Dynamic Functional Connectivity of Motor Network in Patients with Brain Tumor

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Introduction: Brain plasticity is a continuous process during slow-growing tumor formation, which remodels neural organization and optimizes brain network function [1-3]. In our study, we tested the hypothesis that the dynamic functional connectivity of the motor network would associate with the underlying motor function abnormality in tumor patients. Here, We used Wavelet transform coherence (WTC) analysis [4] to explore the temporal dynamics of connectivity between key regions of motor networks in patients with different tumor types (Low-grade gliomas, and Meningioma) in order to achieve a better understanding of the relationship underlying brain plasticity mechanisms and dynamic functional connectivity. These results can enhance our understanding of motor network functional reorganization within different tumor type.

Materials and Methods: 14 patients with low grade gliomas, 14 patients with meningioma and 14 healthy controls participated in this study. Both structural images (3D FSPGR 1x1x1 mm3, 140 slices) and BOLD EPI data (TR/TE = 2500/40 ms, flip angle=90°, 3.75x3.75x3mm3) were acquired. In this experiments, first all the subjects perform a resting state block (6.15 minutes, eyes closed). After resting state scanning, then they were asked to perform a hand-movement task, which consisted of five 30s blocks of movement task and six 30s fixations; the total time is 5.5 minutes. All subjects performed a motor task-based fMRI used to identify individual motor activity in bilateral primary motor cortex (PMC) and supplementary motor area (SMA). WTC analysis was then used to investigate possible temporal dynamics of resting state motor network connectivity alterations in different tumor types. The analysis of variance (ANOVA) was used for multiple comparison of low frequency fluctuation coherence in the three groups. A probability (P) value of <0.05 was considered statistically significant.

Results: Example of the wavelet transform coherence for one control subject key motor regions (see Fig.1). Our results demonstrated significant group differences of coherence of LPMC-RPMC, LPMC-SMA, RPMC-SMA between healthy controls and patients with brain tumors (Fig.2). A decreased inter-region coherence pattern was found in both tumor groups compared to controls. In addition, the coherence of patients with gliomas was significantly lower than the coherence of patients with meningioma.

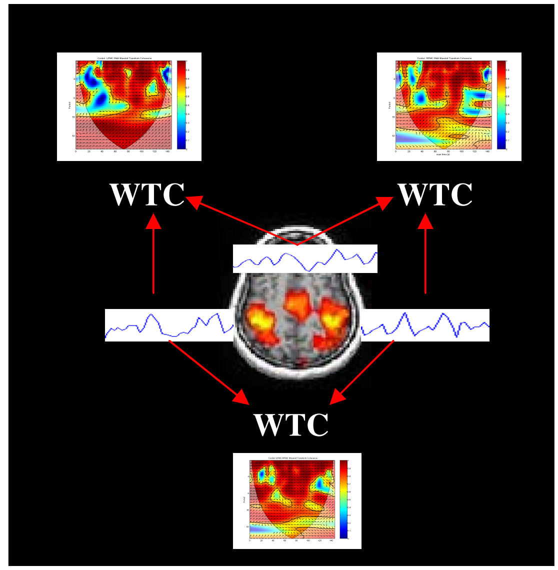

Fig.1 Example of the wavelet transform coherence for one control subject key motor regions (including LPMC,RPMC and SMA) analysis

Discussion and Conclusions:
In this study, we used both fcMRI and wavelet coherence analysis, we examined the relationship between the alteration in dynamics functional connectivity and changes in motor functional plasticity in patients with brain tumor. Interestingly, we observed the patients with two type tumors (low grade gliomas and meningioma) and control show significant difference dynamic functional connectivity within motor network. To further investigate dynamic functional connectivity between different brain tumors, we observed the patients with meningioma and patients with low grade gliomas show significant difference dynamic functional connectivity within motor network. Specifically, dynamic functional connectivity may be useful for separate different tumor type within subjects. The dynamic characteristic of motor network functional connectivity in the time frequency could further enhance understanding of the relationship underlying brain plasticity mechanisms and dynamic functional connectivity. In addition, dynamic functional connectivity could provide new insights into treatment for different types of tumor in clinical neurosurgery.

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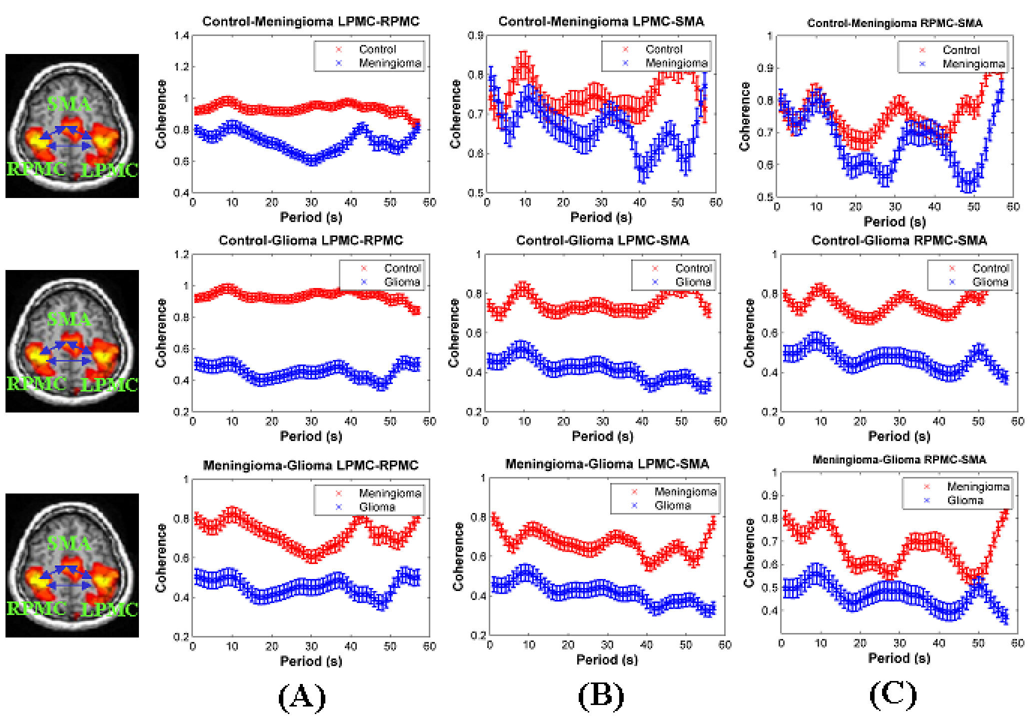

Fig.2 Inter-region time averaged coherence across subjects (Low-grade gliomas, Meningioma and healthy controls). (A) time averaged coherence of LPMC-RPMC ; (B) time averaged coherence of LPMC-SMA; (C) resting state data between RPMC-SMA.