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VIRTUAL DISSECTION – AS A NEW MEDICAL TEACHING TOOL

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ABSTRACT
Anatomy teaching for centuries is based only on the dissection of cadavers. Though it has evolved from only dissection of cadavers, to integration with the study of prosected and plastinated specimens. Virtual dissection is a touch-screen table, which facilitates 3D visualization of structures along with their relations and familiarize students with radiological and CT scan images. In AIIMS Rishikesh, virtual dissection and surgical planning stations are used for clinical teaching, so to explore and evaluate impact of these tools in learning anatomy, the present study was planned. Effect of virtual dissection teaching techniques (VDTT) on first-year MBBS students (Batch-2019-20), was analysed using marks obtained in monthly tests before and after the introduction of VDTT and a questionnaire on Students perceptions of VDTT. In routine teaching of anatomy more easy to understand anatomical areas are covered first and difficult areas are covered towards end, so areas after introduction of VDTT had more complex concepts. To our surprise, significant improvement was observed in marks obtained after the introduction of these modern teaching techniques, and other important finding was, improvement in marks was significant in below-average performers. Students admitted that virtual dissection teaching techniques enhanced their learning and understanding of the subject when they were analysed using questionnaire. Hence, it is important to use multiple techniques to effectively instruct as many different types of learners as possible to the best of ability. Using these innovative strategies as an adjunct to traditional methods in teaching anatomy will help to reshape teaching skills**.**

KEYWORDS: Virtual dissection, Surgical planning, Teaching skills, 3-D Visualisation.

INTRODUCTION
Anatomy teaching is an important basis of medical education these days, as curriculum changes are geared towards integrating foundation sciences with clinical and applied lessons (Nnodim, 1990). Many approaches for teaching anatomy exist like dissection, prosection, models, computer software, medical imaging (Darras et al., 2016), and each approach has its own strengths and weaknesses.

Virtual dissection is a touch-screen table, which facilitates 3D visualization of structures along with their relations and familiarize students with radiological and CT scan images (Darras et al., 2016). Virtual Dissection stations are advanced anatomy visualization systems, adopted by many of the world's leading medical schools and institutions (Yammine et al., 2014). The Table's technological compatibility ensures its use in large lecture halls through the use of projectors, and small group settings through multiple external monitors. It enables to present focused lectures with customized content and enhance classroom experience of learners (Anand et al., 2017).

It Keeps students occupied in Dissection hall and give them the opportunity to explore individually and lead their own discussions. Synergistic effects of virtual dissection table, prosections, and cadavers are reported. Studies on the variable scope of the efficacy of this technology are indicator of its positive impact on basic and advanced anatomical learning (Chan et al., 2015).

It provides an opportunity to simulate operation procedures in a natural and intuitive manner. Patients Dicom data can be accessed and simulation surgery can be performed, as these models are a copy of anatomy of the patient itself (Anatomage Table, 2018). It helps operating surgeon in planning best surgical approach in such a way, so as to minimize surgical time, amount of blood and tissue loss with the best recovery. This also helps in implant contouring, to minimize the extent of dissection, as a result, it increases recovery and decrease postoperative complications.

Cadaver based learning facilitates understanding authentic anatomy entailing variations, exposure to surgical skills and involves differential identification of structure through specificity of tissue texture. Although cadaveric dissection is very time consuming, it aids in tactile identification and comprehend kinaesthetic information. On the other hand, students appreciate the ability to manipulate virtual cadaver to visualize cross-sectional anatomy. It can be because students had the opportunity to redo and undo dissection as required and explore individually.

Aim: To evaluate impact of virtual dissection teaching techniques (VDTT) on first year MBBS students (Batch-2019-20) in learning anatomy.

Objectives:

1. To evaluate marks obtained in monthly tests before and after introduction of virtual dissection teaching techniques (VDTT).
2. To explore effect of VDTT using valid questionnaire (Custer et al., 2015) on Students Perceptions of virtual dissection teaching.

MATERIAL AND METHODS

The department of anatomy, AIIMS, Rishikesh acquired set of equipment's developed by Anatomage (Anatomage Table, 2018) and Sectra (Sectra Education Portal, 2019). To evaluate these tools for learning anatomy, a study was planned to assess effectiveness of virtual dissection teaching techniques (VDTT) over conventional methods. In routine teaching of anatomy more easy to understand anatomical areas are covered first and difficult areas are covered towards end, so areas covered after introduction of VDTT had more complex concepts. Study type: Observational, Study design: Cross-sectional, Study area: AIIMS Rishikesh, Study Period: One year, Study Population: First year MBBS students (Batch 2019-20), Sample size: Out of 100 students 92 were included and rest were excluded as did not appear in all monthly tests during evaluation period, Study variables: Marks obtained in monthly tests and an already validated questionnaire on Students Perceptions of VDTT (Custer et al., 2015) , Study tool: Conventional teaching tools (chalk and board, Books, Traditional Dissection) and Virtual dissection teaching tools (VDTT). Virtual stations have touch enabled interactive display, licensed software, PACS integration. Hardware is in form of Wall mounts and virtual dissection table. Operating software is windows 10 with Library having more than 1500 pathological cases, along with CT and MRI of patients, Study analysis: Performance of study group was assessed on basis of marks obtained in monthly tests held before and after introduction of these virtual dissection teaching techniques, using paired student t-test. Ethical point: Permission for retrospective data analysis was taken.

RESULTS

Mean of marks obtained by MBBS students (Batch 2019-20), in monthly assessments before and after the introduction of Virtual Dissection teaching techniques (VDTT) were analyzed using paired student-t-test. It was observed that mean marks obtained before VDTT were 50.38±1.17(SE) and after VDTT were 56.94±1.18(SE). Mean marks significantly increased after the introduction of VDTT with P-value < 0.001 (Table 1)

Students were classified into two groups: Good performers (scored marks ≥ 50) and Bad performers (scored marks <50). It was observed that out of 92 students, 45 were good performers and 47 were bad performers. Mean change in marks of good performers was 3.3±2.08 (SE) and in bad performers mean change in marks was 16±1.83(SE). Significant improvement in terms of marks obtained after the introduction of VDTT, was seen in bad performers with P-value < 0.001 (Table 2).

Table 1: Performance of students in monthly test (n=92) before and after introduction of Virtual Dissection Teaching Techniques (VDTT).

Performance in Monthly tests	Mean marks	Std. Deviation	Std. Error Mean	P Value
PBT (Performance before VDTT)	50.38	11.30	1.17	P<0.001
PAT (Performance after VDTT)	56.94	11.35	1.18	

*Paired student-t test.

Table 2: Difference in marks before and after introduction of VDTT in Good (M≥50) and Bad performers (M<50).

Performance in Monthly tests	Performers	Mean Difference marks	Std. Deviation	Std. Error Mean	P value
Good 1 (M ≥ 50)	42	-3.31	13.95	2.08	P<0.001
Poor 2 (M<50)	47	16.02	12.59	1.83	

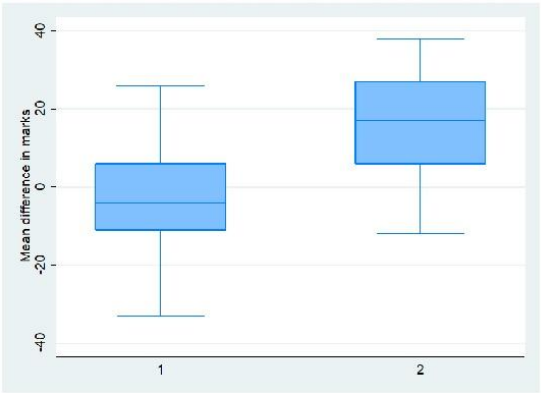
*Paired student-t test.

In Whiskers plot /box plot Good and Bad performers were numbered as 1and 2 respectively. More gain in marks was observed in bad performers as compared to good performers (Figure 1)

This very important finding can be used to generate hypotheses to conduct better-designed studies on the use of these modern technologies. As the main aim of a teacher is to effectively instruct different types of learners especially poor performers, as good students

will mostly perform good, so the target population should be generally bad performing students. Data in the literature regarding how the use of this modern technology in impacting students learning is limited.

Figure 1 : Whiskers plot /box plot representing Good and Bad performers as 1 & 2 respectively, more gain in marks can be appreciated in bad performers as compared to good performers.



On assessment through interviews and voluntary questionnaires; 80% of Students agreed that virtual dissection deepened their understanding. It provided them with a three-dimensional perspective of structures and helped them recall.

DISCUSSION

Eppler et al., 2018 compared student's performance in; Cadaver based versus Prosection and model-based dissection, found performance in dissection based was better. Author said first method increased the level of learning and understanding among students. In the present study, on assessment through voluntary questionnaires; it was found 80% of students agreed that virtual dissection software teaching deepened their understanding.

McMenamin et al., 2018 presided a Symposium to encourage a debate subjected to the need of cadavers to learn anatomy in undergraduate medicines and possible alternatives. In this debate, the advantages and disadvantages of cadaver use in modern medical pedagogy were discussed. At the end of the debate, the audience split equally on the question of using cadavers for learning anatomy in the undergraduate medical curriculum. In the present study, impact of virtual dissection teaching techniques (VDTT) in learning anatomy was assessed and significant improvement in terms of marks obtained, was observed. An important finding was significant improvement in poor performers as compared to good performers. Indicating a real need to change learning methodologies in anatomy as different students have different learning potential and requirement.

In a randomized cross-sectional prospective study with 122 students of MBBS first year to understand Neuroanatomy. To procure a statistically significant data, a t-test was performed. These were equally divided into two groups: group A and Group B. Group A were trained by the usage of virtual dissectors whereas Group B was educated by the traditional method of teaching. Pre-test and post-test were performed of both groups with pre-validated questionnaires. The results obtained indicated that the use of Anatomage, Sectra, and prosected parts makes learning lucid and enhanced classroom experience. This concluded that 3D visualization aids in fast learning but it is not complete (Anand MK et al., 2017). In the present study retrospective data analysis of marks obtained by 100 MBBS students before and after the introduction of VDTT was done.

The study of four learning sessions with an instructor and group of four students was conducted, in which Anatomage and prosection learning sessions were held for 60 and 70 minutes respectively. The author demonstrated that learning knee anatomy with Anatomage is more effective for naïve learners as compared with prosected specimens. He also commented that with Anatomage, students had better spatial understanding and it can be used to enhance their performance. The study was an attempt to explore the synergistic learning effects of Anatomage, prosection, and other learning methods (Chan et al., 2015).

Animations are more effective for certain knowledge domains especially in learners with a higher level of prior knowledge. Although new technologies appear promising, but it is important to understand that learners have limited working memories. On basis of observation of the present study, it can be inferred that these virtual dissection teaching techniques can supplement traditional teaching, to cover as many different domains and learners as possible (Wong et.al., 2015).

Fredieu et al., 2015 stated that Medical educators use models to depict anatomical structures in a more efficient format than a cadaver, it can be due to discomfort, and complexity associated with cadaveric dissection; or to clarify characteristics or functions of an anatomical structure that are not readily apparent in cadavers. The Author examined methods of implementation of visual and tactile resources in medical curricula and stated that by enabling students to interact with these resources from the moment they begin their medical education, will be priming them for their future careers.

The study was aimed to evaluate the effectiveness of the anatomy glove learning system to understand gross anatomy (AGLS) of hand and musculoskeletal functions by drawing structures onto a worn glove with imprinted bones. It demonstrates that AGLS and traditional 2D learning approaches are equally effective in promoting student's self-confidence and knowledge of hand anatomy. The inclusion of 3D and 2 D simulation has made learning more interactive. The two learning conditions in this article were 2D group (control learning conditions) and 3 D group (interventional learning conditions). 2D group consists of a short didactic lecture and an instructor-guided drawing activity. 3D group

consists of the same didactic lecture along with AGLS interaction using videos. Fisher's exact test was used for data analysis. Results procured states that AGLS gives a positive approach for understanding anatomy and it can be used as an effective learning tool for future students on hands-on practice. This study has significant limitations that revolves around classroom settings and time allowed for the curriculum. Precisely, AGLS provides hands-on learning and contributes to the improvement of traditional teaching methodology (Lisk et al., 2015).

Lombardi et al., 2013 explained a negative approach towards the use of plastic models and virtual dissection in comparison to cadaveric dissection. A Three-way experimental study with 29 students was performed. The solicited volunteers participated in a supplemented activity and a follow-up examination. Three treatment groups were created, 13 for organ dissection, 8 for virtual dissection, and 8 for plastic model group. Mann-Whitney U test was performed to identify the differences between learning approaches. The results obtained were conflicting. All students from the organ dissecting group found learning more interesting and interactive since the use of other teaching models makes anatomy oversimplified and less exploratory. In the era of information technology, plastinated specimens and virtual dissectors have brought pedagogical changes but comes with inherited limitations. Virtual dissections prove to be an attractive alternative but at times, it is expensive and controversial.

Over past decades' medical schools have experimented with abandoning cadavers and dissection and reinstated it a few years later. Since each student has a different baseline of skills and learning, therefore the introduction of virtual dissectors has brought eminent improvements acting as a supplement. In the present study, significant improvement in marks after the introduction of VDTT was observed and especially in poor-performing students. Results can be used to generate hypotheses to conduct better-designed studies on the use of these modern technologies.

CONCLUSION

Traditional teaching methods should not be replaced rather supplemented with modern virtual dissection teaching techniques to achieve better results and cater maximum number of students. However, consistently educators and students have found the use of cadavers irreplaceable for teaching human anatomy. But there are benefits of utilizing technology when it comes to train students, as teaching should be made available to all as per their understanding / IQ. It is important to use multiple techniques to effectively instruct as many different types of learners as possible to the best of ability. There is a real need to change and improve upon teaching-learning methodologies. Using these innovative strategies in teaching anatomy will help to reshape teaching skills.

Notes on contributors

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