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Determination of Morphometric Characteristics of Glandula Lacrimalis in Siirt-Colored Mohair Goat (*Capra hircus*) and Romanov Sheep (*Ovis aries*) by Computed Tomography Images

Fatma İŞBİLİR[1,a,✉] Barış Can GÜZEL[1,b]

[1]Department of Anatomy, Faculty of Veterinary Medicine, Siirt University, Siirt, TÜRKİYE

[a]ORCID: 0000-0002-6110-1302; [b]ORCID: 0000-0002-2504-120X

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Abstract

Through the use of computed tomography (CT) images, the morphometric parameters of the glandula lacrimalis in Romanov sheep and Siirt-colored Mohair goats were determined as part of this study, which also examined sex and species differences. Computed tomography images of the glandula lacrimalis of ten male and ten female Siirt-colored Mohair goats and ten male and ten female Romanov sheep were used in the study. In both male and female animals, morphometric measures were taken from the transversal, sagittal, and dorsal sections of the right and left glandula lacrimalis. Morphometric values were statistically analyzed. As a result of the study, there was no sex-related difference in morphometric measurement parameters in the Romanov sheep breed. In Siirt-colored Mohair goats, statistical differences were observed in terms of TY and DU values depending on sex. Statistical differences and similarities were determined between the two species in terms of morphometric parameters. In conclusion, using computed tomography images, statistical variations in the measuring parameters of the glandula lacrimalis of adult Romanov sheep and Siirt-colored Mohair goats were reported.

Key Words: Glandula lacrimalis, Morphometry, Romanov sheep (*Ovis aries*), Siirt-colored Mohair goat (*Capra hircus*)

Siirt Renkli Tiftik Keçisi (*Capra hircus*) ve Romanov Koyunlarında (*Ovis aries*) Glandula Lacrimalis'in Bilgisayarlı Tomografi Görüntüleriyle Morfometrik Özelliklerinin Belirlenmesi

Öz

Bilgisayarlı Tomografi (BT) görüntüleri kullanılarak Romanov koyunları ve Siirt renkli Tiftik keçilerinde glandula lacrimalis'in morfometrik parametrelerinin belirlendiği bu çalışma kapsamında cinsiyet ve türler arasındaki farklılıklar da incelendi. Çalışmada on erkek, on dişi Siirt renkli tiftik keçisi ve on erkek, on dişi Romanov koyunu'nun kafataslarında bulunan glandula lacrimalislere ait Bilgisayarlı Tomografi görüntüleri incelendi. Hem erkek hem de dişi hayvanlarda, sağ ve sol glandula lacrimalis'in transversal, sagital ve dorsal kesitlerinden morfometrik ölçümler alınmıştır. Morfometrik ölçüm sonuçları istatistiksel olarak değerlendirildi. Çalışma sonucunda Romanov koyun ırkında morfometrik ölçüm parametrelerinde cinsiyete bağlı farklılık belirlenmedi. Siirt renkli tiftik keçisinde ise TY ve DU değerleri bakımından, cinsiyete bağlı istatistiksel farklılıklar gözlendi. İki tür arasında morfometrik parametreler bakımından istatistiksel olarak benzerlik ve farklılıklar belirlendi. Sonuç olarak, Bilgisayarlı Tomografi görüntüleri kullanılarak, yetişkin Romanov koyunları ve Siirt renkli Tiftik keçilerinin glandula lacrimalis ölçüm parametrelerindeki istatistiksel varyasyonlar rapor edilmiştir.

Anahtar Kelimeler: Glandula lacrimalis, Morfometri, Romanov koyunu (*Ovis aries*), Siirt renkli Tiftik keçisi (*Capra hircus*)

INTRODUCTION

Besides being used in the weaving of bags, vests, gloves, gloves, headdresses, socks and various ornaments for touristic purposes, mohair is also very important in the weaving of the famous Siirt blanket (1). Due to the importance of mohair, various selection studies have been carried out on the Ankara goat. It is reported that the majority of the colored Mohair goats in Turkey have been raised in Siirt, Batman and Şırnak provinces for a long time (2-5). Siirt-colored Mohair goat, whose breeding is very old, remains uncertain in many areas due to a lack of studies.

Romanov sheep breed is known for its high fertility and fur-like skin. The breed, which is characterized by having a black-gray body, short head, legs and tail structure, was first started to be bred in Russia. It has been reported that Romanov sheep is characterized by an extremely long sexual activity and early sexual maturity season used by breeders (6,7).

In mammals, the eye consists of two parts, the bulbus oculi and the organa oculi accessoria. While the bulbus oculi performs the visual activity, the organa oculi accessoria contain structures that assist the bulbus oculi. Apparatus lacrimalis is included in these auxiliary structures. Apparatus lacrimalis is a structure consisting of glandula lacrimalis (gl. lacrimalis), ductuli excretorii, lacus lacrimalis, canaliculus lacrimalis, saccus lacrimalis and ductus nasolacrimalis. It is an anatomical structure that plays a role in the formation of tear secretion in mammals, the transmission of secretion and the release of excess secretion into the nasal cavity (8-

11). The secretion content of the lacrimal gland has been reported to contain antibacterial factors, immunoglobulins and soluble mucins that help maintain corneal health (12). It is also an important element in the nutrition and cleansing of the cornea (8). The upper and outer borders of the eyeball are home to the lacrimal glands. In general, its location is described as the fossa glandula lacrimalis located under the processus zygomaticus of the os frontalis. In all mammals except pigs, the secreted fluid is quite high (13).

Although the skull structure and orbita have been examined macroscopically in mammals (14), measurements are made from computed tomography images with the developing technology. Computed tomography (CT), which is frequently used today, is founded on the idea of examining an object cross-sectionally with X-rays (15-17). While CT helps in the diagnosis of diseases, it also helps to obtain soft tissue images in high resolution (18). From the obtained sections, 3D models are created by a process called reconstruction. The produced 3D models aid in the detailed examination of the structure, the visualization of atypical organs and structures in anatomical and pathological instances, and the treatment and prognosis of diseases (19-23).

In different mammalian species such as sheep (24), goat (25), cat (26), dog (27), buffalo (28), camel (29), gazelle (30), cattle (31), llama (32), the structure of the bulbus oculi (33) and apparatus lacrimalis have been evaluated macroscopically, morphometrically and histologically. However, there is no morphometric study on the lacrimal gland in Siirt-colored Mohair goats and Romanov sheep.

In this study, the lacrimal glands of Romanov sheep and Siirt-colored Mohair goats were measured morphometrically using CT scans, and the results were used to compare and contrast the sexes and other animal species. Additionally, it was anticipated that the study will benefit the fields developing 3D models for the science of ophthalmology.

MATERIAL AND METHODS

The skulls of Siirt-colored Mohair goats (10 females, 10 males) and Romanov sheep (10 females, 10 males) used in our study were obtained from slaughterhouses in Siirt and Diyarbakır provinces of Turkey. The skulls were collected from healthy, adult (1-3 years old) animals without any clinical signs. The entire skulls were positioned upright and symmetrically in the apparatus to produce CT images of the gl. lacrimalis in sheep and goats. The skulls were scanned using a 64-detector multislice Siemens brand computed tomography system at 80 kv, 200 MA, 639 mGY, and 0.625 mm slice thickness. Digital Imaging and Communication in Medicine (DICOM) format was used to store the sections that were collected. Images were imported into the 3D-Slicer (5.02) software program. The transversal, sagittal, and dorsal sections of the right and left gl. lacrimalis were measured morphometrically using electronic calipers. The definitions and acronyms for the various selection points for measurement parameters are listed in Table 1. The definitions and abbreviations of the selection points for various measurement parameters are provided in Table 1. Figures 1, 2, and 3 show the locations where the gl. lacrimalis was measured. For statistical analysis, the SPSS 22.0 program was utilizedThe correlation between all measurement points was examined using a Pearson correlation analysis, and a independent t-test was utilized to find significant differences between male and female animals.

Table 1. Abbreviations and measurement points for the glandula lacrimalis

Direction	Description	Abbreviation
Transversal	Length: Distance between the gland's most lateral and medial ends.	TL
	Height: Widest point from most ventral to most dorsal	TH
Dorsal	Length: the distance separating the gland's most lateral and most medial ends.	DL
	Width: Distance perpendicular to length, from the cranial edge to the caudal edge at the widest point in the same image.	DW
Sagittal	Width: Distance in the same image from the caudal edge's widest point to the cranial edge.	SW
	Height: the distance between the gland's most ventral and dorsal edges.	SH

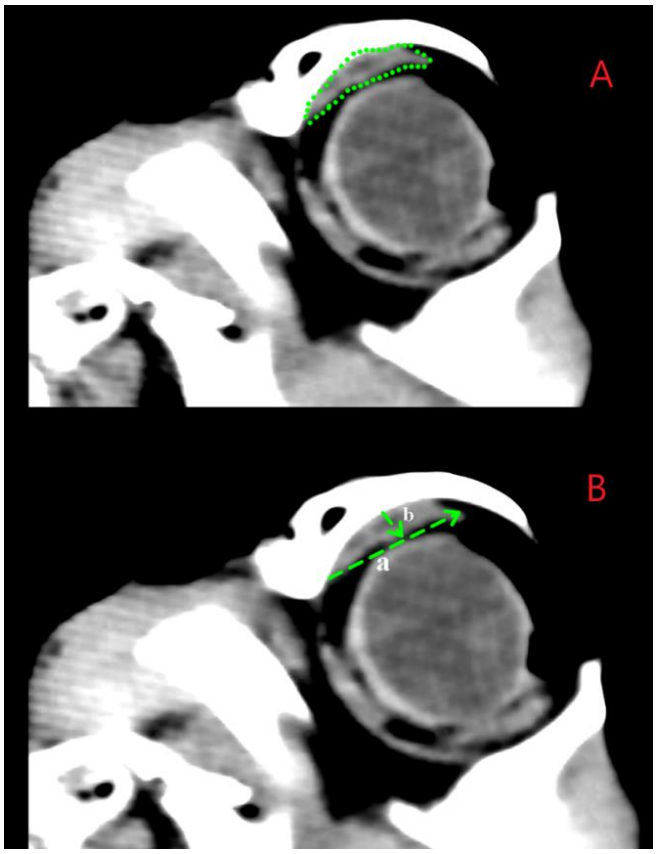

Figure 1. A: Transverse image of the glandula lacrimalis in a Romanov sheep and Siirt colored Mohair goat. B: Transverse views of the glandula lacrimalis measurement sites in the Romanov sheep and Siirt colored Mohair goat. a: Transversal Height, b: Transversal Length.

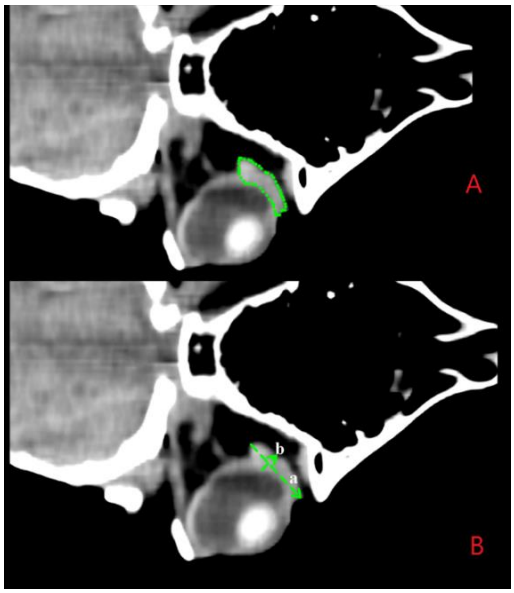

Figure 2. A: Dorsal image of the glandula lacrimalis in a Romanov sheep and Siirt colored Mohair goat. B: Dorsal views of the glandula lacrimalis measurement sites in the Romanov sheep and Siirt colored Mohair goat. a: Dorsal Length, b: Dorsal Width.

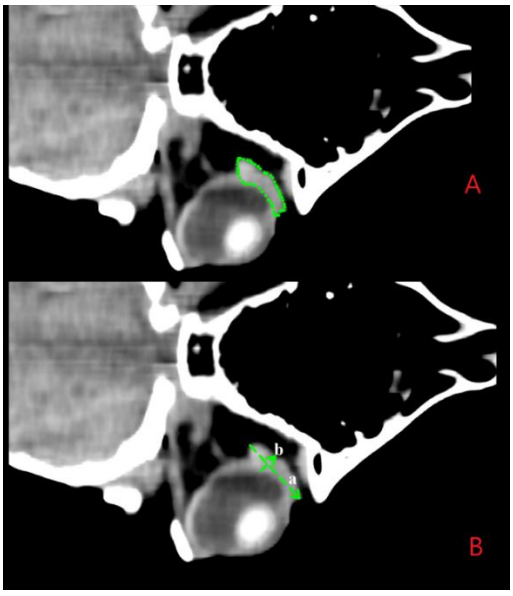

Figure 3. A: Sagittal image of the glandula lacrimalis in a Romanov sheep and Siirt colored Mohair goat. B: Sagittal views of the glandula lacrimalis measurement sites in the Romanov sheep and Siirt colored Mohair goat. a: Sagittal Width, b: Sagittal Height

The procedures applied in our study were approved by the Siirt University Experimental Animals Application and Research Center with the ethics committee reports numbered 2023/03/19 and 05/2023 for two animal species separately.

RESULTS

Descriptive statistics values of the measurements in the skulls of Siirt-colored Mohair goats and Romanov sheep between sexes and between species were given in Tables 2,3,4 and 5. In addition, Table 6 presented the correlation results between animals regardless of sex. TH measurement parameter was detected to be statistically highly significant (P<0.01) when analyzed between males and females of Siirt-colored Mohair goats. DL measurement value was determined statistically significant (P<0.05). In Romanov sheep, there was no statistically significant difference between males and females in terms of measured parameters (P>0.05). When Siirt-colored Mohair goat and Romanov sheep males were examined, SW measurement result a statistically significant result was determined (P<0.05). The TH value was extremely significant (P< 0.01) and the difference between the TL and DL measurement parameters was substantial (P< 0.05) when the statistical difference between females was examined. The TY measurement result had a highly significant association with the DL, SH, and SW parameters, according to the analysis of the correlation table (P< 0.01). The TL, TH, and DL parameters were shown to significantly correlate with the DW measurement parameter (P< 0.5).

Table 2. Using computed CT scans, descriptive statistics and homotypic variations of glandula lacrimalis biometric parameters in Siirt-colored Mohair goats

	Gender	N	Mean	Std. Deviation	P
TL	Male	10	16.32	1.10	0.54
	Female	10	14.99	1.18	
TH	Male	10	6.06	0.88	0.006
	Female	10	4.21	0.19	
DL	Male	10	16.62	0.89	0.02
	Female	10	14.68	0.53	
DW	Male	10	10.79	0.62	0.19
	Female	10	8.81	0.51	
SH	Male	10	6.12	0.67	0.85
	Female	10	4.20	0.71	
SW	Male	10	10.78	1.08	0.25
	Female	10	9.11	0.83	

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width

Table 3. Using computed CT scans, descriptive statistics and homotypic variations of glandula lacrimalis biometric parameters in Romanov sheep

	Gender	N	Mean	Std. Deviation	P
TL	Male	10	15.11	0.75	0.36
	Female	10	13.01	0.67	
TH	Male	10	3.86	0.49	0.38
	Female	10	2.61	0.51	
DL	Male	10	14.06	1.04	0.31
	Female	10	13.08	0.90	
DW	Male	10	8.96	0.57	0.61
	Female	10	7.84	0.61	
SH	Male	10	3.99	0.67	0.61
	Female	10	3.12	0.98	
SW	Male	10	8.88	0.56	0.76
	Female	10	7.84	0.54	

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width

Table 4. Using computed CT scans, descriptive statistics and homotypic variations of glandula lacrimalis biometric parameters in male Siirt-colored Mohair goats and Romanov sheep (Independent t-test)

	Species	N	Mean	Std. Deviation	P
TL	SCMG	10	16.32	1.10	0.35
	RH	10	15.11	0.75	
TH	SCMG	10	6.06	0.88	
	RH	10	3.86	0.49	0.11
DL	SCMG	10	16.62	0.89	0.24
	RH	10	14.06	1.04	
DW	SCMG	10	10.79	0.62	0.51
	RH	10	8.96	0.57	
SH	SCMG	10	6.12	0.67	0.85
	RH	10	3.99	0.67	
SW	SCMG	10	10.78	1.08	0.01
	RH	10	8.88	0.56	

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width

Table 5. Using computed CT scans, descriptive statistics and homotypic variations of glandula lacrimalis biometric parameters in female Siirt-colored Mohair goats and Romanov sheep (Independent t-test)

	Gender	N	Mean	Std. Deviation	P
TL	SCMG	10	14.99	1.18	0.02
	RH	10	13.01	0.67	
TH	SCMG	10	4.21	0.19	
	RH	10	2.61	0.51	0.001
DL	SCMG	10	14.68	0.53	
	RH	10	13.08	0.90	0.02
DW	SCMG	10	8.81	0.51	0.26
	RH	10	7.84	0.61	
SH	SCMG	10	4.20	0.71	
	RH	10	3.12	0.98	0.61
SW	SCMG	10	9.11	0.83	0.21
	RH	10	7.84	0.54	

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width

Table 6. Correlation between biometric measurement points in gl. lacrimalis (n=40).

	TL	TH	DL	DW	SH	SW
TL	1					
TH	0.70(*)	1				
DL	0.59	0.82(**)	1			
DW	0.69(*)	0.79(*)	0.76(*)	1		
SH	0.70(*)	0.81(**)	0.73(*)	0.72(*)	1	
SW	0.68(*)	0.82(**)	0.78(*)	0.77(*)	0.75(*)	1

Green: P<0.01, Yellow P<0.05, Red P>0.05

DISCUSSION AND CONCLUSION

Numerous studies have examined glandula lacrimalis morphometric data. This study is the first study to describe the anatomical structure of the gland called gl lacrimalis, with morphometric measurements from CT images, in Siirt-colored angora goats and Romanov sheep, which are in the Ruminantia subgroup.

The results of the study showed that there was no statistically significant variation between the morphometric parameters of the glandula lacrimalis in Romanov sheep according to sex. Male Siirt-colored Mohair goats had higher values for the TH and DL parameters. The glandula lacrimalis was found to be larger in males than females in investigations on Van Cats (26) and Hamdani sheep (34).

In Hamdani breed sheep, TH measurement result was found to be higher in male animals than in female animals (34). The gland's total length was measured in a study on donkeys, and it was found to be 16.09±1.6 mm in ultrasonographic images and 25.1±3.9 mm in a macro measurement (36). In our study, similar to this result, it was discovered that the same parameter in Siirt-colored Mohair goats had a statistical difference based on sex. Also, this parameter had a significant difference between Siirt-colored Mohair goat and Romanov sheep breed females.

Alsafy, (2010) determined the length and width values of the gland as 2.5-2.8 cm, 2 cm in goats, 3 cm, 1.7-1.9 cm in camel and 3.2 cm, 2 cm in donkey, respectively (36).

Ibrahim et al. (37) reported 55 mm in length and 20 mm in width in camel. Abdalla et al. (29) determined TL 40 mm and SW in their investigation of humped camels, 20 mm. According to the study data, TL value was determined as 15.65±1.10 mm in Siirt-colored Mohair goats and 14.06±0.75 mm in Romanov breed sheep. When the males of Romanov sheep and Siirt-colored Mohair goats were examined, it was reported that the SW measurement parameter was statistically significant.

When the measurements of the glandula lacrimalis on the right and left of male Hamdani sheep were investigated, the DL parameter was found to be 15.47±0.04 mm on the right and 15.32±0.22 mm on the left, and in female, 14.14±0.20 mm on the right and 14.42±0.78 mm on the left (34). In our research, it was found that DL value was larger in male Siirt-colored Mohair goats than in Hamdani sheep. Romanov sheep breed had smaller values.

In a study in dogs, mean values of length, height and width were reported to be 1.95 ± 0.08 cm, 0.79 ± 0.05 cm, 0.79 ± 0.05 cm in males and 1.46 ± 0.09 cm, 0.74 ± 0.03 cm, 0.38 ± 0.02 cm in females, respectively (27). The same values, in van cats, were determined as 14.26 ± 1.59 mm, 8.59 ± 0.44 mm, 3.85 ± 0.21 mm in males and 11.01 ± 1.01 mm, 7.59 ± 0.96 mm, 3.01 ± 0.25 mm in females, respectively (26). When compared to the study with dogs (27), the mean values of length, height and width were higher in male dogs than in Siirt-colored Mohair goats and Romanov sheep. However, the data obtained were close to the results of female dogs. Additionally, it was discovered that these levels were higher than those of cats.

In conclusion, the morphometric characteristics of the glandula lacrimalis were determined from the images obtained by computed tomography in Siirt-colored Mohair goat and Romanov sheep breed. In addition to sex differences within the same species, two different species were also compared. It is thought that this study will contribute to related studies in veterinary medicine, anatomy, pathology, ophthalmology and surgery.

CONFLICTS OF INTEREST

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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✉ **Corresponding Author:**
Fatma İŞBİLİR
Department of Anatomy, Faculty of Veterinary Medicine, Siirt University, Siirt, TÜRKİYE
E-posta: fatmaisbilir42@gmail.com