

COMPARISON OF LEARNING ANATOMY WITH CADAVERIC DISSECTION AND PLASTIC MODELS BY MEDICAL STUDENTS

Khadija Qamar*, Amina Ahmad**, Abid Ashar***

*Army Medical College, National University of Sciences and Technology (NUST), Islamabad, **College of Physicians and Surgeons, Lahore,

***Fatima Memorial Hospital - College of Medicine & Dentistry, Lahore

ABSTRACT

Objective: The purpose of this study at Army Medical College was to assess differences in learning of students from cadaveric dissection or plastic models; and explore their perceptions about efficacy of various instructional tools used during the gross anatomy practical time.

Study Design: Two phase mixed methods sequential study.

Place and Duration of Study: This study was conducted at anatomy department Army Medical College, Rawalpindi, Pakistan over a period of three weeks in July 2013 after approval from the ethical review board.

Participants and Methods: Quantitative phase 1 involved 50 second year MBBS students, selected through non probability convenience sampling, They were divided into two groups of 25 students. Group A covered head and neck gross anatomy dissection course through cadaveric dissection and group B using plastic models. At the end of course MCQ based assessment were conducted and statistically analyzed for both groups. In qualitative phase 2, two focus group discussions (FGD) with 10 second year MBBS students were conducted to explore students' perspectives about and their preferences of various instructional tools used during the gross anatomy practical time. The FGDs were audio taped, transcribed, and analyzed through thematic analysis.

Results: The results of a post test of group A was 24.1 ± 4.26 and group B 30.96 ± 6.23 ($p = 0.024$). Focus group discussions generated three themes (Learning techniques used by students during gross anatomy practical time; Preferred learning techniques; and Non-preferred learning techniques). Students preferred small-group learning method over completely self-directed studies as the study materials were carefully chosen and objectives were clearly demonstrated with directions. Cadaveric dissection and didactic teachings were not preferred.

Conclusion: Students exposed to models performed better in gross anatomy examination than those who learned through cadaveric dissection.

Keywords: Cadaver dissections, Medical students, Plastic models.

INTRODUCTION

There is a flow of excessive information in the field of medicine due to the continuous production and changing nature of scientific knowledge. As, for a medical student, the trend shifts to memorizing all the facts instead of in-depth learning as the overwhelming burden of new information tends to increase in the curricula of medical schools¹. Anatomy, being a major basic subject in medicine and related biomedical sciences, is taught traditionally by methods including didactic lectures and demonstrations. Gross anatomy practicals' time is an important

period of learning. A central tool used for teaching anatomy is dissecting cadavers, in which the medical students learn the basic anatomical principles of the human body². Cadaveric dissection has been an integral and necessary part of a medical curriculum since the inception of modern anatomy teaching. Students within a dissection program also seek learning information in greater depth about the region in focus by using other tools including non-cadaver related activity e.g. studying models.

Several universities in the west have abandoned dissection and have moved from a cadaver-oriented to a cadaver less study of human anatomy. Time constraints is just one factor impacting on an institution's decision to use a specific teaching modality; others include cost, staff requirements, educational impact,

Correspondence: Dr Khadija Qamar, Associate Prof. of Anatomy, Army Medical College, Rawalpindi
Email: colkhadijaqamar@gmail.com

Received: 27 May 2014; Accepted: 09 June 2014

unavailability of sufficient cadavers and decreased number of demonstrators and students' acceptability. Effective teaching and learning strategies are needed to encourage student engagement in the dissection activity³. Numerous researches have been done in the past to find out just the "right portion" to enhance anatomy learning⁴. Web based anatomy teaching has been taken over by some educators that have stated these programs to be "very successful" in terms of acquisition of anatomical knowledge by students⁵. Others claim that in terms of student performance there is an established advantage of traditional dissection over computer based knowledge⁶. However, the findings of previous researchers differ in more than one variable and their conclusions exhibit a wide range of divergence. Hence, it is not possible to generalize their results on one common scale or staunchly state the superiority of one methodology over another. A considerable number of articles have been written in favor of cadaveric dissection for teaching gross anatomy emphasizing the importance of cadaveric dissection for learning gross anatomy⁷.

Considering the above, a need was felt to investigate if students learn anatomy better with cadaveric dissection than with the plastic models and explore students' perspectives about their experiences with various modes of information used during the gross anatomy practical time. The purpose of this two-phase, sequential mixed methods study at army medical college was to assess differences in learning of students taught with either cadaveric dissection or plastic models; and explore their perceptions about efficacy and preferences of various instructional tools used during the gross anatomy practical time.

PARTICIPANTS AND METHODS

This two phase mixed methods sequential study was conducted at anatomy department over a period of three weeks in July 2013 after approval from the institutional ethical review board. The quantitative phase involved data

collection using post test results of two groups of students exposed to either cadaveric dissection or plastic models for learning of head and neck module. The qualitative phase involved 2 focus group discussions exploring students' perceptions of the learning experience during the gross anatomy dissection course and were meant to find answers to questions calling for justification regarding preferred and non-preferred method of learning gross anatomy.

In the quantitative phase, 50 students of second year MBBS of Army Medical College, Rawalpindi were allocated into two groups through non probability convenience sampling for a three weeks "head and neck gross anatomy dissection course" without age and gender considerations. Any chance of participant bias was eliminated by clearly explaining to all participants the objective of the study while obtaining their informed consent. Due approval of the ethical committee of Army Medical College was taken before commencement of the study. The group A consisted of 25 students who performed cadaveric dissection of the neck and face. The group B consisted of 25 students who learned anatomy with the help of models of the neck and face. The groups were of mixed type i.e. consisted of both male and female students with age varied between 18-20 years. The students were treated as a "single class" for the rest of their anatomy teaching-learning activities. Their course modules were identical in terms of lecture content, delivery mode, instructors, duration of theory and practical classes with equal opportunities to utilize additional available tools through self-directed learning. The exam was held within the 1st week of completing the module. Posttest of all fifty students (Groups A & B) was conducted using one correct type multiple choice questions (MCQs) to assess the teaching sessions' learning outcomes. For quantitative phase, data had been analyzed using SPSS version 20. Mean and standard deviation (SD) were calculated for quantitative variables. Independent samples, t-test was applied for

comparison and p -value < 0.05 was considered as significant.

Students' perceptions of the learning experience and to rate their knowledge after the gross anatomy dissection course was carried out using qualitative method through focus group discussions. Two focus group discussions (FGD) of 8 students each were conducted. Sampling technique used for the FGD was non probability convenience. All the students had been exposed in the past to both cadaveric dissection and plastic models learning in addition to other modes being used in the gross anatomy practical time. Each group (8 students) had a moderator (author-1) and an assistant moderator at a single interaction for 45 to 90 minutes. All the participants were given alphabetical pseudonyms to conceal their identities in the audio recordings and transcription verbatim. The focus group was structured around a set of predetermined exploration questions. Our study also explored attitudes and views of students towards cadaveric dissection; in view of variety of emotional reactions and mixed feelings on exposure to cadaveric dissection. Moderator led the discussion, keeping the conversation flowing and taking field notes. The assistant moderator took additional field notes while operating the tape recorder and handling the environmental conditions. The FGDs were transcribed and interpreted.

Following set of predetermined exploration questions were used in the FGDs:

Q. 1 What are various ways you learn anatomy during the gross anatomy practical time?

Q. 2 How have you learned gross anatomy at college during the dissection hours?

Q. 3: Which of the learning method do you prefer and why?

Q.4: Which of the learning method you would rather avoid and why?

Q. 5: How did you initially find the experience of cadaveric dissection when you joined the college?

Qualitative thematic analysis was done through data reduction by transcribing audio recordings of focus group discussions, followed by data display in matrices by identifying themes and trends as they appeared in the text.

Triangulation of themes and sub-themes was done by relating them to the results of the quantitative part of the study; and conclusions were drawn by adopting a constant iterative process of re-visiting research questions, transcriptions and matrices by all 3 researchers by putting each other's interpretation to the test of plausibility, sturdiness and conformability.

Theme identification:

Words and sentences consisting of answers to research questions with similar inferences were grouped under one theme with minimum overlap, representing gist of the ideas. This led to identification of 3 major mutually exclusive themes (Table-2) appearing in transcripts. The comments verbatim (Labenswelt) related to each theme are presented in table-1 to support interpretations.

RESULTS

Quantitative study:

Post test scores were significantly higher in group B (using plastic torso) as compared to group A (using caraveric dissection) (p value = .024.). (Table-2).

Qualitative study:

Themes and sub-themes identified in students perceptions about efficacy and their preferences of various instructional tools used during the gross anatomy practical time along with comments verbatim are shown in table-2.

Triangulation: Triangulation of quantitative and qualitative phases of this study shows improved learning with, as well as preference of plastic models against cadaveric dissection in the head and neck gross anatomy dissection course.

DISCUSSION

Anatomy is very visually oriented in its nature, and using images and animations in lectures is

superior to simply lecturing or using the chalkboard or overhead projector. The use of functions, and relationships are an integral part of science and science education. Images make

Table 1: Posttest score comparison between the group 'A' using the cadaveric dissection and the group 'B' which used plastic torso.

	Group A (n= 25)	Group B (n=25)	p value
Post test exam score	24.1 ± 4.26	30.96 ± 6.23	-.024

Table-2: Thematic analysis of focus group discussions.

Theme	Sub-theme	Quotations as examples
1- Learning techniques during anatomy practical	1- Models and videos	<p>"In my case I learned most from videos and learning through models came second on my list. Correlating and visualizing structures helped." (Group 1-Z1)</p> <p>"I learned from modelsThe models gave 3 dimensional idea of what the structure may actually look like in the human body". (Group 2- Z1)</p> <p>"I gained theoretical experience by watching videos and demonstrations. Models were second on the list for me". (Group 1-Y2)</p> <p>"Models were helpful"(Group 1-X2)</p> <p>"Models give us a 3D view of anatomythe structure in models are always the same they cannot be destroyed" (Group 2-Z2)</p> <p>"I learned through plastic models as they gave a complete idea of how a structure may look like...."(Group 2-X3)</p>
	2- Group discussion	<p>"Group study and discussion was also beneficial" (Group 1-X1)</p> <p>"Learning through discussions and some separate time for self-study (30 mins) were very effective methods" (Group 1-Y1)</p>
2- Preferences in learning techniques	1- Small group discussion	<p>"I prefer discussion because communication is easy, especially in a group of 3-4 persons.....The ideas are exchanged, one gets clear picture of what they are studying....." (Group 1-X1)</p> <p>"Small group discussion with colleagues, group of colleagues 4-8 makes the concept of the topic more clear....." (Group 1-X2)</p> <p>"Group discussion is preferred as it is easy to communicate with friendsthere is no time limit to that discussion". (Group 1-Y2)</p>
	2-Models	<p>"I used help from models during dissection hours "(Group 2- X1)</p> <p>" My methods of learning were models ... (Group 2-Y1)</p> <p>"I used models for learning" (Group 2-Z1)</p> <p>"I used models to learn then drawing to clarify" (Group 2- X2)</p>
3- Non-preferences in learning techniques	1-Didactic teaching	<p>"I prefer to avoid theoretical based lectures as they do not give the complete picture of what is being taught....." (Group 1-Y2)</p> <p>"Avoid long theories based lectures and demonstration as they are dry. Dry means they create boredom in the atmosphere" (Group 1-X2)</p> <p>"I avoid lectures because there is no visual learning in them and it is all theoretical with no aiding material....." (Group 1-Y1)</p> <p>"I would avoid lectures as anatomy is not theoretical....." (Group 2-X2)</p>
	2. Cadaveric dissection	<p>"No knowledge of dissection; as never experienced"(Group 1-X1)</p> <p>"The overcrowded batches during dissection with a large group of students for each cadaver was one of the few reasons that many students didn't get the chance to perform the actual dissection". (Group 1-Y1)</p>

Power point has greatly enhanced the presentation of gross and microscopic anatomical structures. Visual representations of structures, topics more concrete and help to convey ideas for which words alone are inadequate. The appropriate use of relevant visuals can enhance

recall and understanding of material, increase interest and motivation, and promote critical thinking. Students group B, who were taught with plastic models, performed significantly better on their anatomy examinations compared with those students of the group A, who were taught with the dissection (independent t test, $t = -4.527$, p value = .024.) Instead of overcoming the lack of availability of cadavers and addressing the physical and cognitive aspects of cadaveric dissection, solutions are being sought by terming cadaveric dissection obsolete⁸. Most of the students agreed that plastic models deepened their understanding of the human body. This suggests that inculcating the use of plastic models in the regular teaching of gross anatomy of the neck and face improved the students' performance and understanding of the subject. During the review of the literature it was revealed that there are more reported studies related to the physical disorders during dissection time than the other anatomy practical times⁹. Medical students normally experience a variety of over whelming emotional reactions and mixed feelings, when they encounter human cadavers for the first time¹⁰.

The majority of students agreed that training with plastic models gave better results than a demonstration of dissected specimen and also enhanced learning and confidence in the subject matter. In our study, the use of non-dissection-based teaching models initiated behaviors to adopt the "use" of small-group learning strategies, with subgroups of students participating in a short-term, structured activity, (table-2 comment Group 1-Y2). The small-group environment and active participation also helps students to apply medical terminology that they have gathered through rote memorization. However, numerous researches have been done in the past to find out just the "right portion" to enhance anatomy learning. The incorporation of computerized tomography (CT) scan in the study of medical gross anatomy was predictive of positive performance in the course and on questions requiring knowledge of anatomical

spatial relationships¹¹. Students who had the opportunity to use anatomy models as learning tool scored higher on the delayed knowledge test¹².

With the emergence of modern teaching alternatives the cadaver based learning methodology is running a downhill course, with insufficient limited opportunity for dissection¹³. It is necessary to find how students should employ instructional media to learn anatomy inside and outside of the classroom and how they would combine instructional technology with more traditional classroom and laboratory-based learning. Our study is in agreement that students prefer interactive exercises that require problem solving and provide immediate feedback, academic teachers look at model based exercises that have proved to supplement and enhance traditional learning as most of them have a preference for teaching methods by using models. The argument against dissection seems to be that it is expensive and time consuming¹⁴. In more discussions use of multimedia along with semester system with a small group of students and plastic models were thought to be the future methodology of learning anatomy (table-2 Group 2-Y1). Because of dwindling numbers of tutors and reduced teaching hours a more learner-centered approach is required¹⁵. Changes in anatomy teaching are not necessarily being made to improve the knowledge and learning of the students but to fit in with the reduced facilities which are available¹⁶. We expect that cadaveric dissection is one of the modalities of teaching supported by prosected materials, models and radiological imaging throughout the gross anatomy course. In recent years however, there has been much controversy surrounding the ethics and effectiveness of using human tissue as a learning tool¹⁷. In agreement with our study (table-2 Group 2- X2), two recent studies demonstrate that students had significantly better anatomy knowledge after learning using a physical, plastic 3D model compared to using a virtual reality 3D model or textbook images^{18,19}.

CONCLUSIONS

Students exposed to models performed better in gross anatomy examination than those who learned through cadaveric dissection. Small group discussion and plastic models of anatomy were preferred as teaching tool.

Conflict of interest: Authors report no conflict of interest and they alone are responsible for all conclusions drawn from the data. Abstract and results of this study were accepted and presented in an oral presentation at the International Conference on Medical Education organized by Association for Excellence in Medical Education (AEME) held on 7-9 March 2014 at University of Health Sciences (UHS) Lahore Pakistan. No funding was received from any agency

Acknowledgement: Dr. Sabah Rehman, Dr. Aamna Khalil, Mohammad Osama for conducting and moderating FGDs.

REFERENCES

- Gregory JK, Lachman N, Camp CL, Chen LP, Pauline W. Restructuring a basic science course for core competencies: An example from anatomy teaching. *Med Teach* 2009; 31: 855-861.
- Sugand K, Abrahams P, Khurana A. The anatomy of anatomy: A review for its modernization. *Anat Sci Educ* 2010; 3: 83-93.
- Lufler RS, Zumwalt AC, Romney CA, Hoagland TM. Incorporating radiology into medical gross anatomy: Does the use of cadaver CT scans improve students' academic performance in anatomy? *Anat Sci Educ* 2010; 3: 56-63.
- Adesunloye BA, Aladesanmi O, Henriques FM, Ivonye C. The preferred learning style among residents and faculty members of an internal medicine residency program. *J Natl Med Assoc* 2008; 100:172-175.
- Granger NA, Calleson D. The impact of alternating dissection on student performance in a medical anatomy course: Are dissection videos an effective substitute for actual dissection? *Clin Anat* 2007; 20:315-321
- Donnelly L, Patten D, White P, Finn G. Virtual human dissector as a learning tool for studying cross-sectional anatomy. *Med Teach* 2009; 31:553-555.
- Winkelmann A. Anatomical dissection as a teaching method in medical school - a review of the evidence. *Med Educ* 2007; 41: 15-22.
- Marks SC Jr, Bertman SL, Penney JC. Human anatomy: A foundation for education about death and dying in medicine. *Clin Anat* 1997;10:118-122.
- Horst WK, Helmut W, Robert L, Snipes JP, Friedrich P, Gabriele RE, et al. The dissection course - necessary and indispensable for teaching anatomy to medical students. *Annals of Anatomy* 2008; 190:116-122.
- Rizzolo LJ, Rando WC, O'Brien MK, Haims AH, Abrahams JJ, Stewart WB et al. Design, implementation, and evaluation of an innovative anatomy course. *Anat Sci Educ* 2010; 3:109-120.
- Kerby J, Shukur ZN, Shalhoub J. The relationships between learning outcomes and methods of teaching anatomy as perceived by medical students. *Clin Anat* 2011; 24(4): 489-497
- Sergovich A, Johnson M, Wilson, TD. Explorable three-dimensional digital model of the female pelvis, pelvic contents, and perineum for anatomical education. *Anatomical Sciences Education* 2007; 3(3): 127-133.
- Heylings DJA. The curriculum who teaches it and how. *Med Ed* 2002; 36: 702-10.
- Hanna SJ, Freeston JE. Importance of anatomy and dissection: The junior doctor's viewpoint. *Clin Anat* 2002; 15: 377-8.
- Winkelmann A, Güldner FH. Cadavers as teachers: the dissecting room experience in Thailand. *Brit Med J* 2004; 329: 1455-7.
- Boon JM, Meiring JH, Richards PA, Jacobs CJ. Evaluation of clinical relevance of problem-oriented teaching in undergraduate anatomy at the University of Pretoria. *Surgical and Radiol Anat* 2001; 23: 57-60.
- Walter T. Body worlds: Clinical detachment and anatomical awe. *Social Health & Illness* 2004; 26: 464-88.
- Kaufman MH. Anatomy training for surgeons - a personal viewpoint. *J R Coll Surg Edinb* 1997; 42:215-6.
- Khot Z, Quinlan K, Norman GR, Wainman B. The relative effectiveness of computer-based and traditional resources for education in anatomy. *Anatomical Sciences Education* 2013; 6(4): 211-215