

3D Anatomy: Implication For Teachers

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Abstract

Advances in technology have gone far beyond what was possible with cadaveric material. Virtual surgery can be carried out so that surgeons can practice new techniques and see the outcome before bringing it to the patient. Anatomy teaching has progressed with the use of 3D technology to new heights. However, it is time to introspect. These techniques are very cost intensive in the short term. Are they worth it long term? What implications do they have for us as anatomy teachers?

In this paper we review the experiences of teachers using 3D methods over past few years. Various methods have been utilized; 3D graphic models, 3D Arthroscopy, 3D ultrasound, 3D videography, web-based 3D platform etc. The objective results seem to be equivocal when the results are considered *en solatario*. However, when considered *en toto* are very clear. 3D Anatomy has a definite place as teaching technology in the teacher's arsenal, along with other techniques including CHALKBOARD. But in all these articles the subjective report by the students has been indicate that teaching-learning experience is more satisfactory using technology. We teachers have to accept the challenge so that we do not fall behind the technological and also we do not swept aside by younger persons in technical fields.

Key words: Medical Education; Computer Aided Teaching; Virtual Body; 3D Reconstruction.

Introduction

Advances in technology have gone far beyond what was possible with cadaveric material. Virtual surgery can be carried out so that surgeons can practice new techniques and see the outcome before bringing it to the patient. Anatomy teaching has progressed with the use of 3D technology to new heights. However it is time to introspect. These techniques are very cost intensive in the short term. Are they worth it long term? What implications do they have for us as anatomy teachers?

Teaching is now being carried out using various technologies, including 3D graphic models, 3D Arthroscopy, 3D ultrasound, 3D videography, web-

based 3D platform etc. Work done recently in various centers using these teaching methodologies and the objective results as well as subjective reactions were reviewed. The process of review threw up some important questions.

1. Are these new technologies more effective educational tools *vis a vis* the traditional methodologies?
2. Are they more effective in generating interest in learners?

The most important question is whether these technologies are effective teaching tools. The answer is equivocal as different centers have had different results

In a study on teaching neuroimaging at the University of Salamanca, Salamanca, Spain[1] they found that:

"The percentage of correct answers (hit rate) and level of confidence in responses were significantly higher in the 3D visualization condition than in the 2D. In addition, the response time was significantly lower for the 3D visualization condition in comparison with the 2D. The interaction between the experimental condition (2D vs. 3D) and difficulty was significant, and the 3D condition

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facilitated the location of difficult images more than the 2D condition. 3D volumetric visualization helps to identify brain structures such as the hippocampus and amygdala, more accurately and rapidly than conventional 2D visualization."

However in another study at the Department of Surgery, University of Heidelberg, Heidelberg, Germany[2] their result on teaching CT interpretation using 3D techniques is quite different. They have said:

"This study of 73 students showed that training on 3D presentations did not improve the ability to interpret 2D images. Further, the results revealed no significant differences between the results of Week 1 (2D: M = 6.5, SD = 1.8; 3D: M = 6.6, SD = 1.4; $p > .95$) and Week 2 (2D: M = 6.1, SD = 1.9; 3D: M = 6.0, SD = 1.4; $p > .7$). There were no significant gender differences. However, students randomized to 2D who completed only the first EP performed significantly worse if compared to students who completed both EP ($p = .04$). CONCLUSIONS: This randomized controlled study shows that correct interpretation of 2D imaging does not differ in students trained with either 3D or 2D."

Even using 3D Video techniques at the Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, The University of Western Ontario, London, Ontario, Canada[3] have found:

"Despite growing literature suggesting that 3D correlates directly to enhanced skill acquisition, this study did not differentiate significant results contributing to increased surgical performance. This topic will continue to be explored using more sensitive scales of measurement and more complex "open procedures" capitalizing on the importance of depth perception in surgical manipulation".

Because of the limitations of cadaver teaching, Codd AM, Choudhury B[4], had produced an interactive, three-dimensional computer model of human forearm anterior compartment musculoskeletal anatomy with an aim to evaluate the use of 3D virtual reality when compared with traditional anatomy teaching methods. They found the model group mean test score to be significantly higher than the control group and not significantly different to the traditional methods group. They said that: *"Feedback from all users of the e-resource was positive. Virtual reality anatomy learning can be used to compliment traditional teaching methods effectively"*.

Keedy AW, Durack JC, Sandhu P, Chen EM, O'Sullivan PS, Breiman RS[5] also did a comparative study on traditional teaching methods and 3D computer models. They found that the difference in pre-test and post-test scores were not statistically significant. Spatial ability also did not statistically

significantly correlate with post-test scores for the 3D group or the 2D group. However in the post-test satisfaction survey the 3D group expressed a statistically significantly higher overall satisfaction rating compared to students in the 2D control group.

Even in the dental teaching faculty Curnier F[6] had reported about teaching dentistry by Virtual Reality. His results showed that 70% of the students were satisfied or very satisfied with this module and that the simulation boosted their motivation to learn anatomy. It also became evident that it did not introduce an additional complexity that reduced teaching efficiency. They have said *"This was a clear message for us to develop a second-generation virtual reality dental simulator with improved tactile features to teach drilling procedures"*.

Venail F, Deveze A, Lallemand B, Guevara N, Mondain M[7]. studied the effect of supplementing of temporal bone anatomy learning with computer 3D rendered imaging software. They have reported that generally, all participants found this new tool interesting and user-friendly for the learning of temporal bone anatomy. However, they also found that most participants also considered the help of a teacher indispensable to guide them through the virtual dissection. They concluded that: *"The 3D anatomical software, used in parallel with traditional teaching methods, such as lectures and cadaver dissection, appears to be a promising tool to improve student learning of temporal bone anatomy"*.

Coming back to the questions posed at the beginning:

1. Are these new technologies more effective Educational tools *Vis a vis* the traditional methodologies? and
2. Are they more effective in generating interest in learners?

Taking the questions one by one as far as effectiveness as educational tools is considered neither Metzler R[2] et al of the Department of Surgery, University of Heidelberg, Heidelberg, Germany or Roach VA,[3] et al of Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, The University of Western Ontario, Canada find any significant difference between students taught using more traditional methods and the modern technologies. Venail F[7] et al have found that most participants also considered the help of a teacher indispensable to guide them through the virtual dissection.

New strategies are therefore needed to not only make anatomy teaching more clinically integrated,

but also to implement new interactive teaching techniques to help students more efficiently grasp the complex organization of the human body. Among the difficult anatomical concepts that students struggle to understand, the anatomy of the peritoneal cavity with its complex projections of peritoneum and this could benefit strongly from new learning aids.

In a study [8] carried out in Department of Anatomy and Cell Biology, McGill University, Montreal, Quebec, Canada to implement new interactive teaching techniques to help students more efficiently grasp the layout of the mesenteries they built a model consisting of a patchwork of mesenteries and gut made from coloured cloth stitched together onto a T-shirt to denote the origin and outflow of each peritoneum projection. As the lecturer wears the life-size model, the students can appreciate the 3D organization of the peritoneal cavity on a living body.

In another study in Uruguay Rivas RD[9] prepared a multi-coloured cardboard model accompanied by a user manual which provides a thorough description for the most common vestibular diseases. They found that the model had been well received at several Latin American scientific conferences. The model is understood with verbal instruction only; nevertheless, a printed user manual was included. They concluded that this 3 dimensional (3D) cardboard model of the Semi-circular Canals (SC) was a practical, low cost tool for use in private and academic settings.

Taking the experience of these studies it is seen that technology is not the only answer. The Canadian[8] and Uruguayan[9] studies demonstrate that the innovative and out of the box strategies are what is important to get the attention of the student. And once the students' attention is focused even a handkerchief becomes a teaching tool. As every teacher has experienced the tried and tested chalkboard is at present unmatched and has no close rival so far. But these newer technologies are coming up rapidly. As the studies above as well as other studies carried out in Australia[10], Grenoble, France[11] show it is easily concluded that the newer technologies of 3D graphic models, 3D Arthroscopy, 3D ultrasound, 3D videography, web-based 3D platform etc. are not only viable tools but essential tools in the arsenal of the modern anatomy teacher as technology advances.

However, experience has shown and these studies also point out a tool is only as good as the skill of the wielder. Taking into consideration the user satisfaction scores as related by Codd AM, Choudhury B[4], Keedy AW, Durack JC, Sandhu P,

Chen EM, O'Sullivan PS, Breiman RS[5], Curnier F[6] and Venail F[7] as well as the experiences in Australia[8], Uruguay[9] and Grenoble, France[11] it is time for the modern medical teacher to acquire skills in the burgeoning tools of the new technological age so that he is not overtaken by the younger generation of specialists and is able to retain the interest of the new generation techno savvy students.

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STATEMENT ABOUT OWNERSHIP AND OTHER PARTICULARS

“Indian Journal of Anatomy” (See Rule 8)

- | | | |
|--|---|--------------------------------------|
| 1. Place of Publication | : | Delhi |
| 2. Periodicity of Publication | : | Quarterly |
| 3. Printer's Name | : | Asharfi Lal |
| Nationality | : | Indian |
| Address | : | 3/258-259, Trilok Puri, Delhi-91 |
| 4. Publisher's Name | : | Asharfi Lal |
| Nationality | : | Indian |
| Address | : | 3/258-259, Trilok Puri, Delhi-91 |
| 5. Editor's Name | : | Asharfi Lal (Editor-in-Chief) |
| Nationality | : | Indian |
| Address | : | 3/258-259, Trilok Puri, Delhi-91 |
| 6. Name & Address of Individuals | : | Asharfi Lal |
| who own the newspaper and particulars of | : | 3/258-259, Trilok Puri, Delhi-91 |
| shareholders holding more than one percent | | |
| of the total capital | | |

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