A comparative study between a power and a connectivity sEEG biomarker for seizure-onset zone identification in temporal lobe epilepsy

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Abstract: Stereo-encephalography (sEEG) biomarkers are under investigation to help localize the seizure onset zone (SOZ) using ictal activity. Current biomarkers can be classified depending on whether they target abnormalities in signal power or functional connectivity between signals, and they may depend on the frequency and the time window at which they are estimated. This work aimed to compare and optimize the performance between a power and a connectivity-based biomarker to identify SOZ contacts from ictal sEEG recordings as a function of frequency and time windows of interest. To do so, we used a previously introduced power-based measure, the normalized mean activation (nMA), which quantifies the ictal average power activation compared to pre-ictal baseline activity. Similarly, we defined the normalized mean strength (nMS), to quantify the ictal mean functional connectivity (cross-correlation) of every contact with the rest. The optimal frequency bands and time windows were selected using four different criteria: two criteria aimed to maximize the average and the minimum AUC for all patients, respectively, while the other two criteria focused on maximizing the F2-score using inter-patient and intra-patient train-test classifier approaches. The analysis was performed on a dataset of 67 seizures from 10 patients with pharmacoresistant temporal lobe epilepsy. Our results suggest that the power-based biomarker generally performs better for the detection of SOZ than the connectivity-based one. However, an equivalent performance level can be achieved when both biomarkers are independently optimized over frequency bands and time windows. Optimal performance was achieved in the beta and lower-gamma range for the power biomarker and in the higher-gamma range for connectivity, both using a 30 s period after seizure onset. The results of this study highlight the importance of this optimization step over frequency and time windows locked to seizure onset time when comparing different SOZ discrimination biomarkers. This information should be considered when training SOZ classifiers on retrospective patients' data for clinical applications.

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