

Seizure onset zone

The seizure onset zone. The seizure onset zone is the area of the cortex from which clinical seizures are (actually) generated, as opposed to the epileptogenic zone, which is the area of the cortex that is indispensable for the generation of epileptic seizures

[Positron emission tomography](#) (PET) imaging in [epilepsy](#) is an in vivo technique that allows the localization of a possible [seizure onset zone](#) (SOZ) during the interictal period. Stereo-electro-encephalography (SEEG) is the gold standard to define the SOZ. The objective of this research was to evaluate the accuracy of [PET](#) imaging in localizing the site of SOZ compared with SEEG.

Seven patients with [refractory temporal lobe epilepsy](#) (Ep) and 2 healthy controls (HC) underwent 2 PET scans, one with 2-[18F]-fluoro-2-deoxy-D-glucose (FDG) and another with 2'-[18F]fluorofluminaril (FFMZ), acquired 1 day apart. FDG was acquired for 10 min (static scan) 1 h after administration. An FFMZ scan was acquired for 60 min from radiopharmaceutical administration in a dynamic mode. Each brain PET image was segmented using a standard template implemented in PMOD 3.8. The pons was used as the reference region for modeling of the nondisplaceable binding potential (BPND) for FFMZ, and to obtain uptake ratios for FDG. SEEG studies of patients were performed as a part of their surgical evaluation to define the SOZ.

Well-defined differences between HC and Ep were found with both radiopharmaceuticals, showing the utility to identify abnormal brain regions using quantitative PET imaging. Lateralization of the SOZ findings by PET (lower uptake/binding in a specific brain hemisphere) matched in 86% for FFMZ and 71% for FDG with SEEG data.

Quantitative PET imaging is an excellent complementary tool that matches reasonably well with [SEEG](#) to define SOZ in presurgical evaluation ¹.

Approximately 70% of epilepsy patients can be adequately treated with antiepileptic drugs. For the remaining 30% that has pharmaco-resistant epilepsy (or refractory epilepsy), other treatment options such as resection surgery or neurostimulation (like deep brain stimulation or vagus nerve stimulation) must be strongly considered. The purpose of resection surgery is to remove the epileptogenic focus, i.e., a limited area of the neural tissue that is sufficient to be eliminated from the brain, leading to seizure freedom in the patient. During a pre-surgical procedure, the effectiveness of epilepsy resection is evaluated by localizing as accurately as possible the epileptogenic focus that overlaps with eloquent cortex grounded in different neuroimaging techniques. Hence, the localization the brain regions where the seizures originate from [termed seizure onset zone (SOZ)] is of utmost importance. To this end, several anatomical and functional imaging techniques have been used, being intracranial EEG the gold standard. Nevertheless, this technique is invasive and implies one surgery more before the SOZ resection should be carried out.

The rate of [interictal high frequency](#) oscillations (HFOs) is a promising biomarker of the [seizure onset zone](#), though little is known about its consistency over hours to days.

Here we test whether the highest HFO-rate channels are consistent across different 10-min segments of EEG during sleep. An automated HFO detector and blind source separation are applied to nearly 3000 total hours of data from 121 subjects, including 12 control subjects without epilepsy. Although interictal HFOs are significantly correlated with the seizure onset zone, the precise localization is consistent in only 22% of patients. The remaining patients either have one intermittent source (16%), different sources varying over time (45%), or insufficient HFOs (17%). Multiple HFO networks are found in patients with both one and multiple seizure foci. These results indicate that robust HFO interpretation requires prolonged analysis in context with other clinical data, rather than isolated review of short data segments ²⁾.

¹⁾

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²⁾

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