Extensive Bilateral Motor Network Activation in Congenital Hemiparesis with Good Hand Function: a fMRI Study

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Introduction

Functional imaging studies of adult stroke patients have demonstrated additional recruitment of non-primary and also primary motor areas especially in the unaffected hemisphere as correlates of good recovery from hemiparesis [1-4].

Since it is generally assumed that the developing nervous system possesses even higher reorganizational capabilities, we expected to find more extensive and possibly different changes in patients with CONGENITAL hemiparesis and only mild motor deficits.

Subjects and Methods

This study included three young adult patients with congenital hemiparesis due to small unilateral periventricular brain lesions (middle row in Figure = axial proton density images) of pre- or perinatal origin. They showed only a mild impairment of their paretic hand, with well-preserved single-finger movements; none of them suffered from mirror movements. Five age- and sex-matched healthy volunteers served as control.

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 [5] (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

The contralateral primary sensorimotor cortex SMC was strongly activated during hand movement in all patients and controls. Only the patients, however, showed additional activation in the unaffected hemisphere (ipsilateral to the paretic hand) in the SMC (n = 2), the inferior parietal lobule IPL (n = 3), the operculum and insula OP (n = 3) and the prefrontal cortex PFC (n = 2). In the affected hemisphere (contralateral to the paretic hand), additional activation was seen in the IPL (n = 1) and the OP (n = 3).

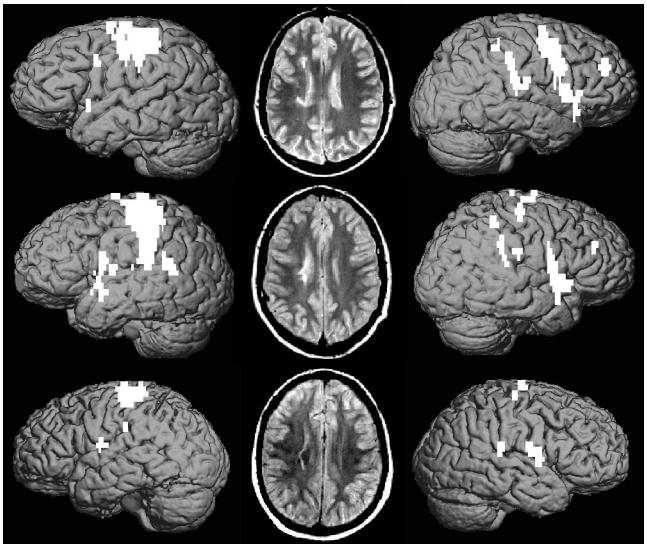

Figure 1

Conclusion

These activation patterns in mild congenital hemiparesis show striking similarities with the patterns reported for good recovery after adult hemiparetic stroke. This suggests that the additional recruitment of a distributed sensorimotor network in both hemispheres is a common mechanism for good recovery from motor tract lesions, independent from the age at which the insult occurred - against our initial expectation.

References

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