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Reaching in virtual reality - haptic robot for rehabilitation

M. Rakusa[1,2], J. Zidar[1], P.P. Battaglini[3], A. Hribar[4], A. Belic[4], M. Munih[4]

[1]Institute of Clinical Neurophysiology, University Medical Centre Ljubljana, Ljubljana, [2]Department of Neurology, University Medical Centre Maribor, Maribor, Slovenia, [3]Dipartimento di Scienze della Vita, University of Trieste, Trieste, Italy, [4]Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia

Background: Reaching may be impaired by different frontal and parietal cortical lesions. Haptic robot (HR) is claimed to be more useful in the rehabilitation processes compared to the natural movements. The aim of our study was to explore which differences in preparation of these two movements contribute to dissimilarities in the results of rehabilitation.

Methods: 10 right handed healthy subjects performed reaching with right hand with and without HR. Reaction times, movement times, accuracy as well as 64-channels EEG were recorded. We analysed current source density (CSD), synchronisation and desynchronisation in the alpha, beta and gamma bands regarding to target onset.

Results: No significant differences in task performance were found. The CSD was significantly bigger for HR-reaching in the electrodes overlying left medial frontal gyrus (from 110 to 130ms), left dorsolateral prefrontal cortex (from 160 to 200ms), right dorsolateral prefrontal cortex (200 to 250ms), and bilateral angular gyrus (150 to 190ms). Desynchronisation was weaker in the gamma band during HR-reaching preparation between 280 and 340ms in electrodes overlying bilateral superior parietal cortex and medial frontal gyrus. There were no differences in other frequency bands.

Conclusions: Absence of differences in task performance suggests the reliability of HR in mimicking actual arm movements. Differences in dorsolateral prefrontal and in parietal cortex may be due to differences in the control of motor programming as well as in motor programming itself. They might be beneficial in neuro-rehabilitation by stimulating alternative cortical connections for the same motor program.

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Stimulation of the proprioceptive system in neurorehabilitation

M. Seidl[1,2,3], A.B. Kunz[1,3], S.M. Golaszewski[1,2,4], M. Christova[5], E. Gallasch[5], R. Nardone[1,2,6], F. Gerstenbrand[3,7], E. Trinka[1,2,4]

[1]Department of Neurology, [2]Spinal Cord Injury and Tissue Regeneration Center, Paracelsus Medical University Salzburg, [3]Karl Landsteiner Institute of Neurorehabilitation and Space Neurology, Vienna, [4]Neuroscience Institute, Paracelsus Medical University Salzburg, [5]Institute of Physiology, Medical University Graz, Austria, [6]Department of Neurology, F. Tappeiner Hospital, Merano, Italy, [7]Department of Neurology, Medical University Innsbruck, Austria

Objectives: The aim of the study was to investigate the human proprioceptive system in healthy subjects and in patients with severe brain damage and to develop a paradigm for the brain mapping of proprioceptive foot stimulation with vibration.

Material and methods: 15 healthy male subjects and 22 patients were stimulated with a vibrotactile stimulus on the right foot by a moving magnet actuator system and at the first and second toe with a cuff-type pneumatic stimulator.

Results: Brain activity within the main centres of the primary and secondary sensorimotor cortex, within the pre- and post-central gyrus bilaterally and the right inferior, medial and middle frontal gyrus, within the inferior parietal lobule, the superior temporal gyrus, the temporal transverse gyrus, the caudate nucleus, the middle cingulate gyrus, the insula and the hippocampus on the left side. Only in 7 out of 22 patients a specific response within the primary and secondary sensorimotor cortex could be elicited.

Conclusions: It could be shown that vibrotactile stimulation of the foot in healthy subjects can elicit specific brain responses in main centres of the sensorimotor system and in centres of attention and arousal. It was possible to map in detail the cortical representation of the proprioceptive system of the foot for a functional diagnosis and a monitoring of the proprioceptive system in neuro-rehabilitation, e.g. in subjects with degradation of the proprioceptive system (space disease, bed-rest syndrome) and in patients with severe brain damage for the planning of specific rehabilitation strategies and the induction of arousal.

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Abstract cancelled

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EFNS EUROPEAN FEDERATION OF NEUROLOGICAL SOCIETIES

HEADOFFICE Breite Gasse 4/7
1070 Vienna, Austria

PHONE + 43 1 889 05 03
FAX + 43 1 889 05 03 13
EMAIL headoffice@efns.org
WEB www.efns.org

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Poster No

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[1]SALZBURG, [2]VIENNA, [3]GRAZ, AUSTRIA, [4]MERANO, ITALY, [5]INNSBRUCK, AUSTRIA

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