ASHBi SEMINAR

Formation, function, and regeneration of corticospinal circuits underlying skilled movements

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Date: Thursday, 4th March 2021
Time: 2:00PM–3:00PM
Venue: Zoom Online Meeting

Our lab is interested in understanding the neural circuits underlying locomotion and skilled motor behaviors in mammals. The motor neuron activity integral to these neural circuits is regulated by synaptic inputs from three main pathways: local interneuron circuits, proprioceptive sensory feedback, and descending fibers from the brain, including the corticospinal (CS) tract.

In this presentation, I will particularly focus on CS circuits. CS neurons control motor neuron activity for skilled movements such as reaching and grasping. We found how species-specific CS circuits may be formed during development. Manual dexterity in higher primates is superior to that of other animals. This trait emerged in part together with the appearance of cortico-motoneuronal (CM) connections during the evolution of the mammalian CS system, and was thought to be unique to higher primates. However, we identified CM connections in early postnatal mice, which are eventually eliminated by Sema6D-PlexA1 signaling. *PlexA1* mutant mice maintain CM connections into adulthood, resulting in superior manual dexterity compared to controls. Furthermore, we showed that species-specific regulation of *PlexA1* expression by Fezf2 may be crucial to the evolution of enhanced fine motor control in higher primates. We also demonstrated how the activity dependent, non-apoptotic Bax/Bak-caspase pathway regulates reorganization of CS motor circuits during development in mice. We further show how axonal projections of CS neurons are regulated by a repellent signaling pathway in the spinal cord. Finally, we demonstrate how CS neurons in the motor and sensory cortex differentially control skilled movements through distinct spinal interneuron connections.

In addition to the formation and function of motor circuits, we are also interested in the regeneration and reorganization of neural circuits following spinal cord injury (SCI). Time permitting, I will briefly talk about our SCI research including roles of semaphorins in inhibition of regeneration of injured CS axons at the end of my talk.

Organizer: Prof Tadashi Isa

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Hosted by Institute for the Advanced Study of Human Biology (WPI-ASHBi)