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Learning of Anatomy with a Virtual Dissection Table: our Immediate Impression of the Anatomage Table

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ABSTRACT

Anatomy is an essential subject in medical and health science programmes. However, it is perhaps the most challenging to students compared to other basic medical science subjects. Although learning anatomy with dissection of cadavers has been the default choice, a range of interactive multimedia devices and virtual visualization software has been available since 2002, for instance, “The Living Human Project”. Emerging technologies have made studying anatomy via three-dimensional visual models increasingly prevalent. The virtual anatomy dissection tables are recent entries and have added to the options available for medical and health science programmes when considering learning tools for their students. A human-size 3D interactive table, the Anatomage table 7 (AT-7), is perhaps the most advanced digital visualization system for anatomy education currently available. AT-7 is a virtual library of human and animal cadavers, which provides a clinical diagnostic tool by visualization of computerized tomography, cone-beam computed tomography or magnetic resonance imaging scan. This present article describes our experience as faculties with the Anatomage table in the process of teaching anatomy. Students and faculty members exposed to AT-7 for six months completed a survey on the effectiveness of the AT-7 in learning anatomy. Response was collated and analysed, results showed that though AT-7 enhanced learning and knowledge of anatomy, it would not be able to stand alone in our local setting, though promising in upcoming medical educational training, is essentially an atlas of anatomy, compared with cadaver.

Keywords: Cadaver, dissection alternative, virtual dissection, simulation, learning

INTRODUCTION

In the last twenty years, the teaching of human anatomy has been reduced in medical curricula globally and replaced with clinical education; resulting in a potential decrease of human anatomical knowledge in newly graduated doctors (1-3). In the United States of America, large anatomy departments have become smaller entities of medical schools or absorbed into surgical departments” (4). However, most medical institutions still utilise didactic lectures and cadaveric dissection as teaching styles in anatomy (5, 6). Nevertheless, cadaveric dissection has progressively experience reduction with the use of prosected or plastinated specimens and virtual anatomy software (7,8). The driving force behind this development was to alleviate the scarcity of donor bodies (especially in developed countries) and make anatomy teaching and learning easier.

Though a range of interactive virtual anatomical visualization software have been available since the last quarter of the twentieth century, but not until 2011 that the Anatomage Table was released as a platform to

present anatomy in a life size scale, Anatomage table 7 (AT-7) (9). The AT-7 is a computerized body-size table which has CT, X-Ray, ultrasound, MRI and stereoscopic images of the human body in 3-dimensional (3-D) reconstruction of the whole body. The AT-7 technology enables virtual dissection and reconstruction of the human body. The fully interactive multitouch screen of the AT-7 allow virtual dissection and exploration of the body (10). Debatable though, it is perhaps the most technologically advanced digital visualization system for anatomy education. It is a virtual library of human and animal cadavers, and also serves as a clinical diagnostic tool for visualization of computerized tomography (CT), cone beam computed tomography (CBCT) or magnetic resonance imaging (MRI) scan (11). Niger Delta University is one of the only two Universities of the over 175 Universities in Nigeria with this learning (medical) technology. This new technology allows faculties to teach anatomy to students in an interactive way (Figure 1).



Figure 1: Here a faculty member (in blue) is seen with students in a virtual dissection session with Anatamage table 7. Observe gross anatomy image alongside CT and MRI images.

Despite these alternatives, cadaveric dissection is still preferred where cadaver source is essential through donor body, substitute to cadaveric dissection is welcome development, but in most big nations of sub-Saharan Africa, especially Nigeria, donor bodies are general given by governmental institutions such as hospital and police stations. Bodies of condemned criminals or prison inmate that died while serving term are donated to medical schools. So also, are unclaimed deceased bodies of individual after due public announcement. Essentially all medical schools in Nigeria get cadavers this way, and it is to foster medical and allied medical

man power training and development. The purpose of this article is to herald our immediate impression of the adaptability or suitability of the Anatamage table in the teaching of anatomy to preclinical students.

MATERIALS AND METHODS

Faculty members and students (80) that were exposed to the AT-7 for one academic session were included in this study. The impression of students was assessed through a questionnaire of ten questions (table 1). Faculty members impression of the AT-7 was through direct interview. A key question for faculty members was their overall impression of the AT-7.

Table 1: Shows 10 items included in the questionnaire served to students

S/No	Knowledge and effectiveness of the anatomage table in learning anatomy
1	Do you have experience with the use of cadaver in learning?
2	Do you have experience with the use of Anatomage -table in learning?
3	How easy and enjoyable is Anatomage -table?
4	Rate your level of satisfaction with the use of Anatomage -table as a dissection method
5	How essential is cadaver dissection?
6	To what extent do Anatomage -table dissection serve as an alternative to cadaver dissection?
7	Rate your level of satisfaction with the use of Anatomage -table as a learning tool or method
8	Rate how Anatomage -table helped you understood the relationship between different parts of the body
9	Does learning with Anatomage -table takes less time than traditional learning with dissection?
10	To what extent did the Anatomage -table enhance your learning and interest in studies?

RESULTS

Images from AT-7

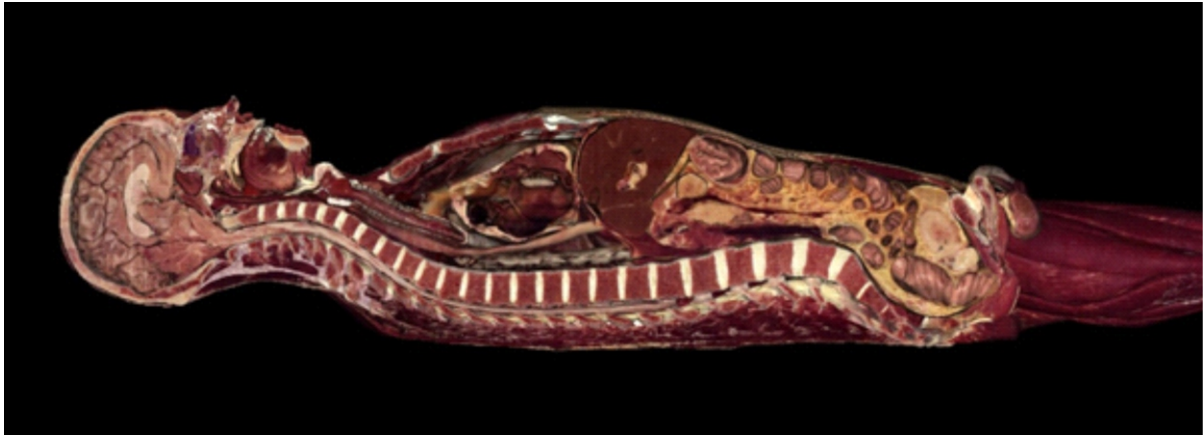


Figure 2: A midsagittal section taken from AT-7. Section like this are not possible with conventional dissections. With AT-7, student can correlate structures to each other and to vertebra levels by simple inspection or an imaginary line as shown.

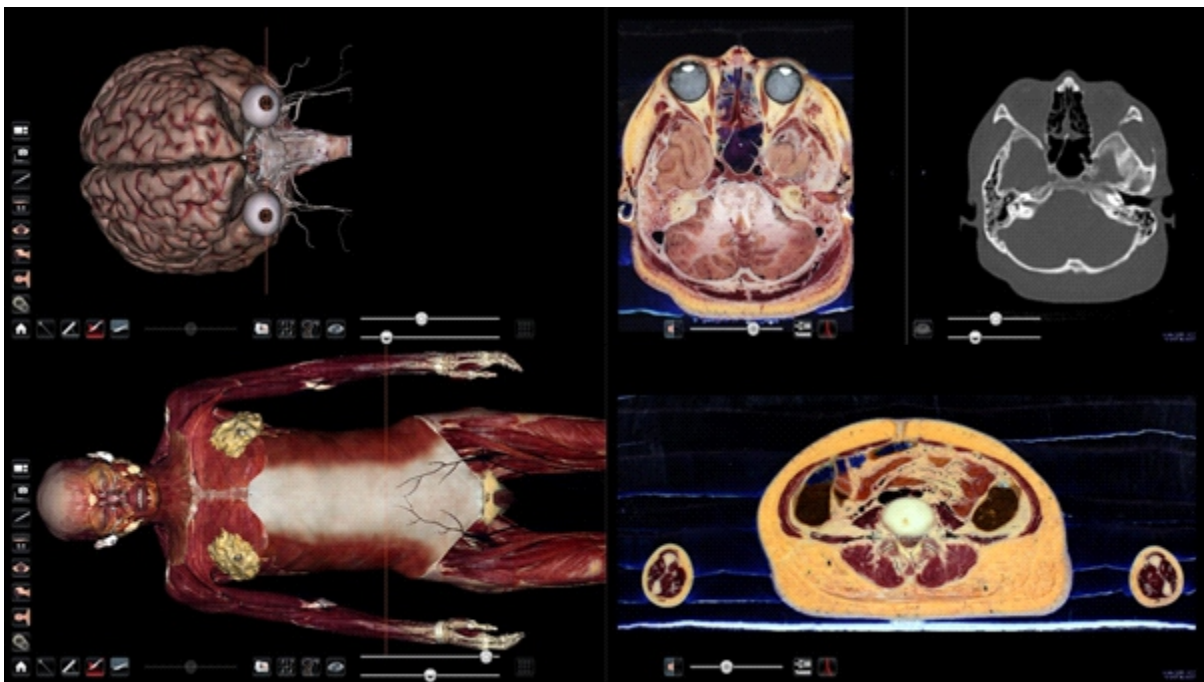


Figure 3: AT-7 images showing gross anatomical features along with cross sectional anatomical MRI images.

Student impression on use of the AT-7: Analysis of over 80 respondents in a survey of our student exposed to the anatomage table indicated the followings when asked the preceding questions.

Table 2: The impression of students on the use of Anatomage table in the learning of anatomy

S/No	Questions	Analysis of responses
1	Do you have experience with the use of cadaver in learning?	Ninety-eight (98) % of students responded that they have some knowledge of cadaveric dissection
2	Do you have experience with the use of Anatomage in learning?	93% of students responded that they have some experience with the use of Anatomage in learning
3	How easy and enjoyable is Anatomage?	69.2% of students find Anatomage learning very easy and enjoyable, 23.1% found it moderately easy and enjoyable
4	Rate your level of satisfaction with the use of Anatomage as a dissection method	69.2 % of students responded that they were very satisfied. 25.6% said they were neither satisfied nor dissatisfied
5	How essential is cadaver dissection in learning anatomy?	84.6% feels that cadaver dissection is indispensable
6	To what extent do Anatomage dissection serve as an alternative to cadaver dissection?	82.1% feels it could be an alternative
7	Rate your level of satisfaction with the use of Anatomage as a learning tool or method	85% of respondents were very satisfied
8	Rate how Anatomage helped you understood the relationship between different parts of the body	65% of respondents indicated that Anatomage helped them greatly understood the relationship between different parts of the body. Similarly, 27.5% indicated that it helped moderately.
9	Learning with Anatomage takes less time than traditional learning with dissection	87.5% agreed with this
10	To what extent did the Anatomage enhance your learning and interest in studies?	62.5% said a lot, while 30% said moderately.

DISCUSSION

Our study showed that the Anatomage-table is a valuable tool in the learning of anatomy. It indeed transforms the lessons into a “Virtual Anatomy Lab”, there was no mess or odour and the added bonus is the “undo” button. If a mistake is made or want to “go back”, it is just a click of a button. Furthermore, every image is annotated and ready to use, providing an excellent tool for anatomy presentations. This present study applauded the four hundred (400) case studies included in the AT-7, arranged by organ system pathology together with patient history, along with cross-sectional imaging. We opined that this fluidity and versatility of the AT-7 could provoke long term learning because students remember information better in this manner (10, 13, 14). Students quickly get the big picture, a critical outcome for quality learning (14). It also exposes students to CT or MRI images early (figure 1), an excellent innovation, especially in centres with scarce resources. It also encourages students to review anatomy with specific anatomic assignments.

We were impressed that students can pinpoint anatomy on the table and capture images with the table's screen shot function. The quiz section also stimulates students to know their anatomy instead of memorization of anatomical information. Furthermore, the table can be used to evaluate students in anatomy practical examination (stipple chase), but this would be achievable with adequate capacity; that is, the availability of more anatomage tables to conduct such practical examination. With the anatomage table, everything can be undone, restoration is not a problem. Unlike a real body, a cut can be undoing to restore the body. Perhaps the most critical importance of this innovative dissection method is that it enables anatomy educators and students to practice dissections over and over again to enhance effective anatomy learning and eliminates the harmful effect of continuous formalin exposure. However, we noticed that the anatomage table despite these numerous benefits, lacks a real 3-D experience; the bodies are not tangible, nothing is palpable.

However, a previous study suggested that procedural dissection with AT-7 enhanced the knowledge of applied anatomy and is beneficial for the development of future clinical skills in students (15), a position that is also supported by this present study; AT-7 would strive well as an augmentation to cadaveric dissection, at least for the near future.

Therefore, a critical or salient question is whether the anatomage table can replace cadaveric dissection in real sense? We opined that the anatomage table should not be planned to replace cadaveric dissection, but rather broadens and deepens the information. It was suggested, and rightly so, that any innovation in technology must be integrated with innovation in pedagogy (16). Virtual dissection can be used not as a replacement for cadaver but actually as an additional tool to improve the educational process. As shown in our survey, over 85% of the students reported that the AT-7 enhanced their study and that it is less time consuming than traditional learning with dissection, but still felt that it is not a replacement for cadaveric dissection (Table 1). A medical student that essentially avoid “cutting” a cadaver during training, may really never be available to “cut” a patient for medical intervention, to avoid maxim, such as this, the quest for real body surgical simulation for diverse specialty in medicine, is advancing, real cadavers' simulation is now used by clinical students and residents to improve and simulate clinical skills (17, 18); this underscores the importance of cadavers in medicine.

The history of using cadavers to understand anatomy dates back over 2000 years (19). Using cadaveric dissections in the learning of anatomy promotion of active and deep learning, provides students with palpable and tangible structures, gives a 3-D experience for clinical practice, help students overcome the phobia of the dead, development of compassion and stress coping strategies, and connecting patients' symptoms with pathology, and also provides a risk free acquiring of clinical skills (20). Although, learning anatomy through cadaver dissection is a proven system, it is not without negative aspects such as regular recurrent cost and exposure to formaldehyde. Learning by cadaveric dissection is however considered the “gold standard” in acquiring anatomical knowledge (21, 22).

CONCLUSION

Learning human anatomy could be meaningfully wedged with 3-D visual anatomy. Therefore, the use of virtual body dissection technology gives the impression to have a promising role in upcoming educational training programs in collaboration with other methods, especially the learning of anatomy with cadaver.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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