

Comparative Analysis of Ergonomic Stress Across Surgical Approaches: A Prospective Assessment from the Operating Room

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BACKGROUND

- Work-related musculoskeletal disorders are common among surgeons. Traditional ergonomic assessments are carried out by trained ergonomists who are not readily available in the operating room
- Over 10% of surgeons who suffer from a work-related musculoskeletal disorder will require a leave of absence, practice modification, or even early retirement¹
- Previous studies have evaluated AI-based ergonomic assessment in simulated operating rooms; in contrast, our study uniquely applies this methodology to real-world surgical procedure

¹ Eppstein S, Sporer EH, Tran BN et al. "Prevalence of Work-Related Musculoskeletal Disorders Among Surgeons and Interventionalists: A Systematic Review and Meta-Analysis". JAMA Surgery. 2018; 153 (2).

METHODS

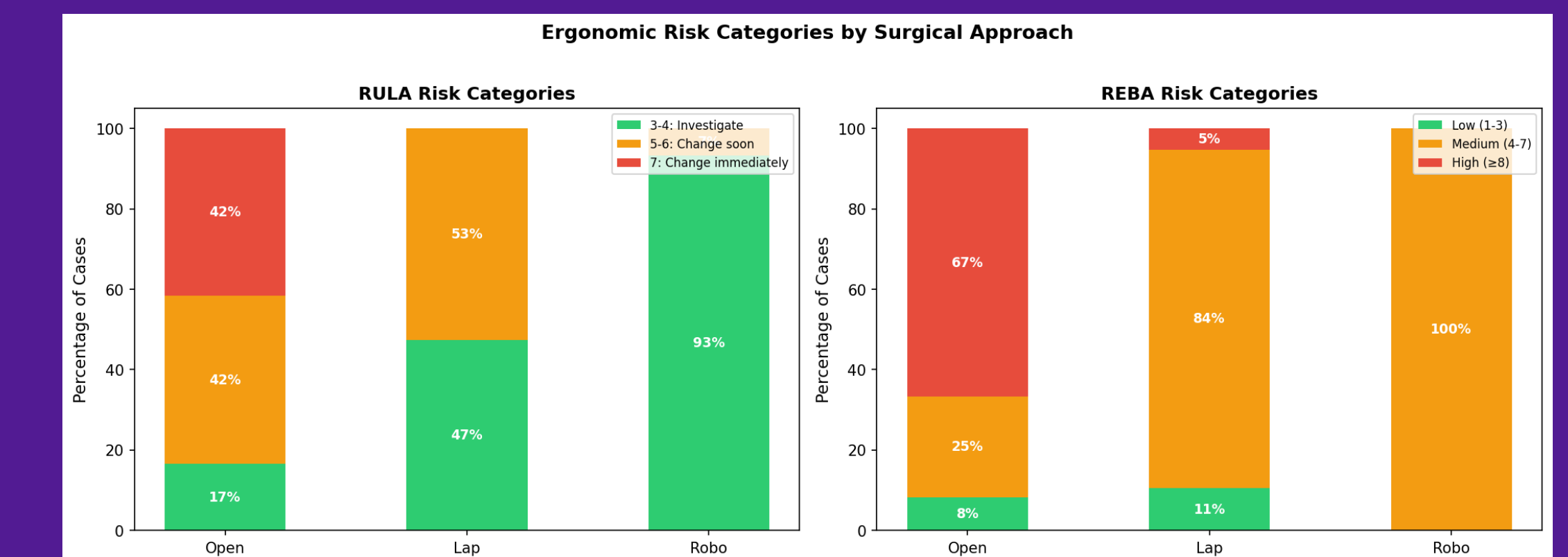
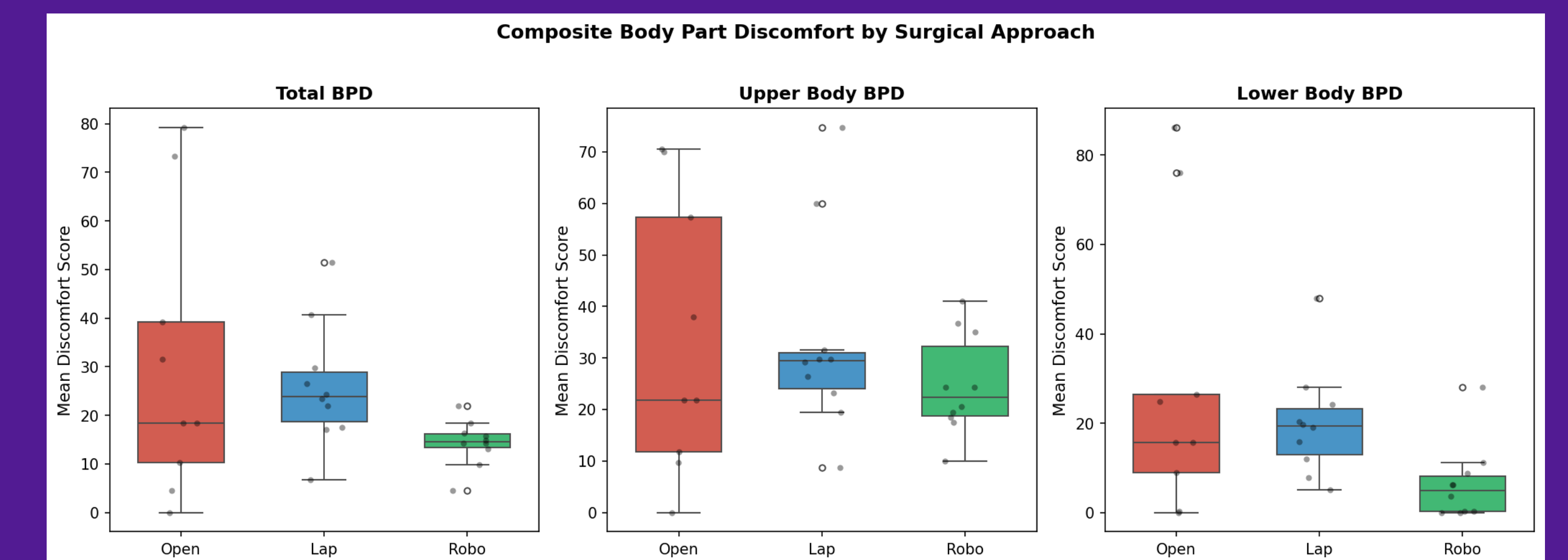
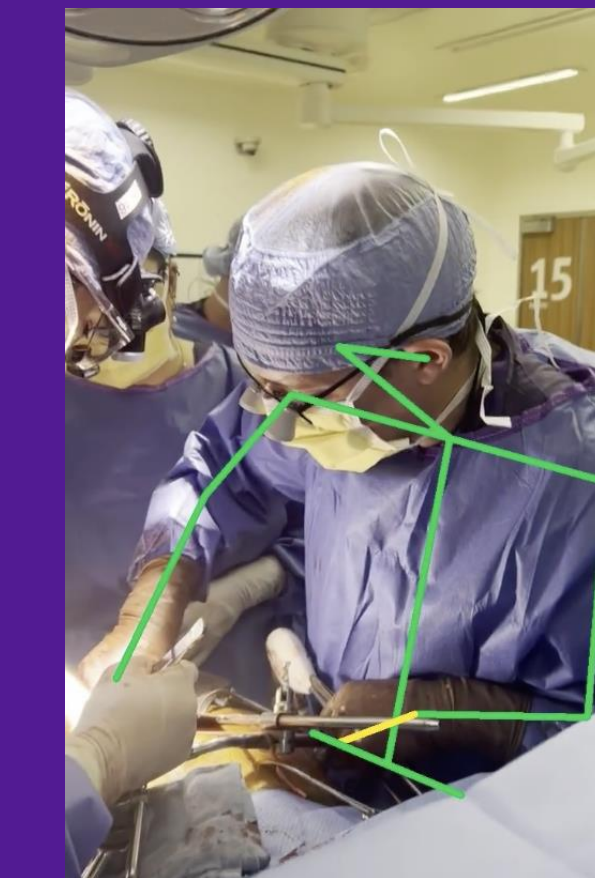
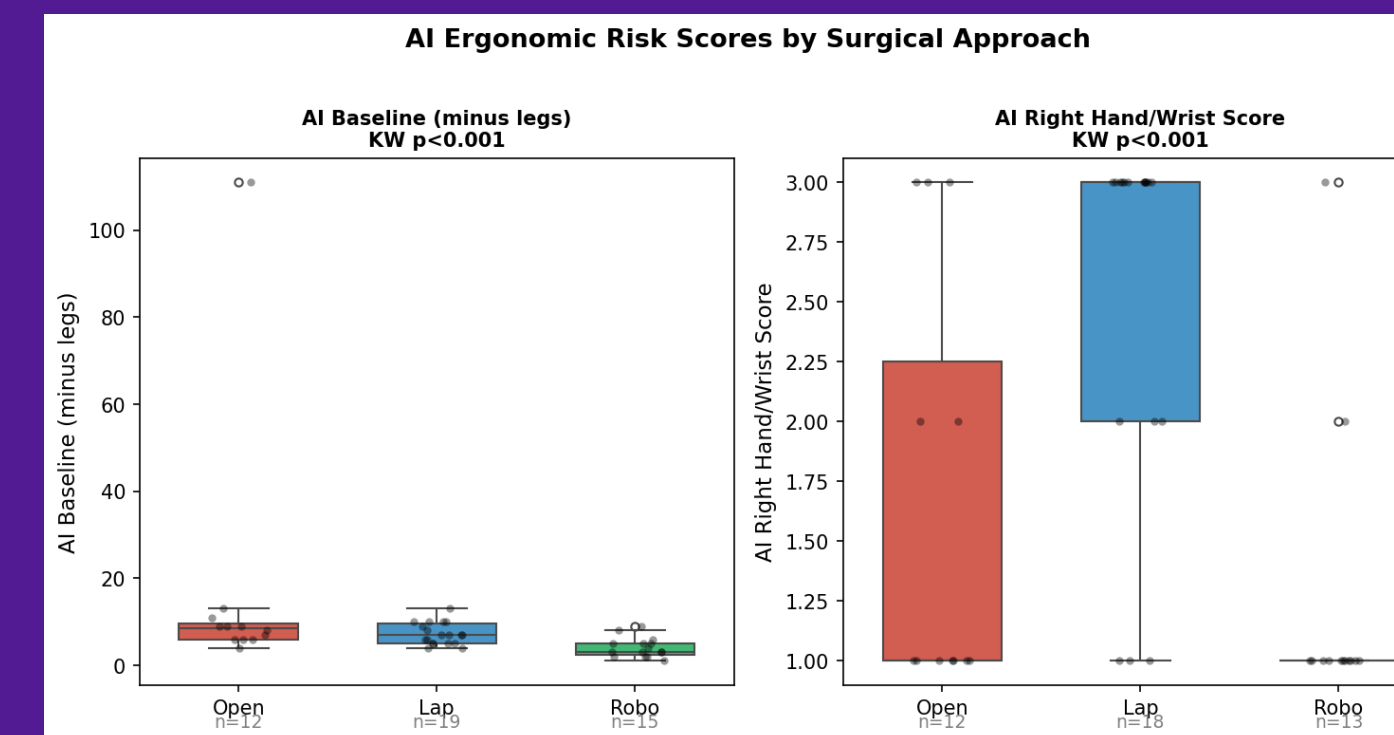
- Prospective observational study at the University of Washington
- Data collected in 46 cases: 12 open cases, 19 laparoscopic cases, and 15 robotic cases
- Three-minute videos of operating surgeons were taken approximately one hour after beginning the case.
- Ergonomics were assessed using an unvalidated proprietary AI-based tool from Velocity EHS (Chicago, IL, USA). As well as with the partially validated measures--the Rapid Upper Limb Assessment (RULA)² and the Rapid Entire Body Assessment (REBA)³
- Post-study survey data was collected which consisted of the SURG-TLX measure, the Body Part Discomfort Scale (BPDS) measure, and surgeon demographic information
- Data was analyzed using R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing; 2024.

² Leamon B, McQuinn J. "The Rapid Upper Limb Assessment (RULA)". *Applied Ergonomics*. 2000; 31: 636-644.

³ McQuinn B, Leamon B. "The Rapid Entire Body Assessment (REBA)". *Applied Ergonomics*. 2001; 32(1): 33-41.

RESULTS

- 78% of participants were attending surgeons, 22% trainee surgeons
- 7% of cases were urologic, 4% were vascular, and 89% were general surgery operations
- All right-handed
- Height: median 177 cm [172–180]
- Weight: median 76 kg [68–79]
- Glove size: median 7.0 [6.0–7.5]



CONCLUSION

- The AI-based assessment method is not as sensitive as either the RULA or the REBA. We encountered frequent technical issues collecting data in the operating room. At present the tool is not sufficient for use in the operating room and it should be further refined prior to adoption in the operating room
- Open surgery is associated with significantly higher ergonomic strain when compared against MIS approaches on both the RULA and the REBA, these scores are driven by increased neck and back strain
- Robotic surgery confers distinct reductions in lower limb strain score, presumably due to the seated position
- Robotic surgery is found by the RULA and the REBA to have lower wrist strain, however these tools may not accurately capture the frequent small hand and wrist movements in robotic surgery

