neurovascular coupling which should be considered in studies (functional imaging) dealing with comparable patient population.

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ALS upper motoneuron involvement in DTI and VBM: A longitudinal MRI study—J. Grosskreutz, C. Keil, L. Emmerich, R. Dengler, T. Peschel (Medizinische Hochschule Hannover)

Extent and distribution of upper motoneuron (UMN) involvement in ALS has been described in post-mortem brains. Little is known about the development of UMN degeneration in vivo. Region of interest based analyses have suggested neuronal loss in central regions, and signal abnormalities were found in the corticospinal tract (CST) by computerized analyses in diffusion tensor imaging (DTI). Detection of cortical atrophy in the sensorimotor and frontal cortex and reduction of the anisotropy in the CST has been demonstrated using voxel-based morphometry (VBM) and DTI analyzed on a voxel-by-voxel basis. The aim of the present MRI study was to describe the development of UMN involvement in ALS patients over time. High-resolution anatomical MRI and DTI (15 directions) were performed in 21 patients with ALS at baseline and in 13 6 month later, and 23 age matched controls on a 1.5 T GE-scanner. Images were analyzed on a voxel-by-voxel basis using SPM2. Group comparisons of regional grey matter and FA and were made using ANCOVA with the global mean voxel value as confounding factor. Longitudinal assessments were done using paired *t*-tests. Compared with controls, ALS patients at baseline showed a relative decrease in GMV in the pre- and postcentral gyrus, inferior parietal lobe and the middle frontal gyrus. The CST showed reduced FA bilaterally. After 6 months, the relative decrease in GMV had progressed to cingulate areas and the cerebellum. In DTI, FA had decreased in the genu of the internal capsule and CST descending into the brainstem bilaterally. The present study confirms our previous findings of largely central atrophy extending to frontal areas and FA reductions in the CST in a second cohort of patients. On follow up examination, the atrophy had spread to larger areas of the sensorimotor cortex and included cingulate and cerebellar structures which is in line with recent histopathological findings. Our results consistently show grey matter atrophy in sensorimotor, parietal and frontal regions which increases during the course of ALS. In groups of patients, voxel-based morphometry and DTI may be used as a monitoring tools in future clinical trials.

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Controlling virtual environments by thoughts—C. Guger [1], R. Leeb [2], D. Friedman [3], V. Vinayagamoorthy [3], G. Edlinger [1], M. Slater [3] ([1] g.tec medical engineering GmbH/ Guger Technologies OEG, Graz, [2] Graz University of Technology, [3] University College London)

A brain-computer interface (BCI) is a new communication channel between the human brain and a computer. BCIs have been developed during the last years for people with severe disabilities to improve their quality of life. Applications of BCI systems comprise the restoration of movements, communication and environmental control. However, recently BCI applications have been also used in different research areas e.g. in the field of virtual reality. For the BCI experiments 2 bipolar EEG derivations where mounted on the subject's head (electrode positions C3 and Cz). The electrodes were connected to a portable amplifier and digitization unit. A Pocket PC was used to control the experimental paradigm for the BCI training of the subject. The subject had to imagine a foot movement and a right hand movement 80 times each. Then the EEG data was analyzed in order to distinguish the two different imaginations. After the initial training three subjects all with classification accuracy above 80% were participating in an experiment in a highly immersive CAVE like, virtual reality (VR) system. We have used a virtual street populated by 16 avatars and shops on both sides of the street. The BCI output signal was transmitted to the VR system in order to navigate in the VE. The goal was to reach the end of the street (see Fig. 1). The subject was instructed by an acoustic cue to imagine a foot movement (double beep) or a right hand movement (single beep). If the foot movement was classified correctly the subject was moving forward, otherwise the subject was remaining on the same position. If a right hand movement was correctly detected the subject was also remaining on the same position otherwise as a punishment the subject was moving backwards. Therefore, only with a 100% BCI classification accuracy the subject was able to reach the end of the street. The accuracy was determined as achieved cumulative mileage and measured how far the subject could move. S1 had a performance of 63.6%, S2 of 78.9% and S3 of 85.4%. The work showed that motor imagery can be used as input signal for a BCI system to control a VE in a highly immersive CAVE system. Subjects reported about an exciting experience of moving forward and backward just by the imagination of different types of movements.

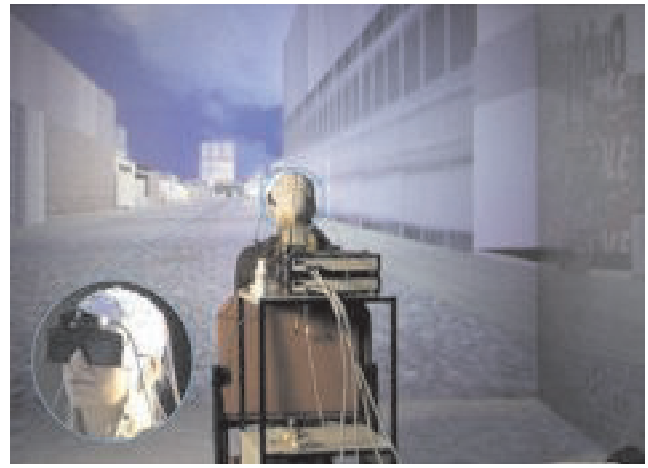

Fig. 1.

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Effects of a fast cable car ascent to an altitude of 2700 m on EEG and ECG—C. Guger [1], W. Domej [3], G. Lindner [2], E. Günter [1] ([1] g.tec medical engineering GmbH/Guger Technologies OEG, Graz, [2] ARGE-Alpinmedizin, Graz, [3] University Medical Center, Graz)