Implementation of Impairment Based Neuro-Rehabilitation Devices and Technologies following Brain Injury: Scientific and Clinical Implications

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Abstract: The implementation of electromechanical devices for the quantification and treatment of movement impairments (abnormal muscle synergies, spasticity and paralysis) resulting from brain injury is the main topic of this presentation. The specific requirements for the use of robotic devices to quantify these impairments as well as treat them effectively are discussed. A case is made that electromechanical devices not only generate a vehicle to augment treatment intensity, but more importantly allow for the precise measurement and treatment of specific impairments using scientifically underpinned approaches. Acceptance of these new technologies is dependent on proof of their effectiveness in treating movement impairments and on future clinical trial evidence for accompanying improvements in activities of daily living and quality of life. Furthermore, the need of a concerted effort to simplify these new technologies, once essential treatment ingredients have been determined, is seen as being a key component for their acceptance in the clinic on a large scale. Finally, a case will be made for the need to demonstrate that electromechanical technologies are likely more effective in delivering rehabilitative care, by reducing required treatment time in expensive clinics while maintaining, and even improving, functional outcomes. This is a requirement for future technology development and acceptance in the clinic and at home, especially in a health care environment where rehabilitation costs become more and more prohibitive.

Dr. Dewald received a Bachelor's degree in Physical Therapy and Rehabilitation Medicine in 1978 and a Master's degree in Neurophysiology and Rehabilitation Medicine in 1980 from the Vrije Universiteit Brussel, Brussels, Belgium. He received a PhD in neurophysiology and biophysics in 1992 from Loma Linda University, Loma Linda, California. From 1988-2001 Dr. Dewald worked as pre-doctoral investigator, subsequently as a post doc, clinical assistant professor and finally as a senior clinical research scientist in the rehabilitation institute of Chicago. From 2001 to 2005 Dr. Dewald worked as tenure-track assistant professor in the departments of Physical Therapy & Human Movement Sciences (PTHMS), Biomedical Engineering (BME) and Physical Medicine & rehabilitation (PM&R) at Northwestern University. He became chair and associate professor in PTHMS and associate professor in BME and PM&R in 2006. In 2010, Dr. Dewald became full professor in PTHMS, BME and PM&R. Dr. Dewald is the director of the neuroimaging and motor control laboratories and his research is funded by the National Institutes of Health (NIH), the department of education (NIDRR), the National Science Foundation (NSF) and the American Heart Association (AHA). His training has been in the neurobiology of movement disorders as well as in biomechanics and basic signal analysis. He has worked for over 20 years in the area of characterizing mechanisms underlying the loss of independent joint control and spasticity following brain injury due to stroke and cerebral palsy. Furthermore, he has 15 years of experience performing high density EEG research and about 8 years of experience in rehabilitation robotic developments. Dr. Dewald's research combines the fields of neurobiology, engineering, and clinical sciences by incorporating applications of brain imaging (MRI, fMRI, and high density EEG), rehabilitation robotics, and pharmacological manipulations of the motor system.


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