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Spike associated High Frequency Oscillations in Magnetoencephalography co-localize with Focal Cortical Dysplasia type IIB

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Purpose: High frequency oscillations (HFO) in invasive recordings are a marker of epileptogenicity in patients with focal epilepsy. In magnetoencephalography (MEG) high gamma activity and HFO could be localized to the epileptogenic zone. The aim of the current project is to noninvasively co-localize visually detected HFO in MEG recordings with the MRI positive part of the Focal Cortical Dysplasia (FCD).

Method: In five epilepsy patients with MRI-based diagnosis of FCD simultaneous MEG and scalp-EEG (MEEG) were recorded with a sampling rate 2400Hz. MEG and EEG data were visually analysed in the frequency band of 3–70Hz for the occurrence of epileptic spikes and in the frequency band of 70-300Hz for HFO/High gamma activity. Without filtering frequency domain beamforming was used for the source localization of spikes and HFO.

Results: HFO associated with epileptic spikes were recorded in 3/5 patients in MEG and in 1/5 in EEG. MEG-identified HFO in the frequency band between 70 and 120 Hz could be localized to the epileptogenic lesion. HFO recorded by EEG correlated with the FCD in sensor space. The high frequency component of epileptic spikes localized more accurately to the lesion than low frequency parts of the spikes.

Conclusion: It is possible to visually detect spike-associated HFO in MEG recordings and to localize them in spatial concordance with the FCD using frequency domain beamforming. This approach might allow to noninvasively identify the epileptogenic zone in non-lesional cases.

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