**The Microtubule Cytoskeleton at the Synapse**

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Abstract

In neurons, microtubules (MTs) provide routes for transport throughout the cell and structural support for dendrites and axons. Both stable and dynamic MTs are necessary for normal neuronal functions. Research in the last two decades has demonstrated that MTs play additional roles in synaptic structure and function, in both pre- and postsynaptic elements. Here, in this review, we examine current knowledge of the functions that MTs perform in the synapse. In excitatory synapses, dynamic microtubules transiently enter dendritic spines in an activity-dependent manner, where they contribute to structural plasticity. In inhibitory synapses, the microtubule cytoskeleton acts as a scaffold at inhibitory postsynaptic sites, where it controls the "influx" and "efflux" of receptors during synaptic plasticity. Presynaptic microtubules play multiple roles in bouton organization, local synaptic vesicle trafficking and mitochondrial arrangement in the terminal. We also evaluate microtubule contributions at the neuromuscular junction and other specialized synapses, and the implications that this knowledge may have in neurological disease.

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