Exoskeleton intervention for work-related musculoskeletal disorders in the operating room

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Introduction

- Work-related musculoskeletal disorders are prevalent amongst surgeons which negatively affects their productivity and quality of life.
- Estimates of prevalence of musculoskeletal disorders amongst surgeons.
  - Neck: 82.9%[1]
  - Shoulders: 68.1%[1]
  - Back: 57.8%[1]
- Ergonomics research has identified the following work-related variables as causative factors.
  - Awkward body segment postures[2].
  - Extended operating hours with static postures[2].
  - Intensive workload and insufficient rest.
- Previous research estimates about 50% of vascular surgeons are worried about career longevity and between 9-26% of surgeons retired due to musculoskeletal pain.[3]
- Exoskeletons have shown potential as ergonomic interventions in non-healthcare applications; however, are unexplored in healthcare applications[4].
- Need to explore exoskeletons, and how to optimally deploy in operating rooms[5].

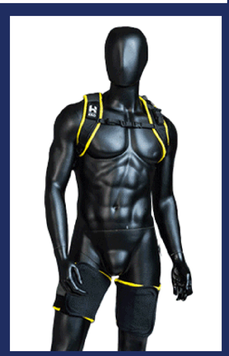
Objective

- Test the ability of a trunk exoskeleton to reduce subjective body discomfort when used in vascular surgery using subjective data

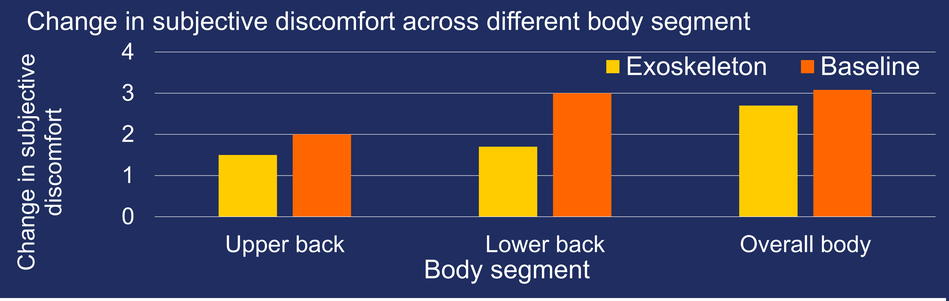
Methods

- A repeated measure pilot study with three vascular surgeons performing various vascular procedures with and without the exoskeleton
- A total of twelve (12) baseline surgeries (without exoskeletons) and ten (10) matched surgeries were completed while donning the exoskeleton
- Inertial measurement units (IMU) were used to measure and record body segment posture (neck, shoulders, and trunk) in real time while operating.
- Pre-post subjective discomfort and post-operative workload survey were administered.





Results and Discussion



- The exoskeleton seems to result in lower post-operative increase in fatigue
- Differences were not statistically significant between exoskeleton vs no exoskeleton
- Data accrual is currently ongoing
- Future research will explore the objective biomechanical data in this study with an increased sample size.

References

1. *Szeto GPY, Ho P, Ting ACW, Poon JTC, Cheng SWK, Tsang RCC. Work-related Musculoskeletal Symptoms in Surgeons. J Occup Rehabil. 2009;19(2):175-184*
2. *Szeto GPY, Cheng SWK, Poon JTC, Ting ACW, Tsang RCC, Ho P. Surgeons' static posture and movement repetitions in open and laparoscopic surgery. J Surg Res. 2012;172(1):e19-e31.*
3. Wohlauer, M., Coleman, D.M., Sheahan, M.G., Meltzer, A.J., Halloran, B.G., Hallbeck, M.S., Money, S.R., and SVS Wellness Task Force. (2021). Physical Pain and Musculoskeletal Discomfort in Vascular Surgeons. Journal of Vascular Surgery, 73(4), 1414-1421.
4. *Kim S, Nussbaum MA, Mokhlespour Esfahani MI, Alemi MM, Jia B, Rashedi E. Assessing the influence of a passive, upper extremity exoskeletal vest for tasks requiring arm elevation: Part II – "Unexpected" effects on shoulder motion, balance, and spine loading. Appl Ergon. 2018;70(September 2017):323-330.*
5. *Wang, T., Mendes, B.C., Hallbeck, Wang, T., Mendes, B.C., Hallbeck, M.S., Tetteh, E., Smith, T., Norasi, H. (2021) Introducing exoskeletons into the Operating Room: A pilot study with vascular surgeons. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 65(1), 1376-1380.*
6. *https://archdesk.com/blog/exoskeletons-for-all-women-exosuits-herowear/*

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