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Presentation Title

Are we optimizing our rehabilitative therapies enough?

Abstract:

Translational research is an essential topic in rehabilitation and neuroscience. However, despite decades of research, new rehabilitation therapies and technologies have had limited impact on functional restoration from neurological disorders and injury. I will discuss the need for work on optimizing our rehabilitative therapies and provide an example of how this effort can contribute to improving functional outcomes. Spinal cord injury (SCI) leads to damaged synaptic connections between corticospinal axons and motor neurons that innervate muscles, resulting in devastating paralysis. Injuries in humans are mostly anatomically incomplete with spared axons having malfunctioning synaptic connections. Throughout life, synapses can be modified by Hebbian plasticity (e.g., “neurons that fire together, wire together”) suggesting that this principle could be used to strengthen residual connections. We have optimized a noninvasive Hebbian stimulation protocol over the years to target in parallel multiple upper- and lower-limb muscles to promote functional restoration of grasping and walking in humans with SCI. Moving from (a) proof of principle studies showing differences in how to target connections to upper- and lower-limb muscles, (b) randomized clinical trials highlighting the need for finding the optimal dose to reach the minimal clinically important difference, (3) the need to develop an animal model to continue to work on protocol optimization to improve functional restoration. Overall, our findings suggest that the optimization of Hebbian stimulation, informed by the physiology of the corticospinal system, represents an effective strategy to promote functional recovery following SCI.

Short CV:

Dr. Perez is the Scientific Chair of the Arms + Hands Lab at the Shirley Ryan AbilityLab, a Professor in the Department of Physical Medicine and Rehabilitation and the Department of Physical Therapy and Movement Sciences at Northwestern University, and a Research Scientist at the Edward Jr. Hines VA Hospital. She has studied neural mechanisms contributing to the control of voluntary movement in healthy humans and in people with spinal cord injuries for over 15 years. Her research aims to understand how the brain and spinal cord contribute to the control of the movement with the goal of using this mechanistic information to develop more effective rehabilitation therapies for people with spinal cord injuries. This theme is mainly investigated from a neurophysiological point of view, using a combination of transcranial magnetic stimulation, magnetic resonance imaging, electrical stimulation, and behavioral techniques.