Fiberoptic Ca^{2+} imaging of dendrites in freely moving rats

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Dendritic recordings in freely moving animals present great challenges using the current approaches. Here we present a microendoscopic technique for measuring intracellular calcium activity directly from the apical dendrites of layer 5 pyramidal neurons in anesthetized and freely moving rats. This method gives high signal-to-noise dendritic fluorescence responses to sensory stimuli, and has been proven to be inexpensive, straightforward and reliable, allowing essentially unrestricted behavior. The method has two main features: *1*) bolus loading of L5 with a membrane-permeant Ca^{2+} dye resulting in specific loading of pyramidal cell dendrites in the upper layers and *2*) a fiberoptic cable attached to a gradient index lens and a prism reflecting light horizontally at 90° to the angle of the apical dendrites. Bi-phasic (fast and slow) dendritic responses evoked by hindlimb stimulation were extremely dependent on brain state. In anesthetized state, a fast component of dendritic activity was linearly correlated with the strength of sensory input. On the other hand, a slow component of dendritic activity was linearly correlated with the strength of hindlimb movement in awake state. These results suggest that population dendrites of layer 5 pyramidal neurons work as a bi-cording element of sensory and motor information in vivo.