*Section A -Research paper*

# India in 2020 teaching human anatomy without cadavers

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**Abstract**

A key component of medical education is the teaching of human anatomy, which gives students a fundamental grasp of the composition and operation of the human body. The main way of teaching anatomy in the past has been through cadaver dissection, however this method is become harder to use because of logistical, financial, and ethical issues. These issues have been made even more difficult by the COVID-19 pandemic, which has compelled many anatomy labs and medical schools to cease corpse dissection due to safety worries and limitations on in-person gatherings.

The utilization of virtual dissection tables, 3D models, and simulation technology are a few alternatives to the traditional ways of teaching anatomy that are becoming more and more popular as a result. These methods are more cost-effective, more accessible, and better able to model a wide range of anatomical variances and diseases than traditional cadaver dissection.

With an emphasis on the difficulties presented by the COVID-19 epidemic and the utilization of alternate methods for teaching human anatomy, this study seeks to provide an assessment of the current situation of anatomy education in India in 2020. We examine the advantages and drawbacks of these different approaches through a review of the literature, as well as their potential to influence how anatomy is taught in medical colleges all throughout India.

The effectiveness of these alternate approaches to teaching anatomy, such as virtual dissection tables, 3D models, and simulation technology, has been supported by numerous research, which we found. These strategies do have some limits, though, and cadaver dissection is still the principal way that many academic institutions and instructors teach anatomy.

In conclusion, this research emphasizes the necessity of an innovative and diverse approach to anatomy instruction in India, especially in view of the difficulties brought on by the COVID-19 pandemic. We come to the conclusion that the use of alternative anatomy teaching techniques has the potential to raise the caliber and accessibility of anatomy

instruction in India while simultaneously addressing some of the problems associated with conventional cadaver dissection.

**Keywords**: Anatomy education, Cadaver dissection, Alternative methods, Virtual dissection tables, 3D models, Simulation technology

## Introduction

Human anatomy instruction has long been a cornerstone of medical education, providing the groundwork for comprehending the composition and operation of the human body. The gold standard for teaching anatomy has long been cadaver dissection, which gives students a practical learning experience. However, due to a variety of factors, such as financial concerns, logistical limitations, and ethical concerns, the use of cadavers in medical education has grown more difficult in recent years [1,2].

These difficulties have been made even worse by the COVID-19 pandemic, which has compelled numerous anatomy labs and medical schools to halt corpse dissection due to safety worries and limitations on in-person gatherings. This has posed a huge issue for both teachers and students in India, where medical education is highly esteemed and revered [3,4].

Alternative approaches to teaching human anatomy are becoming more popular as a result of these difficulties, including the use of virtual dissection tables, 3D models, and simulation technology. Compared to traditional cadaver dissection, these methods have a number of benefits, such as cost effectiveness, improved accessibility, and the capacity to model a wide variety of anatomical variances and diseases [5,6].

Although the use of these alternatives to traditional teaching methods is not new, their uptake has been slow and uneven, and many educators and institutions still rely on cadaver dissection as the main approach to teaching anatomy. With an emphasis on the difficulties presented by the COVID-19 epidemic and the utilization of alternate methods for teaching human anatomy, this study seeks to provide an assessment of the current situation of anatomy education in India in 2020. We will examine the advantages and drawbacks of these different approaches through a review of the literature, as well as how they can influence the way that anatomy is taught in medical colleges all throughout India [7–10].

## Virtual Dissections

Virtual dissection is a different approach to teaching anatomy that simulates the dissection procedure using computer software. Users of these tools may often alter a computer representation of the human body, zoom in on particular features, and remove tissue layers to reveal deeper features.

The affordability of virtual dissection is one of its main benefits. Virtual dissection software can be acquired for a reasonable price and utilized on common computer hardware, unlike cadaver dissection, which necessitates expensive equipment and constant maintenance.

Because of this, virtual dissection is a desirable option for anatomy labs and medical institutions with little funding.

The accessibility of virtual dissection is another benefit. Virtual dissection can be carried out remotely without using a cadaver, allowing students to study anatomy from any location with an internet connection. Due to the COVID-19 pandemic, several anatomy labs and medical institutions have been compelled to discontinue in-person instruction in favor of online instruction.

Virtual dissection has been shown to be an effective tool for teaching anatomy in numerous research. For instance, a research in the Journal of Digital Imaging discovered that virtual dissection software users considerably outperformed students who acquired anatomy through traditional cadaver dissection on exams [1,4-7]. Virtual dissection was discovered to be particularly useful for teaching complicated anatomical structures, such as the cranial nerves, in another study that was published in the Journal of Biomedical Education [2,5,7].

Virtual dissection does have some restrictions, though. The absence of tactile feedback that students would typically receive during traditional corpse dissection is one of the main difficulties. Understanding the density and texture of various tissues, as well as the three-dimensional interactions between structures, may be more challenging for students. The potential for software bugs and errors is another drawback of virtual dissection. Even though virtual dissection software is becoming more sophisticated, there is still a chance that it may not accurately depict the intricate details of the human body. If students have only learned about anatomy through digital means, it may be harder for them to apply their knowledge to practical situations [8,9].

Despite these drawbacks, virtual dissection is still a promising replacement for the standard cadaver dissection in anatomy classes. For medical schools and anatomy labs, it is a desirable option because to its affordability, accessibility, and effectiveness, especially in India where resources may be few. Virtual dissection software will probably become a more significant part of anatomy instruction in India and elsewhere as technology develops and it gets more advanced.

**Multimedia Resources**

Digital media is used as a supplement to traditional lectures and textbook readings in multimedia resources, a form of alternative technique for teaching anatomy. These materials may come in a range of media, including movies, animations, interactive software, and online tests.

Multimedia resources' capacity to graphically and interactively convey complicated anatomical concepts is one of its main advantages. This can be especially beneficial for kids who may find it challenging to understand complex ideas through reading alone. Multimedia resources can also give students the chance to interact with anatomy in a flexible and self-paced way, enabling them to review material as necessary and adjust their learning to suit their particular needs.

The AnatomyZone YouTube channel is one illustration of a multimedia resource that has grown in popularity in recent years. This channel offers a wide range of anatomy-related videos, including quizzes, 3D animations, and dissection demonstrations. The channel has over 500,000 followers and is frequently suggested by educators and medical students as a useful addition to conventional anatomy classes [10].

The Complete Anatomy app is another illustration of a multimedia tool since it gives users access to a detailed, 3D digital model of the human body that can be examined and modified. The app has a library of educational materials that covers a wide range of anatomical themes, interactive quizzes, and tours of various anatomical structures. The software has won praise for its user-friendly interface and thorough content from medical professionals and students all across the world [11].

Although multimedia resources can be a useful addition to a traditional anatomy education, they do have some drawbacks. The possibility for information overload is one of the main difficulties. Students may find it difficult to choose the materials that are most pertinent to their learning objectives because there are so many different sorts of resources available. Before recommending multimedia resources to students, educators should carefully vet and curate them due to the wide variations in the quality and accuracy of these resources.

The potential for an excessive reliance on digital media is yet another drawback of multimedia tools. The tactile sensation of physically dissecting a cadaver or peering at a real specimen cannot be replaced, even though these materials might be useful for visualizing anatomical structures and processes. To ensure that students gain a thorough understanding of anatomy, educators must strike a balance between the use of multimedia tools and hands-on learning opportunities [12–14].

Despite these drawbacks, multimedia resources are still an effective teaching tool for anatomy, especially when there are few resources available or the classroom is far away. It's conceivable that as technology develops, even more cutting-edge and potent multimedia solutions for anatomy instruction will be created.

In conclusion, the COVID-19 epidemic has brought about substantial changes in anatomy education in India, emphasizing the necessity for new approaches to the subject. While cadaver dissection still plays a significant role in anatomy education, newer approaches like virtual dissection and multimedia resources are gaining popularity and efficiency. These approaches have benefits like affordability, accessibility, and improved visual learning chances. They do, however, also bring with them problems like information overload and the risk for excessive dependency on digital media. Teachers can make sure that students receive a thorough and efficient education in anatomy by carefully balancing the use of alternative methods with traditional teaching methods.

**Simulation Models**

Another alternate approach to teaching anatomy that has gained popularity recently is the use of simulation models. These models imitate anatomical structures and processes using

computer programs, giving students a hands-on and engaging learning environment. A wide range of anatomical ideas, including fundamental anatomy and physiology, surgical techniques, and clinical scenarios, can be taught via simulation models.

The capacity of simulation models to give pupils hands-on experience in a secure and controlled setting is one of their main benefits. When teaching complicated procedures or exposing students to uncommon or rare cases that might be difficult to access in a traditional classroom setting, this can be especially helpful. Additionally, by enabling students to explore and manipulate anatomical structures in a dynamic and interactive way, simulation models can aid in the development of students' critical thinking and problem-solving abilities.

The Visible Body software package is one illustration of a simulation model used in anatomy instruction. A virtual dissection lab, an interactive physiology and pathology module, a 3D atlas of human anatomy, and other interactive models and simulations are all included in this package. The software has won praise for its thorough information and user-friendly design from medical schools and experts around the world [15].

The Anatomage Table, a life-sized interactive anatomy table that employs augmented reality and 3D images to produce a realistic and immersive learning experience, is another illustration of a simulation model. Students can study and manipulate anatomical features in-depth using a range of interactive models and simulations in the Anatomage Table. The table has earned praise for providing a realistic and interesting learning environment and has been utilized at medical schools and hospitals all around the world [16].

Although simulation models can be a useful tool for teaching anatomy, they do have some drawbacks. The expense of purchasing and maintaining the appropriate hardware and software is one of the key difficulties. Simulator models can be costly to buy and operate, which limits their usability in universities with little funding. Furthermore, simulation models might not be able to completely replicate the tactile experience of handling real specimens, which could be a drawback for students who prefer hands-on instruction. Another drawback of simulation models is that they run the risk of making children overly dependent on technology. The critical thinking and problem-solving abilities that are formed through hands-on learning experiences cannot be replaced by simulation models, even though they can offer a realistic and captivating learning experience. In order to give students a thorough and well-rounded education in anatomy, educators must strike a balance between the use of simulation models and other teaching techniques [17–19].

In conclusion, simulation models are a useful tool for teaching anatomy, especially when there are few materials available or if you want to expose your students to unique or rare cases. These models provide benefits including interactive functionality, the capacity to mimic intricate processes, and hands-on experience. But they also come with drawbacks like high costs and the potential for excessive reliance on technology. Teachers may make sure that students receive a thorough and efficient education in anatomy by carefully combining the usage of simulation models with conventional teaching approaches.

**Evaluation and Future Directions**

During the pandemic, India used the above-discussed methods to teach human anatomy. To guarantee the efficacy of these measures, however, constant evaluation and improvement are required. Virtual dissections and multimedia tools have been found to be useful in teaching anatomy, although further research is required to assess their effects on student learning outcomes [19,20]. Additionally, more research is required to determine the best materials and methods for building these models as well as to assess the effectiveness of simulation models in anatomy education.

Even after the epidemic, it's likely that virtual and simulation-based anatomy instruction will spread more widely. Particularly in nations with limited infrastructure or resources for cadaveric dissection, these technologies have the potential to offer students a more adaptable, accessible, and engaging educational experience [20]. But it's crucial to make sure that these technological advancements are successful in achieving learning objectives and do not undermine the fundamental tactile and sensory experiences of anatomy education.

**Conclusion**

Global medical education has faced considerable obstacles as a result of the COVID-19 pandemic, particularly when it comes to teaching human anatomy without the use of cadavers. Virtual dissections, multimedia resources, and simulation models have all been used in India to offer alternative methods of teaching anatomy. These tactics have benefits and drawbacks, therefore continual review and development are required to maintain their efficacy. Although virtual and simulation-based anatomy education has the potential to give students a more adaptable, accessible, and interesting learning experience, it is crucial to make sure that these technologies do not interfere with the vital tactile and sensory experiences of anatomy education.

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