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Morphometric examination of glandula lacrimalis of Hamdani sheep by computed tomography

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Abstarct: This study was carried out to obtain morphometric measurements of glandula lacrimalis of Hamdani sheep on computed tomography (CT) images and to determine the biometric differences of these measurement values in terms of both homotypic variations and sexual dimorphism. In the study, CT images of glandula lacrimalis obtained from 10 adult healthy Hamdani sheep, containing five males and five females were used. Morphometric measurements were taken from the transversal, sagittal and dorsal sections of the right and left glandula lacrimalis. Statistical analysis was performed for morphometric values. In the morphometric examinations, the mean length, width, and height values for both the right and left glandula lacrimalis were found to be 15.71 ± 0.17 mm, 9.39 ± 0.9 mm, 4.84 ± 0.5 mm, respectively, for male Hamdani sheep; in females, these values were determined as 13.80 ± 0.37 mm, 8.40 ± 0.5 mm and 4.14 ± 0.67 mm, respectively. As a result, statistical gender differences in the measurement parameters of glandula lacrimalis of adult Hamdani sheep were determined using computed tomography images.
Keywords: Computed tomography, glandula lacrimalis, Hamdani sheep.

Hamdani koyunlarının glandula lacrimalis'inin bilgisayarlı tomografi ile morfometrik incelenmesi

Özet: Bu çalışma, Hamdani koyunlarının glandula lacrimalis'in bilgisayarlı tomografi (BT) görüntüleri üzerinden morfometrik ölçülerini elde etmek ve bu ölçüm değerlerinin hem homotipik varyasyonlar hem de seksüel dimorfizm bakımından biyometrik farklılıklarını belirlemek amacıyla yapıldı. Çalışmada beş erkek, beş dişi olmak üzere toplamda 10 adet erişkin sağlıklı Hamdani koyunu'nun glandula lacrimalis'ine ait BT görüntüsü kullanıldı. Sağ ve sol glandula lacrimalis'e ait transversal, sagital ve dorsal kesitlerden morfometrik ölçümler alındı. Morfometrik değerlerin istatistiki analizi yapıldı. Yapılan morfometrik incelemelerde sağ ve sol glandula lacrimalis'e ait ortalama uzunluk, genişlik, yükseklik değerlerinin erkek Hamdani koyunlarda en yüksek ölçü sırasıyla ortalama 15,71 ± 0,17 mm, 9,39 ± 0,9 mm, 4,84 ± 0,5 mm; dişilerde ise, bu değerler sırasıyla ortalama 13,80 ± 0,37 mm, 8,40 ± 0,5 mm, 4,14 ± 0,67 mm olarak belirlendi. Sonuç olarak, erişkin Hamdani koyunlarının glandula lacrimalis'e ait ölçüm parametrelerinin istatistiksel olarak cinsiyetler arasındaki farklılıkları bilgisayarlı tomografi görüntüleri kullanılarak tespit edildi.
Anahtar kelimeler: Bilgisayarlı tomografi, glandula lacrimalis, Hamdani koyunu.

Introduction

Hamdani sheep is a locally bred breed in the Eastern and Southeastern Anatolia region, albeit small in number (Öztürk, 1998). Hamdani sheep, which originate from Iran, have a very

high adaptation to the harsh conditions of nature (Abdul-Rahman & Al-Barzinjy, 2007; Bingöl & Bingöl, 2015). Computed tomography (CT) is based on the cross-sectional examination of the object with X-rays (Baykal & Oyar, 2003; Capello & Cauduro, 2008; Tuncel, 2007). In computed tomography, sections are obtained by rotating the tube and detector around the object (Kaya et al., 1997). Combining sections and creating a 3D model is called reconstruction. It is used to create treatment protocols in 3D images obtained and to visualize irregular structures and organs in pathological cases and anatomy (Sarıtaş, 2015; Verhoff et al., 2008). While it provides operational contributions such as calculating bone volume, implant positions, and bone angles before surgical procedures, computerized tomography also provides high-resolution soft tissue images (Siu et al., 2010). Apparatus lacrimalis is the anatomical structure that plays a role in the formation of tear secretion and the transmission of the secretion in mammals. This structure consists of five main parts. It consists of glandula lacrimalis, ductuli excretorii, canaliculus lacrimalis, saccus lacrimalis and ductus nasolacrimalis (König & Liebich, 2014; Demiraslan & Dayan, 2021). Glandula lacrimalis is located on the upper and outer sides of the eyeball. The fluid secreted in all mammals except pigs is substantial (Dyce & Wensing, 2010).

This study was carried out to obtain morphometric measurements of the glandula lacrimalis of Hamdani sheep on computed tomography images and to reveal the differences between the sexes and other species of the obtained values.

Materials and Methods

Hamdani heads (five female, five male) obtained from slaugterhouses in Şırnak, Türkiye used in our study. In order to obtain CT images of the glandula lacrimalis of the Hamdani sheep, the total heads were placed in the device in an upright and symmetrical manner. The heads were scanned with a 64-detector multi-slice Simens computer tomography device, 80 kV, 200 MA, 639 mGY, 0.625 mm section thickness. The resulting images were saved in DICOM (Digital Imaging and Communication in Medicine) format. The obtained sections were transferred to 3D-Slicer (5.02) software. Morphometric measurements were taken from the transversal, sagittal and dorsal sections of the right and left glandula lacrimalis using electronic calipers. The definitions and abbreviations of the selection points of these measurement parameters used are presented in Table 1. Measurement points on the glandula lacrimalis are presented in Figures 1, 2, and 3. SPSS 22.0 program was used in our study. An independent t-test was used to reveal statistical differences between males and females, and the Pearson correlation technique was used to examine the correlation between all measurement points.

Table 1. Measurement points and abbreviations of glandula lacrimalis.

Direction	Description	Abbreviation
Transversal	Length: From the most lateral end of the GI gland to the most medial end	TL
	Height: Most dorsal to most ventral at widest point	TH
Dorsal	Length: distance from the most lateral end of the gland to its most medial end	DL
	Width: distance from cranial edge to caudal edge at the widest point perpendicular to length in the same image	DW
Sagittal	Width: distance from cranial edge to caudal edge at the widest point perpendicular to Height in the same image	SW
	Height: Distance from the most dorsal edge of the gland to the most ventral edge	SH

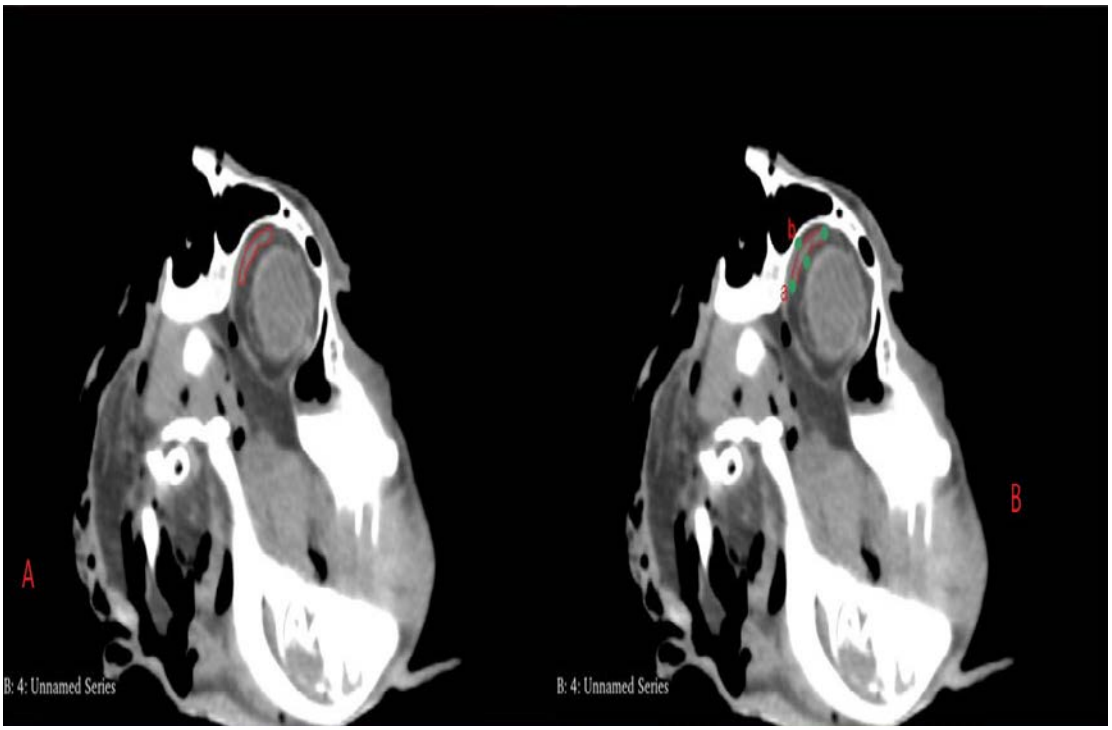

Figure 1. A: Outline of the glandula lacrimalis in a transversal view in Hamdani sheep. B: Measurement points of the glandula lacrimalis in the Hamdani sheep in the transversal view. a: Transversal Height, b: Transversal Length.

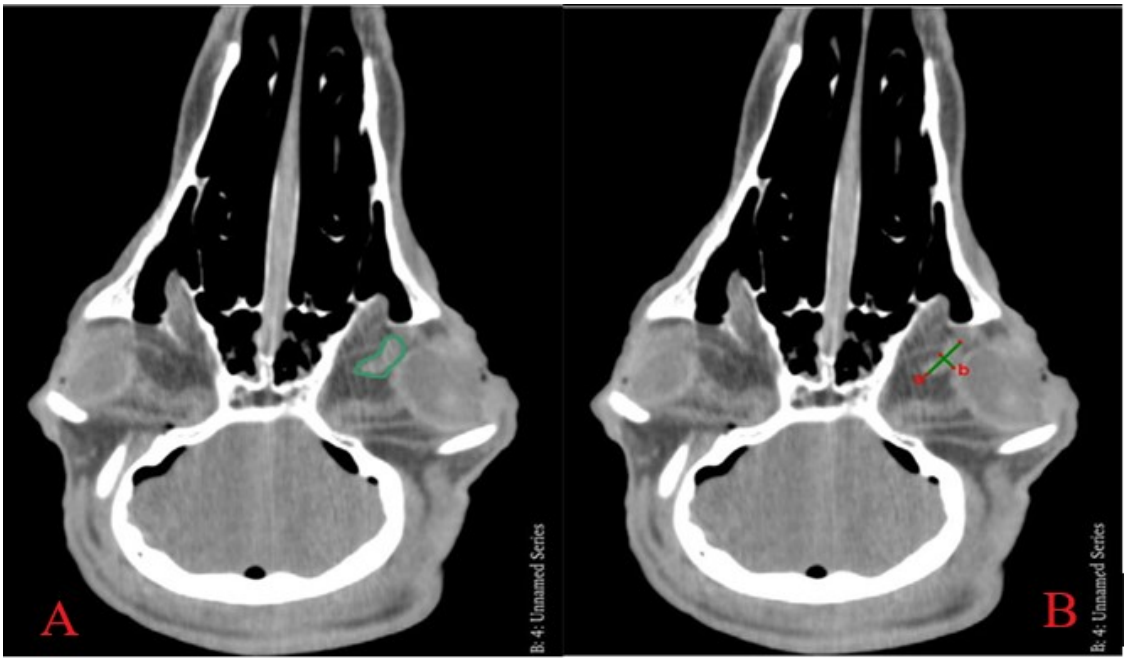

Figure 2. A: dorsal outline of the glandula lacrimalis in Hamdani sheep. B: Measurement points of glandula lacrimalis in the dorsal view in Hamdani sheep. a: Dorsal Length, b: Dorsal Width.

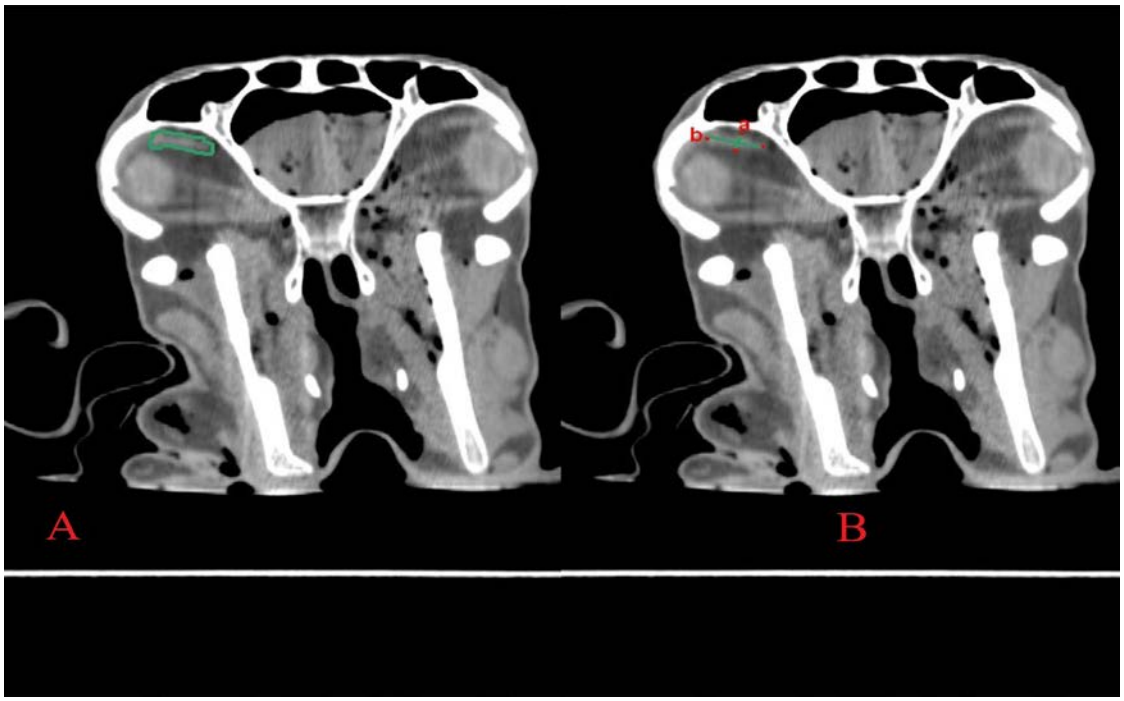

Figure 3. A: Sagittal view outline of glandula lacrimalis in Hamdani sheep. B: Measurement points of glandula lacrimalis in the dorsal view in Hamdani sheep. a: Sagittal Width, b: Sagittal Height.

Results

Statistical differences between the sexes of the measurement points of Hamdani sheep are given in Table 2 and Table 3. Correlation values between measurements are given in Table 4. When the tables are examined, it has been determined that the glandula lacrimalis of males

is larger than that of females. When the right and left glandula lacrimalis measurements of male Hamdani sheep were examined, it was seen that the dorsal width (DW) was 9.39 ± 0.9 mm on the right and 9.38 ± 0.20 mm on the left, the sagittal Height was 4.84 ± 0.5 mm on the right and 4.40 ± 0.20 mm on the left, and it was found to be statistically significant (P<0.05). When the right and left glandula lacrimalis measurements of female Hamdani sheep were examined, dorsal length (DL) was 14.14 ± 0.20 units on the right and 14.42 ± 0.78 mm on the left, dorsal width (DW) was 8.25 ± 0.17 mm on the right and 8.40 ± 0.05 mm on the left (P<0.01). Sagittal Height was measured as 3.10 ± 0.8 mm on the right and 4.14 ± 0.6 mm on the left, and it was found to be statistically significant (P<0.05). When the correlation table is examined, there is a strong positive correlation between the measurement parameters TH-TL, DW-TL, DW-TH, SW-TL, SW-TH, SW-DL, and SW-DW (P<0.01). There was a positive correlation between DL-TL, DL-TW, DW-DL, and SW-SH measurement parameters (P<0.05).

Table 2. Descriptive statistics and homotypic variations of biometric parameters of glandula lacirmalis according to male Hamdani sheep obtained using computed tomography images.

	Direction	**N**	**Mean (mm)**	**Standard Deviation**	**P**
TL	Right	5	15.71	0.17	NS
	Left	5	15.55	0.30	
TH	Right	5	4.75	0.15	NS
	Left	5	4.57	0.12	
DL	Right	5	15.47	0.04	NS
	Left	5	15.32	0.22	
DW	Right	5	9.39	0.09	*
	Left	5	9.38	0.20	
SH	Right	5	4.84	0.05	*
	Left	5	4.40	0.20	
SW	Right	5	9.68	0.23	NS
	Left	5	9.47	0.25	

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width.
*: P<0.05, NS: No Significant.

Table 3. Descriptive statistics of biometric parameters of glandula lacirmalis according to female Hamdani ewes obtained using computed tomography images.

	Direction	N	Mean	Standard Deviation	P
TL	Right	5	13.77	0.56	NS
	Left	5	13.80	0.38	
TH	Right	5	3.27	0.40	NS
	Left	5	3.25	0.07	
DL	Right	5	14.14	0.21	***
	Left	5	14.42	0.78	
DW	Right	5	8.25	0.17	**
	Left	5	8.40	0.06	
SH	Right	5	3.10	0.08	*
	Left	5	4.14	0.67	
SW	Right	5	8.24	0.18	NS
	Left	5	8.44	0.17	

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width.
*: P<0.05, **: P<0.01, ***P<0.001, NS: No Significant.

Table 4. Correlation between biometric measurement points in Hamdani sheep.

	TL	TU	DL	DW	SH	SW
TL	1					
TU	0.92**	1				
DL	0.73*	0.78*	1			
DW	0.88**	0.92**	0.76*	1		
SH	0.57	0.54	0.49	0.59	1	
SW	0.89**	0.88**	0.80**	0.91**	0.70*	1

TL: Transversal Length, TH: Transversal Height, DL: Dorsal Length, DW: Dorsal Width, SH: Sagittal Height, SW: Sagittal Width.
Green: P<0.01, Yellow: P<0.05, Red: P>0.05.

Discussion

This is the first study to determine the morphometric measurement values of right and left glandula lacrimalis in female and male animals using computed tomography in Hamdani sheep. Measurement values of glandula lacrimalis have been evaluated in many studies in terms of sexual dimorphism and homotypic variations in many mammals (Cabral et al., 2005; Gedar et al., 2018; Güngör and Urfalıoglu, 2019; Nawaz et al., 2020; Park et al., 2016; Zwingenberger et al., 2014). In the study, it was determined that the morphometric values of glandula lacrimalis

of Hamdani sheep were higher in males than in females. In addition, when the measurement parameters are examined in terms of homotypic variations, it has been determined that the right side glandula lacrimalis measurement values are generally higher than the left side. In the study conducted by Demircioğlu & Yılmaz (2019) on Awassi sheep, it was observed that the right bulbus oculi were larger at some measurement points, while the left bulbus oculi were larger at some measurement points.

Yılmaz (2021), in his study on Van cats, reported that glandula lacrimalis is larger in males than females, and the right gland is larger than the left gland. Abdelbaset-Ismail et al., (2022) found that while the total length was 16.09 ± 1.6 mm in ultrasound, it was 25.1 ± 3.9 mm in macro measurement in his study, in which he compared the ultrasonographic images and macroscopic measurements of the glaucoma of donkeys. In the study, it was observed that the transversal length was 15.80 ± 0.37 mm at the highest and the highest dorsal length was 15.47 ± 0.04 mm. When studies were compared, it was seen that donkeys had a larger glandula lacrimalis than Hamdani sheep in ultrasound and macroscopic measurements. Alsafy, (2010) found that the length in camels, donkeys, and goats was 1.7-1.9 cm, 2.5-2.8 cm in goats, and 3.2 cm in donkeys. When the Hamdani sheep were examined, it was seen that while they were close to the camel, they were smaller than the glandula lacrimalis lengths of the goats and donkeys. Zwingenberger et al. (2014), in the study of dogs, reported the length as 11.61 ± 1.98 mm in gross anatomical measurement and 9.35 ± 2.34 mm in computerized tomography measurement, with measurements taken on macro-anatomical and computerized tomography images. Glandula lacrimalis of Hamdani sheep was found to have a larger gland than dogs in measurements taken from both males and females on computed tomography images. Abdalla et al. (1970) reported the transversal length as 40 mm and the sagittal width as 20 mm in their study on humped camels. It was seen that the transversal length and sagittal width measurements of males in Hamdani sheep were smaller than those of humped camels.

Conclusion

As a result, the statistical differences between the sexes of the measurement parameters were taken from the glandula lacrimalis of Hamdani sheep on computed tomography images were revealed. This study will contribute to the studies on anatomical, pathological and surgical clinical sciences of sheep.

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This research received no grant from any funding agency/sector.

Ethical Statement

This study was performed with the permission of the Experimental Animals Local Ethics Committee in Harran University with 2022/002/05 dated 28/03/2022 approval number.

Conflict of Interest

The authors declared that there is no conflict of interest.

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