THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Popular Article
Oct, 2026 Vol.6(10), 3344-3351

Alternative-cum-modern anatomical techniques- the future perspectives of teaching Veterinary Anatomy

Lovish Sethi[1], Kamal Sarma[1], J.S. Sasan[1] and Jonali Devi[2]
Faculty of Veterinary Science & A.H., S.K. University of Agricultural Sciences & Technology, R.S. Pura, Jammu-181102 (J&K)
[1]Division of Veterinary Anatomy, [2]Division of Veterinary Physiology & Biochemistry
doi.org/10.5281/ScienceWorld.23724456

The future of teaching veterinary anatomy blends traditional cadaver dissection with modern technological and preservation alternatives. This hybrid model reduces reliance on formalin-fixed specimens, aligns with animal welfare (the 3Rs: Replace, Reduce, Refine), and enhances visuospatial comprehension through digital tools and physical simulation. In many veterinary programs around the world, combinations of computer software-based learning, video demonstrations, virtual reality systems, plastic models, full-body manikins, and plastinated specimens have been used to augment traditional learning methods and substantially reduce and replace the consumptive use of animals (Hart *et al.* 2005; Martinsen and Jukes 2005; Knight 2007; Smeak 1999; Yushchenko *et al.* 2012)

Traditionally, live animals and cadavers have played a large role in teaching and learning anatomy both in human and veterinary medicine. Dissection has often been thought of as the most rigorous method of teaching anatomy and its defenders continue to point to the fact that it remains a unique experience that simulation technology does not entirely replicate (Korf *et al.* 2008). However, the question need not become “cadaver versus cadaver less” anatomy instruction, but rather a matter of investigating the comparative effectiveness of each method alone and then in combination. Indeed, pedagogical research may reveal that dissection alternatives are not only pedagogically sound but, in fact, preferable and produce better learners (Balcombe 2001). As the focus of veterinary teaching faculties on patient safety and evidence-based medical education increases, their incorporation and reliance on simulators and virtual reality training methods will likely follow, as has happened in human medicine (Lovquist *et al.* 2012).

Experience performing procedures on live animals and learning anatomy through cadaver dissection are as vital in veterinary medicine as they are in human medicine, but neither method alone can provide for sufficient repetition to acquire the requisite proficiency and confidence in students without using unacceptably large numbers of animals. Clinical experience with live animals often does not provide the range of experiences that simulators can be designed to provide, as students may never have the opportunity to witness certain conditions or perform certain procedures during their clinical experience (Scalese and Issenberg, 2005).

Teaching using live animals and cadavers can also be structured in such a way as to alleviate animal welfare concerns by establishing willed body donation programs through which to obtain ethically sourced cadavers (Kumar *et al.* 2001; Educational Memorial Programs. Humane Society Veterinary Medical Association 2012, http://www.hsvma.org/ educational_memorial_programs).

Now, the future modern teaching techniques that can be employed effectively in teaching veterinary anatomy are briefly summarized below.

1. **Simulation software:** For example, Colorado State University has successfully incorporated a Virtual Canine Anatomy (VCA) DVD to teach canine anatomy in addition to cadaver dissection (Virtual Canine Anatomy. Colorado State University 2005, http://www.cvmbs. colostate.edu/vetneuro/index2.htm). Linton *et al* (2005) found that students and faculty expressed positive attitudes toward the program. They also found that it increased dissection efficiency (Linton *et al* 2005). Prior to its implementation, instructors overseeing dissection spent most of their time identifying basic structures for students and students spent a significant amount of time waiting for instructor assistance and relying on textbooks. Students who miss this class time are even further hampered in learning the material as the lesson cannot be repeated for individual students. VCA, a computer-assisted program, overcomes these problems. After its incorporation into the anatomy laboratories, students became self-directed in their dissections and their questions became more substantive and functionally related. VCA guides students through a virtual dissection by identifying and describing key structures. It can be used by students studying alone or in groups, whether in the classroom or elsewhere. Perhaps most importantly, VCA allows students to repeat the virtual dissection to reinforce the material; this is not an option when using animal cadavers. While Virtual Canine Anatomy is specific to canine anatomy, there exist a large number of similar applications for various other species. One such program is ScienceWorks's (1760 Jonestown Rd., Suite 200, Winston-Salem, NC 27103 USA; 800.478.8476,

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26/10/2026

www.scienceclass.com). Science Works also makes cat anatomy software, Cat Works, which allows students to perform virtual dissections of the cat and watch videos of selected portions of actual dissections along with voice descriptions of the procedures being performed. Also included in this software are laboratory practical examinations, quizzes, and in-depth comparative histology.

2. **Models and manikins:** Anatomy can also be taught with realistic models and manikins that reproduce a whole animal. While these are most readily available with common species such as cats, dogs, and mice, it is possible to obtain whole body manikins of a vast number of other animals ranging from a flea to a horse. When whole body manikins are not necessary, models of specific and highly detailed parts of animal bodies and biological systems are also available. Models come in human, cat, dog and horse species; as well as full body and forelimb and hind limb models. These models allow anatomy to be learned with a start-to-finish "hands-on" approach accommodating different learning styles (Waters *et al.* 2005: DeHoff *et al.* 2011; Waters *et al.* 2011).

3. **Modern Preservation Techniques used in teaching Veterinary Anatomy:** There are various modern preservation methods of animal tissues which can also be effectively used in teaching Veterinary Anatomy as mentioned below.

a) **Plastination:** This method replaces tissue water and fat with reactive polymers (silicone/epoxy), producing durable, odorless, non-toxic, and dry anatomical specimens that last indefinitely for hands-on study. Perhaps the most significant recent innovation in the teaching of anatomy of humans and animals has been plastination. Plastination is a method of preserving biological specimens for later study. "The results of plastination are clean, dry, odorless, and durable real biological specimens that can be handled without gloves and do not require any special storage conditions or care (Latorre *et al* 2007). Furthermore, by replacing dissection, plastination eliminates student and instructor exposure to toxic substances such as formaldehyde. While the usual form of cadaver dissection requires a significant time input for the learning process to take hold, this investment need not be made with plastinated specimens and therefore can be redirected toward other learning objectives. Now-a-days, larger educational institutions have begun establishing their own plastination laboratories to develop their own specimens and/or offer services to other institutions who lack the equipment required (Melanson, 2008). Latorre *et al* (2007) has demonstrated that students welcomed the inclusion of plastinated specimens in their learning of anatomy and that veterinary surgery students voiced the most positive opinions.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26/10/2026

Plastinated specimens can include particular organs, organ systems and even whole figures. Alternatively, plastinated specimens can be created from cross-sectional slices designed to foster student understanding of imaging techniques such as ultrasound, computerised tomography, and magnetic resonance imaging. Publications on plastination illustrate the diversity of applications for these specimens as well as their efficacy for both veterinary and medical education and related disciplines (Douglass and Glover 2003; Hoffmann *et al.* 2010; Fruhstorfer *et al.* 2011; Caperton and Lopresti-Goodman 2012; The New Plastination Index. International Society for Plastination 2012, http://www.uqtr.ca/plastination). Like many simulation technologies, incorporating plastinated specimens into the curricula can conserve financial resources as well as limited class time. In addition to its clear value in education, plastination and plastinated specimens have begun serving the interests of researchers as well; many of these aspects apply to the veterinary field (Nel, 1997). Possible applications include comparative investigations of human and veterinary developmental anatomy; soft tissue injuries in forensic science, applicable to abuse investigation; orthopedic research regarding functional relationships, alterations in articular cartilage, and the vascularization of bone with multiple clinical implications, and trauma research.

b) **Alternative Embalming:** Embalming was practiced from 2500 BC to till the date. Uses modified chemical formulas (such as Thiel-soft embalming) to preserve realistic tissue color, flexibility, and vascular patency without toxic formaldehyde fumes. Veterinary education traditionally involved sacrifice and embalming of healthy animals, both for dissection and collection of visceral organs for demonstration in practical classes. Concern with the conservation of bodies existed for more than 500 years; several researchers tried to discover techniques for storage of bodies (eSilva *et al*., 2008). Ethical sourcing of animal cadavers for education and training was also defined in the International Network for Humane Education (inter NICHE) policy (Jukes and Martinson, 2008). University Grants Commission in India repeatedly urged the universities to stop sacrifice of animals for teaching and suggested use of alternative mechanisms available to provide hands-on-experience to the students ensuring a close observance of high ethical standards, to prohibit the use of sacrificed animals for dissection. Alternate modes for dissection and demonstration were proposed with a lot of challenges ahead for anatomists (Pederson, 2002). Skill laboratories were proposed to be developed by the institutions to train students on interactive alternative models (Jukes and Chiuia, 2003).

In this regard, Willed-Body programme was established in few divisions of Veterinary Anatomy across the country to minimize sacrifice of animals for dissection and to prepare humane alternatives in veterinary education. In the earlier practices, unfixed organs were collected from cadavers and stored in formalin. Spot injection of formalin was also carried out for fixation of

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26/10/2026

solid organs. But these methods did not ensure adequate fixation and the organs could not be stored for long term use in the gross anatomy laboratory. The inadequately fixed tissues were also not suitable for preparation of microscopic slides.

In the biological museums, these aspects are more controlled and even attenuated with other methods, such as ethanol embalming, hermetically sealed containers, and controlled ventilation, even though the ethanol is highly flammable.

c) **Nitrite pickling salt as an alternative to formaldehyde for embalming in veterinary anatomy:** Formaldehyde is a common fixing agent used to embalm cadavers in human and veterinary medicine. It is a good preservative as it causes denaturation of proteins, acts as an antioxidant and inhibits microbial growth. Exposure to formaldehyde, however, carries significant health risks, including potential tumor development, allergic reactions, and possible negative effects on foetal development.

Nitrite pickling salt supplementation has been emerged as a good alternative for formalin fixation of cadavers. Nitrite pickling salt supplemented with antioxidants successfully conserved, fixed and preserved cadavers which were concomitantly used for dissection over a 12-month period. Among the benefits of formaldehyde are strong anti-microbial properties which make it suitable for conservation of cadavers over periods spanning several years. However, mold can still survive in the tissues and on their surfaces. Other disinfectants, such as phenol, are therefore added to the solutions. However, not much is known about the anti-microbial properties of nitrite pickling salt solution.

d) **Nano-herbal formulation:** Now-a-days nano-herbal formulations are used as fixative and embalming solution. Nano-herbal fixative and embalming solution components are-

1. Camphor oil
2. Clove oil
3. Eucalyptus oil
4. Menthol

The combination of herbal preparation mentioned are taken and sonicated in water by using the probe sonicator to get a nano-herbal embalming solution.

4. Digital and Virtual Innovations:

a) **3D Printing:** It generates precise, species-specific bone and organ models derived directly from live animal CT and MRI scans. Many applications for 3D printing have appeared in the field of veterinary medicine, including many opportunities to use 3D-printed models in anatomical teaching. The size and complexity of the desired model will dictate the

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26/10/2026

type(s) of printer(s) which can be used. Cost, print resolution desired and cleanup time for prints are also key factors to consider when choosing a 3D printer.

b) **3D visualization and printing:** The amalgamation of veterinary anatomy, technology and innovation has led to development of latest technological advancement in the field of veterinary medicine, i.e., three-dimensional (3D) imaging and reconstruction. 3D visualization technique followed by 3D reconstruction has been proven to enhance non-destructive 3D visualization grossly or microscopically, e.g., skeletal muscle, smooth muscle, ligaments, cartilage, connective tissue, blood vessels, nerves, lymph nodes, and glands.

c) Virtual Dissection & Imaging: Utilizes touch-screen platforms (like the Anatomage Table Vet) alongside CT/MRI reconstruction to study deep structures and multi-planar cross-sections.

d) Haptic & Hybrid Phantoms: In this case, high-fidelity physical models are used to train tactile clinical competencies such as bovine rectal palpation, obstetrics, and regional nerve blocks, without stressing live animals. Traditional methods of teaching anatomy to undergraduate medical and veterinary students are being challenged and need to adapt to modern concerns and requirements. There is a move away from the use of cadavers to new technologies as a way of complementing the traditional approaches and addressing resource and ethical problems. Haptic (touch) technology, which allows the student to feel a 3D computer-generated virtual environment, provides a novel way to address some of these challenges.

References

Balcombe J (2001): Dissection: The scientific case for alternatives. Journal of Applied Animal Welfare Science 4, 117–126.

Caperton A, Lopresti-Goodman S (2012): Use of a plastinated human brain for psychology education. In: Poster presented at the 83rd Annual Meeting of the Eastern Psychological Association, Pittsburgh, PA.

DeHoff ME, Clark KL, Meganathan K (2011): Learning outcomes and student-perceived value of clay modeling and cat dissection in undergraduate human anatomy and physiology. Advances in Physiology Education 35, 68–75.

Douglass C, Glover R (2003): Plastination: Preservation technology enhances biology teaching. American Biology Teacher 65, 503–510.

eSilva, E.M., Dias, G., Tavares, M., Marques, T. & Furtado, J. M. (2008). Study of gylcerination method used for conservation of anatomic parts-Experience of Anatomy discipline of the Morphology Department/UnitFOA. Aceito para Publicacaoem 66 (1): 2-5.

Fruhstorfer BH, Palmer J, Brydges S, Abrahams PH (2011): The use of plastinated prosections for teaching anatomy: Th e view of medical students on the value of this learning resource. Clinical Anatomy 24, 246–252.

Hart LA, Wood MW, Weng HY (2005): Mainstreaming alternatives in veterinary medical education: Resource development and curricular reform. Journal of Veterinary Medical Education 32, 473–480.

Hoffmann DS, May N, Thomsen T, Holec M, Andersen KH, Pizzimenti MA (2010): Medical students using plastinated prosections as a sole learning tool perform equally well on identification exams as compared to those performing dissections over the same regions. FASEB Journal 24, Meeting abstract supplement, 176.5, http://www.fasebj.org/cgi/content/meeting_abstract/24/1_MeetingAbstracts/176.5. American Association of Anatomists, http://www.anatomy.org/ content/medical-students-using-plastinated-prosections-sole-learning-tool.

Jukes, N. & Chiuia, M. (2003). From Guinea Pig to Computer Mouse, 2nd Edition., inter NICHE, Leicester, England.

Jukes, N. & Martinsen, S. (2008). Ethically sourced animal cadavers and tissue: considerations for education and training. Aatex 14 (Special issue): 291-293.

Knight A (2007): The effectiveness of humane teaching methods in veterinary education. Alternatives to Animal Experimentation 24, 91–109.

Korf HW, Wicht H, Snipes RL, Timmermans JP, Paulsen F, Rune G, Baumgart-Vogt E (2008): The dissection course – necessary and indispensable for teaching anatomy to medical students. Annals of Anatomy 190, 16–22.

Kumar AM, Murtaugh R, Brown D, Ballas T, Clancy E, Patronek G (2001): Client donation program for acquiring dogs and cats to teach veterinary gross anatomy. Journal of Veterinary Medical Education 28, 73–77.

Latorre RM, Garcia-Sanz MP, Moreno M, Hernandez F, Gil F, Lopez O, Ayala MD, Ramirez G, Vazquez JM, Arencibia A, Henry RW (2007): How useful is plastination in learning anatomy? Journal of Veterinary Medical Education 34, 172–176.

Linton A, Schoenfeld-Tacher R, Whalen LR (2005): Developing and implementing an assessment method to evaluate a Virtual Canine Anatomy program. Journal of Veterinary Medical Education 32, 249–254.

Lovquist E, Shorten G, Aboulafia A (2012): Virtual reality-based medical training and assessment: The multidisciplinary relationship between clinicians, educators and developers. Medical Teacher 34, 59–64.

Martinsen S, Jukes N (2005): Towards a humane veterinary education. Journal of Veterinary Medical Education 32, 454–460.

Melanson K (2008): Preserving innovation. Tufts University E-News, 2008-02-09. http://enews.tufts.edu/ stories/965/2008/09/02/PreservingInnovation

Nel P (1997): Research applications of plastination. Journal of the International Society for Plastination 12, 9–12.

Pederson, H. (2002). *Humane Education*. Stiftelsen Forskning utan djurforsok, Stockholm, Sweden.

Scalese RJ, Issenberg SB (2005): Effective use of simulators for the teaching acquisition of veterinary and Veterinarni Medicina, 57, 2012 (7): 325–337. professional clinical studies. Journal of Veterinary Medical Education 32, 461–467.

Smeak DD (1999): Accent on an alternative: skin and suture pattern simulator. Alternatives in Veterinary Medical Education Newsletter 10, 2–3.

Waters JR, Van Meter P, Perrotti W, Drogo S, Cyr RJ (2005): Cat dissection vs. sculpting human structures in clay: An analysis of two approaches to undergraduate human anatomy laboratory education. Advances in Physiology Education 29, 27–34.

Waters JR, Van Meter P, Perrotti W, Drogo S, Cyr RJ (2011): Human clay models versus cat dissection: How the similarity between the classroom and the exam affects student performance. Advances in Physiology Education 35, 227–236.

Yushchenko A, Berreville O, Wright N, White L, Sullivan E (2012): Elimination of live terminal surgeries in Canadian Veterinary Practice. ALTEX Proceedings, Proceedings of WC8, 395–397.