



EST **30**th ANNIVERSARY
ANNUAL MEETING



Advanced Neuroimaging in Epilepsy Beyond MRI: Post-processing, Functional, and Network-Based Imaging

Kanjana Unnwongse, MD

Postprocessing Imaging

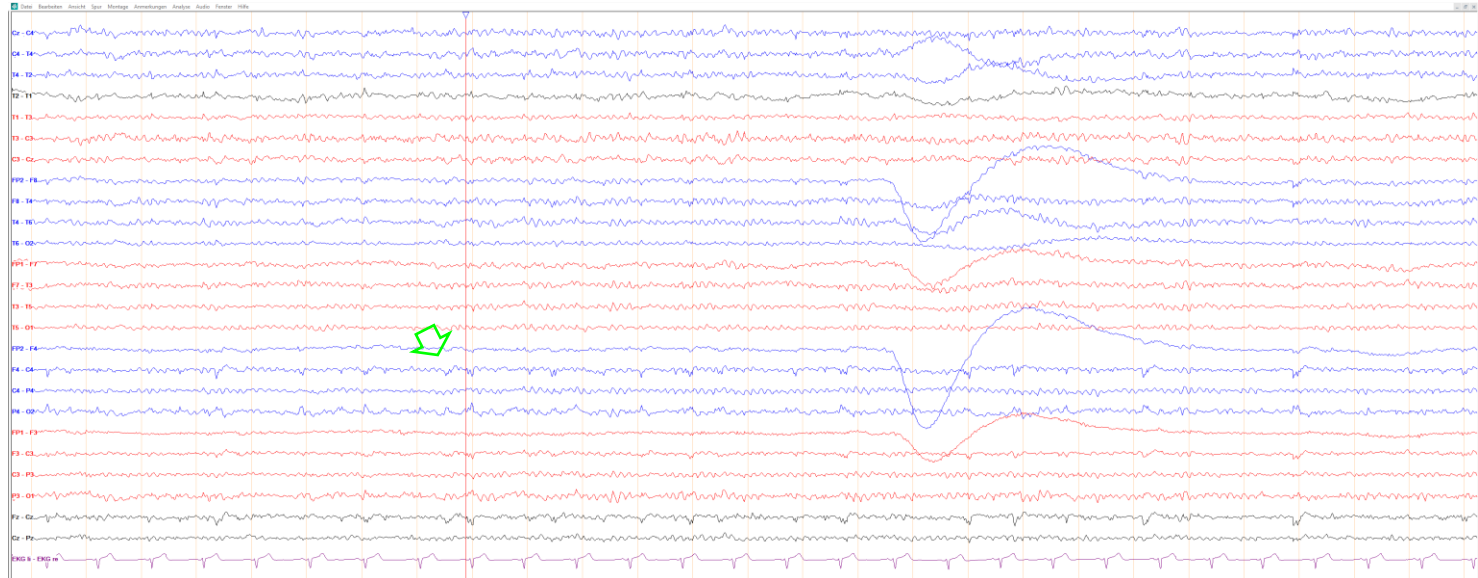
Voxel based Morphometry

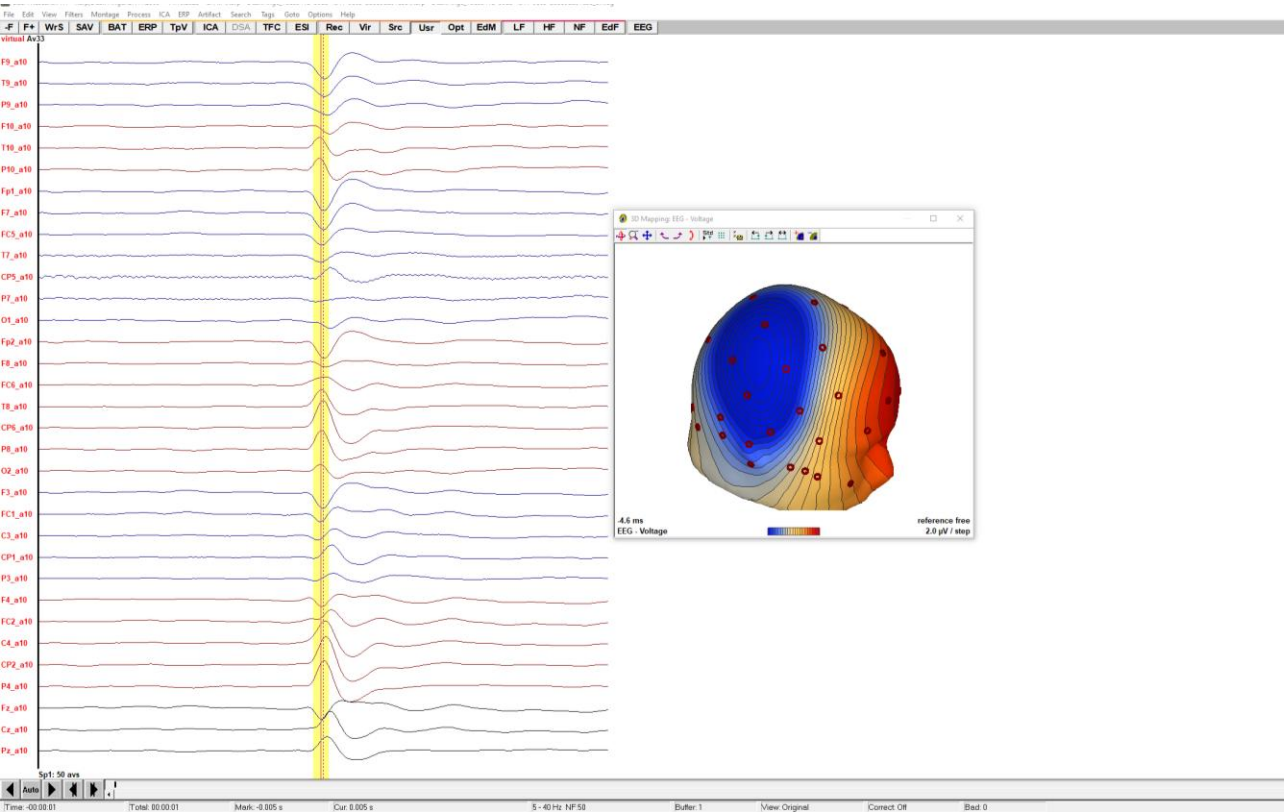
Electrical Source Imaging

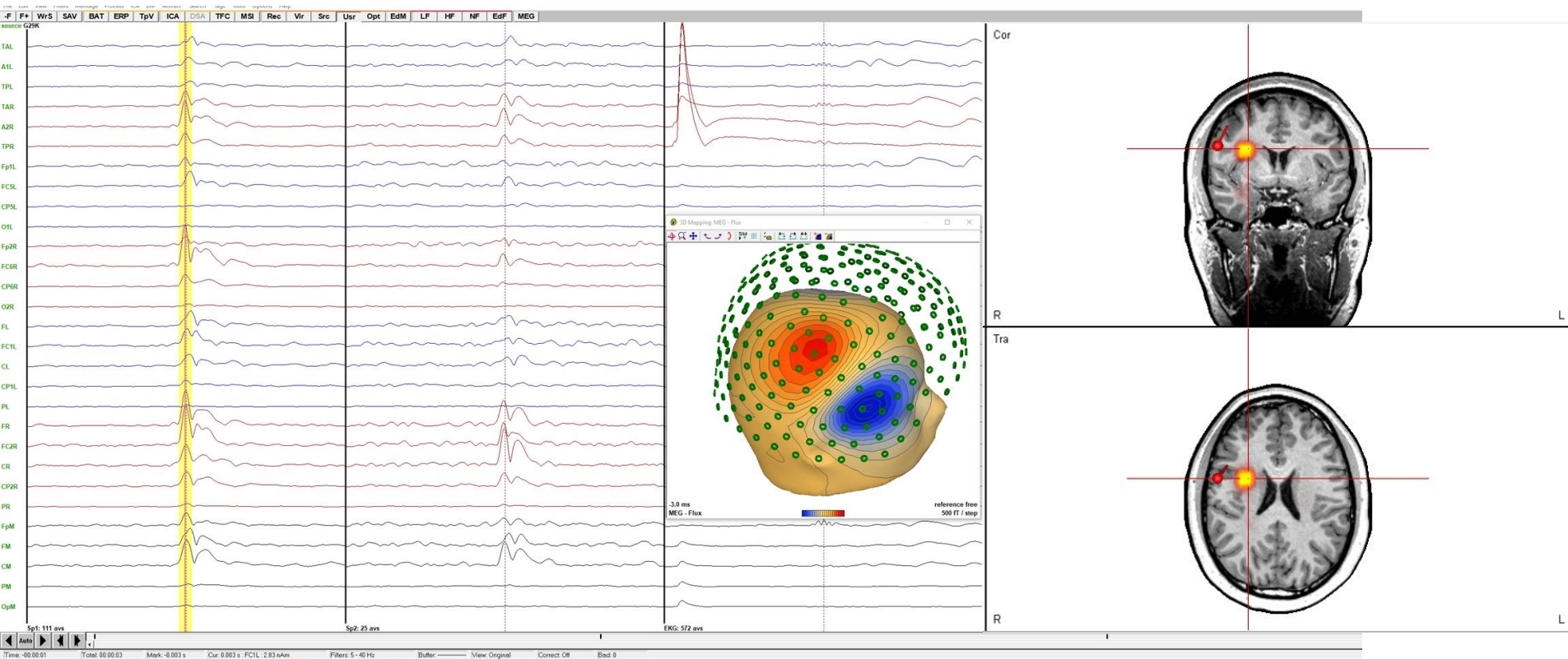
Magnetic Source Imaging

» Video-EEG Findings

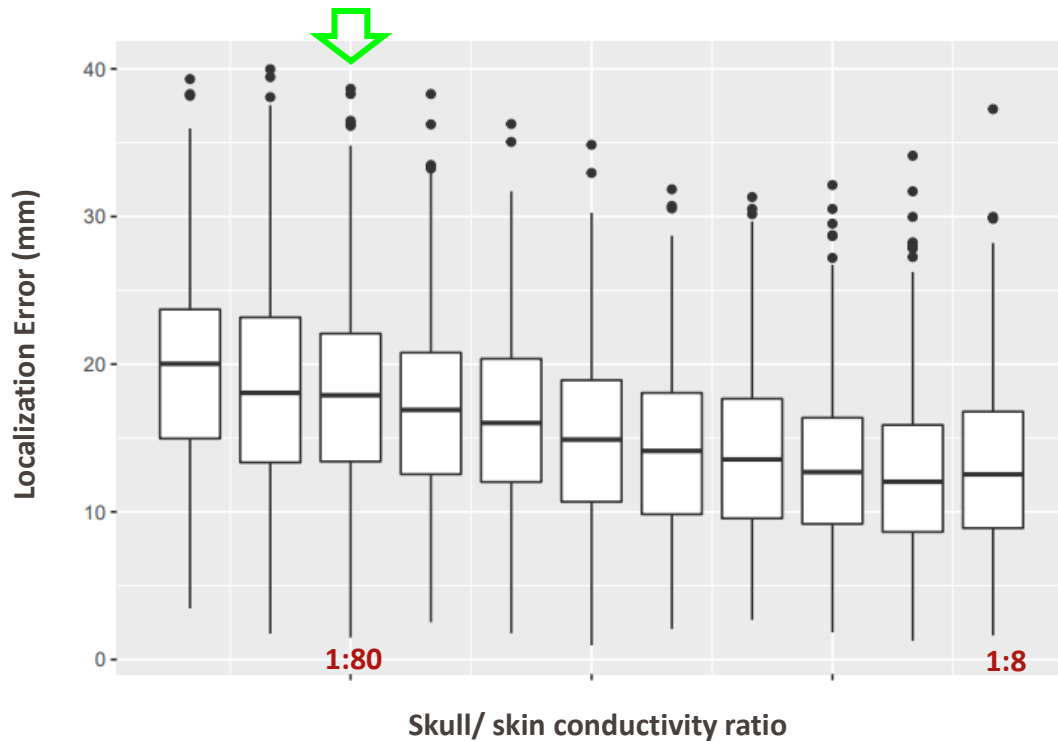
1. Spike, Rt centro-parietal, max CP2
 2. **Clinical seizures:** Clonic (Lt hand, face->arm->shoulder)
- EEG Seizures:** Rt centro-parietal





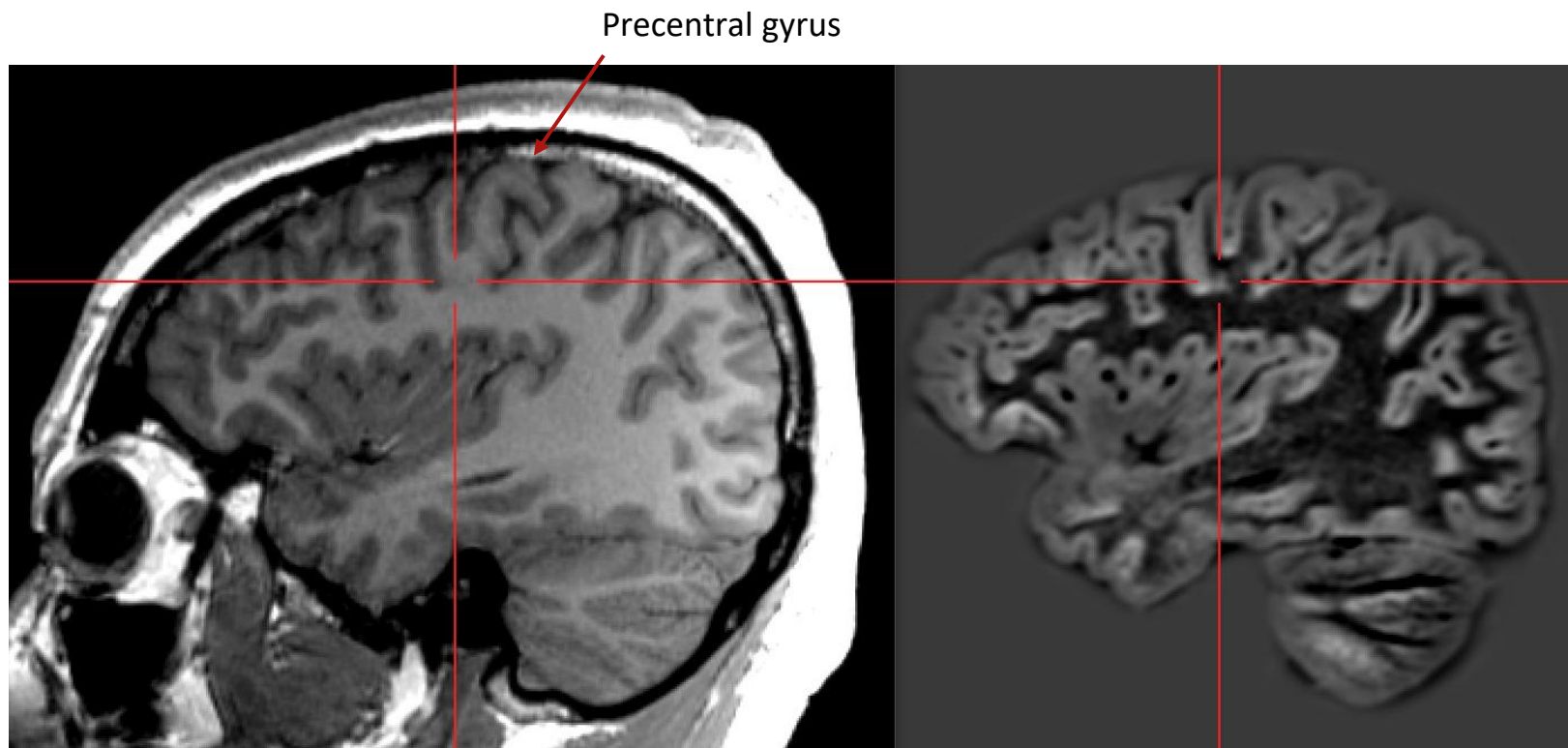


Validation of Electrical Source Imaging

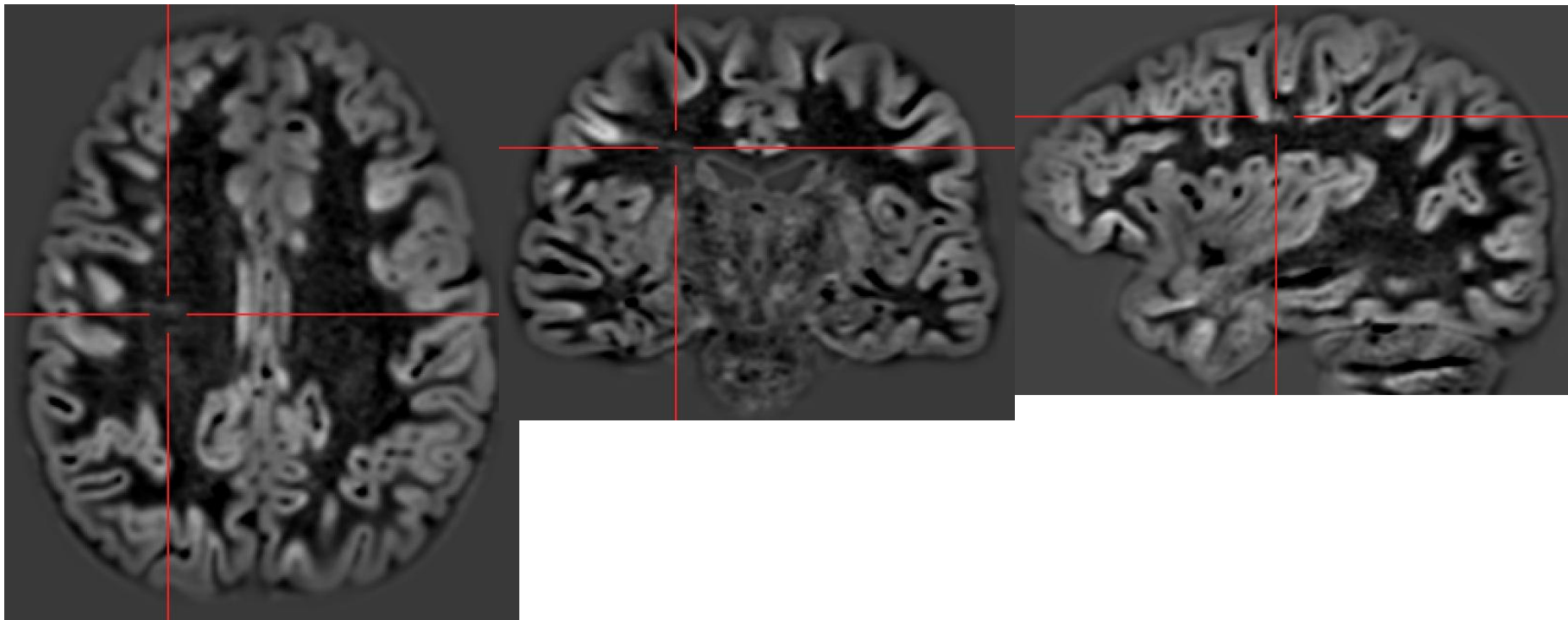


- » At depth of 0.4–47.8 mm from inner skull.
- » Using standard adult skull conductivity, the mean localization error is 14.4–23.4 mm.

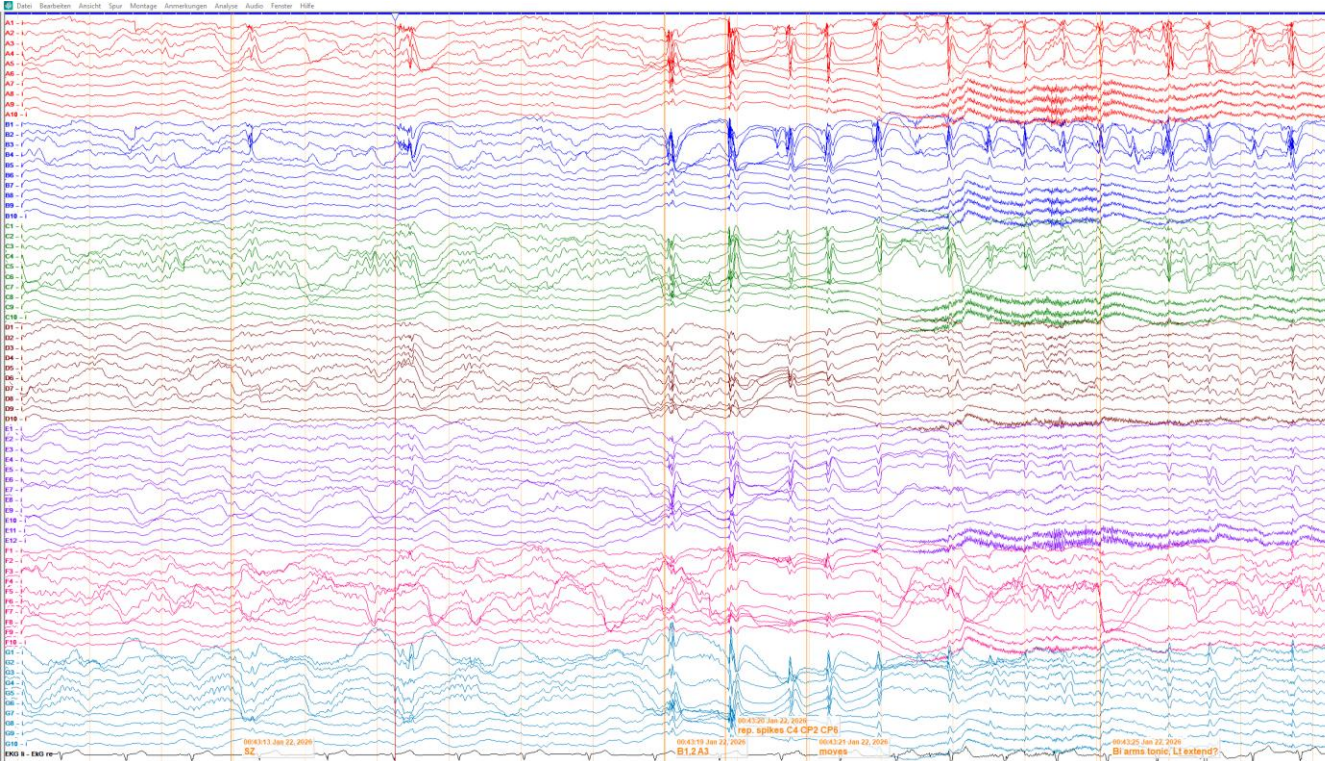
T1 & Flair Z-score (MAP18)



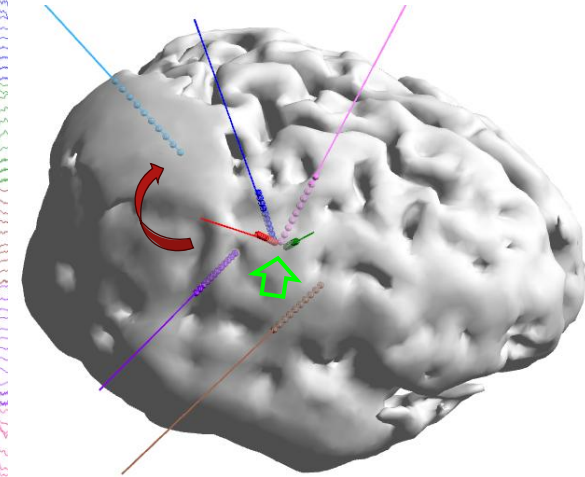
Flair Z-score (MAP18)



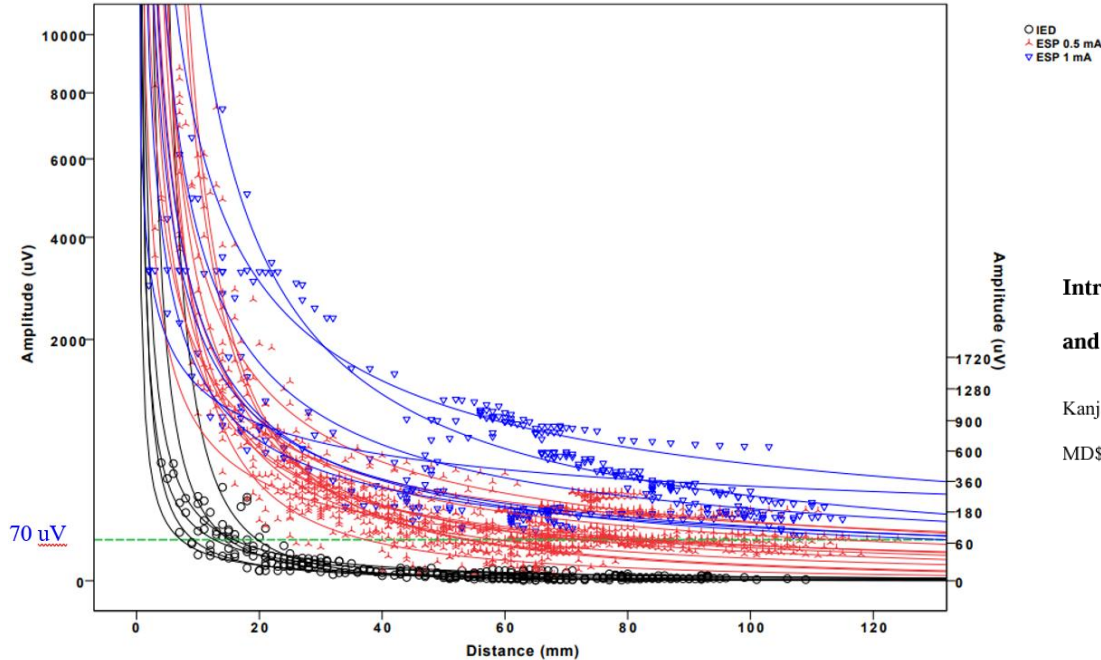
Intracerebral EEG_Interictal Spike



A time lapse between A to G.



Sensitivity of Intracerebral Electrodes (prefrontal)

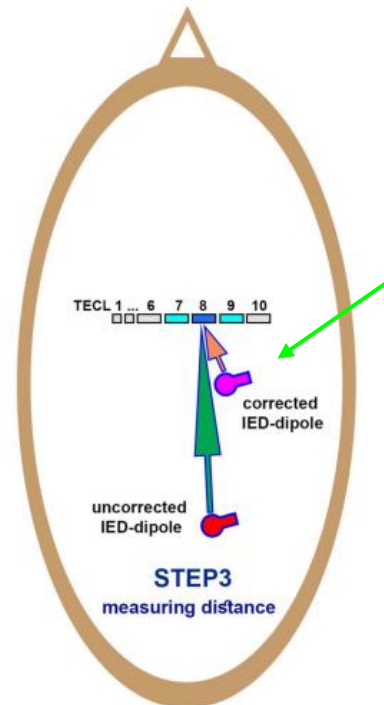
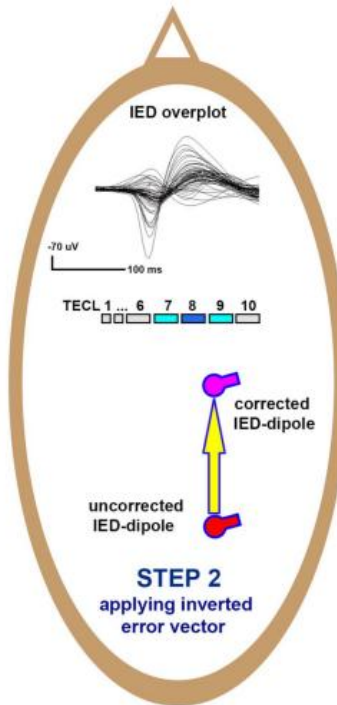
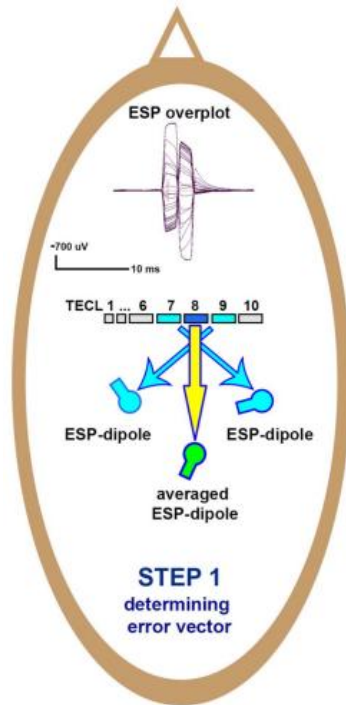


Intracerebral EEG Sensitivity, an Analysis of Interictal Epileptic Discharges and Electrical Stimulation Potentials

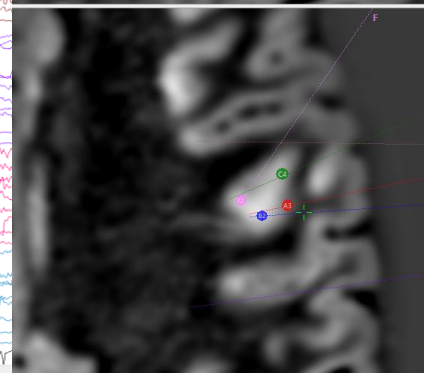
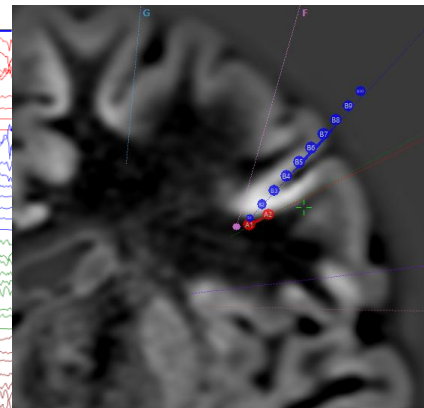
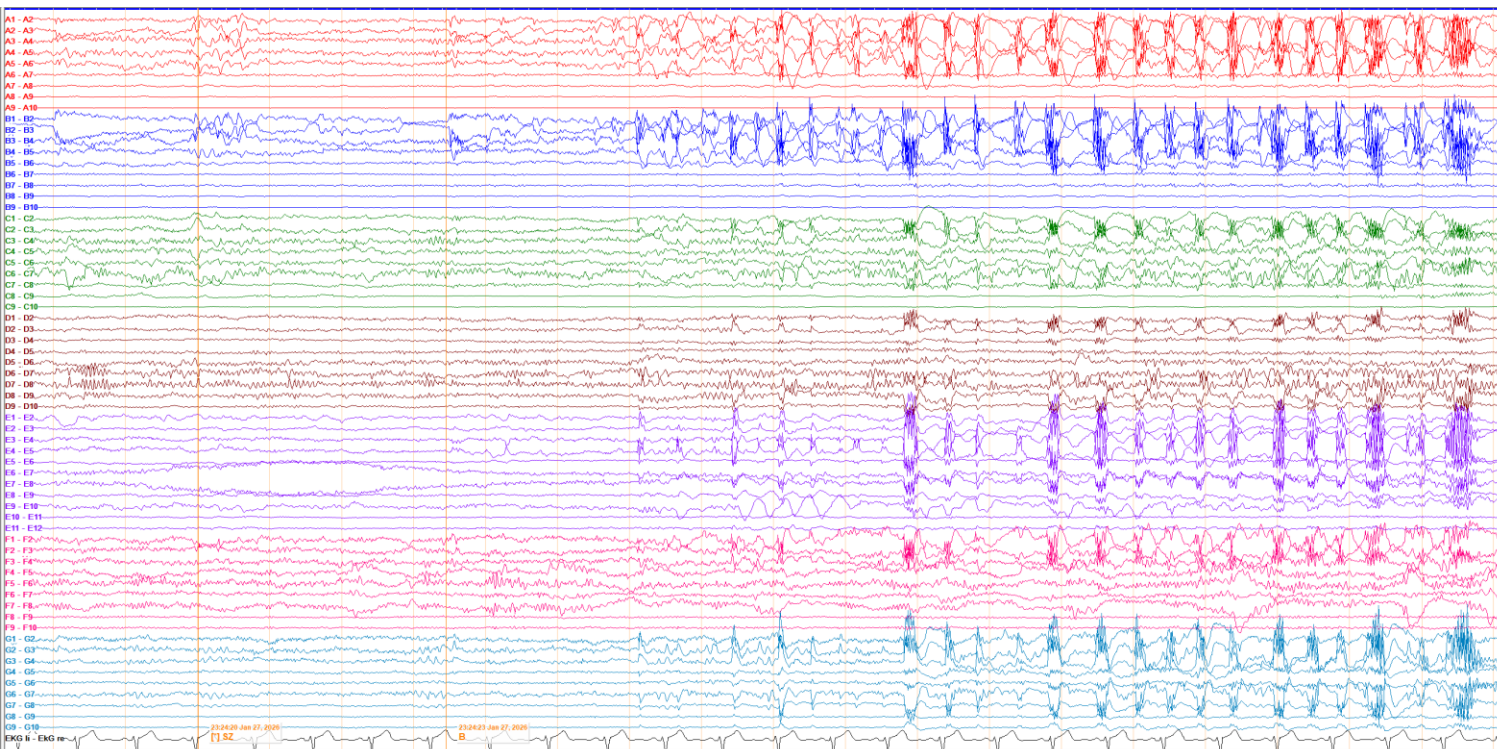
Kanjana Unnwongse, MD*; Carsten H. Wolters, PhD†‡; Tim Wehner, MD*; Yaroslav Parpaley, MD§; Stefan Rampp, MD¶; Jörg Wellmer, MD*

*submitted to Journal

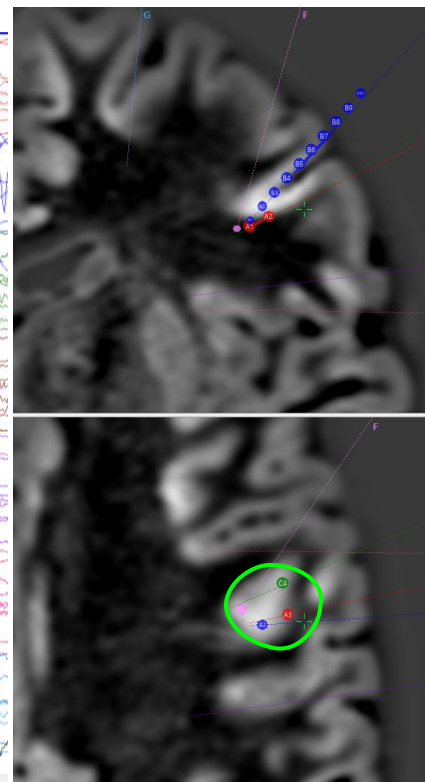
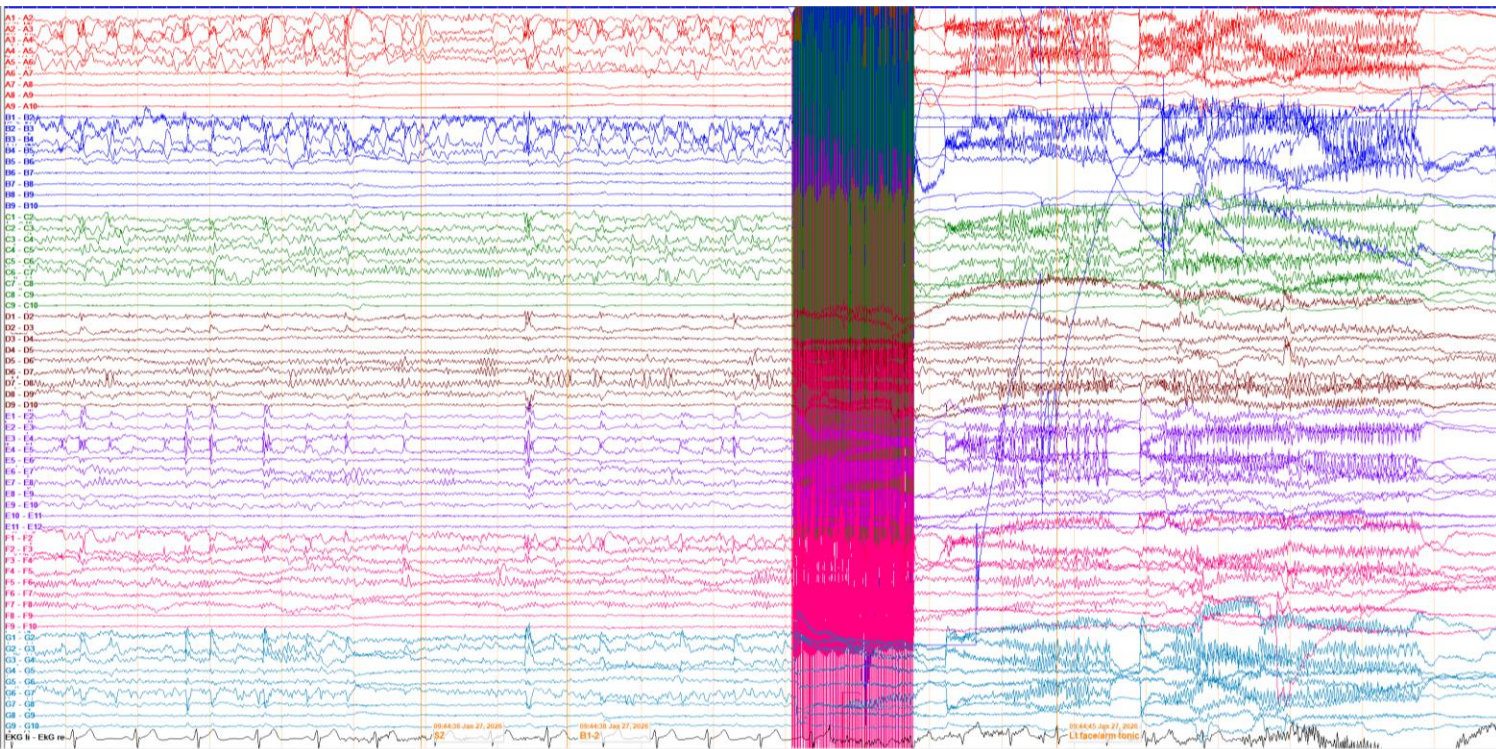
Error Vector Improve Source Localization Results



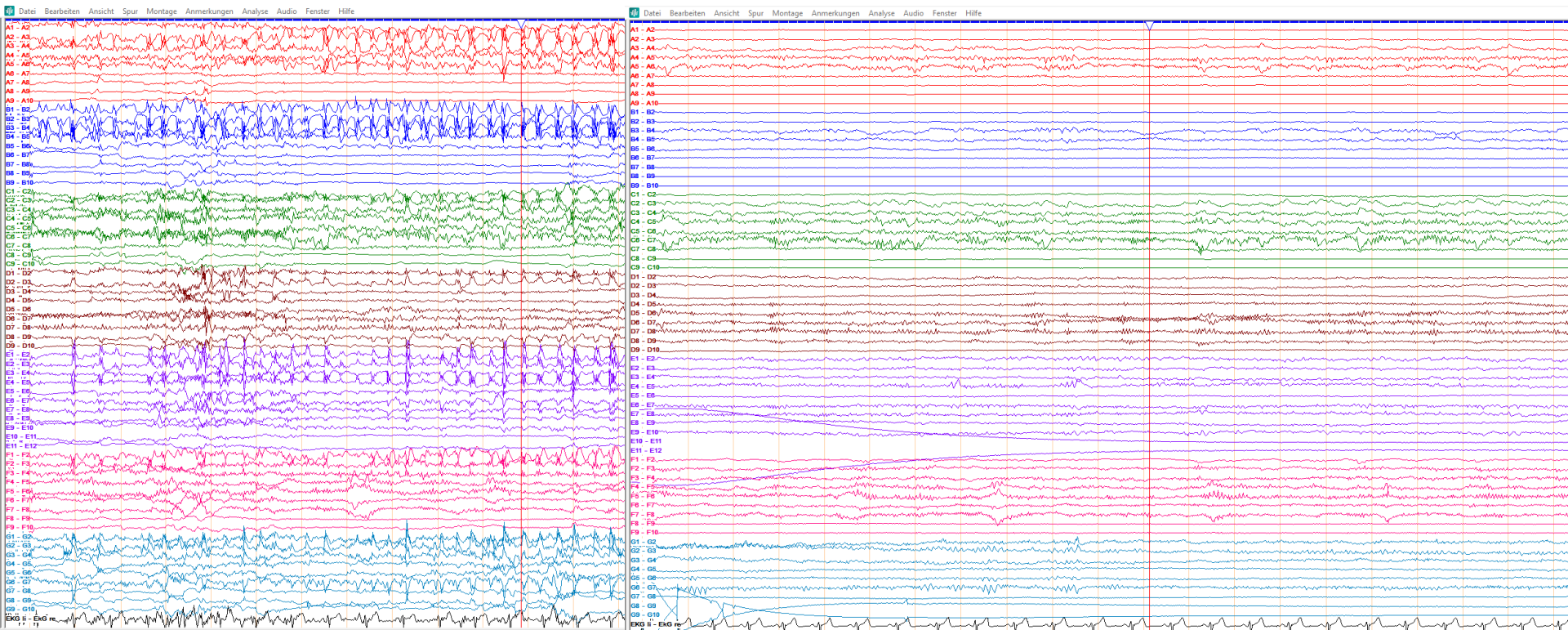
Presumed IED source

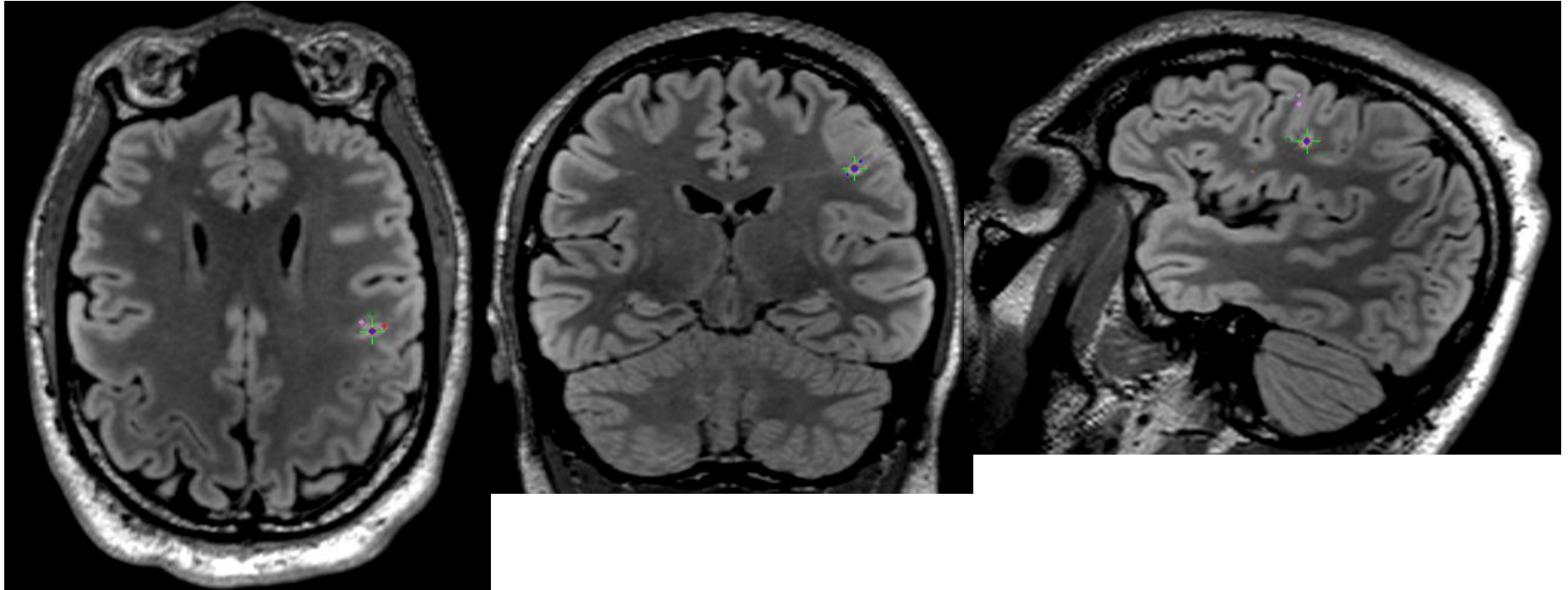


Stimulation (50Hz, 1mA, 2 sec.) Induced Typical Seizures

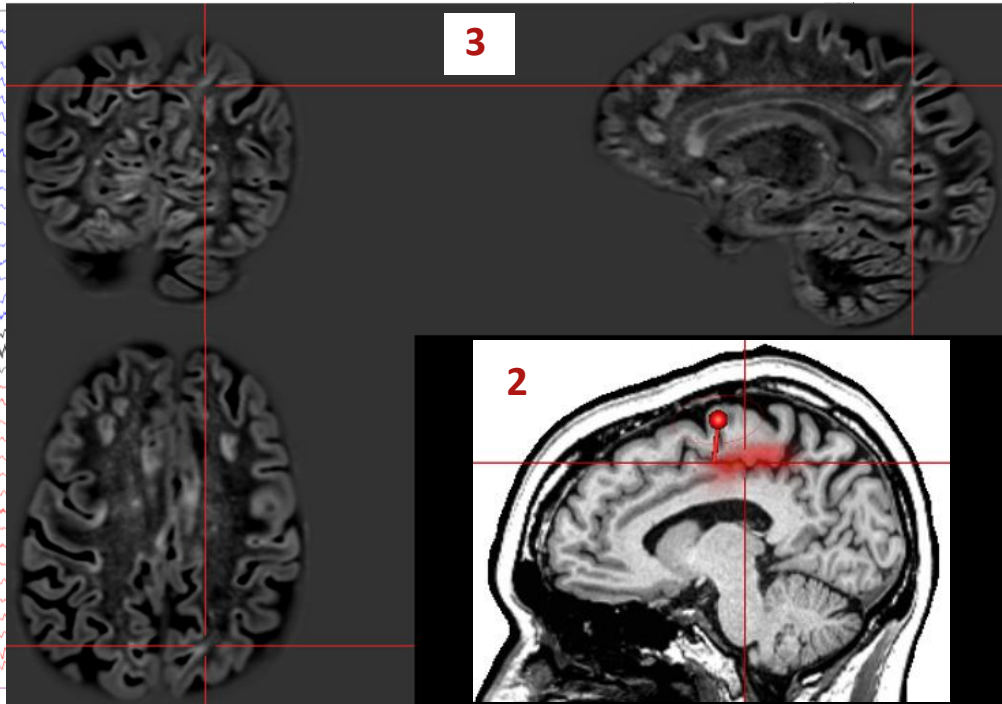
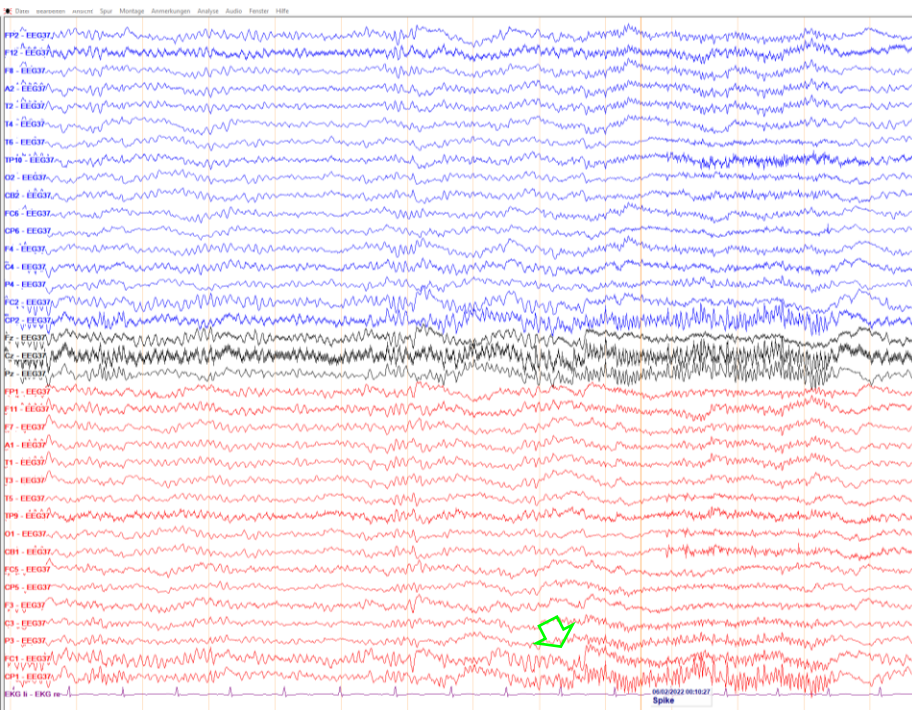


Before & After Radiofrequency Thermocoagulation of A1-2 & A2-3

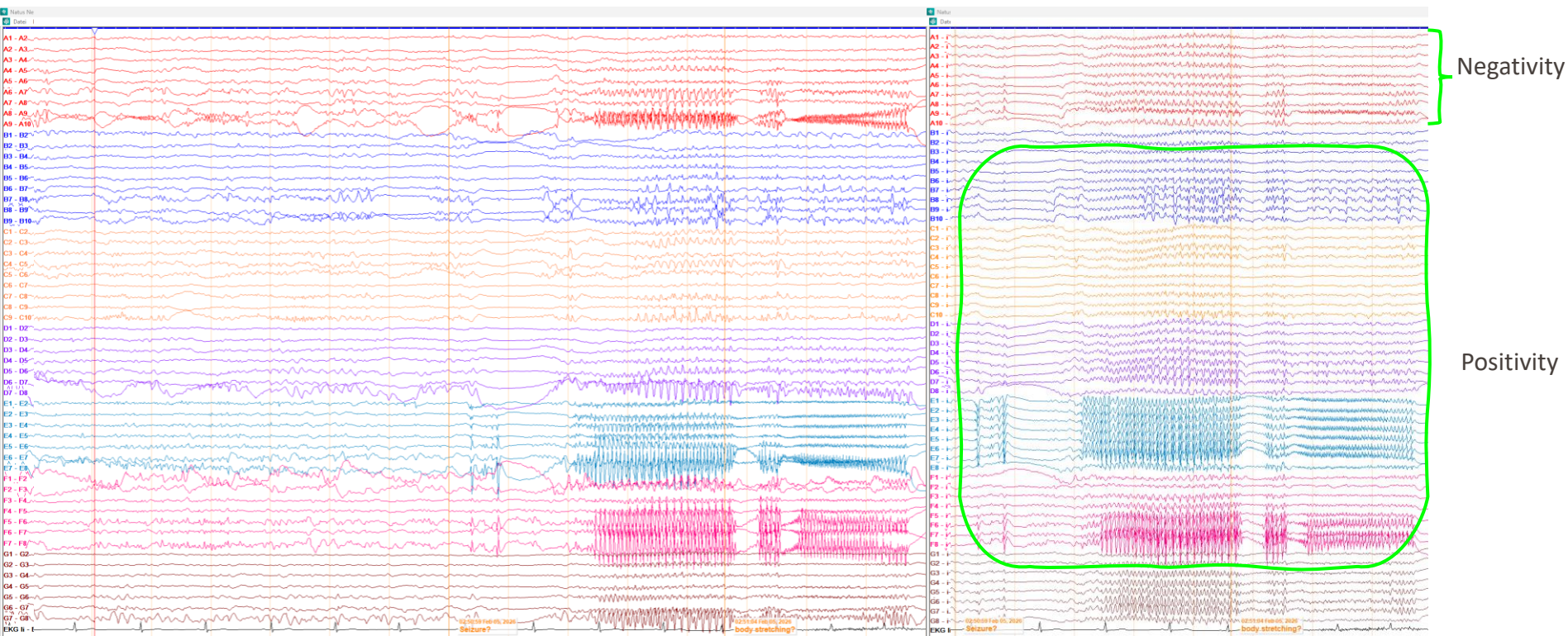


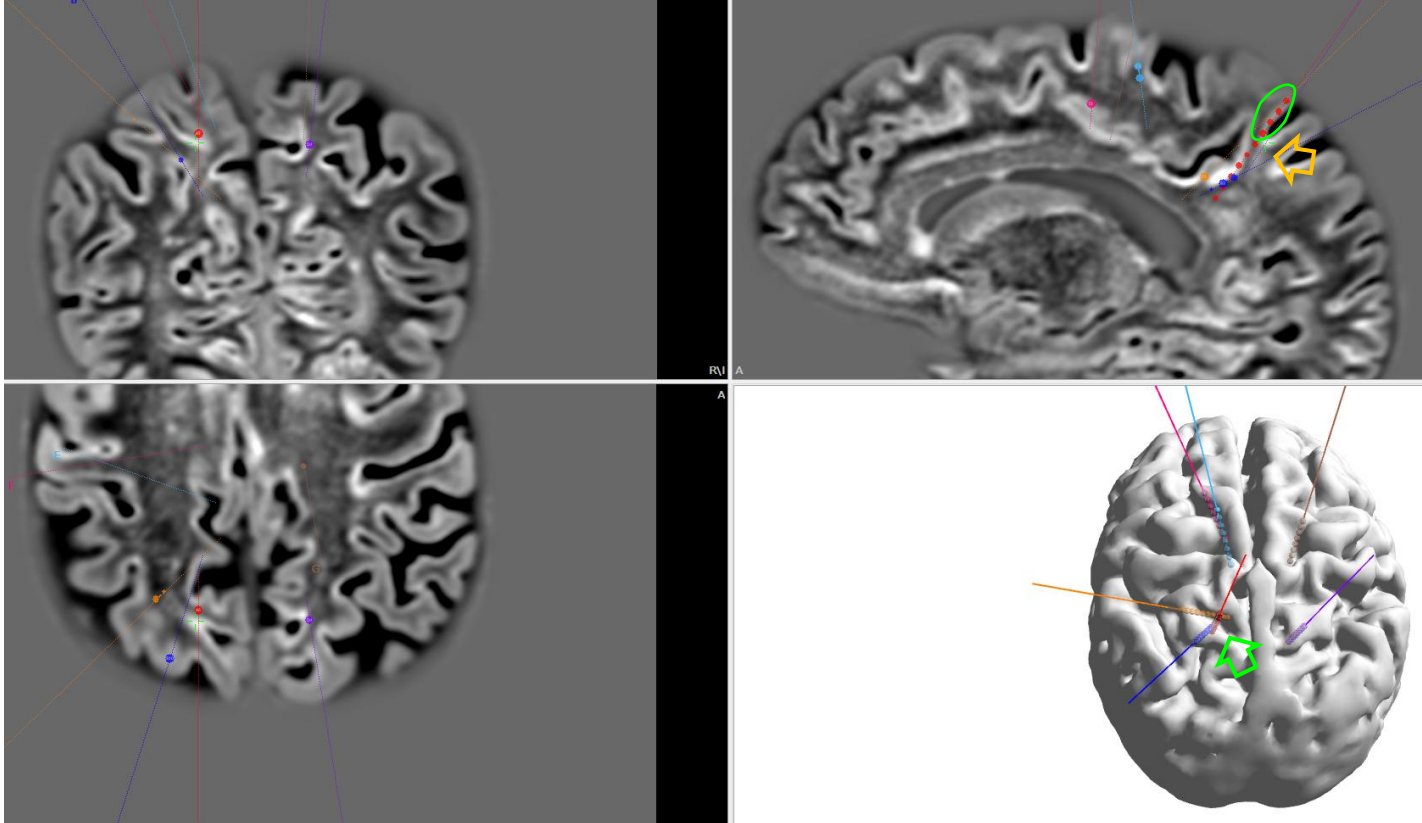


1 » Clinical Seizures: tonic (axial)-> asymmetrical tonic (Rt extend)-> Clonic (upper body)

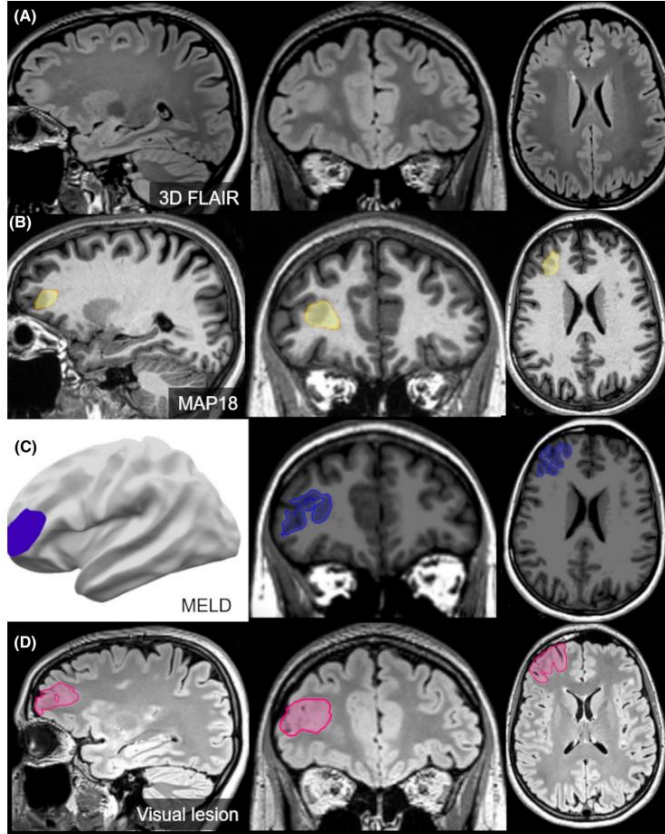


Intracerebral EEG Seizure_Bipolar Montage



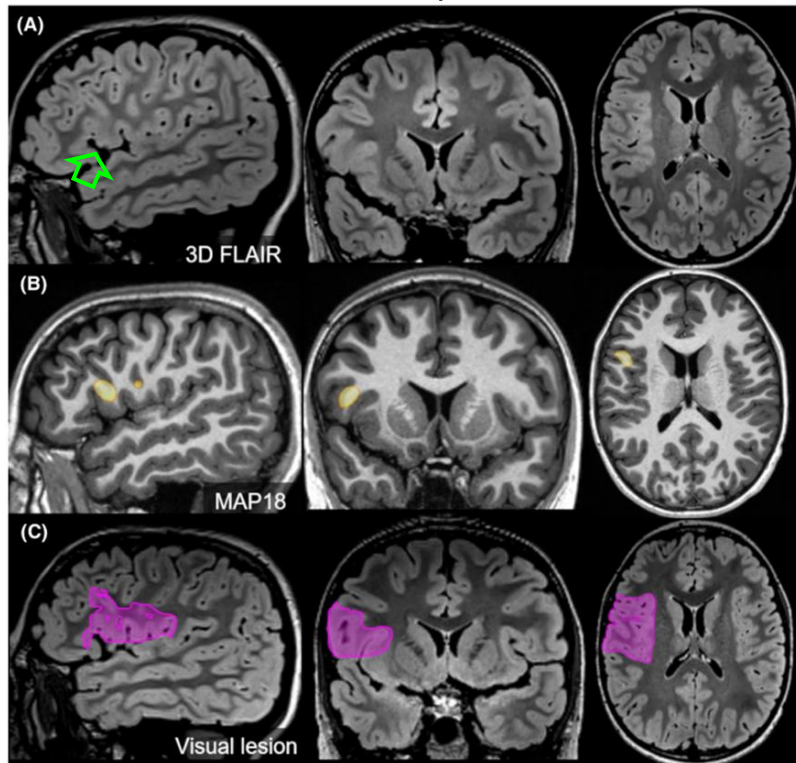


Volume vs Surface Based Morphometry

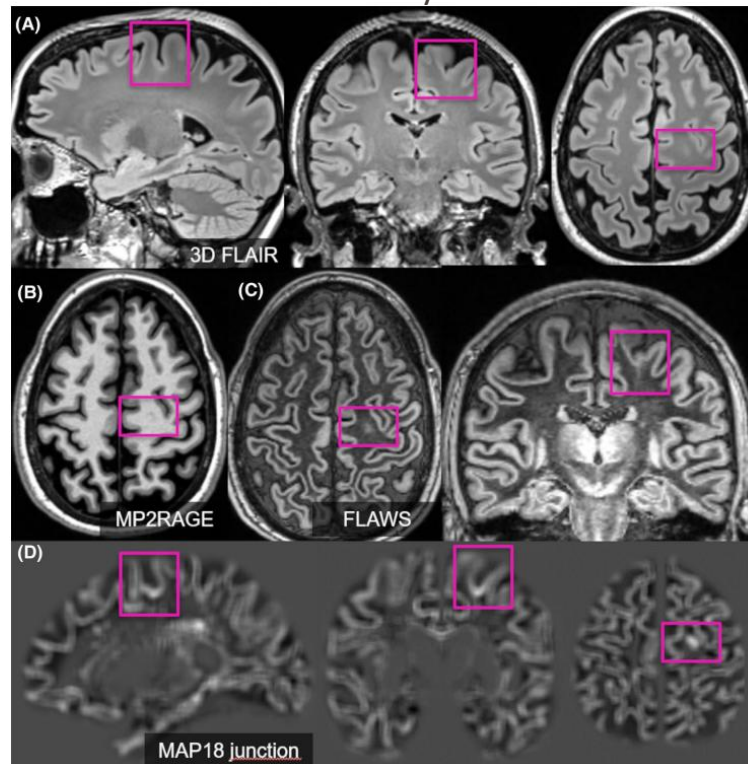


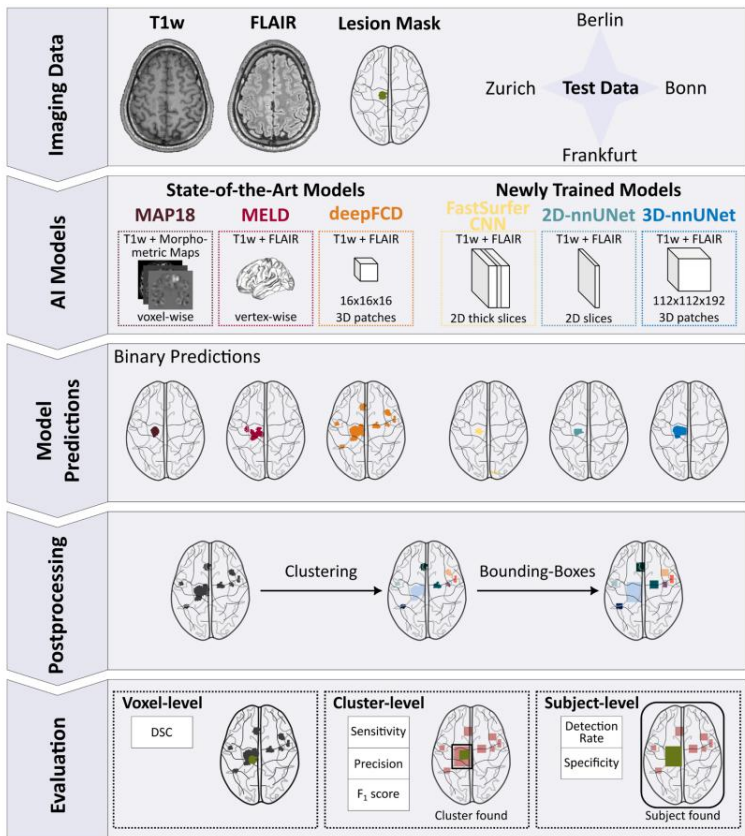
- » **MELD** identified 32 of 34 lesions (94.1%), and **MAP18** identified 33 of 34 lesions (97.1%).
- » **MELD** showed significantly higher precision ($p < .001$) and fewer false positive clusters per patient (median 0 vs. 3, $p < .001$).

FCD missed by **MELD**

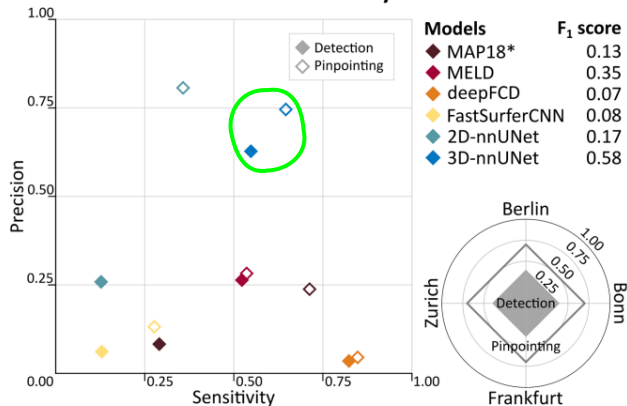


FCD missed by **BOTH**





(A) Combined Precision vs. Sensitivity

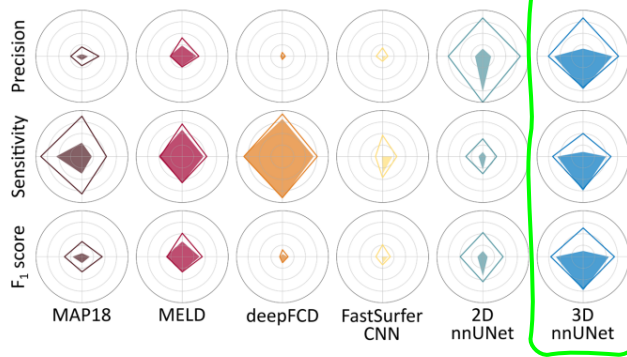


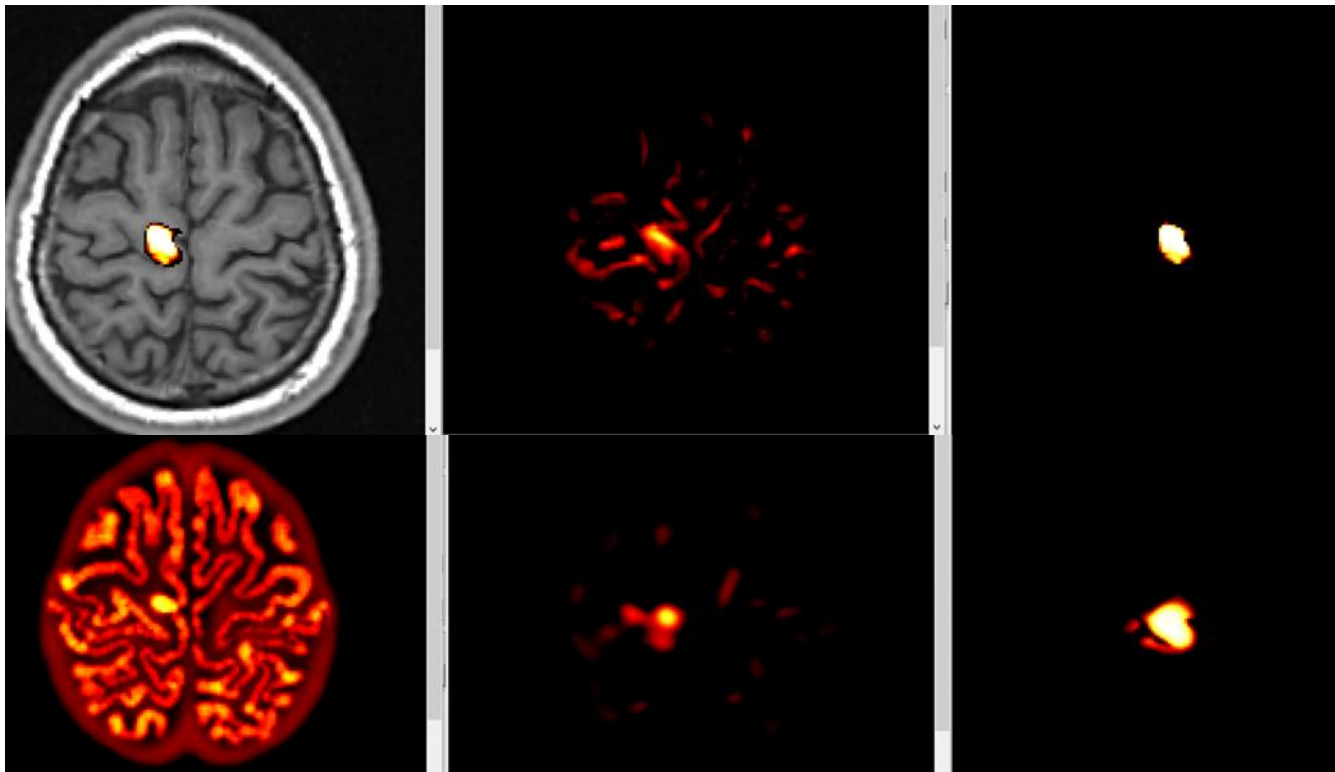
FCD 118 _ train

FCD 154 _ test

Controls 85

(B) Centerwise Performance





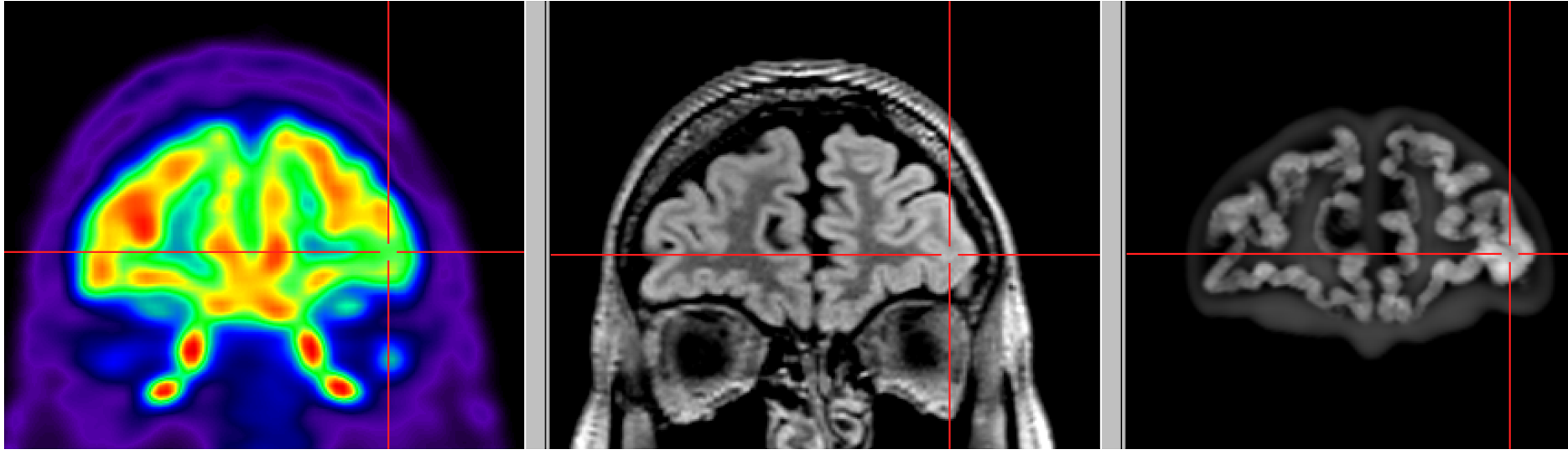
Functional Imaging

Positron Emission Tomography (PET)

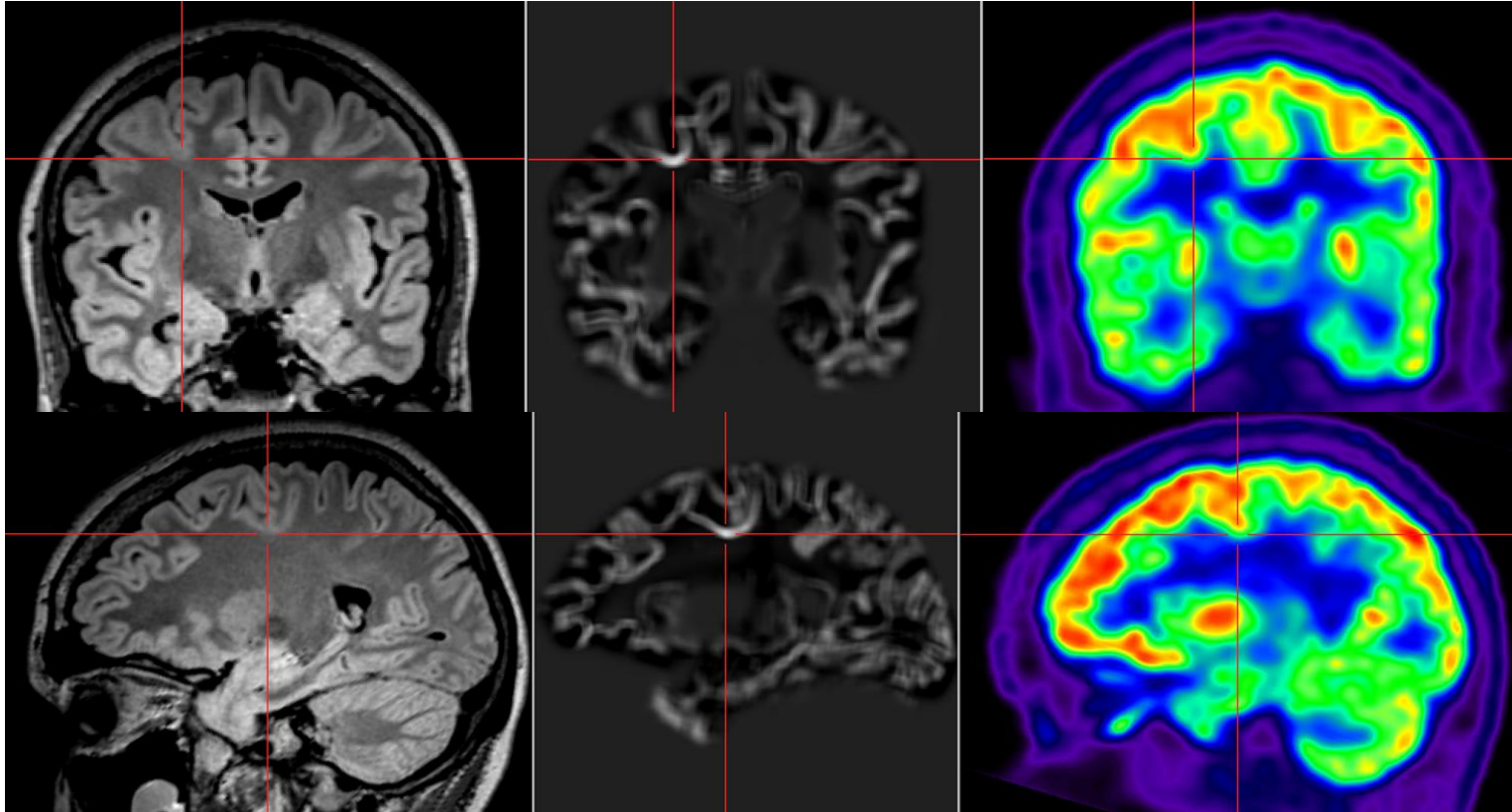
Pulse arterial spin labeling (PASL)

Subtraction Ictal Single-Photon Emission Computed Tomography co-registered to MRI (SISCOM)

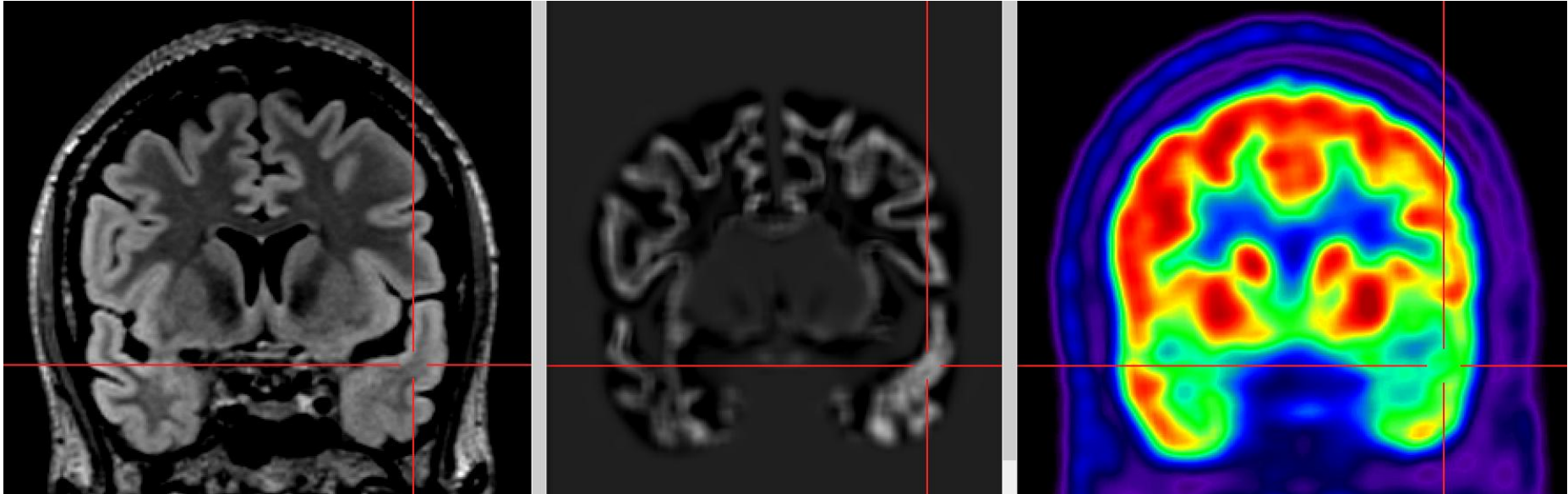
PET (hypo.) in FCD



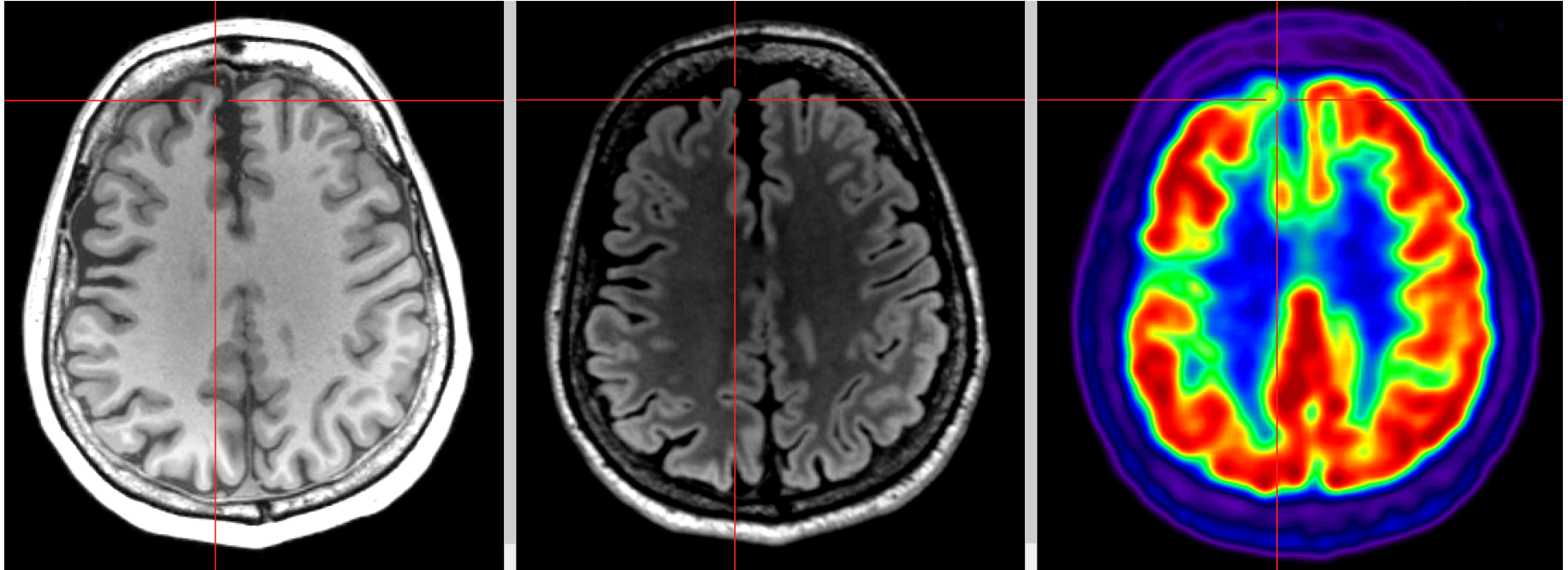
PET (hyper.) in FCD



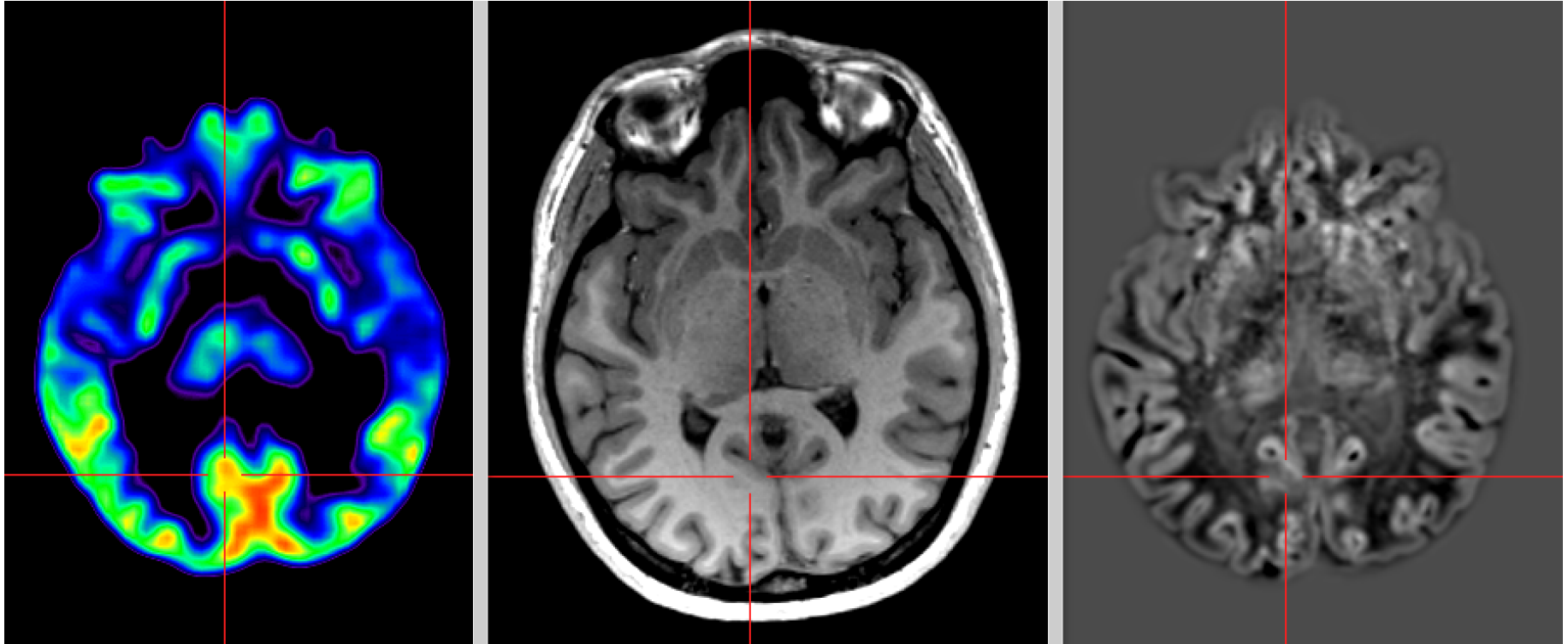
PET in Temporal Sclerosis



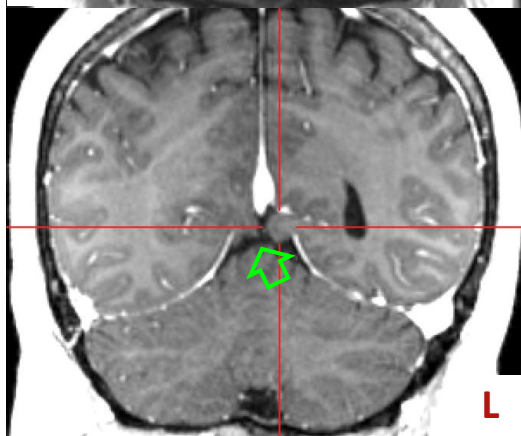
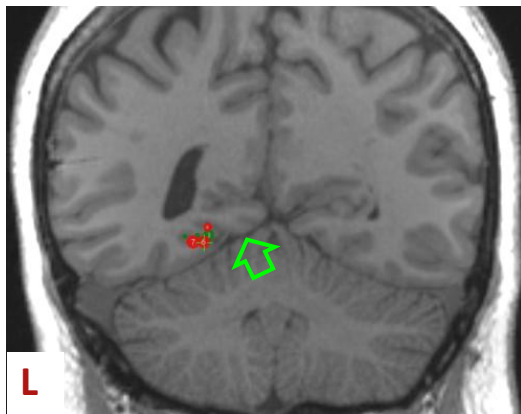
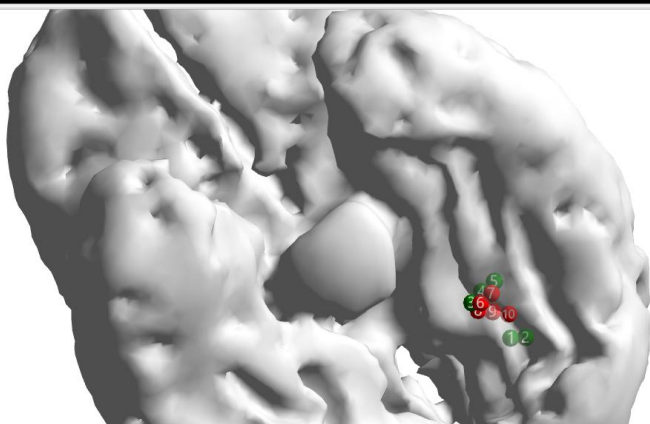
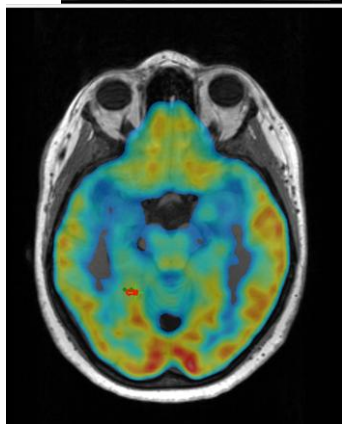
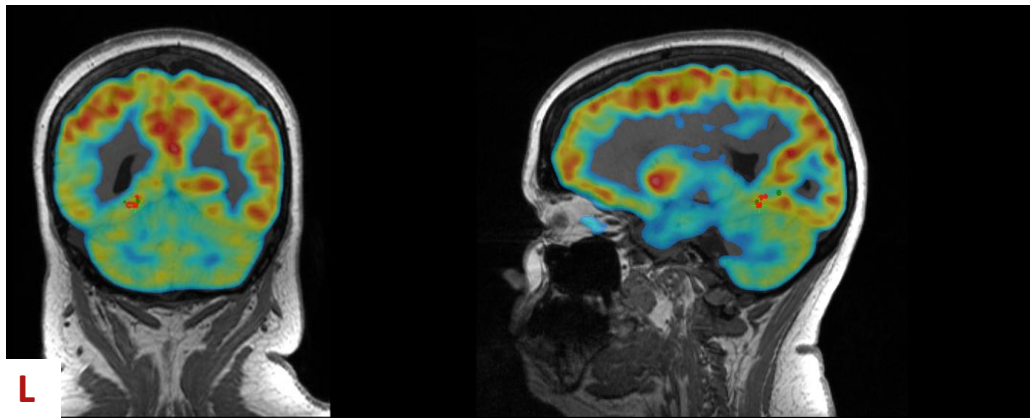
PET in Encephalomalacia



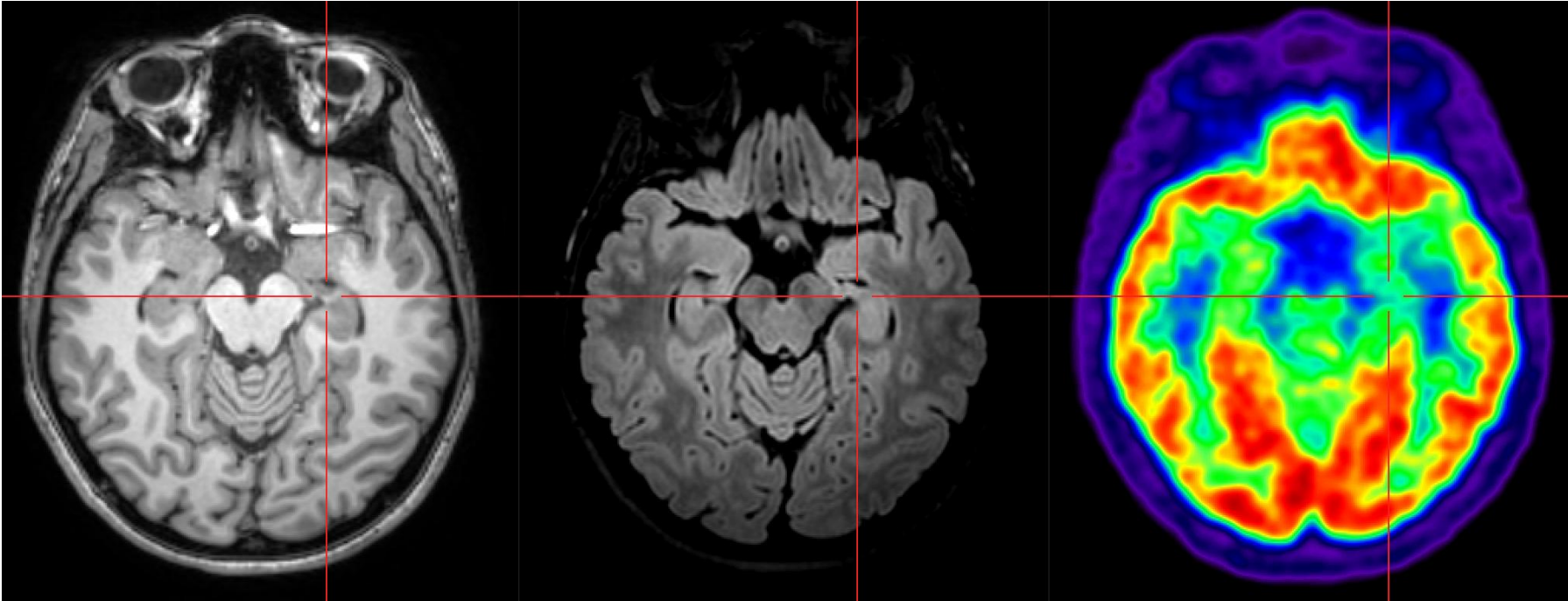
PET in Nonleional 1



PET in Nonlesinal 2



PET in nonlesional 3



PASL (SISCOM)

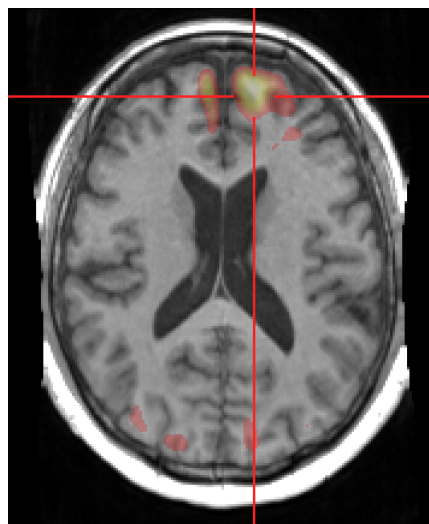
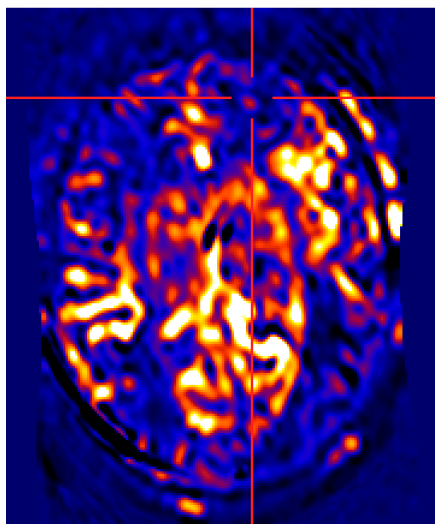
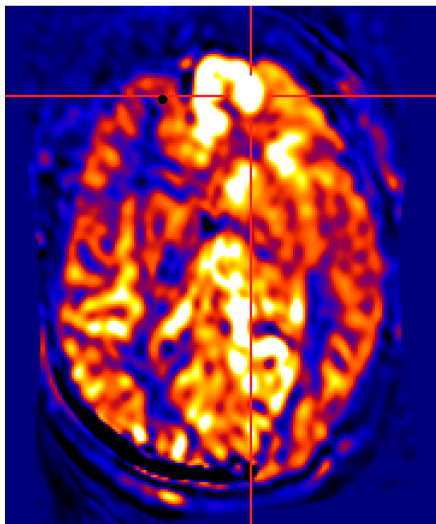
Ictal PASL

-

Interictal PASL

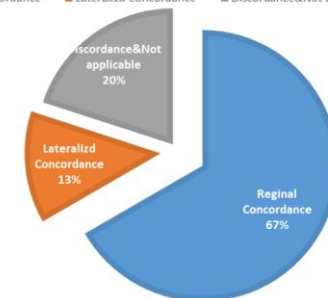
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Subtraction

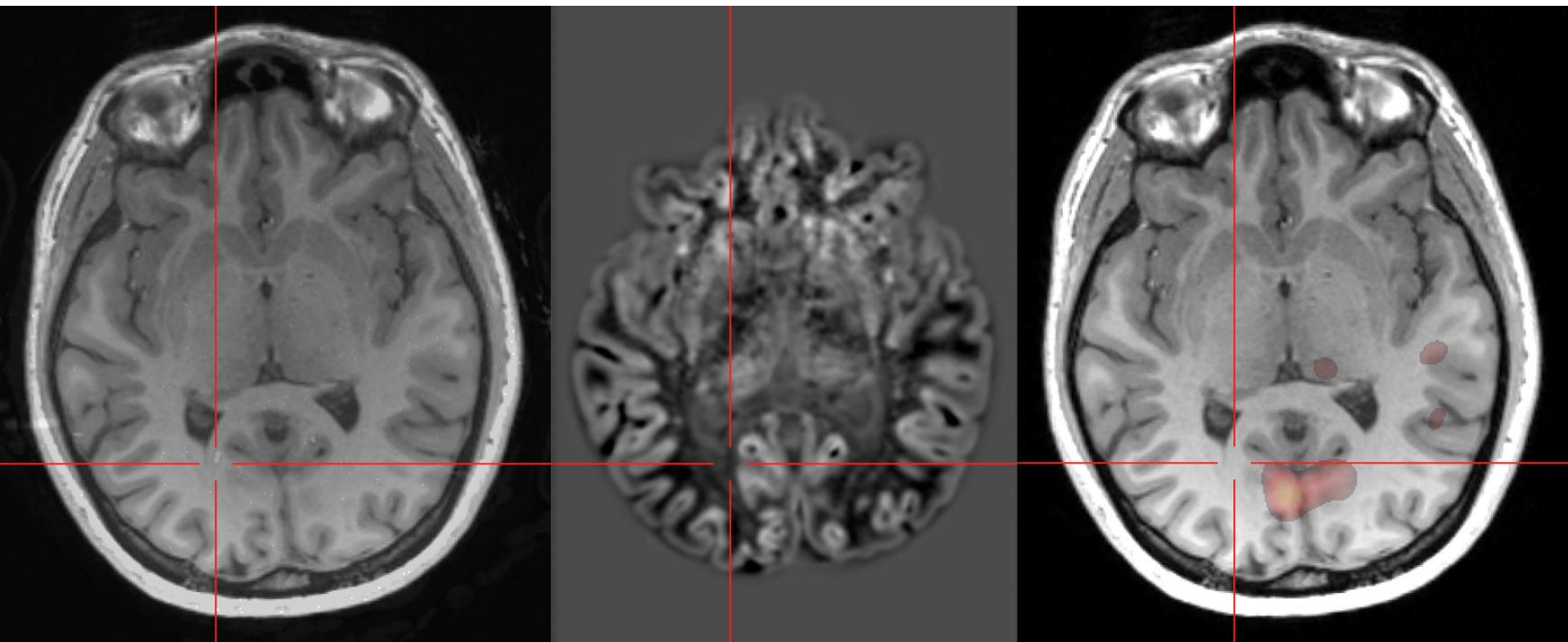


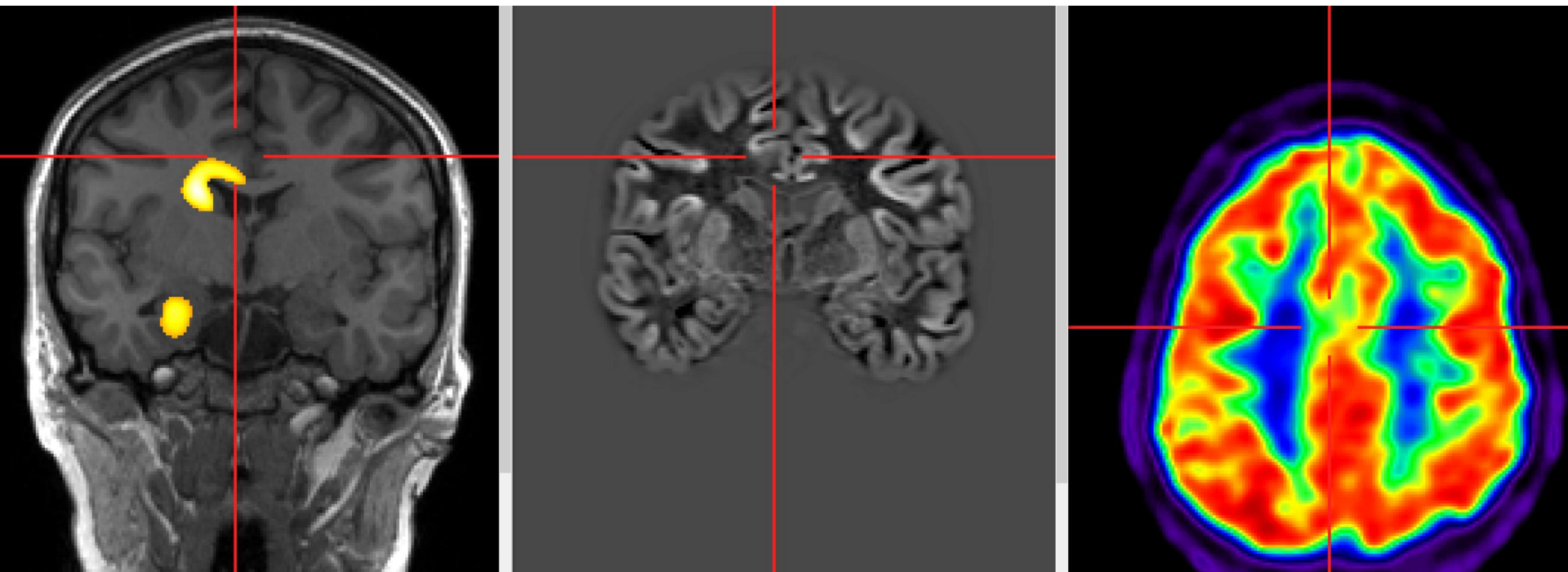
PATIENT MANAGEMENT CONFERENCE AND PASL

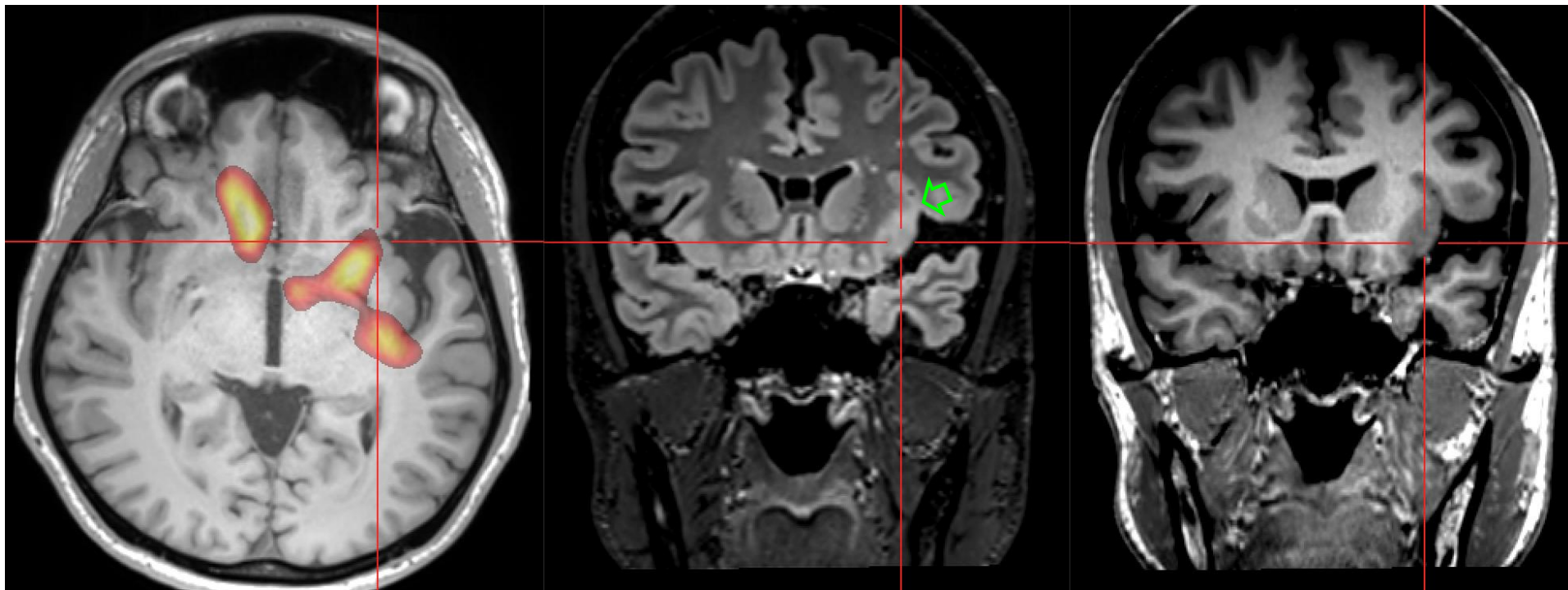
■ Regional Concordance ■ Lateralized Concordance ■ Discordance&Not applicable



Tummark T et al, 3rd IEC 2019.





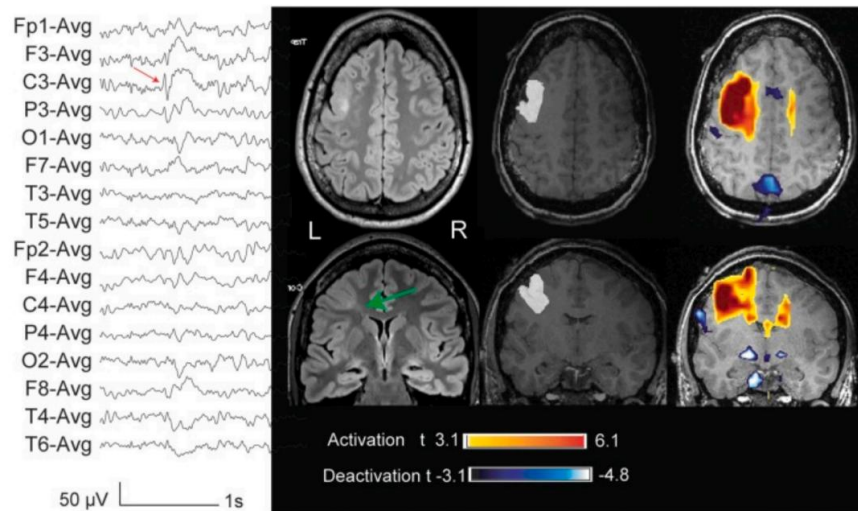


Network-Based Imaging

EEG-fMRI

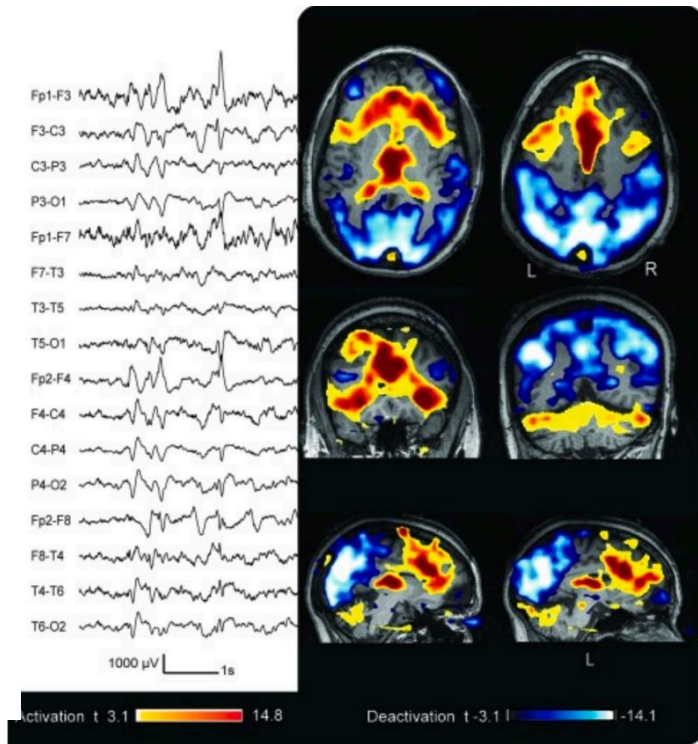
Connectivity Analysis (intracranial EEG based) *

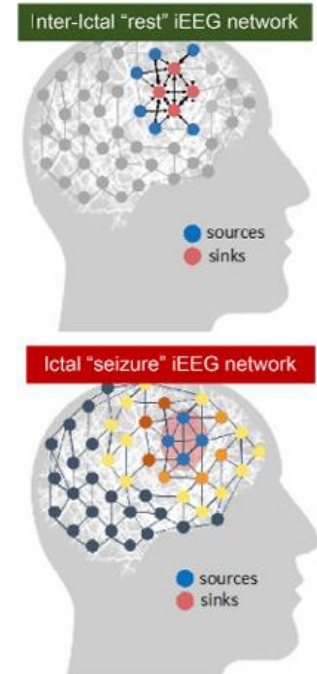
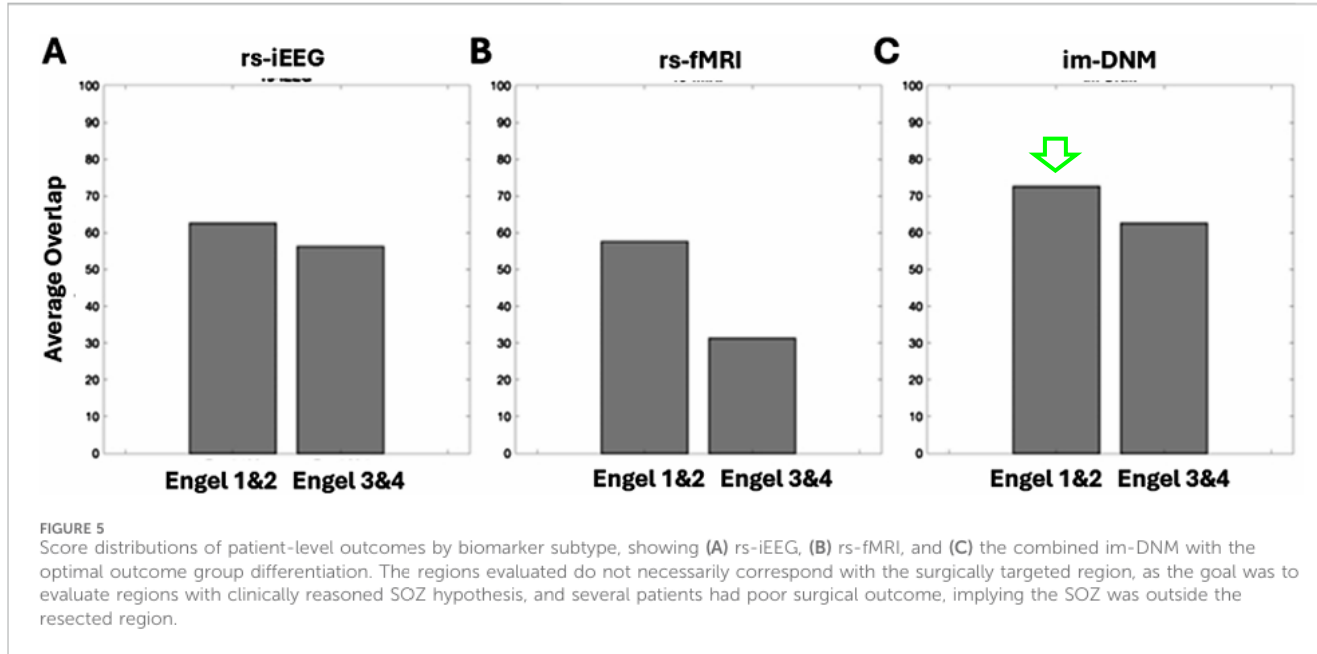
EEG-fMRI for Epilepsy



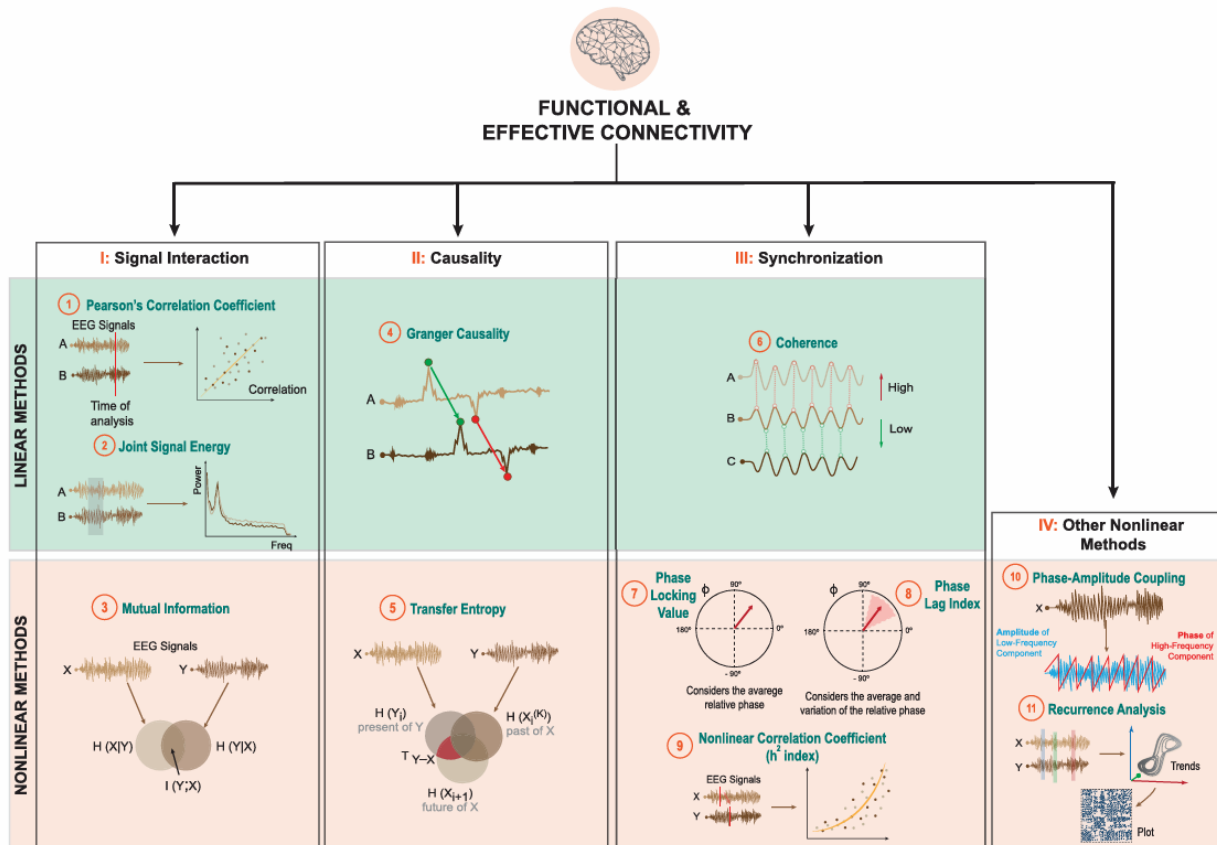
Left: The BOLD response, concordant to the C3 spikes, localizes perfectly within the lesion.

Right: BOLD responses are concordant with EEG but do not contribute further information.





Taxonomy of Brain Connectivity Methods

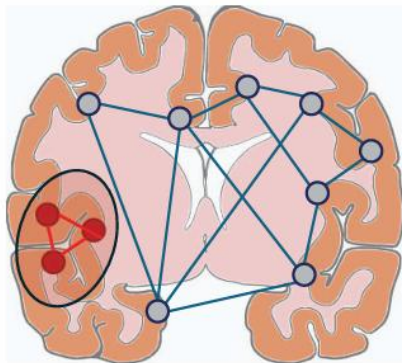


Functional Connectivity: measures the statistical dependence between nodes.

Effective Connectivity: describes the influence one node exerts on another (directionality).

FUNCTIONAL DYNAMICS IN EPILEPSY

Interictal Periods

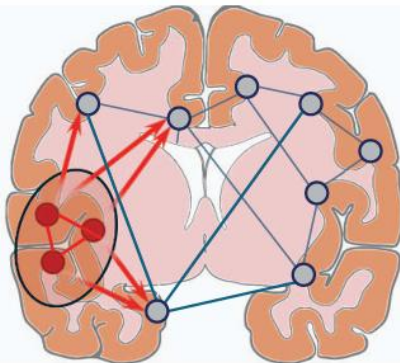


Epileptogenic Nodes are Functionally isolated from the remaining nodes

Methods

- ② JSE, ⑥ Coherence, ⑧ PLI, ③ MI

Seizure Initiation

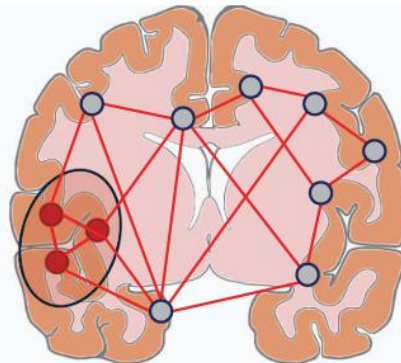


There is a dominant information outflow from the EZ

Methods

- ④ Granger Causality, ⑨ h2 index, ⑩ PAC, ② TE

Late Ictal State

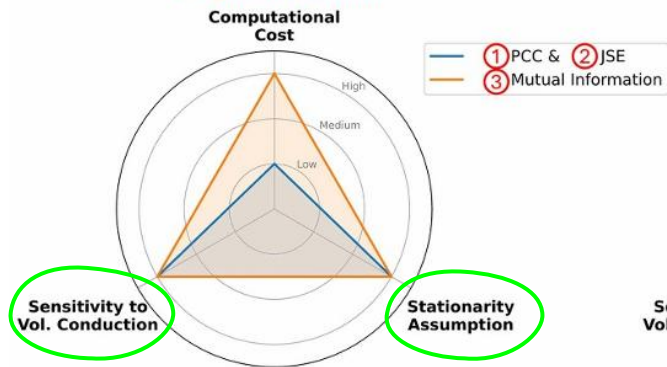


There is an overall Hypersynchronization in the brain network

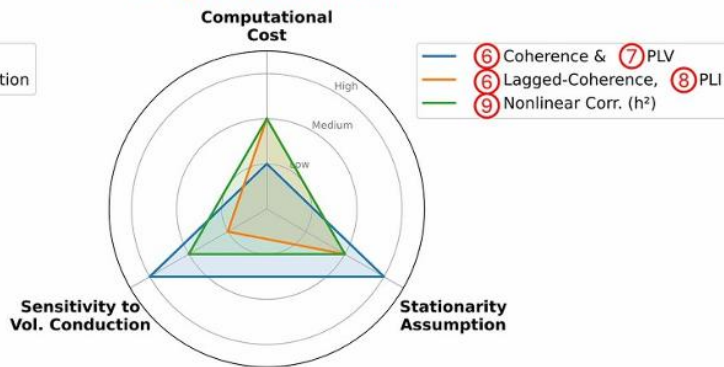
Methods

- ⑦ PLV, ⑥ Coherence, ⑪ Recurrence

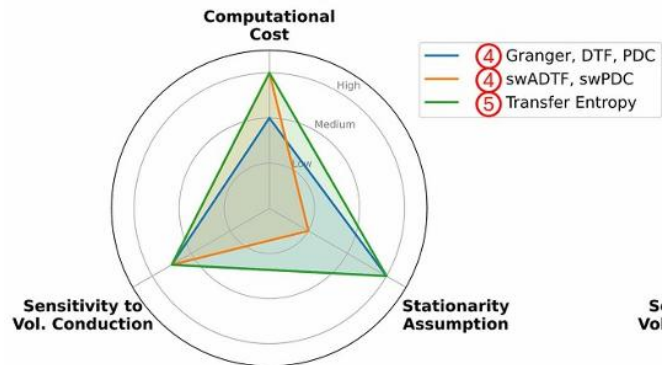
I. Signal Interaction



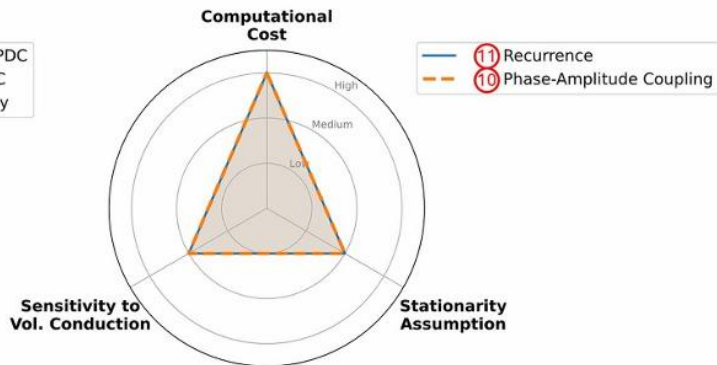
II. Signal Synchronization



III. Causality



IV. Other Nonlinear Methods



Vielen Dank!

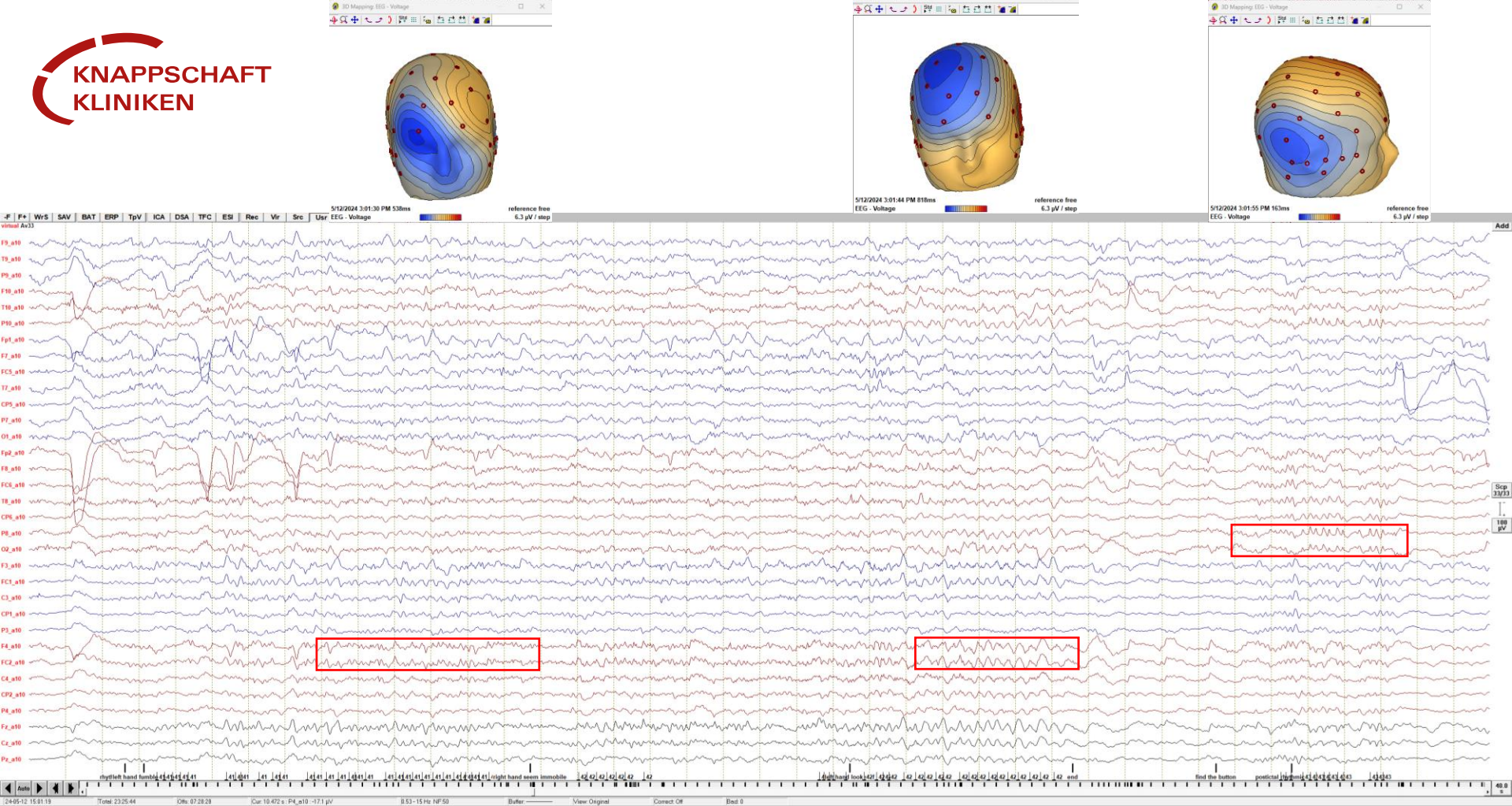
Kontakt

Knappschaft Kliniken Universitätsklinikum Bochum GmbH

In der Schornau 23-25

44892 Bochum

www.knappschaft-kliniken.de

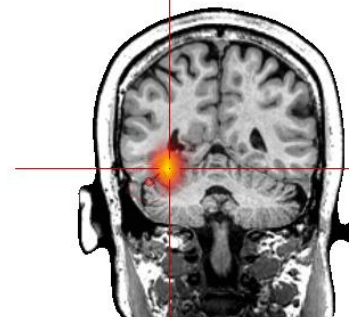
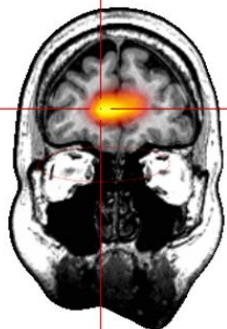


seizure onset

seizure propagation

postictal spikes

Cor



R

R

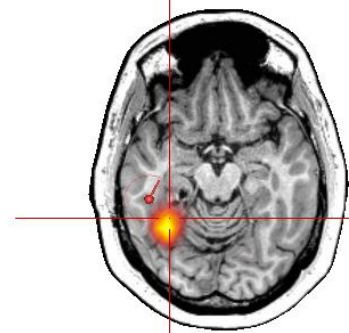
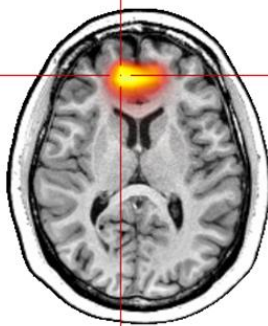
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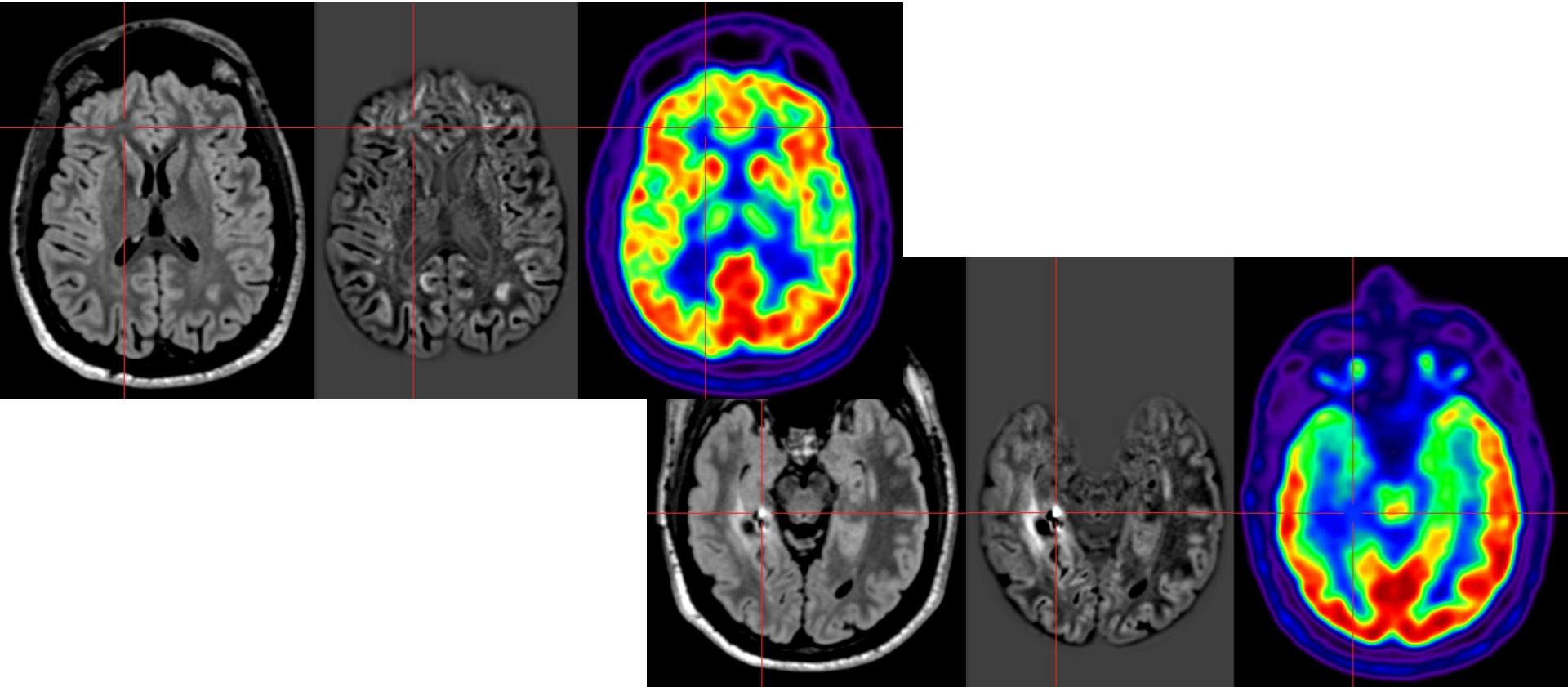


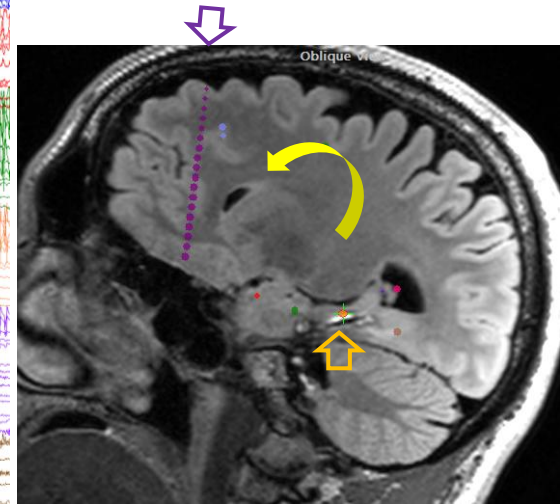
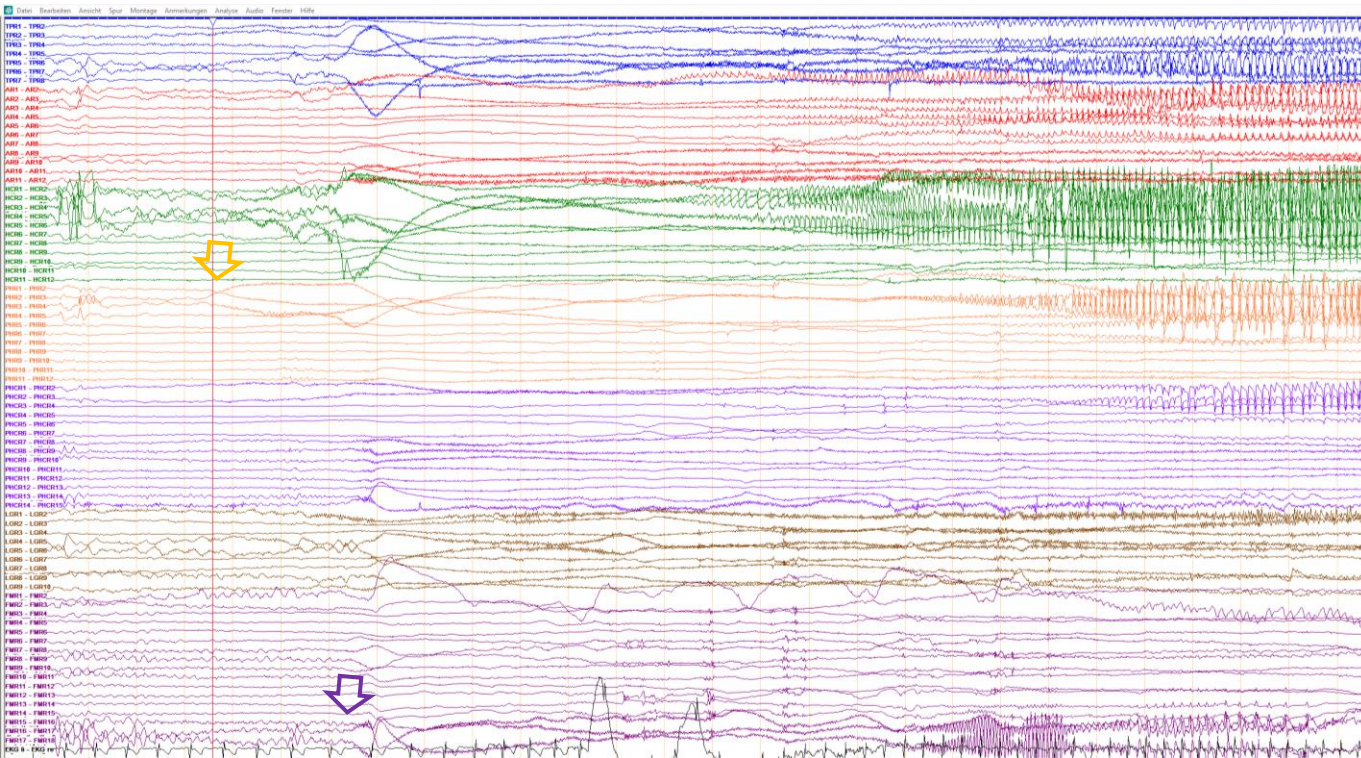
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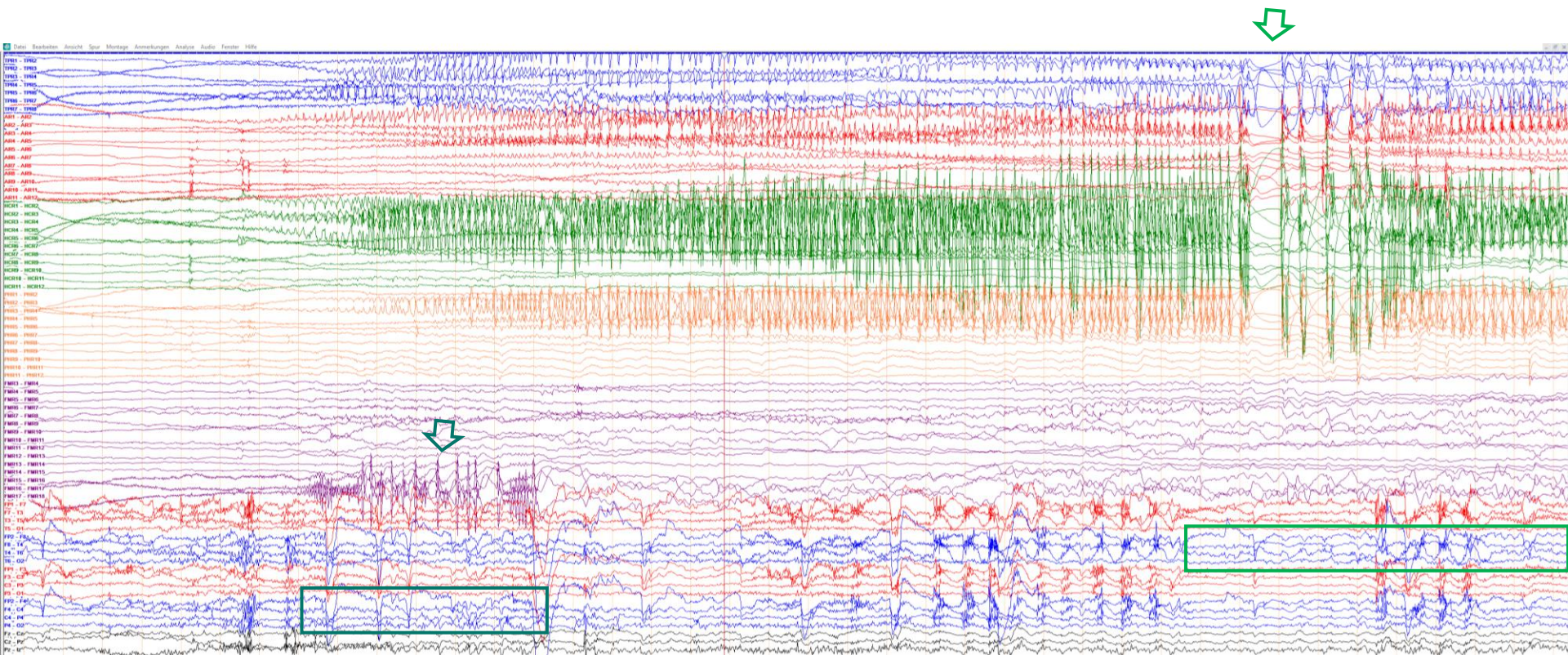
R

L





Simultaneous Intracerebral-Scalp EEG_Seizure



Vielen Dank!

Kontakt

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