**Authors:**

Carlos A. Aguila, Alfredo Lucas, Devin Ma, Akash R. Pattnaik, William K.S. Ojemann, Joshua LaRocque, Brian Litt, Erin Conrad

**Experiment Name:** SpikePropagation effects of Morphology, Timing, and Spike Rate.

**Research Project:** Role of Morphology in Interictal Spikes to Elucidate Seizure Generation

**Purpose and Approach:**

In our previous results, we see that spike morphology tends to vary across brain regions, specifically at the mesial temporal structures (hippocampus, amygdala, etc.). There is also a much lesser effect of SOZ on these same spikes. However, when looking at spikes in seizing electrodes vs. non-seizing electrodes in the proclaimed seizure onset zone (general parcellation), morphological features of the spike seem to significantly vary at the patient level.

This leaves us with the question(s): Are these spikes propagating? Are they dependent on angle of electrode? Where is the electrode located (at the cellular level)? Spike is dependent on more than just SOZ/brain region?

To answer this we want to look at how different spike features spread in patients with good outcome temporal lobe epilepsy (TLE) and/or mesial temporal lobe epilepsy (MTLE). The idea is to take advantage of the geometry of the electrodes to create a function of spike spreading and its effect on a particular feature. Features of interest here will be morphology, timing, and spike rate.

This study will allow us to verify true leaders and account for changes in which electrode is recording the most prominent spike.

*Biological relevance****:*** If spikes are shown to have a consistent pattern of variance across electrodes, we can understand the effect of the positioning of electrodes and better localize leading spikes. Null results will signal that perhaps positioning of electrodes doesn’t play that large a role in the morphological feature we observe.

*Clinical relevance:* Propagation patterns in spiking can help localize electrodes that are closer to the true SOZ, when controlling for good outcome patients. A null result will conclude that perhaps propagated spikes perform just as well as leading spikes in localizing the SOZ. (inverse)

**Design Considerations:**

We will be using the spike\_leaders dataset located in ‘mnt/leif/littlab/users/aguilac/Projects/FC\_toolbox/results/mat\_output\_v2/spike\_leaders’. This dataset provides morphological features for every spike across 100 patients. Additionally, from this dataset timing and spike rate data can be extrapolated. From these 100 patients, we will limit the cohort to unilateral TLE and MTLE patients. Additionally, we will limit channels to just those in the temporal lobe/mesial temporal lobe structures.

**Subject Information:**

*Meta data:*

SOZ distributions:

11 – left mesial temporal patients (SOZ)

12 – left other cortex

11 – left temporal

7 – left temporal neocortical

6 – right mesial temporal patients

10 – right other cortex

5 – right temporal

2 – right temporal neocortical

Temporal Lobectomy, SAH, or Ablation:

Total 🡪 66 (any sort of surgical intervention [56/10])

Temporal Lobe: 8 resection

12 ablation

1 temporoamygalohippocampectomy

1 resection anterior temporal lobe

10 Unknown (5/5)

= 32

Mesial Temporal 5 laser ablation

6 Unknown (1/5)

= 11

Questions:

* 4 w/ both? (hup099, hup088?, hup075?, hup144, hup 146)
* Borderline cases (HUP070)
* Do we want to consider insula? Frontal? Anterior cingulate?

**Planned tests:**

Calculate the average morphological feature for each electrode channel in a patient, if the electrode was placed in a region of interest (temporal lobe/mesial temporal lobe). Get a representative gradient of X feature across each channel in an electrode. Regions with multiple electrodes, will have channels averaged across its parallel electrode channel, resulting in a representative electrode. Quantification of feature gradient similarity across samples and patients calls for a Pearson correlation coefficient.