



## Investigation of the Anatomical Structure of Cervix uteri, Corpus uteri and Cornu uteri in Red foxes (*Vulpes vulpes*)

Gülseren KIRBAŞ DOĞAN<sup>1,a,✉</sup>, Mushap KURU<sup>2,b</sup>

<sup>1</sup>Department of Anatomy, Faculty of Veterinary Medicine, Kafkas University, Kars, TURKEY

<sup>2</sup>Department of Obstetrics and Gynecology, Faculty of Veterinary Medicine, Kafkas University, Kars, TURKEY

<sup>a</sup>ORCID: 0000-0003-3770-9956; <sup>b</sup>ORCID: 0000-0003-4409-251X

Geliş Tarihi/Received  
19.02.2021

Kabul Tarihi/Accepted  
13.04.2021

Yayın Tarihi/Published  
30.06.2021

### Abstract

The Red fox (*Vulpes vulpes*) is the largest of the true foxes and the most abundant wild member of the carnivora. This study aimed to determine the anatomical structure of the cervix uteri, corpus uteri and cornu uteri of the Red foxes. Animals that were taken to the Kafkas University Wildlife Rescue and Rehabilitation Center, Kars, Turkey, because of various reasons, such as traffic accidents and firearm injuries, were used. The uterus of four Red foxes of similar ages, which could not be rescued by the Center despite all interventions, were dissected. Measurements were taken from the cervix uteri, corpus uteri and right-left cornu uteri using digital calipers. The weights of each organ section were measured using a precision scale. The mean length of the cervix uteri 11.54 ± 1.56 mm, width was 4.46 ± 0.52 mm, thickness was 5.18 ± 0.08 mm, and weight was 1.18 ± 0.04 g. The mean length of the corpus uteri was 20.68 ± 3.06 mm, width was 2.88 ± 0.50 mm, thickness was 2.22 ± 0.19 mm, and weight was 0.90 ± 0.01 g. The mean length of the cornu uteri was 79.85 ± 0.86 mm, width was 4.85 ± 0.79 mm, thickness was 4.33 ± 0.18 mm, and weight was 2.33 ± 0.12 g. In conclusion, information about the uterus of the female genital track of the Red foxes, was given in this study. We believe that the findings of this study may be useful for surgical and gynecological operations to be performed in red foxes and studies to be conducted on this subject.

**Anahtar Kelimeler:** Anatomy, Red Fox, uterus

### Kızıl Tilkilerde (*Vulpes vulpes*) Cervix uteri, Corpus uteri ve Cornu uteri'nin Anatomik Yapısının İncelenmesi

#### Öz

Kızıl tilki, tilkilerin en büyüğü ve vahşi yaşamın bir üyesi olan carnivorların en çok görülenidir. Bu çalışma ile cervix uteri, corpus uteri ve cornu uteri'nin anatomik yapısını belirlemek amaçlandı. Kafkas Üniversitesi Yaban Hayatı Kurtarma ve Rehabilitasyon Merkezi'ne (Kars, Türkiye) trafik kazası, ateşli silah yaralanması gibi çeşitli nedenlerle getirilen hayvanlar kullanıldı. Tüm müdahalelere rağmen merkez tarafından kurtarılamayan benzer yaşta dört kızıl tilkinin uterus'u diseke edildi. Dijital kumpas kullanılarak cervix uteri, corpus uteri ve sağ-sol cornu uteri'den ölçümler alındı. Her organ bölümünün ağırlıkları, hassas terazi kullanılarak ölçüldü. Ortalama cervix uzunluğu 11.54 ± 1.56 mm, genişliği 4.46 ± 0.52 mm, kalınlığı 5.18 ± 0.08 mm ve ağırlığı 1.18 ± 0.04 gr idi. Corpus uteri uzunluğu ortalama 20.68 ± 3.06 mm, genişliği 2.88 ± 0.50 mm, kalınlığı 2.22 ± 0.19 mm ve ağırlığı 0.90 ± 0.01 g idi. Cornu uteri'nin ortalama uzunluğu 79.85 ± 0.86 mm, genişliği 4.85 ± 0.79 mm, kalınlığı 4.33 ± 0.18 mm ve ağırlığı 2.33 ± 0.12 g idi. Sonuç olarak kızıl tilkilerde, dişi genital sistem organlarından uterus hakkında bilgi verildi. Bu çalışmanın bulgularının kızıl tilkilerde, yapılacak olan cerrahi ve jinekolojik operasyonlar ile bu konu ile ilgili yapılacak çalışmalarda faydalı olabileceğine inanıyoruz.

**Key Words:** Anatomi, kızıl tilki, uterus

### INTRODUCTION

Red fox (*Vulpes vulpes*) is a mammal of the Canidae family of the carnivora order, 70-90 cm in length and 7-10 kg in weight. This type, which can be seen in many parts of the world, is also found in Turkey. There are species living in Europe, Asia, North Africa and America. It is a seasonal monogamous carnivore with pointy and large ears, long tail, and famous for its intelligence and trickery (1). The gestation period usually varies between 50-60 days. They can give birth to 2-12 pups. The sexual maturity age is 7-10 months (2). Depending on the abundance of food, reproductive activities may vary in red foxes. In red foxes, litter size and reproductive efficiency decreases in parallel with the scarcity of rodents (3).

There is a significant relationship between the ovulation rate and the number of embryos in red foxes, and age, body condition, population density, and adult sex ratio also affect reproductive efficiency (4).

Salpinx provides the transmission of the oocyte combined with the sperm to the uterus. After the fertilization of the oocyte, the fertilized ovum will settle, attach and develop in the uterus (5). Cervix uteri provides corpus uteri and vagina connection. It also acts as a barrier in some periods of estrus and pregnancy. Longitudinal folds are seen in cervix mucosa. The types of these folds differ between animal species. Bovine cervical mucosa contains ring-like folds that radiate around it. Small ruminants (sheep and goats) have

rings that are more prominent and make catheterization of the uterus more difficult. Horse cervix is shorter (~ 60 mm). There are mucosal folds that are prominent in the caudal direction but disappear cranially. Pig cervix is long (~ 250 mm). It has a large number of intertwined mucosal protrusions that obstruct the lumen (6).

Generally, the uterus has a short corpus and a long and very narrow cornu (7). In animals, uterine size varies according to breed, age, parity and estrous cycle period (7). Cervix uteri is an organ that connects the corpus uteri with the vagina with a muscular and short thin canal in the middle. Its anatomy, length, and width vary among mammals. It differs in the junction of the vagina to uterus. There are two cervix uteri in rodents as this junction is limited. The corpus uteri, following the cervix uteri, opens into the vagina with two separate channels (8). It is called the uterus simplex because there is greater association in humans and primates. Since most domestic mammals are between these two forms, the uterus is bicornis (9).

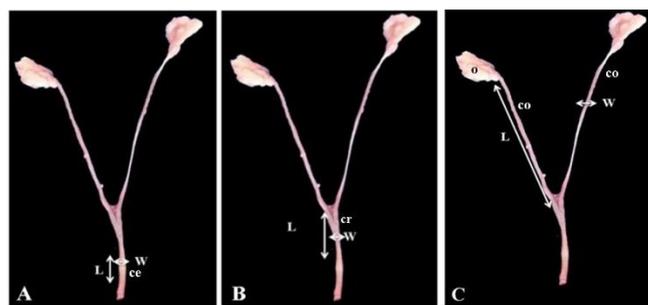
Corpus uteri is the part of the uterus between the place where the cornu start and the cervix uteri. The mean corpus uteri length is 10-30 mm in the dog (10) or 20-30 mm (7, 11, 12) while it is 15 mm in the cat (10). Cornu uteri length has been reported as 120-150 mm (11, 12) or 100-140 mm (7). Cornu uteri thickness is 8 mm (7, 10).

There are studies on Angora goat, Karakaya sheep, Wild goat, Rusa deer and ring-tailed coate on the uterus (13, 14, 15, 16, 17). However, in the literature searches, no anatomical study of the red fox uterus was found.

**MATERIAL AND METHODS**

These red foxes (4 foxes of similar age) were brought to Kafkas University Wildlife Rescue and Rehabilitation Centre (Kars, Turkey) from many provinces of the Eastern Anatolia Region for various reasons such as traffic accidents and fire-arm injury, but could not be saved or needed to be

ethanased according to the Wildlife Rescue and Rehabilitation Centre staff. This study was carried out after the approval received from the Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks (21264211-288.04-E.115615). The foxes that died due to various reasons in the study were brought to the Department of Anatomy of the Faculty of Veterinary Medicine of Kafkas University. The female genital tract was dissected. The uterus was separated from the cavum pelvis and regio sublumbalis by sectioning the ligamentum latum uteri. Measurements were made as described in Figure 1 using a digital caliper (Stainless 0-150 mm). Organ parts weight were measured using precision scales (min: 0.0001 g, max: 220 g, code: XB220A, Precisa®, Swiss).



**Figure 1.** Measurements of cervix uteri (ce) (A), corpus uteri (cr) (B), cornu uteri (co), o: ovary (C) (W: Width of cervix uteri, L: Length of cervix uteri)

**RESULTS**

It was found that most of the uterus was located in the cavum abdominis and in the dorsal of the small intestines. Long and thin cornu uteri were seen in the macroanatomical examination of the uterus, while there were cervix uteri and corpus uteri found short. The mean cervix uteri length was determined as 11.54 ± 1.56 mm, width 4.46 ± 0.52 mm, thickness 5.18 ± 0.08 mm, weight 1.18 ± 0.04 g (Table 1).

**Table 1.** Red fox (RF) cervix uteri measurements

Measurements	RF1	RF2	RF3	RF4	Mean ± SE
Length of cervix uteri (mm)	8.00	11.35	11.20	15.62	11.54 ± 1.56
Width of cervix uteri (mm)	3.25	4.90	4.05	5.66	4.46 ± 0.52
Thickness of cervix uteri (mm)	4.93	5.30	5.27	5.21	5.18 ± 0.08
Weight of cervix uteri (g)	1.08	1.29	1.15	1.21	1.18 ± 0.04

Corpus uteri had two edge named margo uteri dexter and margo uteri sinister. It was observed that the ligamentum latum uteri was attached to these edges. It also had two faces called facies dorsalis and facies ventralis. Facies dorsalis were associated with the rectum and other parts of the large intestine, while facies ventralis were associated with

vesica urinaria and jejunum. It was determined that the ligamentum latum uteri connects the corpus uteri and cornu uteri to the lateral wall of the cavum abdominis and cavum pelvis. The mean corpus uteri length was determined as 20.68 ± 3.06 mm, 2.88 ± 0.50 mm in width, 2.22 ± 0.19 mm in thickness, and 0.90 ± 0.01 g in red foxes (Table 2).

**Table 2.** Red fox (RF) corpus uteri measurements

Measurements	RF1	RF2	RF3	RF4	Mean ±SE
Length of corpus uteri (mm)	21.08	28.50	13.60	19.55	20.68 ± 3.06
Width of corpus uteri (mm)	1.78	4.15	3.06	2.52	2.88 ± 0.50
Thickness of corpus uteri (mm)	1.87	2.50	2.59	1.93	2.22 ± 0.19
Weight of corpus uteri (g)	0.87	0.93	0.92	0.88	0.90 ± 0.01

Cornu uteri had two edges called margo mesovaricus and margo liber. Margo mesovaricus was concave and upright. Its convex and freely located edge was margo liber, pointing down. Cornu uteri were thin, long and straight in shape. (Figure 1). It was determined that the ligamentum

teres uteri progressed ventrocaudally from the cranial end of the cornu uteri to the regio inguinalis. It was like a stick or a worm. The mean cornu uteri length was  $79.85 \pm 0.86$  mm, its width was  $4.85 \pm 0.79$  mm, its thickness was  $4.33 \pm 0.18$  mm, and its weight was  $2.33 \pm 0.12$  g (Table 3).

**Table 3.** Selected red fox (RF) cornu uteri measurements

Measurement	RF1		RF2		RF3		RF4		Mean $\pm$ SE
	right	left	right	left	right	left	right	left	
Length of cornu uteri (mm)	82.65	80.82	83.60	78.07	80.50	77.05	78.32	77.81	
Mean of cornu uteri length (mm)	81.73		80.83		78.77		78.06		$79.85 \pm 0.86$
Width of cornu uteri (mm)	5.54	6.43	6.47	6.00	3.10	2.55	4.92	3.83	
Mean of cornu uteri width (mm)	5.98		6.23		2.82		4.37		$4.85 \pm 0.79$
Thickness of cornu uteri (mm)	3.94	4.02	5.40	3.40	4.26	3.99	4.72	4.91	
Mean of cornu uteri thickness (mm)	3.98		4.4		4.12		4.81		$4.33 \pm 0.18$
Weight of cornu uteri (g)	2.31	2.16	2.53	2.04	1.93	2.35	2.43	2.94	
Mean of cornu uteri weight (g)	2.23		2.28		2.14		2.68		$2.33 \pm 0.12$

## DISCUSSION AND CONCLUSION

Dog's cervix is short. It has a dorsal mucous fold that extends into the vagina as well as the transverse grooves (6). It has been reported that the cervix uteri length of dogs (weighing an average of 25 kg) ranged from 15-20 mm (5). It has been reported as 10 mm in dogs in another source (18). In this study, cervix uteri length was determined as  $11.54 \pm 1.56$  mm in red foxes. The cervix uteri length in red foxes appears to be between the minimum and maximum values reported in dogs. In other words, when catheterization to the cervix uteri in red foxes, the values in dogs can be taken as a basis.

In carnivores, the corpus uteri is usually located in both the pelvic cavity and the abdominal cavity. But the great part is the abdominal cavity (10, 19). Similarly, in the materials we examined, it was seen that most of the uterus was in the cavum abdominis. It has been reported that the length of the corpus uteri is 14-30 mm and its width is 8-10 mm in dogs (average 25 kg) (5). In different sources, the length of the corpus uteri is 10-30 mm in the dog (10) or 20-30 mm (7, 11, 12, 18), while the average length in the cat is 15 mm (10). In our study, the mean corpus uteri length and width were determined as  $20.68 \pm 3.06$  mm and  $2.88 \pm 0.50$  mm in red foxes. When we compared the relevant values, the length of the corpus uteri was higher than that of cats similar to dogs. The corpus uteri length of the red foxes, which can give birth to a large number of offspring, may have been higher than the cats in parallel with the body size.

In adult non-pregnant animals, cornu uteri are usually the same size. Cornu uteri are connected to the ovary with the ligamentum ovarii proprium in the cranial. It was stated that the length of the cornu uteri in dogs can vary between 100-140 mm, while the width of the cornu uteri is 5-10 mm (5, 20). In other sources, the length of the cornu uteri in the dog is reported as 120 mm (18) and 150 mm (19), while the thickness is noted as 8 mm (10). In this study, the length of cornu uteri was  $79.85 \pm 0.86$  mm and its width was  $4.85 \pm 0.79$  mm in red foxes. When we make a comparison, it is seen that the values for foxes are shorter than that of

dogs. However, considering that red foxes can give birth to 12 offspring, it can be said that they have a long cornu uteri.

Red foxes are one of the main stones of the ecosystem. In addition to factors such as global warming, hunting and the effects of chemicals that harm nature, harsh winter conditions also make it difficult for foxes to survive. In this sense, it is important to benefit, indirectly reduce threats to other species and balance the ecosystem. The work we have done to reproduce this species, whose number is decreasing and has begun to become extinct, may be important. The study contributed to the elimination of the lack of knowledge about the anatomical structures of the parts of the uterus from the female genital organs of the red fox. We believe that surgical operations such as ovariohysterectomy to be performed in Carnivores and uterine transplantation (21) operations performed for infertility problems will be beneficial, albeit somehow.

## ACKNOWLEDGMENT

This study was presented orally on August 12–14, 2017, at the International Congress on Domestic Animal Breeding Genetics and Husbandry, İzmir, Turkey.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## REFERENCES

- Larivière S, Pasitschniak-Arts M. (1996). *Vulpes vulpes*. Mammalian Species. 537: 1-11.
- The Reproductive System-The Red Fox Resource, access: <http://www.petplace.com/dogs/structure-and-function-of-the-female-canine-reproductive-tract/page1.aspx> . accessed date: 21.03.2019.
- Halvorsrud E. (2014). Patterns of Reproduction and Body Condition in Red fox (*Vulpes vulpes*). Master Thesis. Hedmark University College, Faculty of Applied Ecology and Agricultural Sciences.

4. Allen SH. (1984). Some Aspects of Reproductive Performance in Female Red Fox in North Dakota. J Mammal. 65(2): 246-255.
5. Miller ME. (1964). Anatomy of the Dog. pp. 391-393, W. B. Saunders Company, Philadelphia.
6. Jennigs R, Premanandan C. (2017). Veterinary Histology. pp. 196-197. The Ohio State University.
7. Kaymaz M, Fındık M, Rişvanlı A, Köker A. (2013). Obstetrics and Gynecology in Cats and Dogs. Medipres Printing, Malatya, Turkey.
8. Bertram CA, Klopffleisch R, Erickson NA, Müller K. (2019). Uterus Duplex Bicollis, Vagina Simplex in Laboratory Guinea Pigs (*Cavia porcellus*), Rats (*Rattus norvegicus forma domestica*) and Mice (*Mus musculus forma domestica*). Anat Histol Embryol. 1-6.
9. König HE, Liebich HG. (2015). Female genital organs. In H. E. König, & H.G. Liebich (Eds.), Veterinary Anatomy of Domestic Mammals: Textbook and Colour Atlas. 6th Ed. pp. 440-445, Medipress Publishing, New York, NY: Schattauer Verlag.
10. Bahadır A, Yıldız H. (2014). Veterinary Anatomy (Locomotor system & Internal organs). revised 5th ed. pp. 325-328, Ezgi Bookstore, Bursa.
11. Sission S. (1910). A Textbook of Veterinary Anatomy. pp. 522-523, W.B. Saunders Company, Philadelphia, London.
12. Sission S, Grossman S. (1975). The Anatomy of the Domestic Animals. 5 th Ed. pp. 1584-1587, W.B. Saunders Company.
13. Dayan MO, Beşoluk K, Eken E, Özkadif S. (2010). Anatomy of the Cervical Canal in the Angora Goat (*Capra hircus*). Kafkas Univ Vet Fak Derg. 16:847-850.
14. Gültiken N, Gültiken ME, Anadol E, Kabak M, Fındık M. (2009). Morphometric Study of the Cervical Canal in Karakaya Ewe. J AnimcVet Adv. 8: 2247-2250.
15. Kırbaş Doğan G, Kuru M, Bakır B, Karadağ Sarı E. (2020). Anatomical and Histological Structure of Cervix Uteri, Corpus Uteri and Cornu Uteri of the Anatolian Wild Goat. TJVR. 4 (2): 63-68.
16. Mahre MB, Wahid H, Rosnina Y, et al. (2016). Anatomy of the Female Reproductive System of Rusa Deer (*Rusa timorensis*). SJVS. 14: 1.
17. Saddi TM. (2014). Aspectos Histológicos de Órgãos do Sistema Reprodutor feminino e Glândula Mamária de Quati (*nasua nasua, linnaeus 1766*). Universidade Federal de Goiás Escola de Veterinária e Zootecnia Programa de Pós-Graduação em Ciência Animal Aspectos. Goiânia.
18. Budras KD, Wünsche A. (2009). Atlas of Veterinary Anatomy (Dog). 2th Ed. pp. 72-73, Medipress Publishing, Malatya.
19. Dursun N. (2008). Veterinary Anatomy III (in Turkish). 7th Ed. pp. 169-173, Medisan Publication, Ankara, Turkey.
20. Alaçam E. (2005). Obstetrics and Infertility in Domestic Animals. 5th Ed. pp. 5-10, Medisan Publication, Ankara, Turkey.
21. Brännström M, Wranning CA, Altchek A. (2010). Experimental Uterus Transplantation. Hum Reprod Update. 16 (3): 329-345.

✉ **Corresponding Author:**

Gülseren KIRBAŞ DOĞAN  
 Kafkas University, Faculty of Veterinary Medicine,  
 Department of Anatomy, Kars, Turkey  
 E-posta: glsrn36@gmail.com