Form 2-3

Japan-U.S. Brain Research Cooperation Program
Group Joint Study Project Program FY2023: Report

Field: 3

1. Principal Researcher
Name: Sho K. Sugawara
Title: Associate Investigator
Affiliation: Neural Prosthetics Project, Tokyo Metropolitan Institute of Medical Science

2. Research Title:

Precise functional MRI of the spinal cord in humans

3. Japanese Group Organization

Collaborating Researcher
Name: Usuda Noboru
Title and Affiliation: Post-doctoral researcher, Neural Prosthetics Project,
Tokyo Metropolitan Institute of Medical Science

Collaborating Researcher
Name: Yukio Nishimura
Title and Affiliation: Project leader, Neural Prosthetics Project,
Tokyo Metropolitan Institute of Medical Science

4. U.S. Group Organization

Principal Researcher
Name: Robert Barry
Title and Affiliation: Assistant Professor, Martinos Center for Biomedical Imaging,
Massachusetts General Hospital, Harvard Medical School

5. Research Period, from/to (yyyy/mm/dd) and total number of years.

From 2023/04/01 to 2024/03/31 (1 year)

6. Abstract, Results, and Research Significance (300 words):

The present study aimed to investigate functional reorganization in the human spinal cord. To achieve this purpose, we developed a brain-spinal cord fMRI using a clinical MRI system. Although there is consensus for the preprocessing pipeline for brain fMRI through enormous studies, the processing pipelines for spinal fMRI have not been established. Through this joint study program, Dr. Barry provided us with their original preprocessing toolbox (NEPTUNE) to preprocess spinal cord fMRI data. Then, we processed our brain-spinal simultaneous fMRI data using the NEPTUNE toolbox. Consequently, we found pre-movement activity of the upper and lower cervical cord in healthy human volunteers. Furthermore, pre-movement spinal activity was associated with subsequent motor parameters such as peak grip force. These findings suggest that spinal interneuron systems, including propriospinal and segmental interneurons, relay cortical descending commands in preparation for motor execution.

Dr. Barry visited Japan in October 2023. During this visit, we visited our collaborative sites (i.e., the National Institute for Physiological Sciences (NIPS) and Chiba Rehabilitation Center). At the Chiba Rehabilitation Center, we implemented the protocol for brain-spinal simultaneous fMRI. Using this protocol, we confirmed that we are able to illustrate brain and spinal activity during grasping movements in the clinical MRI system. At NIPS, we discussed future collaboration using the 7T-MRI system.

The original plan was to visit the U.S. to conduct preliminary experiments on 7T-fMRI, but this was canceled when Dr. Barry decided to move to the NIH. Dr. Barry is the program director of NIBIB's MRI portfolio, which makes it difficult to continue basic research. Therefore, we decided to withdraw from the joint study program and will work together to publish the results.

7. Other (Research-related concerns, particular points of note):

With Dr. Barry's move to NIH, this program does not continue and ends in FY2023.

*Please attach any reference materials as necessary.