

Development and Evaluation of a Low-Cost, 3D-Printed Median Nerve Block Phantom for Ultrasound Education

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INTRO

- Ultrasound-guided nerve blocks improve precision and reduce complications.
- Commercial training models are costly / hard to access.

AIM

- Build a realistic, reusable median-nerve phantom with gel wax + 3D-printed parts.
- Evaluate educational impact on students and residents via randomized instruction.
- Need: durable, reproducible, affordable training model.

METHODS

- Construction: PLA shell/molds (Fusion 360); bones (radius & ulna) 3D-printed from segmented CT.
- Tissues: gel wax muscle/fascia; silicone skin, fascia.
- Nerves/Vessels: yarn in balloon for nerve & nerve sheath; silicone/latex tubing for arteries/veins.
- Design feature: small skin window for internal visualization.
- Study: randomized EM interns (n=11) to video-only (n=6) vs. supplementation with 15-min hands-on training with phantom (n=5); pre/post surveys + evaluation rubric.

RESULTS

- Median nerve ID confidence: 3.8/5, ↑73% (phantom + video) vs 3.3/5, ↑22% (video only)
- Landmark comfort: 3.6/5, ↑63% (phantom + video) vs 3.3/5, ↑60% (video only)
- Overall US procedure comfort: 3.4/5, ↑42% (phantom + video) vs 3.3/5, ↑65% (video only)
- Qualitative: clearer stepwise plans, better landmark recognition, safer needle trajectory verbalization, improved terminology.
- Phantom rated valuable; ultrasound image realism limited (distortion after repeated saline injections).

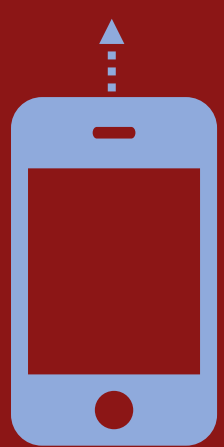


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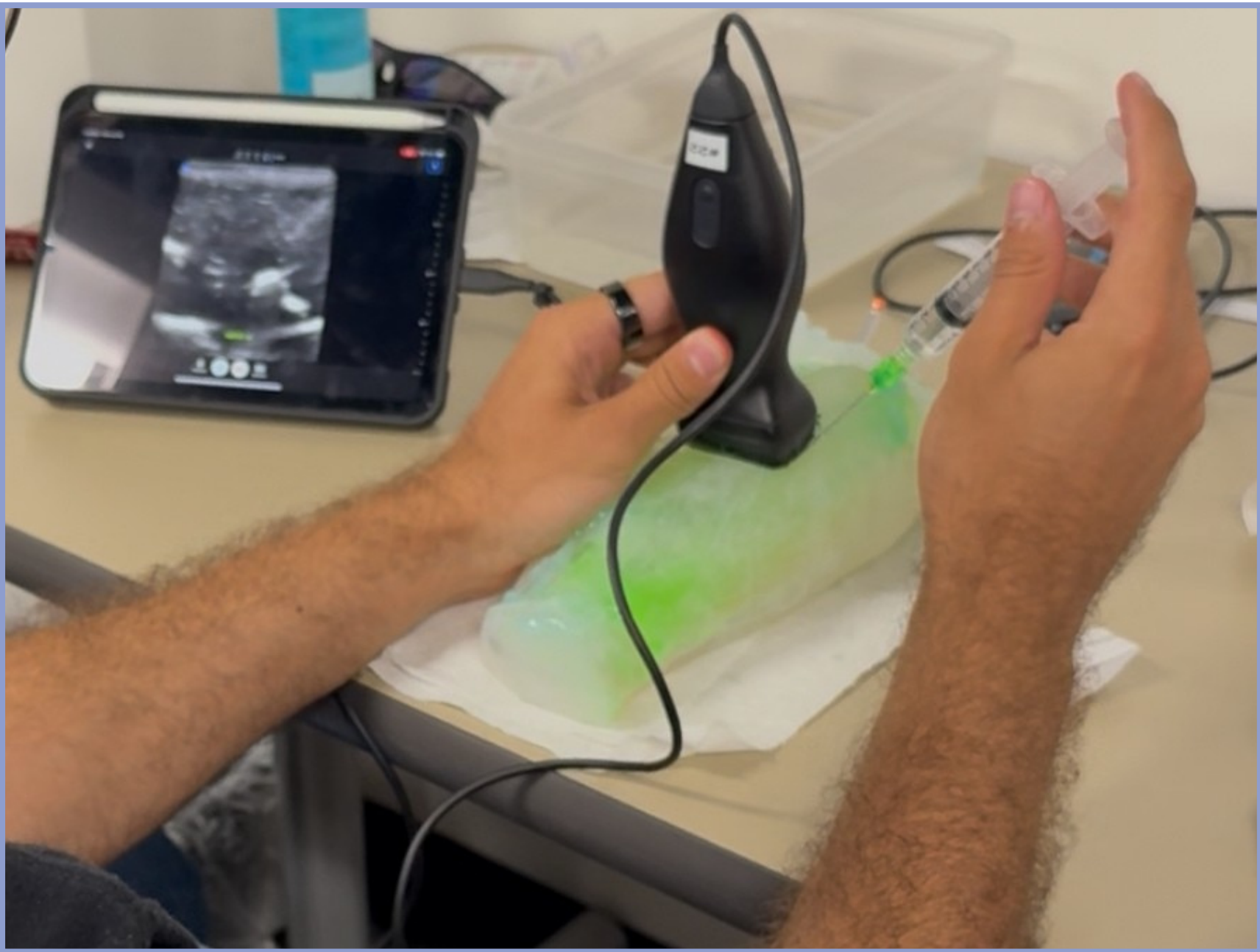
A low-cost, 3D-printed phantom model improved trainees’ confidence in ultrasound versus video-only instruction.



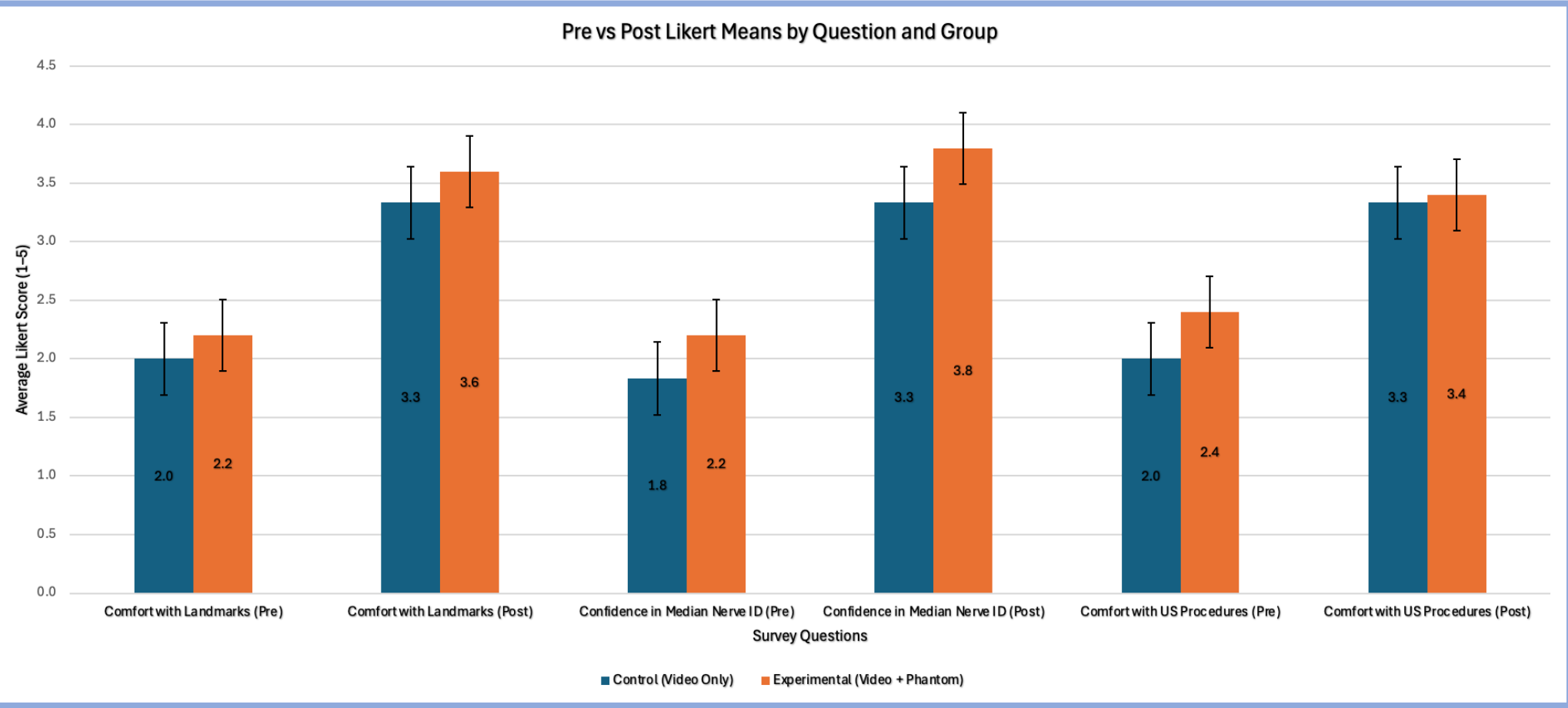
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Criterion	Control Pre	Control Post	Experimental Pre	Experimental Post
Median Nerve Identification	1	4	3	5
Anatomical Landmarks	0	4	2	5
Needle Trajectory Planning	0	3	1	5
Fascial Planes	0	0	0	3
Injection Volume/Technique	0	1	0	4



CONCLUSION

- A low-cost, low-tech phantom model may enhance ultrasound education and procedural confidence in medical training.

LIMITATIONS & NEXT STEPS

- One workshop, small sample size; image fidelity can drop with repeated saline injections.
- Next: address image fidelity, test drainage sheath; facilitate more workshops; adapt to other anatomical blocks.

