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**Editorial**

# The Language of Bodies: Comparative Anatomy as a Unifying Science for Education, Research, and One Health

# Ko telo spregovori: primerjalna anatomija kot povezovalna znanost v izobraževanju, raziskovanju in okviru koncepta Eno zdravje

**Key words**

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Comparative anatomy, the study of structural similarities and differences between animals and humans, remains one of the oldest and most enduring foundations of veterinary and medical science (1). From the dissections of Aristotle, Galen, and Vesalius through to the anatomical theatres and museums of the 19th century and beyond, comparative examination has shaped our understanding of the living world (2, 3, 4). It is no coincidence that the very roots of biology, medicine, and veterinary science are deeply embedded in this discipline. Examining the horse's limb, the ruminant stomach, or the avian lung not only satisfies scientific curiosity but also provides veterinarians with essential knowledge for diagnosis, surgery, and disease prevention, while at the same time revealing important parallels with human medicine (5, 6), and *vice versa*.

For veterinary students, comparative anatomy is far more than an abstract subject or a purely theoretical exercise. It provides a framework for connecting the immense diversity of animals they will encounter in practice, from farm and companion animals to wildlife and exotic animals, with

Primerjalna anatomija, veda o strukturnih podobnostih in razlikah med živalmi in človekom, ostaja ena najstarejših in najtrdnejših osnov veterinarske in medicinske znanosti (1). Od disekcij Aristotela, Galena in Vesaliusa do anatomskih gledališč in muzejev 19. stoletja ter kasneje je primerjalno proučevanje oblikovalo naše razumevanje živega sveta (2, 3, 4). Ni naključje, da so prav v tej disciplini korenine biologije, medicine in veterinarske znanosti. Proučevanje okončine konja, želodca prežvekovalcev ali pljuč ptic ne zadovoljuje le znanstvene radovednosti, temveč veterinarjem zagotavlja temeljno znanje za diagnostiko, kirurgijo in preprečevanje bolezni, hkrati pa razkriva pomembne vzporednice s človeško medicino (5, 6) in obratno.

Za študente veterine je primerjalna anatomija veliko več kot abstrakten predmet ali zgolj teoretična vaja. Predstavlja okvir, s katerim povezujejo izjemno raznolikost živali, s katerimi se bodo srečevali v praksi, od domačih in rejnih živali do prostoživečih in eksotičnih vrst, z osnovnimi strukturnimi in funkcionalnimi načeli. Hkrati deluje kot univerzalni jezik, ki jih uči, kako »brati« telesa številnih vrst, s katerimi bodo delali. V

general structural and functional principles. It also serves as a universal language, teaching them how to "read" the bodies of the many species they will work with. Throughout history comprehensive comparative anatomy has also supported societies during extreme crisis periods. Proficiency in this area has supported veterinary professionals required to work within human healthcare settings, such as during times of war and in epidemics and pandemics. These situations are rare, but arguably the most important rationale for comparative anatomy are the everyday implications and uses.

By understanding differences in the avian respiratory system, the reptilian cardiovascular system, or the mammalian gastrointestinal tract, students learn to adapt their anatomical and clinical knowledge across species. Comparative anatomy trains them to identify differences that have practical implications, for instance, why intubation techniques vary between ruminants and carnivores, while also appreciating the shared features that unify vertebrate structure. In this way, it not only reinforces conceptual understanding but also fosters intellectual flexibility. Once students grasp the underlying blueprint of the vertebrate body, they can extend and adapt their anatomical knowledge, connected to clinical skills to almost any animal they encounter.

The significance of comparative anatomy extends well beyond veterinary medicine. Increasingly, it is recognized as a crucial bridge between animal and human health. The concept of Zoobiquity, popularized in recent years, underscores the fact that many diseases transcend species boundaries (7). Heart disease in chimpanzees, obesity in cats, mammary cancer in dogs, and cruciate ligament tears in horses all mirror conditions familiar in human medicine. Research highlighting the comparative nature of these, and many more conditions, are evidencing the similarities and differences in numerous species. Veterinarians, physicians, and research scientists share common foundations in anatomy, physiology, and pathology, and by approaching these conditions comparatively, all of these, and allied, professions gain valuable insights. Comparative anatomy provides the shared vocabulary for this dialogue. It reminds us that the human body is not unique in its vulnerabilities and that novel solutions may emerge when we look beyond our own species (7, 8).

Within the broader framework of One Health, comparative anatomy has established a great importance and provides the evidence base that links clinical practice, public health, and evolutionary adaptation. It is not merely an academic pursuit, but a dynamic, applied science that connects bodies across species and domains (8, 9). Understanding comparative anatomy highlights interspecies connections and clarifies disease mechanisms and zoonotic pathways. Numerous examples illustrate this integrative potential. Canine models for ocular disease, such as the Swiss Briard dog with Leber congenital amaurosis, have led to human gene therapies like Luxturna®. Cavalier King Charles Spaniels with spontaneous Chiari malformation provide insights into human neurology

zgodovini je celovito poznavanje primerjalne anatomije podpiralo družbe tudi v obdobjih hudih kriz. Usposobljenost na tem področju je omogočala veterinarskim strokovnjakom delovanje tudi v humanem zdravstvenem sistemu, na primer v času vojn, epidemij in pandemij. Takšne situacije so sicer redke, vendar je mogoče trditi, da je najpomembnejši pomen primerjalne anatomije videti v njeni vsakodnevni uporabi in rezultatih.

Z razumevanjem razlik v dihalnem sistemu ptic, srčno-žilnem sistemu plazilcev ali prebavnem traktu sesalcev se študenti učijo prilagajati svoje anatomsko in klinično znanje različnim vrstam. Primerjalna anatomija jih uri v prepoznavanju razlik s praktičnimi posledicami, npr. zakaj se tehnike intubacije razlikujejo med prežvekovalci in mesojedimi živalmi, hkrati pa jih spodbuja k razumevanju skupnih značilnosti, ki povezujejo zgradbo vretenčarjev. Na ta način ne le krepi konceptualno razumevanje, temveč tudi spodbuja intelektualno prožnost. Ko študenti enkrat razumejo osnovni »načrt« telesa vretenčarjev, lahko svoje anatomsko znanje povežejo s kliničnimi spretnostmi in ga uporabijo pri skoraj katerikoli živali, s katero se srečajo.

Pomen primerjalne anatomije sega daleč preko meja veterinarske medicine. Vedno pogosteje jo prepoznavamo kot ključen most med zdravjem živali in človeka. Koncept Zoobiquity, ki je v zadnjih letih pridobil veliko pozornosti, poudarja dejstvo, da številne bolezni presegajo meje posameznih živalskih vrst (7). Srčne bolezni pri šimpanzih, debelost pri mačkah, rak mlečne žleze pri psih in poškodbe križnih vezi pri konjih so le nekateri primeri stanj, ki so dobro poznana tudi v humani medicini. Raziskave, ki izpostavljajo primerjalno naravo teh in številnih drugih bolezni, razkrivajo podobnosti in razlike med različnimi vrstami. Veterinarji, zdravniki in raziskovalci si delijo skupne temelje v anatomiji, fiziologiji in patologiji, in ko k tem stanjem pristopijo primerjalno, te stroke pridobijo dragocene vpoglede. Primerjalna anatomija zagotavlja skupen jezik za tak dialog. Spominja nas, da človeško telo ni edinstveno v svojih ranljivostih in da se lahko nove rešitve pojavijo, ko pogled usmerimo preko meja lastne vrste (7, 8).

Širše gledano ima v okvirju koncepta Eno zdravje (iz angl. One Health) primerjalna anatomija izjemen pomen, saj predstavlja znanstveno podlago, ki povezuje klinično prakso, javno zdravje in evolucijsko prilagoditev. Ni zgolj akademska disciplina, temveč dinamična, uporabna znanost, ki povezuje telesa različnih vrst in področij (8, 9). Razumevanje primerjalne anatomije poudarja medvrstne povezave ter pojasnjuje mehanizme bolezni in poti zoonotskih okužb. Številni primeri ponazarjajo njen povezovalni potencial. Pasji modeli za očesne bolezni, kot je švicarski briard z Leberjevo hereditarno optično nevropatijo, so omogočili razvoj genskih terapij pri ljudeh, med drugim zdravila Luxturna®. Španjeli, kavalirji kralja Karla, s spontano deformacijo Chiari, nudijo pomemben vpogled v človeško nevrologijo in njeno gensko terapijo. Raziskave mačjega koronavirusa (iz angl. feline infectious peritonitis, FCoV) so neposredno prispevale

and gene therapy approaches. Feline coronavirus research (feline infectious peritonitis, FCoV) directly advised treatment strategies for SARS-CoV-2 patients, with GS-441524 as a key therapeutic molecule. Comparative oncology demonstrates how elephants, with over 20 TP53 gene copies, naked mole rats, and bowhead whales naturally resist cancer, inspiring translational cancer research. Comparative reproductive biology reveals the variety of sex determination systems across vertebrates, from XY and ZW chromosomal mechanisms to sequential hermaphroditism and temperature-dependent sex in reptiles (10).

Other examples connect physiology and anatomy more closely to education. The photochemistry and molecular structure of respiratory pigments explain the diversity of oxygen dissociation curves across species, while comparisons of human and avian respiratory systems highlight the efficiency of avian gas exchange and ventilation. The eyes of mantis shrimps, with their 16 color receptors, serve as striking models for teaching eye anatomy and physiology (11). The equine auditory tube and guttural pouch offer instructive parallels to human otitis media (12). Comparative anatomy of the shoulder joint with its stability mechanisms, biomechanics, and vulnerability to dislocation provides another clinically relevant bridge.

Meat inspection demonstrates how anatomical precision underpins food safety and public trust in the food chain (13). Anatomical comparisons help develop surgical tools and techniques, used in one species and adapted for the needs of others. Whilst perhaps historically this was developed in animals to use in people, we now recognise the important of adapting practices used by physicians to support veterinary practice. Understanding anatomical similarities and differences can also help provide insight into diagnostic, prognostic and therapeutic advances across different species.

Anatomy should be recognized as the ideal entry point for One Health thinking. It is taught early in both veterinary and medical curricula, providing the foundation for later professional development. Many accreditation standards for health professions already share One Health core competencies, and these should be introduced from the very beginning of anatomy courses through real case studies and comparative examples (8, 9).

One Health examples should be embedded in lectures, dissections, practical sessions, electives, and problem-based learning. Comparative exchange days or joint projects, modelled on initiatives at Tufts and UPenn Universities, can bring together veterinary, medical, and public health students to learn side by side (14). Modern tools such as virtual anatomy platforms, 3D printing, and shared digital case libraries facilitate cross-disciplinary connections. Real-world applications, outbreak tracing, wildlife crime investigations, and meat safety inspections, should be highlighted to show how anatomical knowledge protects societies. Finally, student

k razvoju terapevtskih pristopov za bolnike s SARS-CoV-2, pri čemer je bila učinkovina GS-441524 ključna terapevtska molekula. Primerjalna onkologija razkriva, kako nekatere živalske vrste, npr. sloni z več kot 20 kopijami gena TP53, gole krtaste podgane in grenlandski kiti, naravno izkazujejo odpornost proti raku ter tako navdihujejo translacijske raziskave raka. Primerjalna reprodukcija pa odkriva raznolikost sistemov za določanje spola pri vretenčarjih od kromosomskih mehanizmov XY in ZW do zaporednega hermafroditizma ter temperaturno odvisnega določanja spola pri plazilcih (10).

Drugi primeri še tesneje povezujejo fiziologijo in anatomijo z izobraževanjem. Fotokemija in molekularna zgradba dihalnih pigmentov pojasnjujeta raznolikost disociacijskih krivulj kisika med vrstami, medtem ko primerjava dihalnega sistema človeka in ptic razkriva izjemno učinkovitost izmenjave plinov in ventilacije pri pticah. Oči rakov bogomolčarjev, ki imajo kar 16 receptorjev za barve, predstavljajo osupljive modele za poučevanje anatomije in fiziologije vida (11). Sluhovod in zračni mehur konja ponujata poučno vzporednico s človeškim vnetjem srednjega ušesa (12). Primerjalna anatomija ramenskega sklepa z mehanizmi njegove stabilnosti, biomehaniko in nagnjenostjo k izpahom predstavlja še en klinično pomemben most med živalskimi vrstami.

Inšpekcija mesa jasno kaže, kako anatomska natančnost podpira varnost hrane in zaupanje javnosti v prehransko verigo (13). Primerjalne anatomske raziskave pomagajo pri razvoju kirurških instrumentov in tehnik, ki se uporabljajo pri eni vrsti ter nato prilagodijo potrebam druge. Če je bilo v preteklosti pogosto tako, da so se postopki razvijali najprej pri živalih in nato uporabljali pri ljudeh, danes vedno bolj prepoznavamo pomen prenosa znanj tudi v obratni smeri iz humane medicine v veterinarsko prakso. Razumevanje anatomskih podobnosti in razlik tako omogoča nov vpogled v diagnostične, prognostične in terapevtske napredke pri različnih vrstah.

Anatomijo bi bilo treba prepoznati kot idealno izhodišče za razmišljanje v okviru koncepta Eno zdravje. Poučuje se že v zgodnjih fazah tako veterinarskih kot medicinskih študijskih programov in predstavlja temelj za nadaljnji strokovni razvoj. Številni akreditacijski standardi zdravstvenih poklicev že vključujejo temeljne kompetence One Health, ki bi jih bilo treba vpeljati že od samega začetka poučevanja anatomije z uporabo resničnih primerov in primerjalnih pristopov (8, 9).

Primeri koncepta Eno zdravje bi morali biti vključeni v predavanja, disekcije, praktične vaje, izbirne predmete in problemsko učenje. Dnevi primerjalne izmenjave ali skupni projekti, po vzoru iniciativ na univerzah Tufts in UPenn, lahko povežejo študente veterine, medicine in javnega zdravja pri skupnem učenju (14). Sodobna orodja, kot so virtualne anatomske platforme, 3D-tiskanje in skupne digitalne baze primerov, omogočajo učinkovite interdisciplinarne povezave. Poudariti bi bilo treba tudi praktično vrednost anatomskega

engagement should be encouraged through One Health clubs, joint research projects, and exchange opportunities, ensuring that the next generation views anatomy not only as a science of structure, but as a discipline at the core of global health and security (13).

Recently published article by Ruberte et al., 2025 (15) is highly relevant for comparative anatomy from another perspective, as it highlights the importance of consistent and comparable terminology for both animal and human biomedical research. The article points out the comparative perspective of using of mice as key models in comparative and translational research for humans and animals. The mouse remains one of the most widely used models for human diseases, yet its anatomical nomenclature is fragmented, with dozens of competing terms for the same liver lobes or muscles, frequent use of outdated eponyms, and even "do-it-yourself" descriptions by researchers unfamiliar with standard references. This terminological confusion mirrors the historical chaos in human anatomy before the introduction of Terminologia Anatomica. It also mirrors the situation seen in molecular genetics whereby genetic and protein nomenclature often differs across species due to independent historical naming events, differences in structure or function, or alternative naming conventions. To solve this nomenclature committee, database curators, identification of orthologs, bioinformatics tools and other methods are being utilised to develop more unified approaches.

With conflicting nomenclature for structures like liver lobes and muscles, cross-species comparisons risk misinterpretation. The authors stress the need for standardized terminology, expert working groups, and a centralized anatomical repository to ensure accuracy, facilitate phenotyping, and strengthen comparative anatomy as a shared scientific language. By highlighting the need for both new anatomical descriptors and a harmonized vocabulary, this work shows that comparative anatomy is not only about structural similarities but also about creating a shared language. Such efforts are vital to improve accuracy in phenotyping, enhance translational research, and strengthen the role of anatomy as a bridge across species and disciplines. They also call for the development of a centralized anatomical repository to integrate emerging knowledge, including novel structures like adipose depots or specialized nerves, which currently lack official terms (15).

This issue of Slovenian Veterinary Research offers an excellent illustration of the value of comparative anatomy and its richness. Several original research articles, spanning different species and methodologies, jointly underline how studying anatomical structures contributes to veterinary practice, translational research, and even the human medical field and can advance both veterinary and biomedical sciences.

The article by Tim Šteferl et al. explores seasonal variations in serum vitamin D levels and growth performance in

znanja, od sledenja izbruhom bolezni in forenzičnih preiskav kaznivih dejanj nad prostoživečimi živalmi do nadzora inšpekcije mesa, saj vse to jasno ponazarja, kako anatomsko znanje prispeva k varovanju zdravja in zaščiti družbe. Pomembno je tudi spodbujati aktivno vključenost študentov prek klubov v okviru koncepta Eno zdravje, skupnih raziskovalnih projektov in mednarodnih izmenjav, da bi prihodnje generacije razumele anatomijo ne le kot znanost o zgradbi, temveč kot disciplino v samem jedru globalnega zdravja in varnosti (13).

Nedavno objavljen članek avtorja Ruberte in sod. 2025 (15), je izjemno pomemben za področje primerjalne anatomije z nekoliko drugačnega vidika, saj poudarja pomen dosledne in primerljive terminologije tako za biomedicinske raziskave na živalih kot na ljudeh. Članek izpostavlja primerjalni vidik uporabe miši kot ključnega modela v primerjalnih in translacijskih raziskavah za ljudi in živali. Miš ostaja eden najpogosteje uporabljenih modelov za preučevanje človeških bolezni, vendar je njena anatomska nomenklatura razdrobljena. Za iste režnje jeter ali mišice obstajajo številni konkurenčni izrazi, pogosto se uporabljajo zastarela poimenovanja, raziskovalci pa včasih oblikujejo tudi lastne opise, ne da bi se sklicevali na standardna anatomska poimenovanja. Takšna terminološka zmeda odraža zgodovinski kaos v humani anatomiji pred uvedbo anatomske terminologije. Podobna situacija je prisotna tudi na področju molekularne genetike, kjer se imena genov in beljakovin pogosto razlikujejo med vrstami zaradi zgodovinsko neodvisnega poimenovanja, razlik v zgradbi ali funkciji, ali pa zaradi uporabe različnih poimenovalnih konvencij. Za razrešitev teh neskladij se danes vključujejo nomenklaturni odbori, skrbniki podatkovnih baz, identifikacija ortologov, bioinformacijska orodja in druge metode, s katerimi se razvijajo bolj enotni pristopi k poimenovanju.

Zaradi neenotne terminologije za strukture, kot so jetrni režnji in mišice, obstaja tveganje za napačno razlago pri medvrstnih primerjavah. Avtorji zato poudarjajo potrebo po standardizirani terminologiji, strokovnih delovnih skupinah in vzpostavitvi centralnega anatomskega repozitorija, ki bi zagotavljal natančnost, olajšal fenotipizacija in okrepil primerjalno anatomijo kot skupni znanstveni jezik. S poudarjanjem pomena tako novih anatomskih opisov kot tudi usklajenega besedišča delo kaže, da primerjalna anatomija ni le veda o strukturnih podobnostih, temveč tudi o oblikovanju skupnega jezika. Takšna prizadevanja so ključna za izboljšanje natančnosti pri fenotipizaciji, za napredek translacijskih raziskav ter za utrjevanje vloge anatomije kot mostu med vrstami in znanstvenimi disciplinami. Avtorji obenem pozivajo k razvoju centraliziranega anatomskega repozitorija, ki bi vključeval novo pridobljeno znanje, vključno z novoodkritimi strukturami, kot so maščobni depoji ali specializirani živci, ki trenutno še nimajo uradnih poimenovanj (15).

V tokratni številki revije Slovenskega Veterinarskega Zbornika sta odlično ponazorjena pomen in bogastvo primerjalne anatomije. Več izvirnih ter preglednih raziskovalnih

Krškopolje pigs raised on organic farms, linking nutritional physiology with skeletal health and animal welfare. By correlating vitamin D status, known to influence calcium metabolism, bone mineralization, and musculoskeletal robustness, with housing conditions and sunlight exposure, the study bridges biochemical and anatomical perspectives. The findings not only provide reference values for vitamin D in outdoor and indoor pigs but also highlight how environmental and anatomical factors jointly shape skeletal development, supporting a holistic One Health approach to animal morphology and welfare.

The study by Mohamed A. M. Alsafy et al. provides new insights into the horse stifle joint using advanced imaging and analytical methods, including 3D computed tomography (CT), scanning electron microscopy (SEM), and energy-dispersive X-ray (EDX) analysis. The equine stifle is one of the most clinically important joints, it is a frequent source of lameness yet is also one of the most complex anatomical regions, both structurally and functionally. By combining CT-based 3D reconstruction with microscopic and elemental analysis, the authors offer a comprehensive description of the joint's bones, ligaments, and synovial components. Their work not only provides a valuable reference for equine clinicians but also enriches the comparative understanding of synovial joints across species, including humans, where cruciate ligament injuries represent a major clinical problem.

Another contribution which focused on surgical anatomy is presented by Mohamed Marzok et al., who carried out computed tomographic and gross anatomical studies of the temporomandibular and supraorbital regions in the one-humped camel (*Camelus dromedarius*). Their detailed dissections and CT scans of camel skulls demonstrate that the extensive supraorbital fossa offers a safe and feasible surgical approach to the orbital cavity. The study highlights how comparative anatomy supports clinical innovation: in this case, facilitating orbital surgeries such as enucleation, prosthetic implantation, and tumor removal in camels. The findings not only enrich camel anatomy but also broaden the comparative understanding of orbital surgery across domestic species, showing again how structural knowledge translates into clinical advances.

From skeletal health in pigs, musculoskeletal anatomy in horses, skull study in camels the issue then turns to poultry physiology and bone biology. Ghulam Murtaza Lochi et al. examined the effects of selenium nanoparticles and chitosan on meat quality, lipid profile, mineral content, and tibial bone morphometry in heat-stressed broilers. While the primary focus was nutritional physiology, the study also emphasizes the anatomical and structural aspects of bone health. The findings that nano-selenium and chitosan supplementation improve tibial robustness and mineralization underpin how nutrition and environmental stress intersect with skeletal anatomy. This work provides not only practical applications for poultry production but also broader insights into how

člankov, ki obravnavajo različne živalske vrste in primerjave ter uporabljajo raznolike metodologije poudarja, kako proučevanje anatomskih struktur prispeva k veterinarski praksi, translacijskim raziskavam in celo k razumevanju v humani medicini, ter tako omogoča boljše razvijanje tako veterinarske medicine kot drugih biomedicinskih ved.

Članek Tima Šteferla in sod. obravnava sezonska nihanja ravni vitamina D v serumu in rastno zmogljivost krškopoljskih prašičev, vzrejenih na ekoloških kmetijah, ter povezuje prehransko fiziologijo z zdravjem okostja in dobrobitjo živali. S povezovanjem statusa vitamina D, ki vpliva na presnovo kalcija, mineralizacijo kosti in mišično-skeletno odpornost, z bivalnimi pogoji in izpostavljenostjo sončni svetlobi raziskava povezuje biokemični in anatomski vidik. Ugotovitve ne ponujajo le referenčnih vrednosti za vitamin D pri zunaj in znotraj hlevsko rejenih prašičih, temveč tudi poudarjajo, kako okoljski in anatomski dejavniki skupaj oblikujejo razvoj skeleta, s čimer prispevajo k celostnemu pristopu Eno zdravje pri preučevanju morfologije in dobrobiti živali.

Raziskava Mohameda A. M. Alsafyja in sod. prinaša nova spoznanja o kolenskem sklepu konja, pridobljena z uporabo naprednih slikovnih in analitskih metod, med katerimi so tridimenzionalna računalniška tomografija (CT), vrstična elektronska mikroskopija (SEM) ter energijsko-disperzijska rentgenska analiza (EDX). Konjski kolenski sklep je eden klinično najpomembnejših sklepov (pogost vzrok šepavosti), hkrati pa tudi eden najkompleksnejših anatomskih predelov tako po zgradbi kot po funkciji. S kombinacijo 3D rekonstrukcije na osnovi CT-posnetkov ter mikroskopske in elementne analize avtorji ponujajo celovit opis kosti, vezi in sinovialnih struktur sklepa. Njihovo delo predstavlja dragocen referenčni vir za klinične veterinarje, hkrati pa bogati primerjalno razumevanje sinovialnih sklepov pri različnih vrstah, vključno s človekom, pri katerem so poškodbe križnih vezi velik klinični problem.

Še en prispevek, osredotočen na kirurško anatomijo, predstavlja Mohamed Marzok in sod., v katerem so izvedli računalniško-tomografske in makroskopske anatomske raziskave temporomandibularnega in supraorbitalnega področja pri enogrbi kameli (*Camelus dromedarius*). Njihove podrobne disekcije in CT-posnetki kameljih lobanj so pokazali, da obsežna supraorbitalna kotanja predstavlja varen in izvedljiv kirurški dostop do orbitalne votline. Študija jasno poudarja, kako primerjalna anatomija spodbuja klinične inovacije, v tem primeru omogoča učinkovitejše orbitalne operacije, kot so enukleacija, vstavitev protez in odstranjevanje tumorjev pri kamelah. Rezultati ne le poglabljajo poznavanje anatomije kamele, temveč tudi širijo primerjalno razumevanje orbitalne kirurgije pri domačih živalih ter znova dokazujejo, kako se anatomsko znanje neposredno prevaja v klinični napredek.

Od zdravja skeleta pri prašičih, mišično-skeletne anatomije pri konjih in raziskav lobanje pri kamelah se tokratna številka nadaljuje s fiziologijo perutnine in morfologijo kosti. Ghulam

bone morphology can be modulated across species, a theme relevant for both veterinary and human bone biology.

A direct comparative anatomical perspective is offered by Bahri Evcim and Mehmet Erkut Kara, who present a morphometric analysis of the mandible in sheep, goats, and rabbits. Their research is an excellent example of how comparative anatomy updates translational and experimental studies. Rabbits and small ruminants are frequently used as animal models in oral and maxillofacial surgery research, yet significant morphological differences exist in mandibular geometry and cortical thickness. By providing detailed morphometric data, the authors help guide researchers in selecting the most appropriate model for implants, screw fixation, or bone defect studies. Their work demonstrates how comparative anatomy bridges veterinary and human medical research, ensuring that experimental surgery is both scientifically valid and clinically relevant.

Nadia Hameed Rija Al-Falahi and Ali Ghazi Atiyah present a study relating to the healing of bone defects in rabbits using eggshell hydroxyapatite powder and autologous bone marrow. Bone regeneration is one of the great challenges in both veterinary and human orthopedics. By testing natural and biologically derived materials such as eggshell hydroxyapatite, combined with stem cell-rich bone marrow aspirates, the authors contribute to the field of regenerative medicine. Their results, showing superior healing when both materials are combined, provide an important reference for translational orthopedic surgery, again underscoring how rabbits serve as a valuable comparative model.

The article by Mohamed A. M. Alsafy et al. investigates how sodium butyrate supplementation influences the microanatomy and immune architecture of the small intestine in broiler chickens. Through detailed histological and immunohistochemical analysis, the study demonstrates significant increases in villus height, crypt depth, and goblet cell number, key structural parameters that enhance nutrient absorption and mucosal defense. Notably, the expression of interleukin-22 (IL-22) and toll-like receptor 8 (TLR8) was markedly elevated, revealing how dietary factors can modulate epithelial integrity and local immunity. By linking cellular morphology, intestinal immunology, and nutritional physiology, this research exemplifies how anatomical studies continue to underpin our understanding of health, function, and disease resistance in animals.

The comparative scope of this issue extends further into aquatic species. Hakan Didinen investigates the use of tea tree and geranium essential oils as anesthetic agents in rainbow trout (*Oncorhynchus mykiss*). While focused on aquaculture and pharmacology, the study contributes towards comparative anatomy and physiology by exploring species-specific responses to anesthetic agents. Understanding how fish tissues react to plant-derived compounds not only provides safer, more sustainable methods for fish handling

Murtaza Lochi in sod. so proučevali vpliv nanodelcev selena in hitosana na kakovost mesa, lipidni profil, mineralno sestavo in morfometrijo golenice pri brojlerjih, izpostavljenih toplotnemu stresu. Čeprav je bilo glavno težišče raziskave na prehranski fiziologiji, delo hkrati poudarja anatomske in strukturne vidike zdravja kosti. Ugotovitve, da dodajanje nano-selena in hitosana izboljšuje trdnost in mineralizacijo golenice, razkrivajo, kako prehrana in okoljski stres vplivata na anatomijo skeleta. Študija ne ponuja le praktičnih aplikacij za rejo perutnine, temveč tudi širši vpogled v to, kako je mogoče obliko in zgradbo kosti modulirati med različnimi vrstami, kar je tema, pomembna tako za veterinarsko kot za humano biologijo kosti.

Neposredno primerjalno-anatomsko analizo uporabita v svojem prispevku avtorja Bahri Evcim in Mehmet Erkut Kara, v katerem predstavita morfometrično analizo mandibule pri ovcah, kozah in kuncih. Njuna raziskava je odličen primer, kako primerjalna anatomija prispeva k translacijskim in eksperimentalnim raziskavam. Kunci in mali prežvekovalci se pogosto uporabljajo kot živalski modeli v raziskavah oralne in maksilofacialne kirurgije, vendar med vrstami obstajajo pomembne morfološke razlike v geometriji mandibule in debeline kosti. Z natančnimi morfometričnimi podatki avtorja prispevata k raziskavam izbire najprimernejšega modela za študije implantatov, fiksacije z vijaki ali kostnih defektov. Njuno delo lepo ponazarja, kako primerjalna anatomija povezuje veterinarske in humane medicinske raziskave ter zagotavlja, da so eksperimentalne kirurške študije tako znanstveno utemeljene kot klinično relevantne.

Nadia Hameed Rija Al-Falahi in Ali Ghazi Atiyah predstavljata raziskavo o celjenju kostnih defektov pri kuncih z uporabo hidroksiapatitnega prahu iz jajčne lupine in avtolognega kostnega mozga. Regeneracija kosti je eden največjih izzivov tako v veterinarski kot v humani ortopediji. Z raziskovanjem naravnih in biološko pridobljenih materialov, kot je hidroksiapatit iz jajčne lupine, v kombinaciji z aspirati kostnega mozga, bogatimi z matičnimi celicami, avtorja prispevata k razvoju regenerativne medicine. Rezultati, ki kažejo na boljše celjenje ob sočasni uporabi obeh materialov, predstavljajo pomemben referenčni prispevek za translacijsko ortopedsko kirurgijo in znova potrjujejo, kako dragocen primerjalni model predstavljajo kunci.

Članek avtorja Mohameda A. M. Alsafyja in sod. proučuje, kako dodatek natrijevega butirata vpliva na mikroskopsko anatomijo in imunsko zgradbo tankega črevesa pri brojlerjih. Z natančno histološko in imunohistokemično analizo so v raziskavi pokazali pomembno povečanje višine resic, globine kript in števila čašastih celic, ključnih strukturnih parametrov, ki izboljšujejo absorpcijo hranil in obrambno funkcijo sluznice. Znatno povečano izražanje interlevkina-22 (IL-22) in Tollu podobnega receptorja 8 (TLR8) razkriva, kako lahko prehranski dejavniki vplivajo na celovitost epitelija in lokalno imunost. Z združevanjem celične morfologije, črevesne imunologije in prehranske fiziologije ta raziskava nazorno prikazuje, kako anatomske študije še naprej

but also enriches comparative knowledge on nervous system sensitivity and metabolic variation across vertebrates.

At the end of the issue case report by Eun-Jae Cho et al. presents an extended subtotal mandibulectomy in a cat with alveolar osteomyelitis showing an unusually aggressive, spiculated ("sunburst") periosteal reaction, an imaging pattern typically associated with malignant bone tumors. Through detailed radiological, surgical, and histopathological assessment, the authors demonstrate that even benign inflammatory lesions can mimic neoplastic processes in their anatomical manifestation. The study highlights how understanding bone morphology and periosteal dynamics is essential for accurate diagnosis and surgical planning. Moreover, it underscores the anatomical precision required in reconstructive and functional preservation surgeries, reaffirming the value of comparative craniofacial anatomy in advancing both veterinary and clinical medicine.

In last few years more studies supporting comparative anatomy have been published. Within the journal Slovenian Veterinary Research, a good complementary example is the study investigating Anatomical Structures in the Rabbit Carpal Tunnel: Comparison with Human (16). This work showed that rabbits share close anatomical similarities with humans in the carpal tunnel, particularly in the flexor retinaculum and tendon arrangement. These parallels make the rabbit a valuable model for studying carpal tunnel syndrome, illustrating the translational power of comparative anatomy for both veterinary and human medicine (16). Furthermore, the study Anatomical and Histological Features of Lingual Papillae in Squirrel (17) described the morphology and histology of five types of tongue papillae, comparing them with rodents. The findings reveal both similarities and species-specific differences, highlighting the role of comparative anatomy in understanding feeding adaptations and oral physiology (17). Moreover, the study Comparative Evaluation of the Komodo Dragon (*Varanus komodoensis*) and the Green Iguana (*Iguana iguana*) Skull by Three-Dimensional Computed Tomographic Reconstruction (18) used advanced 3D CT imaging to visualize and compare cranial structures in two lizard species. The results revealed distinct differences in orbital configuration and neurocranial bones, demonstrating the potential of modern imaging techniques to enhance reptile diagnostics and deepen comparative anatomical understanding of skull morphology and functional adaptation (18).

Recent studies on marine mammals provide striking examples of functional adaptations to live in the sea. Hrvoje Smodlaka et al. examined the ear anatomy and histology of the northern elephant seal (*Mirounga angustirostris*), revealing unique features of the auditory system that support underwater hearing and pressure regulation (19). In another study, the gross anatomy of the ringed seal (*Pusa hispida*) gastrointestinal tract was described, highlighting evolutionary adjustments to a carnivorous, fish-based diet in a cold marine environment (20). Additionally, histological assessment of blood vessels in phocid seals demonstrated vascular

predstavljajo temelj razumevanja zdravja, funkcije in odpornosti proti boleznim pri živalih.

Primerjava med vrstami se v tem članku nanaša tudi na vodne živali. Hakan Didinen preučuje uporabo eteričnih olj čajevca in pelargonije kot anestetikov pri mavrični postrvi (*Oncorhynchus mykiss*). Čeprav je raziskava usmerjena predvsem v akvakulturo in farmakologijo, pomembno prispeva k primerjalni anatomiji in fiziologiji, saj raziskuje vrstno specifične odzive na anestetike. Razumevanje, kako tkiva pri ribah reagirajo na spojine rastlinskega izvora, ne omogoča le varnejših in trajnostnejših metod rokovanja z ribami, temveč tudi bogati primerjalno znanje o občutljivosti živčnega sistema in presnovnih razlikah med vretenčarji.

Na koncu številke študija primera avtorja Eun-Jae Cho in sod. prikazuje izvedbo razširjene subtotalne mandibulectomije pri mački z alveolarno osteomielitisom, ki je kazal nenavadno agresivno, trnasto periostalno reakcijo ("sončni izbruh"), vzorec, ki je običajno značilen za maligne kostne tumorje. Z natančno radiološko, kirurško in histopatološko analizo so avtorji pokazali, da lahko tudi benigne vnetne spremembe anatomsko posnemajo neoplastične procese. Študija poudarja, kako pomembno je razumevanje morfologije kosti in dinamike periosta za natančno diagnostiko in kirurško načrtovanje. Poleg tega izpostavlja anatomsko natančnost, potrebno pri rekonstruktivnih in funkcionalno ohranitvenih posegih, ter znova potrjuje vrednost primerjalne kraniofacialne anatomije pri napredku veterinarske in klinične medicine.

V zadnjih letih je bilo objavljenih vse več raziskav, ki podpirajo pomen primerjalne anatomije. V okviru revije Slovenski Veterinarski Zbornik je lep dopolnilni primer raziskava z naslovom: »Anatomske strukture v karpalnem kanalu kunca: primerjava s človekom« (16). Raziskava je pokazala, da imajo kunci z ljudmi številne anatomske podobnosti tudi v zapestnem kanalu, zlasti v zgradbi fleksornega retinakluma in razporeditvi tetiv. Te vzporednice uvrščajo kunca med dragocene modele za preučevanje sindroma zapestnega kanala ter ponazarjajo translacijsko moč primerjalne anatomije tako v veterinarski kot humani medicini (16). V raziskavi z naslovom: »Anatomske in histološke značilnosti jezičnih papil na jeziku pri veverici (*Sciurus vulgaris*)« (17) opisana morfologija in histologija petih tipov jezičnih papil pri veverici ter primerjava z glodavci. Ugotovitve razkrivajo tako podobnosti kot vrstno specifične razlike in poudarjajo vlogo primerjalne anatomije pri razumevanju prilagoditev na prehrano ter fiziologijo prebave v ustni votlini (17). Raziskava z naslovom: »Primerjava lobanj komodoškega varana (*Varanus komodoensis*) in zelenega legvana (*Iguana iguana*) s pomočjo tridimenzionalne računalniške tomografske konstrukcije« (18) je uporabila napredno 3D CT-slikanje za vizualizacijo in primerjavo kranialnih struktur pri dveh vrstah kuščarjev. Rezultati so razkrili izrazite razlike v zgradbi orbitalnega področja in kosteh nevrokranija ter pokazali, kako sodobne slikovne tehnike lahko izboljšajo diagnostiko pri plazilcih in poglobijo primerjalno anatomsko razumevanje morfologije lobanje ter funkcionalne prilagoditve (18).

specializations crucial for thermoregulation and diving physiology (21). Further morphological studies, such as that by Serkan Erdoğan, Silia Villar Arias, and William Pérez (22), revealed striking interspecific differences between the South American fur seal (*Arctocephalus australis*) and sea lion (*Otaria flavescens*). Variations in the structure and distribution of lingual papillae reflect dietary and ecological adaptations, highlighting how feeding strategies and environment shape anatomical diversity among marine carnivores. Together, these studies underline how comparative and functional anatomy illuminate the complex relationships between structure, environment, and survival strategies in both terrestrial and marine species. By studying these anatomical traits, researchers gain insight not only into evolution but also into the health and conservation of these species, which are increasingly affected by pollution and climate change.

Taken together, these contributions vividly illustrate how comparative anatomy continues to serve as a unifying framework across species, systems, and scientific disciplines. Each study reveals how structural and functional diversity provides not only fascinating biological insight but also practical value for advancing diagnostics, surgery, and welfare. Far from being a limitation, anatomical variation represents a shared foundation for innovation, allowing us to translate findings between species and bridge the gap between veterinary and human medicine. Through such integrative and comparative perspectives, anatomy remains at the heart of scientific discovery, education, and clinical progress.

As veterinary science enters an era defined by One Health, digital technologies, and global collaboration, comparative anatomy remains central. It teaches us that diversity of form is not a complication but an opportunity. By embracing diversity, ranging from the horse's stifle to the broiler's tibia, from the rabbit's mandible to the trout's nervous system, we uncover the principles that unite living beings. In doing so, we not only strengthen our understanding of animals but also enrich human medicine, public health, and the broader science of life. By continuing to support comparative anatomy, we strengthen not only our scientific comprehension and knowledge but also our increase our capacity for clinical and translational breakthroughs.

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Nedavne raziskave morskih sesalcev ponujajo izjemne primere funkcionalnih prilagoditev na življenje v morju. Hrvoje Smodlaka s sod. je proučeval anatomijo in histologijo ušesa severnega morskega slona (*Mirounga angustirostris*) ter razkril edinstvene značilnosti slušnega sistema, ki omogočajo poslušanje pod vodo in uravnavanje tlaka (19). V drugi raziskavi je bila opisana makroskopska anatomija prebavil kolobarjastega tjulnja (*Pusa hispida*), ki kaže evolucijske prilagoditve na mesojedo, z ribami bogato prehrano v hladnem morskem okolju (20). Histološka analiza krvnih žil pri tjulnjih iz družine Phocidae pokazala posebnosti v žilnem sistemu, pomembne za termoregulacijo in fiziologijo potapljanja (21). Morfološke raziskave avtorjev Serkana Erdoğana, Silvie Villar Arias in Wiliama Péreza (22), so pokazale izrazite medvrstne razlike med južnoameriškim morskim medvedom (*Arctocephalus australis*) in morskim levom (*Otaria flavescens*). Razlike v zgradbi in razporeditvi jezičnih papil odražajo prehranske in ekološke prilagoditve ter poudarjajo, kako prehranske strategije in okoljski dejavniki oblikujejo anatomsko raznolikost morskih mesojedcev. Skupaj ti prispevki poudarjajo, kako primerjalna in funkcionalna anatomija osvetljujeta tesno povezanost med zgradbo, okoljem in preživetvenimi strategijami tako pri kopenskih kot pri morskih vrstah. S preučevanjem takšnih anatomskih značilnosti raziskovalci pridobivajo vpogled ne le v evolucijo, temveč tudi v zdravje in ohranjanje vrst, ki so vse bolj ogrožene zaradi onesnaženja in podnebnih sprememb.

Navedeni članki nazorno ponazarjajo, kako primerjalna anatomija še naprej deluje kot povezovalni okvir med vrstami, sistemi in znanstvenimi disciplinami. Vsaka raziskava razkriva, da strukturna in funkcionalna raznolikost ne ponuja le zanimivih bioloških spoznanj, temveč ima tudi praktično vrednost pri razvoju diagnostike, kirurgije in izboljševanju dobrobiti živali. Anatomska variabilnost ni slabost, temveč skupna osnova za inovacije, ki nam omogoča prenos spoznanj med vrstami in povezovanje veterinarske ter humane medicine.

Ko veterinarska znanost vstopa v obdobje, ki ga zaznamujejo koncept Eno zdravje, digitalne tehnologije in globalno sodelovanje, anatomija s celostnimi in primerjalnimi pristopi ostaja v središču znanstvenih odkritij, izobraževanja in kliničnega napredka. Uči nas, da raznolikost oblik ni omejitev, temveč priložnost. S poznavanjem različnih struktur, od konjskega kolenskega sklepa do golenice piščancev, od mandibule kunca do živčnega sistema postrvi, razkrivamo temeljna načela, ki povezujejo vsa živa bitja. S tem ne poglabljamo le razumevanja živali, temveč bogatimo tudi humano medicino, javno zdravje in širšo znanost o življenju. Z nadaljnjim razvojem in sprejemanjem primerjalne anatomije krepimo ne le svoje znanstveno razumevanje in znanje, temveč tudi svojo sposobnost za nadaljnje klinične in translacijske preboje.

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