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Research Abstracts

Enhancing Medical Student Skill Acquisition in Trocar Placement through Physical Simulation

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Introduction: Simulation-based training is increasingly used in surgical education, yet its effect on learning efficiency remains debated. This study evaluated whether practice with a physical abdominal wall model improves biomechanics in medical students learning secondary laparoscopic trocar placement.

Methods: Thirty-one first-year medical students were quasi-randomized into control and experimental groups. All students attended a teaching session on laparoscopic equipment and trocar insertion. The experimental group practiced with 5-mm trocars on synthetic abdominal wall models developed through the Wellcome Leap SAVE program, while the control group received instruction without simulation. Students then placed a 5-mm trocar into the supraumbilical midline of cadavers. Biomechanical parameters, specifically maximum force, angular velocity, and upper-limb muscle activation, were measured using force sensors and the Trigno[®] Delsys Research+ system. Student performance was compared to attending surgeon benchmarks from a prior study. Following cadaver trials, students completed a survey on their experience.

Results: The experimental group outperformed the control group in five of six biomechanical parameters. The largest differences were in puncture force and angle ($p < 0.05$). Control participants applied significantly higher forces than surgeons and the experimental group, and inserted trocars at shallower angles, indicating greater shearing between tissue planes. Survey responses demonstrated strong student support for simulation, and experimental participants reported greater procedural understanding and self-confidence.

Conclusions: Training with abdominal wall models improved student biomechanics and produced performance more consistent with surgeon benchmarks compared to traditional instruction. Subjective feedback reinforced the value of simulation for skill acquisition. Despite the study's quasi-randomized design, the findings support integrating physical models into surgical education to enhance learning and reduce biomechanical errors.