Axon mechanobiology

Shigeki Watanabe

Department of Cell Biology, Johns Hopkins University, USA

Email: shigeki.watanabe@jhmi.edu

In this talk, the speaker will discuss the recent findings on axon morphology and its implication in function and plasticity. Neurons are known for their intricate cellular morphology. Axons in particular are exceptionally long (100-1000 mm) and ultrathin (100 nm). Their cable-like morphology is essential for conduction of electrical signals, or action potentials, throughout the brain and body. Thus, it has been long assumed that axons are tubular structures with occasional synaptic varicosities. However, our work has challenged this assumption. Using high-pressure freezing to preserve membrane morphology for electron microscopy or super-resolution imaging of live neurons, we performed ultrastructural analysis of axons in Caenorhabditis elegans motor neurons, mouse hippocampal neurons, and human cortical neurons. We discovered that axons are not simple tubes but rather exhibit a pearls-on-a-string morphology through their entire length, due to their mechanical properties. Furthermore, neurons control the membrane mechanical properties based on the activity to modulate the degree of pearling and the conduction velocity of action potentials. The speaker will discuss these findings and their unpublished work on the mechanisms.