Functional connectivity related to recovery in gait performance through robot-assistive rehabilitation of chronic gait impairment

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Target audience

Clinical researchers in neuroimaging and functional recovery.

Purpose

Functional brain connectivity has been widely studied over the last few years, and is also becoming increasing used clinically. Diffusion tensor image is popular MRI-based technique used clinically. In addition, resting state functional MRI (rsfMRI) is a new tool for patient assessment. Our facility has developed robot-assistive rehabilitation using robot suits (HAL®, Hybrid Assistive Limbs), and tested them on people with gait impairment. In this study, we obtained gait performance and rsfMRI before and after rehabilitation to investigate the relationships between rsfMRI and rehabilitation.

Methods

Ten patients with chronic disabling conditions that affected their walking participated in this study. The patients suffered from various diseases such as stroke, knee osteoarthritis, spinal cord injury, and polymyositis. Sixteen sessions of rehabilitation were administered over approximately two months. A 10 m walk test (10mWT) was performed before and after the rehabilitation period, and rsfMRI was performed before the rehabilitation. We divided the participants into 2 groups, good recovery (GR) and poor recovery (PR), based on the ratio of their walk speed in the 10mWT before and after rehabilitation. rsfMRI data were acquired at rest and during closing eyes using a 3T MRI scanner. The functional connectivity was computed by an independent component analysis (ICA) on Melodic of FSL.

Results

Walking speed during the 10mWT showed statistically significant improvement between before and after the rehabilitation period in the GR group ($p=0.033$, paired t-test). However, there was no significant change in the PR group ($p=0.112$, paired t-test). We also found several ICA components that contained significant difference between groups ($p<0.05$), which were related to the supplementary motor area, premotor area, orbitofrontal cortex, or lateral prefrontal cortex (Fig. 1).

Discussion

Some aspects of functional connectivity in rsfMRI was significantly different between the GR and PR groups, and the degree of connectivity was correlated to recovery capability in rehabilitation.

Conclusion

The rsfMRI findings in the supplementary motor area, premotor area, orbitofrontal cortex, and lateral prefrontal cortex were related to motor function recovery in rehabilitation. rsfMRI prior to rehabilitation may help to predict the recovery during rehabilitation.

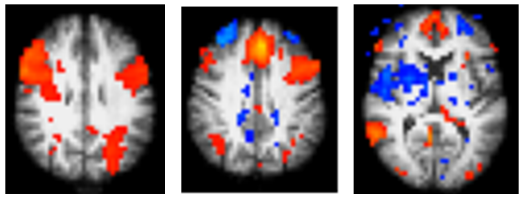

Fig. 1.Component #29(A), #39(B) and #49(C).