Idiopathic generalized epilepsy (IGE) is a neurologic disorder in which periods of normal neuronal activity are suspended by brief intervals of spontaneous, synchronous spike-and-wave discharges and clinical manifestations of seizures. Though the brains of patients appear completely normal on diagnostic imaging, including magnetic resonance imaging (MRI), the 3 Hz synchronous oscillatory features on electroencephalography (EEG) cast little doubt that pathological neuronal function causes the manifestation of seizures. Given our limited ability to study human brains in vivo, the main aim of the research presented here is to show the extent to which emerging MRI techniques can be used to quantify brain abnormalities, even when standard MRI scans reveal no obvious pathology.

Emerging MRI acquisition and analysis techniques can be used to identify structural and functional pathology. T₁-weighted MRI scans, diffusion tensor imaging (DTI) and resting state functional MRI (fMRI) provide an integrated means to study focal and network pathology in IGE. We collected MRI scans from 27 patients with IGE and 27 age- and sex-matched controls. To study cortical abnormalities, we used morphometric measures including cortical thickness and gray-white contrast comparing IGEs to normal controls. We also studied a cortical functional network, the default mode network (DMN) to determine if widely distributed functional architecture is preserved in generalized epilepsy. Because abnormal activity in the thalamus is thought to be the primary node of pathologic activity in IGE, we performed volumetric studies of the thalamus, correlated volumes with cortical measures and studied the fractional amplitude of low frequency fluctuations (fALFF) in specific thalamic subregions. Finally, DTI was employed to examine the integrity of tracts throughout the brain and tracts connecting the thalamus and prefrontal cortex, which is thought to be preferentially involved in IGE.