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### **New perspectives on impairment-based therapy – potential for recovery of disordered movement following neurological lesions**

The equilibrium point (EP) theory provides a framework for the understanding of sensorimotor deficits following neurological lesions such as stroke. According to this theory, to balance a given load, the nervous system shifts the threshold of the tonic stretch reflex (TSRT) and the associated torque/angle characteristic of the muscle, to a desired joint angle – thus setting the threshold of the referent limb posture. Muscle activity is subsequently generated depending on the deflection of the actual limb posture (affected by gravity and external forces) from the referent one. Muscle relaxation occurs when the threshold is shifted completely outside of the biomechanical joint range. In adults and children with central nervous system lesions, the regulation of the TSRT is disrupted due to altered input onto motoneurons from descending and segmental pathways. Evidence shows that after neurological lesions, the TSRT may abnormally lie within the biomechanical range of the joint at rest and that the regulation of the TSRT is limited to a smaller joint range, leading to atypical activation of the muscle in specific joint ranges during passive and active movements. However, in these same patients, movements made in angular zones within the limits of TSRT regulation may be characterized by normal patterns of muscle activation. This suggests that TSRT is an indicator of sensorimotor dysfunction and that recovery of sensorimotor function may depend on treatments that increase the TSRT range of regulation. Results of several studies suggest that increasing the TSRT is possible in targeted joints using different therapeutic approaches. Increasing TSRT regulation is a promising therapeutic approach that may lead to the restitution of pre-morbid movement patterns in people with stroke and other neurological problems.

### **Short CV:**

Dr. Levin, physiotherapist (McGill University), obtained a M.Sc. in Clinical Sciences (University of Montreal 1985) and a Ph.D. in Physiology (McGill 1990). From 1992-2004, Dr. Levin was a researcher and professor in the School of Rehabilitation at U Montreal and since 2004, she has been at the School of Physical and Occupational Therapy (SPOT) at McGill University. She was Research Director of the Rehabilitation Institute of Montreal (1997-2001) and Physical Therapy Program Director at SPOT (2004-2008). She was Research Scholar of the Quebec Health Research Fund (1992-2004) and held a Tier 1 Canada Research Chair in Motor Recovery and Rehabilitation (2005-2019). She is currently a Distinguished James McGill Professor and a member of the Canadian Academy of Health Sciences.

Dr. Levin is the President of the International Society of Motor Control and is a Past-President of the International Society for Virtual Rehabilitation (2015-2017). She is also a Board member of the International Neurological Physiotherapy Association of the World Physiotherapy Association and editor of the journal "Motor Control".

She has over 180 peer-reviewed publications. Her research focuses on elucidating mechanisms underlying sensorimotor deficits and their recovery in patients with CNS lesions. Amongst her research methodologies are new technologies such as virtual reality and robotics.