

## Lateralization of temporal lobe epilepsy using resting fMRI connectivity mapping

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### Introduction

Mesial temporal lobe epilepsy (TLE) is a common form of epilepsy in which seizures originate from the hippocampus and adjacent brain structures. Resection of these structures can effectively reduce or eliminate seizures when onset is accurately lateralized. Current presurgical evaluations are most accurate when hippocampal sclerosis is present on MRI with up to 92% [1] post-surgical seizure free rates. When no structural lesion is detected, these rates fall to 60% [2]. We hypothesize that resting functional MRI (fMRI) connectivity mapping can identify hippocampal networks in these patients that can distinguish left from right seizure onset TLE. In this study we investigated the difference in resting fMRI connectivity hippocampal networks between these left and right TLE patients and healthy controls.

### Methods

We enrolled 8 subjects with right TLE (5F/3M, 2 left handed,  $37.7 \pm 11.1$  yrs), 9 subjects with left TLE (5F/4M, 1 left handed,  $38.1 \pm 9.5$  yrs), and 10 healthy controls (8F/2M, 0 left handed,  $28.5 \pm 6.2$  yrs). The TLE patients were seizure free after mesial temporal surgical resection. Structural and functional imaging (64x64, FOV = 240 mm, 30 axial slices, TE = 35 ms, TR = 2 sec, slice thickness = 4.5 mm/ 0.5 mm gap, 200 volumes) were performed on a 3T MRI scanner using an 8 channel head coil. After slice timing and motion correction, spatial normalization to the MNI template was performed. All data were low pass filtered at 0.1 Hz. Regions of interest were drawn on the left (LH, 7360 mm<sup>3</sup>) and right hippocampus (RH, 7616 mm<sup>3</sup>) individually using WFU Pickatlas [3]. The general linear model was used to create connectivity maps to each hippocampus with the global time course and motion parameters as confounds. The connectivity maps to each hippocampus were entered into an ANOVA to find differences between the three groups.

### Results

The ANOVA (F-Test) analysis showed no regions of connectivity to the LH that were significantly different between the three groups at  $p < 0.0001$  (uncorrected) cluster size 5. There were two regions that met that significance level in the RH connectivity maps. The most significant region was in the right thalamus (MNI coordinate 18, -18, 12 mm,  $F = 21.38$ , volume = 896 mm<sup>3</sup>, RTHAL) (Fig. 1) and the second region was in white matter in the temporal lobe adjacent to the posterior horn of the lateral ventricle (26, -54, 16 mm,  $F = 20.63$ , volume = 960 mm<sup>3</sup>).

### Discussion and Conclusions

This study identifies a resting state functional network in temporal lobe epilepsy patients that potentially distinguishes between patients with left and right hippocampal seizure onset with high sensitivity (0.89) and specificity (1.0). The network involves the right hippocampus and a small region in the ventral lateral nucleus of the right thalamus. The primary advantage of this fMRI method is that it is measured non-invasively at rest, without the confound of task performance. Therefore, this technique may be practical to include in a clinical MRI presurgical examination. Future work will validate this in a larger cohort and in those with and without seizure freedom after surgery.

[1] Ramos E, et al. J Neurosurg 2009;110:1127-1134. [2] Bell ML, et al. Epilepsia 2009;50:2053-2060. [3] Maldjian JA, et al. Neuroimage 2004;21:450-455.

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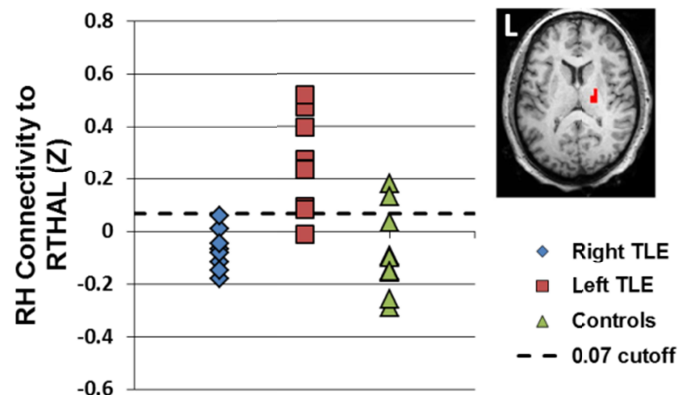


Figure 1. Functional connectivity between RH and RTHAL (inset) in each subject. Cutoff between left and right TLE shown at 0.07.