

# Post-Ictal Oscillations are Associated with Tissue Integrity in the Hippocampus of Epileptic Mice

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## INTRODUCTION

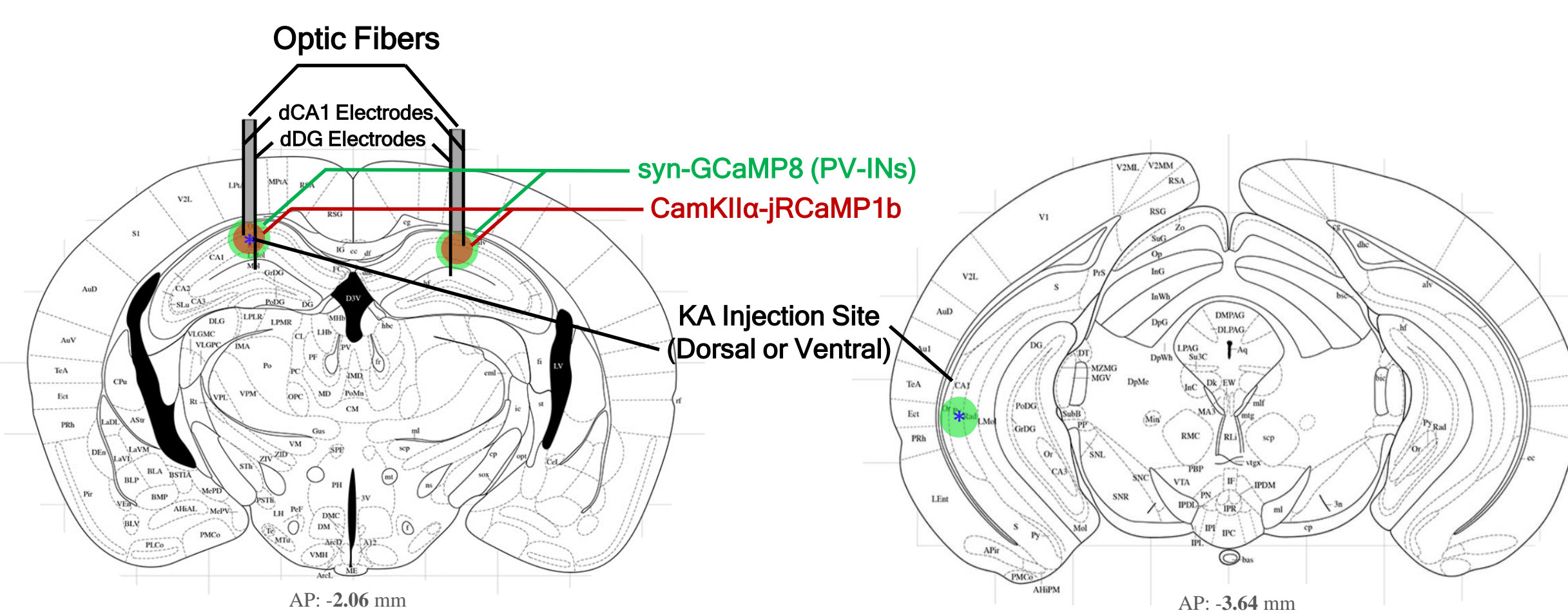
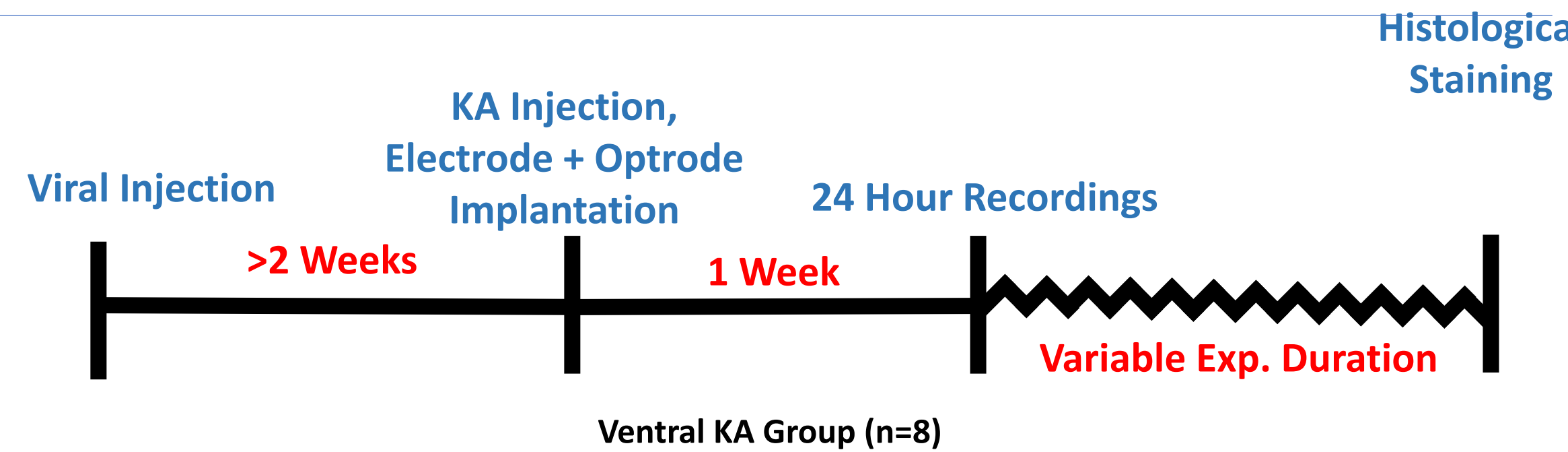
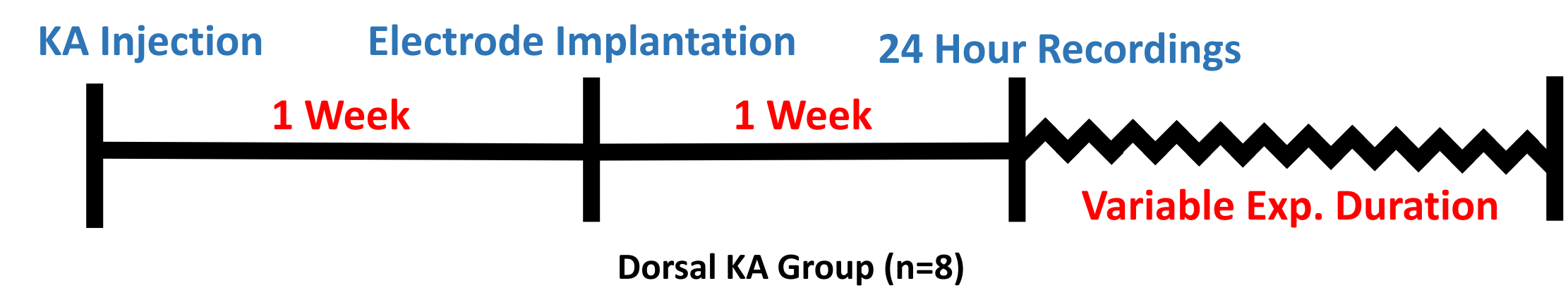
**BACKGROUND:** Historically, research has focused on the ictal onset's electrophysiological signature, leaving the characteristics of the immediate post-ictal state relatively underexplored. Investigating the post-ictal period may uncover insights into how seizure terminates. Here, we identified a seizure-ending pattern termed post-ictal oscillations (PIOs) present only in a subset of mice with temporal lobe epilepsy. The goal of this study is to define the electrophysiological properties of PIOs and investigate the cellular and histopathological findings associated with these activities.

**APPROACH:** The intrahippocampal kainic acid model of temporal lobe epilepsy was used to induce spontaneous seizures in mice. Electrodes were implanted in four areas; bilateral CA1 and bilateral DG. In a subset of animals, intracellular Ca<sup>2+</sup> fluctuations of putative excitatory neurons and parvalbumin-positive interneurons were captured via fiber photometry in bilateral CA1. The immediate post-ictal state was analyzed for the presence of PIOs, and hippocampal brain slices were obtained to analyze hippocampal structural integrity. PIOs were characterized based on duration and frequency characteristics.

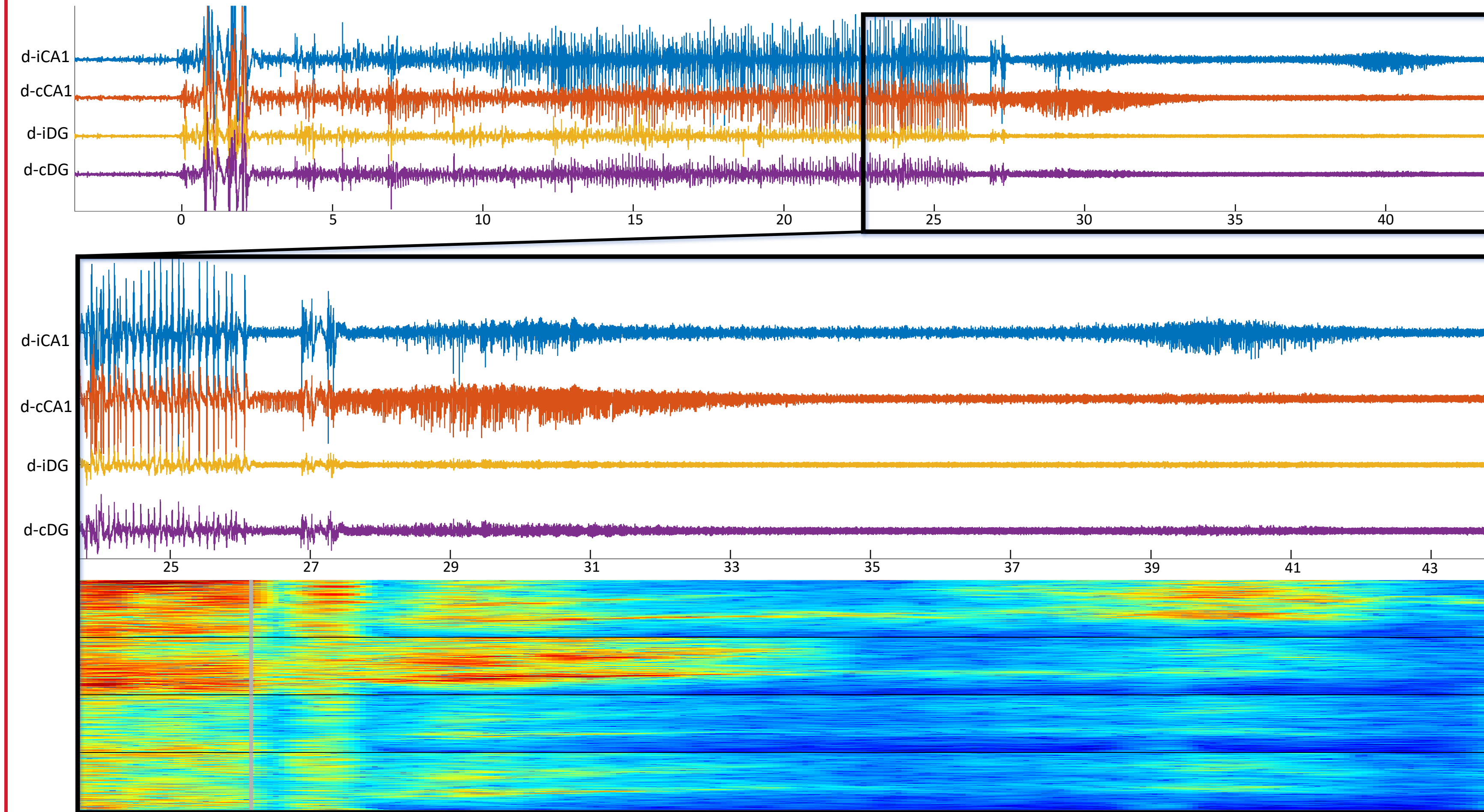
**FINDINGS:** PIOs were only discovered in a subset of mice. There was a negative correlation between hippocampal sclerosis and the proportion of seizures exhibiting PIOs. The ipsilateral hippocampus had higher rates of seizures with PIOs. PIOs are associated with increasing coastline index activity which precedes corresponding increases in excitatory and inhibitory intra-cellular Ca<sup>2+</sup> levels.

## Methods

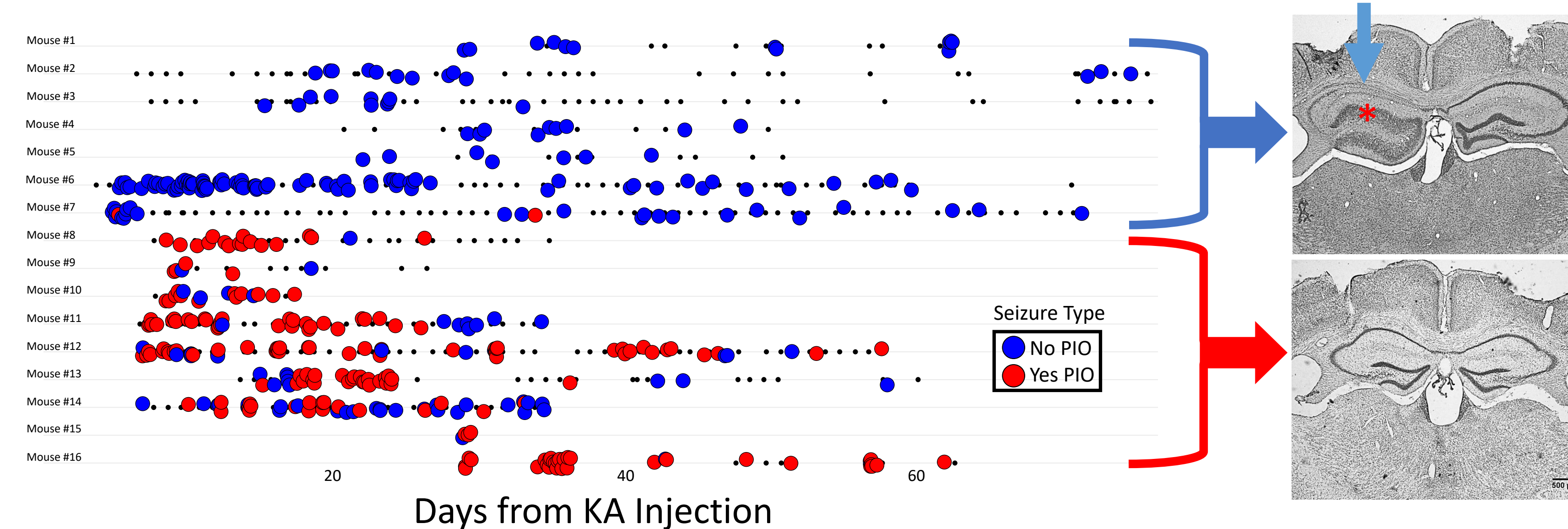
Mice: homozygous PV-Cre knock-in (B6.129P2-Pvalb<tm1(cre)Arb>/+)



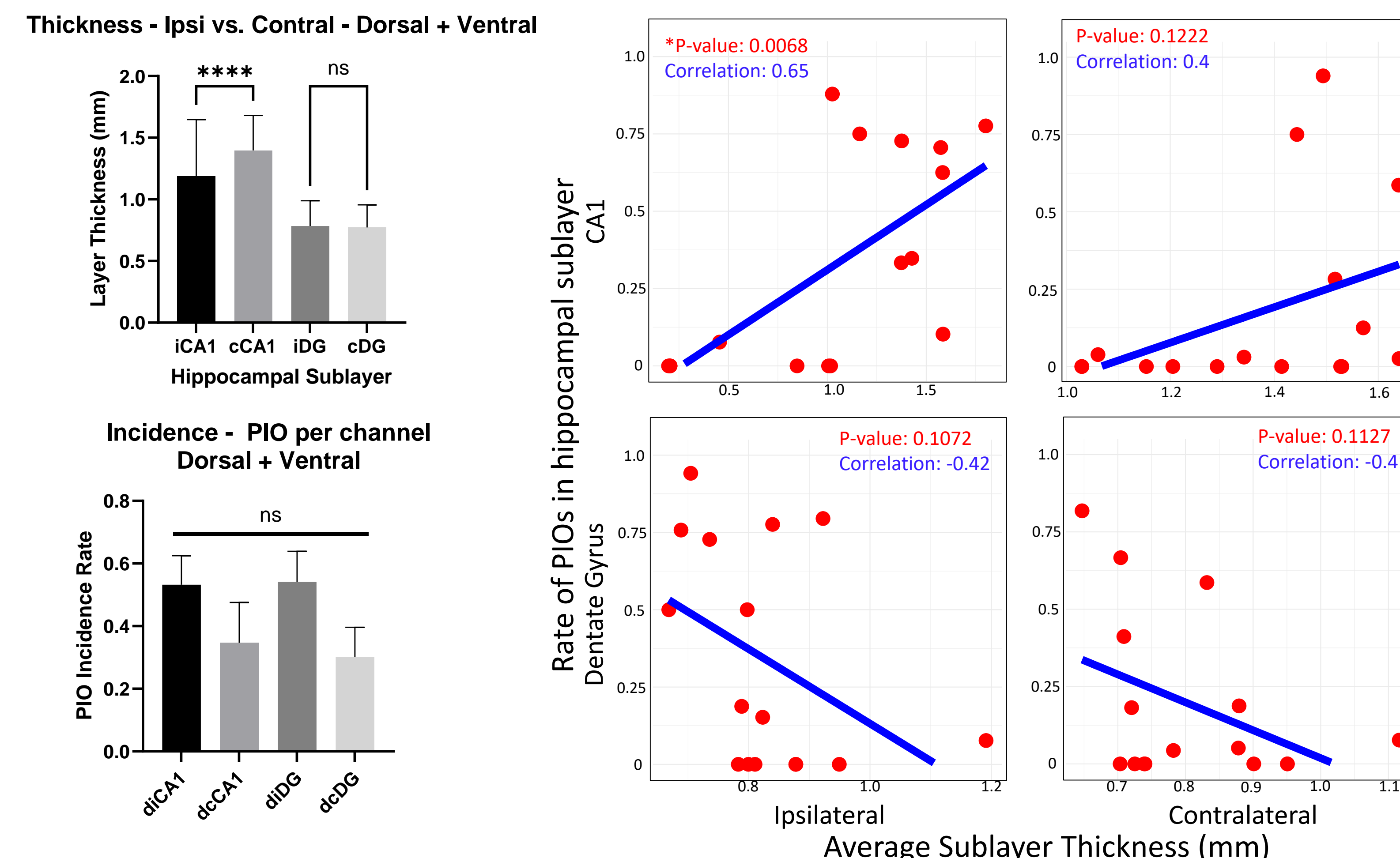
## Post-ictal Oscillation Identification



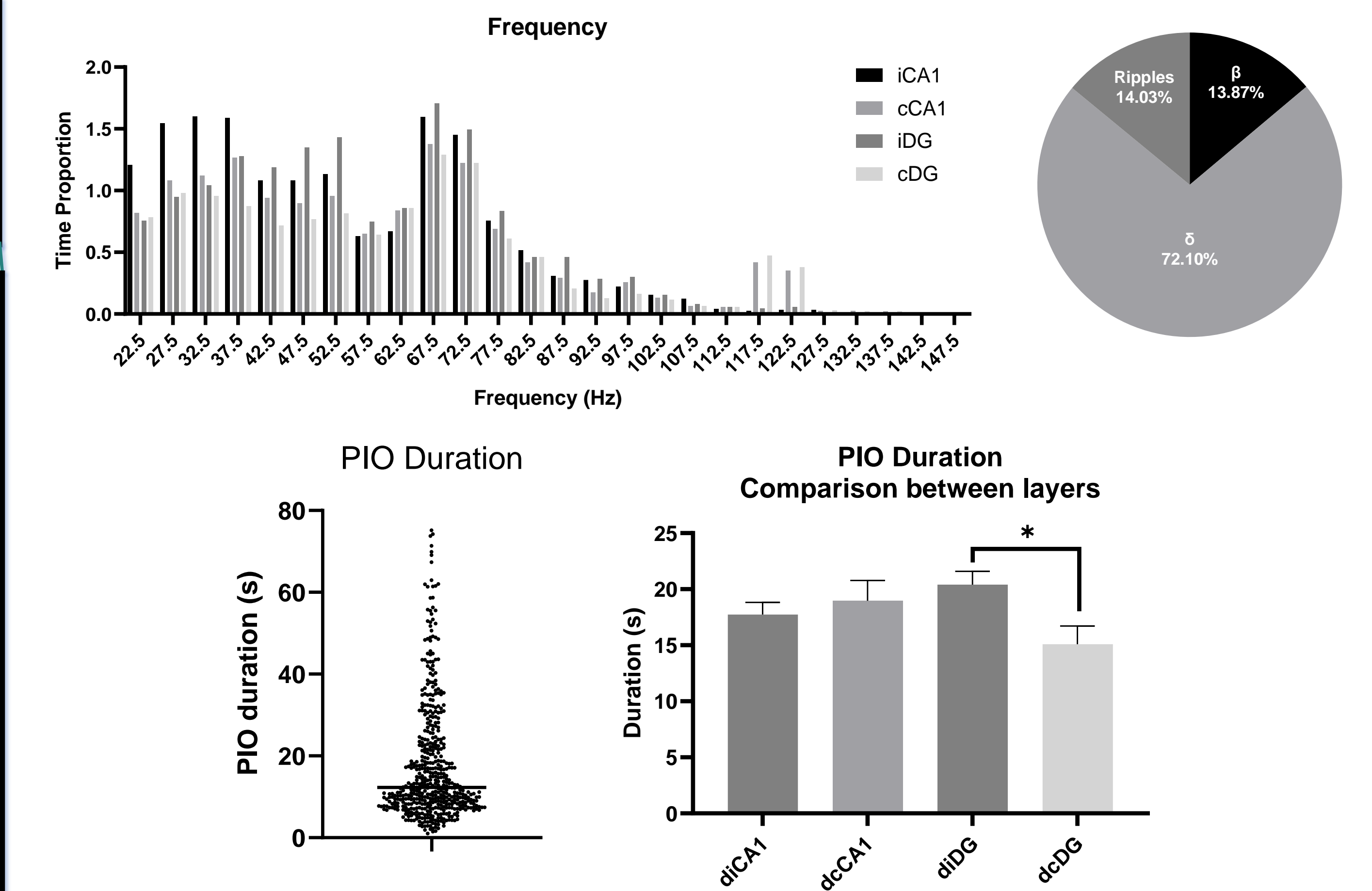
## Recording and Seizure Timeline



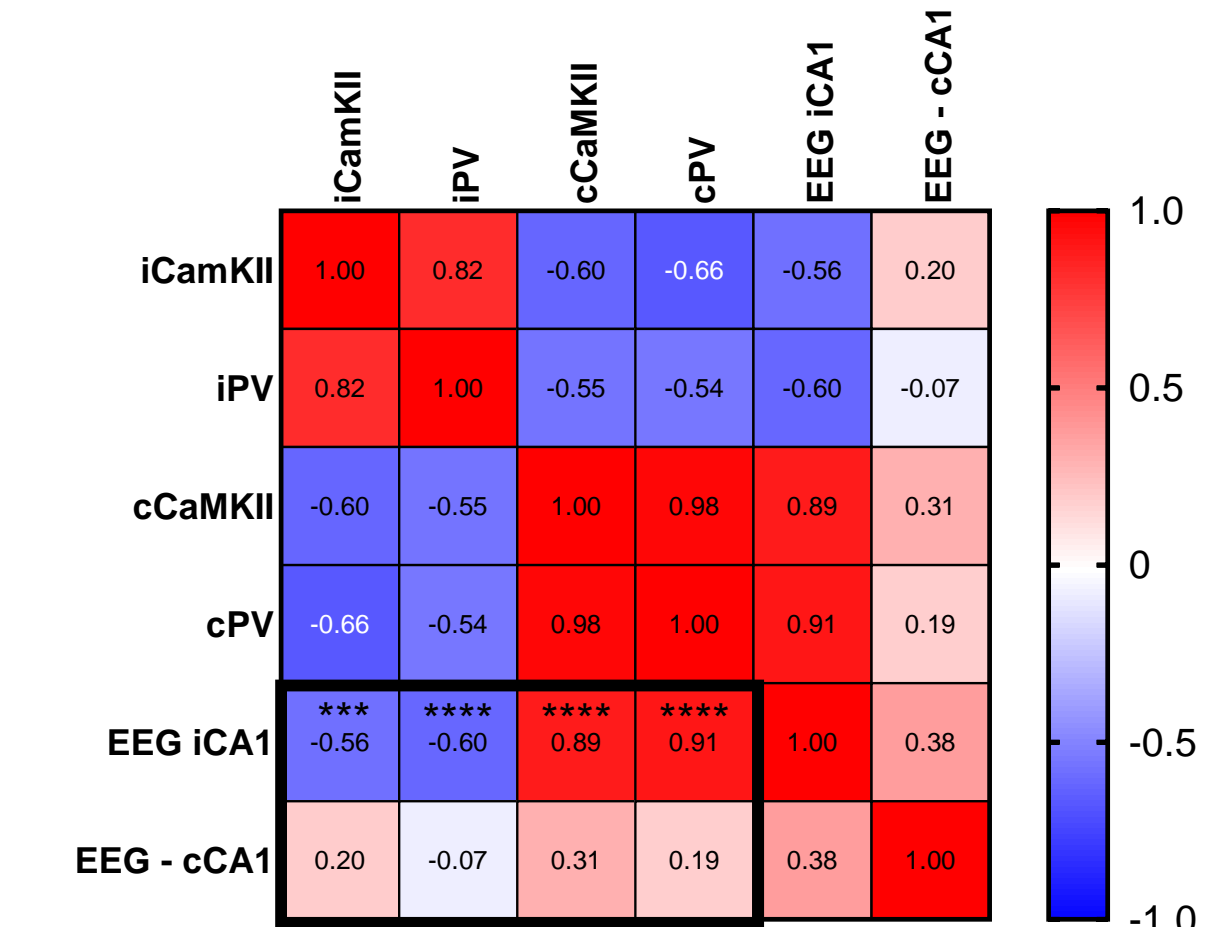
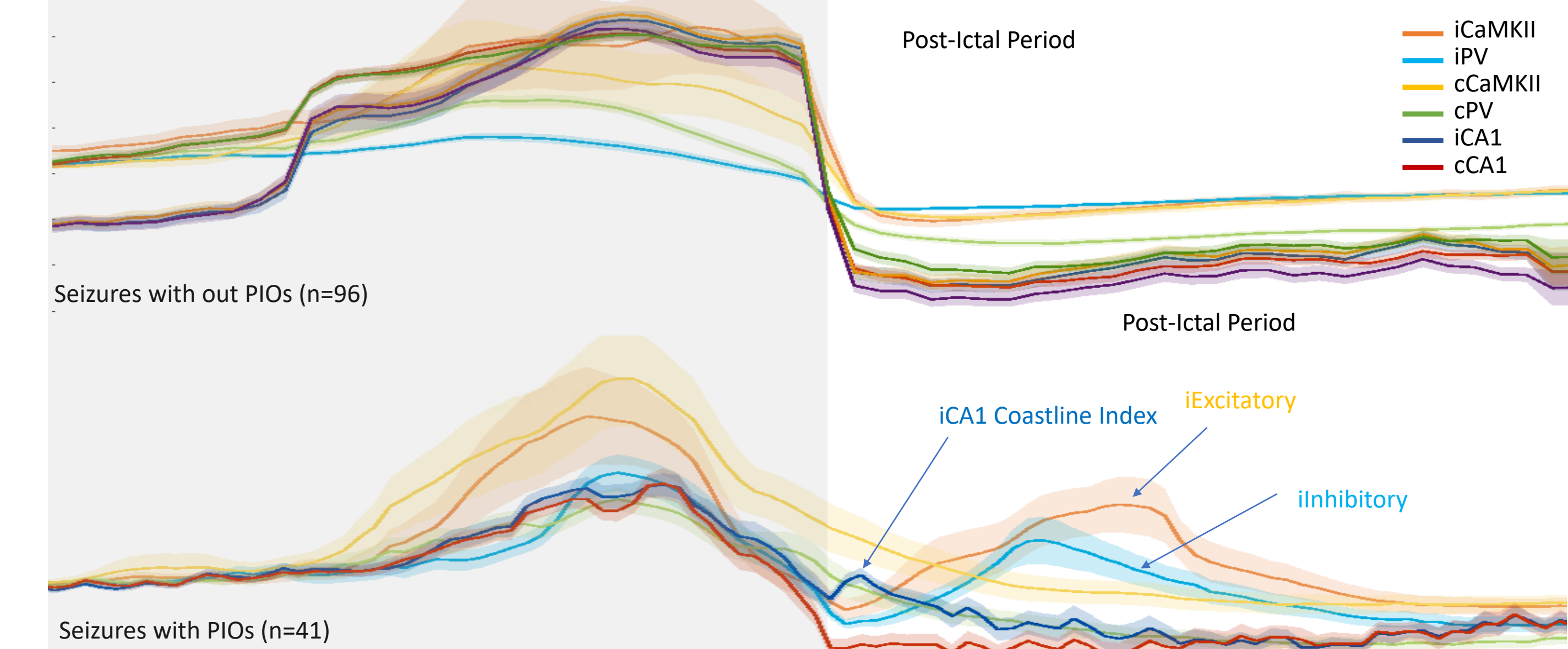
## PIO Emergence Correlates with Sublayer Thickness



## PIO Characterization



## PIO's Coastline Index Precedes Rises in Calcium



## Conclusions

PIOs may be associated with a hippocampus with less degree of hippocampal sclerosis and transient increases in excitatory neuron and inhibitory interneuron intra-cellular Ca<sup>2+</sup> levels. The presence of PIOs in epileptic patients could serve as a potential biomarker for structurally unaffected hippocampal areas, providing clinicians with valuable insights underlying histopathology. A better understanding of the cellular activities associated with the PIOs may lead to treatment strategies for seizure termination.