



**XIII. NATIONAL / IV. INTERNATIONAL
VETERINARY ANATOMY CONGRESS
SEPTEMBER 25 – 28, 2025
BALIKESİR**



CONGRESS BOOK

From his speech at the Zağnos Pasha Mosque in
Balıkesir;

*“National aspirations and national will are not the
thoughts of a single individual, but the combined
desires and aspirations of all the individuals of the
nation.”*

Mustafa Kemal ATATÜRK
February 7, 1923 BALIKESİR

**Balıkesir Zağnos Paşa Camisinde Yaptığı
Konuşmadan;**

*“Millî emeller, millî irade yalnız bir şahsın
düşünmesinden değil bütün millet fertlerinin
arzularının, emellerinin bileşkesinden ibarettir.”*

**Mustafa Kemal ATATÜRK
7 Şubat 1923 BALIKESİR**

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President of Congress Organizing Committee

Prof. Dr. Şükrü Hakan ATALGIN

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Faculty of Veterinary Medicine**

Dear Colleagues,

It is with great pride and pleasure that we welcome you to the Veterinary Anatomy Congress, held in Balıkesir—the city of the *Kuva-yi Milliye*—accompanied by its unique nature and rich cultural heritage. This congress provides an important opportunity to share current research in the field of veterinary anatomy, engage in scientific discussions, develop new perspectives that will shed light on the future of our profession, and perhaps most importantly, reunite with our esteemed colleagues.

Veterinary anatomy is one of the most fundamental pillars of veterinary medicine, playing a key role in understanding all the scientific and practical processes essential for animal health and welfare. In this context, our congress will serve as a meeting point for both young researchers and distinguished scientists, opening new doors for collaborations and joint studies.

The historical texture, natural beauty, and hospitality of Balıkesir add a unique value to our congress. We hope that, beyond the scientific program, our participants will also have the opportunity to explore the cultural and social richness of our city.

Our sincere wish is that this congress will be fruitful, inspire new ideas and projects, and make lasting contributions to the field of veterinary anatomy.

We wish you all a productive, enjoyable, and unforgettable congress.

Respectfully,

Prof. Dr. Şükrü Hakan ATALGIN

Chair of the Organizing Committee

Editors:

Prof. Dr. Mehmet CAN

Res. Asist. Mustafa KORKMAZ

Supports



Supporting Organizations

Balıkesir University

Balıkesir University Faculty of Veterinary Medicine

Balıkesir Metropolitan Municipality

Kepsut Municipality

Thank you for the Activities

Taxidermy Workshop- Sadi BAGANA

Making Ointments – Elif BUDAK from BAÇEM

**Mosaic Align- Gülçin CÖMERT from ANTRADOS
Association**

Scientific Program

1st Day (September 25, 2025)
12:00-14:00 Registration
15:00-16:00 Opening, Opening Speeches, Barcoveision Show
17:00-19:00 Cunda Island Sightseeing
19:00-20:00 Dinner
20:00-21:00 Making Ointment
21:00-22:00 Association Meeting

2nd Day (September 26, 2025)

SESSION 1 ORAL PRESENTATION (SALON A)

Chairs: Prof. Dr. Ali BAHADIR, Prof. Dr. İsmail TÜRKMENOĞLU,
Prof. Dr. Gamze ÇAKMAK

09:00	O.1 “Investigation of the Effects of Heat Stress on Adrenal Gland in Rats Using Morphometric Methods” <u>Dervis ÖZDEMİR</u> , Zekeriya ÖZÜDOĞRU
09:10	O. 2 “Printed Anatomical Model of Reproductive Organs for Application to Rectal Examination in Cows.” <u>Şükrü Hakan ATALGIN</u> , Nevzat SAAT, Murat DAĞLI, Mustafa KORKMAZ
09:20	O. 3 “Three-Dimensional Geometric Morphometric Analysis of Skull Shape and Sexual Dimorphism in Romanov Sheep” <u>İhsan Berat KILIÇLI</u> , Caner BAKICI, Hasen Awel YUNUS, Barış BATUR
09:30	O. 4 “3D Geometric Morphometric Analysis of the Sternum of the Red Fox (Vulpes Vulpes)” <u>Murat BUDUNOĞLU</u> , Asuman ARKAŞ ALKLAY, Hilal KAPLAN, Alaettin KAYA, Mehmet KILINÇ
09:40	O. 5 “Investigations on the Macroscopic and Light Microscopic Structure of the Brain in the Common Kestrel (Falco tinnunculus)” <u>Burhan TOPRAK</u> Aylin BİLEN ÇOBAN, Bahadır KILINÇ
09:50-10:10	Kahve Molası/ Coffee Break (20 dk/min)

2nd Day (September 26, 2025)	
SESSION 2 ORAL PRESENTATION (SALON A) Chairs: Prof. Dr. Nejdett DURSUN, Prof. Dr. Hüseyin YILDIZ, Prof. Dr. Derviş ÖZDEMİR	
10:10	O. 6 “Comparative Analysis of Trimester-Based Placentome Morphology in Singleton and Twin Pregnancies in Sheep” <u>Fatma İŞBİLİR</u> , Banu KANDİL, Ali Osman TURGUT, Muhammed Zahid ATLI, İhsan İŞBİLİR, Barış Can GÜZEL
10:20	O. 7 “Determining Morphometric Differences in Avian Tarsometatarsus Using Artificial Intelligence (Machine Learning)” <u>Sedat AYDOĞDU</u> , Reyhan Rabia KÖK, Mustafa ZEYBEK, Emrullah EKEN
10:30	O. 8 “An Evaluation of the Use of Eponymous Terms in Veterinary Anatomy Education” Begüm ÖZDEMİR, Ezgi Deniz MAVİLİ, Ezgi AKSOY, Barış BATUR, <u>Ahmet ÇAKIR</u>
10:40	O. 9 “Morphometric Examination of Interthalamic adhesion Using Magnetic Resonance Imaging in Van cats” <u>Veysel DELİBAŞ</u> , Zafer SOYGÜDER, Cemil GÖYA, Gamze ÇAKMAK, Tolga ÇETİN, Burçin ÇELİKEZEN
10:50	O. 10 “A Study on Gender Estimation Using Machine Learning Algorithms (Mlas) With Parameters Obtained from Radiographic Images of The Femur in Dogs and Cats.” <u>Lutfi TAKCI</u> , İbrahim KÜRTÜL
10:50-11:10	Kahve Molası/ Coffee Break (20 dk/min)

2 nd Day (September 26, 2025)	
SESSION 3 ORAL PRESENTATION (SALON A) Chairs: Prof. Dr. İsmail Önder ORHAN, Prof. Dr. Erdal ÖZMEN	
11:20	O. 11 “Three-Dimensional Reconstruction and Volume Measurement of the Frontal Sinuses in Brown Bears (<i>Ursus arctos</i>)” <u>Muhammed Zahid ATLI</u> , Iliana Stefanova RUZHANOVA-GOSPODINOVA
11:30	O. 12 “Investigation of the Metacarpus of the Red Fox (<i>Vulpes Vulpes</i>) by 3D Geometric Morfometric Method” <u>Hilal KAPLAN</u> , Asuman ARKAŞ ALKLAY, Murat BUDUNOĞLU, Alaettin KAYA, Mehmet KILINÇ
11:40	O. 13 " Regional Mineral Composition and Microstructural Analysis of Metacarpus and Metatarsus Bones in Cattle.” <u>Beste DEMİRCİ</u> , Fatih Muhammed YAMAN
11:50	O. 14 “Macroscopic Anatomy and Histology of the Thymus in the Fetus of Roe Deer (<i>Capreolus capreolus</i>)” Baran ERDEM, Lutfi TAKCI, Sema USLU, Tuba Cansu ÖZKOCAOĞLU, <u>Sevinç ATEŞ</u>
12:00	O. 15 “Shape Variation of Linea Temporalis and Crista Nuchae in Mesocephalic Dogs” <u>Yasemin ÜSTÜNDAĞ</u> , Yasin DEMİRASLAN, İftar GÜRBÜZ, Ali KOÇYİĞİT, İsmail DEMİRCİOĞLU, Ali ŞİMŞEK, Funda AKSÜNGER KARAAVCI
12:10-14:00	Yemek Molası/ Lunch Break

2 nd Day (September 26, 2025)	
SESSION 4 ORAL PRESENTATION (SALON A) Chairs: Prof. Dr. İbrahim KÜRTÜL, Prof. Dr. Okan EKİM	
14:00	O. 16 “Root Canal Morphology of Canine Teeth in Cats” <u>Nejra DUČIĆ</u> , Faruk TANDİR, Rizah AVDIĆ, Nedžad HADŽIOMEROVIĆ, Anel VEJZOVIĆ
14:10	O. 17 “Some Morphological Features of the Thyroid Lobes and Thyroid Isthmus in the Goat.” <u>Penka YONKOVA</u>
14:20	O. 18 “Morphological and Morphometric Characteristics of the Ethmoid Bone in Mixed-Breed Dogs” <u>Sokol DURO</u> , Ozan GÜNDEMİR, Nedžad HADŽIOMEROVIĆ, Anel VEJZOVIĆ
14:30	O. 19 “Merging Anatomy and Meat: Exploring the Benefits of Immersive Technologies in Veterinary Education” <u>Nedžad HADŽIOMEROVIĆ</u> , Kenan ČAKLOVIĆA, Faruk TANDİR, Migena Gjoni GÜNDEMİR, Anel VEJZOVIĆ, Nejra DUČIĆ, Neira FAZLOVIĆ, Rizah AVDIĆ)
14:40	O. 20 “Comparative Anatomical and Histological Studies on the Intestinal Tract in Male and Female Naked Neck Chicken” <u>Sajid HAMEED</u> , Muhammad SARIM, Adeel SARFRAZ, Evelyn SABA, Mumtaz HUSSAIN, Umer FAROOQ
14:40-15:00	Kahve Molası/ Coffee Break (20 dk/min)

2nd Day (September 26, 2025)	
SESSION 5 ORAL PRESENTATION (SALON A) Chairs: Prof. Dr. Ahmet ÇAKIR, Prof. Dr. Emine Ümran ÖRSÇELİK	
15:10	O. 21 “Origin and Distribution of the Brachial Plexus in Red-Necked Wallaby (Notamacropus Rufogriseus, Marsupialia: Macropodidae). Caner BAKICI, <u>Hasen Awel YUNUS</u> , Baris BATUR
15:20	O. 22 “A Stereological Study on the Volume of the Medulla Oblongata in Turkeys and Guinea Fowls” Veysel DELİBAŞ, <u>Gamze ÇAKMAK</u> , Zafer SOYGÜDER, Eyyup AYTAÇ
15:30	O. 23 “Meta-Analysis of Morphometric Measurements of the Mandible in Sheep Breeds” Güven GÜNGÖR, <u>Funda AKSÜNGER KARAAVCI</u> , Betül KANİK
15:40	O. 24 “Impact of Digital Learning Materials on Student Performance in Veterinary Anatomy Education” <u>Samil SEFERGİL</u> , Seyyid Said SABANCI, Bahri EVCİM
15:50	O. 25 “Examination of the Wild Boar Heart Using Scanning Electron Microscopy” <u>Süleyman YÜKSEL</u> , Beste DEMİRCİ
15:50-16:10	Kahve Molası/ Coffee Break (20 dk/min)

2 nd Day (September 26, 2025)	
SESSION 6 ORAL PRESENTATION (SALON A) Chairs: Prof. Dr. Bahri YILDIZ, Prof. Dr. Zafer SOYGÜDER, Prof. Dr. Kamil BEŞOLUK	
16:10	O. 26 “Use of Interactive Muscle-Joint Model in Myology Education” Fatih GÜRLER, <u>Figen SEVİL-KİLİMCİ</u>
16:20	O. 27 “A Comparative Evaluation of AI Chatbots in Veterinary Anatomy: Performance of ChatGPT, Gemini, and DeepSeek Models” <u>Ezgi Deniz MAVİLİ</u> , Barış BATUR, Çağdaş OTO
16:30	O. 28 “Application of S10B Silicone Plastination to Equine Stomach Infected with Gasterophilus Larvae: Feasibility and Educational Value” <u>Ezgi Su AKSOY</u> , Barış BATUR, Caner BAKICI, Hande İrem SÖNMEZ, Hasen Awel YUNUS, Semih ÖGE
16:40	O. 29 “Morphometric Characteristics of the Foramina Located in the Middle Cranial Fossa in Dog” <u>Nimet TURGUT</u> , Sadullah BAHAR, Tutku MECİT, Yağmur GÜLEÇ, Abdullah Bilal ÇİL
16:50	O. 30 “The Peripheric Shape of the Hemispherium in the Sheep and Goat” Yasin DEMİRASLAN, <u>Tuğba OKTAY</u>

2nd Day (September 26, 2025)	
SESSION 1 ORAL PRESENTATION (SALON B) Chairs: Prof. Dr. Mustafa Orhun DAYAN, Prof. Dr. Yasin DEMİRASLAN	
09:00	O. 31 “Three-Dimensional Modeling of the Cranium of a Wistar Albino Rat Using Stereomicroscope-Assisted Photogrammetry” Burcu ONUK, <u>Eyüp KOÇAK</u> , Semih KURT, Sedef SELVİLER SİZER, Murat KABAK, İbrahim Halil TÜRKER
09:10	O. 32 “Macroscopic Evaluation of Rabbit Eye Morphology” <u>Defne ARICI</u> , İsmail Önder ORHAN
09:20	O. 33 “Determination of Foramen Magnum Morphometry by Computed Tomography Images in Dogs” <u>Yağmur GÜLEÇ</u> , Nimet TURGUT
09:30	O. 34 “Quantitative Evaluation of Retina with Optical Coherence Tomography in Experimental Rabbits” <u>Barış BATUR</u> , Caner BAKICI, Ebru ERDAL, Elif İnci ERBAHCECI TIMUR, Nagihan UGURLU, Reside Merih HAZIROGLU
09:40	O. 35 “Macro-anatomical and Morphometric Examination of the Humerus Bone in German Mast Geese” <u>Yeşim ASLAN KANMAZ</u>
09:50-10:10	Kahve Molası/ Coffee Break (20 dk/min)

2 nd Day (September 26, 2025)	
SESSION 2 ORAL PRESENTATION (SALON B) Chairs: Prof. Dr. Mehmet KILINÇ, Prof. Dr. Burhan TOPRAK	
10:10	O. 36 “A Macro-anatomical and Subgross Study on the Turkey Linguae” <u>Büşra TURAN</u>
10:20	O. 37 “Three-Dimensional Design of Ligaments in Orthopedic and Anatomical Joint Models of Horses (Equidae) and Their Application on the Skeletal Model” <u>Bahri EVCİM</u> , Şamil SEFERGİL, Seyyid Said SABANCI, Sıla YILDIRIM
10:30	O. 38 “Development of Epidural Anesthesia Models in the Dog Using Three-Dimensional Printing Technology” <u>Semih KURT</u> , Murat KABAK
10:40	O. 39 “Examination of Pelvic Muscles in Chickens (Gallus Domesticus) and Their Preservation by Silicone Plastination Method” <u>Hamza YURTTAŞ</u> , Saime Betül BAYGELDİ
10:50	O. 40 “The Use of Artificial Intelligence Language Models in Veterinary Anatomy Education” <u>Ali KOÇYİĞİT</u> , İsmail DEMİRCİOĞLU
10:50-11:10	Kahve Molası/ Coffee Break (20 dk/min)

2 nd Day (September 26, 2025)	
SESSION 3 ORAL PRESENTATION (SALON B)	
Chairs: Prof. Dr. Rizah AVDIC, Prof. Dr. Faruk TANDIR, Prof. Dr. Çağdaş OTO	
11:20	O. 41 “Morphology of the Ovary and Tuba Uterinae in the Roe Deer (<i>Capreolus capreolus</i>)” <u>Betül KANİK</u> , Yonca Betil KABAK, Murat KABAK
11:30	O. 42 “Investigation of the Effect of Sea Water on the Fixation of Poultry Tissues by HxE Staining Method” <u>Esin ÜNSALDI</u>
11:40	O. 43 “Effect of Exposure to Noise Stress on Liver Tissue Histopathology in Rats” <u>Esin ÜNSALDI</u> , Aslan KALINBACAK
11:50	O. 44 “The Effect of Sex and Species on Bill Variation in Chukar Partridge (<i>Alectoris Chukar</i>) and Grey Partridge (<i>Perdix Perdix</i>): Insights from Three-Dimensional Geometric Morphometric Analysis and Linear Morphometric Analysis” <u>Hacer BAŞ EKİCİ</u> , Mustafa Sedat ARSLAN
11:50-12:00	O. 45 “A Study on the Macroscopic, Light and Scanning Electron Microscopic Structure of the Oropharyngeal Cavity in the Common Kestrel (<i>Falco tinnunculus</i>)” <u>Burhan TOPRAK</u>
12:10-12:20	O.46 “The Use of Artificial Intelligence-Supported Systems in the Field of Forensic Veterinary Osteology” <u>Okan EKİM</u> , Semih BOL, Berker BAYDAN
12:10-14:00	Yemek Molası/ Lunch Break

2nd Day (September 26, 2025)
POSTER PRESENTATION (SALON B)
17:00-17:30

P. 1 “Three-Dimensional Reconstruction of the Cranium of the Barn Owl (Tyto alba) Using the Photogrammetry Method”
Fatmanur Sıla KESKIN, Semih KURT, Eyüp KOÇAK, Ali KÖK, Sedef SELVİLER SİZER, Burcu ONUK, Murat KABAK

P. 2 “Volumetric and Morphological Comparisons in Different Skull Types Dogs: 3D Modelling and Printing Study”
Ezgi Deniz MAVİLİ, Gülezgi KARADAĞ, Melek Beste EKER, Çağdaş OTO

P. 3 “Mesiodistal Crown Measurements of Permanent Anterior Teeth in German Shepherd Dogs: A Veterinary Dental Assessment”
Faruk TANDIR, Rizah AVDIĆ, Nedžad HADŽIOMEROVIĆ, Anel VEJZOVIĆ, Nejra DUČIĆ, Redžep TANDIR

P. 4 “An Anatomical and Histological Study on the Spleen and Lymph Node in a Brown Bear Cub”
Gülseren KIRBAŞ DOĞAN, Sevda ELİŞ YILDIZ, Ebru KARADAĞ SARI, Evin KAÇMAZ

P. 5 “Aquaporin 3 Immunolocalization and Histological Characteristics in the Digestive Tract of The Partridge (Alectoris chukar)”
İsmail DEMİRCİOĞLU, Muhammet Bahaeddin DÖRTBUDAK, Ali KOÇYİĞİT

P. 6 “Geometric Analysis of the Nasal and Orbital Region of the Dog According to the Climate”
Mustafa Orhun DAYAN, İftar GÜRBÜZ, Yasin DEMİRASLAN, YASEMIN ÜSTÜNDAĞ

P. 7 “The Protective Effect of Turmeric Powder on Damage Caused by Heat Stress in Young Turkey Spermatogenesis”
Sajjad HEJAZİ, Afshin ZAKERİ, Parmida FATHİ, Sina BABAKORDİ
Mertcan SAYAN

P. 8 “Preservation of Organs for Anatomy Teaching: An Affordable and Non-Toxic Approach”

Rizah AVDIĆ, Faruk TANDİR, Nedžad HADŽIOMEROVIĆ, Anel VEJZOVIĆ, Nejra DUČIĆ

P. 9 “Geometric Analysis of the Mandible in Guard, Hound and Shepherd Dogs”

Yasemin ÜSTÜNDAĞ, Yasin DEMIRASLAN, İftar GÜRBÜZ, Ali KOÇYİĞİT, İsmail DEMİRCİOĞLU, Funda AKSÜNGER KARAAVCI, Ali ŞİMŞEK

P. 10 “‘Aşık Atma’ Game”

Mehmet CAN, Mustafa KORKMAZ, Yaren BEKTİK, Rümeysa ALTUNTAŞ

3rd Day (September 27, 2025)

Social Activities

4th Day (September 28, 2025)

Taxidermy Workshop

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ORAL PRESENTATION

01

Investigation of the Effects of Heat Stress on Adrenal Gland in Rats Using Morphometric Methods

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Abstract

Introduction: The adrenal glands are triangular endocrine glands. They are located just above the kidneys. They consist of two separate parts: the cortex and the medulla. They produce vital hormones such as adrenaline, aldosterone and cortisol. Thanks to these hormones, they play a role in regulating blood pressure, metabolism and stress response. Stress is the interaction between the factors that create action and the organism's defense reactions. Stress factors that threaten the stable internal balance (homeostasis) of the body of animals are internal or external events.

Materials and Methods: This study was conducted to examine the effect of temperature on rat adrenal glands. After the weaning period (week 3), 36 Sprague Dawley rats were divided into three main groups of twelve animals each. Two subgroups were formed for each group (6 males and 6 females). After slaughter, the adrenal glands were quickly removed and semi-quantitatively analyzed by conventional histology. The left adrenal gland of each animal was dissected and prepared for morphometric analysis. This study examined histological and cytometry changes in the cortical and medullary tissue of the adrenal gland in rats under acute and chronic heat stress.

Results: It was found that adrenal weight decreased in males and increased in females with increasing stress duration. Although the volume density of the zona glomerulosa and medulla increased

significantly in the heat-treated groups, it was determined that the zona capsularis, zona glomerulosa and zona fasciculate increased.

Conclusion: It was found that the adrenal gland showed histological changes in both cortical and medullary regions after both types of stress and stress duration.

Keywords: Adrenal glands, cortex, heat, medulla, stress.

Printed Anatomical Model of Reproductive Organs for Application to Rectal Examination in Cows

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Abstract

Introduction: Anatomical models were developed using three-dimensional (3D) printing technology to solve the challenges faced by students training rectal examinations on live animals in veterinary education. These models aim to protect the limitations on adequate practice opportunities due to increasing student numbers, animal welfare restrictions, and accessibility difficulties. This study objects to provide students with a reproducible and anatomically relevant learning experience before performing procedures on live animals.

Materials and Methods: In this study, the genital organs and rectums of cows collected from slaughterhouses that had given at least one birth were used as prototypes. In laboratory, calcium sulfate hemihydrate was mixed with water at a 1:1 ratio to obtain a homogeneous solution. This solution was injected into the uterine lumen via an intrauterine catheter to smoothly coat the inner surface of organ. The material was stored at +4°C for one day to allow the solution to solidify. Organic tissue was dissected 24 hours after injection. The material, shaped like the genital organs, was scanned and coded using a 3D printer. The perianal tissues (anus and vulva) were designed with an elastic structure. Polylactic acid-based thermoplastic filaments and Fused Deposition Modeling (FDM) technology were used in the production of the models. The model in

this study depicts the genital organs (vulva, vagina, cervix, corpus and cornu uteri), anus, and rectum.

Results: The developed rectal examination model is expected to significantly improve ability of students to identify key structures compared to traditional training. Students trained with these simulators are expected to demonstrate a significant superiority in uterine localization in routine clinic experiments. Furthermore, students are expected to experience a significant increase in their clinical skills and confidence.

Conclusion: In conclusion, 3D printer-based rectal examination models are evaluated a valuable method for veterinary education, both pedagogically and ethically. They distinguish themselves from existing methods by being low-cost, highly realistic, and modular. This technology provides a safe and controllable learning environment, while also respecting animal welfare. We are of the opinion that integrating such simulators into veterinary curricula will significantly contribute to increased standardization in education and the development of practical skills.

Keywords: Veterinary education, simulator, rectal examination, genital organ, cow

Three-Dimensional Geometric Morphometric Analysis of Skull Shape and Sexual Dimorphism in Romanov Sheep

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Abstract

Introduction: The employment of three-dimensional geometric morphometric techniques is becoming increasingly prevalent for the purpose of evaluating shape variations with a high degree of accuracy. Shape variation in anatomical structures between males and females provide comprehensive visual and statistical data for comparative anatomy. In this process, skull sexual dimorphism is of great importance for facilitating descriptions, shape analyses, and the use of species in numerous scientific applications. In this context, the study employs three-dimensional (3D) geometric morphometrics to evaluate sexual dimorphism in Romanov sheep.

Materials and Methods: A total of 30 Romanov craniums (15 female, 15 male) were obtained from computed tomography images with a slice thickness of 0.6 mm. Three-dimensional models were created using 3D Slicer software (version 5.8.0). Landmark marking and shape analyses were performed using 3D Slicer, while all statistical analyses were conducted using PAST software (version 4.03).

Results: Geometric morphometric analyses have revealed that the main morphological variations are exhibited in fundamental anatomical structures such as the fissura interincisivum, foramen magnum, condylus occipitalis, processus paracondylaris and the caudal edge of the third molar tooth. In males, differences have been identified in anatomical structures such as the foramen magnum,

condylus occipitalis, processus paracondylaris, external occipital protuberancia, median occipital crest, prosthion, and os palatinum compared to females. Statistical analyses have demonstrated differences in sexual dimorphism ($p<0.001$).

Conclusion: This study statistically identifies sex-related morphological differences in Romanov sheep and provides valuable insights into the role of these differences in shaping morphological variation. The integration of three-dimensional geometric morphometric analyses contributes to a deeper understanding of sexual dimorphism. The findings serve as a valuable reference for disciplines such as forensic science, zooarchaeology, and biology particularly in the contexts of taxonomic classification, reproductive strategy assessment, and anatomical modeling of sex-specific morphological traits.

Keywords: 3D Geometric morphometrics, Principal component analysis, Shape analysis, Veterinary anatomy

Funding: We would like to thank Scientific and Technological Research Council of Türkiye (TÜBİTAK) for their valuable support. This research was funded by TÜBİTAK under Project Code 1919B012416074.

3D Geometric Morphometric Analysis of the Sternum of the Red Fox (*Vulpes Vulpes*)

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Abstract

Introduction: The aim of this study was to determine the characteristics of the sternum in Red foxes using 3D geometric morphometric methods.

Materials and Methods: A total of 13 Red fox cadavers, including 9 males and 4 females, were used in the study. **Materials:** The Red fox cadavers were obtained from the Dicle Wildlife Rescue and Rehabilitation Center affiliated with the 15th Regional Directorate of the Ministry of Agriculture and Forestry, Diyarbakır Nature Conservation and National Parks Directorate, and the dissection room of the Department of Anatomy, Faculty of Veterinary Medicine, Dicle University. The materials obtained were scanned using a 128-detector multi-slice spiral computed tomography device (Somatom Sensation 128; Siemens Medical Solutions, Forchheim, Germany) located at the Department of Radiology, Faculty of Medicine, Dicle University. The dose parameters and scans were performed based on standard protocols. Thus, efforts were made to achieve radiometric resolution at the lowest radiation level and optimal image quality. The device parameters were set by the radiology technician as follows: physical

detector collimation, 32 x 0.6 mm; final slice collimation, 64 x 0.6 mm; slice thickness, 0.5 mm; gantry rotation time, 330 msec; kVp; 120; Ma, 300; resolution, resolution range, 0.92 x 0.92 were set by the radiology technician. The obtained images were analyzed using geometric morphometric analysis on three-dimensional models with the 3D Slicer ver 5.8.1-win program.

Results: It was determined that the sternum consists of the manubrium sterni, corpus sterni, and processus xiphoideus sections. Three-dimensional models of the sternum were created for female and male Red foxes. The sternum models of female and male animals were compared.

Conclusion: It is believed that the data obtained from this study will contribute to studies conducted on other wild animals.

Keywords: Red fox, sternum, three-dimensional modeling, 3D geometric morphometry.

Investigations on the Macroscopic and Light Microscopic Structure of the Brain in the Common Kestrel (*Falco tinnunculus*)

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Abstract

Introduction: The anatomical and histological structures of avian may vary depending on their flying characteristics as well as their food diversity and adaptation to their environment. One of these structures is the brain, and they have a better developed brain than the less developed vertebrates, amphibians and reptiles. Therefore, the aim of this study was to investigate the macroscopic and light microscopic structures of the brain in the common kestrel.

Materials and Methods: The brains of 3 adult kestrels that were brought to Keçiören Municipality Veterinary Affairs Directorate (1) and Afyon Kocatepe University Wildlife Rescue and Rehabilitation Centre (2) for treatment and could not be saved were used in the study. The brains were properly removed and examined macroscopically and light microscopically.

Results: The average weight of the brain was 3.23 g, the total length was 22.5 mm and the total width was 23.5 mm. The cerebrum, cerebellum, lobus opticus and medulla oblongata were the parts of the brain that attracted attention. A well-developed lobus opticus was observed and small and rudimentary bulbus olfactorius was available in the antero-inferior part of the hemispherium cerebri on both sides

of the midline. In the cerebellum, there were 9-10 transverse projections called folia cerebelli and fissura cerebelli separating these projections. Airacula cerebelli were found on the sides of the cerebellum and behind the lobus opticus. The pons and medulla oblongata were available in the posterior part of the brain and were separated from each other by a slightly prominent transverse groove. Microscopic examination revealed the presence of pyramidal neurons and dense glial cells in the cortex cerebri, while the typical three-layered structure of the cerebellum and the histological integrity of prominent Purkinje cells were observed. In addition, numerous multipolar neurons and supporting glial cells were observed in the medulla oblongata, while the ventriculus quartus was found to be covered with ependymal cells.

Conclusion: This study revealed the macroscopic and light microscopic structures of the brain in the common kestrel. The morphological structures of the brain in other avian species were compared with the data obtained and similarities and differences were discussed.

Keywords: Brain, Common kestrel, Falco tinnunculus, Light microscopy, Macroscopy

Comparative Analysis of Trimester-Based Placentome Morphology in Singleton and Twin Pregnancies in Sheep

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Abstract

Introduction: Placental development in sheep is of vital importance for the healthy growth and development of the fetus. Placentome structures, which mediate the exchange of substances between maternal and fetal tissues, undergo morphological and histological changes depending on the gestational age and pregnancy type. This study aimed to comparatively evaluate the placentomes in singleton and twin pregnancies in sheep in terms of macroscopic, morphometric, and microscopic features across trimesters.

Materials and Methods: The study was conducted by examining the uteri of 60 pregnant ewes collected from designated slaughterhouses. The uteri were categorized into three trimesters based on gestational days (0–50, 50–100, and 100–150 days), and within each trimester, they were further divided into two groups: singleton and twin pregnancies. Macroscopic measurements were performed using a digital caliper and ImageJ software. For histometric measurements,

tissue sections were stained with Crossmon's trichrome stain. One-way ANOVA was used to compare trimesters in singleton and twin pregnancies for each parameter, while independent samples t-tests were used for pairwise comparisons between singleton and twin pregnancies within each trimester. In microscopic measurements, Cohen's d value was calculated to assess the effect size between singleton and twin pregnancies. In addition, placentomal surfaces were visualized using scanning electron microscopy (SEM).

Results: As pregnancy progressed, placentomes exhibited a marked increase in size. In singleton pregnancies, placentome length and width values in the third trimester were significantly higher compared to twin pregnancies ($p<0.01$), while no statistical difference was observed in the depth parameter. In the first and third trimesters, the number of placentomes in twin pregnancies was found to be significantly higher than in singleton pregnancies ($p<0.001$). Caruncular vessel diameter and number showed significant differences in the second trimester in twin pregnancies ($p<0.01$). Although no statistically significant difference was observed in cotyledonary vessel diameter, biologically notable differences were detected in the third trimester ($d=0.83$). The number of cotyledonary vessels increased significantly with advancing trimester in both pregnancy types. SEM analyses revealed an increase in the number of caruncular surface epithelial cells and widening of crypt openings in the third trimester.

Conclusion: Placentome morphometry undergoes significant structural changes depending on pregnancy type and duration. Adaptive changes in caruncular vascular structures in twin pregnancies indicate an adjustment to the increased fetoplacental demand. These findings suggest that placental development should be assessed by taking both trimester and pregnancy type into consideration when monitoring pregnancies in sheep.

Keywords: Twin pregnancy, sheep, placental development, singleton pregnancy, trimester.

Determining Morphometric Differences in Avian Tarsometatarsus Using Artificial Intelligence (Machine Learning)

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Abstract

Introduction: Morphometric measurements are frequently preferred in anatomy, archaeology, anthropology and taxonomy for the identification and classification of bones. In veterinary anatomy, morphometric measurements obtained from bones are used to distinguish between breeds, genders, and directions (right/left).

Materials and Methods: The tarsometatarsus of breeding meat-type hybrid breeders was used in the study. A total of 328 tarsometatarsus bones, right and left, were obtained from 81 hybrid breed (Ross) avian in the first group and 83 hybrid breed (Cobb) avian in the second group. The skin and soft tissue on the tarsometatarsus were resected. Then, 10 different morphometric measurements were performed on the tarsometatarsus using a digital caliper. A total of 3200 data sets were obtained for machine learning through morphometric measurements performed on bones. Morphometric data of the first and second group populations were evaluated using both classical statistical methods and machine learning algorithms.

Results: In classical analyses, significant differences were found between the groups in terms of maximum length, proximal width, and the distance between eminentia intercotylaris and trochlea metatarsi II. In the correlation analysis, a high level of positive correlation was

found between morphometric parameters. The effect of high collinearity was taken into account with VIF analyses.

In machine learning applications, especially in the classification made with the Random Forest algorithm, it was observed that the middle trochlea, lateral trochlea and proximal width variables had the highest discrimination in the model. On the other hand, left and medial trochlea variables were determined to be insignificant for the model. The Random Forest model showed superior performance in population discrimination with 100% accuracy on cross-validation and test data. Other algorithms such as support vector machines and logistic regression also exhibited high accuracy, but the variable importance ranking differed in the Random Forest model.

Conclusion: In the current study, both classical statistical methods and machine learning-based variable importance analysis were used to reveal which parameters are more powerful and usable in distinguishing breed and direction (right/left). Machine learning models offer high reliability and explanatory results, especially when multiple and related variables are evaluated together. This study demonstrates that the combined use of both classical statistical tests and machine learning algorithms is useful for high-accuracy and reliable classification in breed and direction discrimination using morphometric measurements.

Keywords: Avian, Morphometry, Tarsometatarsus, Artificial Intelligence

An Evaluation of the Use of Eponymous Terms in Veterinary Anatomy Education

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Abstract

Introduction: Anatomy is one of the oldest and most fundamental scientific disciplines in human history. Structural examinations, which began in the Paleolithic era, were documented in ancient civilizations such as Babylon, Egypt, and Greece, and gained a scientific character particularly through dissections conducted in Alexandria. Pioneering figures such as Galen, Vesalius, and Harvey played significant roles in the development of anatomy. Veterinary anatomy was institutionalized in the 18th century by Claude Bourgelat, and in Turkey, it began with the establishment of the Military School of Veterinary Medicine in 1842, continuing its advancement under the roof of Ankara University. Although the naming of anatomical structures generally relies on standardized terms derived from Latin and Greek, some structures are also named after their discoverers these are known as eponyms. This study evaluates the perspectives of academics working in the field of veterinary anatomy in Turkey regarding eponymous terms and examines the role of these terms in education.

Materials and Methods: As part of the study, an online survey was administered to faculty members of the Departments of Anatomy at veterinary faculties in Turkey. The survey inquired whether participants included eponymous terms in their lectures and their opinions on the necessity of using such terms. Additionally, commonly used eponym examples were also evaluated. The survey

data were analyzed using descriptive statistical methods and presented as percentages.

Results: In the survey conducted with the participation of 79 faculty members, 63.3% of the respondents stated that they include eponyms in their lectures, while 36.7% indicated that they prefer to use only anatomical terminology. Furthermore, 67.1% of the participants believed that the use of eponyms is necessary, whereas 32.9% stated that such usage is not essential. Additionally, 3.8% of the respondents noted that although they do not use eponyms in their own courses, they still consider their use appropriate. The most frequently cited examples of eponyms among the participants were, in order: Eustachian tube (Tuba auditiva), Circle of Willis (Circulus arteriosus cerebri), Ductus Botalli (Ductus arteriosus), Keith–Flack node (Nodus sinuatrialis), and Aschoff–Tawara node (Nodus atrioventricularis).

Conclusion: The findings of this study indicate that the use of eponyms is common in veterinary anatomy education and that a significant proportion of faculty members consider this approach pedagogically and scientifically meaningful. Eponyms not only serve as a tribute to the researchers who contributed to the discovery of anatomical structures but also play a crucial role in facilitating integration with clinical sciences. Familiarity with these terms during medical and veterinary education can support multidisciplinary approaches as well. Therefore, it is recommended that eponyms be used thoughtfully and consciously alongside scientific terminology.

Keywords: Anatomy, Anatomist, Eponym, Scientist, Veterinary Anatomy

Morphometric Examination of Interthalamic Adhesion Using Magnetic Resonance Imaging in Van Cats

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Abstract

Introduction: Interthalamic adhesion; It is a large and distinct circular area formed by the junction of the right and left thalami. The third ventricle surrounds this area. Brain atrophy is a condition commonly characterized by cognitive dysfunction in cats and dogs. It has been reported that the thickness of the interthalamic adhesion is significantly reduced in dogs with cognitive dysfunction and therefore it has been suggested that it may be a suitable parameter to measure brain atrophy. As a result of the examinations conducted in this context, not much literature has been found on the morphometry of interthalamic adhesion in cats. The aims of this study were to reveal the morphometry of interthalamic adhesion in Van cats by Magnetic Resonance Imaging (MRI) method and to examine these morphometric measurements in terms of gender.

Materials and Methods: A total of 20 healthy adult Van cats, 10 females and 10 males, who had not undergone any surgical procedure, were included in the study. The animals were anesthetized using a combination of ketamine and xylazine. Midsagittal and transverse

cross-sectional images were obtained with an MRI scanner. Images were transferred to a workstation and processed in DICOM format. Morphometric measurements were obtained using the Enlil PACS radiological image processing and archiving program.

Results: In this study; Interthalamic adhesion thickness (ITAt), brain height (Bh), Interthalamic adhesion index ratio (ITAr), Interthalamic adhesion sagittal surface area (ITsa), Interthalamic adhesion sagittal height (ITsh) and Interthalamic adhesion sagittal diameter (ITsd) measurements were made. As a result of the examinations, the averages of these values in female Van cats were determined as 3.31 mm, 30.16 mm, 10.96%, 34.23 mm², 6.07 mm and 6.12 mm, respectively. The averages of these values were determined as 4.18 mm, 31.83 mm, 13.18%, 42.66 mm², 6.77 mm, 6.86 mm in male Van cats, respectively.

Conclusion: As a result of the statistical examinations, it was determined that the values of interthalamic adhesion morphometry in male Van cats were higher than in females. A positive difference ($p<0.05$) was determined in all measurements except brain height in favor of males. In addition, in the correlation examinations, a positive correlation ($p<0.01$) was determined between the ITAt measurement and the ITAr measurement parameter in male and female Van cats. Apart from this situation, a positive correlation ($p<0.01$) was determined between the ITAt measurement and the ITsh measurement parameter only in male Van cats.

Keywords: Cat, Interthalamic adhesion, Magnetic Resonance Imaging, Morphometric.

A Study on Gender Estimation Using Machine Learning Algorithms (Mlas) With Parameters Obtained from Radiographic Images of the Femur in Dogs and Cats

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Abstract

Introduction: Determining personal data such as species, gender, breed, age, height, and weight is very vital parameters for forensic medicine and anthropology sciences. Veterinary forensic medicine also has become an increasingly important branch of science. Valuable studies have been conducted in the veterinary field using morphometric analysis methods, but the use of machine learning algorithms has been limited. This study was conducted to estimate gender and species by processing direct graph images of femur bones in dogs and cats through using MLA's.

Materials and Methods: In the study, direct graph (X-ray) images of the femur bone belonging to 140 dogs (70 males, 70 females) and 140 cats (70 males, 70 females) were used, employing nine parameters as follow: the distance between right and left major trochanters, the distance between right and left head of the femurs, the widths of the body of right and left femurs, the widths of right and left medial and lateral condyles, the femur length, and the distance between right and left intercondylar fossa. The numerical data obtained constitutes the input layer of Random Forest (RF), Decision Tree (DT), Logistic Regression (LR), Extra Tree Classifier (ETC), Linear Discriminant Analysis (LDA), and Quadratic Discriminant Analysis (QDA). The output layer constitutes the status of being male and female in gender

estimation, and the status of being cat and dog in species estimation. The multilayer perceptron classifier (MLCP) was also preferred as the Artificial Neural Networks (ANN) model. The analysis was carried out using a Monster Abra A7 V12.5 model computer. Two Sample T test and Mann Whitney U test were used in comparisons in terms of sex and species. Minitab 17 package program was used for statistical analysis.

Results: In the study, an accuracy rate of 79% was achieved with the ETC algorithm in gender discrimination from dog femur parameters. With the application of the same parameters to cat femur, the ETC algorithm gave a 75% accuracy rate. In addition, it was evaluated in terms of ML algorithms in species discrimination using the parameters measured for gender estimation from the femur, and it was determined that species discrimination could be made with an 89% accuracy rate in LR, QDA, DT algorithms.

Conclusion: Since the images used in the study could not be taken from animals of the same breed and size, very high results could not be found in gender estimation. However, the data obtained in terms of species estimation shows that this method gives results with high accuracy and reliability. It shows that conducting such studies using animals of the same breed and size in the future will also give highly accurate results in gender determination.

Keywords: Gender estimation, femur, machine learning algorithms (MLA's), osteology, veterinary forensic medicine,

Three-Dimensional Reconstruction and Volume Measurement of the Frontal Sinuses in Brown Bears (*Ursus arctos*)

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Abstract

Introduction: Paranasal sinuses are air-filled cavities located within the cranial bones of mammals. In particular, the frontal sinuses contribute to an increase in cranial volume without significantly adding to skull mass, thereby facilitating head support and reducing the load on the musculoskeletal system. The presence of these sinuses may aid in thermoregulation in the cranial region by warming and humidifying inhaled air and can support olfactory and masticatory functions. However, the functional role of paranasal sinuses has long been debated.

Materials and Methods: In this study, cranial computed tomography (CT) images of nine adult brown bears (*Ursus arctos*) were retrospectively analyzed. Image processing was performed using 3D Slicer software. In each skull, the frontal sinus cavities were segmented from the surrounding bone tissue using a semi-automated method and reconstructed in three dimensions. The volumes of the segmented sinus models were calculated in cubic millimeters (mm³).

Results: In all nine brown bear skulls examined, the frontal sinuses were radiologically evident and successfully reconstructed in 3D. Volume measurements revealed considerable interindividual

variation. Frontal sinus volumes ranged from 184.602 cm³ to 230.671 cm³. Despite the limited sample size, individuals with larger skull dimensions tended to have greater absolute frontal sinus volumes. These findings suggest that the frontal sinuses in *Ursus arctos* may occupy a substantial portion of the cranial cavity and exhibit notable volumetric variation among individuals. The results provide important insights into the potential adaptive roles of frontal sinuses and lay a foundation for future, more comprehensive studies.

Conclusion: The bilateral symmetry and frontal localization of the sinuses in brown bears suggest that these air-filled cavities may serve as a buffer zone around the brain in scenarios involving cranial trauma. In species like bears, which may sustain blows to the head and face during intraspecific conflicts, such cavities may function, albeit to a limited extent, as shock absorbers. In conclusion, the CT-based evaluation of nine *Ursus arctos* skulls demonstrated that the frontal sinuses in this species occupy a considerable volume. The biological and functional significance of these sinuses may relate to reducing cranial weight, facilitating air conduction, and potentially dispersing mechanical stress.

Keywords: Computed tomography, Frontal sinus, *Ursus arctos*, 3D modeling

Investigation of the Metacarpus of the Red Fox (Vulpes Vulpes) by 3D Geometric Morfometric Method

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Abstract

Introduction: The aim of this study was to determine the characteristics of metacarpus in red foxes by 3D geometric morphometric method.

Materials and Methods: A total of 13 red fox cadavers, 9 males and 4 females, were used in the study. The materials were obtained from the Dicle Wildlife Rescue and Rehabilitation Centre of the 15th Regional Directorate of the Ministry of Agriculture and Forestry, Diyarbakır Directorate of Nature Conservation and National Parks and the Red fox cadavers in the dissection hall of the Department of Anatomy, Faculty of Veterinary Medicine, Dicle University. The materials were scanned with a 128-detector multislice spiral computed tomography device (Somatom Sensation 128; Siemens Medical Solutions, Forchheim, Germany) in the Department of Radiology, Faculty of Medicine, Dicle University. Dose parameters and scans were performed based on standard protocols. Thus, radiometric resolution at the lowest radiation level and optimum image quality were tried to be obtained. The parameters of the device; physical detector

collimation, 32 x 0.6 mm; final section collimation, 64 x 0.6 mm; section thickness; 0.5 mm; gantry rotation time; 330msec; kVp; 120; Ma, 300; resolution, resolution range, 0.92 x 0.92 were set by the radiology technician. Three dimensional models of the obtained images were created with 3D Slicer ver 5.8.1-win programme.

Results: It was observed that the metacarpus of red foxes consisted of five metacarpuses. All the metacarpus of red foxes were modelled in three dimensions and male and female models were compared.

Conclusion: The data obtained from this study can be considered to contribute to the anatomy literature with CT-based 3D statistical bone modelling for future studies on other wild animals.

Keywords: Red fox, metacarpus, three-dimensional modelling, 3D geometric morphometry

Regional Mineral Composition and Microstructural Analysis of Metacarpus and Metatarsus Bones in Cattle

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Abstract

Introduction: Long bones, as components of the skeletal system, undergo endochondral ossification during development. In this process, they form three anatomically and functionally distinct regions: the epiphysis, metaphysis, and diaphysis. Differences in bone mineralization during these developmental stages play a significant role in the emergence of various clinical conditions. While no studies were found in the literature regarding the mineral content of tissues taken from different anatomical regions of bones, metacarpal bones were identified as the most frequently fractured bones in cattle. This study was conducted to investigate the mineral content and microstructural differences in the epiphyseal, metaphyseal, and diaphyseal regions of the metacarpus and metatarsus bones, which are long bones in Simmental bulls.

Materials and Methods: Metacarpus and metatarsus bones from 10 adult male cattle obtained from the Kastamonu Municipality slaughterhouse were used in this study. Five bones were used for microstructural analysis via scanning electron microscopy (SEM), and the remaining five were analyzed for mineral content using (ICP-OES).

Results: SEM analysis revealed that collagen fibers in the epiphyseal region were dispersed irregularly; the metaphyseal region of the

metatarsus exhibited wider trabecular formations, while the diaphyseal region displayed regularly organized lamellar structures. Measurements using the ImageJ software indicated that the Haversian canal density was higher in the metacarpus compared to the metatarsus. ICP-OES analysis showed that the epiphyseal region of the metacarpus contained higher levels of Na, Mg, Ca, K, P, and Mn, whereas the diaphyseal region of the metatarsus had higher concentrations of these elements than its metacarpal counterpart.

Conclusion: The lower calcium content observed in the diaphyseal part of the metacarpus compared to that of the metatarsus may explain the increased incidence of fractures in this region. Although a greater number of Haversian canals in the metacarpal diaphysis may suggest an advantage in terms of vascularization and nutrition, it may also create potential initiation sites for microfractures, thus representing a mechanical disadvantage during fracture formation. Furthermore, the broader trabecular architecture in the metaphyseal region of the metatarsus may assist in force dissipation and contribute to protecting the diaphysis during load transmission.

Keywords: Metacarpus, metatarsus, mineralization

Funding: This study was supported by the TÜBİTAK 2209/A Program for University Students' Research Projects under the project titled "Determination of Mineral Content and Morphological Development of Metacarpal Bones in Cattle."

Macroscopic Anatomy and Histology of the Thymus in the Fetus of Roe Deer (*Capreolus capreolus*)

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Abstract

Introduction: This study aimed to investigate the anatomical and histological characteristics of the thymus in roe deer (*Capreolus capreolus*) fetuses.

Materials and Methods: Thymus tissues from three fetuses of a pregnant female roe deer, which was brought to the Hatay Mustafa Kemal Wildlife Rescue and Rehabilitation Center (located within the campus of Hatay Mustafa Kemal University) for treatment but could not be saved, were examined. Following fixation in 10% formalin, the left ribs of the fetuses were completely removed using forceps and a scalpel to open the thoracic cavity. The dissected thymus glands were photographed both in situ and ex situ. After imaging, the tissues were sent in 10% formalin to the Department of Histology and Embryology at the Faculty of Veterinary Medicine, Sivas Cumhuriyet University for histological evaluation.

Results: Two of the fetuses were female and one was male. The crown-rump lengths of the female fetuses were measured as 30 cm and 32.5 cm, while that of the male fetus was 32.2 cm. The thoracic lobes of the thymus were observed between the 1st and 5th ribs, located in

the upper half of the cranial mediastinum, slightly to the left of the midline, between the thoracic inlet and the aortic arch. The cranial part of the left cranial lung lobe and the cranial part of the right cranial lung lobe were found adjacent to the dorsal and ventral parts of the thoracic lobe respectively. The thoracic lobes, which were wider at the posterior end and narrower at the anterior end, measured between 2.5 and 3 cm in length. The intermediate lobe (isthmus cervicothoracicum), connecting the thoracic and cervical lobes, was identified only in the male fetus, appearing as a thin cord-like structure with a length of approximately 1 cm. In one of the female fetuses, a similar cord-like structure was observed extending from the anterior end of the thoracic lobe toward the anteroventral part of the thoracic cavity. In all three fetuses, the cervical lobes were located ventral to the trachea and extended from the thoracic inlet to the upper half of the neck. The cervical lobes, which varied in shape from narrow and elongated to broader and shorter spindle-like structures, were measured as 2.5 cm, 3.1 cm, and 6 cm in length.

Conclusion: The examination of thymus tissues from three littermate roe deer fetuses revealed anatomical variations, particularly in the cervical and intermediate lobes. The thoracic lobes, in contrast, were more consistent in both location and size. While the intermediate lobe was absent in one fetus, in another it remained within the thoracic cavity without fusing with the cervical lobe. In a third case, the intermediate lobe appeared as a thin cord connecting both the cervical and thoracic lobes.

Keywords: Capreolus capreolus, Fetal Anatomy, Roe Deer Fetus, Thymus

Shape Variation of Linea Temporalis and Crista Nuchae in Mesocephalic Dogs

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Abstract

Introduction: The linea temporalis serves as the origin site for the m. temporalis, one of the major masticatory muscles. Additionally, the crista nuchae provides strong support for the head. Because this regions play a significant role in cranial mechanics and force transmission. Additionally, the crista nuchae is a prominent bony projection located on the os occipitale of the dog skull. Both structures may show breed-specific variation. The aim of this study was to determine the shape variations of the linea temporalis and crista nuchae in mesocephalic dogs according to their functional status.

Materials and Methods: A total of 81 skulls representing various breeds were examined. They were grouped based on the dogs' functional roles: Hunting, guarding, companion, herding, and sled/working and were modelled using 3D images presented by

Kubinyi et al. (2024). Landmark coordinates (x, y, z) were digitised on stl-format models using the Stratovan Checkpoint software. Regression analysis was used to evaluate the effect of size on shape. Procrustes ANOVA was applied to assess statistical differences in shape and centroid size between the groups. Additionally, discriminant function analysis was performed to measure the effect of functional status on shape, and groupings were evaluated based on cross-validation scores.

Results: Principal component analysis revealed 80 components. Shape variation was primarily concentrated on segment of linea temporalis overlapping parietal bone and at dorsal origin of the crista nuchae, with PC1 accounting for 32.665% of variation. PC2 (15.651%) and PC3 (11.528%) showed a steep drop and were not considered further. According to the PC1 scatter plot, companion dogs were somewhat separated from individuals in other groups. Procrustes ANOVA showed statistically significant differences along the analysed anatomical features for both status ($p<0.0001$) and centroid size ($p<0.0006$).

Conclusion: The linea temporalis exhibited strong variation between hunting and companion dogs, as well as between companion and sled dogs. Conversely, only minor variation in the crista nuchae was observed between herding dogs and other status groups.

Keywords: Bone, dog, skull, shape analysis, temporal bone

Root Canal Morphology of Canine Teeth in Cats

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Abstract

Introduction: Traumatic tooth fractures are frequently observed in domestic cats, with canine teeth being the most commonly affected. These fractures often result in pulp exposure, necessitating prompt and effective endodontic intervention. Root canal treatment serves as an alternative to tooth extraction, aiming to preserve or restore the integrity of periapical tissues. The success of this procedure relies heavily on a comprehensive understanding of dental anatomy and the morphology of the root canal system.

Materials and Methods: This study investigated the root canal morphology of maxillary and mandibular canine teeth in domestic shorthair cats using the clearing technique. The method involves decalcification, dehydration, and clearing of the teeth, allowing for detailed three-dimensional visualization of the internal anatomy. A total of 12 domestic shorthair cats were included, and 48 canine teeth were extracted and processed for analysis. Morphological characteristics such as canal shape, the presence of apical deltas, and lateral canals were examined.

Results: Apical deltas were observed and categorized into four distinct types based on their configuration. The most common type was type II with up to 10 ramifications (66.67%). Type IIIA with 10-20 ramifications was present in 8.33% roots, while type IIIB with more than 20 ramifications was present in 4.16% roots. Obliteration was observed in 10.42% roots. No evidence of lateral canals was found.

Conclusion: This study provides valuable insights into the complex root canal morphology of canine teeth in cats. The findings underscore the importance of detailed anatomical knowledge for the successful planning and execution of endodontic procedures in cats.

Keywords: Apical delta, canine teeth, cats.

Some Morphological Features of the Thyroid Lobes and Thyroid Isthmus in the Goat

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Abstract

Introduction: This study aims to clarify the morphological characteristics of the thyroid lobes in the goat, paying special attention to the transition zone between the thyroid lobes and the isthmus.

Materials and Methods: In this study, the thyroid glands of 12 female goats between the ages of one and one year, dissected in the systematic anatomy exercises, were used. Macroscopic observations were made on the thyroid lobes and isthmus after which histological samples were obtained from all glands. The samples were processed using standard methodology and the resulting tissue sections were stained with Trichrome Masson Stain Kit.

Results: Each lobe has a blunt, widened and rounded cranial pole and a thinned and pointed caudal pole, which merges with the corresponding end of the isthmus. The latter crosses the trachea transversely and connects with the caudal pole of the contralateral thyroid lobe. Macroscopically the texture of a isthmus distinguishes from that of the thyroid lobes in its pale or pale pink color. Longitudinal anatomical dissection of the lobes revealed well-defined hilar zones at the cranial poles, corresponding to the area of entry of the anterior thyroid artery and vein into the parenchyma. In addition, cystic structures were observed in the central zones of the lobes in all animals. Light microscopy shows a bundle of compressed elongated thyroid follicles, which in the direction to the isthmus decrease in

number at the expense of the increased amount of interfollicular stroma and dense network of blood capillaries. In the middle third of the isthmus only single follicles were found and capillary network formed a layer along its dorsal surface.

Conclusion: This morphological study complements the information regarding the species characteristics of the thyroid gland in goats and the knowledge can be used successfully in clinical practice during surgical interventions on the gland.

Keywords: Isthmus, goat, morphology, thyroid lobes

Morphological and Morphometric Characteristics of the Ethmoid Bone in Mixed-Breed Dogs

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Abstract

Introduction: The ethmoid bone one unpaired bone that form the rostral wall between brain and nasal cavities. The ethmoid bone usually composed by very fine laminae, one of them is perforated by very fine and numerous holes through which the olfactory nerve bundles transmit from the nasal cavity to the olfactory bulb of the rhinencephalon. Almost in all textbooks of animal anatomy and in the scientific literature to date there are missing such detail information related to the dimensions of the ethmoid fossa, its volume and the exact numbers of the cribriform foramina.

Materials and Methods: In this study 16 mixed breed dog skulls were used. The morphometric parameters of the skull, brain cavity and ethmoid fossa were measured by digital caliper. Additionally, the volume of the brain and the ethmoid fossa were registered and finally the exact numbers of cribriform foramina were counted.

Results: From the study resulted that the average of the brain cavity and the ethmoid fossa volumes were 92.31 ± 14.46^{cc} and 2.0 ± 0.30^{cc} ,

respectively. The average number of cribriform foramina was 189.81 ± 28.63 per side (range: 131–234). Correlation analysis revealed that the maximum width of the ethmoid fossa had the strongest association with the number of cribriform foramina ($r = -0.58$). A simple linear regression confirmed this relationship as statistically significant ($p = 0.0197$), explaining 33.1% of the variance ($R^2 = 0.331$).

Conclusion: This study bring new information related to the ethmoid bone in dogs, especially the numbers of the cribriform foramina and the findings that the maximum width of the ethmoid fossa is a key morphometric factor influencing the number of cribriform foramina in examined mixed breed dogs. These findings contribute to a better understanding of ethmoidal morphology and may have implications in comparative cranial anatomy and clinical veterinary applications.

Keywords: Brain cavity volume, cribriform foramina, skull

Merging Anatomy and Meat: Exploring the Benefits of Immersive Technologies in Veterinary Education

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Abstract

Introduction: Understanding meat categorization is a fundamental component of veterinary education, especially within the context of food hygiene and public health. Veterinary students must grasp legal classifications of meat, which depend on variables such as species, age, quality, and processing techniques. This knowledge is essential for accurate meat inspection, labeling, and compliance with both national and international food safety standards. Despite prior exposure to muscle anatomy in earlier coursework, students often face challenges in applying this knowledge to practical meat classification tasks.

Materials and Methods: This study aimed to assess the effectiveness of three distinct instructional methods in improving veterinary students' ability to identify meat categories and associated muscle structures: (1) traditional classroom teaching, (2) computer-based instruction using 3D models, and (3) immersive virtual reality (VR).

Participants included fourth-year veterinary students enrolled in the practical course “*Hygiene and Technology of Meat and Meat Products*” during the summer semester of the 2024/2025 academic year. To facilitate digital learning, a dedicated 3D model library—3DMeat—was developed.

Results: Results indicate that technology-enhanced instructional approaches, particularly those utilizing interactive tools, can significantly enhance student engagement and understanding of complex topics such as meat categorization. Initial test scores were highest in the group using 3D models (16.3 ± 4.1), followed by the traditional lecture-based group (15.6 ± 3.07), and the virtual reality (VR) group (11.7 ± 5.1). However, a follow-up assessment conducted two weeks later using the same set of questions revealed a shift in performance: the VR group demonstrated the highest retention of knowledge (11.71 ± 3.4), outperforming both the 3D model group (12.8 ± 4) and the traditional group (12.1 ± 2.5).

Conclusions: These findings suggest that although immediate performance may vary, immersive learning environments such as VR can foster stronger long-term retention of complex material.

Keywords: 3D models, virtual reality, meat cuts, anatomy

Funding: This research was funded by a grant from the Sarajevo Canton Ministry for Sciences, Higher Education and Youth for 2024, number 27-02-35-33087-38/23.

Comparative Anatomical and Histological Studies on the Intestinal Tract in Male and Female Naked Neck Chicken

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Abstract

Introduction: This study examined the gastrointestinal tract (GIT) of Naked Neck (NN) chickens, a breed valued for its heat tolerance and distinct anatomical traits. Understanding GIT structure and function in this breed is essential for improving nutrient utilization, especially in hot environments.

Materials and Methods: Forty adult NN chickens, consisting of 20 males and 20 females, were used. Anatomical data including body weight and detailed GIT measurements (organ length, width and weight) were obtained. Histological examination focused on the small and large intestines, assessing villus height and width, crypt depth, tunica muscularis, and propria submucosa thickness.

Results: Male NN chickens had significantly higher body weight (1956.67 ± 79.56 g) compared to females (1368.08 ± 44.41 g), along with larger organs such as the esophagus and gizzard. Female exhibited significantly higher values of villus height in duodenum (537.74 ± 0.74 μ m), jejunum (610.01 ± 0.93 μ m) and ileum (693.91 ± 1.04 μ m), as well as higher values of villus width in duodenum (109.9 ± 0.97 μ m), jejunum (136.55 ± 0.96 μ m) and ileum (115.18 ± 0.96 μ m) as compared to male. However, crypt depth in ileum (276.53 ± 0.53 μ m) was significantly higher in female as compared to male. Villus height-crypt depth ratio was significantly higher in duodenum (2.76 ± 0.01 μ m) and jejunum (2.72 ± 0.01 μ m) in female as compared to male. Male exhibited thicker propria submucosa in duodenum (34.69 ± 1.43 μ m) jejunum (32.94 ± 0.96 μ m) and ileum (41.18 ± 1.36 μ m), however, thickness of tunica muscularis (138.05 ± 1.75 μ m) was higher in jejunum only as compared to female. Caecum in female showed higher values of propria submucosa (196.93 ± 0.85 μ m), tunica muscularis (27.95 ± 0.79 μ m) and caecal gland diameter (244.07 ± 0.3 μ m) as compared to male. Conclusion: The findings reveal notable gender-based differences in the structure of the GIT in NN chickens. Females appear to have more developed villi, while males possess larger digestive organs and thicker gut musculature.

Keywords: Gastrointestinal tract, gender differences, histomorphometry, Naked Neck chicken

Origin and Distribution of the Brachial Plexus in Red-Necked Wallaby (*Notamacropus Rufogriseus*, Marsupialia: Macropodidae)

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Abstract

Introduction: *Notamacropus rufogriseus* (red-necked wallaby) are in the family Macropodidae, which is the second largest family of marsupials after the family Didelphidae. This study was conducted with the aim of providing a detailed description of the origin and distribution of the brachial plexus in *N. rufogriseus*.

Materials and Methods: Two-year-old male and 3-year-old female red-necked wallabies were used for the study. Following fixation, the cadavers were dissected, and the nerves were carefully explored.

Results: The brachial plexus was formed by ventral rami of C4, C5, C6, C7, C8, and T1 spinal nerves. It is composed of 12 principal nerves. Differences between left and right side of the plexus brachialis were not observed. C6 ventral spinal rami contribute the most to brachial plexus nerve formation, while C4 contributes the least. The formation and distribution of the plexus in *N. rufogriseus* exhibited more resemblance to the patterns observed in marsupial animals rather than placental mammals. Marsupial mammals demonstrate the involvement of C4 in the development of the brachial plexus.

Conclusion: Anatomical data from brachial plexus studies optimizes thoracic limb clinical and surgical treatments. This work can provide baseline data for future marsupial brachial plexus studies and fill gaps in the scarce literature.

Keywords: anatomy, nerve, peripheral nervous system, thoracic limb

A Stereological Study on the Volume of the Medulla Oblongata in Turkeys and Guinea Fowls

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Abstract

Introduction: The medulla oblongata is an important component of the brainstem, hosting structures that regulate vital functions such as respiration, cardiovascular control, and reflex centers. This study aims to reveal interspecies morphometric differences by evaluating the volumetric characteristics of the medulla oblongata in *Meleagris gallopavo* (turkey) and *Numida meleagris* (guinea fowl) using stereological methods.

Materials and Methods: In this study, ten healthy, 8-months-old adult female *Meleagris gallopavo* (turkey) and ten *Numida meleagris* (guinea fowl) individuals were used. Anesthesia was achieved by administering ketamine at a dose of 50 mg/kg intraperitoneally, followed by transcardiac perfusion. The brains were fixed in formaldehyde solution for one week, after which the medulla oblongata structures were dissected. Following tissue processing, an average of 8–10 sections with a thickness of 5 µm were obtained from each medulla oblongata using a systematic random sampling method at a 1/40 ratio (Leica RM 2135, Leica Instruments, Nussloch, Germany). Sections were stained with hematoxylin-eosin and visualized under x40 magnification using an Olympus CX31 microscope (Olympus U-TV0.5XC-3, Tokyo, Japan). Total volume, cortex, and medulla volumes were calculated using the Cavalieri Principle with the help of a point-counting grid and the Shtereom I software. Additionally, ratios such as medulla/cortex, cortex/total volume, and medulla/total volume were determined. The length,

diameter, and weight of the medulla oblongata were also measured. The obtained data were analyzed using the SPSS 26 software package, and the relationships between variables were evaluated using Pearson correlation analysis.

Results: In the guinea fowl group, analyses revealed a significant and strong positive correlation between total volume and medulla volume ($p<0.01$). Similarly, a significant positive relationship was found between total volume and weight ($p<0.01$). It was determined that as medulla volume increased, weight also increased ($p<0.01$). A positive correlation was also found between cortex volume and diameter ($p<0.05$).

In the turkey group, positive correlations were found between total volume and medulla, cortex, length, diameter, and weight ($p<0.01$, $p<0.05$). Especially, strong relationships were observed between cortex and weight ($p<0.01$), and between length and weight ($p<0.01$). These findings indicate that the morphometric parameters structurally vary in harmony with each other.

Conclusion: As a result of the study, it was shown that in both guinea fowl and turkey, the volumetric features of the medulla oblongata are significantly related to total volume, weight, and other morphometric criteria. In guinea fowl, correlations were particularly concentrated on medulla volume, whereas in turkeys, more balanced and stronger relationships were observed between both medulla and cortex with morphometric variables. The findings reveal that the morphological characteristics of the medulla oblongata may differ between species and that stereological analyses are an effective method for such comparisons.

Keywords: Cavalieri Principle, volume, poultry, nervous system, stereology.

Meta-Analysis of Morphometric Measurements of the Mandible in Sheep Breeds

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Abstract

Introduction: The mandible is of great importance in ruminants in terms of feeding, rumination, vocalization, and the general morphology of the skull. Mandibular morphology in sheep may vary depending on breed, age, gender, and environmental factors. These anatomical variations are significant for clinical applications as well as zootechnical and evolutionary research. In recent years, there has been an increase in the number of morphometric studies conducted on different sheep breeds. Meta-analysis is a statistical method that combines research findings from independent studies on the same subject to arrive at a common conclusion. This analysis enables the evaluation of studies with different sample sizes together, leading to more robust parameter estimates. In this study, a meta-analysis of morphometric measurements of the mandible bone in sheep was conducted to determine a globally representative value for each measurement.

Materials and Methods: This meta-analysis was conducted using 25 individual research findings extracted from 16 peer-reviewed, open-access articles published between 2012 and 2025. The dataset comprised 25 distinct mandibular measurements obtained from a total of 313 sheep. To evaluate heterogeneity among studies, Cochran's Q

test and the I^2 statistic were employed. When significant heterogeneity was detected, a random-effects model was applied to account for between-study variability. Publication bias was assessed using Egger's linear regression test, and adjustments for potential bias were made using the Duval and Tweedie trim-and-fill method. All statistical analyses were performed using the "meta" package in R studio software.

Results: According to the analysis results, the average values (mm) are 149.35, 179.61, 52.83, 111.49, 111.18, 126.68, 65.06, 49.17, 15.77, 37.55, 63.06, 55.53, 89.86, 36.90, 20.19, 18.23, 7.72, 21.36, 26.17, 25.82, 29.01, 22.56, 25.99, 20.63, and 64.56.

Conclusion: This study resolved inconsistencies in previous research on the subject and expanded the sample size. This resulted in higher accuracy rates in the estimates. The common values obtained from the morphometric measurements of the sheep mandible have the potential to serve as a source for future studies on the subject.

Keywords: Sheep, mandible, meta analysis

Impact of Digital Learning Materials on Student Performance in Veterinary Anatomy Education

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Abstract

Introduction: This study experimentally investigates the effects of digital three-dimensional (3D) content in veterinary anatomy education on practical training, student achievement, and academic motivation. Traditional anatomy teaching materials possess inherent limitations, and unforeseen circumstances such as natural disasters (earthquakes, pandemics) or local/individual restrictions disrupting face-to-face instruction negatively impact learning processes in applied disciplines like anatomy. In this context, digital 3D anatomy models and interactive practical training are posited as solutions to overcome these constraints. Observations indicate a significant increase in student interest in anatomy, a subject often described as "very difficult," following the integration of digital content. High levels of positive feedback were consistently received in student satisfaction surveys.

Materials and Methods: In an experimental setup, first-year students were divided into two groups, each receiving instruction on different anatomical structures through both traditional theoretical and digital theoretical lectures. A practical examination immediately followed.

Results: Students who received digital instruction achieved an average score of 62.29839, while those who received traditional instruction scored 55.94758. Furthermore, an anonymous post-examination student survey revealed that approximately 81% of students found 3D lessons significantly more effective and more beneficial during

laboratory practicals. The data demonstrate that this level of satisfaction, which surpasses both faculty and university averages, reflects digital content's capacity to compensate for learning deficiencies and enhance engagement with the subject. Beyond student achievement and satisfaction, the use of digital content was also found to elevate the faculty's professional recognition and institutional prestige, while simultaneously fostering interdisciplinary collaborations.

Conclusion: These findings collectively indicate that the integration of digital 3D content in veterinary anatomy education not only enhances student performance and motivation but also positively impacts the overall quality of education.

Keywords: Anatomy education, digital education, three-dimensional model

Examination of the Wild Boar Heart Using Scanning Electron Microscopy

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Abstract

Introduction: Since the 1960s, porcine heart valves have been widely used as a xenotransplant for humans. Considering both accessibility and biological compatibility, pig-derived heart valves are regarded as one of the most suitable options for xenotransplantation. However, although this method appears to offer an effective solution, structural degradations such as calcification are frequently observed in the bioprostheses used. Due to the widespread use of these valves in human health, numerous scientific studies have investigated the macro- and microstructure of porcine heart valves. Nonetheless, studies specifically focused on wild boars living in Turkey remain quite limited.

Materials and Methods: In this study, three wild boar (*Sus scrofa*) hearts were used. All hearts were immersed in a 2.5% glutaraldehyde solution for two days for scanning electron microscopy (SEM) examination. Macroscopic examinations were conducted using a stereomicroscope (Optica SZ-10) for subgross anatomical evaluation. Following subgross examination, tissue samples were taken from the valva aorta and the origins of the coronary arteries from the aorta under the guidance of the stereomicroscope. After being washed in phosphate buffer for one hour, the tissue samples underwent post-fixation in 1% osmium tetroxide for one hour. The specimens were dehydrated in a graded acetone series, then dried using a critical point dryer (Quorum Technologies, E3100), and subsequently coated with

gold-palladium using a sputter coater (Cressington, Sputter Coater 108 Auto). After preparation, the samples were examined using a SEM device (FEI, Quanta FEG 250) with an ETD detector at 2.00 kV voltage.

Results: The origins of the valva aorta and coronary arteries in pig hearts were examined in detail using SEM. The anatomical structures in the region were clearly visualized through these analyses.

Conclusion: Although there are detailed studies on the anatomical structures of pig hearts, SEM-based investigations of wild boars living in Turkey are considerably limited. This study aims to contribute to the literature regarding the anatomy of wild boars in our country.

Keywords: Anatomy, Aorta, Pig, SEM

Use of Interactive Muscle-Joint Model in Myology Education

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Abstract

Introduction: Many studies have investigated the effects of materials used in anatomy education on student success and satisfaction. Anatomy education given with traditional methods is limited to cadavers and plastic models. As a result of the studies, it has been concluded that the characteristics of auxiliary educational materials affect learning. However, the disadvantage of cadaver materials, which are an important part of myology education, is the lack of mobility, which causes limitations in the learning process. This project investigated the effects of myology education on academic success and the academic success of interactive muscle-joint models.

Materials and Methods: Before starting the study, determine student groups. The percentage of students who were successful in the midterm exam period from two branches was determined, and the branch with the lowest score was assigned as the “experimental group” and the other branch as the “control group”. Then, 3D computer models were made using CT (computed tomography) images in the Anatomy ABD bone archive, 3D Slicer (v. 5.3.0) and Blender (v. 3.4.1) software. In these models, antagonist muscles in the front and back extremities were selected to evaluate the angular change of the joints. Hinges for the joint areas for leg movement, rotary pulleys and small rings for the origin-insertio regions of the muscles, servo motor pulleys, rotary pulleys and hooks were modelled in Autodesk Fusion 360 program and printed using bone models and Creality Sermoon D1

3D printer. For students to use the system interface, a program was written in HTML, JavaScript and CSS languages using the web-based Visual Studio (v. 17.11.3) program and coded with the ESP-32S microcontroller card and Arduino IDE (v. 1.8.19). The interface includes images of the muscles defined in the extremities, and the toolbar controls the movement of the selected muscle in these images. The experimental group of students worked with cadavers and interactive models. The control group worked only with cadavers.

Results: The general success level of both groups was similar, but the experimental group caught up with the control group in the quiz questions.

Conclusion: This study shows that interactive muscle-joint models used in myology education improve students' understanding and comprehension of anatomical information. Both quiz and survey results reveal that interactive models contribute to the learning process.

Keywords: Education, interactive model, myologia, 3D model,

Funding: 1919B012216234 numbered, 2209/A TUBITAK university students research projects support program was carried out.

A Comparative Evaluation of AI Chatbots in Veterinary Anatomy: Performance of ChatGPT, Gemini, and DeepSeek Models

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Abstract

Introduction: Artificial intelligence chatbots are becoming increasingly common in education and consulting processes, particularly in fields such as veterinary anatomy. In this study, the aim was to comparatively evaluate the veterinary anatomy knowledge of four different artificial intelligence chatbots, namely ChatGPT 3.5, ChatGPT 4.0, Gemini 2.5 Flash, and DeepSeek V3, through multiple-choice questions.

Materials and Methods: In the course of the study, 85 multiple-choice questions were administered, which had been prepared in the domain of veterinary anatomy. The questions were designed to cover the basic concepts, structural relationships, and terminology of veterinary anatomy. Each question was directed to four separate artificial intelligence models, and after the answers were classified as correct or incorrect, success rates were obtained. The data obtained was analyzed based on accuracy rates, and differences between models were observed.

Results: Following the evaluation, it was determined that the Gemini 2.5 Flash chatbot exhibited the most successful outcomes, with a rate of 85.88%. The success rate of ChatGPT 4.0 was found to be 85.53%, whilst that of DeepSeek V3 was 84.71% and that of ChatGPT 3.5 was 82.35%.

Conclusion: According to the findings, model selection is critical in terms of information accuracy when using artificial intelligence systems for educational purposes. This study demonstrates that artificial intelligence models can provide highly accurate responses in the field of veterinary anatomy, but no model has achieved a 100% success rate. In this field, Gemini 2.5 Flash and ChatGPT 4.0 are particularly prominent and are considered to be more suitable for educational and consulting purposes.

Keywords: Artificial intelligence, digital learning, veterinary anatomy education.

Application of S10B Silicone Plastination to Equine Stomach Infected with Gasterophilus Larvae: Feasibility and Educational Value

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Abstract

Introduction: Plastination is a valuable preservation method that provides a safe, durable, and maintenance free alternative to formalin fixation for anatomical and pathological specimens. This study aimed to evaluate the feasibility of preserving parasite induced mucosal damage and larvae using the S10B silicone plastination technique and to assess the specimen's educational potential.

Materials and Methods: An equine stomach infected with *Gasterophilus intestinalis* larvae was processed using standard plastination protocols. Pre and post plastination analyses included color assessment, volume measurement, and shrinkage evaluation.

Results: The stomach exhibited approximately 55–65 ulcerative lesions, primarily in the fundic region, with crater-shaped morphologies. After plastination, the specimens remained dry, odorless, and structurally intact, with preserved topographical features of the lesions and larvae. Minor color changes and shrinkage were observed. Similar alterations in color, shrinkage, and volume were noted in the larvae.

Conclusion: The results demonstrate that plastination effectively preserved both gastric parasitic lesions and larvae. This technique

offers a promising approach for creating reusable, safe, and practical veterinary pathology teaching tools.

Keywords: Equine stomach, *Gasterophilus*, larvae, parasitology education

Morphometric Characteristics of the Foramina Located in the Middle Cranial Fossa in Dog

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Abstract

Introduction: The middle cranial fossa extends from the orbitosphenoidal crest to the dorsum sellae. It is located dorsally to the basisphenoid bone and contains the hypophyseal fossa at its centre. This fossa contains paramedian foramina, which allow similar neurovascular structures to pass through. However, these foramina are named differently across species due to structural variations. The general morphological structure of these foramina in dogs, one of the most commonly kept pets worldwide, has been extensively described using dry skull material. This study aims to determine the morphological and morphometric features of foramina in the middle cranial fossa in dogs, using CT images.

Materials and Methods: In this study, cone-beam CT images of 32 healthy mesaticephalic dog heads (aged 1–17 years; 13 females, 19 males) were used. The images were transferred to a DICOM viewer program and analyzed using multiplanar reconstruction and 3D modeling tools. The morphological characteristics of the foramina were identified, and diameter, area, and length measurements were performed.

Results: Although there were differences in shape and size between the dogs, the following were detected bilaterally: orbital fissure, round foramen and oval foramen. The orbital fissure was narrow in the middle section with a wide intra-extracranial opening, oval-oblique shaped along its course and 3.8 mm long in the form of a canal. The oval foramen was an oval-shaped opening, except in three animals. In the middle cranial fossa, the largest opening was the orbital fissure, with a diameter of 6.1x3.3 mm, and the smallest opening was the oval foramen, with a diameter of 4.5x2.6 mm. While no difference was observed between the foramina in the two halves of the body in female dogs ($p>0.05$), the diameter measurements of the round foramen and the short diameter measurement of the oval foramen were larger in the right body half of male dogs ($p<0.05$). There was no statistically significant difference in gender comparisons ($p>0.05$).

Conclusion: This study provides the first normative data on foramina in the middle cranial fossa of dogs, obtained using a repeatable measurement method. These normative ranges could be useful for researchers specializing in neuroanatomy, neurovascular structure analysis, neuropathology, clinical medicine and zooarchaeology.

Keywords: Canidae, Skull base, Cross-sectional radiological anatomy

*This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK) under the Grant Number 223O401. The authors thank to TUBITAK for their supports.

The Peripheric Shape of the Hemispherium in the Sheep and Goat

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Abstract

Introduction: This study was conducted to determine the variations in the peripheral shape of the hemispherium cerebri in sheep and goats.

Materials and Methods: The brains of 5 goats and 5 sheep were used in the study. The brains of 5 goats and 5 sheep were used in the study. The brains were scanned with the "Polycam 3D Scanner, LiDAR, 360" application. Landmarks were marked on models in stl format using the Stratovan Checkpoint program. Principal component analysis (PCA), regression analysis, procrustes ANOVA and discriminant function analysis were performed using the MorphoJ program.

Results: As a result of the principal component analysis, a total of 8 principal components were calculated. According to PC1, the shape variation was concentrated in the lateral part of the left hemispherium and rostral part of the right hemispherium. In terms of PC2, the shape variation occurred largely in the caudal part of the hemispherium. According to the PC1 and PC2 distribution graphs, it was seen that 4 sheep were positioned separately on a species basis. It was determined that sheep and goat hemispheriums were statistically significant in terms of shape and insignificant in terms of centroid size. It was determined that size did not have a statistically significant effect on hemispherium shape. According to the discriminant function analysis results, differences were detected between the hemispheriums of the

two species. According to the cross validation scores, 3 individuals from each group were in the opposite group.

Conclusion: As a result of the study, shape variations in the hemispherium cerebri in sheep and goats were examined. A limited grouping effect was found between the two groups. It was understood that shape had no significant effect on size. We believe that this study will contribute to the literature on central nervous system studies on small ruminants.

Keywords: Brain, gyrus, ruminantia, shape

Three-Dimensional Modeling of the Cranium of a Wistar Albino Rat Using Stereomicroscope-Assisted Photogrammetry

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Abstract

Introduction: In veterinary anatomy, three-dimensional (3D) modeling of small and complex structures is of great importance for both educational and scientific purposes. Traditional imaging techniques such as magnetic resonance imaging (MRI), computed tomography (CT), and 3D surface scanners are often limited by high cost and insufficient resolution when it comes to capturing microanatomical details. Therefore, there is a growing need for alternative modeling approaches that are more accessible, applicable, and capable of providing high-resolution results. Photogrammetry stands out in this regard due to its ability to visualize both micro- and macro-scale structures in detail, its low cost, and its ease of implementation. This study aimed to generate a three-dimensional model of the cranium of a Wistar Albino rat using a stereomicroscope-assisted photogrammetry method.

Materials and Methods: This study was conducted within the scope of the Ondokuz Mayıs University BAP Project No. 01-2024-5015. An

Olympus SZX7 stereomicroscope and a Sony A7R IV digital camera were optically aligned using a custom-designed adapter, and image acquisition was performed accordingly. Two crania from Wistar Albino rats were used in the study. For each model, a total of 216 high-resolution images were captured from the dorsal and ventral surfaces. Light distribution, sharpness, and focus parameters were optimized to enhance image quality. The images were processed using Agisoft Metashape Professional (v2.0.2), and 3D models were generated using an artificial intelligence-assisted alignment technique.

Results: In the generated 3D digital models, complex structures such as the lamina cribrosa, crista galli, radix preoptica, canalis opticus, fissura orbitalis, and jugum sphenoidale, as well as anatomical foramina such as the foramen incisivum, foramen palatinum majus, foramen infraorbitale, and foramen mentale, were successfully visualized in high resolution and with anatomical integrity. This allowed for a clear analysis of both surface morphology and spatial relationships between structures. The method proved capable of accurately modeling microanatomical features.

Conclusion: It was determined that stereomicroscope-assisted photogrammetry enabled, for the first time, the three-dimensional modeling of small bony structures with this level of detail and accuracy. The developed method offers an innovative and practical alternative for veterinary anatomy education and for the digital archiving of microanatomical structures.

Keywords: Anatomy, Photogrammetry, Stereomicroscope, Three-dimensional modeling, Wistar Albino rat

Macroscopic Evaluation of Rabbit Eye Morphology

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Abstract

Introduction: This study aims to macroscopically evaluate the morphometric characteristics of the main anatomical structures of the rabbit eyeball. The measurements obtained in the study are of a nature that can lay the groundwork for further research in fields such as veterinary ophthalmology, comparative anatomy, and biomedical engineering. The measured structures include the cornea, pupil, lens, optic nerve, and bulbus oculi in various orientations. Means and standard deviations were calculated to identify individual variation. The data obtained reflect intraspecies physiological differences, particularly in optic nerve thickness and lens parameters, and provide reference values for experimental models. In conclusion, due to its anatomical suitability and ease of use in experimental procedures, the rabbit eye emerges as a valuable model for ophthalmologic studies.

Introduction: The eye is the only organ of the central nervous system that directly connects to the external environment. Anatomical changes in the eye can also be used in the diagnosis of various systemic diseases.

Materials and Methods: A total of 24 eyeballs from 12 rabbits (6 male, 6 female) were used in this study. Following dissection, measurements of the cornea, lens, pupil, optic nerve, and bulbus were taken using a digital caliper.

Results: The means and standard deviations of all structures were calculated. Notably, individual variation was most evident in the pupil

diameter. The lens diameter and optic nerve thickness showed physiological variability.

Conclusion: The rabbit eye can be considered a reliable anatomical model for experimental eye research. The measurements provide valuable data for biomedical device development and interspecies comparisons.

Keywords: Anatomy, bulbus oculi, eye, morphometry, rabbit, veterinary

Determination of Foramen Magnum Morphometry by Computed Tomography Images in Dogs

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Abstract

Introduction: The foramen magnum, the largest opening in the skull, is of great neurovascular and biomechanical importance, enabling integration between the encephalon and spinal cord. Morphological and morphometric data relating to this opening have been studied in many animal species. Most of these studies have been conducted on dry skulls, while studies using radiological cross-sectional images are limited. This study aimed to determine the morphological and morphometric characteristics of the foramen magnum in dogs using CT images.

Materials and Methods: The study used cone-beam CT images of 18 mesaticephalic dogs (nine females and nine males over one year of age). The width, height and area of the foramen magnum were measured using bone landmarks on the axial images with the MPR tool of the DICOM Viewer program. These measurements were also taken by placing an ellipsoid in contact with the walls of the foramen magnum. This placement disregarded the dorsal notch formation and the caudal opening of the condylar canal.

Results: The foramen magnum was quadrangular in four females and three males, and oval in one female and one male. An irregularly shaped dorsal notch was observed in four females and five males. The caudal opening of the condylar canal, which is located at the margin of the foramen magnum, was present in 13 dogs, with the exception of

three females and two males (unilateral in one animal). The total foramen magnum index was found to be 91.4 ± 29.2 and 90.4 ± 25.2 for females and males, respectively. When the dorsal notch and condylar canal opening were disregarded, this index was found to be 85.1 ± 21.4 and 86.4 ± 12.8 in female and male dogs, respectively. Foramen magnum height in both male and female dogs, and foramen magnum area in male dogs, were found to be greater when measured using the traditional method than when measured using an ellipsoid ($p < 0.05$). No significant gender-related differences were found in foramen magnum measurements ($p > 0.05$). In mesaticephalic dogs, the foramen magnum index obtained using the ellipsoid was higher than the range reported in previous studies.

Conclusion: Although these data obtained in dogs serve as a preliminary reference, we believe that studies using the same methodology with a larger sample size could provide more detailed and clearer data on patency.

Keywords: Carnivore, sexual dimorphism, foramen, occipital bone

* This study contains preliminary findings from a part of the first author's ongoing master's thesis. This study was supported by Selçuk University Scientific Research Projects (BAP) under the Grant Number 25202002. The authors thank to BAP for their supports.

Quantitative Evaluation of Retina with Optical Coherence Tomography in Experimental Rabbits

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Abstract

Introduction: Optical coherence tomography (OCT) is a widely used, non-invasive imaging technique that enables detailed visualization of retinal layers with micron-level resolution. In preclinical ophthalmic studies, rabbits are frequently preferred due to their anatomical and physiological resemblance to the human eye. However, normative data on retinal thickness across different retinal regions and age groups remain limited. This study aimed to produce accurate normative measurements of retinal thickness in New Zealand White rabbits by employing an OCT system optimized for the unique ocular structure of this species. The results are intended to support the validity of rabbit models in translational vision research.

Materials and Methods: Forty-two clinically healthy New Zealand White rabbits of both sexes were divided into three age groups: 3, 6, and 12 months. Following pupil dilation and general anesthesia, retinal imaging was performed using a rabbit-specific spectral-domain

OCT device. Measurements of retinal thickness were manually recorded at standardized points in four retinal quadrants (superior, inferior, nasal, temporal). Statistical analysis was conducted using three-way ANOVA to evaluate the effects of age, gender, and retinal region

Results: Gender had no significant effect on retinal thickness within the same age groups. However, age-dependent and region-specific differences were evident. Retinal thickness peaked at 6 months and declined significantly by 12 months. The superior quadrant consistently exhibited the lowest thickness values across all age groups. The inferior quadrant showed the highest values in younger rabbits, while nasal thinning was more marked in older animals. Statistically significant differences were detected among most regions, particularly between the superior and other quadrants.

Conclusion: This study presents the first detailed normative map of rabbit retinal thickness based on age and region. These data provide a critical reference for future ophthalmic research, supporting accurate interpretation of structural retinal changes in experimental models of retinal disease and therapy.

Keywords: OCT, rabbit retina, retinal thickness

Macro-anatomical and Morphometric Examination of the Humerus Bone in German Mast Geese

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Abstract

Introduction: One of the most important characteristics of the avian skeletal system is that the bones are light and strong. The wing, which corresponds to the forelimb in mammals, consists of the bones that form the shoulder girdle (scapula, coracoid, and furcula) and the skeleton manus, which forms the free part of the wing (ossa alae), consisting of the humerus, radius, and ulna. The humerus is a strong, tubular, pneumatic bone. When the wing is folded, it rests horizontally against the lateral wall of the chest and extends to the caudal end of the hipjoint in geese. Our study aims to provide a detailed macro-anatomical and morphometric examination of the humerus, an important bone in geese, and to contribute to avian anatomy.

Materials and Methods: In our study, 6 adult (1.5-2 years old) German Mastgeese (Anseranser) were used (3 females and 3 males). Adult males weighed an average of 9.0 kg, while females weighed approximately 8.0 kg. The German Mastgeese were slaughtered at the slaughterhouse located at the goosefarm in Kovancilar district, Elazığ province, Turkey. Bone maceration was performed according to the relevant technical principles. Four measurement points (GL: greatest length of the humerus; SC: smallest width of the humerus corpus; Bp: proximal width of the humerus; Bd: distal width of the humerus) were used for the morphometric analysis of the right humerus of the geese. Nomina Anatomica avium was used as the basis for macro-anatomical descriptions.

Results: When examining the cranial surface of the humerus in the study, the caput humeri was first observed at the proximal end. The presence of the tuberculum dorsale was detected immediately above this anatomical structure, with the tuberculum ventrale located beneath it. Additionally, the crista deltopectoralis, extending along the dorsal edge of the humerus shaft, was one of the notable structures observed. On the caudal surface, a structure called the foramen pneumaticipitalis, which is not found in mammals, was observed. In the morphometric measurements of the humerus, the mean GL value was 178.96 ± 6.01 mm in females and 181.16 ± 5.4 mm in males. The SC value averaged 11.05 ± 1.01 mm in females, while this value was 12.38 ± 0.71 mm in males; in general, it was determined that the measurements of male geese were higher than those of females.

Conclusion: The German Mastgeese used in this study are important species both as a breed and as a meat-producing poultry. The humerus bone, an important part of the skeletal system, has been detailed macro-anatomically and morphometrically and is expected to contribute to avian anatomy.

Keywords: Humerus bone, Goose, Macroanatomy, Morphometry

A Macro-anatomical and Subgross Study on the Turkey Linguae

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Abstract

Introduction: The turkey is a bird belonging to the genus *Meleagris* in the family *Meleagrididae* of the order *Galliformes*. They are recognized as poultry raised for their meat. The tongue is an organ located at the base of the mandible, which includes various tissues such as cartilage and bone, glands, muscles, nerves, blood vessels, and connective tissue. The structure and function of the tongue are closely related to the animals' diet and their adaptation to nature. Birds do not have teeth, lips, or cheeks, and therefore, the tongue performs essential functions such as capturing, separating, processing, and swallowing food. As a result of all these functions and the different feeding habits among various bird species, the morphology of the tongue varies significantly in poultry. The aim is to contribute to the anatomically lacking studies on this subject by conducting a macro-anatomical and subgross study of the turkey's tongue and to structurally detail the tongue of the turkey species, which holds significant importance as poultry.

Materials and Methods: The 5 turkey tongues used in the study were taken from animals that were brought to Firat University, Faculty of Veterinary Medicine, Department of Pathology for necropsy and did not develop any disease. The cadavers were fixated in a 10% formaldehyde solution. The tongues were examined in the oral cavity and then individually cut and detailed. Morphometric measurements were made with a digital caliper (Mitutoyo, Japan). The length, width

and thickness of the tongue, the length of the Sulcus linguae, the length of the Glottis were measured. Nomina Anatomica Avium was used for anatomical nomenclature.

Findings: In the appearance of the tongue in the oral cavity of the turkey, there were parts of the tongue which include the body section corpus lingua, the root section radix lingua, and the tip section apex lingua. The presence of alae linguae, which is different from mammals, was observed between the corpus and radix. In the back middle part of the tongue, the larynx cranialis and a space-shaped glottis were located in the middle. In the back root sections of the tongue, spiny papillae known as papilla linguales caudales and papilla pharyngis caudoventrales were found.

Conclusion: As a result, the morphological structure of the turkey tongue was revealed and morphometric measurements were calculated. The data generated here is considered to be particularly useful for those interested in the morphology of the turkey tongue, an important carnivorous poultry.

Keywords: Linguae, Hindi, Macroanatomy

Three-Dimensional Design of Ligaments in Orthopedic and Anatomical Joint Models of Horses (Equidae) and Their Application on the Skeletal Model

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Abstract

Introduction: The difficulties encountered in veterinary anatomy education, especially the supply of cadavers, the laboriousness and cost of dissection, ethical concerns and time constraints, necessitate innovative educational approaches. The aim of this study is to design ligament models of horse (Equidae) joints using three-dimensional (3D) printer technology, in addition to traditional methods, and to create 3D joint models that will enable students taking anatomy courses to grasp the correct joint angles and details, and help them understand the anatomical localizations and functions of ligaments. In this way, visibility will be increased in anatomy education, memorability will be ensured and the need for biological material will be reduced.

Materials and Methods: As a method, Fused Deposition Modeling (FDM) technology was preferred due to its low cost and ease of use. Within the scope of the study, ligaments were designed in accordance with their anatomical positions on the existing Equidae skeleton with the ZBrush program, made printable with the Prusa Slicer program and printed on a 3D printer. In the printing process, flexible filaments

or combinations of PLA and flexible filaments were used to mimic the mechanical properties of the ligaments.

Results: The obtained 3D ligament models were integrated onto real Equidae bones and 3D printed bone models and used as educational materials. With this study, the function, working dynamics, anatomical localizations of ligaments in important joints were better understood and made more memorable. In addition, it has provided a basis for easier learning of invasive techniques frequently used in the planning and implementation of surgical approaches in ligament ruptures. With the designed three-dimensional anatomical ligament models, the need for cadaver preparation required for ligaments within the scope of the curriculum in each education period has been eliminated and the time spent on dissection has also been saved.

Conclusion: Thus, by staying away from the effects of various chemicals needed for the storage of cadaver material, educational materials that can be used in the curriculum for many years have been designed with the three-dimensional ligament printing method that does not threaten human health and the environment.

Keywords: Skeletal model, fused deposition model, ligament

Development of Epidural Anesthesia Models in the Dog Using Three-Dimensional Printing Technology

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Abstract

Introduction: In veterinary education, it is of great importance to provide training environments that are risk-free, repeatable, and anatomically accurate in order to enhance students' clinical intervention skills. Especially in the teaching of procedures requiring high precision, such as epidural anesthesia, models that support the preparation process for real-life applications contribute to the development of professional competence. In this context, the present study aimed to develop a training model for the epidural anesthesia technique applied in dogs using three-dimensional (3D) printing technology and to evaluate its technical adequacy.

Materials and Methods: The vertebrae from T13 to the end of the sacrum, belonging to an adult dog, were imaged using computed tomography (CT). The obtained DICOM-format data were processed in 3D Slicer software, and each vertebra was digitally reconstructed in three dimensions. Soft tissue structures such as discus intervertebralis, ligamentum flavum, ligamentum interspinale, medulla spinalis, and meningeal layers were manually modeled in Cinema 4D software based on dissection findings. White PLA filament was used for the production of osteological structures, while gray, yellow, and red TPU filaments were preferred for the flexible components. Each part was designed separately to facilitate assembly. The entire production process was carried out using a Bambu Lab X1 Carbon Combo 3D printer with FDM technology.

Results: In the developed model, the vertebral segments from T13 to the end of the os sacrum, as well as the discus intervertebralis, ligamentum flavum, ligamentum interspinale, medulla spinalis, and meningeal layers were observed to be integrated in anatomical continuity. The epidural injection procedure was found to be repeatable and controllable on the model. The use of TPU filament in the flexible structures successfully simulated the resistance felt during needle passage through the ligamentum flavum. Additionally, anatomically referenced regions such as the filum terminale, cauda equina, and spatium lumbosacrale were accurately modeled, offering functional guidance points.

Conclusion: The developed three-dimensional training model was determined to enable anatomically accurate and repeatable teaching of epidural anesthesia applications. The filaments used in simulating various tissues were evaluated as effective in realistically reflecting procedural tactile feedback. It was concluded that the model can serve as a practical and functional tool in veterinary training processes.

Keywords: 3D printing, Anesthesia, Epidural, Veterinary anatomy

Examination of Pelvic Muscles in Chickens (*Gallus Domesticus*) and Their Preservation by Silicone Plastination Method

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Abstract

Introduction: Silicone plastination can be defined as an anatomical specimen preparation technique characterized by replacing tissue fluids with a reactive polymer. However, plastination is a difficult and costly technique compared to other methods. However, the final products are remarkably similar to natural appearance and are also very durable and safe. For this purpose, silicone plastination has been used to preserve the pelvic muscles of domestic chickens, allowing for detailed study of their muscles and the production of durable, natural-looking plastinates.

Materials and Methods: Three chickens were used in this study. The animals were cadavers taken from a chicken farm operating in Elazığ province. Muscle dissection was performed, followed by silicone plastination. These stages included sample preparation, dehydration, degreasing, forced impregnation, and gas curing. Muscle nomenclature was based on the *Nomina Anatomica Avium* (1993).

Results: Silicone plastination revealed a one-to-one correspondence with the fresh chicken cadaver muscle. The iliotibialis lateralis muscle, located on the lateral cranial third of the femur, was found to be much stronger and larger in chickens and consists of two parts: the pars preacetabularis and pars postacetabularis. The long, band-shaped iliotibialis cranialis muscle was located cranial to the femur. The pars lateralis of the gastrocnemius muscle was the strongest branch of the

gastrocnemius muscle. The flexor hallucis longus muscle was identified on the caudal side. The flexor cruris lateralis muscle was identified from the caudal aspect of the ilium.

Conclusion: As a result of this study, the pelvic muscles of chickens were anatomically detailed. Furthermore, silicone plastination produced natural and original educational materials.

Keywords: Pelvic Muscles, Silicone Plastination, Chicken

The Use of Artificial Intelligence Language Models in Veterinary Anatomy Education

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Abstract

Introduction: With the rapid development of technology today, different approaches are seen in anatomy education and teaching. The 21st century we live in is called the age of artificial intelligence, but the concept of artificial intelligence, which envisages learning being carried out by a machine, dates back to the mid-1900s. In recent years, artificial intelligence has become part of our lives and has contributed to humanity in various fields. In the fields of health and education, artificial intelligence studies are increasing day by day. However, studies related to this topic in the field of veterinary anatomy are limited. The aim of this study is to investigate the competence and limitations of artificial intelligence in veterinary anatomy education. **Materials and Methods:** In this study, 15 random questions from the field of veterinary anatomy were asked to different artificial intelligence models (ChatGPT 3.5, ChatGPT 4.0, Gemini 2.0, Deepseek), and the answers were recorded. The answers obtained were compared with classical sources used in anatomy education.

Results: The results of the study showed that while the answers obtained from different artificial intelligence language models contained results similar to those of classical anatomy sources, some answers differed from classical sources, and some questions could not be answered clearly. When the questions that received different answers were rephrased and asked again to the artificial intelligence language models, it was found that the majority of the answers were

parallel to those of classical sources. In conclusion, artificial intelligence language models are rapidly developing and becoming an integral part of our lives.

Conclusion: Therefore, it is observed that artificial intelligence language models can be utilised alongside classical sources in veterinary anatomy education, but some aspects still require further development. The reason for producing different answers to some questions is thought to stem from the literature referenced by the language models. In the study, it was found that by entering prompts within certain limits, more specific answers could be obtained, and it was predicted that the quality of veterinary anatomy education could be improved by utilising artificial intelligence language models in coordination with traditional sources used in veterinary anatomy education.

Keywords: Artificial intelligence, language models, veterinary anatomy education.

Morphology of the Ovary and Tuba Uterinae in the Roe Deer (*Capreolus capreolus*)

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Abstract

Introduction: In Turkey, deaths of roe deer, whose habitat is primarily in the Black Sea and Marmara regions, are frequently encountered due to illegal hunting and traffic accidents related to urbanization. In addition to these reasons, due to their long gestation period (290 days), the birth of only one or two offspring, and a high potential for miscarriage under stress, the species is endangered. Therefore, understanding the anatomy of the female genital system of roe deer is highly important for the continuity of the species.

Materials and Methods: In this study, ovaries and tuba uterinae from four roe deer, each weighing between 20–25 kg and brought to our faculty clinics and the Directorates of Nature Conservation and National Parks due to causes such as traffic accidents, were used. Two of the specimens were pregnant, while the others were not. The morphometric values of the ovaries and tuba uterinae were determined using a digital caliper (Mitutoyo, Tokyo, Japan). Tissues from the same organs were prepared for histological and scanning electron microscopic (SEM) examinations. For histological evaluation, hematoxylin-eosin and Crossman's triple staining methods were applied, and the sections were examined and photographed under a

light microscope (Nikon, Eclipse E600). For SEM examinations, standard tissue preparation protocols were followed. These samples were examined and photographed in detail at different magnifications. Results: The ovaries of the roe deer are located at the level of the midline of the corpus ossis ilii at the entrance of the pelvis. The craniocaudal and lateromedial lengths were measured in the right ovary as 12.98 mm and 7.73 mm, respectively, and in the left ovary as 12.85 mm and 8.18 mm, respectively. The tuba uterinae, which is closely associated with the ovaries and consists of four different segments, measured 79.23 mm in length. No significant differences were found between pregnant and non-pregnant roe deer in these measurements. As a result of histological and scanning electron microscopic examinations, the theca interna and theca externa layers of the ovary were clearly identified. Numerous ciliated and non-ciliated cells were observed in the lamina epithelialis layer of the tuba uterinae examined using the same methods. It was determined that the length of the non-ciliated cells decreased from cranial to caudal. Conclusion: In this study, morphometric, histological, and electron microscopic data of the ovary and tuba uterinae of the roe deer were determined. No significant structural difference was observed in the examined samples depending on the pregnancy status.

Keywords: Anatomy, ovary, roe deer, SEM, tuba uterinae

Funding: This study was supported by Ondokuz Mayıs University under project number BAP04-B-2024-5311.

***:** This study is a summarized section from the doctoral thesis titled “Anatomy of the female genital organs in the roe deer (*Capreolus capreolus*).”

Investigation of the Effect of Sea Water on the Fixation of Poultry Tissues by HxE Staining Method

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Abstract

Introduction: The most commonly used fixative in tissue fixation is still formaldehyde, and since it is carcinogenic and causes serious upper respiratory tract disorders in particular, alternative fixative searches are ongoing.

Materials and Methods: For this purpose, many fixatives are being studied to increase both fixation quality and reliability. In addition, research to reduce the amount of formalin in the solution by using combined fixatives is also up-to-date. In this study, cattle, sheep and poultry tissues collected from private slaughterhouses in Ankara province were subjected to fixation in three different alcohol (70%) and three different formalin (10%) solutions prepared with sea water and distilled water at different concentrations. The aim of the study was to examine the effect of fixation solutions prepared using sea water on the long-term preservation of tissues for anatomy laboratories and on HXE staining, which is accepted as the basic staining method for tissues. Fixation solutions were prepared as follows: 1. 10% Formol and 90% distilled water, 2. 10% Formol and 90% sea water, 3. 10% Formol and 45% distilled water + 45% sea water, 4. 70% Ethyl Alcohol and 30% distilled water, 5. 70% Ethyl Alcohol and 30% sea water, 6. 70% Ethyl Alcohol and 15% distilled water + 15% sea water. Tissues were kept in fixation solutions for 24 hours. Paraffin blocks were obtained by tissue tracking. 4-micron

thick sections were taken, stained with H&E and examined under a light microscope. It was evaluated statistically.

Results: It was seen that the formalin solution dissolved in sea water was superior to the formalin solution dissolved in distilled water at $P<0.05$ and $P<0.01$ levels. It was seen that better fixation was obtained in the formalin groups according to alcohol distribution. Among the prepared formalin solutions, it was observed that the 10% formalin group, which can be dissolved with sea water, gave the best results.

Conclusion: In the current study, it was observed that the fixation period should be longer than 24 hours for better fixation of tissues with alcohol (70%). Despite this, it was determined that 70% alcohol and 30% sea water could be used as an alternative fixative to formalin.

Keywords: Fixation, HXE staining, formalin

O43

Effect of Exposure to Noise Stress on Liver Tissue Histopathology in Rats

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Abstract

Introduction: Stress causes adverse effects and pathologies in the liver and many organs depending on its intensity, severity and duration. However, the exact mechanism of these changes occurring in many organs and systems has not yet been sufficiently understood.

Materials and Methods: This study was conducted to investigate the effects of noise stress on liver histopathology and to contribute to the literature in elucidating the relevant mechanism. 20 rats weighing 250-300 grams were used in the study. The studies were carried out in the A.Ü. Faculty of Medicine, Experimental Animals Unit, where ethical approval was obtained. The rats in the study group were exposed to 70 dB white noise by a noise generator placed next to the cages for 1 hour per day for 1 month according to the protocols in the literature. Then, they were euthanized by halothane in accordance with international standards and liver histopathology was examined. The liver is an organ that protects immunity and filters foreign substances in the body.

Results: When immunity decreases due to stress, inflammation occurs in the liver. There are many mechanisms that trigger this process. Increased stress hormones and sympathetic nerve activation also manage this process.

Conclusion: In the histopathological examination of the liver tissue after stress, moderate steatosis, moderate enlargement of sinusoids in liver tissue, dissociation in remark cords and mild hyperplasia in bile ducts were observed.

The Effect of Sex and Species on Bill Variation in Chukar Partridge (*Alectoris Chukar*) and Grey Partridge (*Perdix Perdix*): Insights from Three- Dimensional Geometric Morphometric Analysis and Linear Morphometric Analysis

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Abstract

This study examines the morphological and shape variations in bills associated with sex and species in Chukar partridge (*Alectoris chukar*) and Grey partridge (*Perdix perdix*). To identify differences in bill size and shape between species and sexes, linear morphometric measurements and 3D geometric morphometric analyses were employed. Morphometric analysis revealed that Chukar Partridges possess longer, higher, and narrower bills compared to Grey Partridges; additionally, female individuals have shorter, narrower, and lower bills than males. The 3D geometric morphometric analysis uncovered significant shape differences between the species, with these variations concentrated primarily in the tip and mid-section of the bill. These differences in bill shape and size may reflect adaptations to environmental factors and foraging strategies.

Introduction: *Perdix perdix* and *Alectoris chukar* are widespread game birds across Europe and Asia. Accurate sex determination is crucial for population monitoring in these species. Bill morphology varies by sex and species and may reflect ecological adaptation. This study aimed to evaluate shape and size differences in bill morphology using morphometric and 3D geometric morphometric methods.

Materials and Methods: A total of 29 partridge specimens from Sivas, Türkiye, were used (21 Chukar: 14 males, 7 females; 8 Grey: 4 males,

4 females). Heads were scanned using a mobile 3D scanning app (Polycam LiDAR & 3D Scanner; Polycam Inc) on an iPhone 13 (Apple Inc). Bill measurements were performed with a digital caliper and included: 1) Bill length (BL), 2) Bill width (BW), 3) Bill height (BH), and 4) Distance from nostril to bill tip (LNBa). The geometric morphometric dataset consisted of 5 type I and 76 semi-landmarks. Analyses included GPA, PCA, and regression. GraphPad Prism and PAST software were used for statistical evaluation (significance level: $p<0.05$). Ethical approval was obtained from the Ethics Committee of Selçuk University Faculty of Veterinary Medicine (approval no: 2024/155).

Results: Morphometric analyses revealed that *A. chukar* had significantly longer, higher, and narrower bills than *P. perdix*. Females had shorter and narrower bills than males. 3D geometric morphometric analysis showed significant shape differences between species, mainly in the tip and middle regions of the bill.

Conclusion: Both size and shape of the bill differed significantly between *A. chukar* and *P. perdix*. These differences likely reflect adaptations to environmental conditions and feeding strategies.

Keywords: 3D geometric morphometric analysis, chukar partridge, grey partridge, morphometric analysis, sexual dimorphism

A Study on the Macroscopic, Light and Scanning Electron Microscopic Structure of the Oropharyngeal Cavity in the Common Kestrel (*Falco tinnunculus*)

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Abstract

Introduction: Birds do not have lips, cheeks and teeth, and their beak structure varies according to their diet. Depending on factors such as the diet of birds, the environment they live in and the food they take, there may be differences in the morphological structures of the oropharyngeal cavity. Therefore, the aim of this study was to investigate the macroscopic, light and scanning electron microscopic structures of the oropharyngeal cavity of the common kestrel.

Material and Method: The study materials consisted of a total of three tongues and palates of 3 kestrels. In the study, 3 adult kestrels that were brought to Keçiören Municipality Veterinary Affairs Directorate (1) and Afyon Kocatepe University Wildlife Rescue and Rehabilitation Centre (2) for treatment and could not be saved were used. The upper and lower beak were carefully removed to expose the oropharyngeal cavity. The roof and floor of the oropharyngeal cavity were examined by macroscopic, light and scanning electron microscopic methods.

Results: A pointed and forked of tongue was present at the base of the oral cavity. The tongue conformed to the structure of the lower beak and did not fill it completely. Three parts of the tongue were identified: apex, corpus and radix linguae. A sulcus medianus starting from the fork at the tip of the tongue was observed on the apex and corpus linguae. Alae linguae with papillae linguales caudales were detected

between the corpus and radix of the tongue. The ala linguae was shaped like a letter “V”. The radix of the tongue was short and the glottis, the entrance of the larynx, was observed just behind it. Papillae pharyngis caudoventrales were symmetrical and in two rows behind the glottis. The choanal cleft in the roof of the oral cavity showed two parts, narrow at the front and wide at the back. Light microscopic examination revealed varying degrees of keratinized layers on the dorsal and ventral epithelial surfaces of the apex of the tongue. Numerous salivary glands were observed especially in the body and root parts of the tongue and in the alae linguae. These glands were also found in the palate. Scanning electron microscopic examination revealed opening of salivary glands on the sides of the body of the tongue. Cone-shaped papillae were observed on the alae linguae of the tongue and behind the glottis in a backward direction. Different types of papillae were present on the roof of the oral cavity around the choanal cleft and behind the infundibular cleft.

Conclusion: In the present study, the macroscopic, light and scanning electron microscopic structures of the oropharyngeal cavity of the common kestrel were investigated. The morphological structures of the oropharyngeal cavity in other domestic and wild avian species were compared with the findings of the study and similarities and differences were revealed.

Keywords: Common kestrel, *Falco tinnunculus*, Light microscopy, Oropharyngeal cavity, Scanning electron microscopy

The Use of Artificial Intelligence-Supported Systems in the Field of Forensic Veterinary Osteology

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Abstract

Introduction: Forensic veterinary osteology is a subfield of forensic science that contributes to legal investigations by analyzing animal bones and skeletal remains, comparing them with human osteological structures, and supporting forensic anthropology. Artificial intelligence-supported systems can significantly speed up the resolution of forensic cases and increase accuracy in forensic processes and other related fields. The applications of artificial intelligence-supported software and systems in forensic veterinary osteology play a critical role in elucidating both crimes committed directly against animals and crimes committed indirectly against humans.

Materials and Methods: In this study, supported by the National New Ideas and Products Research Support Program, all skeletal bones belonging to different animal species were transferred to a digital environment. The digital data were labeled according to animal species and osteological characteristics, and the database was customized. Subsequently, an artificial intelligence-supported architecture was constructed, and the software was taught all digital elements correctly and completely.

Findings: It was observed that software operating with artificial intelligence support and a deep learning architecture can be used quite effectively in learning and identifying osteological structures belonging to different animal species.

Conclusion: In conclusion, it was observed that AI-supported systems will play an important role in the future of forensic veterinary osteology and have the potential to shape newly developed softwares.

Thanks to rapidly developing algorithms, broader databases, and more integrated systems, it is believed that artificial intelligence will be useful not only in the field of forensic veterinary medicine for investigating crimes directly involving animals, but also in identifying animal remains in natural disasters or mass deaths and comparing them with human remains. Therefore, it is anticipated that AI will become an indispensable tool for veterinarians, anthropologists, and other field experts in forensic investigations.

Keywords: Artificial intelligence, forensic osteology, veterinary anatomy.

Funding: TÜBİTAK 1005

POSTER PRESENTATION

Three-Dimensional Reconstruction of the Cranium of the Barn Owl (*Tyto alba*) Using the Photogrammetry Method

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Abstract

Introduction: In the field of veterinary anatomy, the digital documentation of skeletal structures belonging to small-sized animals holds significant importance, particularly for the sustainable use of exotic, rare, or protected species in educational and scientific contexts. In this regard, the photogrammetry method—which operates by processing high-resolution multi-angle images in a software environment—enables the creation of highly detailed and topologically consistent three-dimensional (3D) models. In this study, the photogrammetry method was applied to a cranium specimen of the Barn Owl (*Tyto alba*), and the technical adequacy of the resulting digital model was evaluated.

Materials and Methods: The cranium specimen used in the study was placed into a dermestidarium containing flesh-eating beetles (*Dermestes maculatus*) following the dissection process and was completely cleaned of all soft tissues within approximately eight

hours. The cleaned specimen was photographed under controlled lighting conditions using a Sony A7IV digital camera, capturing a total of 216 images from dorsal and ventral perspectives. The photographs were processed in Agisoft Metashape Professional software to generate, respectively, the dense point cloud, mesh surface, and 8K-resolution texture layers. The final 3D model was uploaded to the Sketchfab platform for online sharing purposes.

Results: The polygon structure of the digital model was found to be uniformly and regularly distributed, with no observed topological deformation or artifact formation. A sub-0.2 mm resolution was achieved in the representation of surface details, allowing fine surface undulations and micromorphological variations to be accurately modeled. The texture map of the model was produced at a resolution of 8192×8192 pixels (8K), and natural color transitions and surface texture were rendered with high accuracy.

Conclusion: Based on the findings and overall evaluation, the photogrammetry method was determined to be a reliable, accessible, and effective tool for the digital reconstruction of small-sized and detail-intensive exotic species. The resulting digital model was found to be of sufficient quality for use in veterinary anatomical education. Furthermore, it was concluded that such models have the potential to contribute to the long-term creation of digital archives for the documentation and preservation of rare biological specimens.

Keywords: 3D printing, owl, cranium, photogrammetry, veterinary anatomy

Volumetric and Morphological Comparisons in Different Skull Types Dogs: 3D Modelling and Printing Study

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Abstract

Introduction: Dogs are the species with the greatest interbreed differences in terms of skull morphology among mammals. These morphological differences are important in clinical practice because they predispose them to certain respiratory diseases, cause orientation difficulties in diagnostic methods involving digital imaging, and present particular challenges during surgery. This preliminary study aims to evaluate differences in skull morphology in three different skull types dog breeds according to the cephalic index (dolichocephalic, mesocephalic, and brachycephalic) by performing volumetric measurements and comparisons, particularly in hollow areas such as the brain cavity, nasal cavity, and paranasal sinuses, using digitally 3D reconstructed and printed models.

Materials and Methods: A total of three different dog skulls according to the cephalic index were scanned and imaged using a computed tomography (CT) device. The DICOM images were transferred to 3D Slicer and digitally reconstructed models were segmented separately in terms of the total nasal cavity, paranasal sinuses, and cranial cavity. The 3D printed skull models were also obtained from scanned CT data.

Results: In the dolichocephalic skull, nasal cavity, total paranasal sinuses and cranial cavity was measured 81.7 cm³, 20.7 cm³, 82.2 cm³ respectively. In the mesocephalic skull, total nasal cavity, total sinus cavity and cranial cavity was measured at 80.1 cm³, 23.2 cm³, 87.5 cm³. In a brachycephalic skull, total nasal cavity, total sinus cavity and cranial cavity was measured 58.3 cm³, 24.3 cm³, 100.2 cm³.

Conclusion: The data obtained demonstrate that disparate cranial types engender substantial volumetric disparities in the total nasal cavity, total sinus cavity and cranial cavities. It is noteworthy that the nasal cavity volume is significantly reduced in brachycephalic dogs compared to dolichocephalic dogs. It is anticipated that these data will facilitate the evaluation of morphological structures in dogs with regard to respiratory systems and neurological functions in forthcoming studies.

Keywords: Brachycephalic, cranium, dolicocephalic, mesocephalic, nasal, sinus.

Mesiodistal Crown Measurements of Permanent Anterior Teeth in German Shepherd Dogs: A Veterinary Dental Assessment

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Abstract

Introduction: The morphometric characteristics of canine dentition are crucial for understanding breed-specific dental anatomy, which has implications for veterinary dentistry, forensic studies, and breed standards. This study aimed to assess the mesiodistal crown dimensions of the permanent anterior teeth in German Shepherd dogs and to evaluate the relationship between these measurements and factors such as age, sex, and jaw length.

Materials and Methods: The study was conducted on 10 German Shepherds aged between 1 and 10 years, all belonging to the lupoid or mesocephalic head type. Dental measurements were obtained postmortem during autopsy examinations performed at the Veterinary Faculty, University of Sarajevo. A total of 160 teeth were analyzed, including 120 incisors and 40 canines. The subjects were categorized based on age, sex, and length of maxillary and mandibular dental arches.

Results: The dental arch lengths in the examined dogs ranged from 8 to 11.5 cm, with the mandibular arch being longer than the maxillary arch in most cases. Statistically significant sex-based differences ($p < 0.05$) were found in the mesiodistal dimension of the first incisor,

with males exhibiting larger values. Although the remaining teeth did not show statistically significant differences, numerical values were consistently higher in males, particularly in the maxilla. The highest tooth dimension values were recorded in dogs aged 4–7 years, while the smallest dimensions were observed in dogs aged 8–10 years. The least variation was observed in the dimensions of the canine tooth.

Conclusion: Mesiodistal crown measurements of permanent anterior teeth in German Shepherds demonstrate variability influenced by age and sex. Males tend to exhibit larger tooth dimensions, particularly in the upper jaw. Tooth size peaks in middle-aged dogs (4–7 years) and declines in older individuals. These findings contribute to the anatomical reference data for German Shepherds and may support clinical applications in veterinary dentistry.

Keywords: Frontal teeth, German Shepherd, tooth crown

An Anatomical and Histological Study on the Spleen and Lymph Node in a Brown Bear Cub

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Abstract

Introduction: Hibernating brown bears are the largest carnivores living on land. They are classified under the genus Carnivora, family Ursidae, species *Ursus arctos*, subspecies *horribilis*. Since these animals hibernate, they have a different immune system. This study was conducted to understand these differences and to make comparisons with other animal species.

Materials and Methods: The aim of this study is to histologically examine the spleen and lymph node samples taken from a female brown bear cub. A 13 kg, 4-month-old female brown bear cub was used in the study. The tissue samples were fixed in 10% formaldehyde solution for 24 hours, then subjected to routine histological procedures and blocked in paraffin. Mallory's modified triple staining (Triple) was applied to 5 µm sections taken from these blocks to show the general structure of the tissue. The prepared preparations were examined under a light microscope.

Results: It was determined that the female brown bear cub spleen tissue consisted of capsular trabeculae, white pulp, and red pulp. It was determined that there was a marginal region between the white and red pulp. It was observed that the young bear spleen was surrounded by a capsule consisting of elastic fibers and smooth muscle. It was

determined that irregularly spaced smooth muscle and fibroelastic tissue trabeculae spread from the capsule to the splenic parenchyma and that these trabeculae also contained blood, lymph vessels, and nerve fibers.

It was observed that the female brown bear cub lymph nodes were divided into two parts, cortex and medulla. It was observed that the cortex was formed from lymph follicles and the medulla from lymphatic cords. It was determined that the cortex generally consisted of two parts, outer cortex and inner cortex (paracortex). It was observed that the lymph nodes were surrounded by a fibrous capsule. It was determined that there were fibrous trabeculae extending from the capsule to the inside of the node to form a supporting frame carrying blood vessels and nerves.

Conclusion: In conclusion, histological information about the spleen and lymph nodes of brown bear cubs was obtained with this study. It is thought that this study will contribute to future studies on the immune system of carnivorous animals.

Keywords: Brown bear, spleen, immune system

Aquaporin 3 Immunolocalization and Histological Characteristics in the Digestive Tract of The Partridge (*Alectoris chukar*)

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Abstract

Introduction: The aim of this study was to make a detailed histological examination of the partridge digestive tract and to determine the distribution and density of Aquaporin (AQP) 3, which is involved in the intracellular transport of water and glycerol in these organs.

Materials and Methods: In the study, 5 healthy partridges were used to examine the digestive tract. The organs of the digestive tract were stained with hematoxylin-eosin for histological examination and immunohistochemical staining for AQP 3 immunolocalization.

Results: Histologic findings were similar to other poultry species. However, unlike other species, villus development towards the lumen was observed in the colon. Immunohistochemical examination revealed AQP3 expression at various intensities in the digestive tract organs and layers. The highest expression was observed in the esophagus, followed by colon and rectum. The least AQP3 expression was observed in duodenum and jejunum.

Conclusion: In conclusion, the expression and localization of AQP3, which plays an important role in body hemostasis and nutritional variability, were determined in the partridge digestive tract in its natural habitat. It is thought that the results obtained will be useful in explaining the function of the aquaporin mechanism, which has limited literature in the avian field, especially on the digestive system.

Keywords: Aquaporin 3, immunolocalization, large intestine, small intestine

Geometric Analysis of the Nasal and Orbital Region of the Dog According to the Climate

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Abstract

Introduction: Nasal and orbital regions play an important role in functions such as respiration, olfaction, thermoregulation and visual perception, which are sensitive to climatic effects. This study was planned to determine the shape variations in the nasal and orbital regions of the mesocephalic dog skull according to the climatic conditions (harsh, temperate, hot) in which the dog lives.

Materials and Methods: The skulls of 31 breeds were used in the study. Dogs were grouped according to whether they lived in harsh (n: 28), temperate (n: 16) and hot (n: 20) climates. The skulls were modeled using three-dimensional images presented by Kubinyi et al. (2024). For the analysis of shape variation, landmarks containing x, y and z coordinates were performed in stl format models using the Stratovan Checkpoint (Stratovan Co., 2018) program. 20 landmarks were marked in the nasal region and 22 in the left orbital region. Principal component analysis (PCA) was performed to determine the shape variation at these points. Procrustes ANOVA was performed for the statistical difference between centroid size and shape in the groups.

Discriminant function analysis was also performed to measure the effect of climate difference on shape. MorphoJ (version 1.07a, Klingenberg, 2011) program was used.

Results: As a result of the PCA, it was seen that hot climate dogs were partially separated according to the PC1 distribution graph. In the regression analysis performed to measure the effect of size on shape, it was determined that size had a statistically significant effect ($p < 0.0159$) on the shape of the nasal and orbital regions. According to cross validation scores, harsh and temperate climate dogs were incorrectly grouped at a rate of 62.5% (procrustes distance $p = 0.9810$), harsh and warm climate dogs at a rate of 25% (procrustes distance $p = 0.2530$), and temperate and warm climate dogs at a rate of 38.9% (procrustes distance $p = 0.3350$).

Conclusion: According to the results obtained, although not statistically significant, it was determined that the hard and hot climate dogs were correctly grouped significantly (75%).

Keywords: Eye, nose, sense, warm

The Protective Effect of *Turmeric* Powder on Damage Caused by Heat Stress in Young Turkey Spermatogenesis

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Abstract

Introduction: Heat stress disrupts the regulation of spermatogenesis. The use of plants in improving fertility, treating infertility, and enhancing sexual health has deep ancestral and cultural roots. Curcumin exhibits powerful antioxidant capabilities by neutralizing oxygen free radicals. To date, no studies have examined the effects of oxidative damage caused by heat stress on the testes of turkeys. This study aims to investigate the protective effects of turmeric on testicular tissue in young turkeys exposed to heat stress.

Materials and methods: Turmeric rhizomes were processed into a fine powder by grinding. Heat stress was induced in Group 3 by exposing turkeys to an elevated temperature of 32–35°C for 5 hours daily over 2 weeks. Testes were fixed in 10% buffered formalin and processed for standard histological sectioning and Hormonal analyses were

conducted using testosterone ELISA kits. Analysed using one-way ANOVA with SPSS v13 software.

Results: In the heat stress + turmeric group compared to the heat stress group, the turmeric-treated group showed a significant increase in sperm in the lumen of the seminiferous tubules. From the results obtained from measuring testosterone levels (DHT), the heat stress variable had a significant decreasing effect compared to the normal group, while the effect of turmeric powder in the treatment group showed a significant increase compared to the heat stress group.

Conclusion: Due to the strong antioxidant properties of turmeric powder, it is recommended to include turmeric powder in the diet of turkeys during summer to prevent fertility loss caused by elevated temperatures and heat stress.

Keywords: Curcumin, heat stress, turmeric, spermatogenesis, young turkey

Preservation of Organs for Anatomy Teaching: an Affordable and Non-Toxic Approach

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Abstract

Introduction: The preparation of educational anatomical specimens for teaching purposes requires specific pre-treatment procedures before final fixation of the organ in its natural anatomical position. By drying hollow organs, it is possible to obtain anatomical specimens suitable for long-term display and physical contact, without the use of harmful chemical substances.

Materials and methods: The method of drying and internal plastination of hollow organs consists of five phases: Dissection, Cleaning, Soaking in a solution of potassium aluminum sulfate ($KAl(SO_4)_2 \cdot 12H_2O$), Drying using a compressor and Internal plastination. This method is applied in the preparation of hollow organs, including lungs, esophagus, stomach, intestines, reproductive organs, and urinary bladder from various animal species. After soaking the organ in a potassium aluminum sulfate solution (0.1 g per 1 liter of water) for 12 to 24 hours, the organ is inflated with air using a compressor. The drying process lasts three to four days. Once the organ is fully dried, plastic foam is gradually injected. The hardening time of the foam ranges from 8 hours to one or two days, depending on the size of the organ.

Results: The foam-filled organ is lightweight, and the foam maintains its shape while protecting the internal surface from insect damage. The external surface is protected by varnishing, and individual anatomical parts may be painted in different colors for easier identification. The use of toxic formaldehyde is completely eliminated. Instead, potassium aluminum sulfate is used as a non-toxic drying agent, disinfectant, natural deodorant and an effective insect repellent that protects the specimens from damage.

Conclusions: This method provides long-term protection of anatomical specimens, which retain their natural form, while the production process is cost-effective. Such specimens are indispensable in the educational process and are particularly valuable for studying the anatomy and development of organs in relation to the animal's age.

Keywords: Anatomy, drying, plastination, specimens

Geometric Analysis of the Mandible in Guard, Hound and Shepherd Dogs

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Abstract

Introduction: The mandible is a critical bone in dogs, playing a central role in essential functions such as mastication, feeding, and defence. It is associated with bite force, muscle attachment points, and dental alignment. Additionally, it reflects interbreed morphological variation, offering valuable insights for clinical and evolutionary analyses. This study aimed to determine the shape variations on the ventral border of the mandible in mesocephalic dogs according to their functional status.

Materials and Methods: A total of 82 dog skulls were examined. The mandibles were classified into three functional groups: hunting (n=29), guard (n=19), and herding (n=22) dogs. Three-dimensional models of the mandibles were created using images published by Kubinyi et al. (2024). These models were saved in “.stl” format.

Landmark data including x, y, and z coordinates were collected using the Stratovan Checkpoint software. A regression analysis was performed to evaluate the effect of size on shape. A Procrustes ANOVA was used to assess statistical differences in centroid size and shape across groups. Additionally, a discriminant function analysis was conducted to determine the impact of dog function on mandibular shape. Group classifications were evaluated using cross-validation scores.

Results: Principal Component Analysis identified 20 components in total. Shape variation was primarily located at LM4, LM6, and LM9 for PC1 (30.254%), at LM1 and LM5 for PC2 (21.826%), and at LM7 and LM8 for PC3 (13.676%). According to PC1 scatterplots, hunting dogs clustered within a narrower range. Procrustes ANOVA indicated no statistically significant difference in shape ($p>0.6524$) or centroid size ($p>0.4872$). However, regression analysis showed that size had a statistically significant effect on shape ($p<0.0001$).

Conclusion: The findings revealed that distinct morphological differences were present in LM8 (canine tooth) particularly between guard dogs and other groups. Moreover, a statistically significant shape distinction was observed between guard and hunting dogs.

Keywords: Bite, carnivorous, mandible, shape, variation

Compete with Game

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Abstract

Introduction:The compete with game takes its name from the knucklebone, main component of the game, found in the tarsal joint of many animals (cow, horse, donkey, deer, mule, buffalo, etc.). Knucklebones (talus) from small livestock, such as goats, sheep, gazelles, and roe deer, are particularly popular for this game. The compete with game are a traditional sport known as the ancestor of marbles. The first written source in which the compete with game is encountered is Divanu Lügati't-Türk, written by Kaşgarlı Mahmud between 1072 and 1074. It is also mentioned in the story of "Boğaç Han, Son of Dirse Han", which is the first of the Dede Korkut Stories, that children played knucklebone. Due to the living conditions of the past, the knucklebone was a rare bone. Therefore, in Anatolia, people would challenge each other to a game of knucklebone, and upon winning, they would say, "You can't dance with me," to demonstrate their mastery, and they would compete.

This game, the national game of the Turkic world, is called the 'aşık atmaca'- 'aşık oyunu' in Türkiye. The Tuva Turks of Southern Siberia call it the "Kajik game. Knucklebone game is among the traditional games played in Central Asia. In 2017, The compete with game was inscribed on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity.

In the game of the compete with, the bone faces are called by different names depending on the region. The hollow belly face is called 'aç, çik, kâhya, tök'; the lumpy face is called 'bey, çöl, tok, tök, tüğ'; the S-shaped face is called 'allı, çik, kazak, mire, say'; and the flat face is

called 'bal, dođan, kıt, k r, mire, řek, tohani, zıđa'. The players divide the knucklebones into two groups. Those in the line, the regular bones, are called "d b let." The main knucklebone, who plays a crucial role during the shooting, is called "enek." An "enek," "saka," or "řaka" is a knucklebone filled with lead, pitch, or wax to make it heavier.

There are many variations of the compete with game, such as the "Line Game", "Castle Game", "Gıynız Game", "   Beř Game" and "Zıdalı." The most common is "Zıdalı." In this game, the knucklebones are arranged in a single row (with their sides, called kazaks, facing down) in the center of a circle called "zida" on the ground, with equal numbers from each player. Players then attempt to move their knucklebones, called 'enek', out of the circle by hitting other knucklebones. The knucklebone that goes out belongs to the player who threw it. If the knucklebone is not removed or a miss is missed, the next player's turn passes. The first shot is fired from a distance determined by the players outside the circle. On subsequent shots, the player whose turn it is to shoot from the edge of the circle. If a shot from the edge of the circle knocks one or more of the knucklebones inside the circle out of the circle, the player continues play from where the knucklebone left off. Because the knucklebone usually remains close to the other knucklebones within the circle, the player has an advantage in subsequent shots. On subsequent shots, the player whose turn it is to shoot from the edge of the circle. If the shot from the edge of the circle knocks one or more of the knucklebones out of the circle, the player continues play where the knucklebone left off. Because the knucklebone usually remains close to the other knucklebones in the circle, the player has an advantage on subsequent shots.

Conclusion and Recommendations

In conclusion, the compete with game is not just a childhood pastime or a simple means of competition, but also a deeply rooted intangible heritage element dating back to the ancient past of Turkish culture. While the fact that it is played under different names in different regions demonstrates the game's intercultural interaction and spread, the limited availability of the knucklebones has led to the attribution of social value to the game. In this context, knucklebones should be considered an important cultural heritage that remains embedded in the collective memory of the Turkic world and reinforces a sense of identity and belonging.

Keywords: Knucklebone, döbület, enek, talus, zıdalı.