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## Action observation and motor imagery improve motor imagery abilities in patients with Parkinson's disease: a functional MRI study

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*Introduction*: Motor imagery (MI) is a recognized motor learning skill that could be impaired in patients with Parkinson's disease (PD).

*Objective*: To assess MI ability changes and brain functional reorganization after 6 weeks of action observation training (AOT) and MI associated with increasingly difficult gait/balance exercises in PD patients with postural instability and gait disorders (PD-PIGD) relative to gait/balance training alone.

*Methods:* Twenty-two PD-PIGD patients were randomized into 2 groups: the DUAL-TASK+AOT-MI group performed 6 weeks of gait/balance exercises including dual-tasks combined with AOT and MI; DUAL-TASK group performed the same exercises combined with watching landscape videos. MI was assessed using the Kinaesthetic and Visual Imagery Questionnaire (KVIQ). A group of 24 healthy controls was also included. All the subjects performed brain MRI including a MI fMRI-task: subjects were asked to watch first-person perspective videos representing challenge gait/balance tasks, identify themselves in the proposed environment and mentally simulate to move themselves in each condition.

*Results:* At baseline, during MI task, PD-PIGD showed reduced activity of pre/post-central gyri, temporal areas, motor and cognitive cerebellar areas and an increased activity of the parahippocampal gyri relative to controls. After training DUAL-TASK+AOT-MI group showed improvement in the KVIQ score together with increased activity of cerebellar lobule IX, anterior cingulate and fronto-temporal areas and a reduced recruitment of cerebellar lobule VI and crus I. The KVIQ improvements correlated with the increased activity of cerebellar lobule IX and anterior cingulate, and with the reduced activity of crus I.

*Conclusions:* PD-PIGD patients showed an altered recruitment of brain areas belonging to the mirror neuron system and related to sensorimotor functions. A motor-learning training including AOT and MI can improve MI abilities in PD-PIGD patients, promoting the functional plasticity of brain areas involved in MI processes and gait/balance control.