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Predictive Imaging Markers According to Different Upper Limb Recovery Patterns in Severe Stroke

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Objective
Understanding recovery mechanism and predicting recovery pattern after stroke are important to make individually-tailored rehabilitation plans. In case of recovery of upper limb (UL), many clinical and neuroimaging studies were investigated and predictive markers were also reported. However, most predictive markers show relatively low predictive accuracy in severe stroke. This study focused on the comparison of imaging values in severely impaired stroke patients with different UL recovery patterns and investigation of their predictive markers using multimodal imaging analysis.

Materials and Methods
Forty-two subacute ischemic stroke patients (24 males, mean age 57.2±12.4 years) with severe impairment participated. They underwent T1-weighted, diffusion tensor imaging (DTI), resting-state functional MRI (rs-fMRI) data acquisition, and motor function using the Fugl-Meyer Assessment at two weeks after stroke. Motor function was assessed again at three months after stroke. Subjects were divided into the Fitter and Non-fitter groups according to whether they had achieved 70% of their initial FMA-UE motor impairment at three months (i.e., their recovery fit or did not fit the proportional recovery rule). Important neuroimaging markers in motor recovery were investigated. Fractional anisotropy (FA) values of the corticospinal tract (CST), corpus callosum (CC), superior cerebellar peduncle (SCP), lesion volume, lesion load of the CST, interhemispheric homotopic connectivity, and whole brain connectivity were extracted from imaging data.

Results
Between both groups, there were significant differences in most imaging markers. Common imaging markers such as CST FA, lesion load of the CST, and interhemispheric homotopic functional connectivity were predictable in all patients with severe motor impairment. However, these markers were not related to UL recovery in subgroup. Especially, initial FA values of the SCP and CC were predictive imaging markers for UL

recovery in the Fitter and Non-fitter groups respectively. The strength of functional connectivity between the left auditory and bilateral occipital areas were predictive markers in the Non-fitter group. Predictive accuracy of specific markers in each subgroup was higher than that of common markers in all patients.

Conclusions

In conclusion, we investigated predictive imaging markers in stroke patients with initially severe motor impairment. Different primary predictive markers existed according to recovery pattern. These meaningful predictive markers will help to establish high accuracy prediction model after stroke and provide useful information for determining the target area for noninvasive brain stimulation in an early stage of recovery in stroke patients.