

Benefits and pitfalls of learning anatomy using the dissection module in an indian medical school: A millennial Learner's perspective

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ABSTRACT

Background: For generations, the use of cadavers has been the chief pillar for learning anatomy. However, the limited availability of cadavers and the advent of modern technologies in learning have led to the use of substitutes such as prosection, anatomical models, and audio-visual (AV) aids. The current study was therefore undertaken to seek students' opinions regarding the usefulness of the traditional dissection module in the modern era of teaching-learning.

Methodology: The questionnaire-based study involved 145 medical undergraduate students exposed to dissection in anatomy during their first year (2018–19). Three themes were identified based on the students' responses. They were advantages of learning anatomy by dissection, disadvantages of learning anatomy by dissection, and dissection classes versus other educational resources used in learning anatomy. The students' opinions related to the themes were considered.

Results: The majority of the students stated that the act of dissection deepens one's understanding (91.8%) and provides a three-dimensional perspective of structures (92.4%). A group of students felt that the dissection is time-consuming (57%) and prosection (64.6%) helped them gain information quicker. However, when asked whether dissection should be eliminated from the curriculum, the majority (86%) of the students disagreed. However, the students agreed that dissection should be supported by educational tools (74%).

Conclusion: The study strengthens the belief of using dissection for better anatomy learning and adds that dissection hall teaching is the best approach for anatomy teaching-learning. Millennial learners prefer the act of dissection to learn practical anatomy and consider the recent advances such as simulator-based education, video demonstrations, virtual and augmented reality only as supplements.

1. Introduction

The art and science of Medicine are defining the problem with as much precision as possible. Identifying the anatomical site of the lesion is crucial if a physician is to resolve the issue effectively and compassionately [1].

Therefore, a sound knowledge of anatomy is essential from the beginning of medical education. It is possible only by exposing and examining the tissues and structures within the body, best revealed and studied by dissection [2].

For centuries, the whole idea of anatomy teaching-learning is all about "dissection" of the body. For generations, the use of cadavers has been the chief pillar for learning anatomy. However, factors such as lack of time to dissect, limited availability of cadavers, difficulties imposed by the ethical issues for their use; have left the students with the option

of using pre-dissected/prosected specimens or cadavers for their study [3]. The students are deprived of the privileges of dissecting a human body to study anatomy. Further, the advent of modern technologies in learning has led to the use of substitutes such as anatomical models, simulation, AV aids, YouTube videos, and virtual (VR)/augmented reality (AR) tools [4,5].

The students have also evolved as millennial learners. Unlike their generation X predecessors, the millennial generation is technologically well informed and prefers technology-based learning practices. Students have immediate access to vast amounts of information, and learning tools including YouTube videos, and VR/AR [6]. However, the effectiveness of these modern modalities in meeting the practical needs of anatomy is debatable.

A substantial appreciation of human anatomy is still a necessary part of understanding pathology and treatments. Therefore, considering

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these changes, the following queries were posed: Can dissection still be considered as a valuable learning tool for exploring human anatomy? Or are there other options/methods that students can undertake to develop their anatomical knowledge?

The current study aims to seek the students' perceptions on the usefulness of the dissection module to understand the intricacies of human anatomy in the modern teaching-learning era.

2. Material and methods

The present cross-sectional study recruited 250 undergraduate medical students involved in cadaveric dissection during their first year. The study was approved by the Institutional Ethics Committee (IEC 28/2017). All the students were given an option to participate or to decline participation in the study. Informed consent was taken from the students who agreed to participate.

A questionnaire was constructed to acquire the students' feedback on the benefits and pitfalls of learning anatomy via the dissection module. Three themes/sections were identified based on the student responses to assess the usefulness of the dissection module in the modern teaching-learning era. Each theme/section included a set of relatable statements/questions to which the students had to respond (provide choices). The themes were:

- Advantages of learning gross anatomy by dissection
- Disadvantages of learning gross anatomy by dissection
- Dissection classes versus other educational resources used in learning anatomy

2.1. Quantitative analysis

A 5-point Likert scale was used to score the responses ranging from 'strongly disagree' to 'strongly agree' in every section. The results were expressed in frequency (N) and percentages (%). The data were recorded and analyzed using SPSS version 16 (SPSS Inc., Chicago, IL).

2.2. Qualitative observations

The last part of the questionnaire had a 'comments' section wherein the students were free to express their opinions on learning anatomy through dissection. Selected responses have been paraphrased and presented.

3. Results

Out of 250 students, 146 (52 males and 94 females) responded to the survey. The age group of the students ranged between 19 and 21 years.

The undergraduate students involved in cadaveric dissection during their first year of Medicine were invited to express their views on the three themes identified.

3.1. Advantages of learning anatomy by dissection

The millennial learners' perception of the 'advantages of learning gross anatomy by dissection' is displayed in [Table 1](#).

In addition to the responses, a few students have also added that the variations that they came across during routine dissection were interesting to follow.

"Encountering rare variations during routine dissection was highly enticing" (Female student).

"Seeing cadavers with kidney transplantations, artificial joints, etc. was an interesting experience!" (Male student).

The students had reported visualizing the signs of surgical

Table 1

Millennial learners' perception on the 'Advantages of learning gross anatomy by dissection'.

Questions	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)
The act of dissection deepens my understanding	5 (3.4%)	0	7 (4.8%)	47 (32.2%)	87 (59.6%)
Dissection provides three-dimensional perspective of structures	4 (2.7%)	1 (0.7%)	6 (4.1%)	38 (26%)	97 (66.4%)
It helps me recall what I have learnt	4 (2.7%)	1 (0.7%)	13 (8.9%)	48 (32.9%)	80 (54.8%)
It makes learning more interesting	3 (2.1%)	1 (0.7%)	7 (4.8%)	45 (30.8%)	90 (61.6%)
It prepares me for surgery by getting used to the idea of cutting into a human body	4 (2.7%)	4 (2.7%)	21 (14.4%)	54 (37%)	63 (43.2%)
It enhances my respect towards human body	4 (2.8%)	3 (2.1%)	19 (13.1%)	49 (33.8%)	70 (48.3%)

procedures such as kidney transplantation, hysterectomy, artificial joints, etc. persistent in some cadavers. The students also noted gross anatomical variabilities such as diaphragmatic hernia, hydroureter, and neurovascular variations.

3.2. Disadvantages of learning anatomy by dissection

The millennial learners' perception of the 'disadvantages of learning gross anatomy by dissection' is represented in [Table 2](#).

Some students even added that the dissection tables are too crowded and not all get an opportunity to dissect.

Table 2

Millennial learners' perception on the 'Disadvantages of learning anatomy by dissection'.

Questions	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)
The act of dissection is stressful	10 (6.9%)	59 (41%)	47 (32.6%)	27 (18.8%)	1 (0.7%)
Dissection demands a lot of physical work	5 (3.5%)	29 (20.1%)	51 (35.4%)	55 (38.2%)	4 (2.8%)
It is time consuming	6 (4.2%)	30 (20.8%)	51 (35.4%)	48 (33.3%)	9 (6.3%)
The smell is unpleasant while dissecting	3 (2.1%)	9 (6.3%)	52 (36.1%)	56 (38.9%)	24 (16.7%)
It is difficult to identify structures by self-dissection	10 (6.9%)	20 (13.9%)	38 (26.4%)	57 (39.6%)	19 (13.2%)
Prosection (Pre-dissected specimens) helped me to get to the important information quicker without spending extra time on dissection	7 (4.9%)	12 (8.3%)	32 (22.2%)	67 (46.5%)	26 (18.1%)

“There used to be many people around the table. It was too crowded. Only the same students got to dissect every day! Some of us had to just sit and read at times” (Female student).

3.3. Dissection classes versus other educational resources used in learning anatomy

When asked whether dissection should be removed from the curriculum, the majority of the students disagreed (86%) (Fig. 1). A few of the students also commented that dissection cannot be replaced by any other educational tool.

“Dissection can never be replaced by any other educational tool in learning anatomy” (Female student).

“We followed YouTube videos, but they were only for revision. Nothing could replace dissection” (Male student).

“YouTube videos help us follow the concept. But it does not provide a 3D understanding of the structures” (Male student).

The students’ perception about ‘dissection classes versus other educational resources used in learning anatomy’ is also represented in Table 3.

Overall observations indicated that the dissection module should be supported by other educational tools (plastinated specimens, video demonstrations, dissected specimens) (74%) for a better learning experience (Fig. 2).

4. Discussion

Gross anatomy is one of the fundamental topics in a medical curriculum and is commonly studied using the dissection module. Sound knowledge of anatomy is essential from the beginning of medical education. It is possible only when a student is exposed and permitted to examine the tissues and structures within the body. The same is better revealed and studied by dissection [2].

However, in recent times, students have retorted to the use of pre-dissected/prosected specimens or cadavers for their study. This may be due to factors such as lack of time to dissect, shortage in availability of cadavers, and the stringent ethical policies imposed on the procurement of cadavers.

Table 3

Millennial learners’ perception on the ‘Dissection classes versus other educational resources used in learning anatomy’.

Questions	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)
Time allocated for dissection should be more	12 (8.3%)	58 (40%)	45 (31%)	17 (11.7%)	13 (9%)
Dissection classes complement my learning of anatomy	3 (2.1%)	3 (2.1%)	8 (5.5%)	71 (49%)	60 (41.4%)
Dissection should be replaced by pre-dissected specimens	33 (22.6%)	55 (37.7%)	39 (26.7%)	13 (8.9%)	6 (4.1%)
Dissection should be replaced by videos of pre-dissected specimens	79 (54.5%)	41 (28.3%)	17 (11.7%)	6 (4.1%)	2 (1.4%)
Dissection should be replaced by YouTube videos, VR/AR	72 (49.3%)	50 (34.2%)	14 (9.6%)	6 (4.1%)	4 (2.7%)
Dissection should be replaced by didactic lecturers	80 (55.2%)	39 (26.9%)	23 (15.9%)	2 (1.4%)	1 (0.7%)
I prefer dissection classes over any other approach	5 (3.4%)	10 (6.9%)	29 (20%)	49 (33.8%)	52 (35.9%)
It would be advantageous if I attend dissection classes	4 (2.7%)	4 (2.7%)	8 (5.5%)	55 (37.7%)	75 (51.4%)

Further, the current generation of students is technologically sound. They prefer recent trends in learning and are abreast with all the modern learning tools. Therefore, the use of anatomical models, artificial organs, AV aids, VR/AR tools are also in practice as a part of technology-enhanced learning. Thus, students are deprived of the privileges of dissecting a human body to study anatomy [4,5].

By dissecting a cadaver, the student encounters the reality of life, morbidity and mortality, and the responsibility of a physician. It is best

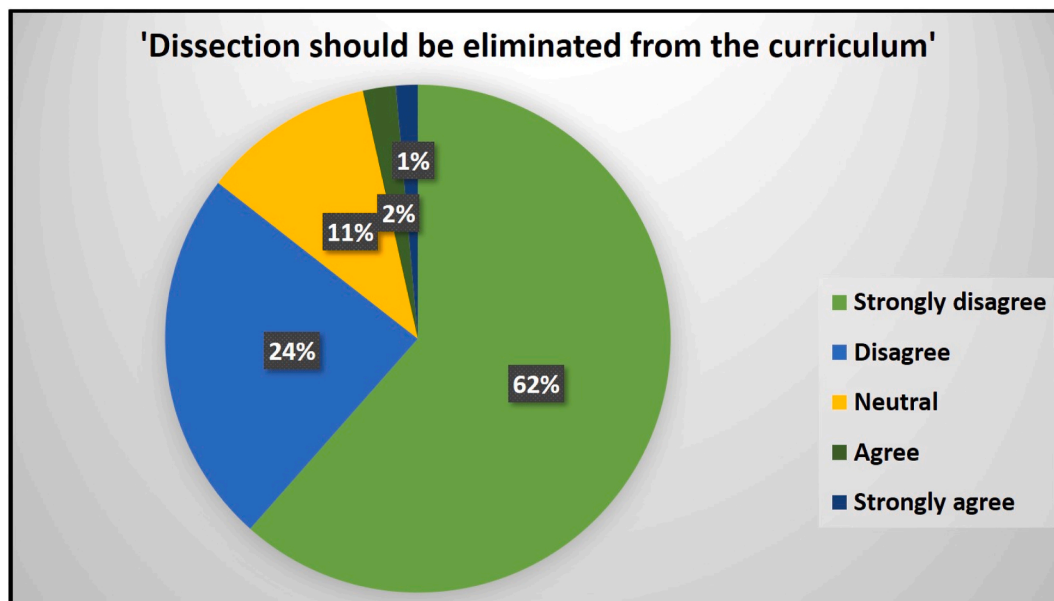


Fig. 1. Millennial learners’ perception of the statement (in percentage) ‘Dissection should be eliminated from the curriculum’.

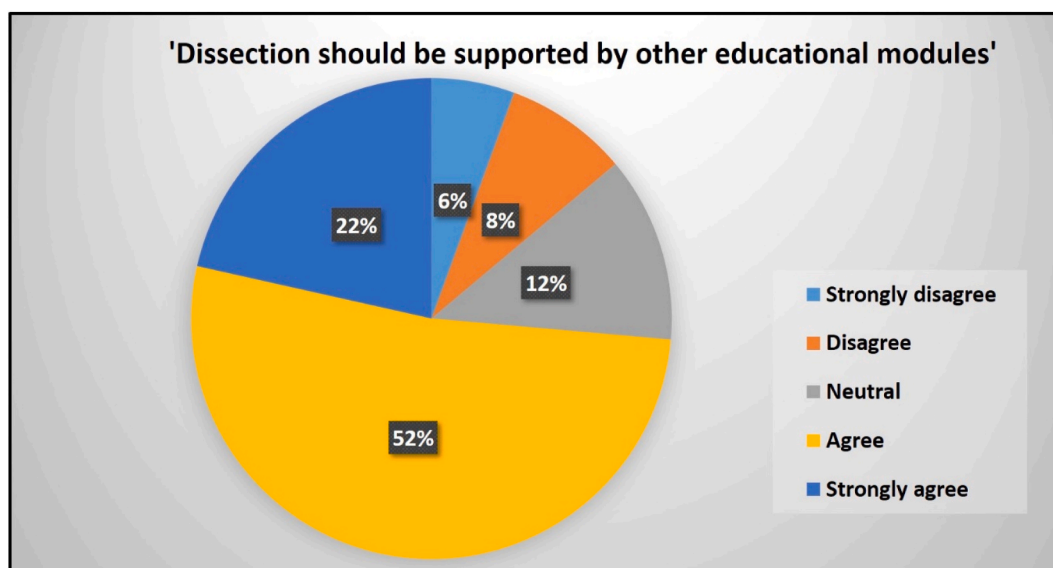


Fig. 2. Millennial learners' perception on the statement (in percentage) 'Dissection should be supported by other educational modules'.

to begin the anatomy teaching with the cadaver. The act of dissection reduces complexity and gives a better understanding of gross anatomy integrated into structure and function. It also provides a 3D visualization of the structures [7,8]. This understanding can be easily correlated to living [9,10]. Similar observations were made in the present study, as noted by the student responses.

"Anatomy by whole-body dissection (AWBD) significantly improves topographical anatomical knowledge" as stated by a study in the past. The study also concluded that the surgeon-facilitated AWBD permitted excellent acquisition and long-term retention of knowledge by the students [11].

Observations made in an earlier study revealed that the students disliked the aspect of prosections. It meant that they were disconnected from their human bodies. They preferred dissection to the prosected bodies [12].

Contrary to this belief, some students favored prosections/pre-dissected bodies over dissection as observed in another study [13]. The present study also observed students (64.6%) endorsing prosection (pre-dissected specimens) by stating that it helped them to get to the vital information quicker without spending extra time on dissection. However, 60.3% of the students expressed that dissection should not be replaced by pre-dissected specimens. Further, when asked whether dissection should be removed from the curriculum, the majority (86%) disagreed. Time constraints might have deterred them from involving in the act of dissection and they have found prosection as an easy alternative. Though, students preferred prosected specimens for learning to save time, dissection is still considered as an essential and most useful learning tool in anatomy.

The students' perspective revealed that the act of dissection deepens one's understanding (91.8%). The majority of the students agreed, saying dissection provides a three-dimensional view of structures (92.4%). It also helped them to quickly recall the concepts learned (87.7%), as was found in the present study.

Dinsmore et al. indicated that dissection puts undergraduates at the sharp end of medical education. They may experience anxiety and stress not as a detachment or indifference but as a defense mechanism, often coming for the first time, connecting with reality and a detached concern [14].

During dissection, students are subsequently able to overcome the stress/fear related to handling cadavers [15,16]. It, in turn, is replaced by professional curiosity and a positive learning experience of the

situation [14,17–19].

The act of dissection was not considered stressful by the majority of the students, as observed in the present study. However, it was stated that dissection demands a lot of physical work. The act of dissection is time-consuming, and the unpleasant smell while dissecting was one of the other concerns which were raised. Permitting the students to dissect at their leisure time (during the break-time) could address the time constraints. The unpleasant smell of formalin while dissecting could be avoided by considering alternate methods of preservation or fixatives that are less pungent.

Students (52.8%) have also stated that it is difficult to identify structures by self-dissection. The dissection table being crowded and not getting equal opportunities to dissect added to the disadvantages of learning anatomy via dissection. These issues can be sorted by making the students take turns while dissecting such that all get equal opportunity to dissect and learn. In addition, the entire process of dissection should be carried out under the supervision and guidance of the teacher to enhance learning.

One of the essential concepts in Medicine is biological variation. As students wander from one cadaver to the next in the dissection hall, they come across multiple anatomical variations associated with developmental anomalies. It may reveal something new, previously unknown, and especially crucial in the rapidly evolving field of developmental anatomy. Students will appreciate the actual complexity revealed by dissecting the whole body-the concept of individuality [2].

Human anatomical variations are common and are often of clinical importance, especially in invasive surgical procedures. The undergraduates will also learn about the various surgical procedures for the first time when encountered in different cadavers, for example, inserted pacemakers, artificial joints, and bypass vessels [20–22]. The present study had also identified the students reporting that they were enticed by visualizing the signs of surgical procedures such as kidney transplantation, hysterectomy, and artificial joints in some cadavers. The students also noted gross anatomical variabilities such as diaphragmatic hernia, hydrourerter, and neurovascular variations.

Current trends in undergraduate courses involve reduced exposure to dissection and dissected specimens, increased use of plastic bones, models, YouTube videos, and computer-generated images, which view the body as a fixed identical type or norm [2,23].

Using YouTube videos is a popular learning method and holds many benefits [24,25]. However, studies have shown that YouTube is an inadequate source of information for learning specific aspects of human

anatomy [26,27]. Further, some students might perceive using YouTube as challenging, time-consuming, and frustrating, similar to the act of cadaveric dissection as considered by other students [24]. In the present study, the students opined that YouTube videos on dissection were easy to follow but only for revising the topics already learned by dissection. It clarifies the concept but fails to provide a 3D understanding of the structures which otherwise can be easily attained by dissection.

Three-dimensional high-resolution VR and AR modalities can serve as a substitute for the cadaver itself or its parts [2,23]. However, they are not always user-friendly and require high-quality computers/internet connectivity for smooth functioning. Besides, the costs incurred to obtain a license that makes a virtual model available to a large number of students can be high. These issues may constrain the full or partial substitution of cadaver dissection by virtual models in medical schools in certain countries [24]. Further, these VR/AR modalities fail to provide a natural experience that is otherwise quickly gained from handling the cadaver. Therefore, they can only serve as an enhancement in addition to the anatomy learning by dissection.

Simulation-based training is yet another trending approach to teaching-learning anatomy. It is the second most frequent method of anatomy teaching next to dissection in many countries including North America [28]. High-fidelity parts of the body manikins are used to demonstrate anatomical structures. However, cadaveric dissection is still the most popular method as added by the authors. The authors have further opined that identification of anatomical structures during virtual surgical procedures or laparoscopic robotic procedures in simulation can be integrated into the traditional anatomy curriculum to enhance learning [28]. In the present study, the students opined that dissection should be supported by other educational modules and not replaced by them.

The sensation of touch between physician and patient is essential. It is best learned early in the dissection hall. Hands-on teaching on real cadavers is the first experience of the structural organization of the body, both at the surface and in-depth. It leads to a better understanding of the three-dimensional configuration of patients' anatomy [29].

Similar observations are made in the present study. Further, the students believed that dissection also provides an understanding of the effects of trauma/injury on the human body. It sensitizes them towards emergency procedures and prepares them for performing surgeries. Thus, dissection makes anatomy learning more enjoyable.

The use of dissection modules in undergraduate medical education not only permits better learning in anatomy but also familiarizes the students with concepts of professionalism, manual dexterity, teamwork, self and peer-evaluation, and ethics [7]. It thus helps in reshaping the attitude of novice medical students and helps them in their transformation into competent medical graduates. Therefore, in the millennial era, dissection is still considered the most relevant learning tool for anatomy. The newer modalities, such as simulation, plastination, YouTube videos, VR/AR, artificial organs, and AV aids only complement it [30].

The absence of cadaveric dissection in the curriculum may impair the student's ability to apply the scientific method during diagnosis [2]. The present study, too, agrees with the same and adds that dissection should not be eliminated from the curriculum. It is because dissection classes complement anatomy learning.

Considering all the positivity, the authors Institution continues to endorse 'the exposure to dissection and dissected specimens as a significant source of anatomy teaching-learning'. This practice has been well appreciated and successfully followed by the student community.

5. Limitations and practical implications

The current study can be extended involving more students from various academic years. The effectiveness of dissection versus other teaching tools in learning anatomy can also be explored. The student perceptions can further be correlated with their performance in the

examinations. Future investigations may be required to focus on how students learn from dissection and other teaching tools. The findings would aid the teachers in equipping themselves with better teaching pedagogies. Further, considering the current COVID scenario, catering to the practical needs of learning anatomy during a pandemic-induced worldwide lockdown also invites extensive research.

6. Conclusion

The study strengthens the belief of using dissection for better anatomy learning and adds that dissection hall teaching is the best approach for anatomy teaching and learning even in modern times. Irrespective of the students being millennial learners, dissection still holds a special place in their learning practices. The newer modalities such as simulation, VR/AR, plastination, 3D anatomical models, and AV aids may serve as supplements to enhance the teaching-learning process.

Ethics approval

The study has been approved by the Institutional Ethics Committee (IEC: 28/2017).

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Declaration of competing interest

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CRediT authorship contribution statement

Sneha Guruprasad Kalthur: Conceptualization, Methodology, Formal analysis. **Arvind Kumar Pandey:** Methodology, Writing – original draft. **Sushma Prabhat:** Methodology, Formal analysis, Writing – original draft.

Declaration of competing interest

None declared.

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