

Developing Neuraxial and Regional Pain Procedure Skills Through Innovative Technology Using 3D Printed Models

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INTRODUCTION

Neuraxial spine and pelvic joint injections are commonly used procedures in anesthesiology, pain medicine, and a variety of other medical specialties. The mastery of these procedures by residents and practitioners is necessary for future patient care. Initial experience with neuraxial anesthesia procedures often rely on the use of expensive commercial trainers, but there are no training models for nerve root, facet joint, sacroiliac joint, or caudal epidural injections. The current study investigated the perception of 3D-printed lumbar, cervical, and pelvic models for mastering various injection techniques by osteopathic medical students and residents and evaluated the efficacy of 3D-printed models for ultrasound needle guidance.

OBJECTIVES

To assess comfort levels of medical students and residents when performing various injection techniques after participating in an educational training activity that used lifelike, in-house-made 3D-printed ballistic gel models.



Figure 1. 3D Ballistic gel spine and pelvic models for joint injection techniques training (patent pending).

MATERIALS AND METHODS

The local institutional review board approved the current project. Study participants (N=36) included third-year and fourth-year osteopathic medical students and internal medicine, anesthesia, osteopathic manipulative medicine, and family medicine residents. Participants used in-house-made 3D-printed ballistic gel joint models for mastering the various injection techniques under ultrasound guidance. The 3D-printed gel models provided a visual representation of human anatomy and a realistic feel when training for caudal epidural, sacroiliac, and facet joints injections and for neuraxial procedures including spinal and epidural anesthesia. Students and residents learned injection techniques with ultrasound guidance through a brief introductory lecture and a hands-on session using the models. After the training session, they completed a 15-question survey about their perception of the models in their education and the value of the models in their future practice. The survey evaluated their comfort levels when performing the various procedures after using the models, overall satisfaction with the models, and likelihood of using models in the future. The survey also required participants to compare commercial injection-training models with the in-house models (feel, anatomical correctness, and comfort when using the models).

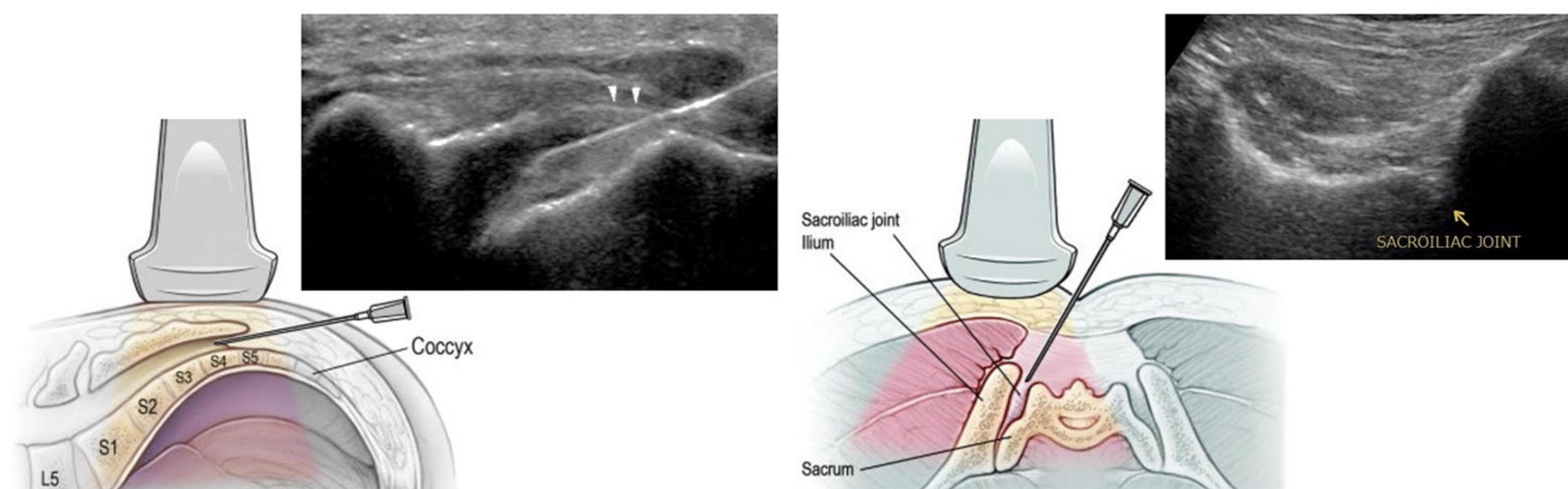


Figure 2. Examples of sacroiliac and caudal-epidural joints injection techniques using ultrasonography.

RESULTS AND DISCUSSION

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 and residents believed using 3D-printed models increased their comfort with the corresponding injection procedures (all $P < .001$), 30%-33% of participants felt neutral about being capable of successfully performing these procedures. The majority of participants believed 3D-printed models were beneficial for development of their clinical skills and would help them in their future practice; 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 ($P < .001$).

The current study assessed comfort levels of medical students and residents when performing joint injections after participating in an educational training activity that used in-house-made 3D-printed ballistic gel models. The models offered participants a visual representation of human anatomy and provided a realistic feel of the various injection procedures.

CONCLUSION

Our results suggested the 3D-printed models provided realistic training for various injection procedures and may serve as a cost-saving alternative to commercial trainers. The new neuraxial spine and pelvic models were well received by medical students and residents. Further, both models seemed to allow the participants to quickly master the new injection techniques, which would potentially improve future patient care.

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