Rehabilitation and Reorganization of Brain at Task State after Stroke

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***Abstract*—Rehabilitation after stroke accompanies with neural reorganization in brain. Previous studies of brain reorganization post stroke are mainly based on resting state fMRI or EEG, while the reorganization of brain networks at task state is rarely reported. With this consideration, we collected functional magnetic resonance imaging from twelve stroke patients during blocked finger-tapping task at four post-stroke time points respectively. Further, we examined the reorganization of functional brain networks and their prognostic value during recovery after stroke. In general, our results suggest that the task-state motor execution networks significantly changed over recovery time and is capable of predicting the motor function recovery after stroke.**

I. Introduction

The process of neuroplasticity or brain reorganization after stroke was closely related to the motor function restoration during stroke recovery, which usually started from the first several days post stroke onset up to years [1]. Wang and colleagues [2] found that the motor execution network shifted towards a non-optimal topological configuration with less functional segregation by examining topological change of the motor execution network based on resting-state functional magnetic resonance imaging (fMRI) during the recovery after stroke. Previous studies mainly focused on the reorganization of task-related brain activity and resting-state networks after stroke. The reorganization of task-state brain network and its relationship with motor function recovery were rarely reported. Resting-state connectivity and task-state connectivity represent different aspects of functional integration. The statuses of resting-state and task-state functional brain networks during stroke recovery, as well as brain networks might be different. Therefore, we would like to perform a longitudinal study on the dynamic reorganization of task-state motor execution network by comparing with the resting-state motor execution network during finger tapping task from several days to three months post stroke.

II. Methods

Blood-oxygen-level-dependent (BOLD) signals of 12 stroke patients were acquired while performing blocked finger-tapping task within 10 days (P1), around 2 weeks, 1 month, and 3 months after stroke respectively (Fig. 1). For each subject at each scan, resting-state and task-state motor execution networks containing 21 motor related brain regions were constructed, and the dynamic reorganization of brain network during recovery was evaluated based on a mixed-effects regression model, which estimates the longitudinal trend between network measurements (i.e., topological parameters) and the days of recovery or FMI [2]. Furthermore, the the prognostic network parameters were identified by Spearman's correlation coefficients between networks parameters at P1 and motor function restoration during sub-acute phase.

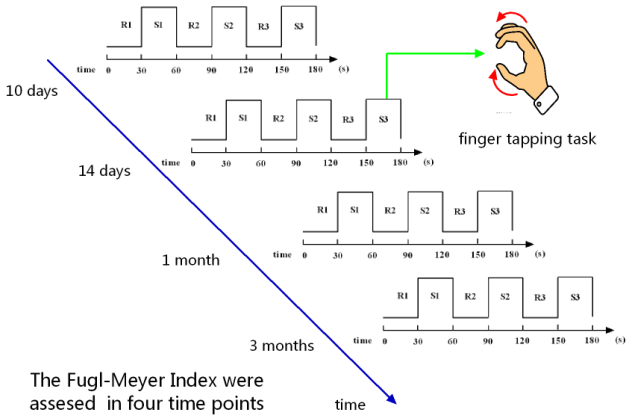

Figure 1. Experimental paradigm.

III. Results & Discussion

This study found that the topological reorganization of task-state motor execution networks was significant than resting-state motor execution networks in sub-acute phase post stroke. In addition, the topological configuration of task-state motor execution networks at the early recovery stage were capable of predicting the motor function restoration during sub-acute phase. In general, this study demonstrated the reorganization and prognostic value of task-state brain network after stroke, which provides new insights into understanding the brain reorganization and rehabilitation after stroke.

References

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