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Bilateral Structural Network Abnormalities in Epilepsy Associated With Bottom-of-Sulcus Dysplasia

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Study Question

What are the white matter fiber tracts that exhibit structural abnormality in patients with bottom-of-sulcus dysplasia (BOSD)?

What Is Known and What This Paper Adds

Focal epilepsies are now widely viewed as network disorders, where focal lesions lead to extensive abnormalities within brain networks. This network conceptualization of epilepsy is predominantly driven by evidence from temporal lobe epilepsy. Recent work, however, suggests that focal cortical dysplasia (FCD) may also be characterized by widespread disruption to brain networks. BOSD is a highly localized type of FCD that could be associated with widespread disruption to brain organization. The results of this study show that patients with a BOSD exhibit disruption to specific structural brain networks.

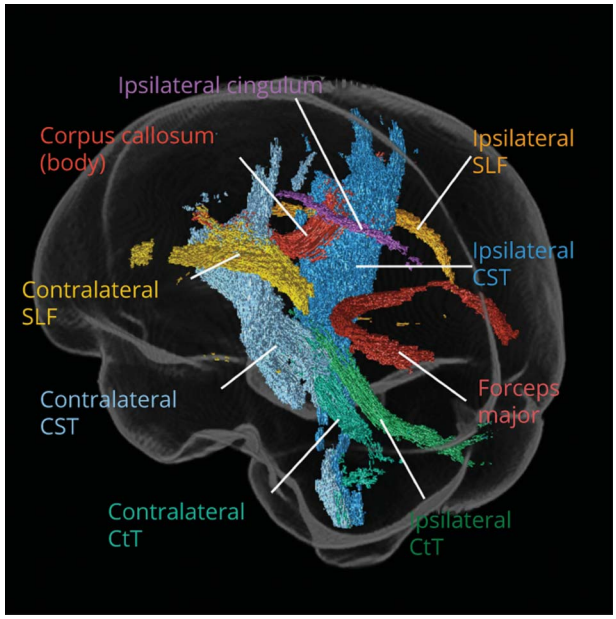
Methods

For this case-control study, diffusion MRI data were collected in 20 patients with intractable epilepsy due to BOSD and 40 healthy control participants who matched patients in age, sex, and scanner on which MRI was acquired. BOSD lesions were in the right hemisphere in 13 of 20 (65%) patients and in the left hemisphere in 7 of 20 (35%). Diffusion MRI data were preprocessed and images were flipped for patients with left-sided BOSD and matched control participants to align lesion hemisphere across all patients. We applied a technique known as fixel-based analysis (FBA), which enables identification of specific white matter structures that exhibit clinically important reductions in structural connectivity, here comparing patients with BOSD to healthy controls. Results from the whole-brain FBA were used as priors to investigate the association of fiber tract abnormality with seizure frequency and epilepsy duration.

Results and Study Limitations

Whole-brain FBA revealed widespread abnormality in white matter fiber tracts in BOSD, including the bilateral corticospinal, corticothalamic, and cerebellothalamic tracts, superior longitudinal fasciculi, body of the corpus callosum, and forceps major. These bilaterally distributed connectivity reductions were not related to the laterality of the lesion. Post hoc analyses showed that high seizure frequency at the time of MRI scan was associated with connectivity reductions at least in some fiber tracts, suggesting that seizure activity may drive abnormalities within these structural networks. No significant associations were observed between tract-specific reductions and disease duration. Limitations of the study include a small cohort size. These post hoc analyses must be considered hypothesis-generating.

Figure Fiber Tracts Affected in Bottom-of-Sulcus Dysplasia



White matter tracts that exhibited significant abnormalities in patients with bottom of sulcus dysplasia when compared to healthy control participants are shown in a glass brain representation.

Study Funding and Competing Interests

This study was funded by the National Health and Medical Research Council (NHMRC) of Australia. The authors have no competing interests to declare. Go to Neurology.org/N for full disclosures.