Abstract:

Mammalian dendrites are active structures, capable of regenerative electrical activity. Dendritic spikes can mediate synaptic plasticity and could enrich the computational properties of neurons. Besides sodium-based action potentials, which can propagate throughout the dendritic tree, neocortical pyramidal neurons also sustain dendritic spikes that are spatially restricted. The function of these 'local' dendritic spikes is unknown. We show that local spikes, which require activation of N-methyl-d-aspartate receptors (NMDARs), induce long-term synaptic depression (LTD) in layer 5 pyramidal neurons. This depression does not require somatic spiking and is input specific. Moreover, a single synaptic stimulus can evoke a dendritic spike and a brief local dendritic calcium transient, and is sufficient for the full induction of LTD.