

Augmented reality training to improve needle-based percutaneous interventions

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Motivation: The purpose of our study was to determine if medical trainees would benefit from augmented reality image overlay and laser guidance in learning how to set the correct orientation of a needle for simulated percutaneous facet joint injection.

Methods: The study protocol was approved by the Queen's University Research Ethics Board. A total of 28 medical students were randomized into two groups of 14: The Overlay group received a training session with image and laser overlay; The Control group was trained by freehand insertions. Finally, two freehand insertions were used to evaluate the performance in each group.

Experiments were carried out using the Perk Station (Vikal et al. 2010) hardware and software system (Figure 1). The needle was tracked by an NDI Aurora (Northern Digital Inc., Waterloo, ON, Canada) electromagnetic measurement system. The position and orientation of the needle was recorded into files in XML format.

To evaluate the recordings, a new software module was developed for the 3DSlicer software framework. After reading the XML files, the evaluator module can measure multiple parameters of each recorded procedure. Animated virtual model of the needle and the phantom ensures that gestures are annotated correctly (Figure 2).

Results: The number of successful placements was considerably higher in the Overlay group, compared to the Control group (85.7% vs. 57.1%, $p=0.038$; Figure 3). Neither total procedure time, nor time spent inside the phantom was found to be significantly different between the two groups. The distance covered by needle tip, which would be the analogue of soft tissue damage in a real patient, was mildly reduced in the Overlay group (207.1 ± 175.8 vs. 297.8 ± 227.9 , $p=0.24$). This suggests that they could find the target joint with less probing.

Conclusion: Training with augmented reality image overlay and laser guidance improves the accuracy of needle placement for medical students learning the correct orientation of a needle for percutaneous facet joint injection.



Figure 1. The Perk Station in use.

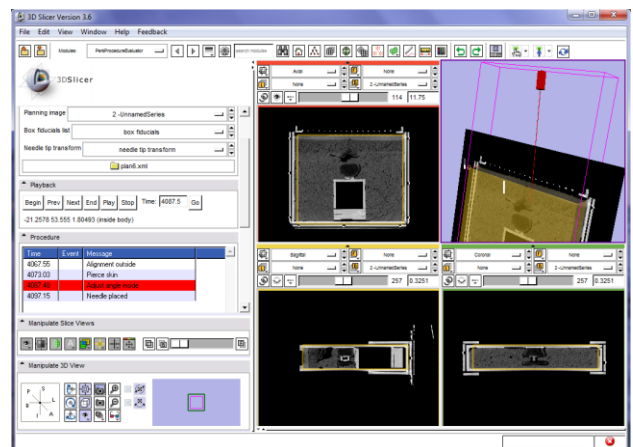


Figure 2. Software module running in 3D Slicer to evaluate recorded surgical gestures.

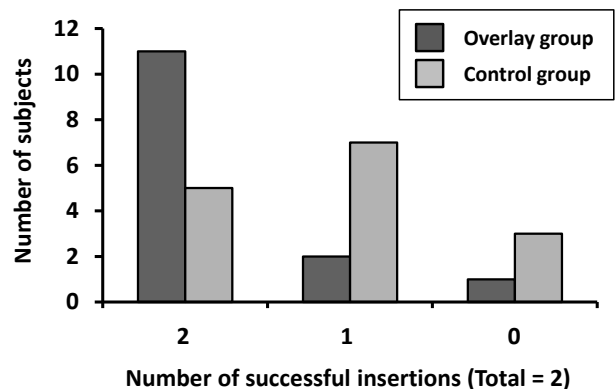


Figure 3. Number of subjects, who successfully inserted 2, 1 or 0 needles, out of 2 attempts in the assessment session. N=14 in both groups.