

# Medical Student Opinions of a Gross Anatomy Course Aided with Prosection

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## Abstract

Dissection manuals and color atlases are useful tools in the anatomy lab, but do not provide the important three-dimensional (3-D) relationships between structures. For the first time at the University of Arkansas for Medical Sciences (UAMS), a whole body prosection (A cadaver dissected by an expert anatomist for demonstration purposes) with important structures clearly marked was available to the first-year medical students (freshmen, M1) taking a 16-week gross anatomy course. In order to determine student opinions about its usefulness, a brief online survey was prepared using a Likert scale (1= not useful; 5 = very useful). A total of 95/160 students of the class of 2016 voluntarily completed the survey, and responses were subsequently deidentified. Most students believed the prosection was very useful for their overall understanding of anatomy (4.37/5); mixed response was obtained about the usefulness of the prosection for exam preparation (3.90/5); but the response was very positive concerning the usefulness of prosection in aiding dissection (4.52/5). Of the 95 participants, 71 indicated the prosection did not diminish dissection manual use, while six answered, "yes, a lot." Virtually all responding students (94/95) believe a prosection will be useful in a compressed, eight-week gross anatomy course. Over 90% of the participants (88) used the prosected cadaver during lab hours, while 24% also used the prosection outside normal lab hours. Many students used the prosection with or without a faculty demonstrator during their regular lab hours and also for review before an exam. Students felt the prosection was a valuable learning tool in the dissection laboratory and should be continued in the future.

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## INTRODUCTION

Anatomy, which has long been considered one of the foundations of medicine (1, 2), is generally regarded by most medical students as a vast collection of information (e.g., origins, insertions, innervations, etc.) they should memorize. They are often overwhelmed with learning complex details with little attention paid to understanding the clinical relevance of the material (3). Therefore, many students fail to correlate the basic anatomical information they are learning with its future application in the clinic as a physician (4-7). This, in turn, presents an uninteresting face of anatomy to students, thus making learning laborious and unrewarding.

The most suitable and educationally effective delivery method of gross anatomy knowledge is an ongoing debate. Several methods and strategies were tested, but there was no consensus on the best teaching modality (8). For centuries, full cadaver dissection was considered the only acceptable way of teaching medical gross anatomy, and this traditional way of teaching gross anatomy using cadaver dissection still continues at most allopathic and osteopathic medical schools (2,9,10). Importantly, dissection of the human body not only promotes an understanding of structure and function, it also acts as the student's first "patient," which plays an important psychological role in the development of a competent physician (11-14).

Most medical school administrators appreciate the importance of cadaveric dissection. However, they also realize teaching gross anatomy via cadaveric dissection is resource intensive in a number of ways and creates several challenges. These challenges may include one or more of the following: reduction of hours for teaching gross anatomy in order to make time for additional accreditation-required information added to the medical school curriculum (2), hiring difficulties due to a shortage of qualified anatomists (15), and funding a body donation program accompanied with obtaining, embalming, and maintaining a sufficient number of cadavers (1).

To mitigate the above challenges, several schools have tested alternative methods of teaching gross anatomy. These alternatives include hybrid approaches of combining dissection and prosection (16) or alternating dissection with student-to-student peer teaching in every other lab session (17,18). Recent advances in technology have given rise to several computer programs where an electronic cadaver can be "virtually dissected." These devices, such as the Virtual dissection table (Anatmage, San Jose, CA) or the Sectra table (ToLTech, Aurora, CO), are becoming popular aids to teaching gross anatomy, and in some medical schools the use of these virtual cadavers has replaced cadaveric dissection. For years, many medical schools used plastinated specimens and/or high quality models to supplement cadaveric dissection (17).

To date, no single alternative teaching tool has been found that is superior to cadaveric dissection, where students, by examining the many bodies being dissected by their classmates, can appreciate the subtle differences in the anatomy from one cadaver to another and even learn from some of the pathologies or anatomical variations they may uncover. However, the best results for teaching gross anatomy can be achieved by combining multiple pedagogical resources to complement one another, and students appear to learn more effectively when multimodal and system-based approaches are integrated (19).

From at least the 1980's, student comments obtained from the University of Arkansas for Medical Sciences (UAMS) gross anatomy course evaluations have consistently requested a prosected body to examine during dissection labs. (The same request is made yearly by students at Campbell University, whose osteopathic medical school was started in 2013.) In the 2012-2013 academic year, the UAMS gross anatomy course was revised so that there were five students per cadaver (versus four per cadaver) and dissection time was reduced from 2.5 to 2 hours per lab session. Because of these changes, the authors felt that a "tagged" prosection (in this case a male body) was needed in order to increase efficient student use of the reduced laboratory time. The current study was conducted to determine if the students felt the prosected cadaver was a useful adjunct to their dissection experience.

## METHODS

Before the beginning of the gross anatomy course, where the students performed their dissection, an anatomy faculty member (BWN) prosected a single male cadaver. An immersion tank was used to store the cadaver to ensure hydration of the prosected material. Just before the beginning of a laboratory session, various structures were "tagged" using quilting pins with different colored heads (Figure 1), and the key to the pinned structures was written on an adjacent whiteboard. At times during the two-hour laboratory session, various faculty members would answer student questions about the prosection. At the end of the laboratory session, the pins were removed (in order to prevent potential rusting of the pins), the cadaver submerged and the immersion tank closed. Students were informed they could examine the prosection at any time during non-course hours.

An eight-question survey instrument with three 5-level Likert scale items was developed for this study (Supporting File S1. Medical Student Opinions – Survey instrument). Voluntary participation of students was solicited online via UAMS electronic mail. The students were informed that participation or non-participation would have no impact on their gross anatomy course grade. No direct or indirect compensation was offered for the participation in the study. The survey was sent to the M1 class of 2016 after they completed one-half of the 16-week gross anatomy course. There were two email reminders to take the survey. Of the total 174 UAMS College of Medicine first-year medical students (M1) who took the course, 95 students participated in this study. Collected data were de-identified to afford student anonymity.

All procedures performed in the current study were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments and the comparable

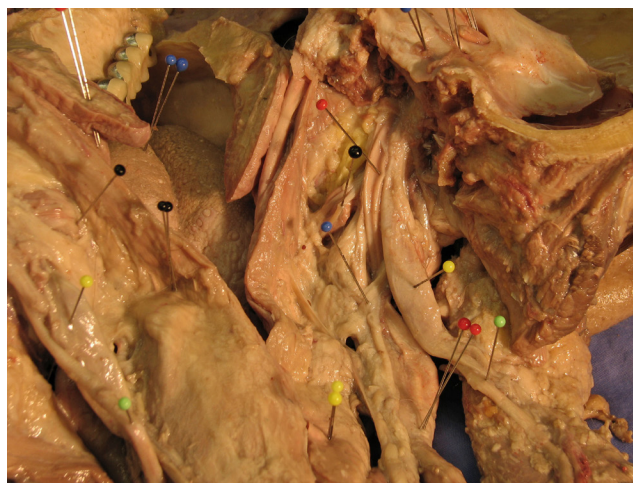


Figure 1. Prosection of the posterior aspect of the bisected neck musculovisceral column. Different colored pins are used to "tag" various structures: e.g., 1 Yellow = superior cervical ganglion; 1 Black = glossopharyngeal n. on stylopharyngeus m.; 2 Blue = tongue; 1 Light green = vagus n.; 2 Yellow = posterior cricoarytenoid m. of bisected larynx.

ethical standards. University of Arkansas for Medical Sciences Institutional Review Board or Designee reviewed the material and determined that this project is NOT human subject research as defined in 45 CFR 46.102, and therefore it does not fall under the jurisdiction of the IRB review process.

## SCIENTIFIC TEACHING THEMES

One of the most effective ways of teaching and learning anatomy is through cadaver dissection. Although resource intensive, no suitable alternative is yet available that can replace cadaver dissection.

### Active Learning

Learning anatomy by cadaver dissection is laborious and time consuming. Students use dissection manuals and atlases for step-by-step dissection and identification of structures. Availability of an experienced faculty dissected cadaver in the gross anatomy dissection lab was found to be a helpful teaching aid. Students can individually or in a group examine the prosected cadaver, which helps them learn and complete their own dissection efficiently. The prosected cadaver is a useful resource for the pre-exam review of the study material.

### Assessment

The prosected cadaver is a useful tool that can be used to assess student learning of the material. Students can also use this resource as a self-assessment tool.

## RESULTS

Based on the students' responses (summarized in the Table 1) to the survey questions, it was clear that they considered the prosected cadaver as a valuable tool that enhanced their learning experience in the gross anatomy lab. When asked about the usefulness of a prosected cadaver in a compressed gross anatomy course, 94 out of 95 students who participated in the study answered "yes." While an overwhelming majority of the students considered the prosected cadaver as a valuable aid in the step-by-step dissection of their own cadaver, mixed

responses were obtained about the usefulness of this tool in their exam preparation.

## DISCUSSION

The survey data show that students appreciated the presence of the prosection, and it helped them perform a better dissection at their own table. The 2012-2013 gross anatomy course was 16 weeks long with three-lab sessions per week. With this schedule, there was almost always enough time to perform the prosection the day before the lab session. A single faculty member (BWN) did the entire body prosection in a total of 190 hours (Back and Upper Limb = 41.5 hrs., Thorax = 22 hrs., Lower Limb = 27 hrs., Abdomen = 21.5 hrs., Pelvis and Perineum = 18 hrs., Head and Neck = 60 hrs.). However, at the start of the new academic year in August 2013, the gross anatomy course was shortened to eight weeks with four lab sessions per week. In order to have a prosection for each lab session in this shortened course, the prosector would have to be in the gross anatomy lab almost all day, assisting the students with the current day's lecture and lab session in the morning and then doing the prosection for the next session in the afternoon. Therefore, with a reduced to eight-week course, it would be preferable if the prosection workload were distributed among several gross anatomy faculty. However, with only six faculty available for gross anatomy teaching, it was not possible to dedicate the 190 hours of faculty time used to prepare the first prosection or prepare future prosections.

Considering the overwhelmingly positive response from the students in favor of having a newly-prosected cadaver to aid their dissection, an alternative plan was devised. Instead of having faculty members prosect a cadaver each year, we now preserve some well dissected cadavers from the previous medical gross anatomy class and use them for demonstration purposes for students in the following academic year. In addition, these preserved dissected cadavers are also used for the senior gross anatomy elective review courses, nursing students, and some resident trainees.

One concern of the gross anatomy faculty was that the presence of a prosection would greatly reduce the use of the dissection manual in the lab and that students would just try to replicate the prosection without following the dissection manual instructions. The data show that only a small number of the students who participated in the survey (6/95) said the prosection reduced the use of their dissection manual "a lot." Therefore, this faculty concern proved to be unfounded.

Although students wanted a video of the dissection process, editing a 3-4 hr. dissection of a particular body region into something manageable would be cost prohibitive due to the need for the equipment and media services personnel needed to make a "professional-looking" product. Another concern was students posting the videos on a website without UAMS permission and the express consent of the body donor. As an alternative to UAMS-produced videos, the students were guided to other excellent dissection resources, such as Ackland's DVD Atlas of Human Anatomy (Wolters Kluwer, Lippincott Discovery). Although several sets of this DVD series are available in our medical library, library records indicate the students did not view them. Anecdotal information indicates that some students went on-line to view dissection videos produced at other medical schools.

Another student request was to leave the pins in the prosection for that lab session and the identification key on the board, so students could study the cadaver after normal class hours. For the last few prosections of the course, the pins were left in when the cadaver was submerged. Fortunately, the pins did not rust or come out of the specimen. When accommodating this request, the students were warned about the possibility that pins may fall out or be inadvertently repositioned by fellow students when they manipulate the prosection after-hours.

There are limitations and concerns to be considered in this study. As mentioned earlier, it took a faculty member (BWN) 190 hours to prosect the male cadaver and then additional time to "tag" structures before a gross laboratory session. The amount of time spent by a faculty member prosecting needs to be weighed against other duties assigned to that faculty member. In other words, is the time spent prosecting worth the dollars per hour that could be spent writing grants or performing research? Another potential concern is the length of time a prosected cadaver is used before the remains are returned. This length of time may differ from one medical school to another depending upon the contract signed by the donor or the donor's family. If a donated body can only be used for certain amount of time (e.g., 18 months) before it has to be cremated and returned to family members, then this would necessitate a prosection being performed on a fairly regular basis. (One way to avoid this potential complication is to use an unclaimed donated body for the prosection.) If a prosected cadaver is used for more than two years, there is the real concern of deterioration of the specimen due to handling by students. In addition, the use of an immersion tank is recommended in order to keep the cadaver hydrated. In this study, the prosected cadaver was used for two years before being cremated.

## CONCLUSIONS

It is clear the students felt the prosection was a valuable aid in the laboratory and a prosected cadaver should be used in the future. The students felt the prosection was more valuable as a resource to assist them during the dissection process versus being a study aid for an exam. A small number stated they were not able to see the prosection during the dissection session. Students wanted the pins to remain in the cadaver so they can study the prosection during non-class hours. Although students wanted a video and/or labeled photos of the prosection, this was not feasible due to cost as well as current regulations concerning our anatomical gift program. Therefore, cadaveric dissection remains essential, including its use for surgical training.

## SUPPORTING MATERIALS

S1. Medical Student Opinions – The Survey Instrument

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The authors thank the UAMS Class of 2016 for their participation in completing the survey. The Institutional Review Board Director or Designee reviewed the material and determined that this project is NOT human subject research as defined in 45 CFR 46.102, and therefore it does not fall under the jurisdiction of the IRB review process.



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Table 1: Summary of student responses to the survey questions:

Survey questions	Likert score (on a 5-level scale)	Students replied with a "5" on the Likert scale	
		Number	Percentage
How useful is the prosection to your overall understanding of anatomy?	4.37	44	43.3%
	No answer	51	53.7%
How useful is the prosection in preparing for examinations?	3.9	26	27.4%
	No answer	69	72.6%
How useful is the prosection in assisting you in the dissection of your cadaver?	4.52	60	63.2%
	No answer	35	36.8%
Are the number of pinned structures sufficient?	Too few	3	3.2%
	Adequate	89	93.6%
	Too many:	3	3.2%
Does the use of the prosection diminish the use of your dissector since you can see 3-D relationships not possible in a text?	Yes, a lot	6	6.3%
	A little	19	20.0%
	No	71	73.7%
In August 2013 the Gross course will be 8 weeks long. Should a prosection still be used as an aid to dissection?	Yes	94	99%
	No answer	1	1%
Do you use the prosection outside of normal class hours? If yes, about how many hours?	Yes	23	24.2%
	No	72	75.8%
	Average time	48 min	
Do you get time to see the prosection during normal dissection hours?	Yes	88	92.6%
	No	7	7.4%

Table 2. Selected comments from the students. Selected student comments that highlight the usefulness of a prosected cadaver in the gross anatomy lab.

Student No.	Comment
#1	"I find this a valuable tool. It is very helpful to view it before I begin dissection because it helps me understand 3-D relationships between structures. I am picky about my work and it is really nice to see how deep structures are and how they relate to others before I begin so I don't destroy important elements."
#2	"I think the prosection is a very valuable tool for students. It serves as an additional guide to correct dissection technique, and it is also a very valuable review and quiz tool for students to test their knowledge on an additional body after they complete their own dissections."
#3	"I personally like it there for me to compare to our body when we are doing the dissection. It gives us a sort of real-life landmark to go by."
#4	"The prosection is also a great way for us to quiz ourselves with the pins and labeling on the board. It's quick, clearly labeled, and dissected better than our cadavers, making it, to me, the most important tool in the gross lab."
#5	"It would be incredible if we could take pictures of the prosector (sic) to use while studying at home."
#6	"If the pins could be left in the cadaver and the key on the board, then we could come in after hours and review."
#7	"As an additional means of before lab/after lab review, would it be possible to also video tape the prosection as you are doing it? I think this would really aid in learning what the relationships and key objectives to look out for before we get into the lab and also a great review after we have been in lab to solidify what we have learned."