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Gross anatomy and biometry of the testes of indigenous dog of Mumbai (*Canis domesticus*)

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Abstract
The present research work was conducted on "Gross anatomical and histomorphological studies on testis of dog (*Canis Domesticus*)". The testis of dogs collected from 6 non-descript, healthy adult dogs at sterilization center BSPCA, Parel, Mumbai. Gross anatomical examination of the testis was recorded and determines their colour, weight, length, width, thickness. The biometrical observations recorded that the left testis was larger and heavier than right testis. The height of the germinal epithelium was 164.54 µm and thickness of capsule was 725.95 µm. The numbers of Sertoli cells were more than the Ledyig cells in present investigation. The thickness was recorded with the ranged of 611.60 to 1122.54 µm with an average of 725.95±4.47 µm. The height of the germinal epithelium layer was ranged from 111.89 to 203.90 µm with an average of 164.56±0.88 µm.

Keywords: *Canis domesticus*, testes, anatomy, biometry

1. Introduction
According to Hindu mythology, Lord " Dattatreya" was the first person in the world to use a dog as a bodyguard. During the Mahabharata era, King Yudhisthira owned a dog as a pet around 3400 years B.C. Dogs were kept by monarchs and caravan traders in ancient India. ln the pre-independence era, the Nawab of Junagadh, kept big number of dogs and spent great lot of money to celebrate male and female dog marriage festivities. In today's world, dogs are regarded as companion animal. The dog, both domestic and wild, developed from "Miacis" in history. They are Canids or Canidae, which word Canine, comes from. Dogs are said to be descended from numerous variations of real wolves, including the possibility of Jackals and perhaps Foxes. Dogs were the first animal to be domesticated in several regions almost at the same time. Coyotes (*Canis latrans*), Azara dogs (*Canis azrae*), and other Canidae may have influenced the domestic dog. In agriculture, the dog was the first species to be domesticated by hunter. As a result of their long contact with humans, dogs have grown into a large number of domesticated individuals. Dogs have evolved to be specially attuned to human behavior over millennia, and the human-canine link has been the subject of much research. The dog has been selected for a variety of behaviors, sensory capacities, and morphological characteristics. The testes of dog are comparatively small and round oval shape (Sisson *et al*. 1953) [9], which varies from species to species in shape, size and location but essential structure is same (Frandson, 1986) [1]. Testes are placed in pouch like structure called scrotum in the position of intermediate between the perineum and groin (Dyce *et al*., 1996) [2]. Testis helps in breeding and also produce male reproductive hormone, testosterone. Testis architecture disorganized by various disease like testicular tumor, Leydig cell tumour etc. Sisson (1961) [10] mentioned that the dog testicles were relatively small and have a round oval form in domestic animal. The scrotum was situated about half way between the inguinal region and the anus. The skin covered it's pigmented and covered sparsely with fine hairs. The long axis oblique and were directed dorsally and caudally. The mediastinum testis was located at central and well developed. It gave rise to connective tissue septa, which was divided the testis into incomplete lobules. The epididymis was large and closely attached along the dorsal part of the lateral surface of the testicles. Miller *et al*. (1964) [6] described the male gonads of dog, which were located within the scrotum. The normal position of the testis of dog was situated obliquely, with the long axis running dorso-caudally. The epididymis was adherent to the dorsolateral surface of the organ, with its tail located at the caudal extremity of the testis and its head at the cranial end. Each testis was oval in shape and thicker dorso-ventrally. The length of the testis in a 12-pound-weighted dog was 2.8 to 3.1 cm. The width (dorso-ventrally diameter) was 2 to 2.2 cm and the thickness, 1.8 to 2.0 cm. The fresh organ weight 7.8 to 8.2 gm.

The normal position of the dog testis situated obliquely with the long axis dorso-caudally. The gross anatomy study is important to understand the physiology, endocrinology, surgical anatomy of testis, which also helped to diagnosed the breeding potential. Therefore, the current research is intended to examine the macro and micro structures of dog testis with the objective of study the gross anatomical structure of testis.

2. Materials and Methods

For the present study, both the testis from non-descript healthy adult dog, whose body weight was ranging from 14 to 17 kg, was collected immediately after castration at BSPCA Hospital, Parel, Mumbai. The study was carried out at the Department of Anatomy and Histology, Mumbai Veterinary college, parel. Gross anatomy the gross anatomical observations of testis of dog were recorded in respect of shape, external surface, size, color and location. The testes were washed with normal saline. The biometrical observations were recorded and tissue samples were preserved in 10% formalin. Biometry a) Weight of testis (gm): The testis (left and right) weighed with the help of electronic weighing balance and recorded in grams. b) Length of testis (cm): The length of testis (left & right) was measured with Vernier Caliper and recorded in centimeter (cm) from anterior extremity to posterior extremity. c) Thickness of testis (cm): The thickness of testis (left & right) was measured with Vernier caliper and recorded in centimeter (cm) from dorsal border to ventral border. d) Width of the testis (cm): the width of the testis (left and right) was measured with Vernier caliper and recorded in centimeter (cm) from lateral surface to medial surface.

3. Results and Discussion

3.1 Gross Anatomy of Testis

The testis was oval and reddish white in color. It was compound tubular gland situated below the anus within the scrotum. The internal compartment of scrotum filled by the generally asymmetrical testes was separated from the rest of the body by a deep groove. Each testicle was dorso-caudally within the scrotum, along with its epididymis and distal spermatic cord. The left testicle was farther caudal than the right testicle because the testes were oriented differently; this reduced pressure on each testis and allowed the testes to glide effortlessly over another. It was located dorso-caudally at the perenial region, along an axis, oblique in direction. Grossly, each testis showed two borders, two surfaces and two extremities. The medial surface of the testis was flattened and the lateral surface was convex in nature. The epididymis was located on dorso- lateral aspect of testis. Both the extremities were rounded. The mediastinum in the testicle was central and well developed. (Figure-1 and 2). It resulted in connective tissue septa, which split the testis into lobules that were incomplete. These observations were similar to the observation reported by Miller (1964) [6] in dog, Getty (1975) [3] in dog, Evan and Christensen (1979) [11] in dog, Heather (2016) [12], Ghosh (1995) [13], Dyce (1996) [2], Anuradha *et al*. (2003) [14] in Dalmatian dog, Zade (2007) [4] in dog testis, Bhagyalakshmi *et al*. (2020) [8] in dog.

3.2 Biometry

The biometrical observations on various parameters of testes of dogs were recorded in the Table No. 4.1 and the statistical analysis was depicted in the Table No. 4.2. 4.2.1 Length of testis (cm) The length of each left and right testis was recorded immediately after the castration from anterior extremity to posterior extremity with the help of Vernier calliper (plate 3). The length of the left testis was ranged from 3.20 to 3.50 cm with an average of 3.35±0.20 cm. The length of the right testis was ranged from 3.00 to 3.40 cm with an average of 3.21±0.29 cm. However, Bhagyalakshmi *et al*. (2020) [8] recorded the length of left and right testis in dog was 3.73±0.07 cm and right testis 3.47±0.13 cm in dog, respectively. The length of the testis in the dog having about 25-pound weight was ranged from 2.80 to 3.10 cm Miller (1964) [6]. Zade (2007) [4] reported that each testicle measured with in ranged of 3.9 to 5.1 cm in length, with an average of 4.49±0.12 cm. These differences in length of testis various workers might be due to the age and breed variation. The thickness of the testis (cm) The thickness of each testis was taken from dorsal border to ventral border with the help of Vernier caliper and recorded in centimeter. The maximum thickness of the left testis was ranged from 2.00 to 2.50 cm with an average of 2.8±0.43 cm. The maximum thickness of the right testis was ranged from 1.90 to 2.40 cm with an average of 2.03±0.27. However, Bhagyalakshmi *et al*. (2020) [8] recorded the thickness of left and right testis in dog was 1.77±0.04 cm and 1.72±0.22 cm, respectively. Zade (2007) [4] mentioned that the thickness of testis was ranged 3.00 to 3.90 cm with mean value of 3.42±0.10 cm. These differences in thickness of testis various workers might be due to the age and breed variation. The width of the testis (cm) The width of each testis was taken from lateral surface to medial surface with the help of Vernier caliper and recorded in centimeter. The width of the left testis was ranged from 2.30 to 2.80 cm with an average of 2.53±0.43 cm. The width of the right testis was ranged from 2.20 to 2.70 with an average of 2.30±0.29 cm. However, Bhagyalakshmi *et al*. (2020) [8] recorded the width of the left and right testis in dog was 2.51±0.11cm and right testis was 2.42±0.08 cm. The width of the testis in the dog having 25-pound weight was ranged from 1.80 to 2.00 cm. Zade (2007) [4] the width of testicle measured ranged between 3.42 cm to 4.6 cm with a mean value of 3.76±0.14 cm. These differences in width of testis various workers might be due to the age and breed variation. The weight of the testis (gm) The weight of each testis was taken with digital weighing machine and recorded in gram. The weight of the left testis was ranged from 13.90 to 16.60 gm with an average of 14.95±0.23 gm. The weight of the right was ranged 13.00 to 16.00 gm. with an average of 14.38±0.26 gm. The weight of the testis in dog having 25-pound weight was ranged from 7.8 to 8.20 gm (Miller 1964) [6]. Zade (2007) [4] the weight of each testicle was ranged between 13.89 to 21.98 gm with a mean value 18.79±0.77 gm (Table 1). These differences in weight of testis various workers might be due to the age and breed variation. In the present study it was observed that the value for various biometrical parameters of left testis were more as compare to the right testis. The left testis in dog was larger and heavier than right testis.

Table 1: Biometrical observations of dog testes

S. No.	Testis	Length (cm)	Width (cm)	Thickness (cm)	Weight (gm)	Age of dog (Year)	Weight of the dog (Kg)
1	Left	3.5	2.8	2.5	16.6	1.5	16
	Right	3.4	2.7	2.4	16		
2	Left	3.3	2.5	2.1	16	1.7	16
	Right	3.2	2.3	2.0	15.5		
3	Left	3.2	2.3	2.0	14	1.5	14
	Right	3.0	2.2	1.9	13.5		
4	Left	3.4	2.4	2.2	13.9	1.5	15
	Right	3.2	2.2	2.1	13		
5	Left	3.3	2.7	2.0	14.2	1.3	17
	Right	3.2	2.5	1.8	13.8		
6	Left	3.4	2.5	2.3	15	1.4	15
	Right	3.3	2.4	2.0	14.5		

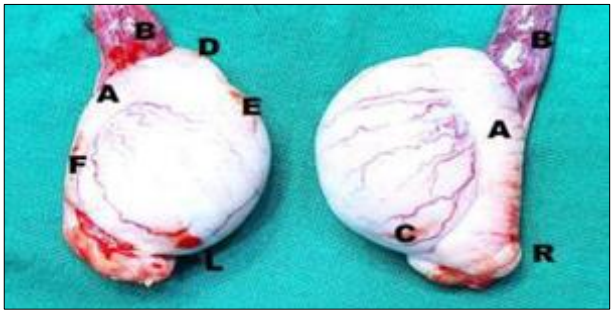

Fig 1: photograph showing the testis along with epididymis (A) Epididymis, (B) Pamniformplex, (C) Posterior extremity, (D) Anterior extremity (E) Lateral border, (F) Medial border.

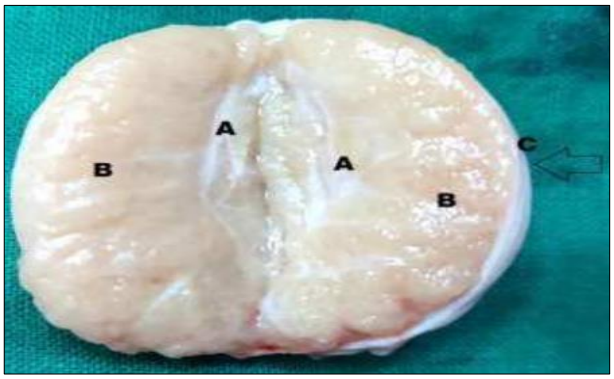

Fig 2: Photograph showing the sagital view of testis (A) Mediastinum testis (B) Prenchyma (C) Capsule

Fig 3: Photograph of testis showing biometrical observation (A) Vernier caliper (B) dog testis

Conclusion

From the present study, it was concluded that the testis of non-descripts dogs was oval in shape and reddish white in color. The value for biometrical observations in left testis was more than right, which indicated that the left testis was larger and heavier than right testis. The testis was covered by dense connective tissue capsule, from which trabaculae entered into parenchyma and divided into lobules. The thickness was recorded with the ranged of 611.60 to 1122.54 µm with an average of 725.95±4.47 µm.

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