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Beyond the intervention: long-term morphological changes after surgical resection

The brain is characterized as a network of interdependent regions that carry out complex tasks. In epilepsy it is believed that seizure generating tissues utilize network structure for the pathological spread of synchronous electrical activity. The primary treatment for refractory epilepsy is surgical excision of brain regions containing epileptogenic tissue. Given the complex connectivity between brain regions, we anticipate that resective surgery will cause long-term restructuring of the brain network. Loss of functional input and compensatory neuroplasticity are expected to result in morphological changes for regions that are associated with resected tissues. Here we characterize alterations in brain morphology that result from the most common surgical procedure, a temporal lobectomy. Using image processing pipelines provided by Advanced Normalization Tools (ANTs), we compare cortical thickness and regional volumetric between presurgical MRI and 1-5 years post operative imaging. We demonstrate that in the temporal lobe contralateral to surgical excision, there are decreases in cortical thickness. Additionally, we find that cortical thickness increases in regions outside the temporal lobe that are associated with the limbic system. Our findings suggest that brain networks adapt to tissue removal. The decrease in contralateral temporal lobe could result from the loss of functional input from the symmetric hemisphere, while the increase in remote task associated regions is likely a compensatory response. Establishing morphological changes is an important step towards understanding patient outcomes, including seizure-freedom and cognitive deficits. Furthermore, the methodology outline here may be adapted to study long-term morphological alteration in other lesional diseases, such as stroke and brain tumors.