



Citation: Fulceri, F., Ryskalin, L., Morucci, G., Soldani, P., Ratti, S., Manzoli, L., & Gesi, M. (2024). Perception of physical therapists towards cadaver dissection: a qualitative survey study. *Italian Journal of Anatomy and Embryology* 128(2): 85-92. <https://doi.org/10.36253/ijae-15380>

© 2024 Author(s). This is an open access, peer-reviewed article published by Firenze University Press (<https://www.fupress.com>) and distributed, except where otherwise noted, under the terms of the CC BY 4.0 License for content and CC0 1.0 Universal for metadata.

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

Perception of physical therapists towards cadaver dissection: a qualitative survey study

FEDERICA FULCERI¹, LARISA RYSKALIN¹, GABRIELE MORUCCI¹, PAOLA SOLDANI¹, STEFANO RATTI², LUCIA MANZOLI², MARCO GESI^{1,*}

¹ Department of Translational Research and New Technologies in Medicine and Surgery, University of Pisa, Italy

² Department of Biomedical and Neuromotor Sciences, University of Bologna, Italy

*Corresponding author. Email: marco.gesi@unipi.it

Abstract. A deep understanding of gross anatomy is imperative for healthcare professionals for clinical examination, diagnosis, and safe and effective treatment of their patients. In this regard, satisfactory assessment of musculoskeletal disorders by physical therapists (PT) requires an in-depth knowledge of the morphology, position, and spatial relations of the structures of the locomotor system. Within this frame, traditional anatomical teaching and learning practices alone appear as a limit. Although they represent the mainstay of anatomy education, formal lectures, textbooks, or atlases only provide a theoretical knowledge of gross anatomy. Contrariwise, cadaver dissection offers unique advantages, namely appreciation of 3D concepts of body organization and spatial relationships between anatomical structures, being the most significant ones. Again, hands-on educational experiences can stimulate student interest, increase knowledge retention, and enhance the development of clinical skills. Thus, the use of human cadaver dissection is of paramount importance in the development of PT's core competencies, such as clinical education and reasoning. Therefore, the present study aimed to examine the appraisal and attitude toward the cadaver dissection experience of physical therapists (n=56) attending the postgraduate course in Sports Physiotherapy at the University of Pisa. The one-day human cadaver dissection course was held at the Institute of Human Anatomy of the University of Bologna. At the end of the course, the PT were invited to complete a self-administered questionnaire. All participants agreed that dissection is important, relevant, and highly beneficial to their anatomy education. They also perceived that this educational experience has the potential to improve learning outcomes that are essential to the development of healthcare professionals. The results presented in this study provide preliminary evidence that cadaver dissection is a highly valuable tool for developing fundamental skills and competencies in the training and professional careers of PT.

Keywords: human anatomy, cadaver dissection, hands-on learning, gross anatomy education, clinical knowledge.

INTRODUCTION

Human anatomy is one of the basic medical sciences that has always played a fundamental role in the education and training of medical doctors

and healthcare professionals. Indeed, adequate anatomical knowledge is essential for a safe and effective clinical practice, a correct diagnosis, and patient management. Many authors have drawn attention to how anatomical ignorance may be detrimental in surgery, sometimes leading to increased litigation in failure cases (Ellis 2002; Fischer 2002; Goodwin 2002; Singh et al. 2022). Again, poor anatomical knowledge may be a potential negative factor in clinical practice, though a direct correlation with malpractice would be difficult to substantiate (Rompolski et al. 2023). Contrariwise, properly defining the anatomical site of the lesion is crucial for health professionals, including physical therapists (PT), to manage the injury and solve the problem effectively, thus successfully pursuing clinical practice (Estai and Bunt 2016; Ghosh 2017).

When looking at the worldwide educational trends over the last century, it clearly emerges that teaching anatomy has been undergoing reforms for a long time. In particular, with evolving technology, traditional anatomy education, such as didactic lectures and body dissection, has been complemented and, in some cases, superseded by a wide range of novel educational approaches, including plastic models, 3D anatomy atlases, virtual/augmented reality, and many other teaching tools (Peterson and Mlynarczyk 2016; Richardson et al. 2021; Asad et al. 2023; Funjan et al. 2023). As a result, there has been a significant reduction in the amount of time dedicated to traditional cadaveric dissection, which has sometimes also been referred to as an obsolete practice (Memon 2018).

On the other hand, despite the increasing trend toward the integration of innovative learning methodologies, increasing evidence demonstrates that cadaver dissection remains an irreplaceable part of medical education (Dissabandara et al. 2015; Thompson et al. 2019; Jeyakumar et al. 2020; Huynh et al. 2021; Asante et al. 2021; Orsini et al. 2021; Cullinane and Barry 2023; Pradhan et al. 2024). As a proof of concept, a recent study showed that, in medical students' opinion, replacing physical specimens with augmented reality models would not be beneficial for pathology learning (Moro et al. 2023). Again, many reports have highlighted the facilitation due to cadaveric dissection in classifying human body components and the mapping of the organs and their surface projections (Johnston 2010; Mitchell et al. 2022; Rompolski et al. 2023). In this regard, in his work dating from 25 years ago, Moore claimed the role of human dissection as an educational modality that teaches medical students how to use their hands, helping them to develop touch-based skills used in palpation, percussion, and auscultation (Moore 1998). Another study showed that medical students commonly

conveyed that dissection is a valuable educational tool, useful for teaching and learning anatomical knowledge, appreciating structures' spatial relationships and variations, developing teamwork skills, and coping with death/dead bodies (Flack and Nicholson 2018). In fact, besides developing manual skills, getting close to the human body through cadaver dissection can reduce all the emotional impact of an unhealthy and suffering patient, and finally, can introduce students to the reality of death (Older 2004). Therefore, it is important to take into account that dissection should also be considered as an opportunity to strengthen human body familiarization and integration of theory into clinical practice (Lempp 2005).

Within this frame, some authors have emphasized how attending to dissection is fundamental for developing important clinical skills and manual dexterity required of healthcare professionals (Moore 1998; Granger 2004; McLachlan 2004; Slotnick and Hilton 2006). However, compared to the growing interest in students' perceptions and learning outcomes related to medical education using dissection, literature regarding PT conceptions of the human body in relation to experiences with human cadavers in anatomy teaching is extremely scarce (Keim Janssen et al. 2014; Khan et al. 2015; Condo and Justice 2022; Bergen et al. 2023), and so far only a few studies investigate the role of dissection in light of professional PTs' (Latman and Lanier 2001; Rompolski et al. 2023).

Given that anatomy is a core course for healthcare professionals, it is essential to determine whether anatomy education meets PT needs. Since data regarding the usefulness of human cadaver dissection in professional PT education is limited, the present study was designed to investigate the appraisal and attitude toward a dissection course of professionals attending a postgraduate course in "Sports Physiotherapy" at the University of Pisa.

MATERIAL AND METHODS

Subjects

Post-graduate physical therapists (n=56), who attended the course in "Sports Physiotherapy" at the University of Pisa, were involved in the study. The human cadaver dissection course took place at the Institute of Human Anatomy of the University of Bologna, and it was held by senior students at the School of Medicine trained by anatomy teachers.

Three groups of survey participants were identified: the early-career group (licensed less than 1 year before participation in the dissection course), the mid-career group

(licensed 1-5 years before dissection), and the late-career group (licensed for more than 5 years before dissection).

The “feedback” survey was sent to the participants via mail at the end of the dissection training. The study was conducted in accordance with the principles of the Declaration of Helsinki. All data were collected anonymously without any possibility to identify the participants. Participants were informed about the nature of the study and their participation was voluntary and without any compensation. Informed consent was obtained from all study participants, who were invited to complete an anonymous questionnaire and encouraged to answer questions openly and honestly. Those who did not want to participate were exempted from completing the survey.

Survey features

The inquiries eligible for the survey were chosen by the authors by matching previous studies presented in the current international literature. Two professional PT were involved in the survey development as expert validators, and their feedback was taken into consideration to draft the final version.

The 30 questions included the following sections: i) demographic data (age, gender, level of education), ii) professional profile (post-qualification experience), iii) anatomy educational approaches (e.g., formal lectures, textbooks, 3D atlases, plastic models), and iv) perceptions of anatomy education including dissection. Furthermore, survey respondents were asked in which year of their physical therapy degree course anatomy was taught, and whether they participated in a dissection laboratory dur-

ing their anatomy course. They were also surveyed about the perception and relevancy of the dissection to anatomy education and the emotional impact of dissection, pointing out the feelings of anxiety, disgust, and fear.

The participants were asked to give their personal opinion using a 5-point Likert Scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree), which was applied to 15 questions covering the following broader themes: anatomy knowledge, emotional reaction to human dissection, and appraisal of human dissection experience.

Statistical analysis

A Kruskal-Wallis test was used to compare Likert Scale responses from the three groups of survey participants: early, mid, and late-career PT.

The null hypothesis H0 was refused for $p < 0.05$.

RESULTS

The demographic characteristics of all the subjects enrolled in the present study are shown in Table 1. In total, 43 participants filled out the questionnaire, resulting in a completion rate of 76.78 % (43/56). The remaining thirteen dropped out of the study. The respondents’ date of birth ranges from 1973 to 2002, thus, it is likely that their answers were not influenced by any social context related to a particular decade.

All responders (100%) attended an anatomy course in the first year of their degree program and the majority of them stated they preferred traditional textbooks

Table 1. Demographic data of study participants.

Demographics	TOT	Early-professional	Mid-professional	Late-professional
<i>Gender</i>				
Female	25.60%	20%	38.46%	20%
Male	74.40%	80%	61.54%	80%
Mean age (years)	25.46±0.78	24.28±0.87	25.23±0.67	32±0.63
Mean experience (years)	2.35±0.37	1±0	2.54±0.18	8.4±0.74
<i>Work setting</i>				
Public hospital	2.33%	0%	7.69%	0%
Private clinic	34.88%	28%	46.15%	40%
Private practice	51.16%	60%	46.15%	20%
Other	11.63%	12%	0	40%

Data are expressed as mean±SEM.

(55.81%), and atlases (30.23%) as the most common learning aids. Of the latter, only 9.30% of respondents adopted 3D atlases as a novel tool for anatomy instruction. Plastic models were used by 6.98% of the responders. Fewer than 10% of respondents stated they used didactic lectures alone.

Before attending the dissection course, 95.34% of respondents agreed that anatomy is taught in a sufficient manner in their physical therapy degree (mean Likert score of 3.21 ± 0.09). Accordingly, less than 5% found it difficult to recognize and locate anatomical structures during dissection (mean Likert score of 2.37 ± 0.10). However, less than 10% have had previous experience with human cadaver dissection during their degree program. At the same time, the majority (93.02%) of the participants stated that they were strongly interested (mean Likert score 4.58 ± 0.12) in attending the dissection course.

With reference to the positive perception of PT on cadaver dissection, 93.02% agreed or strongly agreed that dissection has made anatomy more interesting (mean Likert score of 4.56 ± 0.12), as it provided a three-dimensional perspective of the anatomical structures (mean Likert score of 4.47 ± 0.08). The majority of participants also agreed that the dissection helped strengthen human anatomy knowledge (mean Likert score of 4.28 ± 0.09). Moreover, they considered that participating in cadaver dissection provided clinically relevant anatomical knowledge (mean Likert score of 4.28 ± 0.12) while providing more opportunities to develop professional skills (mean Likert score of 4.35 ± 0.13). Most of them disagree or strongly disagree that dissection can

be replaced by educational videos of anatomical models, which indicates high satisfaction with the dissection session (mean Likert score of 2.00 ± 0.21). Besides, respondents also stated that they would have needed more time in the dissection room for more in-depth anatomy knowledge (mean Likert score of 3.19 ± 0.15).

Finally, regarding the negative emotional and physical reactions of the attendants (e.g., anxiety, disgust, discomfort, and fear), only 3 (6.98%) agreed they felt anxiety before dissection (mean Likert score of 1.53 ± 0.13) and 2 participants (4.65%) reported distress when undertaking human dissection. Of note, of the 43 respondents, only 1 perceived the dissection situation as emotionally stressful (mean Likert score of 1.65 ± 0.13). Thus, most of them disagree or strongly disagree about the need for mental preparation before dissection (mean Likert score of 2.33 ± 0.15).

On the contrary, the majority of participants (95.35%) reported that cadaver dissection aroused various positive emotions (e.g., curiosity, interest, satisfaction) and described the experience as interesting and stimulating. In line with this, all respondents stated that they actively participated in the dissection course and remained in the dissecting room all the time (mean Likert score of 4.07 ± 0.12).

Interestingly, when analyzing the data concerning the appraisal of dissection from the different career groups, no significant differences were obtained between groups (Table 2). Indeed, the late-career professional, which implies a more lasting contact with the human body, did not influence the perception and attitude toward cadaver dissection.

Table 2. Opinion of dissection experience of study participants.

Themes	Groups			<i>*p</i> value
	Early- professional	Mid- professional	Late- professional	
Perception of cadaver dissection				
Do you think your anatomical knowledge was sufficient to take part in the dissection?	3.12 ± 0.10	3.38 ± 0.14	3.2 ± 0.2	0.61
Did you have difficulty locating and/or distinguishing anatomical structures?	2.36 ± 0.11	2.46 ± 0.14	2.4 ± 0.4	0.78
Did the dissection help you strengthen your knowledge of human anatomy?	4.16 ± 0.08	4.38 ± 0.18	4.67 ± 0.24	0.3
Was the dissection helpful for understanding the 3D of the anatomical structures?	4.36 ± 0.09	4.62 ± 0.14	4.6 ± 0.24	0.45
Did dissection make learning human anatomy more interesting?	4.44 ± 0.14	4.62 ± 0.18	5 ± 0	0.38
Did the dissection experience provide you with clinically relevant anatomical knowledge?	4.12 ± 0.12	4.38 ± 0.21	4.8 ± 0.2	0.2
Attitude towards cadaver dissection				
Did you actively participate in the dissection?	3.96 ± 0.14	4 ± 0.28	4.8 ± 0.12	0.09
Was the dissection emotionally stressful?	1.64 ± 0.13	1.85 ± 0.36	1.2 ± 0.2	0.44
Were you nervous before attending the dissection?	1.60 ± 0.19	1.54 ± 0.18	1.2 ± 0.2	0.67
Do you think it is necessary to prepare students emotionally before carrying out the dissection?	2.16 ± 0.18	2.46 ± 0.27	2.8 ± 0.58	0.42

*95% confidence limits.

Data are expressed as mean \pm SEM

Finally, overall, all of the respondents believe that cadaver dissection is a unique and privileged experience, and among them, 93.02% would like to attend a dissection course again, if they had the opportunity. In this regard, the participants strongly felt that a dissection course should be offered to undergraduate and professional physiotherapists (mean Likert score of 3.91 ± 0.15).

DISCUSSION

This study aimed to examine early-, mid-, and late-career PT perceptions and attitudes in attending a human cadaver dissection course and how this latter could have a significant impact on their anatomical knowledge, professional identity formation and skills. To the best of our knowledge, this is the first study that investigates perceptions and attitudes of practicing PT in attending a dissection course during a postgraduate course at an Italian university. As highlighted by current literature, much of the research has been focused on undergraduate medical students' experiences of learning gross anatomy from human dissection. At the same time, it is important to point out that, with reference to the Italian educational context, cadaver dissection, as a learning tool, is rarely adopted within Bachelor of Science undergraduate courses in physiotherapy. Contrariwise, dissection courses have globally remained the cornerstone of the medical school curriculum as a potential tool to broaden the range of learning outcomes (Lempp 2005). Indeed, acquiring in-depth knowledge of human anatomy through dissection is considered an academic pillar as it integrates theoretical and practical knowledge, enhances practical skills, and promotes familiarization with dead bodies (Older 2004; McLachlan 2004). Concurrently, previous studies highlight that acquiring manual skills within the dissection room should be crucial for all ongoing clinicians (Prakash et al. 2007). Indeed, the hands-on nature of dissection allows a comprehensive understanding of the three-dimensional aspect of the human body, while contributing to critical relational and topographical knowledge enhancement. Again, undertaking dissection provides the opportunity to observe and experience structures in situ with a texture similar to that of a living body (Webb et al. 2022). In line with this, previous research also indicates that practical training in the dissection of human cadavers can promote an active and engaged experience of how to approach the whole body. In particular, our results showed that all the attendants (100%) consider cadaver dissection a stimulating learning experience and indispensable for understanding the body's structure and function. Within this

frame, it appears fundamental to underlie how, although most of the participants' anatomy courses in physical therapy schools did not include anatomy practice, in any case, the dissection course has been regarded as a fundamental tool to improve knowledge of gross anatomy and develop clinical reasoning skills (81.40% of the participants). All the participants also demonstrated a profound interest in learning anatomy because they felt anatomy as crucial to their good and safe clinical practice, thus becoming competent health professionals. Of note, increasing evidence demonstrates that cadaver dissection represents the most productive approach to learning anatomy since it stimulates the investigative approach toward clinical cases and lays the foundations for problem-solving abilities and teamwork skills resembling future collaborative teamwork (Miller et al. 2002). Finally, within the frame of widening scopes of the dissection, it is also important to emphasize how the concentration required during the slow but active sequential process of discovery through dissection represents a unique opportunity for studying gross anatomy (Dissabandara et al. 2015). In this way, the dissection experience allows the students to explore, retain, and recall complex anatomical structures and spatial relations, in a way that other forms of learning anatomy cannot replace.

Interestingly, from the present study, it clearly emerges how the difference in years of practice did not influence the perception towards dissection, and even the late-career participants, who are supposed to be more confident with anatomy structures, stated that the dissection was a great opportunity to enhance the retention of clinically relevant anatomical knowledge and develop clinical skills (100% of the respondents).

Though cadaver dissection has long been considered crucial for learning gross anatomy, it is worth mentioning that some recent studies investigated the feasibility and perceived benefits from students of introducing the use of other "innovative" learning methods and exploring other "cadaverless" anatomy education tools (Singal 2022). This is mainly because some authors reported that students might experience negative attitudes toward dissecting human cadavers (Dempster et al. 2006; Chiou et al. 2021). In particular, most of the negative perceptions towards dissection were related to psychological (stress, anxiety, and emotional trauma) or physical factors, including fear, restlessness, and nausea due to unpleasant smells (Horne et al. 1990; Qamar and Osama 2014; Asante et al. 2021). Other studies reported the potential hazardousness of the chemicals used for cadaver preservation as another dissatisfaction aspect with dissection (Asante et al. 2021). Therefore, some studies suggested that emotional preparation before the beginning of the

course or engagement in discussing their experiences and emotions with academic staff after dissection activities could help lower students' anxiety levels (Chiou et al. 2021; Ong et al. 2023). Unlike previous studies, our results demonstrate that most (95.35%) of the surveyed physiotherapists had no negative perceptions of dissection. In detail, among the surveyed PT, only one of the respondents found the dissection of cadavers stressful, while another one felt a little nervous before entering the dissection room. As a proof of concept, 88.37% of them actively participated in the dissection. Consequently, none of them reported the need for emotional support or preparation before starting the dissection.

In any case, it is important to point out that the emotional and physical stress from dissection activities should not be overlooked and more attention should be given to the students facing human cadavers for the first time. Indeed, a stressful experience in the dissection room might determine a negative disposition toward such an experience, which in turn might negatively impact student learning.

Again, the effectiveness of digital support in learning anatomy is still a matter of debate (Miller et al. 2002; Older 2004; Asante et al. 2021). Despite several authors agreeing that computer-simulated models and 3D software are undoubted supports for anatomy education, they present several biases (Older 2004). On the other hand, it is well known that technology tends to dehumanize patient and professional relationships reducing clinician care, and growing rejection of patients towards physicians (Older 2004). Thus, innovative educational tools should be regarded as supplements and not substitutes for human cadaver dissection in the study of gross anatomy. Within this frame, our results demonstrate that all three groups of surveyed participants disagree about the anatomy dissection replacement with video recordings, augmented reality platforms, and 3D virtual models.

In conclusion, although literature regarding physical therapists' conceptions of the human body related to experiences with human cadavers in anatomy teaching is extremely scarce, from the survey reported in the present work it clearly emerges that physical therapists perceive cadaver dissection as highly beneficial to their anatomy education. Therefore, greater efforts and attention should be made to include such an invaluable experience of cadaver dissection in the anatomy curricula of physical therapists.

REFERENCES

- Asad MR, Asghar A, Tadvi N, et al (2023) Medical Faculty Perspectives Toward Cadaveric Dissection as a Learning Tool for Anatomy Education: A Survey Study in India. *Cureus*. <https://doi.org/10.7759/cureus.37713>
- Asante EA, Maalman RS, Ali MA, et al (2021) Perception and Attitude of Medical Students towards Cadaveric Dissection in Anatomical Science Education. *Ethiop J Health Sci* 31:867–874. <https://doi.org/10.4314/ejhs.v31i4.22>
- Bergen R, Lowry E, Gregg L, et al (2023) Habituation for professional learning: a qualitative study of physiotherapy students' experiences working with anatomy cadavers. *Physiotherapy Theory and Practice* 1–14. <https://doi.org/10.1080/09593985.2023.2232865>
- Chiou R-J, Tsai P-F, Han D-Y (2021) Impacts of a gross anatomy laboratory course on medical students' emotional reactions in Taiwan: the role of high-level emotions. *BMC Med Educ* 21:489. <https://doi.org/10.1186/s12909-021-02923-1>
- Condo M, Justice B (2022) Student Perceptions of the Use of Case-Based Cadaver Dissections in Doctorate of Physical Therapy Program. *MedSciEduc* 32:679–682. <https://doi.org/10.1007/s40670-022-01540-x>
- Cullinane DP, Barry DS (2023) Dyad pedagogy in practical anatomy: A description of the implementation and student perceptions of an adaptive approach to cadaveric teaching. *Anatomical Sciences Ed* 16:99–115. <https://doi.org/10.1002/ase.2184>
- Dempster M, Black A, McCorry N, Wilson D (2006) Appraisal and Consequences of Cadaver Dissection. *Medical Education Online* 11:4592. <https://doi.org/10.3402/meo.v11i.4592>
- Dissabandara LO, Nirathanan SN, Khoo TK, Tedman R (2015) Role of cadaveric dissections in modern medical curricula: a study on student perceptions. *Anat Cell Biol* 48:205. <https://doi.org/10.5115/acb.2015.48.3.205>
- Ellis H (2002) Medico-legal Litigation and its Links with Surgical Anatomy. *Surgery (Oxford)* 20:i–ii. <https://doi.org/10.1383/surg.20.8.0.14518>
- Estai M, Bunt S (2016) Best teaching practices in anatomy education: A critical review. *Annals of Anatomy - Anatomischer Anzeiger* 208:151–157. <https://doi.org/10.1016/j.aanat.2016.02.010>
- Fischer JE (2002) The effect of litigation on surgical practice in the USA. *British Journal of Surgery* 87:833–834. <https://doi.org/10.1046/j.1365-2168.2000.01457.x>
- Flack NAMS, Nicholson HD (2018) What do medical students learn from dissection? *Anat Sci Educ* 11:325–335. <https://doi.org/10.1002/ase.1758>
- Funjan K, Ashour L, Salameh M, et al (2023) Perceptions and Attitudes of Jordanian Medical Students on Using 3D Interactive Anatomy Dissection in Teach-

- ing and Learning Anatomy. AMEP Volume 14:837–844. <https://doi.org/10.2147/AMEPS419333>
- Ghosh SK (2017) Cadaveric dissection as an educational tool for anatomical sciences in the 21st century. *Anatomical Sciences Ed* 10:286–299. <https://doi.org/10.1002/ase.1649>
- Goodwin H (2002) Litigation and surgical practice in the UK. *British Journal of Surgery* 87:977–979. <https://doi.org/10.1046/j.1365-2168.2000.01562.x>
- Granger NA (2004) Dissection laboratory is vital to medical gross anatomy education. *Anat Rec B New Anat* 281:6–8. <https://doi.org/10.1002/ar.b.20039>
- Horne DJ, Tiller JW, Eizenberg N, et al (1990) Reactions of first-year medical students to their initial encounter with a cadaver in the dissecting room: *Academic Medicine* 65:645–6. <https://doi.org/10.1097/00001888-199010000-00011>
- Huynh N, Burgess A, Wing L, Mellis C (2021) Anatomy by Whole Body Dissection as an Elective: Student Outcomes. *Journal of Surgical Education* 78:492–501. <https://doi.org/10.1016/j.jsurg.2020.07.041>
- Jeyakumar A, Dissanayake B, Dissabandara L (2020) Dissection in the Modern Medical Curriculum: An Exploration into Student Perception and Adaptions for the Future. *Anatomical Sciences Ed* 13:366–380. <https://doi.org/10.1002/ase.1905>
- Johnston ANB (2010) Anatomy for nurses: providing students with the best learning experience. *Nurse Educ Pract* 10:222–226. <https://doi.org/10.1016/j.nepr.2009.11.009>
- Keim Janssen SA, VanderMeulen SP, Shostrom VK, Lomneth CS (2014) Enhancement of anatomical learning and developing clinical competence of first-year medical and allied health profession students. *Anatomical Sciences Ed* 7:181–190. <https://doi.org/10.1002/ase.1398>
- Khan MSG, ul Ain Q, Hussan SI, et al (2015) Opinion of Pakistani physiotherapists/students about anatomy as a subject and method of teaching anatomy: a cross sectional survey. *J Pak Med Assoc* 65:153–155
- Latman NS, Lanier R (2001) Gross anatomy course content and teaching methodology in allied health: Clinicians' experiences and recommendations. *Clin Anat* 14:152–157. [https://doi.org/10.1002/1098-2353\(200103\)14:2<152::AID-CA1024>3.0.CO;2-A](https://doi.org/10.1002/1098-2353(200103)14:2<152::AID-CA1024>3.0.CO;2-A)
- Lempp HK (2005) Perceptions of dissection by students in one medical school: beyond learning about anatomy. A qualitative study. *Med Educ* 39:318–325. <https://doi.org/10.1111/j.1365-2929.2005.02095.x>
- McLachlan JC (2004) New path for teaching anatomy: living anatomy and medical imaging vs. dissection. *Anat Rec B New Anat* 281:4–5. <https://doi.org/10.1002/ar.b.20040>
- Memon I (2018) Cadaver Dissection Is Obsolete in Medical Training! A Misinterpreted Notion. *Med Princ Pract* 27:201–210. <https://doi.org/10.1159/000488320>
- Miller SA, Perrotti W, Silverthorn DU, et al (2002) From college to clinic: Reasoning over memorization is key for understanding anatomy. *Anat Rec* 269:69–80. <https://doi.org/10.1002/ar.10071>
- Mitchell K, Bickley C, Leis A, Tsang A (2022) A Survey of Human Gross Anatomy Laboratories in DPT Programs across the United States. *IJAHS*. <https://doi.org/10.46743/1540-580X/2022.2109>
- Moore NA (1998) To dissect or not to dissect? *Anat Rec* 253:8–9. [https://doi.org/10.1002/\(SICI\)1097-0185\(199802\)253:1<8::AID-AR6>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0185(199802)253:1<8::AID-AR6>3.0.CO;2-Z)
- Moro C, Bu D, Gadgil A, et al (2023) Virtual Models Using Augmented Reality May Provide a Suitable Supplement, Although Not a Physical Specimen Replacement, in Pathology Education. *MedSciEduc* 33:879–885. <https://doi.org/10.1007/s40670-023-01809-9>
- Older J (2004) Anatomy: A must for teaching the next generation. *The Surgeon* 2:79–90. [https://doi.org/10.1016/S1479-666X\(04\)80050-7](https://doi.org/10.1016/S1479-666X(04)80050-7)
- Ong CX, Foo YY, Compton S (2023) The impact of human cadaveric dissection on professional identity formation in medical students. *BMC Med Educ* 23:970. <https://doi.org/10.1186/s12909-023-04913-x>
- Orsini E, Quaranta M, Mariani GA, et al (2021) Near-Peer Teaching in Human Anatomy from a Tutors' Perspective: An Eighteen-Year-Old Experience at the University of Bologna. *IJERPH* 19:398. <https://doi.org/10.3390/ijerph19010398>
- Peterson DC, Mlynarczyk GSA (2016) Analysis of traditional versus three-dimensional augmented curriculum on anatomical learning outcome measures. *Anatomical Sciences Ed* 9:529–536. <https://doi.org/10.1002/ase.1612>
- Pradhan S, Das C, Panda DK, Mohanty BB (2024) Assessing the Utilization and Effectiveness of YouTube in Anatomy Education Among Medical Students: A Survey-Based Study. *Cureus*. <https://doi.org/10.7759/cureus.55644>
- Prakash null, Prabhu LV, Rai R, et al (2007) Cadavers as teachers in medical education: knowledge is the ultimate gift of body donors. *Singapore Med J* 48:186–189; quiz 190
- Qamar K, Osama M (2014) Role of dissection in light of students' perceptions. *J Pak Med Assoc* 64:1021–1024
- Richardson NS, Zwambag D, McFall K, et al (2021) Exploring the Utility and Student Perceptions of Synthetic Cadavers in an Undergraduate Human Anatomy Course. *Anatomical Sciences Ed* 14:605–614. <https://doi.org/10.1002/ase.2024>

- Rompolski KL, Fojas CL, Taylor MA (2023) How do practicing physical therapists perceive anatomy education? *Anatomical Sciences Ed* 16:979–988. <https://doi.org/10.1002/ase.2277>
- Singal A (2022) Transforming anatomy education: then and now. *Anat Sci Int* 97:230–231. <https://doi.org/10.1007/s12565-021-00645-4>
- Singh R, Jones DG, Pandey M, Yadav N (2022) Can traditional teaching of Anatomy be replaced by alternative methods?
- Slotnick HB, Hilton SR (2006) Proto-professionalism and the dissecting laboratory. *Clin Anat* 19:429–436. <https://doi.org/10.1002/ca.20311>
- Thompson KL, Gendreau JL, Strickling JE, Young HE (2019) Cadaveric Dissection in Relation to Problem-Based Learning Case Sequencing: A Report of Medical Student Musculoskeletal Examination Performances and Self-Confidence. *Anatomical Sciences Ed* 12:619–626. <https://doi.org/10.1002/ase.1891>
- Webb AL, Smyth L, Hafiz M, Valter K (2022) The question of dissection in medical training: Not just “if,” but “when”? A student perspective. *Anatomical Sciences Ed* 15:281–290. <https://doi.org/10.1002/ase.2168>