Research Abstracts to be Presented at the 13th Annual International Meeting on Simulation in Healthcare

January 26th–30th, 2013
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1st Place – 1359

Using Virtual Reality Simulation to Assess Performance in Endobronchial Ultrasound

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2nd Place – 1168

Low-hanging Fruit: Using Clementines for Laparoscopic Surgery Training in Gynecological Oncology

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2nd Place – 1118

Using a Spatial Task to Measure Laparoscopic Mental Workload: Initial Results

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3rd Place – 1464

Simulated Arterial Blood Pressure Feedback Improves Chest Compression Quality in a Single Rescuer Model

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an authentic manner to a greater degree, and reported fewer errors. As educators, we value the open-ended, exploratory nature of chat mode without system-generated cues. This exchange mimics unscripted dialogue between physicians and patients, which may enhance skills transfer, and allows for development of critical thinking skills. We are compelled to improve the chat mode algorithm, rather than replace it with selection-based scaffolding.

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How Much Force? A Possible Gap in Surgical Training

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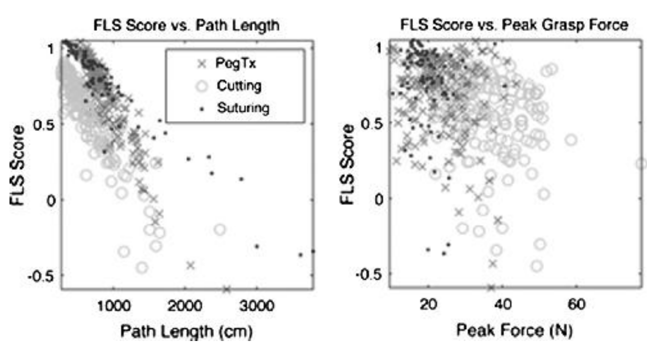
Introduction/Background: Simulation has become a valuable adjuvant to training laparoscopic technical skills, particularly in the widely-adopted and validated Fundamentals of Laparoscopic Skills (FLS) curriculum, which is used both for training and high-stakes evaluation.[1,2] FLS scoring is based on task time and an error penalty intended to reward precision. However, these errors may not adequately address the levels of force exerted on the tissues by the tool, and thereby allow laparoscopic trainees to acquire poor habits of tissue handling. De et al.[3] point out that excessive grasper-induced tissue stress injury, like crush injury, may cause "pathological scar tissue formation, bleeding, adhesions, and loss of bowel motility" and other groups report that laparoscopically manipulated organs "are susceptible to severe grasping injuries including perforation or hemorrhage.[4,5] Even less severe immediate injury from grasping or manipulation may still result in clinically relevant consequences such as ileus (paralysis of the bowel), increased infection due to local breach of the bowel's protective barrier and increased adhesion formation."[5,6] We hypothesize that the FLS scoring system does not adequately address the force levels trainees exert on tissues either in training or high-stakes evaluation.

Methods: We conducted an IRB-approved (ref), multi-institutional, cross-sectional study at three laparoscopic teaching hospitals (Seattle, Minneapolis, New Orleans) with surgical faculty, fellows, and residents as subjects. We employed the Electronic Data Generation and Evaluation (EDGE) platform (Simulab Corp, Seattle, WA) to measure tool motion and grasping force. Subjects were requested to perform the Block Transfer, Cutting, and Intracorporeal Suturing FLS tasks multiple times (3x, 2x, 2x respectively, in that order). FLS scores were computed for each task iteration along with peak grasping force and tool path distance.

Results: A total of 98 subjects participated, completing 447 FLS task iterations (193 Block Transfer, 165 Cutting, 89 Suturing). The correlations from FLS score to path length and peak force were measured via Pearson's R for linearity and Spearman's *r* for monotonicity. FLS score and path length correlated favorably for Block Transfer, Cutting, and Suturing with Pearson's R = -0.92, -0.87, -0.95 (each *p<0.0001 or less*), respectively and Spearman's *rho*=-0.89, -0.88, -0.93 (each *p<0.001 or less*), respectively. FLS score and Peak Grasp Force did not correlate, with Pearson's R = -0.18(p<.01), -0.27 (p<.001), -0.16 (*p <.13*), Spearman's *rho* =-0.08(p<.30), -0.27(p<.001), -0.26 (*p <.01*), again respectively. The attached scatter plots (Fig. 1) indicate a somewhat uniform dispersion of FLS scores vs. Peak Force, showing multiple instances where extremes of high peak forces occur in both the best and worst FLS score categories.

Conclusion: If two clinically-relevant metrics correlate perfectly, they are redundant; one provides no added information over the other. We observed a strong correlation, and therefore possible redundancy, between FLS score and path length but not for grasping force. This suggests grasp forces provide additional information not present in the FLS scores. If minimal forces or respect for tissue were training objectives, we would expect to see less spread in peak force among higher (better) FLS scores. Such phenomena are not present in our data, particularly for the Block Transfer and Suturing tasks. To be clinically relevant, tissue-specific levels of safe peak force must be established as errors and training targets. Since FLS instructions do not specify a target tissue to establish this level, we cannot conclude that any of our high-force subjects exhibited clinically deleterious tissue handling. Should such levels be established, the FLS scoring system would not provide a means to discriminate such errors. We conclude the FLS scoring system may not adequately address the force levels trainees exert on tissues either in its training or evaluation.



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Disclosures: Timothy Kowalewski, PhD, is a consultant for Simulab Corporation. Thomas Lendvay, MD, is a co-founder in SPI Surgical, Inc. Blake Hannaford, PhD discloses that the Edge technology (described in this abstract) has been licensed from my laboratory at the University of Washington.

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Assessing High-fidelity Mannequin Facial Expressivity: A Preliminary Gap Analysis

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Introduction/Background: High-fidelity mannequin based medical simulators (HFMs) are limited by their lack of facial expressivity. Our preliminary work suggests that this lack of expressivity may negatively affect the realism of medical simulations, learner immersion, and patient safety.[1,2,3] The objective of this study is to characterize how educators and clinicians perceive current HFM expressivity, and identify gaps. This gap analysis identifies the areas where HFM technology is unsatisfactory, and our preliminary work allows us to begin the initial stages toward technology improvement.

Methods: We created an online pilot survey to characterize this gap in HFM expressivity, and understand which limitations were most critical to learner education. To create the survey questions, we conducted three contextual inquiries with simulation center directors, each from a representative medical school, nursing school, and hospital educational setting. Based on these responses, we drafted and distributed a 70 question survey. The survey asked participants demographic questions to characterize their role within the simulation center, current HFM technology questions to characterize their existing HFM usage, and future HFM technology questions to characterize how they would envision the technological attributes of a new, facially expressive HFM. The current and future HFM technology questions were 5-point, discrete visual analogue scale questions (strong agree – strongly disagree), which addressed key technological issues and themes that emerged from the contextual inquiries. We randomly selected 65 members from the Society for Simulation in Healthcare (SSH) LinkedIn group who are employed in the fields of hospital and health care, higher education, and/or medical practice, and emailed them a link to our Survey Monkey instrument.

Results: The survey response rate was 33%, with 15 respondents finishing (23%). Survey participants consisted of mainly academic professionals, simulation program directors, and education specialists. Of the 15 respondents who completed the survey, 13 (87%) reported that they perform simulations on a high fidelity mannequin, 11 (73%) reported that they have worked with HFM technology for longer than six years, and 11 (73%) reported that over half of their simulations involve the HFM being awake and responsive. 11 respondents (73%) reported that when they perform simulations they required either themselves or someone else to verbally provide symptoms from a cue card for the HFM. 13 respondents (87%) reported that if an HFM could make eye contact with learners, as well as track a learner's finger, it would result in greater learner immersion. 14 respondents (93%) reported that having a mannequin that had a more expressive face would improve the realism of simulations. Similarly, all 15 respondents (100%) reported that having a mannequin that could express pain or drowsiness would improve realism.

Conclusion: The results of this pilot study illustrate some limitations in existing HFM technology, such as the inability to synthesize facial expressions and requiring a cue card to express certain HFM symptoms. Our survey respondents desire HFMs to have more overall facial expressivity, and in particular be able to express pain and drowsiness, make eye contact, and track a learner's finger. This work compliments our previous work that suggests expressive HFM technology may increase learner engagement, and create a more realistic training scenario. We will soon conduct this study on a much larger pool of SSH members to further define the HFM expressivity gap.

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