

# Neural Prosthesis Seminar

## Neural Mechanisms and Treatment of Motor Impairments Following Unilateral Brain Injury: Smart Use of Therapeutic Devices

Friday, February 16 • 8:30 am  
Wolstein Research Building, Room 1413  
Case Western Reserve University



### Julius PA Dewald, PT, PhD

Professor and Chair  
Department of Physical Therapy and Human Movement Sciences | Feinberg School of Medicine  
Professor of Biomedical Engineering and Physical Medicine & Rehabilitation  
Northwestern University, Chicago, Illinois  
Adjunct Professor  
Biomechanical Engineering  
TU Delft & University of Twente, The Netherlands

### Abstract

The main goal of this presentation is to discuss possible neural mechanisms underlying the loss of independent joint control or synergies and flexor hypertonicity in the paretic arm/hand following a unilateral brain injury. Furthermore, novel treatments using a combination of neurophysiological and engineering techniques to reduce the effects of especially the flexor synergy will be discussed. I will present evidence for the loss of independent joint control in the paretic limb of individuals with stroke during isometric multi-degree of freedom load cell measures and during movements in haptic environments. Furthermore, the relationship between the loss of independent joint control and cortical reorganization using high-resolution EEG combined with peripheral robot-mediated quantitative measures of losses of independent joint control. The possibility of an increased reliance on bulbospinal pathways, especially the reticulospinal pathway, following the loss of brain injury induced corticospinal projections will be discussed. Additional research I will briefly discuss involves the study of quantitative computer driven visual and haptic feedback techniques that seek to improve the ability to produce the necessary torque combinations for reaching and retrieval motions with the paretic arm/hand using novel bio-robotic approaches. We are also working on man machine interfaces and on pharmacological interventions that seek to alter brain, spinal and/or brainstem neuronal excitability. Concurrently, we have been studying the impact of the loss of independent joint control on muscles properties and hand opening as well as the use of an EMG controlled FES device to facilitate hand opening. An up-regulated reticulospinal system is believed to be the source for the loss of independent joint control and the flexor bias in the paretic elbow/wrist and fingers. An argument for the need of FES to activate finger extensors but also to inhibit wrist and finger flexors will be made.

For more information, please contact Cheryl Dudek  
(216) 231-3257 | [cdudek@FEScenter.org](mailto:cdudek@FEScenter.org)

Live stream video link for each lecture at [www.FEScenter.org/Seminar](http://www.FEScenter.org/Seminar)