Correlation of Multi-Modal Neuroimaging with SEEG and Post-Operative Outcomes

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Financial disclosures

- None

Background and Purpose

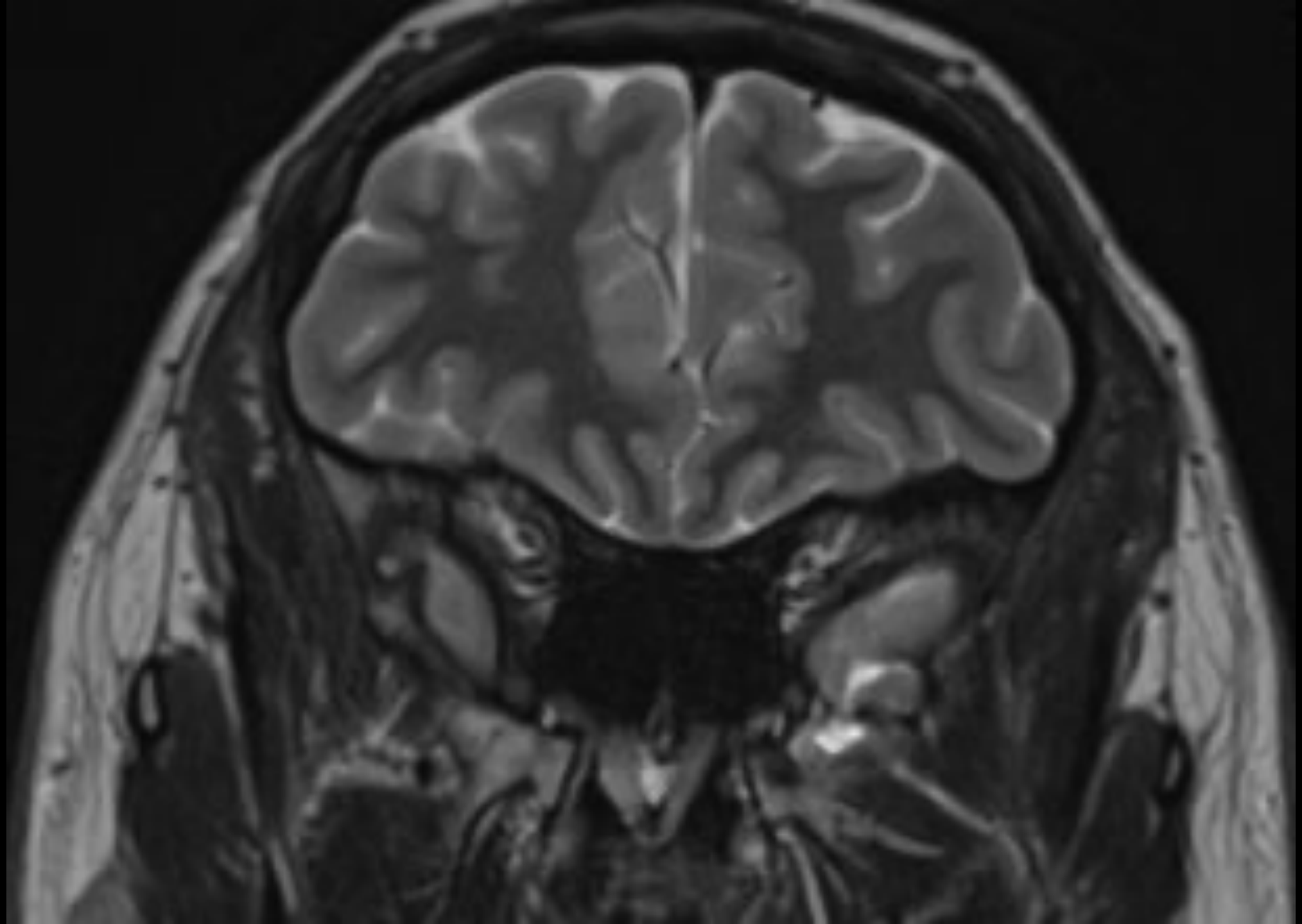
- SEEG is considered gold standard for epileptogenic zone (EZ) localization in children with epilepsy
- SEEG also used for functional cortical mapping.
- MRI and fMRI offer unique non-invasive measures for pre-operative EZ and functional mapping
- Few pediatric epilepsy studies explore sEEG agreement with functional and structural neuroimaging and compare with clinico-anatomical post-op outcomes for ground truth.

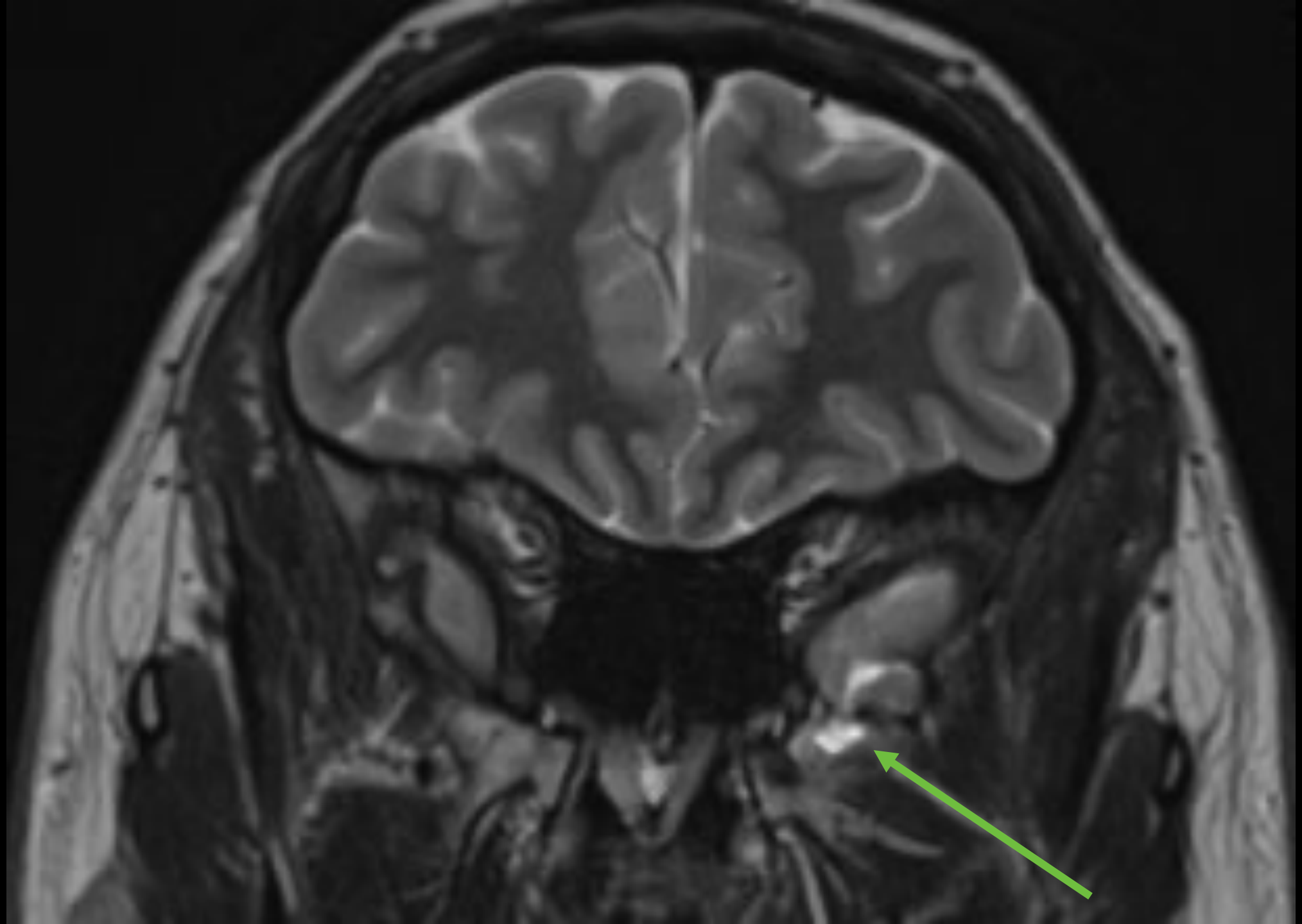
Methods

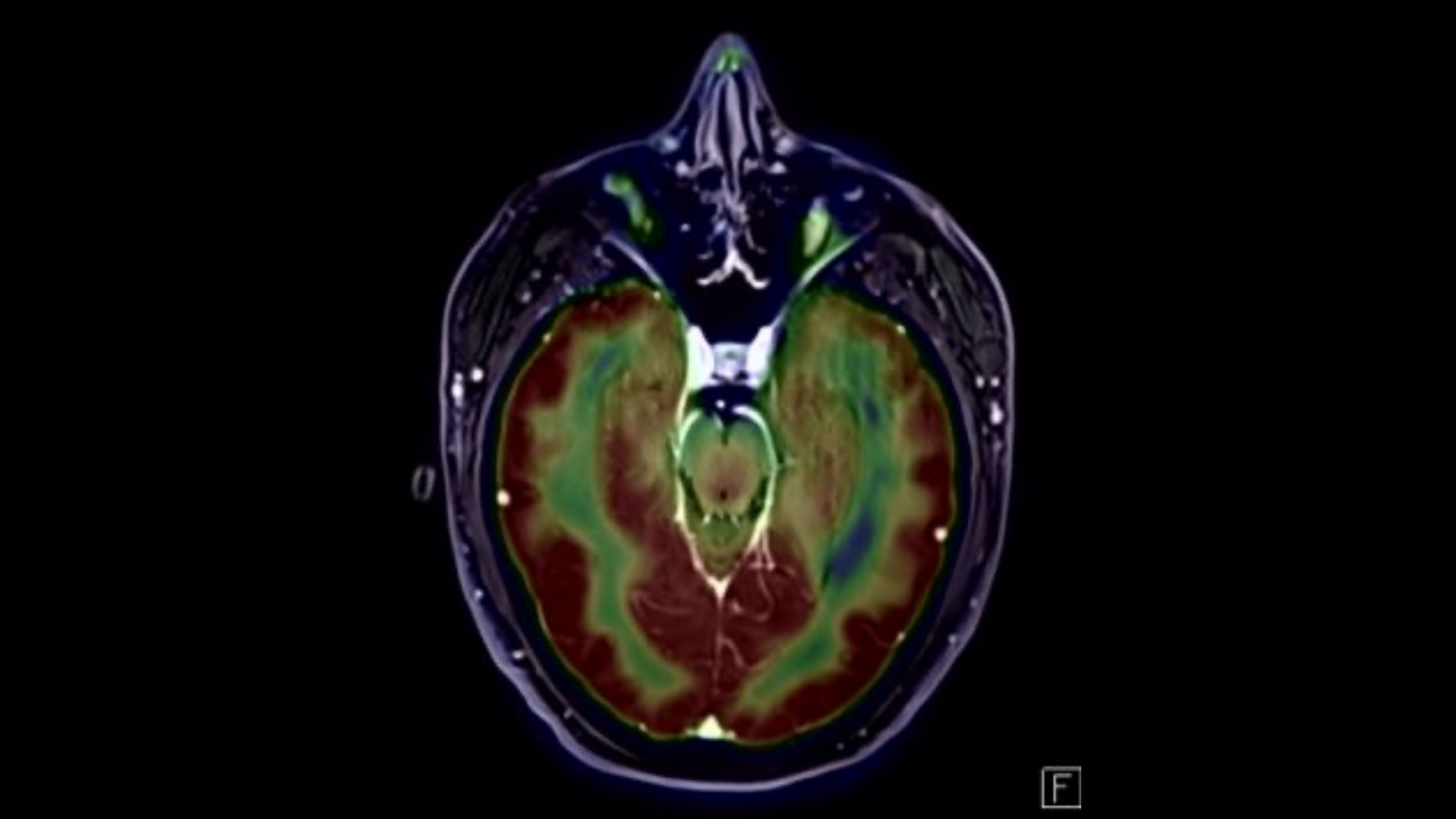
- 30 patients with focal epilepsy

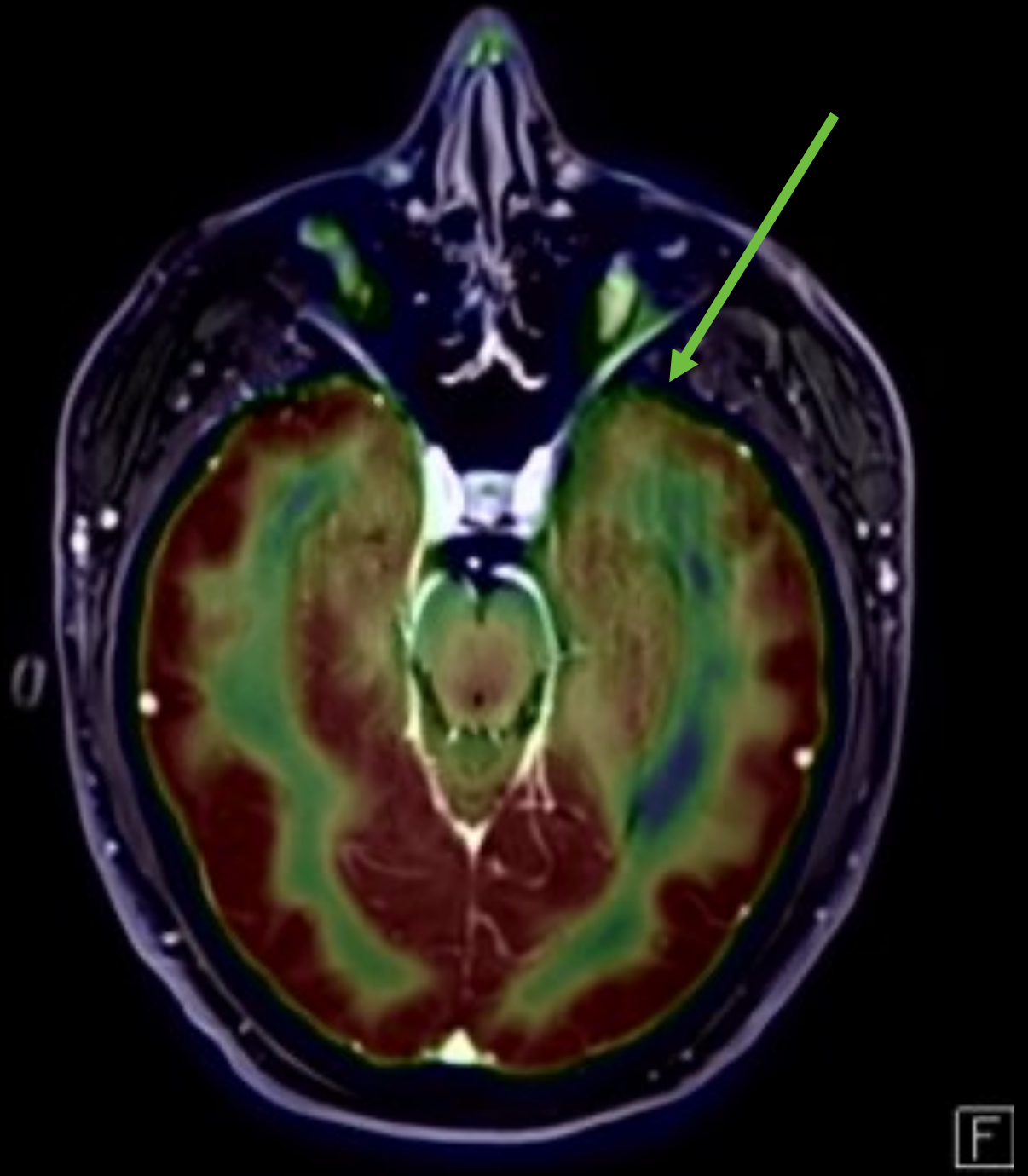
  Aim 1: Determine language laterality agreement between sEEG, fMRI, Wada, and assess clinical evidence of language decline as ground truth.

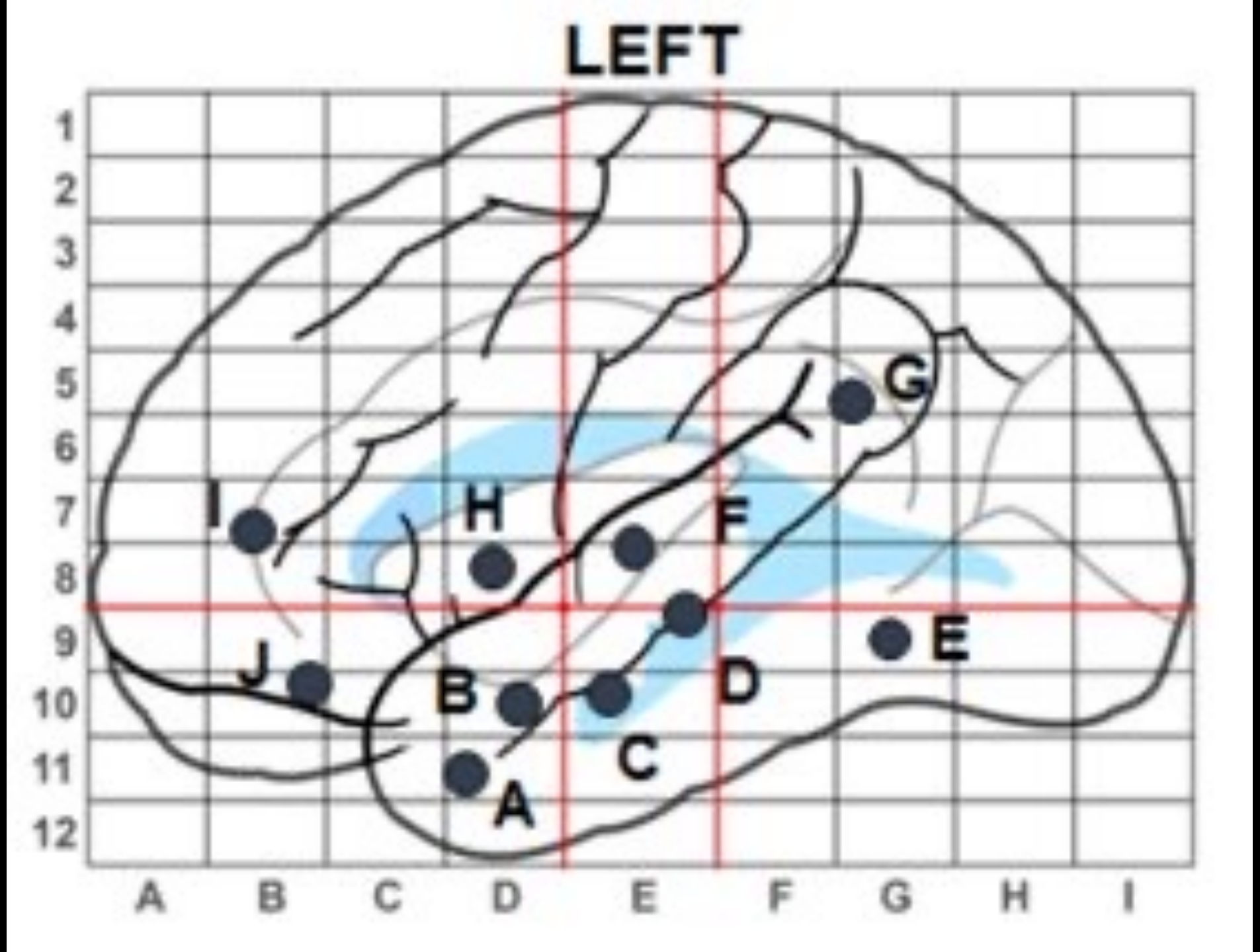
  Aim 2: Determine epileptogenic zone localization agreement between sEEG, MRI, PET/CT, and assess post-op seizure outcome as ground truth.







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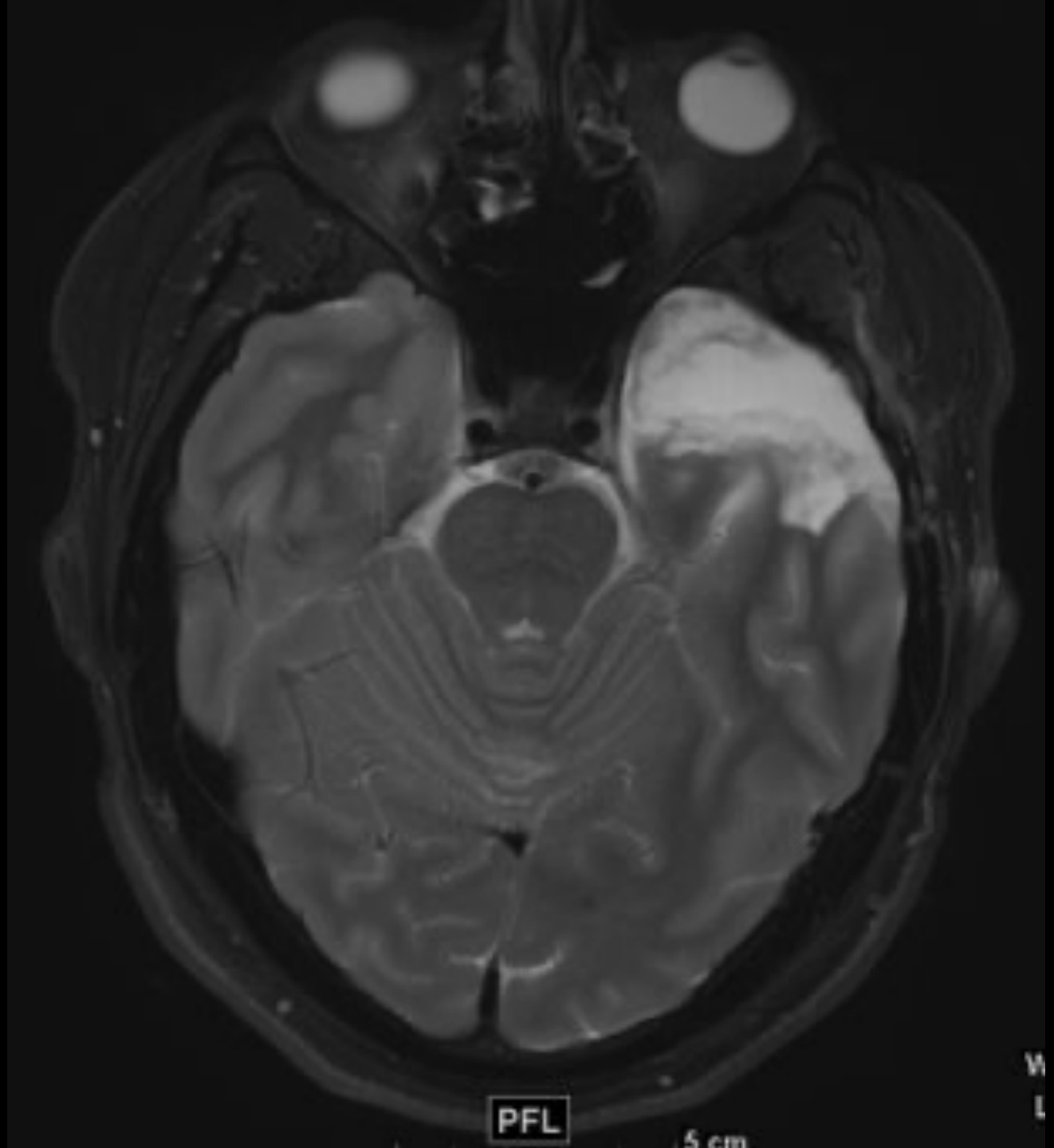
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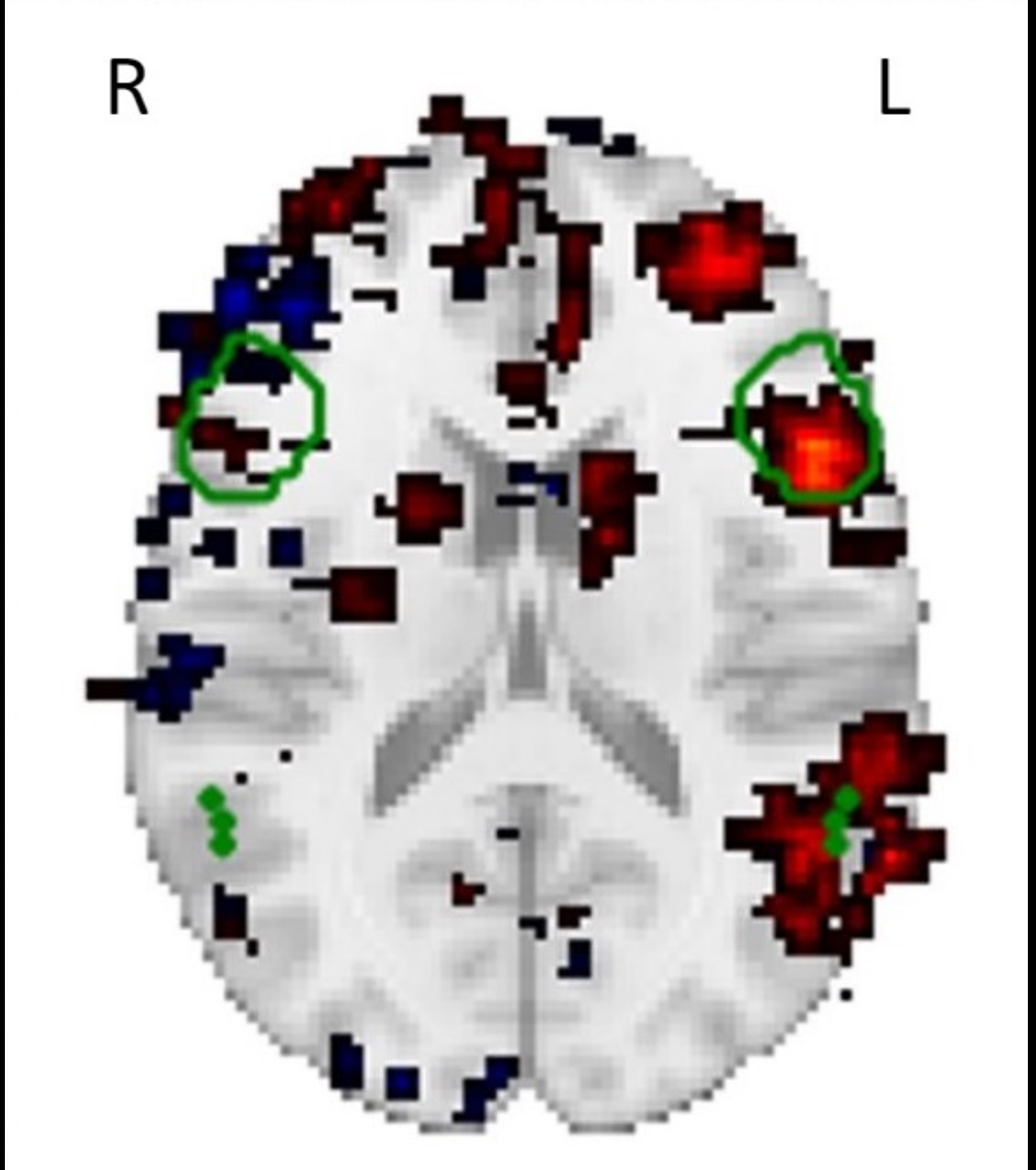
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Results – Aim 1

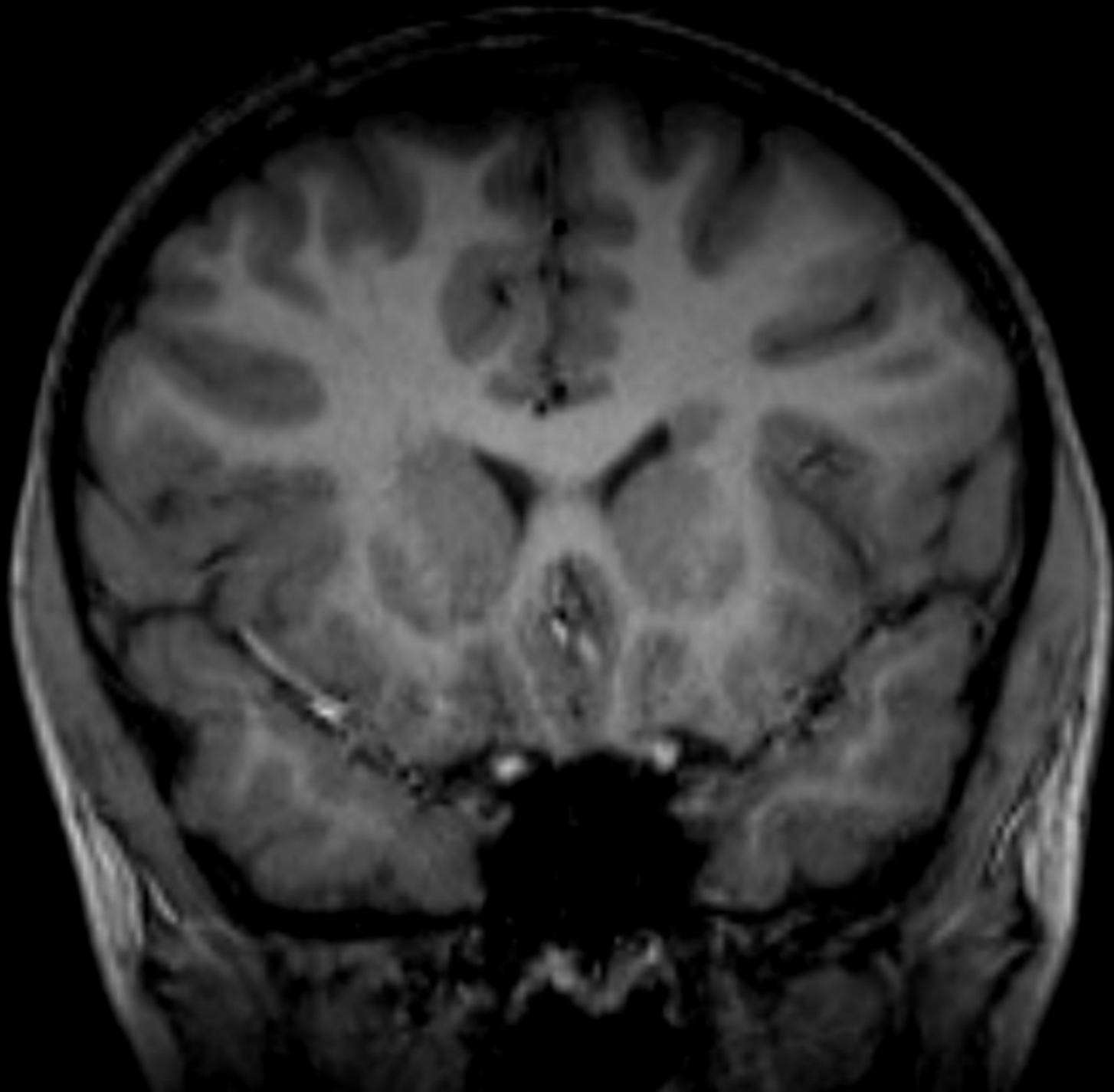
25 patients had both sEEG and task-fMRI

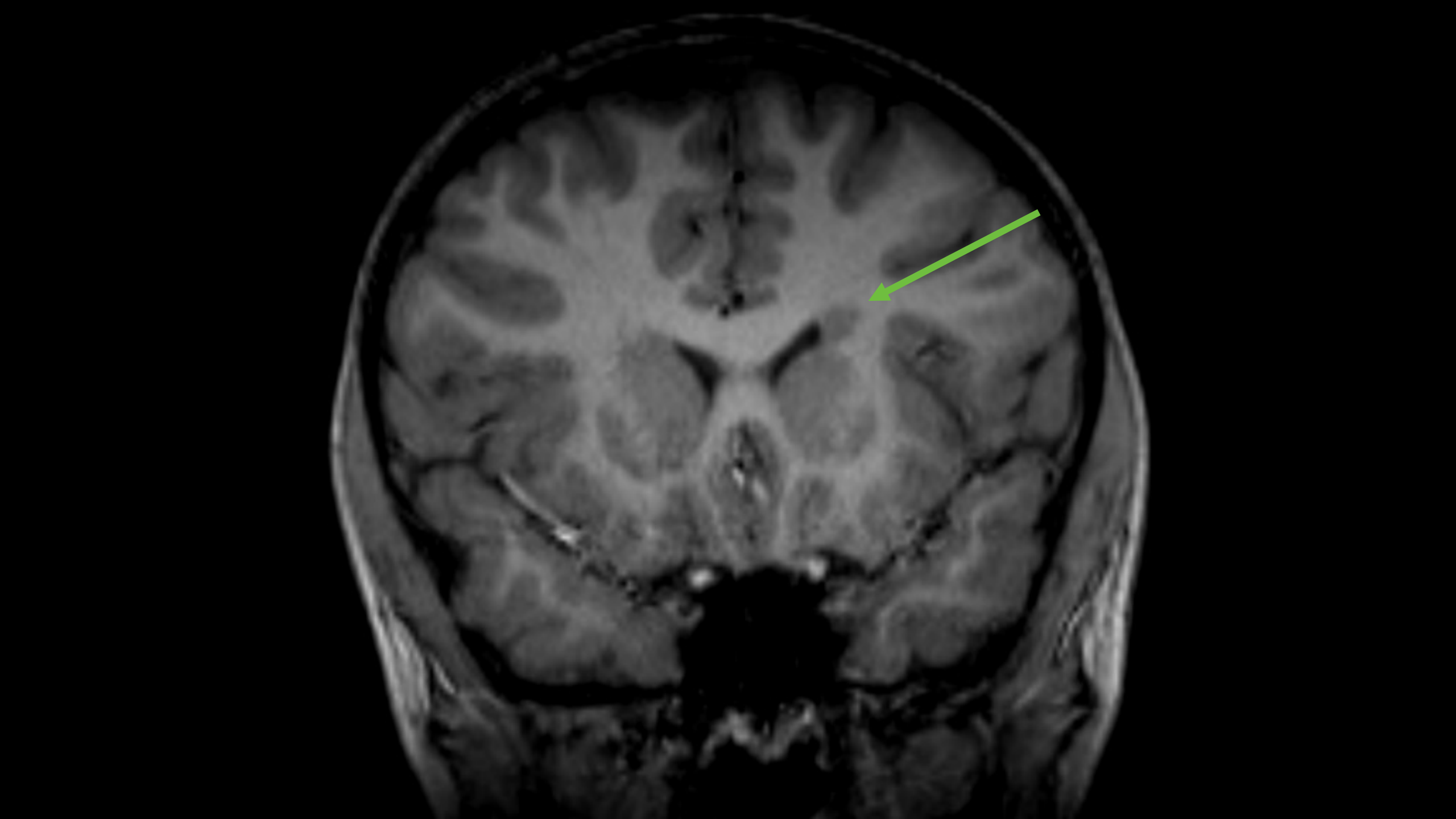
	FMRI left	FMRI right	FMRI B/L	FMRI NL
SEEG left	7	-	-	2
SEEG right	-	-	-	-
SEEG B/L	-	-	-	-
SEEG NL	11	3	1	1

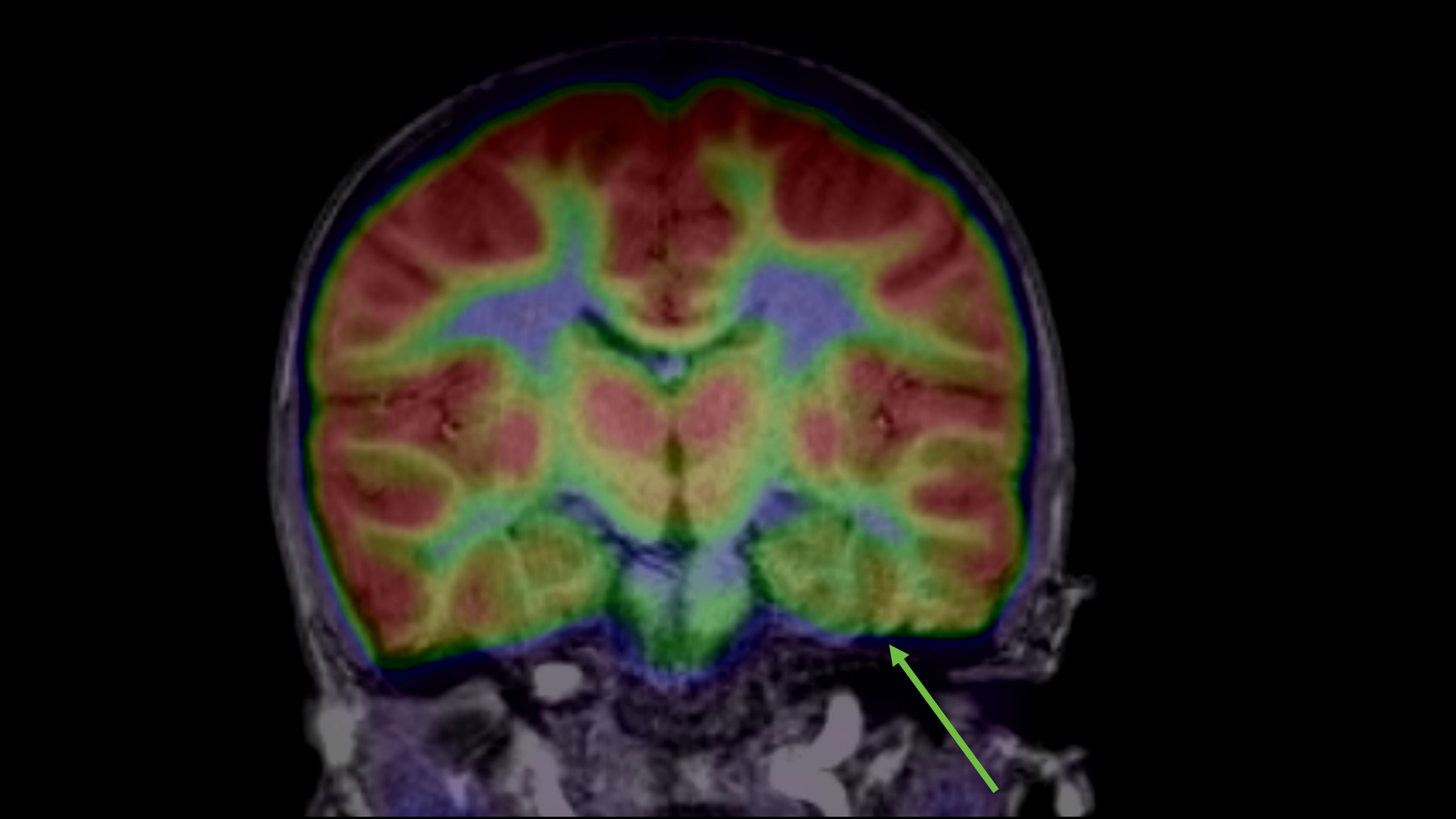
Wada agreed with fMRI and sEEG in 2/2 patients

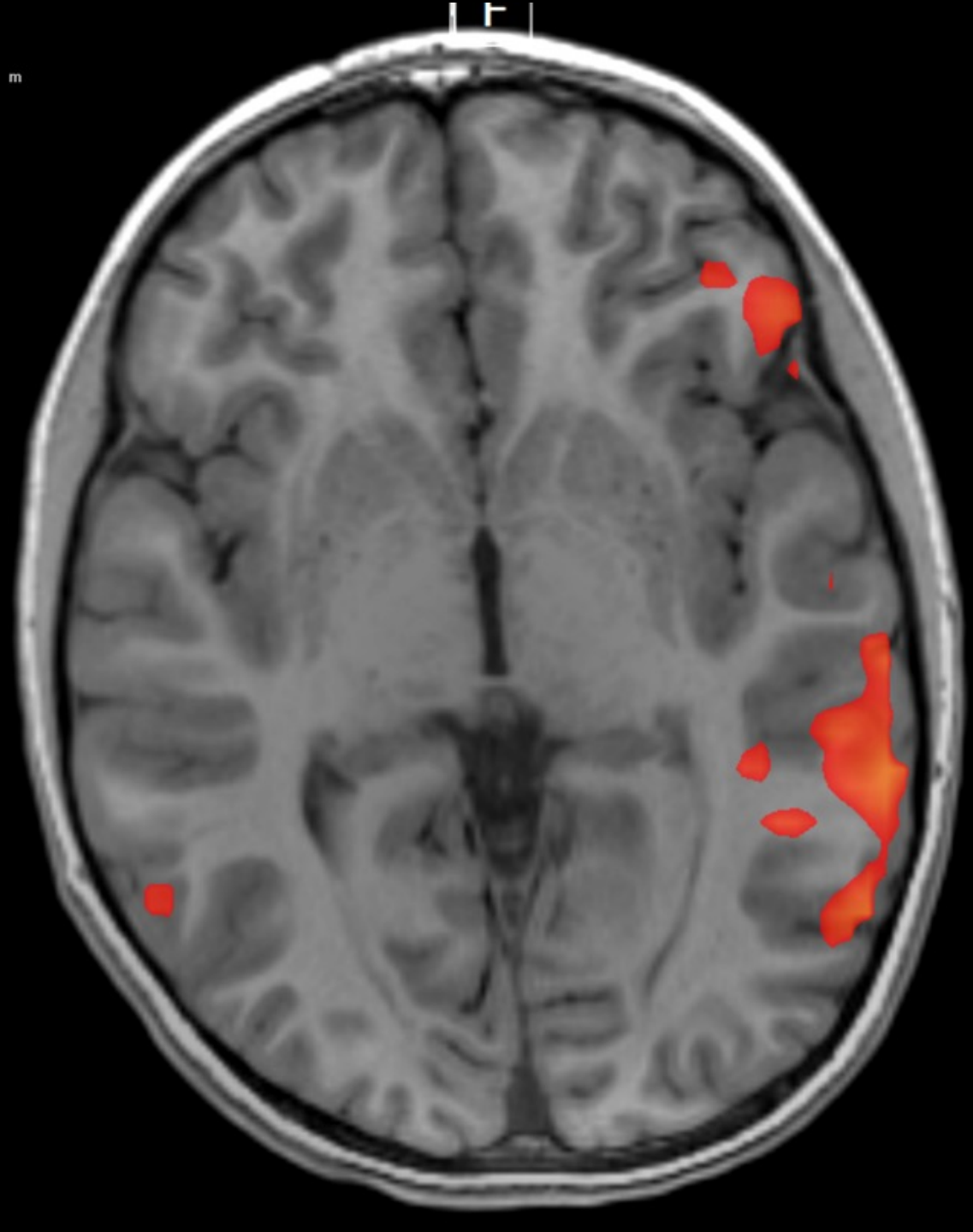
Results – Aim 1

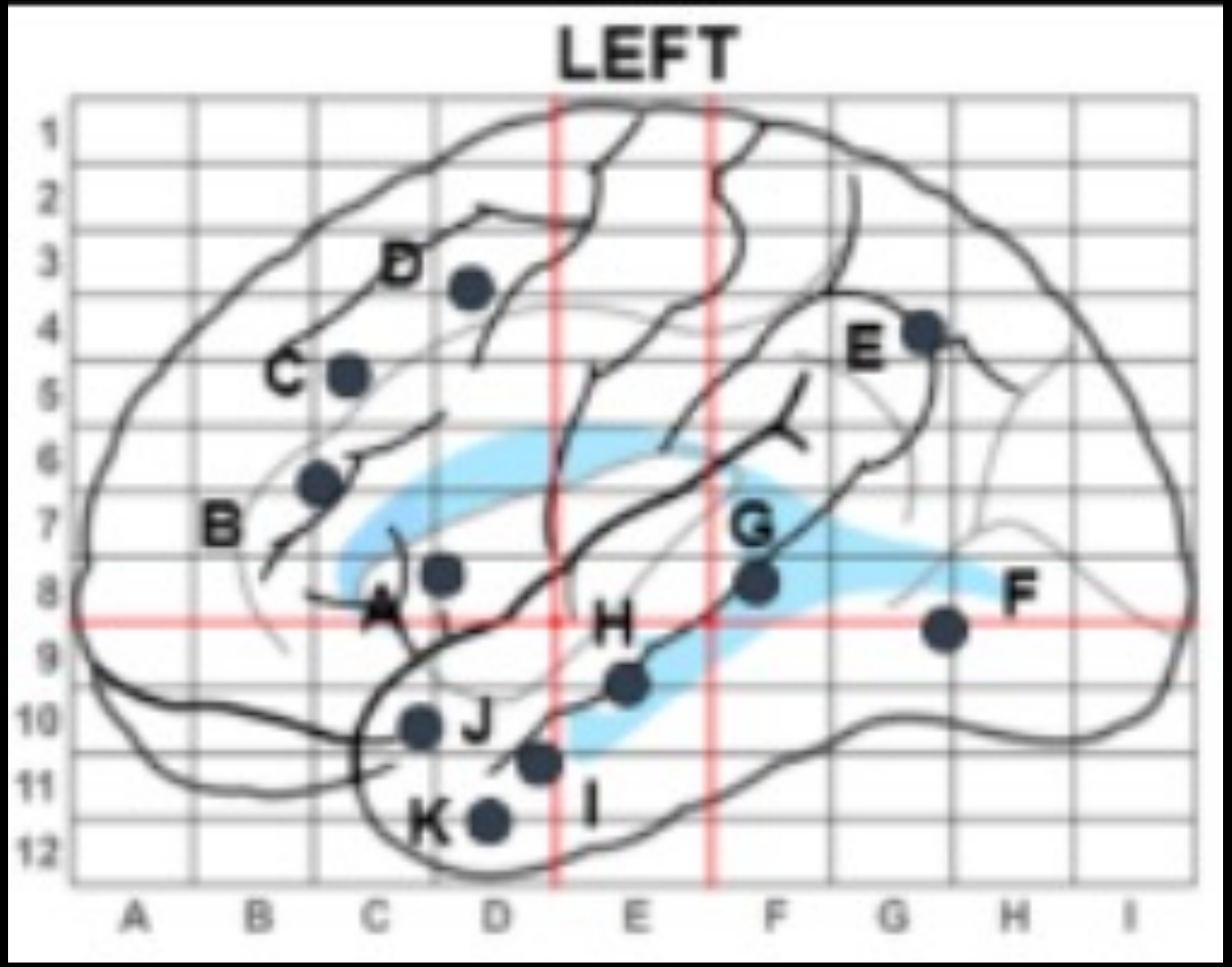
- Neuropsychological evaluation
  - Language decline in 2/8 patients
    - Subject 4
      - Language – left on fMRI, sEEG, and Wada
      - Surgery - L temporal pole and amygdala resection, L hippocampal transection
    - Subject 6
      - Language - left on fMRI, indeterminate on sEEG
      - Surgery - L occipitotemporal junction, posterior parahippocampal gyrus resection



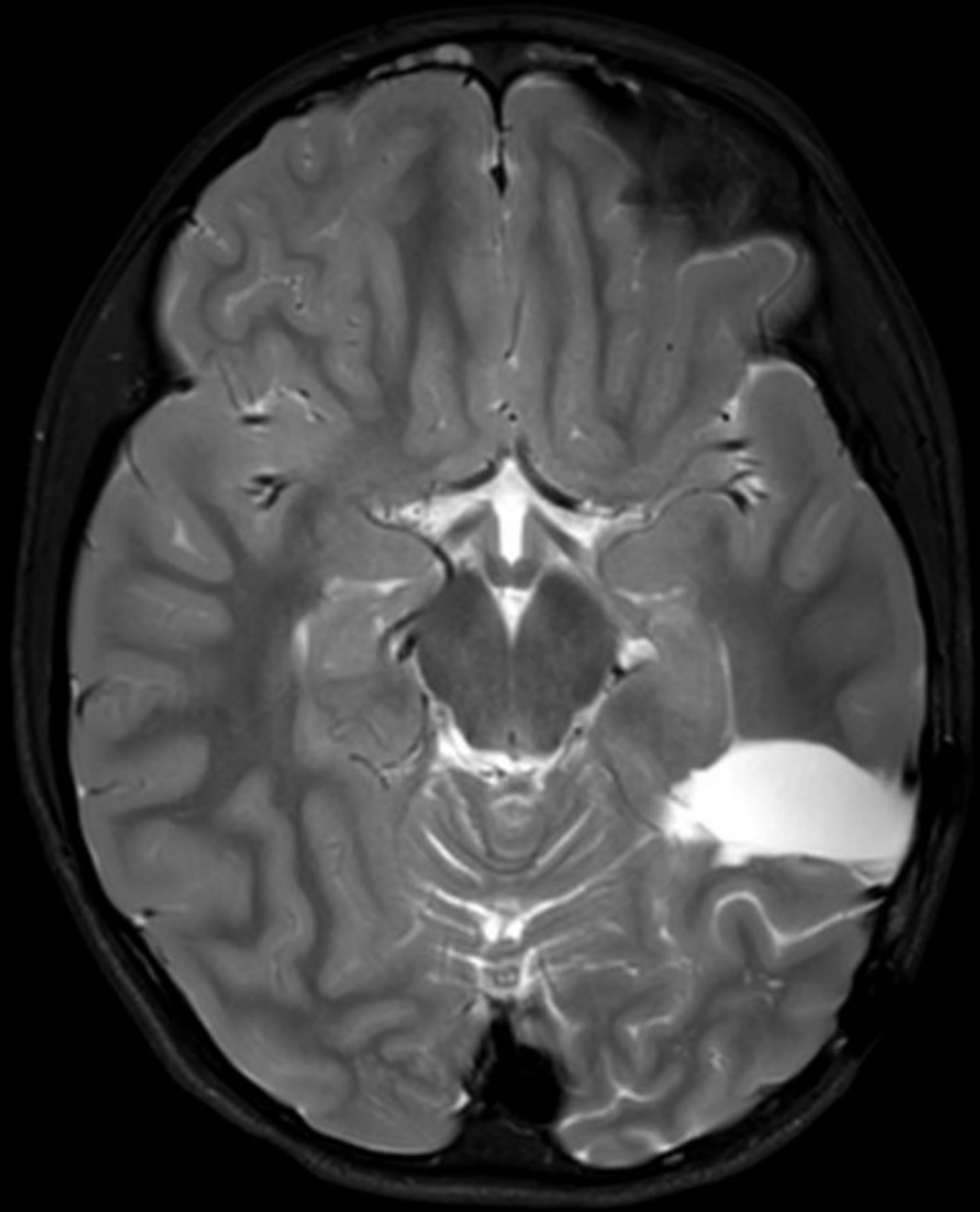


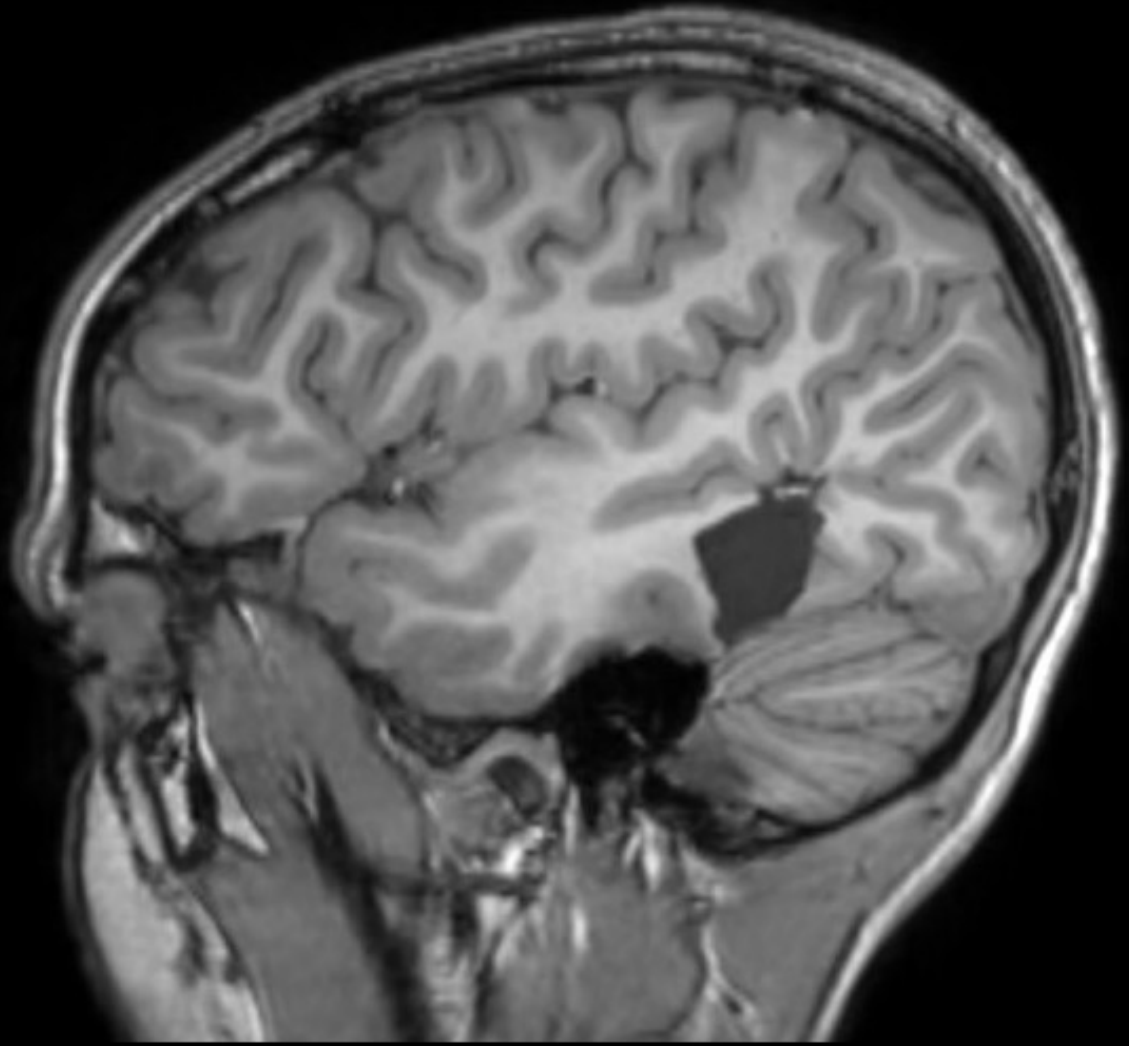






Multiple independent populations of interictal discharges were seen over electrodes F1-8 (fusiform gyrus), G1-4 and H1-4 (hippocampus), I1-4 (amygdala), J7-9 and K7-9 (temporal pole), A1-5 and B6-10 (insula/inf frontal sulcus).





Results – Aim 1

- Neuropsychological evaluation
  - Language stable in 6/8 patients
    - Subject 1
      - Left on fMRI, left on sEEG, left on Wada
      - Surgery to left temporal pole with hippocampal transection
    - Other stable subjects had surgery outside language regions

Results – Aim 2

29 patients had sEEG, MRI, PET

Agreement	MRI EZ	PET/CT EZ
SEEG EZ	21	26

Treatment option	N=29
Surgery or ablation	21
Poor surgical candidate	4
RNS/VNS	3
Pending surgery	2

Results – Aim 2

21 patients had surgery or ablation
- 15 improved or with complete freedom
- 4 with similar or frequent seizure burden
- 2 too soon for f/u

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Results – Aim 2

15 improved or with complete freedom

Surgical resection and sEEG localization overlapped with MRI abnormality in 12/15

MRI failed, surgery succeeded in 3/5

Results – Aim 2

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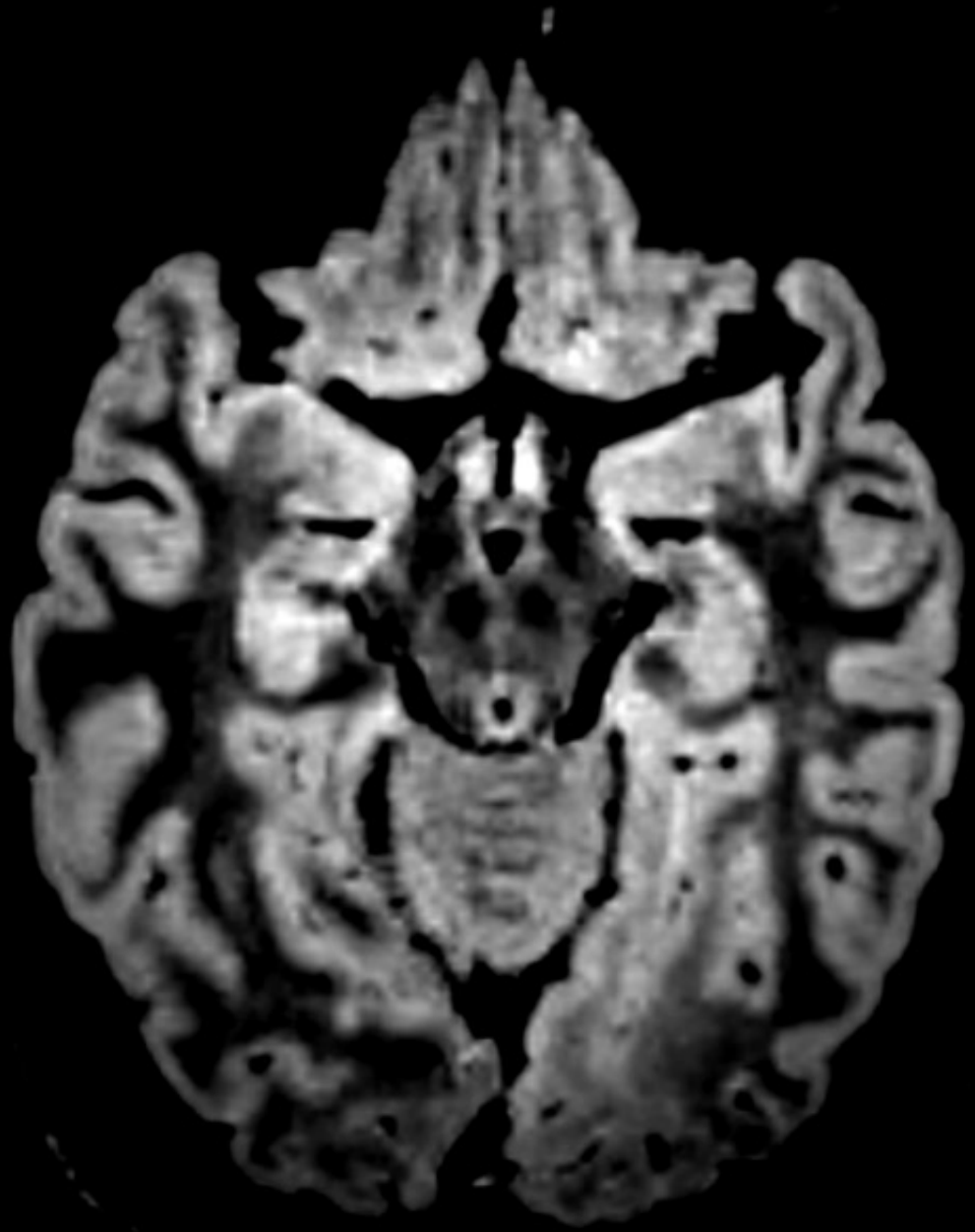
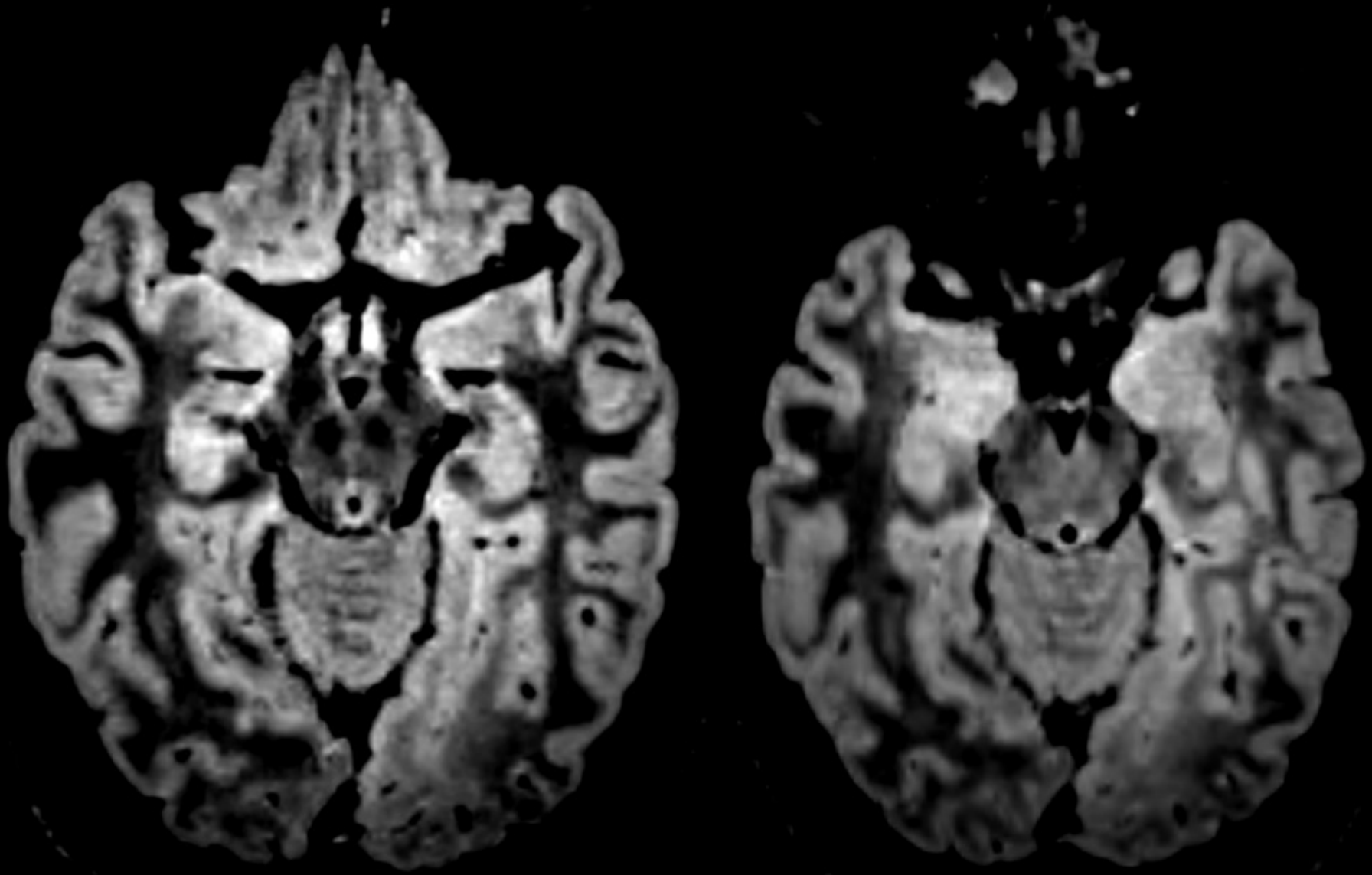


pre vs post-ablation



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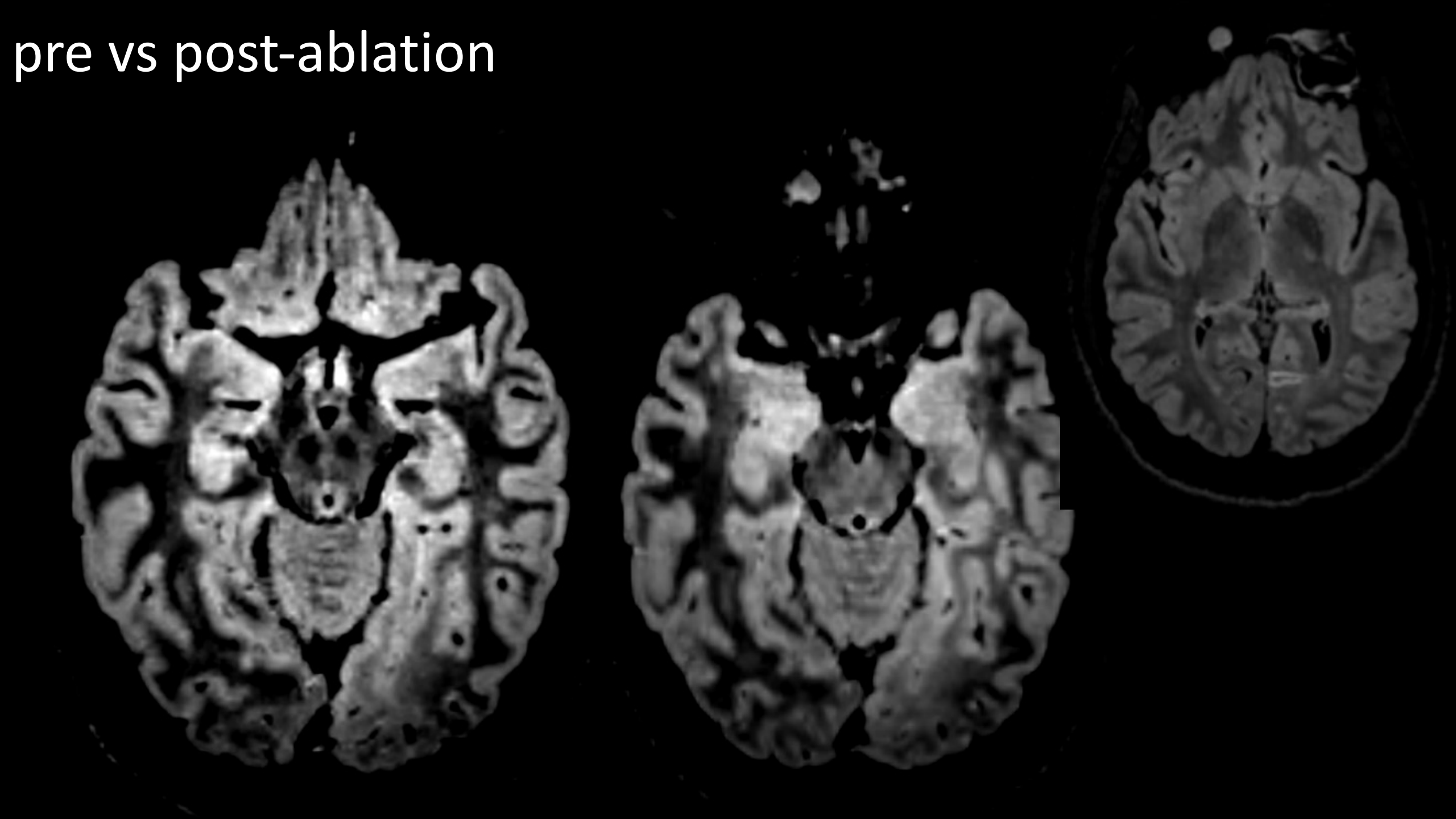

pre vs post-ablation

Conclusion

- Aim 1
  - Task-fMRI localizes language when sEEG does not
  - Need to study more cases with post-op correlation as ground truth
- Aim 2
  - SEEG more likely than MRI to successfully identify EZ for surgical resection
  - PET higher agreement with sEEG but may overestimate size of EZ

Future studies may benefit from large cohorts and comparing post-operative voxel-wise analysis with neuropsychological testing to improve understanding of "eloquent" brain regions, epileptogenicity and pre-operative planning