Spinule-Bearing vs. non Spinule-Bearing Presynaptic Boutons in Developing Visual Cortex

Maryam Al Darraji and Marc Nahmani

Abstract

Synapses are neuronal junctions that allow electrical signals to transmit from one neuron to another. Synapses are essential because they are responsible for all our motor and sensory functions. Previous research has shown that 25 – 75% of the synapses in the brain contain mysterious finger-like projections called 'spinules' that originate from one neuron and extend into the presynaptic bouton (neurotransmitter-releasing side) of another. However, the role of these spinules remains unclear. We hypothesized that if spinules acted as 'anchors' to make boutons more stable, the inclusion of a spinule would make these boutons' volumes larger, with consequently larger postsynaptic densities (PSDs; synaptic junctions), versus boutons without spinules. As a first step toward understanding spinules' function, we analyzed Spinule Bearing Boutons (SBB) versus non-Spinule Bearing Boutons (non-SBBs), to determine how boutons with spinules differ than those who do not, and how spinules might be impacting the overall function of the postsynaptic neuron. We analyzed SBBs and non-SBBs within the primary visual cortex of a postnatal day 60 (p60) ferret brain, an age when the levels of synaptic plasticity are declining. We compared the volumes and areas of non-SBB verses SBB along with their PSDs. We found that boutons from SBBs at p60 were three times larger with two times larger PSDs versus non-SBBs. These data suggest that the presence of a spinule is a marker for larger boutons. In addition, since a larger bouton is a stronger bouton (i.e., releasing more neurotransmitters), and larger boutons have larger PSDs with more receptors present to bind these neurotransmitters, the presence of a spinule may also be a marker for a stronger bouton. In conclusion, we find that spinules may indicate the presence of the strongest, most important boutons in a neuronal circuit.