Indian Journal of Veterinary Anatomy 37(1): 33-37, June 2025

Mapping Vasculature and Nerve Networks in the Canine Skeleton: A Tool for Veterinary Anatomy Education and Learning

Amit Challana[1], Jyoti Saini[2] and Om Prakash Choudhary[2*]
Department of Veterinary Anatomy, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Rampura Phul, India

Received: 1 September 2025; Accepted: 28 September 2025

ABSTRACT

The skeletal system of dogs provides essential structural support, protects vital organs, and facilitates movement. One nondescript adult dog cadaver was used as animal material in this study. The cadaver was mascerated to collect the bones. Holes were drilled on the articular surfaces of bones to form the skeleton. Thick Nylon thread of three colors viz; red, blue and yellow were used to demonstrate the major arteries (red color), major veins (blue color), and major nerves (yellow color) on the dog skeleton. This teaching model explores the normal blood vessels and nerve patterns that permeate the Canis lupus familiaris skeletal framework, highlighting their roles in various functions of the body. The development of effective teaching tools is crucial in veterinary education, particularly when studying complex anatomical systems, such as the vascular and nervous networks. The study presents the development and evaluation of a life-sized Canis lupus familiaris skeleton model that visually and accurately maps the major blood vessels and nerve networks. The model is designed to serve as an educational tool, enhancing students' understanding of these intricate systems in veterinary anatomy courses.

Keywords: Dog skeleton, Arteries, Veins, Nerves, Diagnostics, Surgery

INTRODUCTION

Veterinary anatomy encompasses a wide range of biological systems, and learning these systems in isolation can sometimes obscure their interrelationship. The teaching of Anatomy has long been conducted with a strong emphasis on practical demonstrations, handling of bones, dissection of cadavers for body regions, and organs of various domestic animals and birds, as part of comparative veterinary anatomy (Paramasivan, 2025). Skeletons give students a “hands-on” method for learning name of bones, their location, as well as a visual tool to relate bone and joint structure to muscle structure (Allouch, 2014). These traditional anatomical teaching models cannot be replaced by the modernized anatomical methods in the era of artificial intelligence and technological advancements (Choudhary and Sarkar, 2025; Choudhary et al., 2025).

Mapping arteries, veins, and nerves on a skeleton model enhances three-dimensional understanding and facilitates visualization of how systems interact dynamically during both normal and disease processes. Integrating detailed mapping of arteries, veins, and nerves onto Canis lupus familiaris skeleton models enhances the depth of veterinary training (Benali et al., 2022).

This article aims to compile a comprehensive vascular and nervous anatomy of Canis lupus familiaris, in conjunction with a skeletal framework, providing a novel teaching aid that can be adapted for in-person use. It facilitates understanding of spatial relationships between different anatomical structures and how they correspond to clinical procedures, such as surgeries, intravenous treatments, and nerve blocks. The current work was undertaken to standardize the method in preparation for vascular and nervous mapping, making it more economical and efficient for the purposes of teaching and museums.

MATERIALS METHODS

The study was conducted on a non-descript adult dog cadaver, which was willingly donated by the owner for the purposes of teaching and research. The carcass was deskinned, and visceral organs were removed from the body cavities and kept in neutral buffered formalin for teaching purposes. The bones from the cadaver were removed by maceration method. Holes were drilled on the articular surface of the bones to form the dog skeleton. Nylon thread of varying sizes, 1.6 mm, 1 mm, and 0.6 mm in diameter, in three colors red, yellow and blue, was used to demonstrate the major arteries (red), were veins (blue), and nerves (yellow) on the dog

1,2. Assistant Professors; 3. Associate Professor
*Corresponding Author: dr.om.choudhary@gmail.com

skeleton. All the threads were pasted over the skeleton with glue using a glue gun (Figure 1).

RESULTS AND DISCUSSION

The arterial system delivers oxygenated blood from the heart to various tissues throughout the body. In canines, this system closely mirrors the arterial patterns found in other mammals, though with distinct species-specific features (Dyce *et al*, 2017; Pollard and Uhllahorn, 2015; Konig and Liebich, 2009; Pijanowski and Newman, 2008).

Carotid arteries: The external carotid artery and its branches are particularly prominent due to the well-developed muscles and sensory structures in the head, reflecting their reliance on smell and hearing (Benali et al., 2022).

Aorta and aortic arch: The largest artery in the canine body, the aorta, arches from the left ventricle of the heart and distributes blood to the body. The research identified several important branches, including the ascending Aorta, which supplies the coronary arteries that feed the heart. The aortic arch branches to the brachiocephalic trunk, the left subclavian artery, and, ultimately, the descending aorta.

Subclavian artery: The artery supplies blood to the forelimbs and neck. The left subclavian artery arise directly from the aorta, while the right subclavian artery originates from the brachiocephalic trunk (Pijanowski and Newman, 2008).

Brachiocephalic trunk: This major trunk supplies the head, neck, and right forelimb. It divides into the right subclavian artery and the right common carotid artery.

Deep femoral artery: This artery branches medially from the femoral artery and courses deep along the femur, supplying the adductor muscles and surrounding soft tissue. Its location medial to the femoral shaft makes it a key structure in hindlimb orthopedic surgeries and fracture repair (Dyce et al., 2017).

Internal thoracic artery: It runs caudally on the inner surface of the sternum, adjacent to the costal cartilages. It supplies the ventral thoracic wall and is relevant during sternotomy or thoracotomy procedures (König and Liebich, 2009).

Common carotid arteries: They ascend along either side of the trachea to supply blood to the head, neck, and brain.

Pulmonary artery: Unlike other arteries, the pulmonary artery carries deoxygenated blood from the right ventricle to the lungs for oxygenation.

Renal artery: Supplies the kidneys, a vital organ responsible for filtering blood and maintaining homeostasis.

Femoral artery: Located in the hind limbs, this artery provides blood to the lower extremities and is crucial in assessing pulse and circulation during clinical exams.

Celiac artery: This artery supplies the stomach, liver, spleen, and portions of the intestines, being an essential artery in the abdominal cavity. The celiac and mesenteric arteries are prominent, reflecting their role in supplying the digestive system for protein metabolism.

Veins return deoxygenated blood to the right atrium of the heart. Mapping major veins on the Canis lupus familiaris skeleton can offer students insights into safe venipuncture sites and areas of possible obstruction or vascular compromise. The major veins in the body were made as described by Dyce et al, 2017; Pollard and Uhllahorn, 2015; Konig and Liebich, 2009; Pijanowski and Newman, 2008; Benali, 2022 (Refer to Figs. 2 and 3).

Cranial and caudal vena cavae: The cranial vena cava collects blood from the head, neck, and forelimbs, while the caudal vena cava collects from the abdomen and hind limbs, both draining into the right atrium of the heart. The caudal vena cava is highly developed, facilitating a large volume of venous return during physical activity.

The cephalic vein is easily accessible and large, making it ideal for venipuncture in veterinary practice.

Jugular veins: Located on either side of the neck, these veins are often used for intravenous access in clinical settings. The external jugular vein is large and superficial, commonly used in clinical practice for venipuncture.

Femoral and Saphenous Veins: These veins run alongside the femoral artery in the hind limbs and are frequently used for blood drawing and intravenous catheter placements. The saphenous vein is prominent, facilitating easy venous return and providing clinical access.

Portal Vein: This crucial vessel collects blood from the gastrointestinal tract and spleen and delivers it to the liver for filtration before it enters systemic circulation.

Pulmonary Veins: These veins carry oxygenated blood from the lungs to the left atrium, functioning in the opposite direction from systemic veins.

Axillary Vein: This vein runs medial to the shoulder joint, parallel with the axillary artery and brachial plexus, near the scapula. It serves as an access site for catheterization and a surgical landmark in limb amputation procedures (Pijanowski and Newman, 2008).

The nervous system controls voluntary and involuntary functions, from muscle movement to organ regulation. Mapping key nerves on the skeleton provides Veterinary students with practical knowledge relevant to surgery, anesthesiology, and pain management (Evans and Lahunta, 2016; Sisson and Thomas, 2010; Popesco, 2011; Martín-Alguacil and Avedillo, 2023) (Figure 3).

Brachial plexus: A complex network of nerves originating from the cervical spine, it supplies the forelimb. This network branched to the radial, ulnar, and median nerves, which are essential for limb movement and sensation. The radial nerve is vital for the forelimb's extensor muscles, reflecting the dog's reliance on forelimbs for support during running. The radial nerve is highly developed, supporting weight-bearing functions and extension of the elbow and carpus, which are crucial in running and standing (Busoni et al., 2018).

Sciatic Nerve: It runs along the femur and extends into the hind limb. This extensive nerve controls lower limb function and is a key area for anesthesia administration during surgery. The sciatic nerve is a large nerve that provides motor control to the muscles of the lower hind limb, which are essential for flexion and extension during running.

The facial nerve has distinct branches, particularly the caudal auricular branch, which controls ear movement —a crucial feature in dogs for detecting sound.

The trigeminal nerve branches, particularly the mandibular nerve, innervate powerful jaw muscles that are essential for their carnivorous feeding habits.

Vagus Nerve (Cranial Nerve X): This nerve controls the functions of the heart, lungs, and digestive system and is critical for autonomic regulation. The vagus and phrenic nerve are critical for controlling breathing and heart rate, particularly during high-energy tasks like running.

Accessory nerve (Cranial Nerve XI): Passing dorsally over the atlanto-occipital joint and coursing caudally along the scapular spine, this nerve innervates the trapezius and brachiocephalicus muscles. Injury can impair neck mobility and scapular stabilization (Evans and de Lahunta, 2016).

Phrenic nerve: Arising from spinal nerves C5–C7, it travels through the thoracic inlet alongside the pericardium to the diaphragm. It is essential for respiration and critical in cases of trauma, diaphragmatic hernia repair, or thoracic surgery (Sisson and Thomas, 2010).

Femoral nerve: This nerve is responsible for innervating muscles that extend the hind limb, and it is crucial for movement and stability. The femoral nerve, accompanied by the femoral artery, is highly vascularized and innervates the powerful muscles of the hind limb, reflecting the role of the hind limbs in propulsion and speed.

Intercostal nerves: These nerves run along the ribs and help control respiratory muscles, particularly those involved in breathing.

Pudendal Nerve: This nerve controls the functions of the urinary bladder, rectum, and reproductive organs, making it essential in both reproductive and urinary health.

CONCLUSION

The anatomical mapping of arteries, veins, and nerves onto a 3-dimensional Canis lupus familiaris skeleton model significantly enhances veterinary education by offering an integrative, three-dimensional understanding of key systems. Veterinarians require an in-depth understanding of vascular and nervous anatomy for various procedures, including surgeries, diagnostic imaging, and emergency care.

This model of vascular and nervous anatomical features maps the vascular and nervous systems that support the dog's sensory acuity, agility, speed, predatory behavior, and endurance during locomotion. This comprehensive teaching aid enhances students' understanding of Canis lupus familiaris anatomy, facilitating better learning outcomes and preparing them for practical applications in clinical practice. Incorporating these anatomical maps presents new opportunities for interactive learning, marking a crucial advancement in veterinary education.

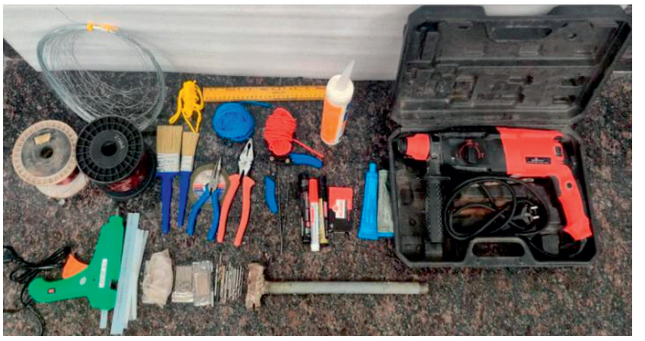

Fig. 1: Photograph showing the list of materials used for making the skeleton mapping model.

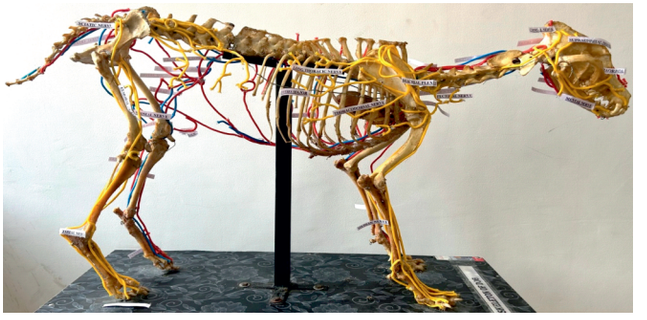

Fig. 2: Major arteries (red color) and veins (blue color) on the left side of the dog skeleton.

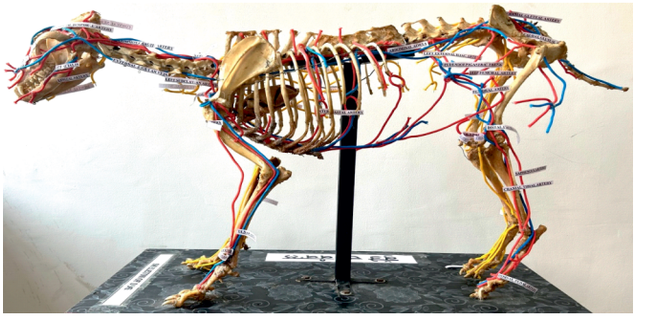

Fig. 3: Photograph showing major nerves (Yellow color) on the right side of the dog skeleton.

ACKNOWLEDGEMENT

The authors express their gratitude to the Dean, College of Veterinary Science, Rampura Phul, for providing the necessary facilities for the department to prepare these skeletons. Additionally, Mr. Moti Masih, Laboratory Assistant, and Mr. Namdev Singh, DPL from the Department of Veterinary Anatomy, assisted in preparing the mapping of the vasculature and nerve network on the dog's skeleton.

REFERENCES

Allouch, G. 2014. Scientific technique for skeletons preservation and preparation of anatomical models to promote veterinary anatomy. *Journal of Veterinary Anatomy* 7 : 133-139.

Benali, S., Benslama, H., Zemmouri, S. and Hamzaoui, A. 2022. Three-dimensional models of the canine head and neck arteries: A morphometric study. *Journal of Veterinary Research* 66 : 202-210.

Blázquez-Llorca, L., Morales de Paz, L., Martín-Orti, R., Santos-Álvarez, I., Fernández-Valle, M.E., Castejón, D., García-Real, M.I., Salgüero-Fernández, R., Pérez-Lloret, P. and Moreno, N. 2023. *The application of 3D anatomy for teaching veterinary clinical neurology. Animals* 13 : 1601.

Busoni, V., Van Goethem, B. and Balligand, M. 2018. Ultrasonographic evaluation of the brachial plexus in dogs. *Veterinary Radiology and Ultrasound* 59 : 339-345.

Choudhary, O.P. and Sarkar, R. 2025. Animal anatomical teaching models for enhanced veterinary anatomy education and learning. *Pakistan Veterinary Journal* http://dx.doi.org/10.29261/pakvetj/2025.250

Choudhary, O.P., Infant, S.S., Vickram A.S., Chopra, H. and Manuta, N. 2025. Exploring the potential and limitations of artificial intelligence in animal anatomy. *Annals of Anatomy* 258 : 152366.

Cissell, D.D., Wisner, E.R. and Schultz, B. 2020. The use of CT angiography in the study of canine vascular anatomy. *Veterinary Radiology and Ultrasound* 61 : 35-42.

Dyce, K.M., Sack, W.O. and Wensing, C.J.G. 2017. *Textbook of Veterinary Anatomy*. 5th edn., Saunders, Philadelphia.

Evans, H.E. and de Lahunta, A. 2016. *Guide to the Dissection of the Dog*. 8th edn., Elsevier, St. Louis.

Kainer, R.A. and McCracken, T.O. 2002. *Dog Anatomy: A Coloring Atlas*. Teton New Media, Jackson, Wyoming.

König, H.E. and Liebich, H.G. 2009. *Veterinary Anatomy of Domestic Mammals: Textbook and Colour Atlas*. 4th edn., Schattauer, Stuttgart.

Martín-Alguacil, N. and Avedillo, L. 2023. *Anatomic variations of the perineal arteries and nerves in the male and female dog and its clinical implications. Animals* 13: 1912.

Paramasivan, S., Sathyamoorthy, O.R., Sivagnanam, S., Rajathi, S. and Sivakumar, S.A. 2025. Tools and techniques in preparation of coloured bones and skeletons for effective teaching, learning and museums. *Indian Journal of Animal Research* 59 : 17-21.

Pijanowski, G.J. and Newman, J.A. 2008. The anatomy and function of the canine vascular system. *Journal of Veterinary Science* 22 : 124-134.

Pollard, R.E. and Uhlhorn, M. 2015. Canine thoracic limb vascular anatomy: An update for clinicians. *Journal of Veterinary Surgery* 34 : 189-197.

Popesco, P. 2011. *Atlas of Topographical Anatomy of Domestic Animals*. 4th revised edn., Priroda, Slovakia.

Raffan, H., Guevar, J., Poyade, M. and Rea, P.M. 2017. *Canine neuroanatomy: Development of a 3D reconstruction and interactive application for undergraduate veterinary education*. PLoS One 12 : e0168911.

Sisson, A.F. and Thomas, W.B. 2010. Peripheral nerve injuries in dogs: Anatomy, diagnosis, and treatment. *Veterinary Clinics of North America: Small Animal Practice* 40 : 1-18.