ABSTRACT

Author: Nicholas A. Isabella

Title: Subsynaptic Localization of BMP Signaling at Drosophila NMJ

Thesis Advisor: Mikolaj Sulkowski

Department: Department of Biology and Honors College

Year: 2022

The synapse where a motor neuron innervates a muscle cell is known as the neuromuscular junction (NMJ) and many molecular pathways cross this important structure. One of the most important trans-synaptic pathways present at the NMJ is bone morphogenic protein (BMP) signaling. BMP signaling is a retrograde pathway that directly influences synaptic plasticity by promoting synaptic growth and release of neurotransmitters among other factors. Knowing where BMP signaling localizes within the synapse is important for understanding the mechanism of this pathway. However, this is hindered by the small size of the synaptic cleft (~20 nm across) and the limitations of current microscopy techniques. The results of current research indicate BMP signaling is either localized presynaptically, postsynaptically, or present in both compartments. Given these seemingly conflicting results, we asked which subsynaptic compartment BMP signaling is localized in and hypothesized its co-localization with Ca2+ channels located in the presynaptic terminal. As the current research remains widely inconclusive, this study aims to determine the localization of BMP signaling with the use of stimulated emission depletion (STED) super-resolution microscopy. This form of super-resolution microscopy allows the diffraction barrier to be broken to view structures at a higher resolution compared to confocal microscopy. Drosophila larvae were dissected and stained using immunohistological techniques in order to label important synaptic compartments and proteins of interest. The prepared samples were viewed on both confocal and STED microscopes and the stained structures were analyzed for their relative intensity within the synapse. Upon analysis using intensity plots, the results suggest BMP signaling is exclusively localized postsynaptically. The outcome of this study both confirms and refutes the results of past research, but the use of STED super-resolution microscopy increases the confidence of the findings demonstrated in this study.