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Analysis and 3D Reconstruction of Perisomatic Inhibitory Boutons in CA1 Hippocampus

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Inhibitory synapses regulate the timing of neuronal activity and are critical to normal brain function. It has been observed that neurites (e.g., axon, dendrites) and the cell body (soma) can produce synaptic spinules, thin projections enveloped by another neuron's presynaptic bouton (neurotransmitter releasing side of a synapse). Synaptic spinules may play roles in stabilizing mature synapses and/or acting to communicate between neurons. While we understand synaptic spinule prevalence and characteristics in excitatory synapses, there is no published information about spinule characteristics within inhibitory synapses. Thus, by analyzing synaptic spinules within inhibitory synapses, we may be able to determine what roles they may play within these crucial sets of connections. We obtained an electron microscope image volume from CA1 hippocampus (memory center) of an adult male mouse and analyzed all the inhibitory perisomatic synapses (n = 60) made with one pyramidal neuron soma. We found that 48% of inhibitory presynaptic boutons were spinule-bearing boutons (SBBs), suggesting that spinules are common within inhibitory synapses in hippocampus. In addition, we three dimensionally reconstructed 21 SBBs and non-SBBs, along with their spinules (if present), postsynaptic densities (PSD; synapse size), and mitochondria (if present). We observed that SBBs tended to have larger volumes (114%) and PSD surface areas (128%) than non-SBB, indicating that spinules may impart physiological synaptic strength. This data support ideas that spinules help strengthen synapses due to SBBs larger volume and synapse size, indicating spinules are markers of the strongest and most mature inhibitory synapses in CA1 hippocampus.