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Titel des Beitrags: Linear integration of spine Ca2+ signals in layer 4 cortical neurons in vivo.

Abstract: Sensory information reaches the cortex through synchronously active thalamic axons, which provide a strong drive to layer 4 (L4) cortical neurons. Because of technical limitations, the dendritic signaling processes underlying the rapid and efficient activation of L4 neurons in vivo remained unknown. Here we introduce an approach that allows the direct monitoring of single dendritic spine Ca(2+) signals in L4 spiny stellate cells of the vibrissal mouse cortex in vivo. Our results demonstrate that activation of N-methyl-D-aspartate (NMDA) receptors is required for sensory-evoked action potential (AP) generation in these neurons. By analyzing NMDA receptor-mediated Ca(2+) signaling, we identify whisker stimulation-evoked large responses in a subset of dendritic spines. These sensory-stimulation-activated spines, representing predominantly thalamo-cortical input sites, were denser at proximal dendritic regions. The amplitude of sensory-evoked spine Ca(2+) signals was independent of the activity of neighboring spines, without evidence for cooperativity. Furthermore, we found that spine Ca(2+) signals evoked by back-propagating APs sum linearly with sensory-evoked synaptic Ca(2+) signals. Thus, our results identify in sensory information-receiving L4 cortical neurons a linear mode of dendritic integration that underlies the rapid and reliable transfer of peripheral signals to the cortical network.