

## An 8-week rehabilitation training using the HBP exoskeleton improves cognitive brain functions in multiple sclerosis patients

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It has been showed that a single application of the exoskeleton (HBP) in multiple sclerosis patients is able to improve mobility and ambulation. These effects have been associated with brain changes in high-level executive functions decisive for improving patients' motor control [1].

We applied an 8-weeks rehabilitation protocol in 12 MS patients, half of them randomly assigned to a standard protocol (control group, CG) and the other half to a protocol based on the HBP use (experimental group, EG). Patients were evaluated before and after rehabilitation training using multiple neurological, physiotherapeutic and cognitive testing. During the cognitive task, high-resolution EEG was also recorded for ERP analysis. Results showed that both groups improved their performance in the Barthel, Rivermead, 2-WT, 25-FWT, Tinetti and BBS tests. Only in the EG, other positive treatment effects were observed as measured by the EDSS disability scale and the FSS. Accordingly, in cognitive testing, only the EG showed significant benefits in response time (RT) and accuracy. At brain level the EG showed enhancement in task-related preparatory activity in frontal and prefrontal cortices and stronger post-stimulus activity in the anterior Insula, whose activity is related to more efficient decision making. The CG didn't show enhanced performance in the cognitive task but only large activity in visual areas, as observed in EG. Concluding, both rehabilitation protocols brought substantial neurophysiological benefits to MS patients, however, the HBP protocol was particularly effective, boosting cognitive functions in prefrontal and frontal brain areas, it allowed improvements in RT and accuracy. The integration of HBP with standard rehabilitation procedure may considerably reduce disability in MS patients.

### Reference

[1] Di Russo F, Berchicci M, Perri LR, Ripani FR, Ripani R. (2013). A passive exoskeleton can push your life up Application on multiple sclerosis patients. *Plos One*, 8(4): e60241.

### Keywords:

Exoskeleton, electroencephalography, prefrontal cortex. multiple sclerosis