論文内容の要旨

論文題目

Local motoneuronal activity regulates the frequency of larval fictive locomotion in a segment-specific manner

（運動神経細胞の局所的な活動操作がぜん動運動の頻度変化に与える影響）

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I studied the problem of how central circuits coordinate intersegmental movements, using the peristaltic crawling of *Drosophila* larvae as a model. Larval peristaltic crawling is achieved by propagation of muscle contraction from tail to head, which is in turn generated by sequential activation of motoneurons (MNs) in the corresponding neuromeres (segmental units in the central nervous system). The larval ventral nerve cord (VNC) consists of three thoracic (T1~T3) and eight abdominal neuromeres (A1~A8), each of which contains ~80 MNs. A Previous study in the laboratory characterized the effects of local optical perturbation of MNs and suggested that MNs activity in each neuromere is required for the peristaltic wave to propagate across the segment (Inada et al., 2011). However, since muscle contraction was used to monitor the motor output, how the optical perturbation affects the activity dynamics of the motor circuits was unknown. In this study, I developed an experimental system in which one can study the effects of optical manipulation on MNs activity dynamics, in order to more comprehensively analyze the role of MNs activity in motor wave propagation. In particular, I focused the analysis on the global MNs outputs, namely formation of the forward waves, upon MNs perturbation.

Under a confocal microscopy, I applied photo-stimulation temporally at the motor nerve root, through which all MNs in the hemisegment send axons to the periphery,

to inhibit or activate the activity of MNs, while monitoring the motor activity corresponding to forward crawling with an EMCCD camera. I found photo-inhibition of MNs in A5 neuromere dramatically decreases the frequency of the motor waves. I then manipulated the MNs activity in other segments, in order to examine segmental difference. I found photo-inhibition of MNs in middle segments (A4, A5, and A6), but not other segments (A1-A3, A7-A8), decreases the motor frequency. I next studied the effects of local activation and found that photo-activation of MNs in posterior segments A6 and A7 but not in other segments, increases the frequency of forward motor wave. These results indicate that local changes in the activity of MNs affect the activity pattern of the entire motor circuits in a segment specific manner. Furthermore, I found that gap junctions are involved in this process: the local activity manipulations of MNs did not affect the frequency of motor waves in gap junction mutants. Thus, our data suggest that local MNs activity modulates the frequency of forward motor waves via gap junctions.