

Teaching Lumbar Puncture and Ultrasound-Assisted Techniques Using Simulation-Based Courses

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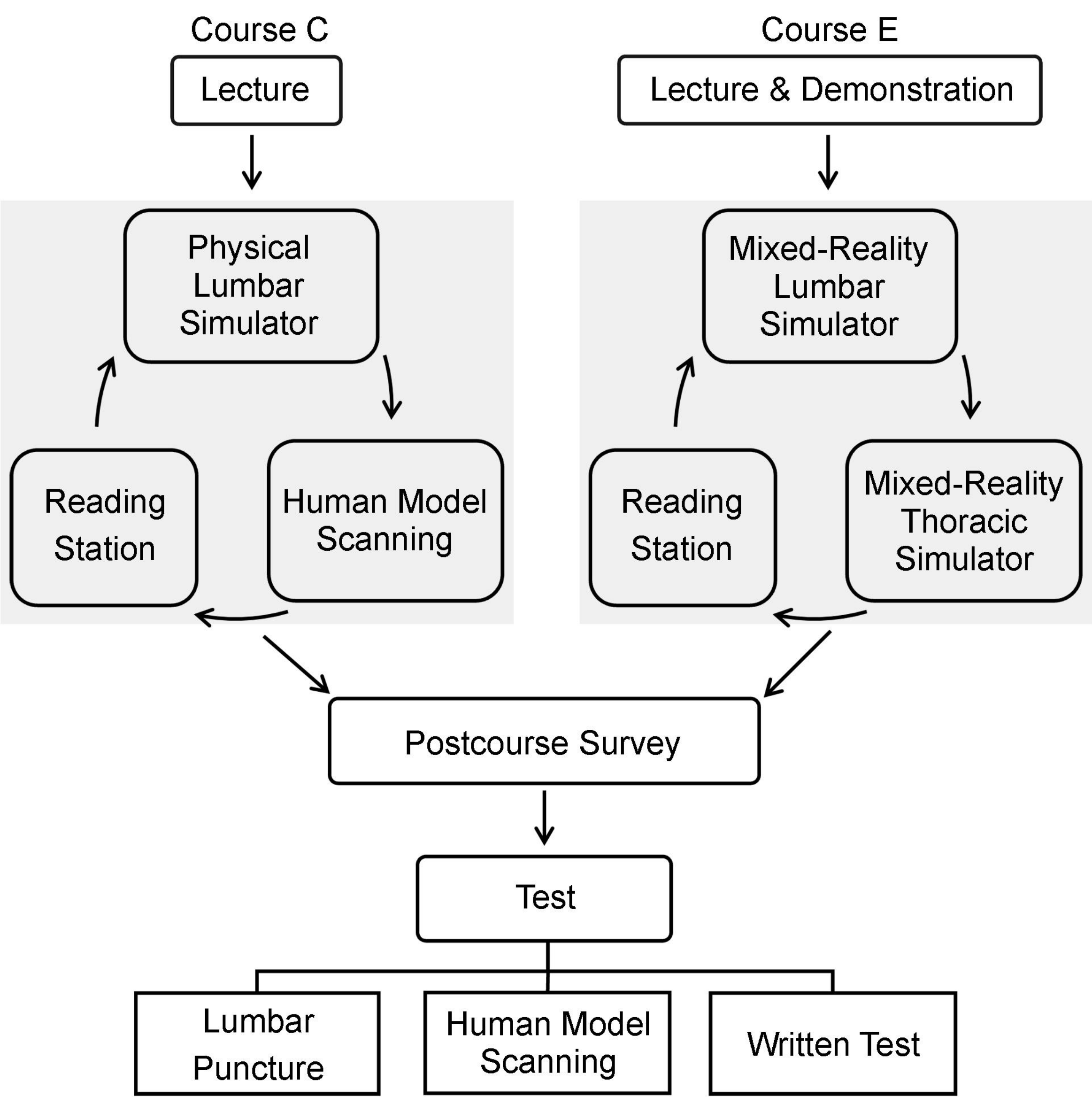
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Introduction

Teaching novices to perform lumbar punctures to deliver spinal anesthesia to patients in the operating room presents challenges for learners and instructors, while also increasing the risk of patient discomfort and complications. The procedure is often performed when the patients are awake, and patient anxiety can hinder the instructor from delivering timely, effective feedback. Simulators offer a controlled, risk-free environment for trainees to practice neuraxial procedures, and may improve the learning experience and reduce patient discomfort.

Methods

We designed a mixed-reality lumbar simulator and two courses to teach lumbar puncture using palpation or ultrasound-assisted techniques. Twenty-four learners were randomized into the two courses. We compared the effectiveness of the two courses in teaching lumbar puncture using subjective and objective measurements.



Results

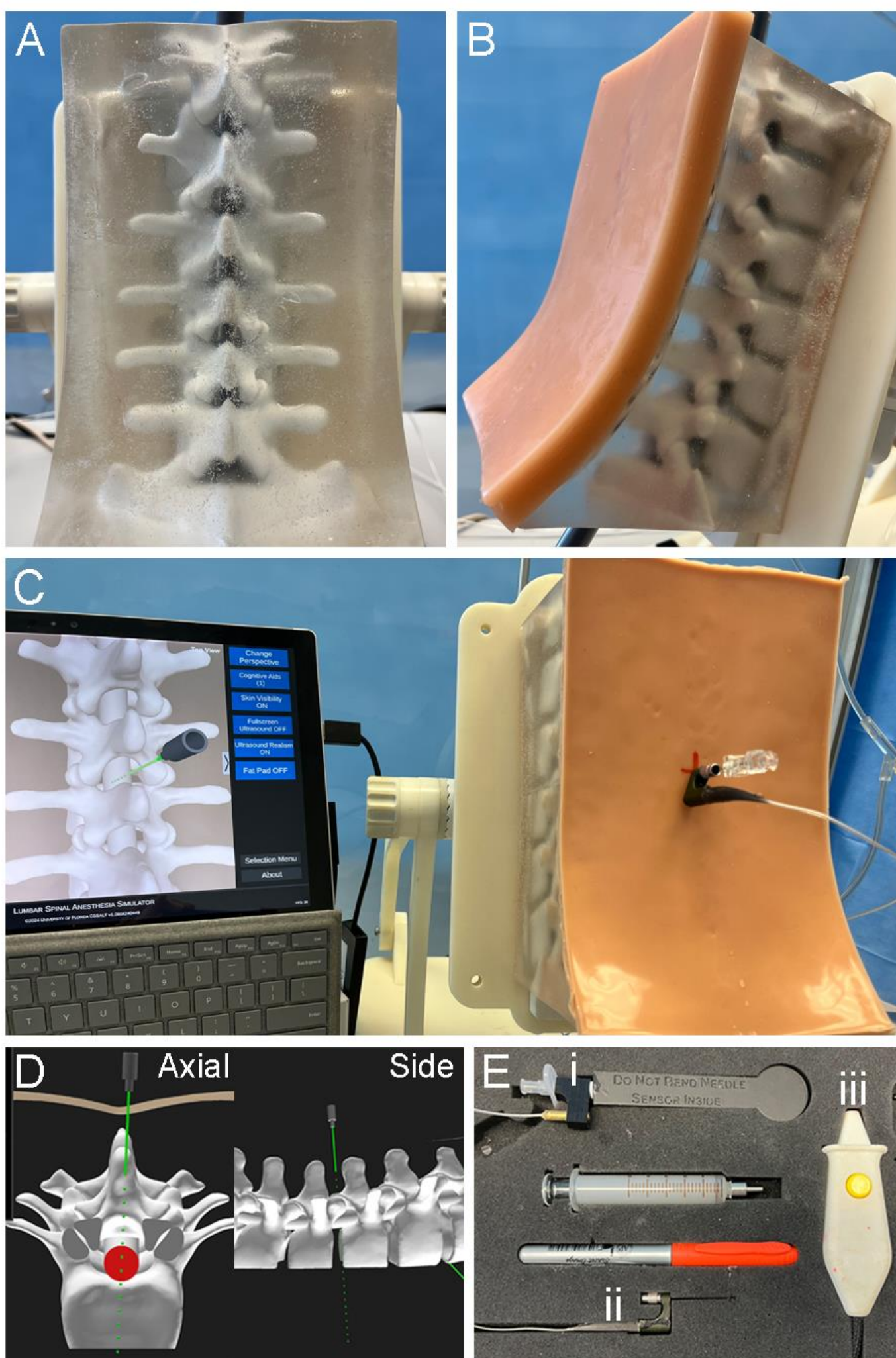


Figure 2. Mixed-reality lumbar simulator.

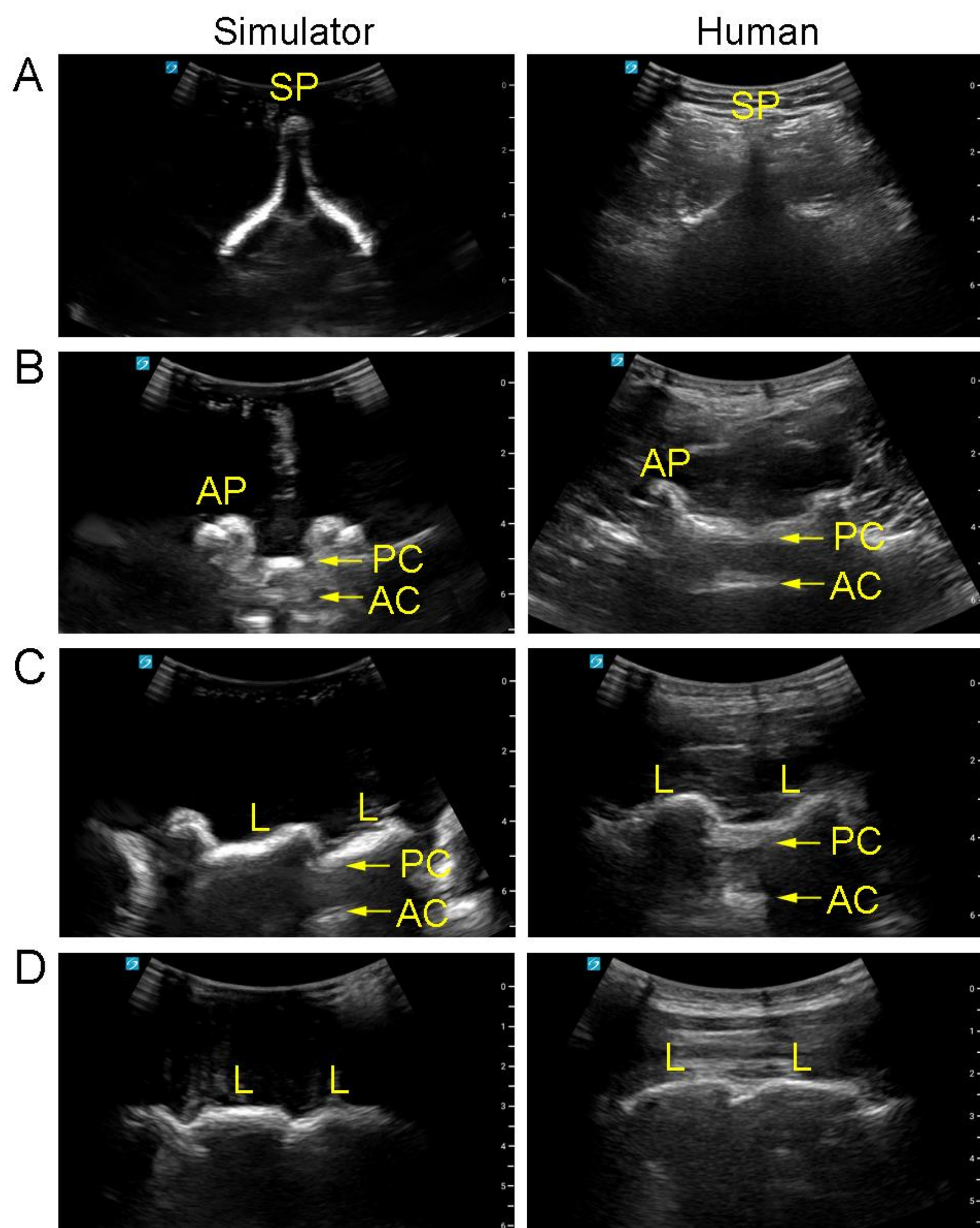


Figure 3. US images of the lumbar simulator and human lumbar spine.

Table 1. Comparison of outcomes of the two courses

Course		C	E	P value
Confidence level	Pre-course	1.4 ± 0.3	1.3 ± 0.1	>0.05
	Post-course	4.1 ± 0.2	3.8 ± 0.2	>0.05
	P value	<0.001	<0.001	
Assessment Consistency	Palpation Mark	16.7%	75%	<0.01
	Reassessment	8.3%	66.7%	
	Ultrasound Mark	85.7%	100%	<0.05
	Reassessment	0%	41.7%	
Success rate in lumbar punctures		83%	92%	>0.05
Total number of lumbar punctures		2.8 ± 0.7	1.9 ± 0.3	>0.05
Scanning and marking test		5.8 ± 0.5	6.8 ± 0.3	>0.05
Written test scores		73.0 ± 3.2	74.6 ± 6.3	>0.05

Discussion

- ❖ The 3D visualization of the mixed-reality simulator was rated by all the learners in Course E as “very helpful.”
- ❖ Learners in Course E did not outperform those in Course C in the lumbar puncture test.
 - Learning a procedural skill requires more than cognitive understanding. Lack of fine motor skills in the novices and short practice sessions may be limiting factors.
 - Limited number of residents
- ❖ Scanning and marking skills learned on the simulators are directly transferable to humans.
- ❖ Deliberate practice emphasized in Course E yielded better adherence to assessment steps in the learners.
- ❖ The total number of successful lumbar punctures performed by each learner showed different distribution patterns in Course C and E.
 - Polarized distribution in Course C
 - Normal distribution in Course E

