

Schirmer tear test, a useful diagnosis tool for the clinician**Teste lacrimal de Schirmer, uma ferramenta diagnóstica útil para o clínico**

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ABSTRACT

It was evaluated the Schirmer Tear Test 1 (STT-1) in 100 dogs randomly attended in order to identify its variations and possible relations with the clinical review, disease, breed, age and sex. The STT-1 was accomplished in both eyes in dogs over two years old, females or males. Of these, those whose complaint included ocular clinical signs or those with previously identified ocular disease were excluded from this study. After analysis it were computed 92 dogs (194 eyes), 34 males and 58 females with $7,79 \pm 3,7$ e $7,76 \pm 3,7$ years old, respectively. About the breeds, 40,2% were mixed breed, 13,0% Poodle, 6,5% Shih-tzu and Basset Hound and 5,4% Pitbull. STT-1 <10 mm/min was observed bilaterally in 4,3% of the dogs with mean age $7,4 \pm 3,9$ years old. Of these, 75% females and 25% males. STT-1 ≥ 10 e ≤ 14 mm/min was observed in 3,2% of the dogs, of these, 66,7% males and 33,3% females, 66,7% mixed breed and 33,3% Teckel. The mean age was $7,6 \pm 3,8$ years old. About the systemic diseases observed in the animals with STT-1 <10 mm/min it were found reproductive apparatus changes(42,8%). It is emphasized the STT-1 in the clinical-surgical veterinary attendance even when the main complaint does not relate the ocular system, mainly in patients over seven years old.

Key-words: dogs, tear film, veterinary ophthalmology, keratoconjunctivitis sicca

RESUMO

Avaliou-se neste estudo o teste lacrimal de Schirmer – tipo 1 (TLS) em 100 cães atendidos aleatoriamente a fim de identificar suas variações e possíveis relações com a resenha clínica, afecção, raça, idade e gênero. O TLS-1 foi realizado em ambos os olhos, em cães com mais de dois anos de idade, fêmeas ou machos. Destes, excluíram-se aqueles cuja queixa incluísse sinais oculares ou os portadores de doença ocular previamente identificada. Após análise, computaram-se 92 cães (194 olhos), 34 machos e 58 fêmeas com $7,79 \pm 3,7$ e $7,76 \pm 3,7$ anos de idade, respectivamente. Das raças mais atendidas, 40,2% eram Sem Raça Definida, 13,0% Poodle, 6,5% Shiht-zu e Basset Hound e 5,4% Pitbull. TLS-1 <10 mm/min bilateralmente foi observado em 4,3% dos cães com idade média de $7,4 \pm 3,9$ anos, destes 75% fêmeas e 25% machos. TLS-1 ≥ 10 e ≤ 14 mm/min bilateralmente foi

observado em 3,2% dos cães, e destes 66,7% machos e 33,3% fêmeas, 66,7,3% Sem Raça Definida e 33,38% Teckel, a idade média foi de $7,6 \pm 3,8$ anos. Das enfermidades sistêmicas observadas com TLS-1 <10 mm/min destacaram-se alterações envolvendo o aparelho reprodutor (42,8%). Salienta-se a importância do TLS-1 na rotina de atendimento clínico e cirúrgico veterinário, mesmo quando a queixa principal não envolva o sistema ocular, principalmente, em pacientes com mais de sete anos de idade.

Palavras-chave: cão, filme lacrimal, oftalmologia veterinária, ceratoconjuntivite

1 INTRODUCTION

The Schirmer tear test (STT) is a semiquantitative method that measures the amount of the aqueous portion of the tear film, and STT-1 evaluates the basal and tear reflex production being performed in the absence of eyedrops instillation like anesthetics, medications or physiological solution (MAGGS et al., 2013; VERBOVEN et al., 2014). The STT-2 is the basal tear film measurement, for this purpose, instillation of anesthetic eye drops is necessary (MAGGS et al., 2013; VERBOVEN et al., 2014).

In dogs, the STT-1 normal parameter is above 15 mm / minute, below 10 mm / minute is considered positive for keratoconjunctivitis sicca (KCS) and between 10 and 14 mm / minute suspicious (ASTRAUSKAS and CAMARGOS, 2013; MAGGS et al. 2013). The KCS results from lacrimal hypoproduction due to aqueous fraction deficiency and / or by evaporation of this layer (LIMA et al., 2014). The most common causes of KCS include hyperadrenocorticism, hypothyroidism, diabetes mellitus, distemper infection, autoimmune diseases, intoxications (sulfonamide, fenozopyridine and etodolac) (AROCH et al., 2013) nutritional and neurological causes and local radiotherapy (HARTHEY et al., 2006).

The incidence of KCS is high in canine species (LIMA et al., 2014), as well as in humans (BUSNARDO et al., 2013), however, many patients remains undiagnosed or are misdiagnosed, which affects their prognosis. The diagnosis is based on the association of the patient's history, clinical signs and Schirmer test results.

Because of the high number of KCS cases in dogs, this study aimed to verify changes in the STT-1 values in 100 dogs randomly attended to identify its changes and possible relations with the clinical review, disease, breed, age and sex.

2 MATERIALS AND METHODS

This research followed the international guidelines from the *Association for Research in Vision and Ophthalmology – ARVO (National Institutes of Health Publications number 85-23: Revised 1985)* and was approved and overseen by the Ethics Committee on the Use of Animals from the Franca University (protocol number 019/14).

It were randomly evaluated 100 dogs with ages between two and 18 years old, males and females, castrated and not castrated, with varied weights from the clinical and surgical attendande of the Veterinary Hospital of the University of Franca. Those whose main complaint included ocular signs or those with previously identified eye disease were excluded.

After physical restraint, the measurement of STT-1 was performed between 8 am and 5pm in both eyes with the animal in standing position and without using topical anesthetic by the same veterinary ophthalmologist. It was inserted a small (0.5 cm) piece of graduated filter paper (Tear Flo Diagnostic Test Strips® HUB Pharmaceuticals, Rancho Cucamonga, CA. United States), into the lower fornix of the eye, at the middle portion of lower eyelid for 60 seconds. Direct contact of the filter paper with the evaluator's hands was avoided, because of possible alteration with the results.

Test result was measured in the area of the millimeter filter paper wetted by the tear. Reference value in canine is ≥ 15 mm/minute wetting of the paper; suspicious between 10 – 14 mm/minute; and positive for KCS lower than 9 mm/minute (ASTRAUSKAS and CAMARGOS, 2013; MAGGS et al., 2013). The animals with STT-1 alterations were referred to the Veterinary Ophthalmology sector of the same institution to investigate the possible causes and treatment recommendation.

All tests were performed indoors and under similar temperature and humid conditions, avoiding interference of external factors such as wind and lightness, according to Hartley et al. (2006).

3 RESULTS AND DISCUSSION

From 100 evaluated animals, 40 were males and 60 females. It were excluded eight dogs because two had the main complaint related to the ocular system, two presented mucoid secretion, one presented conjunctival hematoma, one was under glaucoma treatment and another to KCS, and the last because the tutor did not allow the performance of the STT-1.

The low values of STT-1 (<10 mm/min) were verified in 4,3% of the dogs, of these, 75% were females and 25% males (Table 1). Alterations in lacrimal production was mainly seen in middle-aged ($7,6 \pm 3,8$ years old) or older dogs, as well as observed by Hartley et al. (2006) and Williams (2008). These authors also affirmed that there are some reports of decreased lacrimal production in older human patients. In dogs, the relation between KCS and senility may be because of reduction of the functional capacity of lacrimal glands and third eyelid (ASTRAUSKAS and CAMARGOS, 2011).

Table 1. Breeds, ages, sex, Schirmer tear test (STT-1)(mm/min) and organ systems or disease of the attendance:

Number	Breed	Age	Sex	STT-1 Right Eye	STT-1 Left Eye	Affected system/disease
1	teckel	12	male	14	14	Oncology/neurological
3	mixed breed	6	female	10	13	tegumentar
4	poodle	5	female	20	22	Oral cavity
5	basset hound	13	female	19	20	endocrine
6	mixed breed	6	male	20	18	locomotor
7	teckel	11	female	17	20	endocrine
8	shihtzu	12	female	20	18	locomotor
9	cocker	9	male	15	12	Oral cavity
10	mixed breed	12	female	20	22	urinary
11	mixed breed	5	male	25	15	tegumentar
13	poodle	8	female	20	22	urinary
16	mixed breed	7	female	20	18	urinary
17	poodle	15	female	0	5	oncology/reproductive/cardiorespiratory
18	labrador	10	female	18	19	neurological/locomotor
19	mixed breed	12	female	18	25	cardiorespiratory
20	mixed breed	3	female	18	22	oncology
21	poodle	4	female	0	14	reproductive
22	shihtzu	2	female	8	14	reproductive
24	basset hound	5	female	24	20	tegumentar
25	basset hound	14	female	15	14	oncology/cardiorespiratory
26	poodle	14	female	18	22	locomotor/cardiorespiratory
27	mixed breed	8	male	18	22	Oral cavity
28	basset hound	13	female	16	15	locomotor/neurological
29	shihtzu	8	male	20	23	Oral cavity
30	mixed breed	4	female	22	19	neurological
31	pitbull	10	male	20	22	tegumentar
32	mixed breed	10	male	14	5	oncology
33	mixed breed	2	female	20	22	tegumentar
34	pitbull	11	female	20	18	oncology
35	mixed breed	5	female	25	20	tegumentar
36	teckel	4	female	20	23	tegumentar
37	pitbull	8	female	24	23	auditory
38	pinscher	4	male	25	30	tegumentar
39	rottweiler	4	female	18	20	oncology
40	mixed breed	13	female	20	18	oncology
41	boxer	7	male	22	18	locomotor
42	border collie	8	female	18	20	locomotor
43	mixed breed	3	female	23	18	auditory
44	pastor alemão	4	female	20	25	auditory

45	poodle	12	female	18	20	oncology
46	poodle	11	male	28	23	locomotor/oncology
47	pitbull	5	male	17	28	locomotor
50	mixed breed	9	male	19	23	urinary/cardiorespiratory
51	mixed breed	2	male	23	25	reproductive?
52	mixed breed	11	female	18	19	Oral cavity
53	mixed breed	5	male	18	10	infectious/parasitary disease
54	mixed breed	7	female	30	25	neurological
55	mixed breed	5	female	18	25	neurological
56	shihtzu	4	male	25	13	auditory
57	shihtzu	4	male	25	20	general inspection
58	poodle	15	female	20	18	auditory
59	mixed breed	4	female	20	20	reproductive
60	mixed breed	5	female	16	25	tegumentar
62	pinscher	11	male	15	16	soft tissue
63	poodle	11	male	23	17	locomotor
64	teckel	8	female	12	23	cardiorespiratory/locomotor
65	rottweiler	8	male	4	9	locomotor
66	mixed breed	12	female	15	16	Reproductive/cardiorrespirator y
67	fila brasileiro	6	female	5	0	auditory
68	mixed breed	13	female	15	20	oncology
69	mixed breed	5	female	24	28	Reproductive?
70	rottweiler	8	female	15	14	oncology
71	mixed breed	5	female	16	19	locomotor
72	mixed breed	6	female	17	20	soft tissue
73	labrador	12	male	20	29	oncology
74	fox terrier	4	male	18	15	locomotor
75	mixed breed	6	female	18	24	infectious/parasitary disease
76	pug	8	female	20	18	oncology
77	mixed breed	4	female	22	24	reproductive
78	basset hound	6	male	18	20	neurological
79	poodle	9	female	20	24	endocrine
80	mixed breed	2	female	18	20	auditory
81	pointer	7	female	24	23	endocrine
82	poodle	5	male	12	16	neurological/locomotor
83	mixed breed	4	female	13	24	neurological
84	mixed breed	12	male	19	25	cardiorespiratory
85	labrador	11	male	20	18	locomotor
86	blue heller	3	female	21	26	infectious/parasitary disease
87	shihtzu	2	female	17	19	endocrine
88	mixed breed	5	male	20	22	auditory
89	cocker spaniel	18	male	20	18	oncology

90	mixed breed	7	female	22	24	auditory
91	pinscher	14	male	20	22	locomotor
92	poodle	7	female	24	22	oral cavity
93	labrador	9	male	20	18	tegumentar
94	yorkshire	5	male	20	18	tegumentar
95	mixed breed	12	male	18	28	oral cavity
96	basset hound	12	male	14	4	cardiorespiratory
97	yorkshire	7	female	9	14	oral cavity
98	mixed breed	10	female	8	2	reproductive
99	mixed breed	5	male	14	14	infectious/parasitary disease
100	pitbull	5	female	20	18	reproductive

The KCS incidence in the canine species is high (LIMA et al., 2014) as well as in humans (BUSNARDO et al., 2013), however, countless patients are wrongly diagnosed undiagnosed or misdiagnosed which significantly disfavors the prognosis. The STT-1 has been considered for more than 30 years as the standard semi-quantitative diagnosis, for being practice, minimal invasive, quickly, and low cost (BROADWATER et al., 2010). In this study, we selected the standardized commercial label for schirmer test strips, because type, width and thickness of the material could interfere in absorption, thus affecting the results of the lacrimal genesis (LAUS et al., 1995; VERBOVEN et al., 2014).

One dog was excessive reluctant about the physical restraint and just one sample of the STT-1 was collected. This patient was excluded because Broadwater et al. (2010) stated that stress may cause sympathetic stimulation and temporarily minimize the tear production, interfering in the obtained results during the experimentation

The criteria of inclusion of adult animals in this study was based on other report recorded by Broadwater et al. (2010), in which they described that tissues and ocular attachments of puppies are not fully developed during the first weeks of life, occurring significant decrease of lacrimal production. Furthermore, Verboven et al. (2014) also point out that the eye is immature at birth, making it impossible to evaluate in a proper ophthalmologic exam.

All animals in the present study were seen during the day, that is, between 8 and 17 hours, as according to Giannetto et al. (2009), in dogs, observed that dogs showed more STT-1 alterations during nocturnal phase when compared to diurnal phase with an increase of 2.31 mm/minute between them, suggesting the circadian rhythms in tear production.

Lagofthalmia is frequently observed in brachycephalic dogs and it disfavours the ocular surface lubrication besides there is a precocious evaporation of the tear film, leading to corneal dehydration, mainly in its central region (WILLIAMS, 2008). Despite only 8,7% of all dogs of this study are

brachycephalic breeds like Shih-tzu (75%), Boxer (12,5%) and Pug (12,5%) it was observed that 33,3% of the Shih-tzus presented STT-1 below 15mm/min.

The STT-1 alterations observed in Yorkshire's breed, congenital acinar hypoplasia was not ruled out, although infrequent in the canine species, it affects miniature breeds, especially females (GIULIANO and MOORE, 2007).

Despite Astrauskas and Camargos (2011) and Lima et al. (2014) reported that the most dogs with KCS have bilateral involvement, it was not observed in this study this relationship, because the bilateral affection occurred in 4,9% whilst unilateral affection was observed in 7,6% of the dogs.

Among the neurological disorders observed, distemper was the most common alteration. distemper may cause temporarily or permanent KCS (MARTINS et al., 2009), one of the proposed mechanism of action is to promote conjunctival adenitis, characterized by mononuclear and neutrophilic inflammatory infiltrate and degenerative alterations in glandular tissue leading to lacrimal reduction (RIBEIRO et al., 2008). Still Aroch et al. (2013) explained that 50-70% of the infection are subclinical, corroborating the results of the present study which had low tear production and no ocular clinical signs manifestation.

This study also observed two dogs affected by inflammatory disease of the ear with one female and male dog affected bilateral and unilateral, respectively, with KCS. Accordingly, to Stades et al. (1999) inflammatory diseases of the ear can promote sympathetic alterations of the lacrimal glands leading to KCS.

Endocrine diseases like diabetes mellitus, hyperadrenocorticism and hypothyroidism, significantly decrease the lacrimal production both in dogs and humans (WILLIAMS et al., 2007; RIBEIRO et al., 2008). In this study the dogs identified with endocrine disorders did not present STT-1 less than 15 mm/min.

Animals with altered STT-1, no breed predisposition to KCS and no systemic illness associated to reduction of lacrimal production, probably had atrophy of the lacrimal glands secondary to senility, corroborating with descriptions of Astrauskas and Camargos (2011). Moreover, any factor that could destabilize the tear film and generates an increase in the evaporation of the aqueous layer may also contribute to the onset of KCS, such as direct contact with air conditioner, fans, the wind impact during car rides, use of dryers after baths, exposure to irritating products such as shampoos and perfumes and environmental pollution or low humidity (LAUS et al., 1995).

4 CONCLUSIONS

According to the applied methodology and its results it was concluded that the STT-1 accomplishment in the clinical and surgical attendance routine is important mainly in elderly dogs,

even that ocular clinical signs are absent, once tear production decreasing may be related to systemic diseases and breed predisposition.

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