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Tumor Compression Effect on White Matter Pathways Revealed by Local Connectome Fingerprint

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Introduction

Low-grade gliomas (LGGs) are slow growing tumors that often cause infiltration and/or compression of the white matter pathways. Regular imaging modalities are no capable of revealing such a pathologic condition. Furthermore, up-to-date there is no reliable noninvasive imaging method to address this issue. Here we report that the local connectome fingerprint, an along track density measurement derived from diffusion MRI (dMRI), is capable of revealing the tumor compression effect on the surrounding white matter pathways.

Methods

We acquired high angular resolution dMRI data on 16 patients diagnosed of LGG (WHO grade II). Peritumoral fiber tracts underwent qualitative and quantitative evaluation. Contralateral hemisphere counterparts were used for comparison. The local connectome fingerprint of peritumoral tract segment and their ratio to healthy side were visualized and calculated in comparison with 842 normal subjects from the Human Connectome Project.

Results

Our results showed significant increase in the ratios to the normal side among displaced tracts and decreases among the infiltrated tracts when compared to their healthy counterpart. Qualitative analysis of 65 peritumoral tracts revealed 9 (13.8%) unaffected, 24 (36.9%) displaced, 13 (20%) infiltrated and 19 (29.2%) tracts with a combination of displacement and infiltration. There were no disrupted tracts. The along tracks local connectome fingerprint further localizes the track segments with compression effect caused by the tumor mass. This feature cannot be observed in conventional tensor and diffusivity analysis.

Conclusions

The unique capability of local connectome fingerprint in revealing the compression and infiltration effect can provide potential diagnostic and prognostic applications in clinical intervention of patients with WHO grade-II low-grade gliomas.

Learning Objectives

-Understand white matter tracts involvement in WHO grade II low-grade gliomas.

-Study the applications of affected/whole tract ratio for tumor compression.

-Study the applications of affected/whole tract ratio for tumor infiltration.

-Potential applications for low-grade tumor surgery.

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