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Research Abstracts

Objective Measurement of Standing Related Fatigue in Operating Room

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Introduction: Surgeons and surgical teams work in unique conditions that require prolonged standing and a limited dynamic movement around the operating table, potentially exposing them to musculoskeletal symptoms in the back and lower extremities. Medical experts and researchers have raised the attention on investigating occupational health consequences of prolonged standing during surgery. This study aimed to assess whether objectively measured shifts of surgeons' weight during an operation were associated with lower extremity musculoskeletal fatigue.

Methods: An IRB-approved study was conducted to quantify the intraoperative standing-related metric. All participants self-reported musculoskeletal discomfort using a 3-point Likert body-part discomfort survey. Standing data was recorded from laparoscopic operations using a pressure measurement system. The reaction forces were identified for each foot and were used to determine a weight shift by normalizing the difference between the right and left ground reaction forces over the total body weight. Based on reported pre- and post-operative discomfort ratings, participants were divided into fatigued and non-fatigued groups. A linear mixed-effects model was performed to determine the relationship between objective measurements and subjectively reported discomfort.

Results: A total of sixteen surgeon assessments were collected. The fatigued group had 2.84 ($p < 0.05$) more shifts per minute compared to the non-fatigued group. The average body weight shifts slope overtime increased by 21% for the fatigued group (compared to the non-fatigued group). No statistical differences were found based on age, gender, and role ($p > 0.05$).

Conclusions: The results of this study showed an association of objective measurements with subjective standing-related fatigue ratings during surgical operations, indicating that the body weight shifts could be implemented as an objective variable to identify lower extremity fatigue. The future steps would be leveraging the objective measurements to develop models to predict fatigue during surgery. Beyond predicting lower extremity fatigue, this approach may also help assess the impact of interventions more effectively and efficiently.

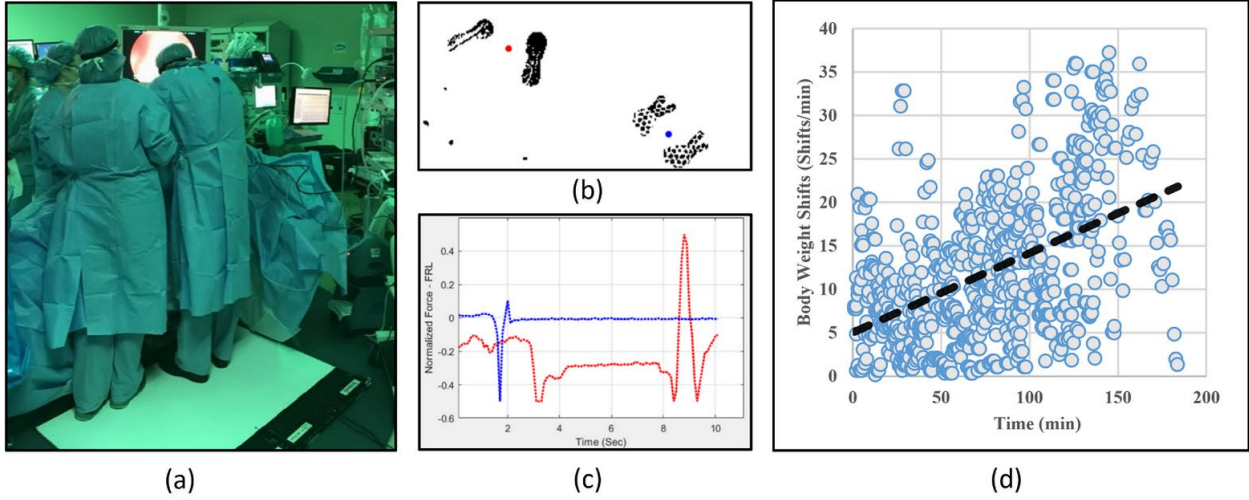


Figure 1: Pressure sensing platform, reaction forces, and weight shifts in fatigued group over time of operation.