

ACADEMY OF SPINAL CORD INJURY PROFESSIONALS



Leg Stretching by a Fully Wearable, Hybrid/FES Exoskeleton in Spinal Cord Injury Patients with Spasticity

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Objective:

- *Spasticity* is a debilitating condition in people with chronic spinal cord injury (SCI)
- The objective is to develop a *wearable device* that applies safe, customized forces to assist with *leg stretching*, as an alternative to manual stretching

Results:

- *Stretching movements*: ankle plantar flexion and dorsiflexion, knee extension, hip flexion with the knee flexed, and toe flexion and extension
- Joint kinematics, leg postures, applied forces, and surface muscle activity → *preliminary performance* of the device
- Safe range of motion for each participant

Learning Objective:

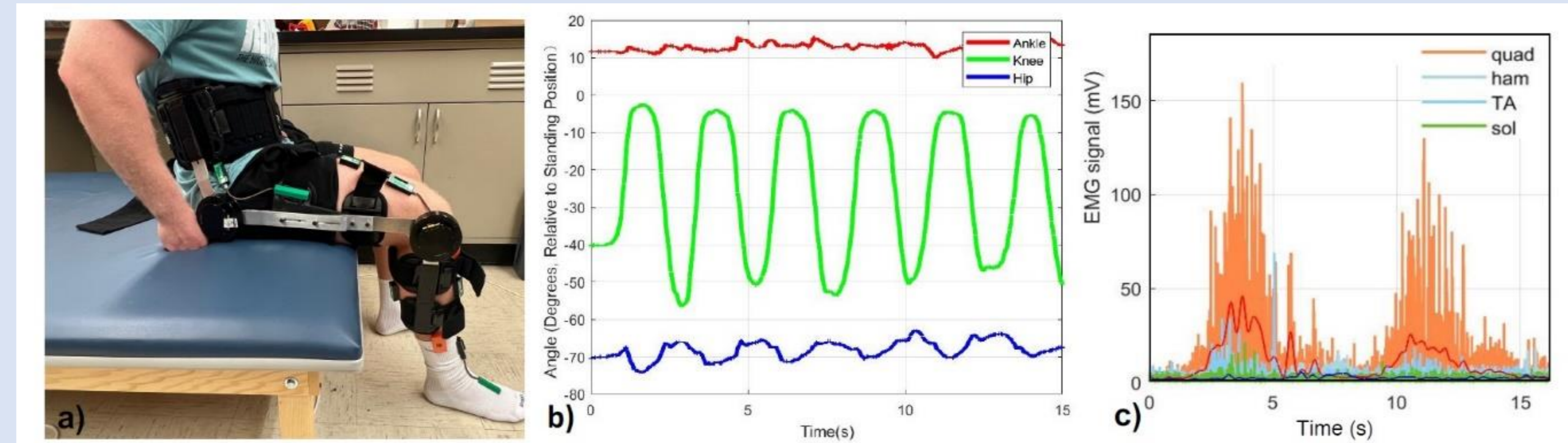
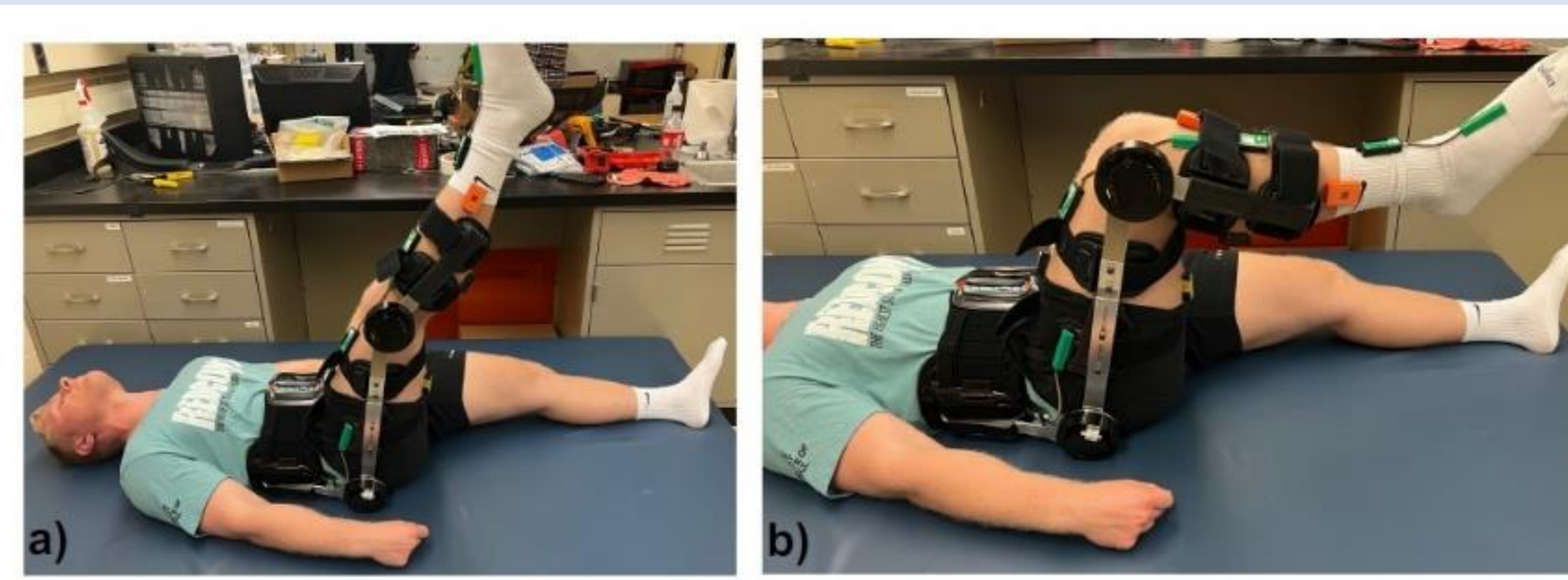
To establish the feasibility of a wearable robotic exoskeleton to provide leg stretching in people with spasticity

Conclusion:

- Fully customizable and safer on-demand stretching approach
- Data analysis and post-processing to inform the next phase of testing

References:

1. T. G. Hornby, D. S. Reisman, I. G. Ward, P. L. Scheets, A. Miller, D. Haddad, and the Locomotor CPG Appraisal Team, "Clinical practice guideline to improve locomotor function following chronic stroke, incomplete spinal cord injury, and brain injury," *J. Neurol. Phys. Ther.*, vol. 44, no. 1, pp. 49–100, Jan. 2020.
2. E. Hong, P. H. Gorman, G. F. Forrest, P. K. Asselin, S. Knezevic, W. Scott, S. B. Wojciehowski, S. Kornfeld, and A. M. Spungen, "Mobility skills with exoskeletal-assisted walking in persons with SCI: Results from a three center randomized clinical trial," *Front. Robot. AI*, vol. 7, no. 93, 2020.
3. M. M. Mirbagheri, M.W. Kindig, and X. Niu, "Effects of robotic-locomotor training on stretch reflex function and muscular properties in individuals with spinal cord injury," *Clin. Neurophysiol.*, vol. 126, no. 5, pp. 997–1006, 2015.



Design/Methods:

- 1 able-bodied individual
- Rotation of the hip, knee, and ankle joints bilaterally at low to moderate stretching rates (e.g., 10-50 cycles/minute)
- The movements are attempted 3-4 times and rest breaks are provided in between repetitions