Interactive virtual three dimensional (3D) cadaver- The latest tool in medical education and health care system

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Abstract

The scenario of medical education and health care delivery system are changing in a dramatic ways. The aspirations and expectations of the students and the patients are at all-time high. Medical educators and health care providers are in search of methods, ways and means to satisfy these growing needs. One of the important bases of learning medicine is the human cadaver and every doctor starts his / her career of medicine with the touch, feel and examination of it by dissection. The deficiency of getting the bodies for dissection is as old as the modern medicine itself. This problem is compounded in modern era due to various social, economical and health factors. There is always been a search for alternatives for real body dissection. The progress in the software technology is helping us to some extent in this regard and the result is 3D virtual cadaver. Use and limitations in brief of this innovation is high-lightened in this article.

Keywords: Dissection, Medical education, Three Dimensional (3D), Virtual cadaver.

Introduction

Anatomy courses are laboratory based and the laboratory is an outstanding small group, faculty/student interactive opportunity. However, we must show flexibility and innovation in our educational approaches whatever the curricular design being proposed.[1] The biggest challenge of for any budding medical college is to acquire the required number of cadavers to the Anatomy department for dissection. This challenge is existing from the day when the teaching of modern medicine started. Providing/supplying body for dissection had given rise to many unethical professions like 'grave thieves', criminals like 'Burke and Hare' anatomists like 'Dr Knox' etc. To prevent these type of practices 'the anatomy act' was passed so as to facilitate legally, the use of unclaimed dead bodies for educational purposes. In India all unclaimed bodies are sifted to the government medical colleges or private colleges performing medico legal autopsies by police. Rest all other colleges have to depend on them for cadavers required for dissection. The supply depends upon the several factors and is erratic. Ultimately it is the medical students who has to bear the brunt. Keeping all these things in mind the Medical Council India (MCI) has removed the dissection part from the anatomy practical examination format, instead the dissected parts are examined by the students. This may be a solution for the problem, but the knowledge gained by systemic, layer by layer dissection of cadaver is unquestionable to the under graduates and also to the surgical post graduates involved in skill development dissection. Scientists throughout the world are trying to find out a reasonable solution for this like, using plastinated organs, fiber models, acrylic bones etc. The most recent one is the use of Digital Three Dimensional (3D) virtual human body. Estevez et al. in their assessment quiz indicated that students who built 3-D models performed significantly better on questions that required 3-D understanding of periventricular structures.[2] It may be true that most doctors do not need to dissect a cadaver or study a prosection in order to practice, but if it can improve their understanding of what they do and why they do it, this surely has to be of benefit both for the safety of the patient and satisfaction of the doctor as a professional. Integration of newer teaching modalities and modern technology will encourage interest and retention of anatomical knowledge and its clinical relevance.[3]

Why we need it?

Nayef Al-Rodhan defines "a sustainable history as a durable progressive trajectory in which the quality of life on this planet or other planets is premised on the guarantee of human dignity for all at all times and under all circumstances".[4] Every invention is directed towards improving the quality of human life. Innovations in medical curriculum or education are not an exception for that. We need to consider the human dignity while facing the challenges and while trying for new innovations. Growing challenges to traditional medical education and dramatic changes in the healthcare delivery system are prompting curricular reform projects in medical education. As part of this curriculum, the medical institutions are taking full advantage of computer-assisted instruction innovations and new capabilities of web-based digital applications to drive the evolution of medical education. In future the teaching will rely heavily on new web-based modules, computer-assisted instruction, and simulation.

By adopting the latest innovations in communication we can increase collaborative teaching and learning among scientists, physicians, nurses, and other health professionals. The inventions in educational informatics and simulation technologies provide opportunities for new teaching and learning strategies never before possible. These learning tools support the students in better understanding of the subjects and also gives them the freedom of learning things any time, at any point and also they can go back to review the same information as many times as required. Still the cadaver's matter because the experiences in cadaver labs help students develop respect for patients. Cadavers are often their first experience with death. Cadavers are, in a way, their first patient.

How it works?

First-year students at NYU School of Medicine were introduced to a pioneering online 3D interactive virtual human body called the BioDigital HumanTM in Jan 2012.[5] The BioDigital Human is a three-dimensional, fully interactive visualization program. While it won't completely replace old-fashioned dissection, its users can explore a human body in ways not possible with a cadaver, much less a medical atlas.[6] This is a unique educational experience supplements the traditional use of human cadavers in anatomy but do not remove the cadavers in toto. This allows the students to both view and interact with realistically simulated 3D organs and other anatomical structures which were only possible in cadavers in the past. Adam Hamrol et al. in their paper present a process of building a prototype of an educational application for teaching anatomy with elements of physiology, with use of a Virtual Reality environment.[7] The virtual anatomy becomes better suited for teaching, allowing students to see smooth contours and colorful representations of structures similar to what they were already familiar with in their anatomy textbooks. It is one step to break the lockstep of traditional medical education being carried all these years. Anatomy students view the life-size digital content displayed on a projector screen in anatomy lab using sophisticated consumer-grade 3D glasses. They also use laboratory iPads to magnify and explore the models in great detail. Similar to experiencing a 3D film, viewing the graphics stereoscopically provides the illusion of depth and greater appreciation for the 3D models and their relationship to each other. With just a few clicks students can zoom in on an organ, spin it to view from any perspective, reveal and hide layers of muscle, bone, and nerves and use tools to dissect or analyze it as you would with a CT scan. Using this new technology, students and residents can now train in and out of the classroom to practice until they achieve mastery.

Access to human anatomy models online provides faculty and learners an easily accessible visual interface for organizing and viewing a diverse range of educational content and allows users to focus and find information on a body region in a visual, intuitive manner. Students must aggregate information from a vast array of static, Two Dimensional (2D) sources including atlases, textbooks, dissection manuals, and class lecture notes. These resources are inherently limited in their capability to foster a spatial understanding on par with the knowledge gained through working with real cadavers. Using highly accurate animated simulation, digital cadaver allows students and faculty to practice dissections in a real-time, Three Dimensional (3D) environment. Users can mark incisions in virtual skin, reveal underlying tissue layers and then manipulate these layers from different perspectives. Students can explore it without fear of making a dissection-ruining mistake.

This tool is postulated as the next generation of Dr. Frank Netter's Atlas of Human Anatomy, a true staple in anatomy medical education.[8] Virtual anatomy for the department of surgery was built in 2002 from a series of multimedia modules now known as the Web Initiative for Surgical Education (WISE-MD). The set of surgical anatomical models created for those modules was constructed while referencing the national library of medicine's visible human project as well as patient specific CT and MRI volumes. With the current state of anatomical education, the addition of 3D anatomy on top of a crowded schedule can be daunting. Haphazard use can lead to student dissatisfaction and negative feedback. Through the use of research articles, we sought to discuss the advantages and disadvantages as well as highlight some the challenges that come with 3D anatomy.[9] The budding surgeons can make use of this module before actually performing a surgery on a patient. Doctors can demonstrate techniques and pinpoint problems while patients watch on outpatient basis.

Conclusion

Medical education reforms are must to improve the quality of medical education given to the aspiring students of medicine, enabling them to deliver a quality health care to the society. This can only be made possible by exploiting the advances which are happening in the fields of electronics, computers and software. Using these advances suitably to improve the medical education and health care delivery system is the need of the hour. When used throughout the continuum of medical training digitalization could lead to reduced errors, lower healthcare costs, improved outcomes and most importantly, improved patient care.

Recommendation

This program could be used by patients to better understand their bodies, and also as a promotional tool for generating interest in science-related careers. Cost may also be prohibitive, as only the basic version online is free. The advanced version is quite expensive and come at a price.

That's not to say that it could replace the cadaver lab, but for schools that don't have one, it could be an option, and for those that do, it could augment the educational experience.[10]

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