

## ACS 2022 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

### Research Abstracts

#### Evaluation of Exoskeleton Implementation in the Operating Room

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**Introduction:** Musculoskeletal symptoms and injuries adversely impact worker health and performance in the operating room (OR). Though the ergonomic risks in surgery are well-recognized, their mitigation is especially difficult due to the demanding work and restrictive work environment (e.g., sterility) that must prioritize patient safety. The study's aim was to assess potential benefits of exoskeleton technology when used by OR team members.

**Methods:** After Institutional Review Board approval, and consent from the patient and participating OR team members, participant posture angles and muscle activity were collected during laparoscopic or open procedures. Measurements were recorded in cases where a passive arm-support exoskeleton (Levitate AirFrame™) was worn by participants and in cases that it was not worn. The exoskeleton was fitted and was worn under the sterile surgical gown. Participants were equipped with inertial measurement units and surface electromyography (EMG) sensors on their upper body. Posture angles and muscle activity metrics were calculated and compared between the baseline and exoskeleton conditions using differences Wilcoxon tests.

**Results:** Twenty-seven total cases were collected, 12 with and 15 without the exoskeleton. One surgical nurse, one attending surgeon, and five trainees participated in the study. Two participants were female, and all were right-hand dominant. Decrease in percent time in demanding postures for the right (7%,  $p=0.03$ ) and left (17%,  $p=0.19$ ) shoulders were observed with the exoskeleton. There were also significant decreases in metrics representing static (0.34%,  $p=0.02$ ) and dynamic (0.87%,  $p=0.02$ ) demands on the left trapezius; however, there were increased signs of fatigue in the right deltoid (17% decrease of EMG median power frequency) with the exoskeleton.

**Conclusions:** The use of an exoskeleton during a variety of operations led to lower posture angles of the shoulders and decreased muscle fatigue while muscle activity of the arms increased. While exoskeleton technology has the potential to reduce musculoskeletal symptom and fatigue indicators, training on using the exoskeleton by OR personnel may be needed to minimize increased load on the arms and improve surgical team members' health and safety.