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Noninvasive brain imaging shows readiness of trainees to perform operations

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While simulation platforms have been used to train surgeons before they enter an actual operating room (OR), few studies have evaluated how well trainees transfer those skills from the simulator to the OR. Now, a study that used noninvasive brain imaging to evaluate brain activity has found that simulator-trained medical students successfully transferred those skills to operating on cadavers and were faster than peers who had no simulator training.

The study, led by Arun Nemani, MS, a PhD candidate at Rensselaer Polytechnic Institute in Troy, N.Y., evaluated the surgical proficiency of 19 medical students, six of whom practiced cutting tasks on a physical simulator, eight of whom practiced on a virtual simulator, and five of whom had no practice. Study results were presented at American College of Surgeons Clinical Congress 2017.

"We plan on using these study findings to create robust machine learning-based models that can accurately classify trainees into successfully and unsuccessfully trained candidates using functional brain activation," Mr. Nemani explained.

The medical students who practiced on the physical simulator completed the task in an average of 7.9 minutes with a deviation (±) of 3.3 minutes. Those who used the virtual stimulator did the task in 13.05 minutes (±2.6 minutes) vs. an average of 15.5 minutes (±5.6 minutes) for the group that had no practice (p Brain imaging measured activity in the primary motor cortex, located in the frontal lobe. The researchers found that the simulator groups had significantly higher cortical activity than the group that had no training. "By showing that trained subjects have increased activity in theprimary motor cortex when performing surgical tasks when compared to untrained subjects, our noninvasive brain imaging approach can accurately determine surgical motor skill transfer from simulation to ex-vivo environments," Mr. Nemani said.

The researchers believe this study is the first one to show clear functional changes that transfer into surgical skill in individuals who had simulator training. "This work addresses underlying neurological responses to increased motor skill training that is often missing in current surgical simulator literature," Mr. Nemani said.

Mr. Nemani said objectively determining if a surgeon in training has achieved the motor skills necessary to perform surgery before actually doing surgery in the OR is crucial. "Brain function-based metrics, which do not depend on subjective or inaccurate task performance metrics, may bring significantly more objectivity in surgical skill transfer assessment," he said.

This study underscores the value of simulation and pre-planning operations by objectively showing functional changes in brain activity as surgeons learn new skills. "Now, we can quantify changes in brain activation as trainees master surgical tasks on a simulator and transfer to more clinically relevant environments," Mr. Nemani said.

Future research will expand to include other cortical areas associated with motor skill learning, such as the prefrontal cortex and supplementary motor areas, according to Mr. Nemani. "These next steps will help provide a comprehensive map on functional changes within the brain as surgical motor skill increases," he concluded.

Provided by American College of Surgeons