Announcement of Public Dissertation Defense

Thursday, February 20th, 2020 @ 9:00 am
Engineering Hall, Room 323, Marquette University

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ABSTRACT

“INDIRECT STRUCTURAL CONNECTIVITY AS A BIOMARKER FOR STROKE MOTOR RECOVERY”

In this dissertation project, we demonstrated that diffusion magnetic resonance imaging and measures of indirect structural brain connectivity are sensitive to changes in fiber integrity and connectivity to remote regions in the brain after stroke. Our results revealed new insights into the effects local lesions have on global connectivity—in particular, the cerebellum—and how these changes in connectivity and integrity relate to motor impairment. We tested this methodology on two stroke groups—subacute and chronic—and were able to show that indirect connectivity is sensitive to differences in connectivity during stroke recovery. Our work can inform clinical methods for rehabilitating motor function in stroke individuals. By introducing methodology that extends local damage to remotely connected motor related areas, we can measure Wallerian degeneration in addition to providing the framework to predict improvements in motor impairment score based on structural connectivity at the subacute stage.

We used diffusion magnetic resonance imaging (dMRI), probabilistic tractography, and novel graph theory metrics to quantify structural connectivity and integrity after stroke. In the first aim, we improved on a measure of indirect structural connectivity in order to detect remote gray matter regions with reduced connectivity after stroke. In a region-level analysis, we found that indirect connectivity was more sensitive to remote changes in connectivity after stroke than measures of direct connectivity, in particular in cortical, subcortical, and cerebellar gray matter regions that play a central role in sensorimotor function. Adding this information to the integrity of the corticospinal tract (CST) improved our ability to predict motor impairment. In the second aim, we investigated the relationship between white matter integrity, connectivity, and motor impairment by developing a unified measure of white matter structure that extends local changes in white matter integrity along remotely connected fiber tracks. Our measure uniquely identified damaged fiber tracks outside the CST, correlated with motor impairment in the CST better than the FA, and also was able to relate white matter structure in the superior cerebellar peduncle to motor impairment. Our final aim used a novel connectome similarity metric and the measure of indirect structural connectivity in order to identify cross-sectional differences in white matter structure between subacute and chronic stroke. We found more reductions in indirect connectivity in the chronic stroke cerebellar fibers than the subacute group. Additionally, the indirect connectivity of the superior cerebellar peduncle at the subacute stage correlated with the improvement in motor impairment score for the paired participants. In conclusion, indirect connectivity is an important measure of global brain damage and motor impairment after stroke, and can be a useful metric to relate to brain function and stroke recovery.

Engineering Hall is located at 1637 W. Wisconsin Ave. on the Marquette University campus. Visitor parking is available in the parking garage on N. 16th Street between Wisconsin & Wells Aves.