Journal of Morphological Sciences
J Morphol Sci
Brazilian Society of Anatomy

Review Article
J Morphol Sci 2023;40:363-369

The Role of 3d Printing and Image Exams in Human Anatomy Teaching

Claudio Silva Teixeira[1,2], Renata Souza e Silva[2], Vanessa Ribeiro de Souza[1], Natchelly Cristina de Souza[2], Valeria Paula Fazan Sassoli[3], Gilberto Santos Cerqueira[4]

[1]Professor at the University of Rio Verde, Três Corações, MG, Brazil
[2]Postgraduate Program in Morphofunctional Sciences, Faculty of Medicine, Department of Morphology, Federal University of Ceará, Fortaleza, CE, Brazil
[3]Department of Surgery and Anatomy, School of Medicine of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil
[4]Department of Anatomy, Federal University of Ceará, Fortaleza, CE, Brazil

Disclose and conflicts of interest: none to be declared by all authors

ABSTRACT

Introduction: The teaching of anatomy is the basis for understanding the other disciplines taught during undergraduate courses in the medical field. For its teaching, the presentation of corpses is used as a gold standard. However, obtaining new cadaveric pieces has become increasingly scarce, due to several factors, such as ethical, and cultural, among others. Therefore, new teaching tools have been applied, such as the use of parts developed by 3D printing and radiological examinations, and their application has had a positive impact on student learning.

Review: For the acquisition and evaluation of articles, the PICo strategy was used, which guided the selection of the following descriptors: anatomy, 3D printing, radiology, and teaching. The databases used for the search of the articles were: PUBMED, Science Direct, and Scielo. A total of 487 articles were evaluated, 20 of which were included in this review, as they addressed the themes proposed by the review. 3D printing has been used for planning complex surgeries, creating custom prostheses, and in anatomical education and training. Therefore, 3D printing has been increasingly used in the process of teaching and learning anatomy in different ways, including a new perspective for the dissemination of the method in places where cadaveric parts and anatomical accidents and structures that are difficult to visualize are missing.

Conclusion: It was found that most publications demonstrate that 3D printing has been used in teaching morphology and radiology for several purposes, including demonstrating structures that are difficult to dissect, accessing difficult cavities, and clinical correlation.

Keywords: Human anatomy; Teaching; 3D printing; Radiology.

Introduction

Anatomy is one of the pillars common to all health courses, helping, a posteriori, in the understanding of subsequent disciplines[1]. Due to the intrinsically three-dimensional content of this discipline, in addition to reading materials and atlases, objects or pieces with volume are necessary for better learning of the content, most often detaching themselves from the use of cadavers, which are preserved in glycerin, formaldehyde or plastinated, as well as digital resources and images, whether illustrative or real[2–5].

It should be noted, however, that obtaining some of these resources, especially cadavers and/or anatomical specimens of cadaverous origin, has been a challenge for many medical schools. This results not only from financial difficulties for the acquisition of specimens but from a whole diversity of ethical, cultural, and legal precepts related to this theme[6,7].

It is also noteworthy that, even when cadavers are available, their storage and conservation are carried out, in most cases, using chemical substances, such as formaldehyde, which can pose risks to the health of students and professionals. who manipulate them[8]. There are also factors intrinsic to the body donated to universities that can interfere with the quality and preparation of the pieces, among them we can mention rapid deterioration, obesity, age, and other factors that can prevent success in the production of quality pieces for classes[9,10].

Considering these difficulties, one should think of other substitute or complementary methods for the use of cadavers. The use of different teaching methods has been shown to facilitate learning and motivation for students[11,12]. Among these alternative methods, the study in 3D parts and the use of radiological images were considered tools to improve the teaching and learning process of students[13,14].

Three-dimensional printing was introduced into practice in 1986 but has become more widely available in the last decade[15]. This is due to several factors: computers have become more powerful and, more importantly, software that handles 3D models has

DOI: 10.51929/jms.40.363.2023
ISSN 2177-0298

become more sophisticated and efficient[16]. As a result, its use has become increasingly common in medical courses, with research showing many applications in teaching cardiovascular diseases, and human and animal anatomy[17].

Despite the limited number of studies demonstrating and comparing the use of three-dimensional printed parts with the traditional anatomy teaching methodology, the use of such utensils has had a positive impact[18,19]. Like anatomical structures that have already been used in scientific studies for comparative purposes of the aforementioned methods, we find bone structures such as skulls[19], internal organs such as the nervous system[20,] and even vascular and lymphatic structures[21,22].

Likewise, radiological images, acquired from x-rays, computed tomography, and magnetic resonance imaging, have also been applied as a complementary tool in the process of teaching human anatomy[23]. Studies have been demonstrating that the use of radiological images helps in a better spatial understanding of anatomical components24 In addition, the use of three-dimensional images, acquired from computed tomography, was able to guarantee long-term learning[23–25].

Imaging exams are non-invasive, being the recommended method for an initial analysis, follow-up, and diagnosis of pathologies. Thus, in addition to radiological images helping to ensure a better understanding and applicability of the anatomy learned in the classroom, it can help prepare health professionals to perform their duties with excellence[26,27].

Some studies show that 3D printed models based on the use of radiological images can accurately replicate complex anatomical structures of human anatomy and pathologies of the cardiovascular and cerebrovascular system[6,23]. Therefore, the present work aims to evaluate the impact of 3D impressions and imaging examinations in the teaching-learning process of human anatomy, as a way to meet the need for studies related to this theme.

Methodology

In this analysis, the use of radiological images and 3D impressions was placed from the perspective of teaching human anatomy. For this, the PICo methodology was used to better determine the patterns evaluated during the research. This acronym corresponds to population (P), interest (I), context (C), and outcome (o)[28]. With this, the guiding question can be determined: What is the impact of using 3D impressions and radiological images on the teaching-learning process in human anatomy?

With that, a systematic review of the literature was carried out from the evaluation of scientific articles. This review has as its theme the "Use of 3D impressions and radiological exams in the teaching of human anatomy". A systematic review consists of a review methodology that allows the evaluation and inclusion of various types of study, to group knowledge to understand the theme or phenomenon[29].

To start the search, the Health Sciences Descriptors (DeCS) were investigated using Health Terminology, identifying the following descriptors: Teaching 3D printing and teaching with radiology. Finally, it was determined that the keywords for researching the articles would be: teaching, human anatomy, 3D printing, and radiology.

The following inclusion criteria were used: quantitative and/or qualitative original articles, published in Portuguese or English, which were directly related to the keywords and published between January 2012 and December 2022. As exclusion criteria, we have duplicate articles, outside the subject of the study, academic works (theses, dissertations, and monographs), abstracts, languages not listed in the inclusion criteria, and review articles.

Initially, the abstracts of the articles and their keywords were evaluated, and the articles that presented items present in the exclusion criteria were removed from the analysis. Subsequently, the studies that were selected for complete evaluation were evaluated in terms of content, looking for information that answered the guiding question.

Results

Of a total of 487 articles identified, 20 were excluded because they were duplicated. Subsequently, the process of selecting articles began with the application of screening tests, which were initially applied to 467 studies. After analyzing the titles and abstracts of each of the articles that were candidates for exclusion at this stage of the screening, 446 articles were excluded according to the criteria.

Of this total, there were 21 eligible articles, which were read in full and analyzed according to the criteria previously defined for this review, which did not allow the additional exclusion of other works. Therefore, the articles included in the qualitative synthesis to be worked on the subject of this study were represented in a total of 21 articles. There were no restrictions on the type of 3D printer. All literature and systematic review articles related to the topic were excluded from the study. Articles that went through the entire screening process were included in this study and are shown in Table 1. For a better visualization of the evaluation process of the articles present in this review, a Prism Flow was created, shown in Figure 1 [30,31].

In Brazil, due to the COVID-19 pandemic in the country, there was a decrease in scientific production related to 3D printing, but in the world with everyone, several scientific works were published. Many works published in Brazil are focused on veterinary anatomy

Table 1. Compilation of the main articles that include relevant information on the theme of this review.

Author/year	Objective	Results	Conclusion	Journal	Database
SILVA *et al*., 2019	To study the perception of medical students about the insertion of radiology in undergraduate education using active methodologies.	Need for early introduction of radiology due to its transversality and its role in in-service teaching activities; systematic teaching of biophysical principles and vocabulary to facilitate study;	Morphofunctional curricular component, it can be used to address diagnostic imaging in a multidimensional view, contextualized anatomy and pathology, facilitating the learning of both radiology	Revista Brasileira de Educação Médica	Scielo
SAVOLDI *et al*., 2020	To investigate the impact of using dry human skulls and cone beam computed tomography in teaching anatomy	Greater overall subjective satisfaction (4.9 ± 0.8 of 6), but no significant difference was present between teaching methods.	Students found they learned more using skulls, but their objective learning outcomes were not significantly affected. There seems to be a discrepancy between students' perception of learning and their actual performance.	Anat Sci Educ	PubMed
VRIES *et a*l., 2018	To verify if the use of ultrasound as an educational supplement can improve the confidence of medical students	students in the ultrasound group had a greater increase in confidence after the session in their ability to identify structures	Ultrasonography in the preclinical curriculum can improve students' confidence and accuracy of palpation	J Am Osteopath Assoc	PubMed
KLEIMAN *et al*., 2017	Evaluate retention of specific anatomy knowledge	There was no statistically significant difference in baseline scores between groups, but TEE showed significant improvements in cardiovascular anatomy over time.	Medical students and inexperienced anesthesiology residents showed improved learning and retention with basic cardiovascular ultrasound	Anesth Analg.	PubMed
WEEKS *et al*,. 2021	Assess student performance after using 3D tools for those using two-dimensional (2D) screens.	Comparing the pre-test with the post-test of the average percentage of questions answered correctly showed that both groups had significant results.	Immersive 3D visualization has the potential to improve short-term anatomical recovery in the head and neck compared to traditional	Academic Radiology	PubMed
BEERMANN *et al*. 2010	Evaluate whether the 3D presentation has a beneficial impact	Male students gave significantly more correct answers in 3D modalities	3D imaging has significantly improved the identification of the complex surgical anatomy of the liver.	Med Educ	PubMed
LOKE *et al*., 2017	To evaluate the impact of 3D models on how pediatric residents understand and learn about tetralogy of Fallot after a teaching session.	Students who were taught with 3D models had a higher composite satisfaction score. The 3D model group also had higher aggregate self-efficacy scores, but the difference was not statistically significant.	Physical 3D models enhance resident education around the theme of tetralogy of Fallot, improving student satisfaction.	BMC Med Educ	PubMed
HAKIMI *et al*., 2019	To present the utility of a smartphone-enabled otoscope as a teaching aid in preclinical otoscopy training.	Participants using the smartphone-enabled otoscope reported a significant increase in confidence in performing otoscopy compared to those using the conventional otoscope	The smartphone-enabled otoscope serves as a valuable teaching tool for preclinical otoscopy education.	Eur Arch Otorhinolaryngol	PubMed
MARKER *et al*., 2010	Evaluate the implementation of a digital anatomy lecture series based primarily on radiographic images	With regard to areas for improvement, 63% of students reported that they benefited from the teaching methods, and only 9% of students indicated that they did not.	The combination of electronic radiology resources available in lecture format and on the Internet can provide multiple opportunities for medical students to learn	Academic Radiology	ScienceDirect

SADLER *et al*., 2018	To investigate the current use of radiology in anatomy teaching across the UK and determine the level of interest expressed in expanding its role in medical education.	Most schools have implemented the method	Increase in radiological anatomy in the curricula of medical schools with a greater presence of radiologists in anatomy teaching	Clin Radiol.	ScienceDirect
PHILLIPS *et al*., 2013	Determine the contribution of the specialty to undergraduate medical training.	Studies report somewhat mixed results of pedagogical effectiveness, but demonstrate generally high acceptance by students and instructors, and often significant improvement in exam scores.	It is important that radiologists continue to develop new anatomy pedagogies and contribute to the teaching of anatomy in larger roles.	Academic Radiology	ScienceDirect
JACK, 2012	Determine the use of diagnostic imaging (radiology) as a department and/or means of imaging in anatomy teaching at the Canadian level of undergraduate medical education.	All schools were using imaging methods for teaching, but few had radiologists teaching	Diagnostic imaging has an important role to play in teaching anatomy	Canadian Association of Radiologists Journal	ScienceDirect
DREHER, 2014	Evaluate whether ultrasound should have a greater role in the anatomy curriculum	Students with self-perceived interest and experience report comfort and confidence in ultrasound skills.	Ultrasound can be effectively incorporated into an anatomy course for first-year medical students, using didactics and hands-on exposure.	The Journal of Emergency Medicine	ScienceDirect
	The objective of the present work was to create 3D models and their respective radiographs representing canine hip dysplasia	The 3D pieces represented the bone deformations of the different degrees of canine hip dysplasia, yet it was possible to observe and determine each of the bones that constituted the hip joints, as well as demonstrate the precise points to determine the Norberg angle.	It was evidenced that 3D impressions can be a possible tool to be used in the teaching of veterinary anatomy.	Arq. Bras. Med. Vet. Zootec	Scielo
SIMON; POOR, 2022).	Demonstrates the application of 3D printing in the teaching of anatomy and forensic sciences.	The first publication on 3D printing in the field of forensic medicine and pathology was published in 2011, but publications were sparse until 2017. Publication numbers increased in 2017 and have remained constant ever since.	The publications reveal that 3D printing can be used in everyday forensic medical practice for a variety of purposes, including wound reconstruction, wound and weapon comparison, presentation,	Annals of 3D Printed Medicine	Pub med

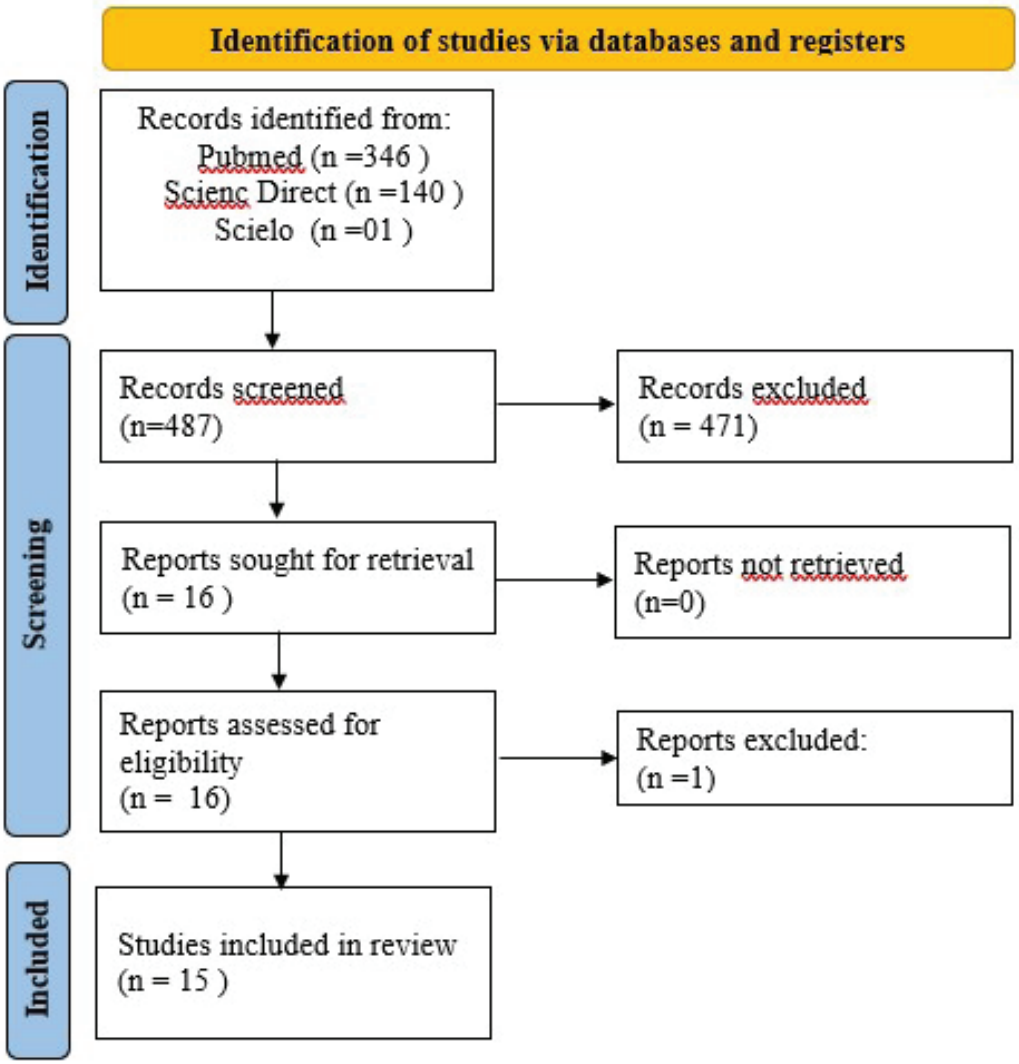

Figure 1. Prisma Flow, showing more detailed information about the selection, inclusion, and exclusion of the articles searched in the databases.

or embryology, the works focused on clinical anatomy are incipient. In this document, we demonstrate an overview of studies with 3D printing aimed at teaching human and animal anatomy as well as some clinical work involving anatomy and radiology, since many 3D parts are used for planning surgery in places with difficult surgical access or various infrequent anatomical features or implies is greater planning of the surgical intervention and thus 3D printing becomes an essential tool. In Table 1 we can see the main summaries of works on 3D printing involving anatomy and radiology.

Discussion

The knowledge of anatomy is one of the great bases for medical reasoning, therefore, it is necessary to use different pedagogical methods to optimize the teaching of anatomy and, consequently, for learning directed towards application in the clinical context[24]. Thus, imaging and 3D printing are important tools for teaching anatomy. Based on this, the use of diagnostic imaging tests, such as ultrasound, computed tomography, magnetic resonance imaging, and 3D printing; proves to be an excellent tool for clinical and anatomical correlation[32].

3D printing is an important tool in the teaching and learning process of health sciences, in particular, anatomy, histology, and embryology, and has become more widely available in the last decade, its medical applications are growing rapidly[6]. The technology also has great potential in forensic sciences including forensic medicine and pathology[33,34].

Three-dimensional (3D) printing technology is a layer-by-layer process for forming 3D objects from digital drawings and allows for the on-demand fabrication of objects of virtually any shape and size. The introduction of this methodology in teaching improves the teaching and learning process in health sciences[35].

In applied studies in veterinary medicine, researchers have demonstrated the potential of 3D printing technology to be effectively applied to spinal stabilization surgeries for small breed dogs, allowing for precise screw placement and minimizing

peri- and postoperative complications, particularly in anatomical in which screw aisles are narrow and technically demanding. and the cause appeared to be related to the sub-optimal screw plate interface[36].

Understanding the three-dimensional (3D) nature of the human form is imperative to effective medical practice and the emergence of 3D printing creates countless opportunities to enhance aspects of medical and healthcare training. 3D-printed anatomical models can be successfully produced from cadaveric tomography datasets. These models can be used in anatomy education as a teaching tool in its own right, as well as a method to augment the curriculum and complement established learning modalities such as dissection-based teaching[37].

Brazilian researchers studying printed anatomical pieces that make up the base model showed great accuracy in replication, in which they observed that the printed bones maintain the same length, width, and thickness as the bones in natura with rich details[38]. In the hip bone, the acetabulum impressions maintained the depth and shape of the concavity of the acetabular fossa; the dorsal acetabular edges were perfectly visible and had the same thickness as the original bone; the obturator foramina maintained their oval shape and symmetry with each other, in addition to the other characteristic anatomical structures[38].

In this way, we can say that 3D printing faithfully maintains the details of anatomical accidents, avoiding structural errors that occur in several synthetic parts sold on the market.

Among the benefits derived from 3D printing of models, we can highlight the low economic cost of manufacturing, biosafety, and potential to favor the learning and teaching of morphology. However, it is necessary to analyze the perception and benefits in student learning resulting from the application of models through quantitative and qualitative assessment techniques[39].

Conclusion

3D printing is a versatile tool in the anatomy teaching and learning process, it demonstrates several learning benefits for students of Medicine and Health Sciences. Applications for the development of technological teaching include the use of specific 3D models to demonstrate anatomical variations and structures that are injured during dissection and for the planning of surgeries as well as for undergraduate and graduate medical teaching. However, it is necessary to analyze the perception and benefits of student learning derived from the application of models through quantitative and qualitative assessment techniques and long-term knowledge retention. A limiting factor these days is the high price of printers and filaments and resins, associated with difficulties in replacing printer parts in the domestic market.

Funding sources: No Funding was received.

Ethical approval: Not applicable.

References

1. Oliveira, P. S. *et al*. The teaching of human anatomy in Brazil: the reality of northeast Brazil. Inter Jour of Anat and Res 2017;5:4623–4629.
2. Fang, X. Plastinated Human Samples Are Efficient Tools In Anatomy Teaching. The FASEB Jour 2020;34:1–1.
3. Narnaware, Y. R. & Neumeier, M. Use of a virtual human cadaver to improve knowledge of human anatomy in nursing students: research article. Teach and Lear in Nurs 2021:16;309–314.
4. Deng, X. *et al*. Effectiveness evaluation of digital virtual simulation application in teaching of gross anatomy. An of Anat - Anatomischer Anzeiger 2018:218;276–282.
5. Balta, J. Y., Cronin, M., Cryan, J. F. & O'Mahony, S. M. The utility of cadaver-based approaches for the teaching of human anatomy: A survey of British and Irish anatomy teachers. Anat Sci Educ 2017:10;137–143.
6. AbouHashem, Y., Dayal, M., Savanah, S. & Štrkalj, G. The application of 3D printing in anatomy education. Med Educ On 2015:20;29847.
7. Vieira, P. R. A Utilização do Cadáver para Fins de Estudo e Pesquisa Científica no Brasil. Rev Bras Educ Med 2021:25;60–63.
8. Medeiros, N. W. M., Brandolfi, J. de A. & Longen, W. C. Análise ergonômica dos postos de trabalho em um laboratório de anatomia humana: riscos ocupacionais inerentes à saúde do trabalhador. Inova Saúde 2017:6.
9. Pereira, K. F., Santos, F. F. dos, Minuzzo, L. G. & Salles, V. E. R. Dissecação anatômica como estratgia para estudo do sistema neurinal em fetos humanos. Arq de Ciên da Saú da UNIPAR 2023:27;291–312.
10. Mcmenamin, P. G., Quayle, M. R., Mchenry, C. R. & Adams, J. W. The production of anatomical teaching resources using three-dimensional (3D) printing technology. Anat Sci Educ 2014:7;479–486.
11. Fasel, J. H. D. *et al*. Adapting anatomy teaching to surgical trends: a combination of classical dissection, medical imaging, and 3D-printing technologies. Surg and Rad Anat 2015:38;361–367.
12. Bardeen, C. R. The Use of Radiology in Teaching Anatomy. Radiology 1927:8;384–386.
13. Silva, V. A., Vilela, D. M., Gonçalves, F. R. & Regacini, R. First-year medical undergraduate students opinion about the use of radiology in gross anatomy course. Jour of Morph Scien 2016:33;55–61.
14. Backhouse, S., Taylor, D. & Armitage, J. A. Is This Mine to Keep? Three-dimensional Printing Enables Active, Personalized Learning in Anatomy. Anat Sci Educ 2019:12;518–528.
15. Aimar, A., Palermo, A. & Innocenti, B. The Role of 3D Printing in Medical Applications: A State of the Art. J Healthc Eng 2019.
16. Vaccarezza, M. & Papa, V. 3D printing: a valuable resource in human anatomy education. Anat Sci Int 2015:90;64–65.
17. Sun, Z. & Lee, S.-Y. A systematic review of 3-D printing in cardiovascular and cerebrovascular diseases. The Anat Jour of Cardio 2017:17;423–435.
18. Li, Z. *et al*. Three-dimensional printing models improve understanding of spinal fracture—A randomized controlled study in China. Sci Rep 2015:5;11570.

19. Chen, S. *et al*. The role of three-dimensional printed models of skull in anatomy education: a randomized controlled trail. Sci Rep 2017:7.
20. Yi, X. *et al*. Three-Dimensional Printed Models in Anatomy Education of the Ventricular System: A Randomized Controlled Study. World Neurosurg 2019:125;e891–e901.
21. Su, W., Xiao, Y., He, S., Huang, P. & Deng, X. Three-dimensional printing models in congenital heart disease education for medical students: a controlled comparative study. BMC Med Educ 2018:18.
22. Hojo, D. *et al*. Utility of a Three-Dimensional Printed Pelvic Model for Lateral Pelvic Lymph Node Dissection Education: A Randomized Controlled Trial. J Am Coll Surg 2019:229;552-559.e3.
23. Weeks, J. K. *et al*. Harnessing Augmented Reality and CT to Teach First-Year Medical Students Head and Neck Anatomy. Acad Radiol 2021:28;871–876.
24. Phillips, A. W., Smith, S. G. & Straus, C. M. The Role of Radiology in Preclinical Anatomy: A Critical Review of the Past, Present, and Future. Acad Radiol 2013:20;297-304.e1.
25. Átila, A. P., Rodrigues, M. do S. de S., Alexandre, J. weliandre C. & Adriola, W. B. Tecnologia em radiologia: estudo comparativo do uso de métodos do diagnóstico por imagem no ensino da anatomia humana. Educitec - Rev de Est e Pesq sobre Ensi Tecno 2019:5;210–233.
26. Sérgio, A. V. B., Lima, F. T. V., Silva, L. R. & Silva, R. F. Importância da radiologia no diagnóstico do câncer no intestino grosso (colorretal). Rev Bra Interd Saú 2023:5;39–43.
27. Chagas Neto, F. A. das *et al*. A importância do diagnóstico por imagem na classificação dos endoleaks como complicação do tratamento endovascular de aneurismas aórticos. Radiol Bras 2010:43;289–294.
28. Santos, C. M. D. C., Pimenta, C. A. D. M. & Nobre, M. R. C. A estratégia PICO para a construção da pergunta de pesquisa e busca de evidências. Rev Lat-Ame de Enf 2007:15;508–511.
29. Galvão, T. F. & Pereira, M. G. Revisões sistemáticas da literatura: passos para sua elaboração. Epi e Serv de Saú 2014:23;183–184.
30. Carmo, F. M. A. *et al*. The Didactic Contract from the Perspective of the Theory of Didactical Situations: An Integrative Review. Int J Innov Educ Res 2020:8;123–134.
31. Page, M. J. *et al*. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. Inter Jour of Sur 2021:88;105906.
32. Marker, D. R., Bansal, A. K., Juluru, K. & Magid, D. Developing a Radiology-Based Teaching Approach for Gross Anatomy in the Digital Era. Acad Radiol 2010:17;1057–1065.
33. Blau, S., Phillips, E., O'Donnell, C. & Markowsky, G. Evaluating the impact of different formats in the presentation of trauma evidence in court: a pilot study. Aust Jour of Fore Scien 2018:51;695–704.
34. Baier, W., Warnett, J. M., Payne, M. & Williams, M. A. Introducing 3D Printed Models as Demonstrative Evidence at Criminal Trials. J Forensic Sci 2018:63;1298–1302.
35. Shin, S. *et al*. Development of a gastroretentive delivery system for acyclovir by 3D printing technology and its in vivo pharmacokinetic evaluation in Beagle dogs. PLoS One 2019:14;e0216875.
36. Kamishina, H. *et al*. Clinical application of 3D printing technology to the surgical treatment of atlantoaxial subluxation in small breed dogs. PLoS One 2019:14;e0216445.
37. Smith, C. F., Tollemache, N., Covill, D. & Johnston, M. Take away body parts! An investigation into the use of 3D-printed anatomical models in undergraduate anatomy education. Anat Sci Educ 2018:11;44–53.
38. Nunez, R. Y. G. *et al*. 3D printing of canine hip dysplasia: anatomic models and radiographs. Arq Bras Med Vet Zootec 2020:72;769–777.
39. Toledo-Ordoñez, I. *et al*. Design and manufacturing of 3d printed models as a complement for medical histology practical classes. Int. J. Morphol 2022:40;355–359.

Received: March 8, 2023
Accepted: May 7, 2023

Corresponding author
Renata Souza
E-mail: renatasosi@alu.ufc.br