the disorder’s aetiology.

### Materials and methods

*Animals.* Medical records of a total of 481 eyes of 328 brachycephalic cats of seven different species that were referred to the Ophthalmology Clinic of the Istanbul University-Cerrahpaşa, Faculty of Veterinary Medicine, and Department of Surgery as the primary care centre or that were sent from private veterinary clinics between January 2018 and January 2022, were retrospectively evaluated.

This study was approved by the Animal Experiments Local Ethics Committee of Istanbul University-Cerrahpaşa (Approval no: 2021/43).

*Method.* The original patient files, issued at initial admission between 2018 and 2022, and the patient monitoring forms, filled in by an ophthalmologist, were evaluated along with the surgery records, and the incidence and breed-wise prevalence of the disorders were determined. Radiological and laboratory results were derived from the hospital’s computer-based patient record database. Phone calls and face-to-face inquiries were required if there was any ambiguity concerning individual patient information. The data derived comprised the patients’ initial referral date, patient signalment, affected eyes, characteristics of the eye condition (disease type, ocular structure involved, and the aetiology), diagnosis, and treatment procedures.

According to the lesion site, the ocular disorders were categorized as the orbita, eyelids, third eyelid, conjunctiva, cornea, uvea, lens, retina, and optic nerve. The seven brachycephalic cat breeds involved were: Persian, Scottish Fold, British Shorthair/Longhair, Chinchilla, Himalayan, and Exotic Shorthair. The animals were classified into five groups in relation to age-wise distribution: two months to 1-year-old, 2-5-years old, 6-9-years old, 10-13years old, and 14 years of age and above. The collected data were listed on an Excel worksheet (Microsoft Office 2010, Excel 2010).

Patient demographics and final diagnosis were also recorded in Excel. Ratios and percentage values were calculated and converted. The results were summarized and are shown in Tables 1 and 2 followed by an interpretation of the overall data.

Only the brachycephalic cat breeds mentioned above and of these only those manifesting disorders of the eye and adnexa were involved in the study. The brachycephalic cats referred to the hospital for a general clinical examination or other health issues with no sign of an ocular disorder, and those with unidentified or unclassified ophthalmological complaints that failed to meet the established parameters were excluded.

*Ophthalmological examinations.* The cats were examined for particular parameters, including anomaly in ocular globe size or position (Fig. 1), anatomical asymmetry, abnormal ocular adnexa, and ocular discharge.



Fig. 1. A case of severe unilateral proptosis after trauma in a 6-year-old Persian cat

The ophthalmological examinations, including ocular reflexes, such as bilateral menace response, dazzle reflex, and pupillary light reflex, biomicroscopic examination of anterior ocular segments, fluorescein staining, Schirmer's tear test, direct ophthalmoscopy, and tonometric measurement of intraocular pressure (Tonovet), were performed by an experienced specialist or

a qualified assistant. Posterior ocular segment examination was performed after mydriasis pharmacologically achieved using 1% tropicamide. Subsidiary complementary examinations such as ocular ultrasonography were applied in patients when the fundus was not visible. Additional ophthalmological tests were performed to reach a diagnosis, and a treatment protocol was initiated if necessary. The patients with comorbid clinical signs of a systemic disease, referred initially to the ophthalmology clinic, were referred to consultation with internal medicine professionals, and the diagnoses were confirmed. The patients presenting signs of a systemic disease with ocular involvement that had been referred initially to the internal medicine clinic were also individually examined in the ophthalmology clinic. The final diagnosis or diagnoses were recorded in each patient's file after consultations.

This study assessed the prevalence of eye disorders in brachycephalic cat breeds, but the treatment protocols and outcomes were not within the study's scope.

## Results

Patient files of 2429 cats examined at the ophthalmology clinic were investigated during the study period (January 2018 – January 2022). Four hundred and eighty-one eyes of 328 cats of the seven brachycephalic breeds were evaluated. The study's cat population consisted of Persian (n=118), British Shorthair (n=89), Scottish Fold (n=53), Exotic Shorthair (n=34), Himalayan (n=15), Chinchilla (n=14), and British Longhair (n=5) breeds. The cats with no signs of ophthalmological disorder and breeds other than the above-mentioned brachycephalic cats accounted for 86.49% (2101) patients and were excluded. Distribution of common eye diseases are presented in Fig. 2 and less common diseases in Fig. 3 in brachiocephalic breeds.

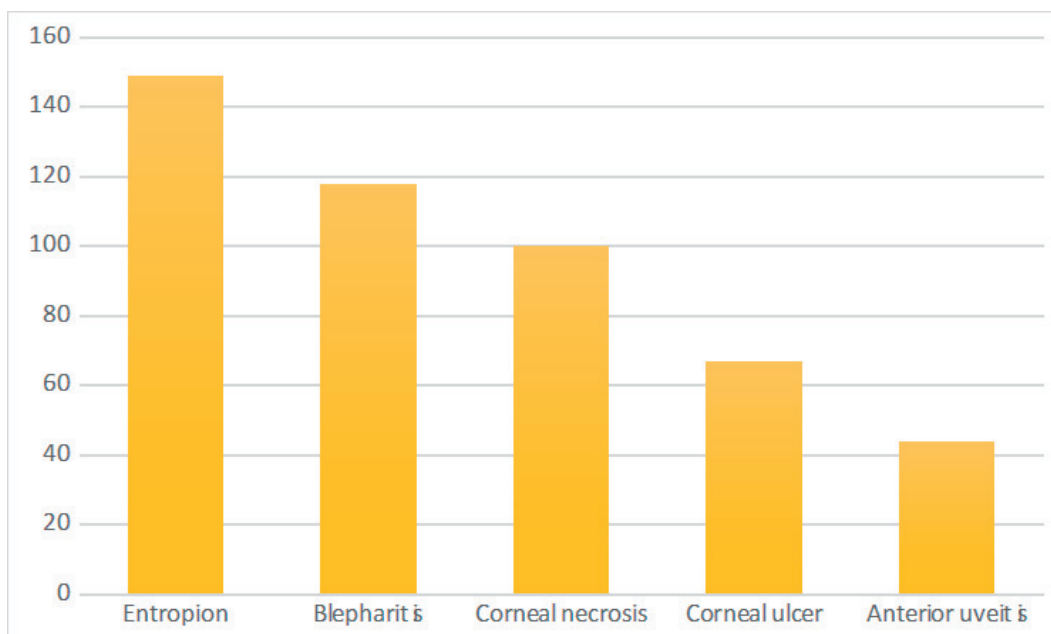


Fig. 2. Distribution of common eye diseases encountered in brachiocephalic cats

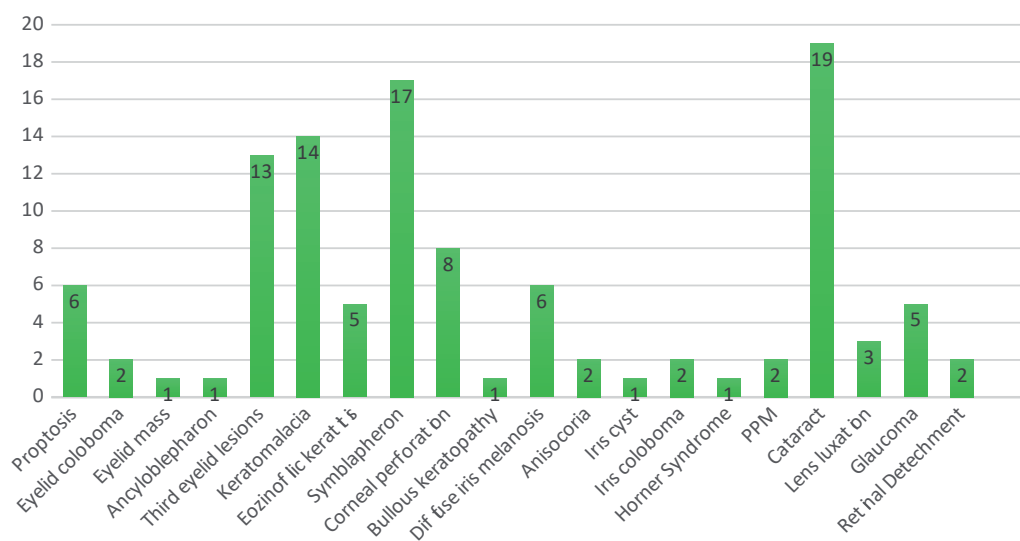


Fig. 3. Distribution of less common eye diseases encountered in brachiocephalic cats

The cats comprised 179 females (54.5%) and 149 males (45.4%), aged between two months and 14 years (Average: 4.65 years). The highest consultation frequency was determined for two to five-year-old cats, amounting to 53.15%. The distribution of cats by breed, age and sex is listed in Table 1. The distributions of disease type and lesion site are given in Table 2. The distribution of ocular manifestations of systemic conditions is indicated in Table 3.

The prevalence and pattern of ocular disorders differed according to age and breed. The

distribution of eye diseases according to breeds is shown in Fig. 4 and anatomical regions in Fig. 5. Conjunctival conditions were the most prevalent (97.86%) disorders (Fig. 6). Within this category, conjunctivitis was encountered in every breed included and most frequently affected two to five-year-old cats (57.94%). The ocular conditions comprised corneal diseases (49%), eyelid disorders (23.15%), intraocular diseases (14.6%), and infection-related pathologies (5.7%). The most prevalent breeds were Persian (35.51%) and British shorthair (26.16%).

Table 1. The distribution of cats by breed, age and sex

Variables	Categories	No. of cases	% of total
Age	2 weeks - 1.5 years	156	47.56
	2-5 years	142	43.29
	6-9 years	22	6.70
	10-13 years	7	2.13
	≥ 13	1	0.30
Sex	Male	149	45.42
	Female	179	54.57
Breed	Persian	118	35.97
	Chinchilla	14	4.26
	British Shorthair	89	27.13
	Scottish Fold	53	16.15
	British Longhair	5	1.52
	Himalayan	15	4.57
	Exotic Shorthair	34	10.36

A. Demir: Eye disorders in brachycephalic cat breeds

Table 2. Type of disease, distribution of locations of the lesions, by breed and age

Item	Cat breed <sup>1</sup>							Total n=328	Age (yrs)				
	P n=118	C n=14	H n=15	ES n=34	SF n=53	BS n=89	BL (n=5)						
	35.97%	4.26%	4.57%	10.36%	16.15%	27.13%	1.52%		≤1.5 n	2-5 n	6-9 n	10-13 n	≥14 n
Anatomical region													
Orbita-bulbus	2	-	-	2	-	1	1	6	3	1	2	-	-
Eyelid	64	5	10	25	25	30	-	159	53	83	16	6	1
Conjunctiva	116	13	15	32	49	76	5	306	90	186	19	9	2
Cornea	80	7	12	28	36	46	3	212	78	114	15	5	
Uvea	10	4	1	1	3	22	-	41	31	8	1	1	-
Lens	7	-	1	-	4	7	-	19	12	4	1	2	-
Retina	2	-	-	-	-	-	-	2	1	-	-	1	-
Common eye diseases													
Conjunctivitis	114	13	15	32	49	74	5	302	90	184	19	8	1
Entropion and Blepharitis	64	5	10	25	23	28	-	155	50	82	16	6	1
Corneal necrosis	44	2	9	20	11	13	1	100	19	67	12	2	-
Corneal ulcer	24	1	2	7	13	19	1	67	32	34	1	-	-
Anterior uveitis	9	2	1	-	2	14	-	28	25	2	-	1	-
Less common eye diseases													
Proptosis	2	-	-	1	-	-	1	4	1	1	2	-	-
Panophthalmitis	-	-	-	1	-	1	-	2	2	-	-	-	-
Eyelid coloboma	-	-	-	-	2	-	-	2	1	1	-	-	-
Eyelid mass	-	-	-	-	-	1	-	1	1	-	-	-	-
Ancyloblepharon	-	-	-	-	-	1	-	1	1	-	-	-	-
Conjunctival dermoid	-	-	-	-	-	1	-	1	-	1	-	-	-
Dacryocystitis	1	-	-	-	-	-	-	1	-	1	-	-	1
Glandula nictitans hyperplasia	5	-	-	2	1	1	-	9	4	2	3	-	-

Table 2. Type of disease, distribution of locations of the lesions, by breed and age (continued)

Nictitans membrane protrusion	-	-	-	-	1	-	-	1	1	-	-	-	-
Cartilage eversion of nictitans membrane	1	-	-	-	-	1	-	2	2	-	-	-	-
Mass of nictitans membrane	-	-	-	-	-	1	-	1	1	-	-	-	-
Keratoma-lacia	6	1	1	1	3	2	-	14	5	7	1	1	-
Eozinoflic keratitis	2	1	-	-	-	2	-	5	3	2	-	-	-
Symblapher-on	-	-	-	-	9	8	-	17	15	2	-	-	-
Corneal perforation	4	2	-	-	-	2	-	8	3	3	1	1	-
Bullous keratopathy	-	-	-	-	-	-	1	1	1	-	-	-	-
Diffuse iris melanosis	1	1	-	1	-	3	-	6	1	4	1	-	-
Anisocoaria	-	-	-	-	-	2	-	2	1	1	-	-	-
Iris cyst	-	-	-	-	-	1	-	1	-	1	-	-	-
Iris coloboma	1	1	-	-	-	-	-	2	2	-	-	-	-
Horner syndrome	1	-	-	-	-	-	-	1	1	-	-	-	-
PPM	-	-	-	-	1	-	-	1	1	-	-	-	-
Cataract	7	-	1	-	4	7	-	19	12	4	1	2	-
Lens luxation	2	-	-	-	-	1	-	3	1	-	1	1	-
Glaucoma	4	-	-	-	-	1	-	5	2	-	-	3	-
Retinal detachment	2	-	-	-	-	-	-	2	1	-	-	1	-

BL= British Longhair; ES= Exotic Shorthair; SF= Scottish Fold; BS= British Shorthair, P= Persian, C= Chinchilla, H= Himalayan  
PPM= Persistent pupillary membrane

Table 3. Distribution of ocular manifestations of systemic conditions

Ocular lesions	Parasitic diseases		Bacterial diseases	Viral diseases				Neoplastic diseases			Vascular diseases	Metabolic diseases		Immuno-mediated diseases	Iatrogenic Diseases	Physiological situations	Total
	Toxoplasmosis	F. Demodicosis		Bartonellosis	FeLV	FIP	FHV-1	Calicivirus	Adenocarcinoma	Lymphoma		Polyyps	SH				
Panophthalmitis						1				1							2
PD		2				1					1			1			5
Entropion						5	1										6
Ankyloblepharon						1											1
Conjunctivitis						9	6										15
Haws syndrome													1				1
Symblepharon						10	3										13
Corneal ulcer						16											16
Corneal necrosis						4									3		7
EK						2											2
BK						1											1
Keratoma-lasia						3											3



Table 3. Distribution of ocular manifestations of systemic conditions (continued)

Ocular lesions	Parasitic diseases		Bacterial diseases	Viral diseases				Neoplastic diseases			Vascular diseases		Metabolic diseases		Immuno-mediated diseases	Iatrogenic Diseases	Physiological situations	Total	
	Toxoplasmosis	F. Demodicosis	Bartonellosis	FeLV	FIP	FHV-1	Calicivirus	Adenocarcinoma	Lymphoma	Polyps	SH	FNA	GID	PP	POTNP	Sexual cycle			
CP						1												1	
Anterior uveitis	1		1	1	13			1										1	20
Anisocoria				1														1	
Iris melanosis					1													1	
Homer syndrome										1								1	
Cataract				1	2													3	
Glaucoma					1													1	
RD											2							2	
Total	1	2	1	3	17	54	10	1	1	1	4	1	1	1	1	3	1		

PD: periocular dermatitis, EK: eosinophilic keratitis, BK: bullous keratopathy, CP: corneal perforation, RD: retinal detachment  
 F: feline; <sup>3</sup>FeLV: Feline leukaemia virus, FIP: feline infectious peritonitis, FHV-1: Feline herpes virus-1, SH: systemic hypertension, FNA: food nutrition allergy, GID: gastrointestinal diseases, PP: *Pemphigus foliaceus*, POTNP: post-operative trigeminal nerve paralysis

A. Demir: Eye disorders in brachycephalic cat breeds

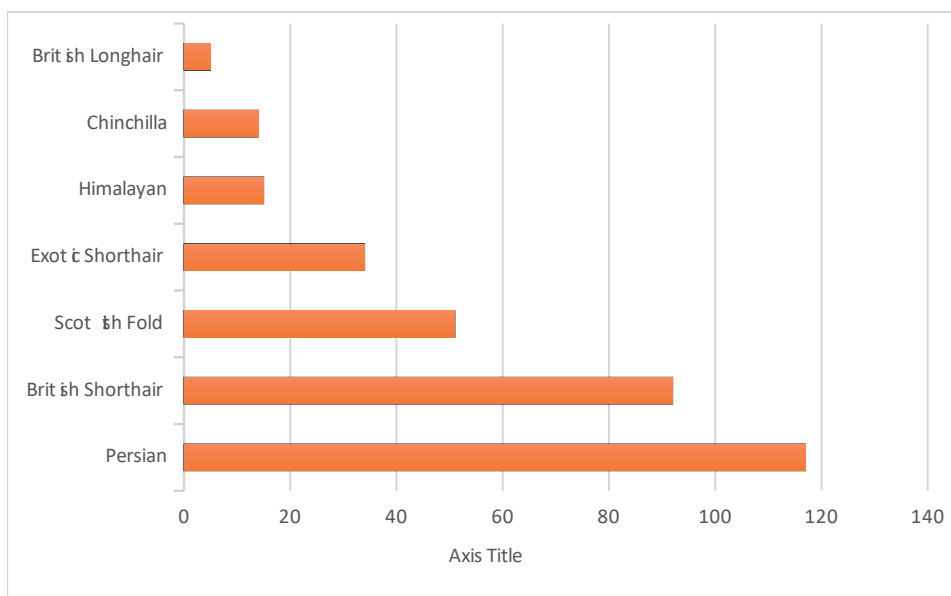


Fig. 4. Distribution of eye diseases according to breeds

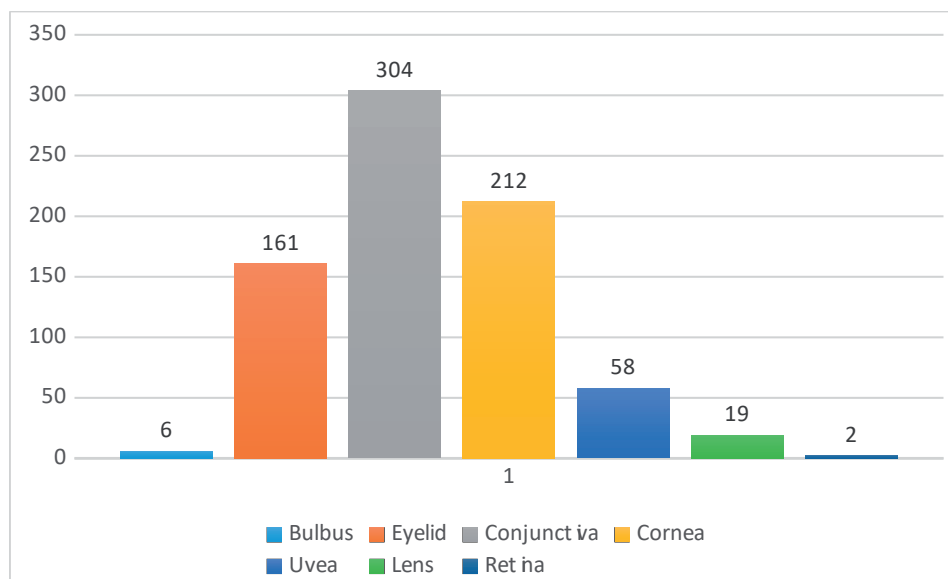


Fig. 5. Distribution of eye diseases by anatomical region



Fig. 6. Symblepharon in which the bulbar conjunctiva is attached to the cornea due to FHV-1 infection in a 1-year-old Scottish Fold cat

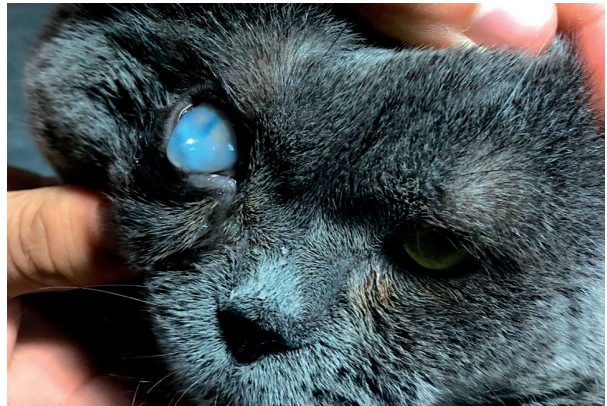


Fig. 8. A case of keratomalacia in a 1.5-year-old Scottish Fold cat

Corneal diseases were the second most prevalent ocular condition and represented 59.45% of the cases (Fig. 7, 8, 9, 10). The most frequently encountered disease within this category was corneal necrosis (51.28%) and was most prevalent in two to 5-year-old Persians (44%). As the second most frequent disease (35.35%), corneal ulcers affected 35.82% of the Persians, particularly those under five years of age. Corneal necrosis was associated (Fig. 11), in descending order, with entropion (43%), unknown causes (35%), chronic corneal ulcers (13%), chronic corneal infections (4%), trauma (3%), and tear film deficiency (2%). Corneal ulcers were determined to have developed due to an infection (28.35%), breed predilection (22.38%), entropion (20.89%), trauma (17.91%) (Fig. 12), and unknown causes (10.44%).

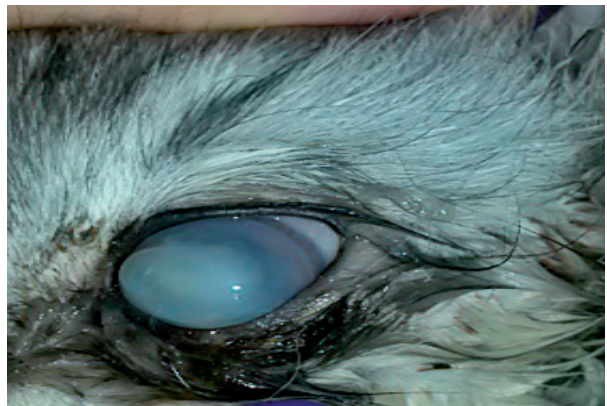


Fig. 9. Bullous keratopathy in a 2.5-month-old British Shorthair cat



Fig. 7. A case of corneal perforation in the right eye, and fibrin and clot in the anterior chamber due to trauma in a 13-year-old Persian cat



Fig. 10. Eosinophilic keratitis in a 3-year-old Scottish Fold cat



Fig. 11. Right paracentral corneal necrosis, bilateral medial entropion and epiphora in an 8-year old Persian cats



Fig. 13. Unilateral severe blepharitis and conjunctivitis due to bacterial infection in a 5-year- old Persian cat



Fig. 12. Stromal corneal ulcer, oedema and neovascularization in a 2-year-old Exotic Shorthair cat



Fig. 14. Ankyloblepharon due to viral infection in a 2.5-month-old British shorthair breed

Eyelid disorders accounted for 50.91% of the cases (Fig. 13, 14, 15, 16). Entropion and epiphora were the most prevalent disorders within this category (92.81%). Entropion most frequently affected 0 to 5-year-old cats in every breed except for British Longhairs, with the Persians ranking first (41.29%). Medial entropion with bilateral involvement was encountered in 106 cases, with the Persians being the most affected cats (n=54/100). Entropion involved the lower and upper eyelid in 43 cases, most frequently occurring in British Shorthairs (n=16/43).



Fig. 15. A case of unilateral upper eyelid coloboma accompanied by PPM in a 1.5-year-old British Shorthair cat

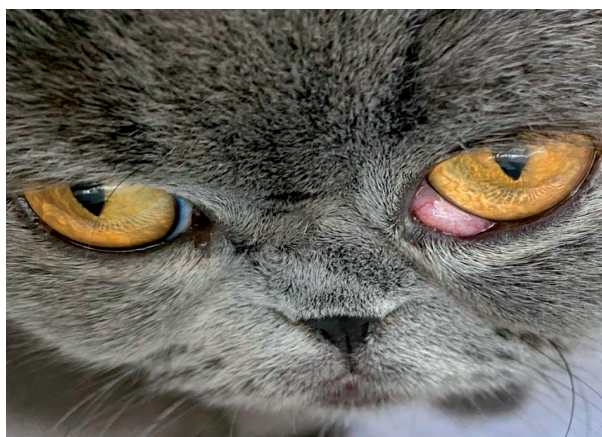


Fig. 16. Prolapsed gland of the nictitans in a 1.5-year-old Scottish fold cat

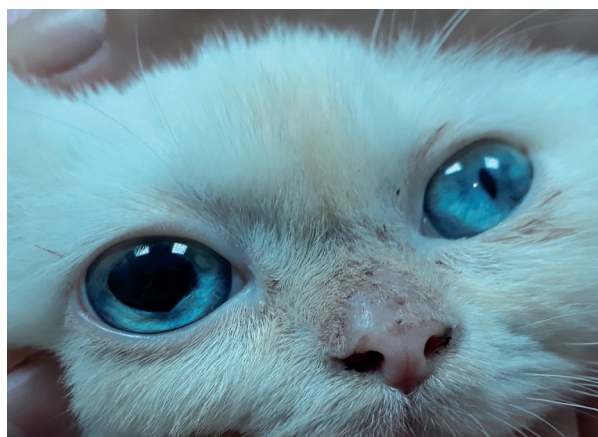


Fig. 18. A case of right eye iris coloboma in a 4-month-old Persian cat

Uveal diseases comprised 12.5% of the cases (Fig. 17, 18, 19), and anterior uveitis (Fig. 20) was the most prevalent disorder within this category by 68.29%. Fifty per cent of the cases were in British Shorthairs, and it was most prevalent in the age range below 1.5 years (89.28%).



Fig. 19. Iris cyst in the right eye of a 2-year-old British Shorthair cat



Fig. 17. Diffuse iris melanosis in a 5-year-old Exotic Shorthair cat

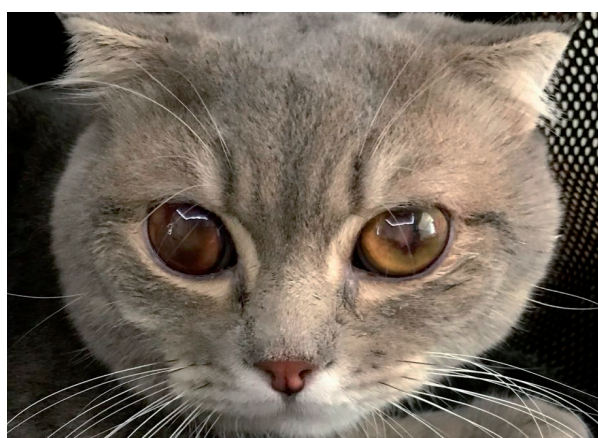


Fig. 20. Bilateral anterior uveitis due to FIP infection in 1-year-old Scottish Fold cat

Lens disorders were the least encountered ocular condition, in 6.70% of the cases. Cataracts were detected in all patients within this disease category, with the Persians (n=7, 36.84%) and British Shorthairs (n=7, 36.84%) being the most affected breeds under 1.5 years of age, with a prevalence rate of 63.15%. Cataracts were genetic in 10 patients (Fig. 21), while they developed due to uveitis and trauma in eight and one single cat, respectively.



Fig. 21. Bilateral congenital mature cataracts in a 9-month-old Scottish Fold cat

## Discussion

Brachycephaly is a term used to refer to animals with prominently shortened maxilla and noses. Brachycephalic ocular disease is a syndrome that defines a complex of disorders most frequently involving the eyelids, conjunctiva, and cornea in these breeds (MAGGS et al., 2008). This syndrome raises more health and welfare issues in brachycephalic breeds than in dolichocephalic animals due to the morpho-anatomic changes in the oculo-facial conformation. Moreover, particular abnormalities might have initially gone unnoticed due to the lack of any clinical complaints; however, they might have progressed over time, hampering vision and thus adversely impacting the animal's welfare. Therefore, it is of utmost importance to recognize the impact of the morphological features of brachycephalic breeds, and stay alert for potential clinical manifestations. To the best of our knowledge, this study is the first to report the spectrum of ocular disorders in brachycephalic

cat breeds admitted to the teaching hospital of the faculty of veterinary medicine. The study facilitated assessment of the incidence of brachycephalic conformation-related ocular conditions in 328 brachycephalic cats by defining the lesion types, prevalence, and clinical signs.

Persians are one of the most ancient cat breeds with worldwide recognition, and they are the second most popular cats in the UK, after British Shorthairs (O'NEILL et al., 2019). Several other cats, such as Himalayans, Chinchillas and Exotic Shorthairs with several peculiar phenotypic features such as colour and fur texture are kindred breeds of Persians (BLOCKER and WOERDT 2001). It has been reported that, despite their popularity, their facial conformation and genotypic heritage render them more susceptible to ophthalmological conditions, such as reduced corneal sensation affecting the anterior ocular segment, eyelid agenesis, dermoids, entropion, chronic epiphora due to nasolacrimal duct obstruction, facial irritation, non-healing corneal ulcers, and corneal sequestrum, than in non-purebred cat breeds (NARFSTROM, 1999; O'NEILL et al., 2019). O'NEILL et al. (2019), reported that conjunctivitis was detected in 4.5% of Persians compared to its prevalence rate of 3% in the entire purebred cat population involved in their study, indicating that the risk for conjunctival inflammation was mainly associated with conditions such as entropion. In the same way, the most frequently detected eye disorders, such as conjunctivitis (37.74%), entropion (41.29%), and corneal necrosis (44%), were mainly noted in Persian cats in the present study. The increased population of Persians in parallel to the current growing demand for such breeds in Turkey was considered to have had an impact on our results, revealing a higher incidence of ocular lesions in Persians.

TRBOLOVA (2014) showed that conjunctivitis was the most prevalent eye disorder in cats, and infections were the most frequent cause. NASISSE et al. (1993), demonstrated that the clinical manifestations and laboratory findings of chronic conjunctivitis primarily developed due to an infection, in a retrospective study conducted on 91 cats, aged between one month and 11 years old,

with an average age of 2.9 +/-2.7 years (+/- SD). MITCHELL (2006) indicated that infectious agents were the most frequent cause of conjunctivitis, and multiple agents might have been involved in the inflammation process (MITCHELL, 2006). Furthermore, ÇAKMAKÇI (2019) reported that conjunctivitis in cats might have occurred due to adnexal anomalies such as entropion, as in their canine counterparts. WILLIAMS and KIM (2009) reported this to have developed due to the chronic irritation of the cornea and conjunctiva resulting from congenital entropion in longhair cat breeds such as Persians and Himalayans. Likewise, conjunctival diseases were the most frequently detected disorders in the present study's cat population, with a prevalence rate of 97.86%. Within this category, conjunctivitis was monitored in 302 cats (92.7%), which affected all cat breeds, with the highest prevalence rate between 0 to five years of age (60.92%), and most commonly in Persians (37.74%) and British Shorthairs (24.50%). In our study, conjunctivitis occurred due to other ocular disorders such as corneal (49%) and eyelid (23.1%) defects, unlike in previous studies indicating that conjunctivitis was more likely associated with infection.

Corneal diseases were the second most frequently encountered ocular disorder, with a prevalence rate of 59.45%. Corneal necrosis was the most prevalent lesion (51.28%) within this category, primarily affecting Persians and Exotic Shorthairs, even though every breed was affected. The cats' ages ranged between seven months and 13 years, with the highest incidence in two to five-year-old cats, with an average age of 3.3 years. DALLA (2007), noted that the most affected cats were Persians aged two months to 14 years. According to a recent study by GRAHAM et al. (2017), Persians, Burmese cats, and Himalayans were the most affected cats, ranging from eight months to 18 years of age. Our results revealed that these lesions more frequently (44%) developed in 2-5-year-old Persian cats, in line with the previous data. These lesions were also noted to be prevalent in Exotic Shorthairs as an additional finding. While FEATHERSTONE and SANSOM (2004) and WILLIAMS and KIM (2009) reported that brachycephalic cats were

more prone to develop corneal sequestrum due to exposure keratopathy (prolonged exposure of the central cornea to the outside environment), along with other predisposing factors such as feline herpes virus (FHV-1) infection and palpebral defects like entropion, BARACHETTI et al. (2010) indicated entropion as the leading cause of corneal necrosis. In our study, corneal necrosis was associated with entropion (43%), chronic corneal ulcers (13%), chronic corneal infection (4%), trauma (3%), tear film deficiency (2%), and unknown causes (35%). Similar to BARACHETTI et al. (2010), we noted that corneal necrosis primarily developed due to secondary entropion (43%), and secondarily to the chronic exposure of the central cornea (35%). We may deduce that the damage generated on the cornea by facial fur due to entropion leads to severe corneal necrosis in such breeds, and patients with entropion should be closely monitored for potential corneal damage and necrosis. Furthermore, the high incidence of corneal necrosis in brachycephalic cats was associated with their unique facial and ocular conformation, regardless of the underlying causes, which is compatible with the previously mentioned studies.

Corneal ulcers (n=67/328) were found with a high prevalence in our study's cat population. In a recent study, KARTASHOV et al. (2019), showed that corneal ulcers were most prevalent in British Shorthairs and Scottish Folds due to FHV-1 infection, with high frequency and severity. Furthermore, ocular trauma, ocular viral infections or systemic infections affecting the eye, inadequate tear production, eyelid abnormalities, chemical burns, and facial paralysis were listed among the underlying causes (KARTASHOV et al., 2019). On the other hand, GLAZE (2005) and O'NEILL et al. (2019) reported that all cats are susceptible to corneal ulcers; yet, cats with large eyes and flat-faces, such as Himalayans, Persians, and Birmans, are more prone to develop corneal ulcers. In our study, corneal ulcers affected all cat breeds, being more prevalent in Persians (35.82%), British Shorthairs (28.35%), and Scottish Folds (19.40%), indicating a potential breed-wise predisposition. Infection, hereditary predisposition, entropion, and trauma were the underlying causes of corneal

ulcers in 19, 15, 14, and 12 cats, respectively. It was shown that infection-associated corneal ulcers in Persians, British Shorthairs, and Scottish folds most frequently affected three month to 5-year-old (Average: 1.6 years) individuals. Breed predilection was most prominent in Persians (n=5), British Shorthairs (n=4), and Scottish Folds (n=4) at four months to 7 years of age (Average: 2.4 years) (O'NEILL et al., 2019).

Eyelid disorders were the third most frequently detected condition, with a prevalence rate of 50.91% in the study, with entropion comprising 92.81% of all eyelid diseases. British Longhairs were the only unaffected breed, which was related to the low number of individuals belonging to this breed in the study's cat population. Bilateral medial entropion was noted in 71.14%, with Persians (n=60) being the most affected breed, followed by British Shorthairs (n=27). Both eyelids (upper and lower) were involved in 25.44%, and the condition was most prevalent in British Shorthairs (n=16) followed by Scottish Folds (n=9). Entropion (mainly bilateral medial entropion) most frequently occurred in Persians (40.2%). The prevalence rates in British Shorthairs (%), Exotic Shorthairs, and Scottish Folds were 18.1%, 16.1%, and 14.7%, respectively. WILLIAMS and KIM (2009) stated that feline entropion developed due to progressive blepharospasm caused by chronic irritation induced by conjunctivitis and corneal ulcers in young cats. In contrast, eyelid floppiness and enophthalmos were the most common underlying causes of entropion in elderly patients. It occurred more frequently in Maine Coon and Persian cats (WILLIAMS and KIM, 2009). KIM et al. (2020), reported that primary entropion was more prevalent than secondary entropion in cats. Persians are known to be more susceptible to developing medial canthal entropion in the lower eyelid due to their prominent globe and hollow orbital gap; however, feline entropion was shown to have developed more frequently at later ages, unlike canine entropion occurring in young dogs (O'NEILL et al., 2019). MCDONALD and KNOLLINGER (2019), reported that the average age of cats with entropion was 9.7 years (mean  $10 \pm 5.5$  years), while that of dogs was 3.1 years (mean  $5.1 \pm 5.5$  years) (7). KIM

et.al. (2020); ANAGRIUS et al. (2021), detected entropion in 32% of 76 Persian + Exotic Shorthair cats, in which the lesion was medially located in the lower eyelid in all cases, indicating that entropion was mainly associated with epiphora. In the present study, entropion, particularly medial entropion, was directly associated with the facial conformation of brachycephalic breeds, simultaneously occurring with epiphora most frequently in two to 5-year-old cats (52.90%).

In the present study, uveal diseases were among the most prevalent intraocular conditions, comprising 12.5% (n=41) of the cat population. Anterior uveitis, with a prevalence rate of 8.53% (n=28/328), most frequently occurred in British Shorthairs and Persians with prevalence rates of 50% (n=14/28) and 32.14% (n=18/60), respectively. Cataracts (5.79%) were detected in seven Persian and seven British Shorthair cats. Cataracts were of genetic origin in ten cases and developed due to uveitis and trauma in eight and one single cat, respectively. Some authors reported that cataracts are a hereditary condition due to an autosomal recessive gene in Persians, British Shorthairs, and Himalayans (TELLE and HENDRIX, 2016; GUYONNET et al., 2019), and most frequently occur in 0.2 to 9.3-year-old cats (GUYONNET ET AL., 2019). In the present study, hereditary cataracts were noted in six month to 10-year-old (Average: 2.4 years). British Shorthairs (n=4), Scottish Folds (n=3), and Persians (n=3).

As a result, this study demonstrated that the increase in the brachycephalic cat population induced by selective breeding due to these breeds' popularity among pet owners has brought along with it particular health issues, rendering them susceptible to ocular conditions, like BOS in their canine counterparts, due to their characteristic flattened facial conformation. According to the results of our study, it was determined that brachiocephalic breeds are particularly prone to eyelid, conjunctiva, and corneal diseases due to this structural defect. Among the brachiocephalic breeds, the breeds with the most common ocular lesions were Persian, British Shorthair, and Scottish Fold. It should be noted that the likelihood of entropion-associated corneal ulcers developing into



corneal necrosis is respectively high in these breeds. Symblepharon, primarily affecting domestic cat breeds, was more prevalent in Scottish Folds and British Shorthairs. FIP played a significant role in the aetiology of anterior uveitis, while FHV-1 was the underlying cause of conjunctivitis, corneal ulcers, and symblepharon. We have deduced that BOS-like conditions will remain a significant health problem in the future with the increasing demand for these breeds. Therefore, a comprehensive understanding of the common health issues in these breeds is crucial for veterinary practitioners to estimate the risks, the course of the diseases, and possible outcomes, and carefully monitor their patients for their particular requirements. We assume that the present study will offer guidance for breeding strategies in cats and, most importantly, for owners and veterinarians to recognize their health issues in advance and take specific preventive measures against further complications. We also believe that it will assist in raising awareness regarding the challenges of owning a brachycephalic cat breed and the necessity to improve their welfare and quality of life.

### Ethics approval

This study was approved by the Animal Experiments Local Ethics Committee of Istanbul University-Cerrahpaşa (Approval no: 2021/43).

### Declaration of Competing Interest

The author declare no conflict of interest.

### References

- ANAGRIUS, K. L., M. DIMOPOULOU, A. N. MOE, A. PETERSON, I. LJUNGVALI (2021): Facial conformation characteristics in Persian and Exotic Shorthair cats. *J. Feline Med. Surg.* 23, 1089-1097.  
<https://doi.org/10.1177/1098612X21997631>
- BARACHETTI, L., C. GIUDICE, C. M. MORTELLARO (2010): Amniotic membrane transplantation for the treatment of feline corneal sequestrum: pilot study. *Vet. Ophthalmol.* 13, 326-330.  
<https://doi.org/10.1111/j.1463-5224.2010.00821.x>
- BLOCKER, T., A. VAN DER WOERDT (2001): A comparison of corneal sensitivity between brachycephalic and Domestic Short-haired cats. *Vet. Ophthalmol.* 4, 127-130.  
<https://doi.org/10.1046/j.1463-5224.2001.00189.x>
- COSTA, J., A. STEINMETZ, E. DELGADO (2021): Clinical signs of brachycephalic ocular syndrome in 93 dogs. *Ir. Vet. J.* 74, 1-8.  
<https://doi.org/10.1186/s13620-021-00183-5>
- ÇAKMAKÇI, E. (2019): Studies on the Diagnosis and Treatment of Conjunctival Diseases in Cats and Dogs Brought to Our Clinic. Master's thesis, Aydin Adnan Menderes Univ Health Sciences Institute, Aydin.
- DALLA, F., L. PISONI, L. MASETTI (2007): Feline corneal sequestration: a review of medical treatment in 37 cases. *Vet. Res. Commun.* 31, S285-S288.  
<https://doi.org/10.1007/s11259-007-0098-0>
- ESSON, D. W. (2015): Corneascleral diseases. In: *Clinical atlas of canine and feline ophthalmic disease*. 1st ed., John Wiley & Sons, USA, pp. 30-31.
- FEATHERSTONE, H. J., J. SANSOM (2004): Feline corneal sequestra: a review of 64 cases (80 eyes) from 1993 to 2000. *Vet. Ophthalmol.* 7, 213-227.  
<https://doi.org/10.1111/j.1463-5224.2004.04028.x>
- GLAZE, M. B. (2005): Congenital and hereditary ocular abnormalities in cats. *Clin. Tech. Small Anim. Pract.* 20, 74-82.  
<https://doi.org/10.1053/j.ctsap.2004.12.011>
- GRAHAM, K. L., J. D. WHITE, F. M. BILLSON (2017): Feline corneal sequestra: outcome of corneconjunctival transposition in 97 cats (109 eyes). *J. Feline Med. Surg.* 19, 710-716.  
<https://doi.org/10.1177/1098612X16645144>
- GUYONNET, A., E. DONZEL, A. BOURGUET, S. CHAHORY (2019): Epidemiology and clinical presentation of feline cataracts in France: A retrospective study of 268 cases. *Vet. Ophthalmol.* 22, 116-124.  
<https://doi.org/10.1111/vop.12567>
- KARTASHOV, S., E. KARTASHOVA, A. BUTENKOY, A. RAKITYANSKAYA, M. PETROVA, M. OBOEVA, M. SULTANOVA (2019): Corneal ulcers associated with FHV-1 in cats. *IOP Conf. Ser.: Earth Environ. Sci.* 403, 012024.  
<https://doi.org/10.1088/1755-1315/403/1/012024>
- KIM, Y., S. KANG, K. SEO (2020): Hyaluronic Acid Subdermal Filler for Correction of Lower Eyelid Entropion in a Cat. *J. Vet. Clin.* 37, 292-294.  
<https://doi.org/10.17555/jvc.2020.10.37.5.292>
- MAGGS, D. J., P. E. MILLER, R. OFRI (2008): *Slatter's Fundamentals of Veterinary Ophthalmology*. 4th ed. Elsevier Health Sciences, Edinburgh, UK.
- MCDONALD, J. E., A. M. KNOLLINGER (2019): The use of hyaluronic acid subdermal filler for entropion in canines and felines: 40 cases. *Vet. Ophthalmol.* 22, 105-115.  
<https://doi.org/10.1111/vop.12566>
- MITCHELL, N. (2006): *Feline Ophthalmology Part 2: Clinical presentation and aetiology of common ocular conditions*. *Ir. Vet. J.* 59, 223-232.

- NARFSTROM, K. (1999): Hereditary and congenital ocular disease in the cat. *J. Feline Med. Surg.* 1, 135-141.  
[https://doi.org/10.1016/S1098-612X\(99\)90202-4](https://doi.org/10.1016/S1098-612X(99)90202-4)
- NASISSE, M. P., J. S. GUY, J. B. STEVENS, R. V. ENGLISH, M. G. DAVIDSON (1993): Clinical and laboratory findings in chronic conjunctivitis in cats: 91 cases (1983-1991). *J. Am. Vet. Med. Assoc.* 203, 834-837.
- O'NEIL, D. G., C. ROMANS, D. C. BRODBELT, D. B. CHURCH, P. CERNA, D. A. GUNN- MOORE (2019): Persian cats under first opinion veterinary care in the UK: demography, mortality and disorders. *Sci. Rep.* 9, 12952.  
<https://doi.org/10.1038/s41598-019-49317-4>
- SCHMIDT, M. J., M. KAMPSCHULTE, S. ENDERLEIN, D. GORGAS, J. LANG, E. LUDEWIG, A. FISCHER, A. R. SCHAUBNER, N. ONDREKA (2017): The relationship between brachycephalic head features in modern persian cats and dysmorphologies of the skull and internal hydrocephalus. *J. Vet. Intern. Med.* 31, 1487-1501.  
<https://doi.org/10.1111/jvim.14805>
- TELLE, M. R., D. HENDRIX (2016): Cataracts in Cats: Diagnosis. *Ophthalmology. Feline Medicine.* 1-4.
- TRBOLOVA, A. (2014): Eyelid agenesis in a cat, clinical case. *Pol. J. Vet. Ophthalmology.* 4, 1-6. <https://bibliotekanauki.pl/articles/9967.pdf>
- WILLIAMS, D. L., J. Y. KIM (2009): Feline entropion: a case series of 50 affected animals (2003–2008). *Vet. Ophthalmol.* 12, 221-226.  
<https://doi.org/10.1111/j.1463-5224.2009.00705.x>

Received: 18 February 2022

Accepted: 16 November 2023

Online publication: 5 April 2024

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**DEMIR, A.: Procjena bolesti oka u brahicefaličnih pasmina mačaka – retrospektivno istraživanje na 328 slučajeva (2018. – 2022.). *Vet. arhiv* 94, 237-254, 2024.**

#### SAŽETAK

Prekomjeran selektivni uzgoj koji uzrokuje znakovite promjene u strukturi lica brahicefaličnih pasmina rezultirao je potencijalnim oftalmološkim poremećajima koji mogu oštetiti vid. Cilj je ovog istraživanja procijeniti prevalenciju oftalmoloških poremećaja u sedam pasmina mačaka upućenih na Kliniku za oftalmologiju u sklopu sveučilišne Veterinarske bolnice, od siječnja 2018. do siječnja 2022. Pažljivo su praćeni nalazi svih pacijenata u kojih je proveden kompletan oftalmološki pregled, uključujući opis životinje (nacional), kliničke znakove, nalaze osnovnih i dodatnih oftalmoloških pretraga, dijagnozu, učestalost i datume posjeta, a podaci su sažeti u programu Microsoft Office Excel 2010®. Prosječna dob pri prvom dolasku oftalmologu bila je 4,65 godina (u rasponu od dva mjeseca do 14 godina). Najzastupljenije su pasmine bile perzijska mačka (35,9%; n=118/328), britanska kratkodlaka mačka (27,1%; n=89/328) i pasmina škotski fold (16,1%; n=53/328). Najčešće su bolesti oka bile entropija, konjunktivitis i nekroza rožnice, a svaka je od njih otkrivena u 100 i više mačaka. U pogledu anatomske smještaja lezija, one su se najčešće nalazile na konjunktivi (42,57%; n=321/754), rožnici (25,86%; n=195/754) i vjeđama (22,14%; n=161/754). Zaključno, cilj je istraživanja bio uputiti vlasnike kućnih ljubimaca i uzgajivače na važnost i potencijalnu ozbiljnost zdravstvenih poteškoća kod brahicefaličnih pasmina mačaka. Navedeno će bez sumnje biti doprinos veterinarskim kliničarima u pristupu različitim stanjima oka tih pasmina mačaka, pri čemu učestalost pojedinih bolesti može biti važan podatak.

**Ključne riječi:** brahicefalične pasmine; entropia; mačka; konjunktivitis; nekroza rožnice

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