

The morphology of high frequency oscillations (HFO) does not improve delineating the epileptogenic zone

Sergey Burnos^{1,2}, Birgit Frauscher³, Rina Zelman³, Claire Haegelen⁴, Johannes Sarnthein^{1,2}, Jean Gotman³

¹ Neurosurgery Department, University Hospital Zurich, Zurich, Switzerland

² Institute of Neuroinformatics, ETH Zurich, Zurich, Switzerland

³ Montreal Neurological Institute and Hospital, Montreal, Quebec, Canada

⁴ MediCIS, INSERM, Faculté de Médecine, University of Rennes, Rennes, France

Rational:

We hypothesized that high frequency oscillations (HFOs) with irregular amplitude and frequency more specifically reflect epileptogenicity than HFOs with stable amplitude and frequency.

Methods:

We developed a fully automatic algorithm to detect HFOs and classify them based on their morphology, with types defined according to regularity in amplitude and frequency: type 1 with regular amplitude and frequency; type 2 with irregular amplitude, which could result from filtering of sharp spikes; type 3 with irregular frequency; and type 4 with irregular amplitude and frequency. We investigated the association of different HFO types with the seizure onset zone (SOZ), resected area and surgical outcome.

Results:

HFO rates of all types were significantly higher inside the SOZ than outside. HFO types 1 and 2 were strongly correlated to each other and showed the highest rates among all HFOs. Their occurrence was highly associated with the SOZ, resected area and surgical outcome. The automatic detection emulated visual markings with 93% true positives and 57% false detections.

Discussion:

HFO types 1 and 2 similarly reflect epileptogenicity. For clinical application, it may not be necessary to separate real HFOs from “false oscillations” produced by the filter effect of sharp spikes. Also for automatically detected HFOs, surgical outcome is better when locations with higher HFO rates are included in the resection.