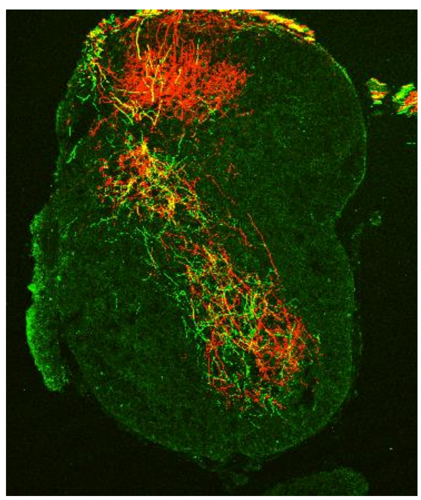
BIOMEDICAL SCIENCES PhD PROGRAM

Dr. Mill W. Miller, Director, 114 BS I, 775-2504

DISSERTATION DEFENSE

YIYUN DAI
PhD Candidate

"THE PATTERN OF SENSORY AXONAL ENDINGS TOGETHER WITH SYNAPTIC TRANSMISSION INFLUENCE THE DEVELOPMENT OF PROPRIOCEPTIVE CIRCUITS IN THE SPINAL CORD"



Tuesday, December 4th, 2018

9:00 a.m.

NEC auditorium (101)

Advisor: David Ladle, PhD

Department of Neuroscience, Cell Biology & Physiology

WRIGHT STATE UNIVERSITY | BIOMEDICAL SCIENCES PhD PROGRAM

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Proprioceptive circuits provide information regarding limb position and movement status, and are essential to producing correctly executed motor behaviors. Exploring the mechanisms underlying the formation of proprioceptive circuits is therefore critical for understanding neurological disorders with altered motor coordination and for restoring circuits damaged by injury.

One important proprioceptive circuit, the stretch reflex circuit, is formed between proprioceptive sensory neurons (PSNs) and motor neurons (MNs) that innervate the same muscle. Progress has been made in understanding the spatial organization of MNs based on their muscle-specific subpopulation identities, which contributes to the specificity of stretch reflex circuit formation. However, whether PSNs share similar properties is underexplored. As PSNs form connections with MNs via highly elaborated axonal terminals (termed arbors), we assessed the spatial and morphological patterns of arbors from PSNs innervating the quadriceps (Quad) and adductor (Add) muscle groups (supplied by Obturator nerve [Obt]). We found that the arbors of Quad and Obt PSNs exhibit muscle-specific morphologies and spatial arrangements consistent with their target MN locations.

PSNs also make connections with multiple spinal interneurons, including Renshaw cells (RCs), which are inhibitory interneurons that regulate the output of MNs. In contrast to the stretch reflex circuit, little is known about the organization of PSN contacts on RCs. Therefore, we mapped the connectivity pattern between RCs and PSNs from Quad and Obt afferents. We found that, although some RCs were selectively contacted by afferents from only one nerve, others received convergent input from both nerves. Interestingly, we found RCs with different connectivity patterns appear to be enriched in distinct regions of the ventral cord.

During development, PSNs continually experience patterned neural activity. Though the importance of neural activity in remodeling neural circuits has been demonstrated in multiple systems, whether it affects development of PSN arbors or PSN-RC circuits remains unknown. Using an existing transgenic mouse model in which synaptic transmission of all PSNs was blocked, we found that synaptic activity blockage generally decreased the elaboration of PSN arbors without affecting their spatial organization. We also found that activity blockage decreased the probability that RCs receive any sensory input.