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Clinical (Human) Anatomy, the Mother of Surgical & the Companion of Medical Sciences: Analyzing the current teaching methodology

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I. Introduction

Anatomy, the study of the structures of the human body is one of the first, most basic and important subjects studied by medical students when they begin their medical education career. Generations of doctors have been initiated into the medical profession by cutting into their first cadavers. A solid appreciation of human anatomy is still a necessary part of understanding pathology and treatments. (1,2). The format of teaching anatomy in terms of content and methods has evolved and changed considerably over the last two decades along with changes in the demands of the medical profession. The changes are attributed to scarcity of cadavers, time constraints and rapid advances in information technology among the many others. Two approaches are debated in the methodology of teaching anatomy, the teacher-centered and the student-centered. Integration of the two approaches can best give the solution to teaching this giant of a subject (3).

The anatomists all over the world are polarized into those who consider the teacher-centered approach in the form of formal didactic lectures followed by dissection of cadavers as central to learning gross anatomy and those who favor replacement of traditional teaching by student-centered approach with newer teaching modalities such as self-directed learning, team-based learning, problem-based learning and computer-assisted learning (4). Over the last few decades, a major paradigm shift in medical education has been to move from passive, didactic and teacher-centered approach to active, clinical-based and student-centered approach, i.e., from teaching to learning. Both the teachers and learners need to constantly reinvent themselves to keep pace with the changing demands of the profession and the technological advances.

Traditional didactic lecture Vs. Bi-directional learning

Lectures have been the most common form of teaching and learning since ancient times. Didactic lecture is more passive in nature and less effective teaching tool when compared with active learning methods, such as problem‑based learning and bedside clinics. However, a well‑organized lecture remains one of the most effective ways to integrate and present information from multiple sources (5). assistance in the form of audio‑visual aid is needed to enhance the quality of the lecture. A blackboard is commonly used in lectures as a mode of delivering information, while the use of transparencies and PowerPoint with an overhead projector are the other effective modes of delivering lectures. Technological advancements have revolutionized in every field including teaching (6).

During lecture, the individual PPT slides serve as memory aids, which reduce the mental strain on the lecturers. As most of the contents are already given in the form of handouts, this reduces the need to take notes during the lecture and students find this PPT method less tiring. Moreover, students able to pay more attention to the discussion part of the topic instead of taking notes. The handouts are also more portable and distributed as softcopies rather than printed copies. Students can easily view these softcopies on any electronic device such as a personal computer, laptop or even in mobile phone. PPT slides can be reused or can be edited with ease for future lessons; this makes lectures to prefer this aid. However, few drawbacks come with PPT presentation. Some lecturers tend to create PPT slides that are more suitable for them to read rather than explaining. As suggested by Nirenberg, lectures also serve an effective way of communicating the enthusiasm of the teacher to the learners, by motivating them (7). Therefore, lectures continue to remain the most common instructional mode in contemporary undergraduate medical education.

Some of the activities that can be introduced in the lecture session are as follows:

- Quizzing the students
- Presenting a clinical picture and asking the student to give its clinical correlate based on the lecture
- Role playing by students to effectively demonstrate the relations of anatomical structures
- Lecture sketch books, wherein students can be encouraged to draw or label specific diagrams

Dissection as a method of teaching

Dissection is a basic technique for undergraduate students to understand the basic concepts of anatomy. The effectiveness of teaching human topographical anatomy to medical students been recognized for centuries (8). A way to improve student's learning is to change the method of teaching and allow students to take active participation. Oh CS et al advised digital reporting of dissection by the students. They asked a group of students to make a digital report of dissection and submit it to the authorities, this lead to active teamwork of students during dissection (9). Dissection also encourages students to confront the topics of death and dying. Many cases of students fainting or getting hysterical have been reported when they first come in contact with cadaver. A small number of students are not able to cope up with psychological aspect of working with cadaver and are severely stressed for a long time. Students are unable to express fear and ask for support. For this reason every medical school should organize seminar and counseling to help students deal with cadaver and anatomical preparation.

Active learning of anatomy by dissection has many benefits. Most of the anatomy teachers complain about student's lack of interest in dissection. One of the reasons reported by Naz S et al was aversion to formaldehyde smell. Formalin is a colorless irritant which gives out a pungent formaldehyde vapors and is widely used in anatomy for preservation of cadaver. Students usually report symptoms of burning eyes, shortness of breath, headaches and skin irritation on exposure to formalin. As preventive measure students should be encouraged to use gloves and laboratory coats. Dissection halls should be well ventilated (10). Esima R et al suggested thiel embalming as an alternative to formalin fixing. Thiel-fixed specimens have more life-like and visually specific properties but are more expensive. There are many restrictions for its use for student's dissection in facilities with limited storage space and air circulation. Moreover thiel-fixed specimens are not suitable for histological preparations and thus more research work is required on thiel fixed specimens (11).

Arguments against dissection pivot on both the practical demands of obtaining cadavers and topographical learning outweighing the intricacies of inner structures. However, a study undertaken at the University of Sydney (whereby dissection is not part of anatomy teaching) assigned 29 students to a 34-day full body dissection course). Surgeons and anatomists tasked students with identifying structures at regular intervals throughout and up to one month after the course. The outcome of this study indicated that students' anatomical knowledge improved significantly on completing the course (12). The practice of cadaveric dissection allows students grasp the three –dimensional anatomy and concept of biological variability (13).

Through dissection, students are able to visualize firsthand actual structures of the human body. It has also been called the "sharp end" of medical education (14). Because of current arguments on balancing learning outcomes, problems related to the use of human cadaver, teaching methods and resources, many recent curricula in anatomy have introduced a shift towards greater use of alternative modalities of teaching involving cadaveric plastination, non-cadaveric models and computer-based imaging (15,16). Moreover, the use of cadavers for dissection in anatomy learning has been identified by some scholars as expensive, time consuming and potentially hazardous (17). Although there is no consensus on its effect, working with cadavers, whether through active dissection or by examination of prosected specimens constitute a potential stress (18).

In medical schools where cadaveric dissection mainly constitutes preclinical teaching of anatomy, students are exposed to cadavers in the early stages of their training but this exposure induces both positive and unintended negative experiences in these students. The emotional impact of such exposure on students and their ability to cope has been examined in some studies. The effects which have been described include the physical (smell, nausea, conjuctival irritation) and psychological (anxiety, stress, emotional trauma, depression) but available evidences suggest that adaptive mechanisms for coping with exposure are triggered soon afterwards in these students (18–21).

Use of Virtual Models

Although criticized for lacking the variability and intricacies of the human body, we have found virtual models a useful adjunct to other methods of learning. These models allow students to isolate structures that may be difficult to appreciate from books or video, by zooming, rotating and even transecting them in order to appreciate anatomical form and relationships. A criticism of dissection surrounds its one directional nature. Once cut, damage to structures remains irreversible. Hence, one could argue that dissection may result in students missing out on learning opportunities due to the lack of flexibility and finite chances. This is of course not an issue for virtual models, where structures can be stripped away or made translucent to follow the course

of a nerve or blood vessel, and then reconstructed at the touch of a button. Nevertheless, even plastic life-like models, which medical schools utilize, still do not provide the true physical textures of human anatomy (2).

Photogrammetry

Photogrammetry—the applied science of using photographs to represent an object in 3D—combines the advantages of photographs, videos, and computerized models while avoiding most of their drawbacks. In photogrammetry, 2D photographs of an object are taken at varying angles and then overlaid using computer software to generate a 3D reconstruction. Photogrammetry creates authentic anatomical models, by generating 3D renderings from digital photographs. This authenticity surpasses most computerized models, which often simplify subtle anatomical features. Its digital 3D models are virtually interactive, offering visuospatial engagement which pictures and videos lack. Users can actively manipulate and annotate such models, given the appropriate software. This interactivity will be discussed later in this study. Photogrammetry does not damage physical specimens nor rely on grayscale or cross-sectional data to build 3D models. Finally, photogrammetric prosection models are digital. They can therefore be distributed without limit and will not degrade over time. When interacting with the digital 3D prosection models developed in this study, faculty found the models anatomically representative and authentic to the original specimens. One lecturer noted that, as opposed to many computerized versions, the models "represent authentic anatomy because they are based on real cadaver specimens. The models are extremely accurate, and represent very well what the actual prosections look like." Other instructors noted that the detail of these models matches or exceeds that of many high-definition textbook images (22).

The Anatomage Table

Currently, the Anatomage table 5 is the most advanced anatomy visualization system in teaching the anatomy of the human body. Although there are some published abstracts and full papers regarding the use of the Anatomage in various anatomy courses, there is no other similar study to ours in the field yet to compare and discuss these results with. Most studies agree that a multifaceted approach to teaching and learning the subject of gross anatomy is ideal. As Anatomage continues to evolve even more usable features, such as the recent update featuring a model with abducted arms and the ability to change the background color, it will likely gain further popularity and precipitate more studies as to its effectiveness in teaching human anatomy in the chiropractic profession. Students utilizing combined Anatomage tables and models scored higher on laboratory examinations than students testing on models only or cadavers only. A similar testing competency in lecture examinations was observed, suggesting a possible change in laboratory examination difficulty between the cohorts but a similar knowledge base. Further studies are warranted to evaluate the long-term retention of student knowledge in anatomy following these cohorts with their respective laboratory experience (23).

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