3

Biomechanics and Neurophysiology of Impaired Movement Preparation, Initiation and Execution in Neurological Disorders

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The successful completion of voluntary movement involves complex spatial and temporal coordination of systems across the neuraxis. During the planning stages of movement, preparatory neuronal activity occurs at the level of cortex, midbrain, brainstem and spinal cord which act in concert to select the appropriate effectors, suppress unwanted actions, regulate feedback gains and generate appropriate anticipatory postural adjustments in anticipation of the mechanical and sensory feedback consequences of the movement. The pathways contributing to the successful planning, initiation and execution of movement are also critically dependent upon whether the movement is self-initiated or generated in response to sensory stimuli in the environment. This presentation will review current evidence for the role of cortical (e.g., motor, premotor), brainstem (e.g., reticular formation) and spinal systems in the planning and initiation of upper and lower limb movements that require precise coupling of posture and movement and how this control is disrupted in people with movement disorders. The talk with focus principally on movement initiation in people with Parkinson's disease and stroke survivors. Examples will be provided illustrating that profound deficits in the capacity to initiate movement can be overcome with appropriately timed sensory stimuli. These findings demonstrate that there are multiple pathways by which movement can be initiated. An increased understanding of these pathways and how they interact could lead to unique interventions that improve motor function and quality of life in people with movement disorders.