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Development of Methods for Studying the Physiology Behind the Recovery of Individuals after Stroke

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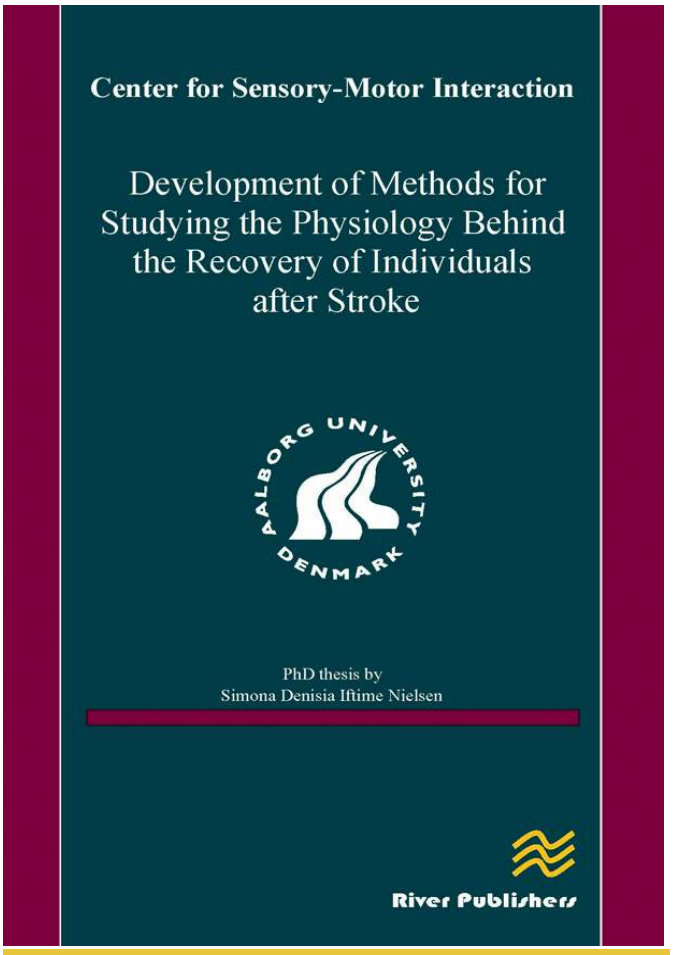
Electrical stimulation when paired with voluntary component (therapeutic FES), appears to facilitate recovery in an additive or interactive way, in clinical studies. We applied fMRI and EEG technique to obtain objective information about the neural consequences of neuromuscular stimulation combined with voluntary effort (FESVOL) peripheral electrical stimulation alone (FES) or voluntary activation alone (VOL) (Study 1 and 2). FESVOL revealed greater cerebellar activity compared with FES alone and reduced activity bilaterally in secondary somatosensory areas (SII) compared with VOL alone. The decreased SII activity may reflect a better match between the internal model and the actual sensory feedback (Study 1). Different task-related afferent inputs determined also different distribution in brain areas in preparation and execution phases of the movement as quantified by movement related cortical potentials. Additionally, they produced a state of activation/deactivation (inhibition) of neural networks in different cortical areas reflected in the modulation of alpha and beta rhythms (Study 2). Study 3 tested a novel tool for studying motor coordination with an altered visual input. The altered visual input was created using special glasses that presented the view as recorded by a video camera placed at various positions around the subject. We found that the trajectory errors decreased after three days of practice with the altered vision for 20 minutes per day, suggesting that recalibration of the visual systems occurred relatively quickly. The potential benefits to be gained by this research will be the objective understanding of the effective therapeutic FES treatment that assist post stroke individuals in achieving the hand/arm/leg function, as well as other vital functions, and to return to independent life-style in the easiest, simplest, and fastest way. This information will be extremely beneficial for the researchers investigating optimal methods of intervention for stroke survivors. In Study3 we show that the alteration of the visual input can be graded; hence, allow studying of different concepts of learning of the movement.



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