In Vivo Voltage Imaging of Deep and Superficial Ca1 Pyramidal Cells.

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The mammalian hippocampus is important for processing spatial information and episodic memory. Anatomically, the hippocampus is divided into regions including the dentate gyrus, CA3, and CA1. Pyramidal neurons in area CA1 are important for carrying the output of hippocampal circuit to downstream areas. Recent studies have revealed that CA1 pyramidal neurons are in fact a heterogeneous group of cells. Specifically, CA1 neurons located at different depths (i.e. superficial and deep layers) are known to differ in both their birthdays and electrophysiological properties. To investigate the in vivo function of these neurons, we used in utero virus injection to E14.5 and E17.5 mice embryos to label deep and superficial CA1 cells, respectively, with a novel fluorescence voltage indicator, Voltron. We characterize the ability of this approach to express Voltron in specific sublayers of CA1 pyramidal neurons using in vivo two photon imaging and post-hoc histological analysis. The success of specific labeling will allow us to record dynamics of membrane potentials, such as complex spikes and subthreshold oscillation, in populations of deep and superficial CA1 pyramidal cells while mice learn spatial tasks. Such experiments will reveal specific roles of CA1 sublayers in supporting learning and memory functions.

Keywords: Hippocampus, CA1 sublayers, Voltage imaging

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