

Introduction

Intractable focal epilepsy is a devastating disorder with profound effects on cognition and quality of life. Epilepsy surgery can lead to seizure freedom in patients with focal epilepsy, however, sometimes it fails due to an incomplete delineation of the epileptogenic zone (EZ). Brain networks in epilepsy can be studied with resting-state functional connectivity (RSFC) analysis, yet previous investigations using functional MRI or electrocorticography have produced inconsistent results. Magnetoencephalography (MEG) allows noninvasive whole-brain recordings, and can be used to study both long-range network disturbances in focal epilepsy and regional connectivity at the EZ.

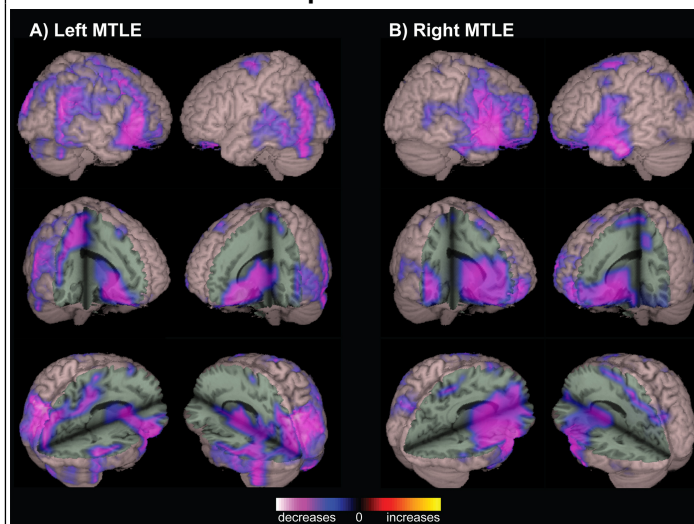
Methods

In MEG recordings from presurgical epilepsy patients, we examined: i) global functional connectivity maps in patients vs. controls, and ii) regional functional connectivity maps at the region of resection, compared to the homotopic non-epileptogenic region in the contralateral hemisphere.

Results

Sixty-one patients were studied, including 30 with mesial temporal lobe epilepsy (MTLE) and 31 with focal neocortical epilepsy (FNE). Compared to 31 controls, epilepsy patients had decreased RSFC in widespread regions, including peri-sylvian, posterior temporo-parietal, and orbitofrontal cortices ($p < 0.01$, FDR-corrected) (Figs. 1, 2). Decreased global connectivity was related to longer duration of epilepsy and higher frequency of consciousness-impairing seizures ($p < 0.01$, linear regression) (Fig. 3). Furthermore, patients with increased regional connectivity within the resection site ($n = 24$) were more likely to achieve seizure post-operative

Figure 1: Decreased functional connectivity in MTLE patients



Similar results seen in FNE patients (not shown).

Figure 2: Decreased functional connectivity in FNE patients

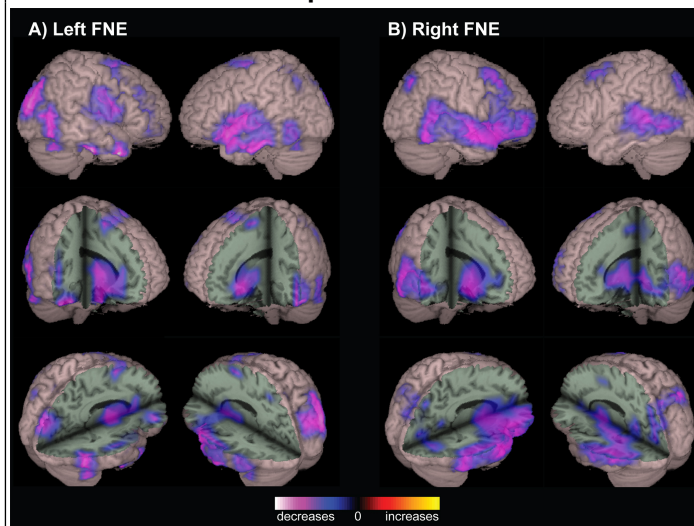


Figure 3: Longer epilepsy duration (A) and higher seizure frequency (B) are associated with decreased functional connectivity

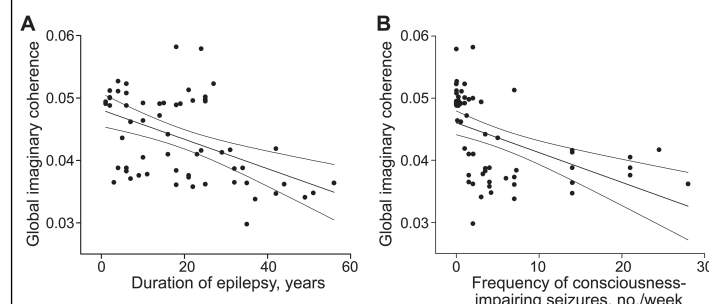
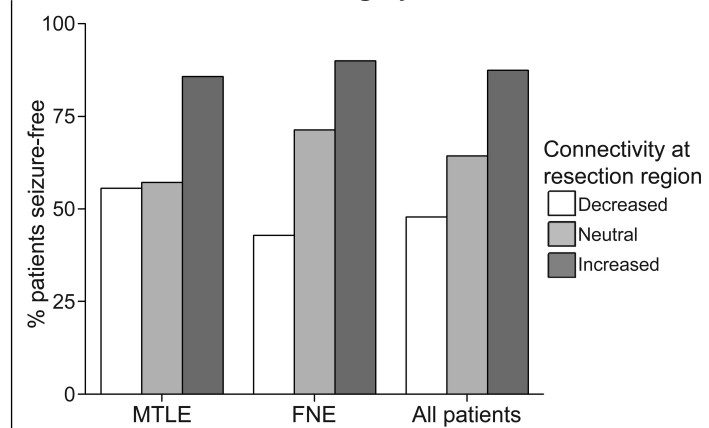


Figure 4: Increased connectivity at the resection region is associated with seizure freedom after surgery



Conclusions

Widespread global decreases in functional connectivity are observed in patients with focal epilepsy, and may reflect deleterious long-term effects of recurrent seizures. Furthermore, enhanced regional functional connectivity at the area of resection may help predict seizure outcome and aid surgical planning.