Perk Tutor Improves Ultrasound-Guided Facet Joint Injection Training

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Introduction

Background

Ultrasound (US) guided needle insertions are commonly used to perform facet joint injections to treat and diagnose facet joint syndrome. However, US-guided needle insertions are challenging because they demand simultaneous mastery of sonography and needle placement [1]. This motivates the development of a computer-assisted teaching method.

Objective

This study aims to assess whether students trained with the Perk Tutor [2], a computer-assisted simulation training platform, exhibit improved performance during US-guided facet joint injections in comparison to those trained with traditional methods.

Methods

Phantom

A synthetic phantom of the vertebral column and surrounding tissue is used. (Fig. 1.)

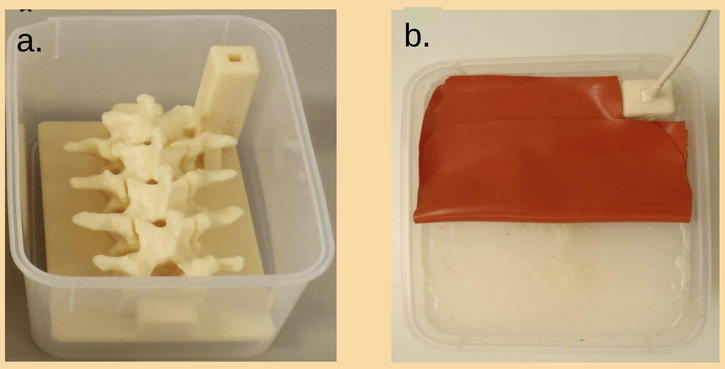

Figure 1: *(a)* The vertebral column model before being covered in gel *(b)* Perk Tutor phantom including vertebral column immersed in gel and covered in rubber skin

Software

- The Perk Tutor is a customizable computer assisted open source software platform developed earlier for supporting training of image-guided interventions
- The Perk Tutor uses 3D-Slicer(www.slicer.org) to display the positions and orientations of the needle and US probe with respect to the reference sensor on Perk Tutor Phantom (Fig. 2.)

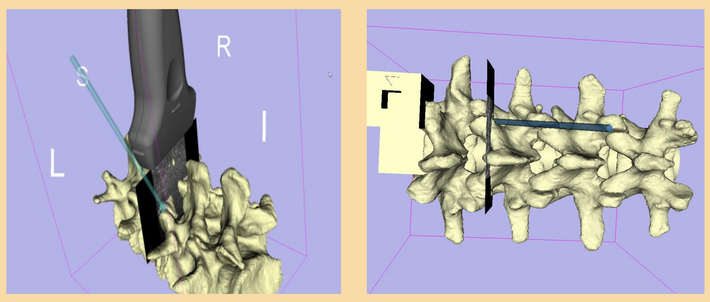

Figure 2: Perk Tutor display of successful needle insertions

Study Protocol

- 28 students were split into two groups, each with 14 subjects
- The control group received traditional training and the Perk Tutor group was trained using US and Perk Tutor together (Fig. 3.)
- After training each student performed four test insertions without access to the Perk Tutor. During these insertions, the motions of the US probe and needle were tracked and recorded for later analysis

Figure 3: Trainee instructed during Perk Tutor training on how to perform US-guided facet joint injection

Results and Discussion

Success Rate

- Perk Tutor group (n = 14): Mean success rate of 64.3%
- Control group (n = 14): Mean success rate of 35.7%
- Success rate of the Perk Tutor group was significantly higher than the success rate of the Control group (p = 0.0046) (Fig. 4.)

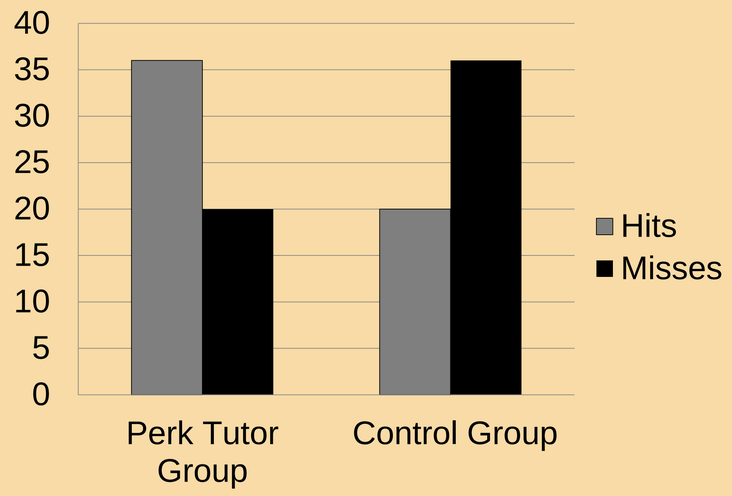

Figure 4: Hit and miss rates for Perk Tutor Group and Control Group

Needle Metrics

The following four metrics were calculated from subjects' recorded needle trajectories.

Metric	Perk Tutor	Control	p
Total Time (s)	66±6	73±8	0.70
Total Path (mm)	1366±185	1803±290	0.93
Time Inside (s)	296±45	243±28	0.97
Path Inside (mm)	42±16	25±3	0.91

Table 1: Needle metrics

Discussion

The Perk Tutors 3D needle-US-spine overlay helps trainees develop connections between 2D US images and the 3D anatomy of the spine. This results in improved needle placement during US guided facet joint injections when tested on a synthetic phantom. The ability to correct the positioning of misplaced needles is believed to be the cause of the increased time and path lengths of the Perk Tutor Group.

Conclusions

The pilot study suggests that training with the Perk Tutor system improves the accuracy of needle placement for students learning to perform US-guided facet joint injections.

References

[1] Chen C.P, Lew H.L, Tsai W. C, Hung Y. T., Hsu C. C. Ultrasound guided injection techniques for the low back and hip joint. Amer. J. Phys. 434 Med. Rehabil. 90(10): 860-867 (2011).

[2] Ungi T, Sargent D, Moult E, Lasso A, Pinter C, McGraw R, Fichtinger G. Perk Tutor: An open-source training platform for ultrasound-guided needle insertions. IEEE Trans Biomed Eng. 59(12):34475-3481 (2012).

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