Evaluating Training Effects of HOPS

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Abstract. This paper describes a study to evaluate the Horse Ovary Palpation Simulator. In order to examine training effects, a comparison was made between the performance on specimen ovaries of a group of students trained using the simulator, with a group of students trained using traditional anatomy lab methods. Results showed no significant performance differences between the groups. Similar mean scores for both groups suggest that the simulator could provide an environment for students to practice their skills when traditional training methods are not available.

1 Introduction

Virtual Reality simulation for medical training is a growing area of research. VR simulators offer the potential of providing a risk free environment for novices to practice their skills. However, evaluation of these systems is essential before they can be integrated into any course. Particularly when a simulator that has not been evaluated may not provide the training that it has been designed to provide. In the worst case, a simulator may train a novice in such a way that it degrades his or her performance in the actual task. Gorman *et al.* [1] show repeated simulator sessions can improve performance on the simulator, however, they note that it is important to show that these skills will carry over to the real procedure.

This experiment is designed to study the performance of students trained using the Glasgow Horse Ovary Palpation Simulator (HOPS) in ovary palpation. In order to achieve this, a comparison was made between students trained using the HOPS simulator, and students trained using traditional methods in diagnosing anatomy lab specimen ovaries.

2 The Horse Ovary Palpation Procedure

During an ovary examination, the vet inserts a gloved hand into the pelvic area of the horse through the rectum. The vet must then search through the pelvic region to locate the ovaries. This is difficult in itself, since the vet must perform this search through touch alone. It usually requires several attempts before an inexperienced

student can even locate an ovary. Once located, the vet will cup the ovary with one or more fingers, and palpate it using his or her thumb. In particular he or she will look for any abnormalities in the shape or surface properties of the ovary, and through experience, will be able diagnose different conditions through touch alone.

A common task carried out by a veterinarian is to locate follicles - spherical fluid filled sacs - that grow on the surface of the ovaries. It will typically grow from a small size to a few centimetres in diameter. Depending on the size, position and feel of the follicle a vet can diagnose the stage of ovulation of the horse.

Students have very limited opportunities to practice this skill. Due to lack of resources and ethical concerns, students may only be able to rectal a few cows during their training and there is no guarantee by this stage that they have even managed to locate an ovary.

3 The Horse Ovary Palpation Simulation

The HOPS environment is shown in Figure 1. The environment shows two virtual ovaries that have been developed through close collaboration with Glasgow University Veterinary School. A user interacts with the simulation using a PHANToM force feedback device.

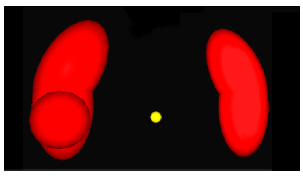

Fig. 1. The Horse Ovary Palpation Simulator. This environment consists of a left and right ovary. On the bottom half of the left ovary, a spherical follicle can be seen. The user's cursor is shown as the sphere in the centre

The environment is designed to concentrate on the palpation stage of the examination only, and all structures other than the ovaries have been removed. The ovaries are fixed in space to allow palpation with one point of contact. Because of similarities between the methods of palpation of horse and cow ovaries, the models can be thought of as generic large animal ovaries. Therefore, this system could also be used for training in palpation of cow ovaries as the required skills are similar.

4 Traditional Training Versus Virtual Training

This experiment was designed to compare the performance of students trained using the HOPS simulator and those training using traditional anatomy lab methods. The study therefore examined the performance of two groups of 8 students:

- Group 1 (G_{VR}) was trained using HOPS simulator
- Group 2 (G_{AL}) was trained through using traditional anatomy lab methods.

Both groups were at a stage during their course where they had received the theory through lectures but had no practical experience of the examination. The groups were trained using the methods described below.

4. 1 Multi-Session Virtual Training (G_{VR})

This initial study looked at the training effects of HOPS over multiple sessions. One group of eight students took part in this stage of the experiment. The task set to participants was to place and size follicles on the surface of the virtual ovaries through touch alone. Each participant took part in four training sessions spaced a week apart. The same 32 ovary cases were attempted by all participants in a counterbalanced order, with 8 ovary cases in each session. The cases were arranged such that there were 17 follicles in total per session and participants had a maximum of five minutes to explore each case. The participants were not told whether their answers were correct or incorrect until after the virtual training and the specimen examination sessions had been completed. This ensured that all benefits were as a result of repeated exposure to the simulator.

Results showed that participants improved significantly in placing and sizing the follicles over the four sessions although a levelling off in performance was noted between sessions 3 and 4. Participants also performed the task significantly faster over the four sessions, although a levelling off times was noted between sessions 3 and 4. A fifth session was performed by all participants in this group one month after the fourth session. No significant decrease in performance or increase in time taken was noted. The results of this study are discussed in more detail in the following paper [2].

4.2 Traditional Anatomy Lab Training (G_{AL})

Towards the end of the second year at Glasgow University Veterinary School, all students take part in a two hour anatomy lab on the reproductive tract of a cow. During this lab, the students can handle the tracts, and can identify the different structures on the ovary surface. This traditional anatomy lab method was used to train the eight participants from G_{AL}.

4.3 Training Comparison Experiment

Before the experiment started, participants were allowed to see a sample cow tract but not allowed to palpate it. Once the experiment had started, the participants were separated from the tracts by a curtained barrier. They were allowed to explore the tracts with one hand only, as would be the case in the real life procedure. The experimental task was to locate and size follicles on ovaries using touch alone. The same 8 cases were attempted by all participants in both groups in a counterbalanced order. Participants were limited to a maximum of five minutes for each examination.

They were not told whether they were correct or not until after the experiment was completed.

4.4 Results

An experienced veterinarian identified and sized 14 follicles in total on the eight cases. When assessing the results, a reported follicle was matched to the nearest sized follicle in the place specified by the participant if one existed. Of these 14 follicles, G_{VR} placed a mean of 12.9 follicles correctly compared to 11.8 for G_{AL}. This was analysed using a T-test and found not to be significant (T_{14}=1.4, p=0.18).

For follicles correctly placed and sized within 0.5cm of the correct size, G_{VR} correctly identified a mean of 9.6 compared with 7.5 for G_{AL}. This was again analysed using a T-test and again the result was not significant (T_{14}=1.1, p=0.29).

The mean distance of correctly placed follicles from correct size was also analysed. The mean distance of G_{VR} from the correct size was 0.48cm compared to 0.60cm for G_{AL}. A T-test again showed that this difference was not significant (T_{14}=0.79, p=0.45).

The mean time taken for each examination for G_{VR} was 200.5s compared to 225.4s for G_{AL}. This difference was not significantly mainly due to the large variance in the data (T_{14}=1.40, p=0.31). However, each participant in G_{AL} on average was stopped at the 300s time limit a mean of 2 out of the 8 cases compared to a mean of 0.75 for G_{VR}. Without this time limit the difference in timing data would be expected to be more pronounced.

5 Conclusions

Although no significant performance differences were detected between the groups, it is encouraging to note that mean performance results for each of the groups are similar. This would seem to suggest that the haptic training is as effective at providing ovary palpation training as the traditional methods. Due to the limited resources, students can be severely restricted in the amount of practical ovary examination training that they receive. The HOPS simulator could provide a potential solution by greatly increasing access to practical training, and allowing students to practice their skills when it would be otherwise impossible.

References

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2. Gorman, P. J., Lieser, J. D., Morray, W. B., Haluck, R. S., and Krummel, T. M. "Assessment and Validation of a Force Feedback Virtual Reality Based Surgical Simulator." *Proceedings of Phantom User Group 98*, 27-29.