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Presentation Abstract

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Presentation Title:	Design of an implantable artificial dural window for chronic two-photon optical imaging in non-human primates
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Presentation time:	Wednesday, Oct 21, 2015, 8:00 AM -12:00 PM
Presenter at Poster:	Wed, Oct. 21, 2015, 9:00 AM - 10:00 AM
Topic:	++G.03.a. Staining, tracing, and imaging techniques: Light microscopy
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Abstract:	Optical functional imaging methods such as calcium imaging have become a powerful tool for investigating neural activity in-vivo. We present an implantable titanium chamber with silicone artificial dura, which enables two-photon (2P) calcium imaging in non-human primates (NHP). This chamber accommodates imaging with large, multiphoton objective lenses, and remains sealed, protecting the brain from the environment. In addition, we describe a stabilization system to restrict tissue motion while imaging during motor behaviors. Calcium imaging presents several advantages over more traditional multi-electrode recordings, including the ability to genetically target specific cell types and to densely sample from every neuron within a recording volume. However, translating optical imaging techniques to awake, behaving macaques presents a set of unique challenges. First, the optical window must be designed around the large, high

numerical aperture objective lenses typically required for 2P imaging. We developed a novel optical imaging chamber for NHP, which is compatible these lenses. Second, the imaging chamber must be durable enough to last for several months to years to align with trained NHP experimental timescales. Our design incorporates a replaceable window, which is sealed from the external environment to minimize immunoreactivity. Third, cardiac and respiratory rhythms induce cortical pulsations, making stabilization prerequisite for 2P imaging in NHP. In our case, a motor reaching task provides another source of potential brain motion, increasing the need for stabilization. To address this, we developed a stabilization system, which uses gentle pressure on the window to restrict total XY motion to ~5-10 μm for prolonged experiments. The work here describes a system that addresses each of these three key challenges, enabling the capture of stable, cellular resolution, 2P images of superficial motor cortex, and facilitating optical interrogation of neural activity using calcium reporters in future work. The applications of this artificial dural window are not limited to 2P calcium imaging. This implant design may benefit a number of experimental modalities, including single and multiphoton imaging of voltage and calcium reporters, optogenetics, or electrophysiology experiments using fragile silicon electrodes, high-density multielectrodes, or where precise localization relative to identifiable cortical landmarks is essential. We anticipate that this design may soon facilitate a new class of circuit and systems neuroscience experiments in behaving non-human primates.

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Keyword (s): CALCIUM IMAGING

PRIMATE

MOTOR CONTROL

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