Introduction
Mirror movements (MM), i.e., involuntary movements of the opposite hand during unimanual tasks, are a frequent finding in patients with congenital hemiparesis. They result probably from reorganization of the paretic hand in the unaffected hemisphere, with bilaterally branched cortico-spinal projections to both the paretic and the non-paretic hand [1, 2]. Since this phenomenon occurs in most, but not all patients with congenital hemiparesis, we compared structural and functional MRI during paretic hand movement in congenital hemiparesis with and without MM.

Subjects and Methods
This study included seven young adult patients with congenital hemiparesis due to unilateral periventricular brain lesions of pre- or perinatal origin. Paretic hand function was impaired, with inability to perform sequential finger opposition, but a preserved grasp function. Since MM occurred only in association with impaired hand function, patients with good hand function were excluded from this analysis; their fMRI results are reported separately.

Reorganization of the sensorimotor system was studied by functional magnetic resonance imaging (fMRI) during repetitive fist clenching of the paretic hand (metronome-paced at 1 Hz). The experiment was arranged in a block design that consisted of 4 x 6 scans of rest and 4 x 6 scans of activation. The MRI measurements were performed on a 1.5 Tesla Siemens Vision Scanner, using a whole-brain multi-slice Echo Planar Imaging (EPI) sequence [3] (TR 8 s, TR 4.87 s, TE 84 ms, 27 axial slices, 1 mm gap).

Image postprocessing (realignment, smoothing with an anisotropic 6 x 6 x 15 mm Gaussian kernel, and coregistration with the anatomical data) as well as statistical analysis (activation threshold p < 0.05, corrected for multiple comparisons) was performed using the SPM99 software (Statistical Parametrical Mapping, Wellcome Department of Cognitive Neurology, University College London).

Results
Neurological examination revealed MM in 5/7 patients. Functional MRI demonstrated a strong activation in the primary sensorimotor cortex (SMC) of the affected hemisphere in all patients; additional activation in the unaffected hemisphere was only detected in the patients with MM, and was restricted to the SMC.

This ipsilateral SMC activation and the presence of MM did not correlate with the total extent of the lesion (r = 0.474, p = 0.141, Spearman correlation rank), but with the severity of damage to callosal projections (quantified as the maximum distance of the lesion from the bicommissural plane = superior lesion extent SLE; r = 0.791, p = 0.017).

Conclusion
This correlation suggests that early damage to transcallosal (inhibitory?) projections in the periventricular white matter can facilitate the development of ipsilateral projections from the intact hemisphere to the paretic hand that were consistently reported in neurophysiological studies of hemiparetic children with MM [1,2].

References

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