Developing Injection Skills Through Innovative Technology Using 3D-Printed Models

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CONTEXT
Lumbar spine and pelvic joint injections are common procedures used across a variety of medical specialties. The mastery of these procedures by medical students and residents is necessary for future patient care. Lumbar puncture and epidural procedures rely on the use of expensive commercial trainers, but currently there are no training models for facet, sacroiliac joints, or caudal epidural injections. We propose the use of 3D-printed models (made in-house) (Figure 1) allow trainees to master the skills required to become proficient in performing these procedures.

OBJECTIVES
To determine the perception of 3D-printed cervical (Figure 1B), lumbar (Figure 1C), and pelvic models (Figure 1D) for mastering joint injection techniques by osteopathic medical students and residents and to evaluate the efficacy of 3D-printed models for ultrasound needle guidance training.

METHODS
Study participants (N=36) included:
• osteopathic medical students (OMS III and IV);
• internal medicine residents;
• anesthesia residents;
• osteopathic manipulative medicine residents;
• family medicine residents.
Students and residents learned injection techniques with ultrasound guidance through a brief introductory lecture and a hands-on session using the models. They used the in-house 3D-printed ballistic gel joint models (Figure 1, 2) to practice lumbar, caudal epidural, sacroiliac, and facet joints injection techniques.

After the training session, participants completed a 15-question survey about their perception of models. The survey evaluated their comfort levels when performing joint injections after using the models, overall satisfaction with the models, and likelihood of using models in the future. The survey also asked participants to compare commercial injection training models with the in-house models (feel, anatomical correctness, and comfort when using the models).

RESULTS
Both students and residents agreed that 3D-printed models were easy to use, were a helpful tool, and helped them better understand the corresponding procedure (all P<.001). Further, 97% of participants believed the 3D-printed models were reasonable alternatives to commercial models, and 100% believed the 3D-printed models were a useful tool for injection training. Significantly more students than residents believed using 3D-printed models increased their comfort with the corresponding injection procedures (all P<.001). Despite that 30-33% of participants felt neutral about being capable of successfully performing these procedures. 97% believed the 3D-printed models could improve the existing medical curriculum. Overall, medical students were more likely to agree to the survey questions than residents (P<.001).

CONCLUSION
The new spine and pelvic models were well received by both medical students and residents. Our results suggested the 3D-printed models were also easy to use with ultrasound imaging, provided realistic training for injection procedures, and may serve as a cost-saving alternative to commercial trainers. The majority of participants believed 3D-printed models were beneficial for development of their clinical skills and would help them in their future practice.