TEMPORAL LOBE EPILEPSY ACROSS THE AGE: CASE-BASED APPROACH

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Talk overview

- Pediatric and adult case study
- Semiology
- Etiology
- Electrophysiology
- Surgical outcome

ADULT TLE: CASE STUDY

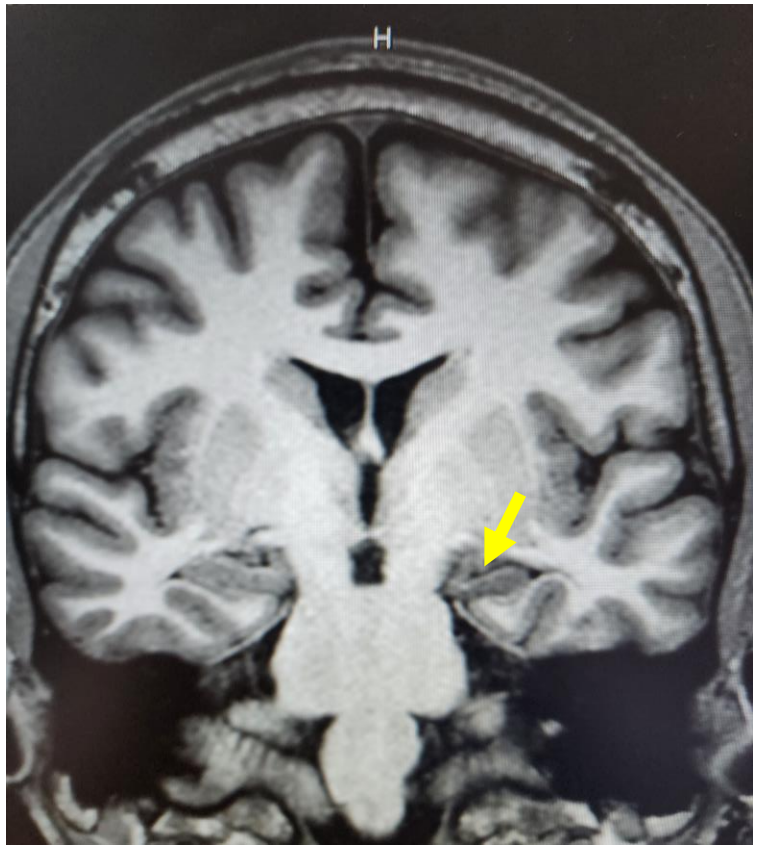
History

- Male 37 y/o, RHD, teacher
- Seizure onset : 23 y/o
- Seizure type :
  - 1. FBTC
  - 2. Focal impaired awareness automatism
  - 3. Focal sensory seizure (autonomic seizure i.e., palpitations, piloerection)

- ASMs : PHT 300 mg/d, LVT 3000 mg/d, CBZ 600 mg/d
- Significant PMHx : FS at age 8 months

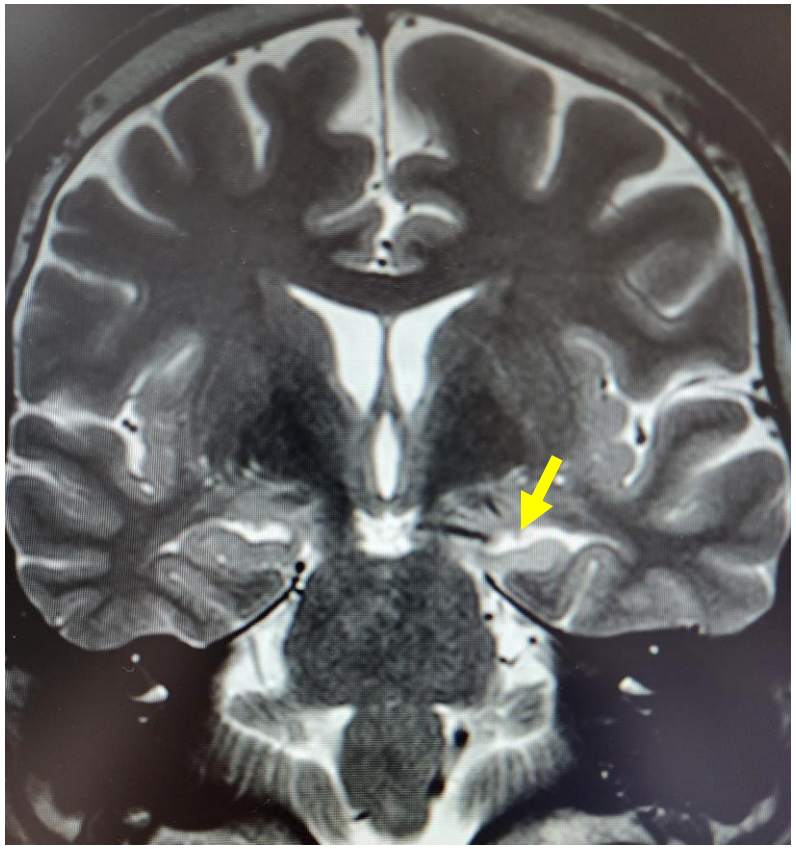
MRI

T1WI



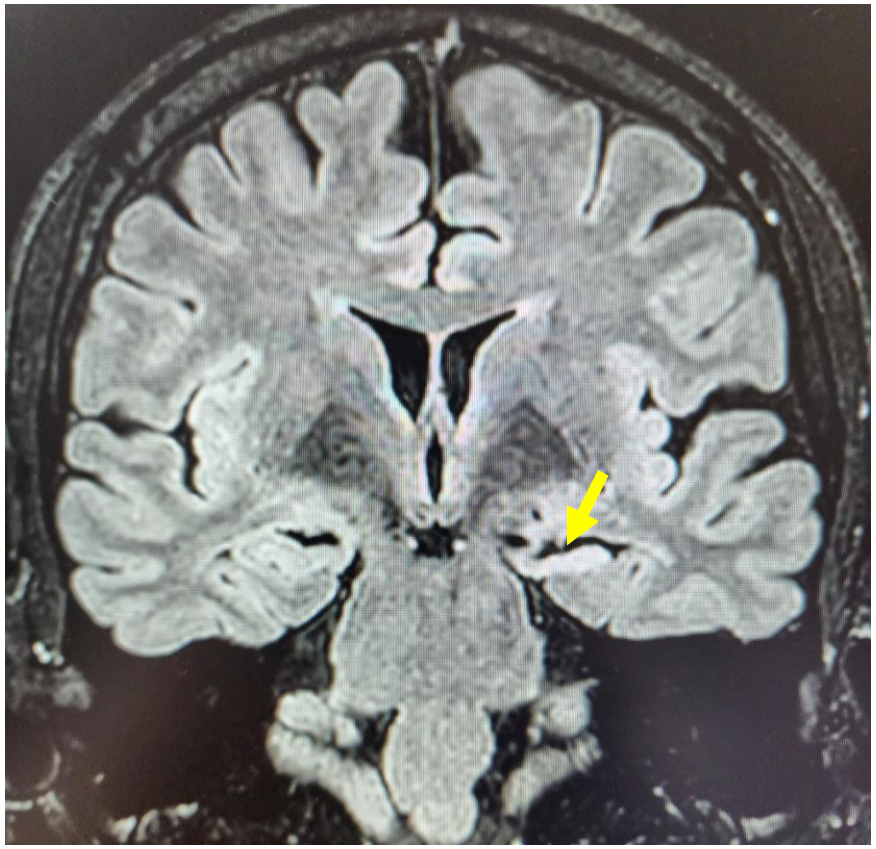
Left HC atrophy

T2WI



- Increased SI
- Loss of internal architecture

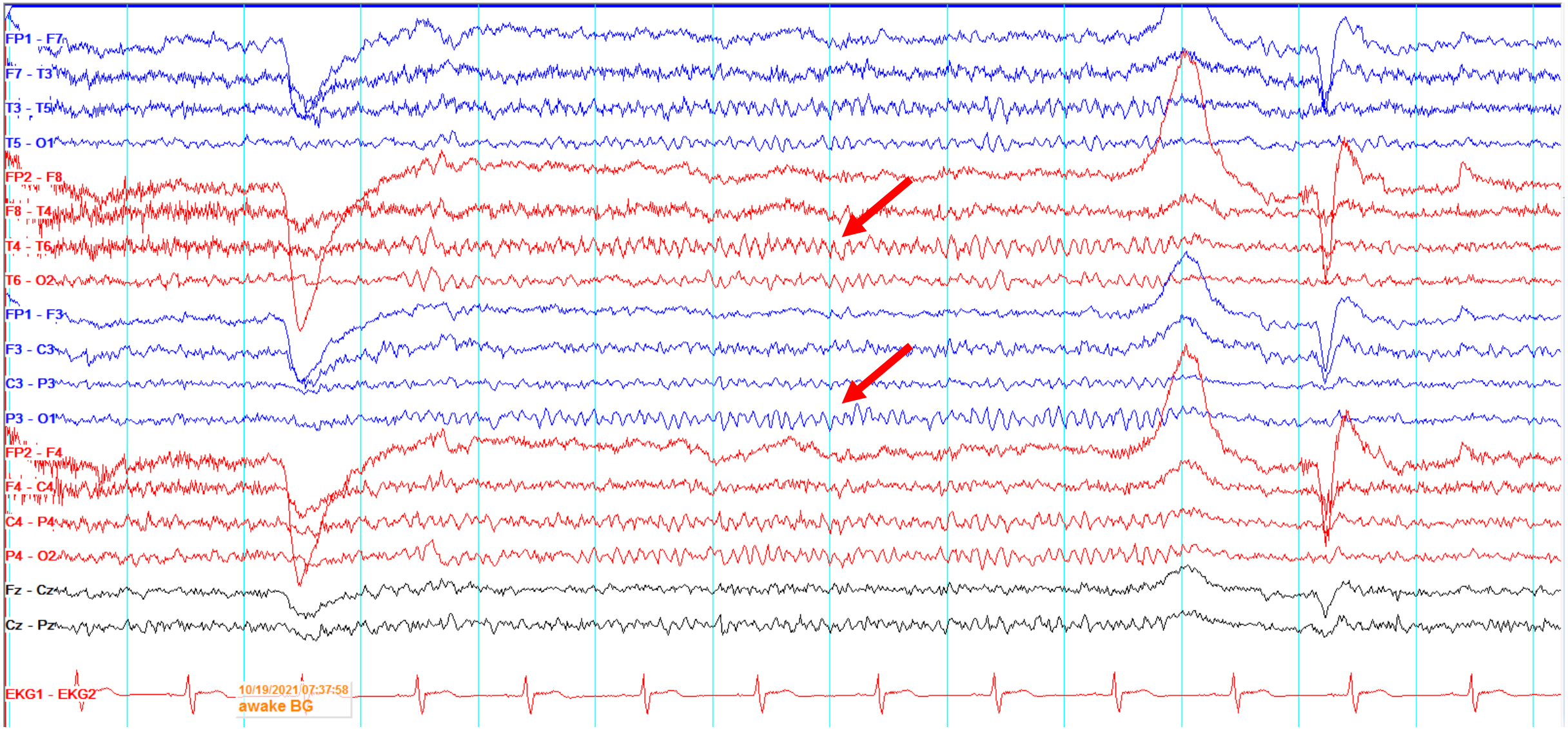
FLAIR



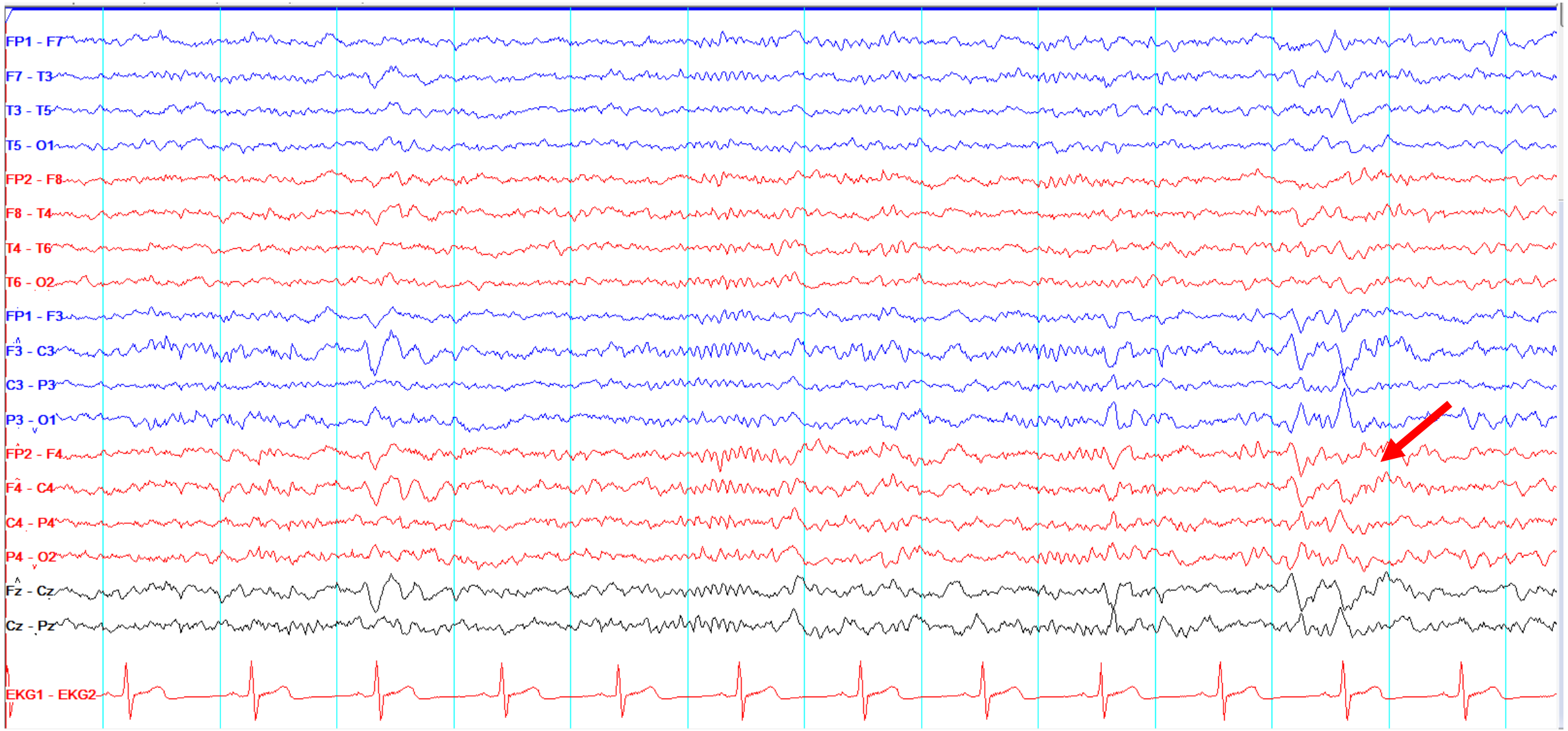
Increased SI

SCALP PROLONGED VIDEO-EEG MONITORING (VEM)

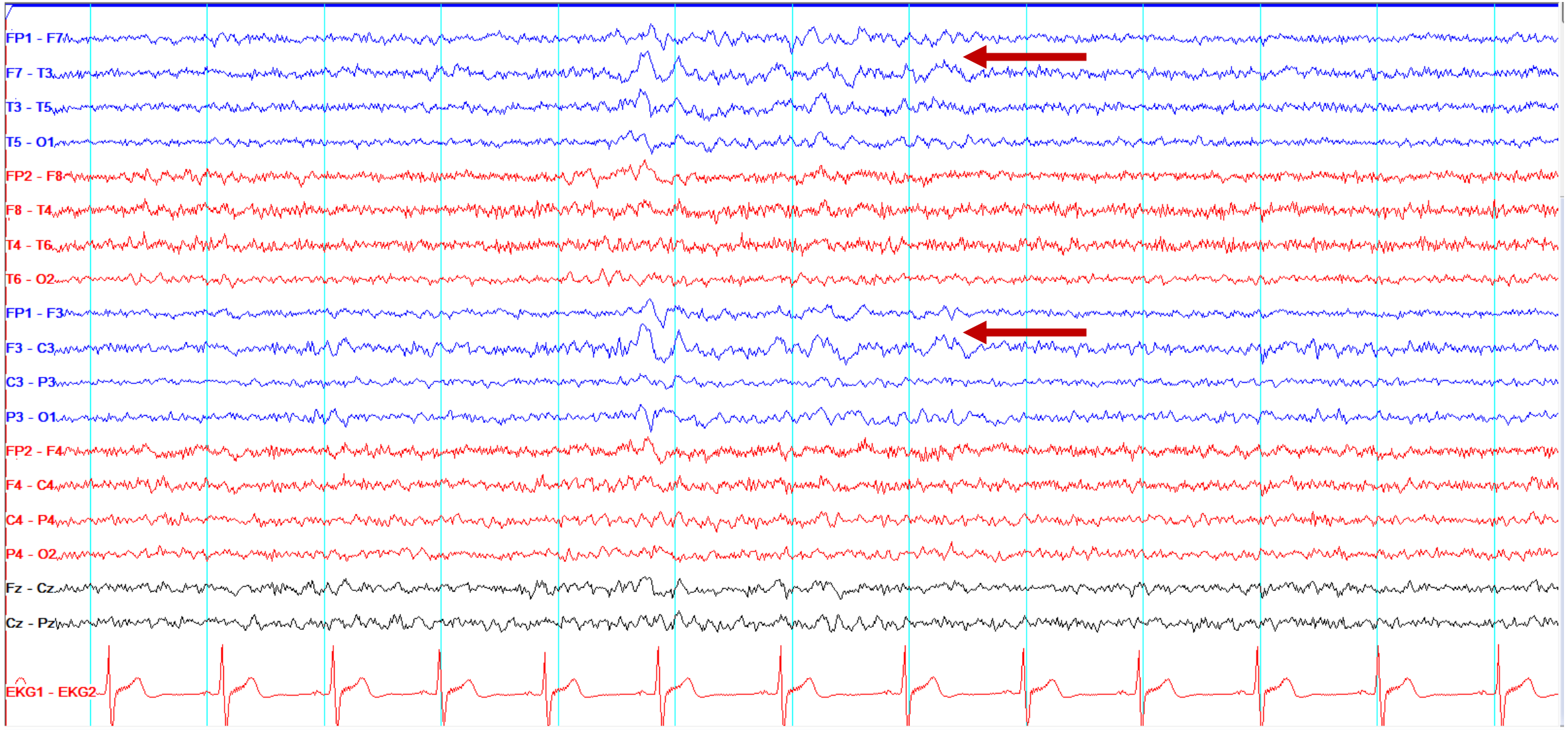
Awake Background: symmetric 9.5-Hz posterior alpha rhythm



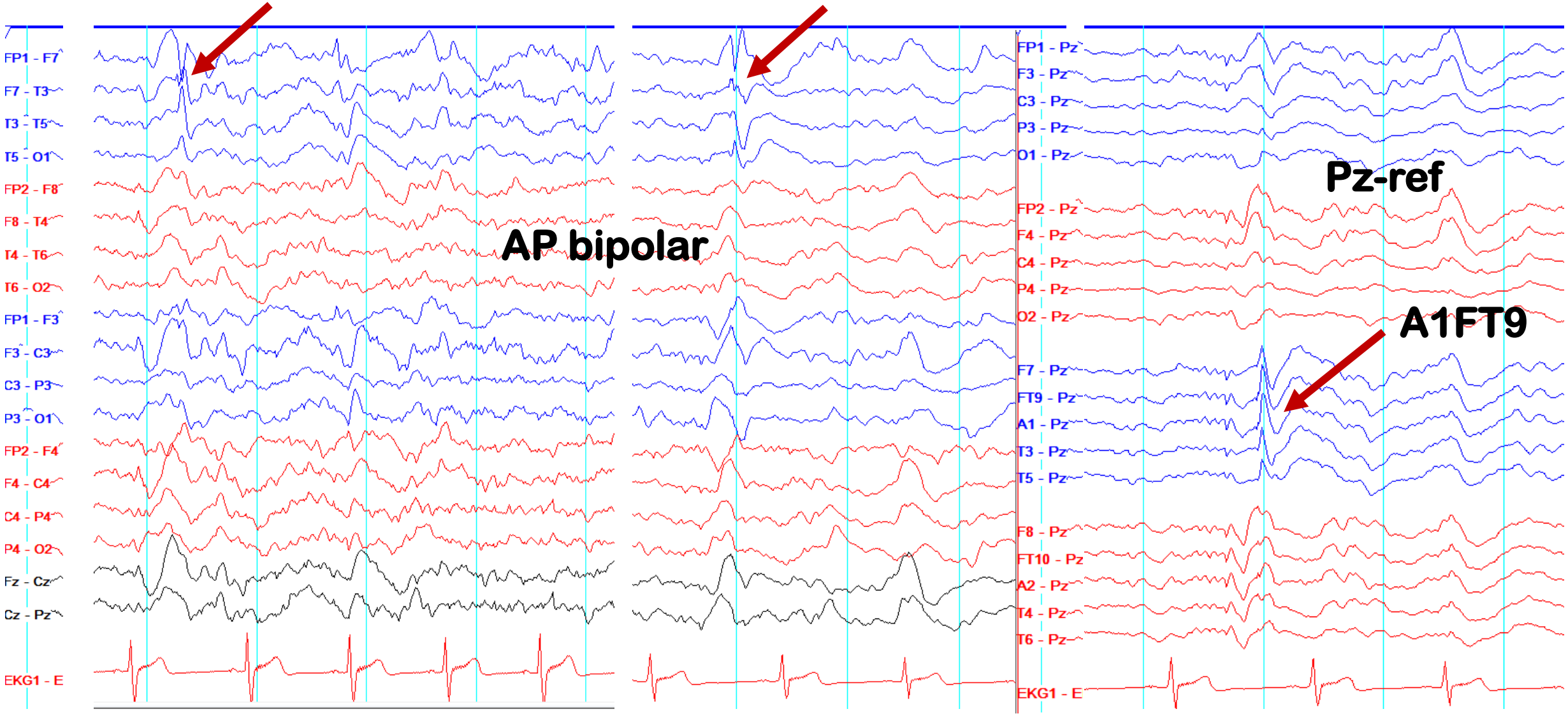
Sleep Background: symmetric sleep features



Non-epileptiform abnormality:
Intermittent slow waves (ISWs) at left fronto-temporal regions



Epileptiform abnormality: Interictal epileptiform discharges (IEDs) at left antero-basal temporal area (A1FT9)

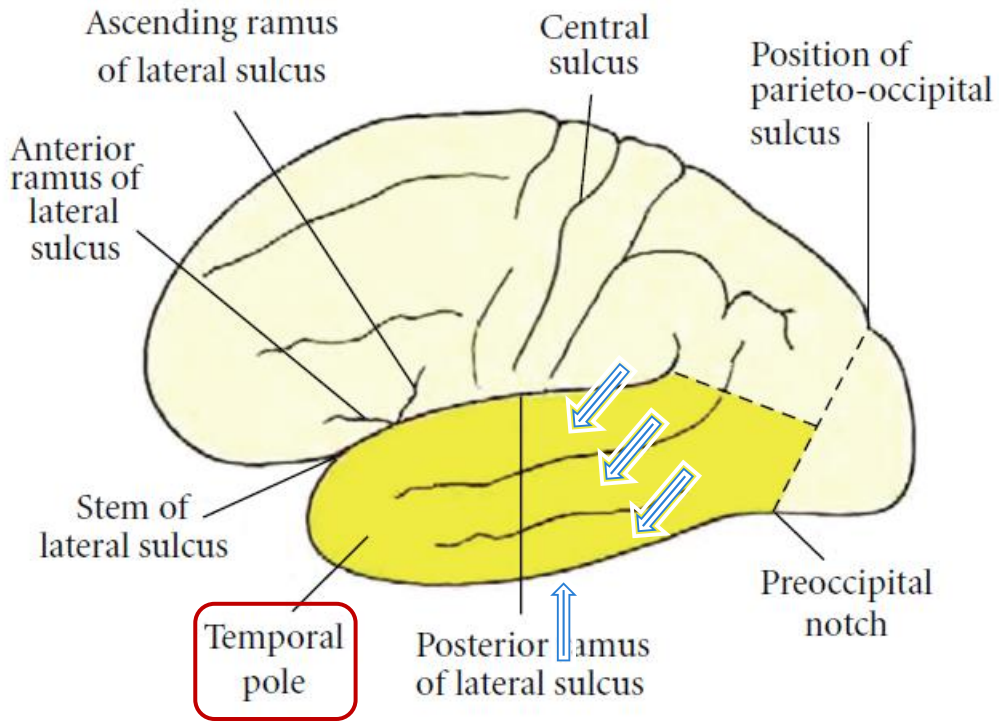


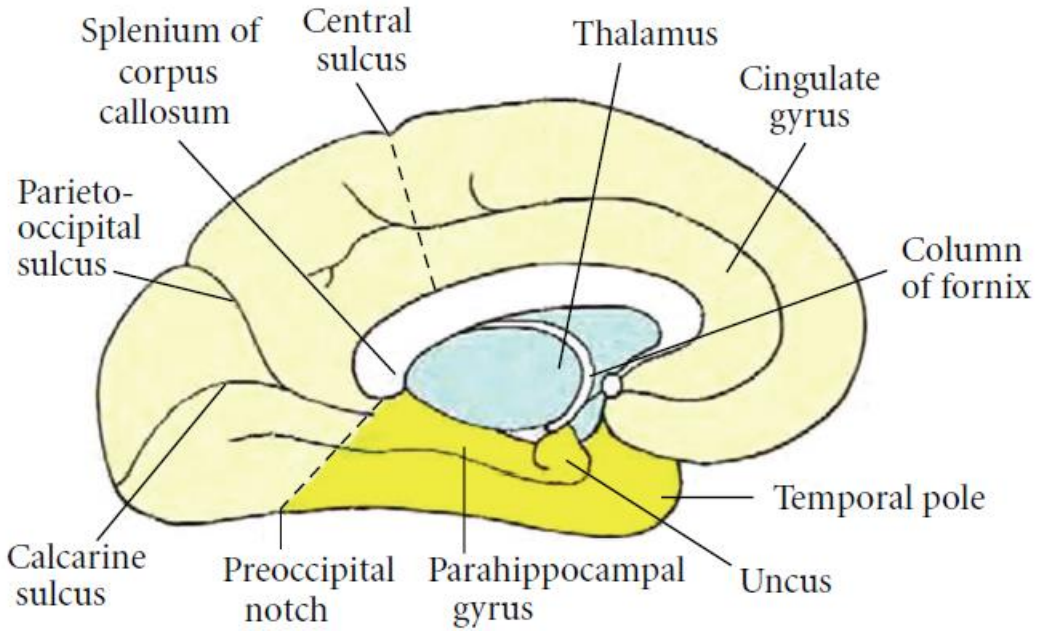
SEMIOLOGY IN ADULT TLE

Lateral temporal area

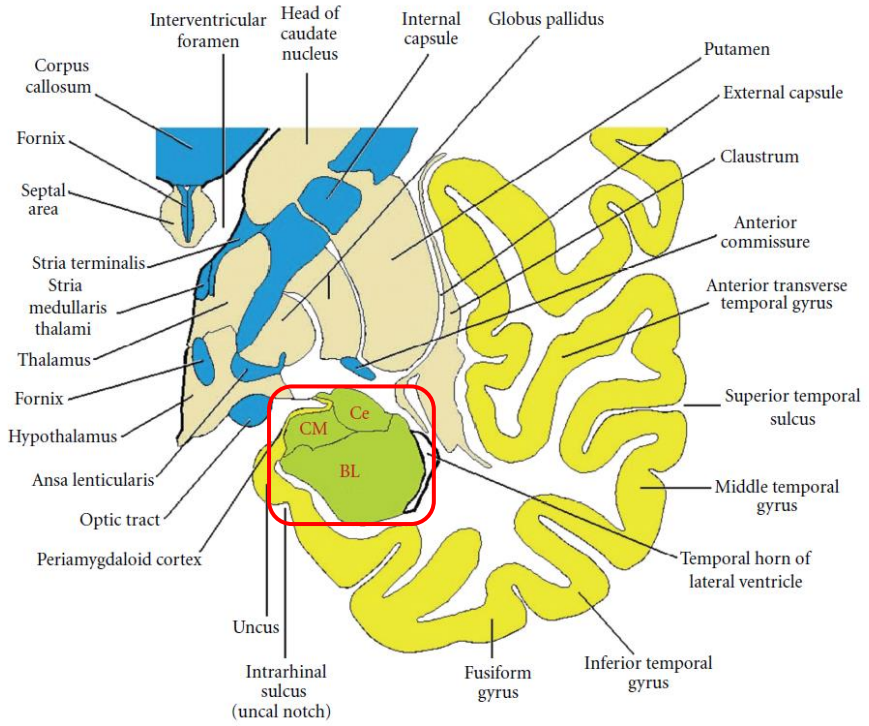
Extrahippocampal

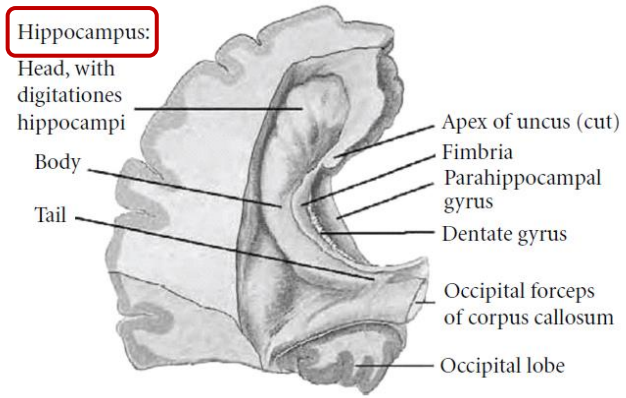
Non-hippocampal

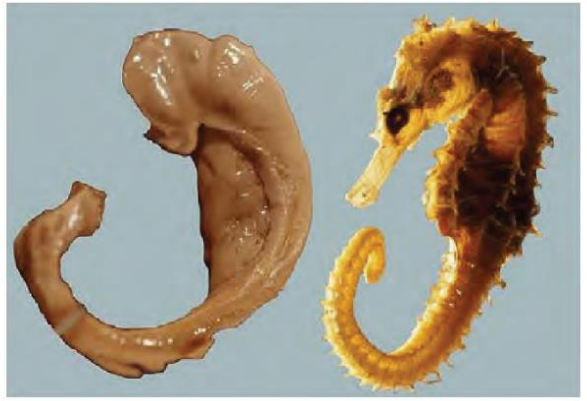




Kiernan JA; Epilepsy Research and Treatment 2012





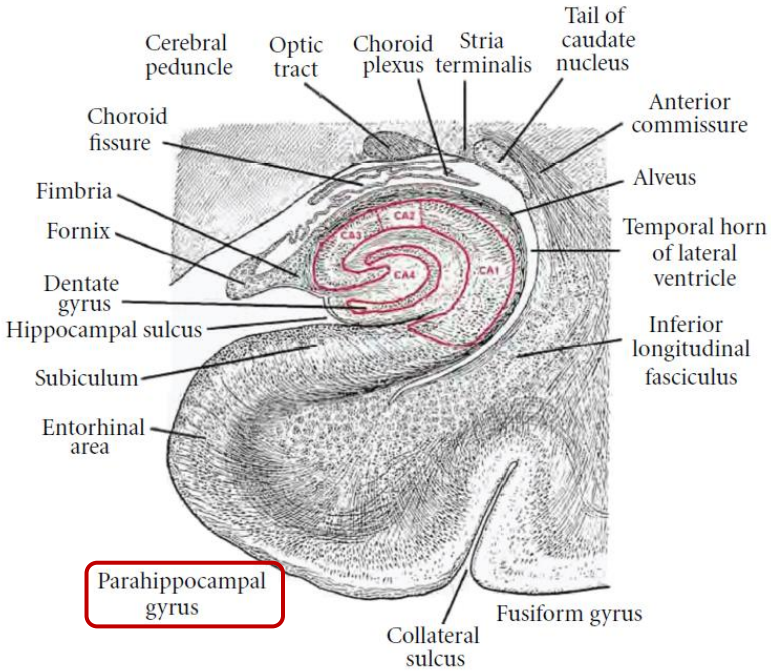


Mesial temporal area

Amygdala

Hippocampus

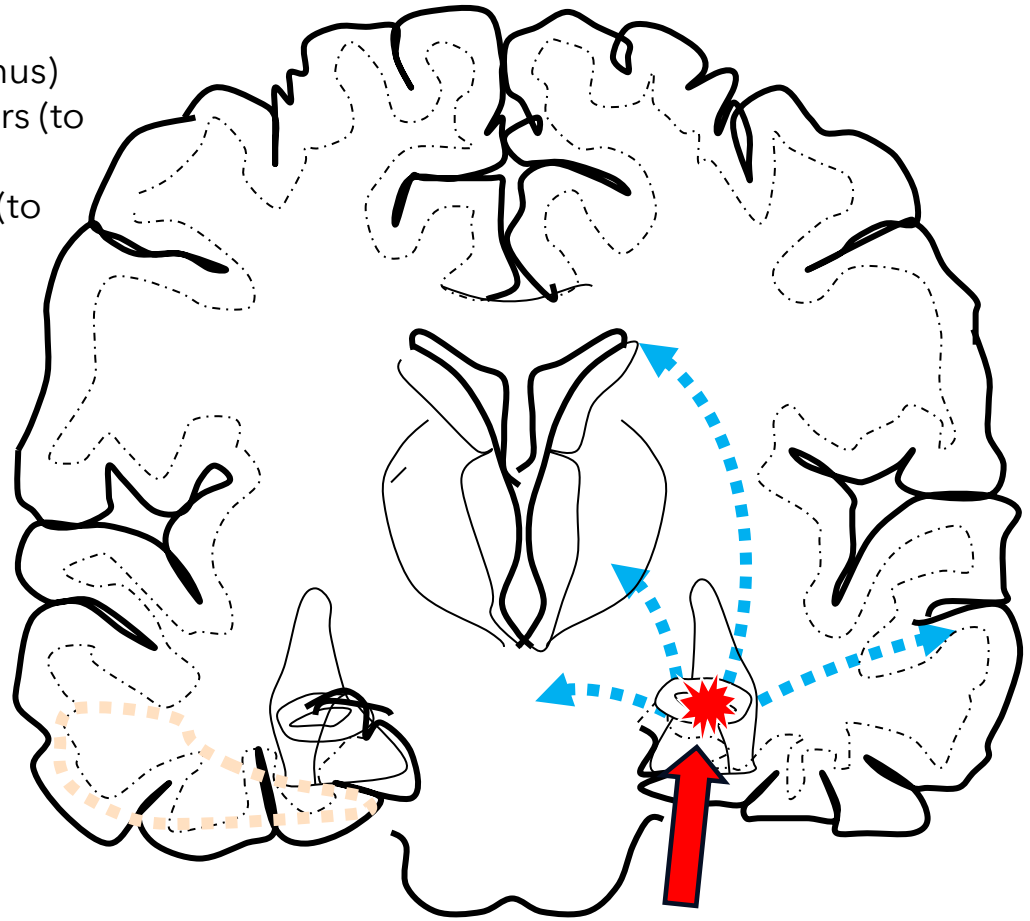
Parahippocampus



Kiernan JA; Epilepsy Research and Treatment 2012

Preferential propagation pathways of mesial temporal epileptic focus Mayanagi Y et al.; Epilepsia 1996

- Fornix and stria terminalis (to thalamus)
- Amygdalofugal fibers (to hypothalamus)
- Uncinate fasciculus (to orbitofrontal)



Seizure-onset zone (SOZ)

Mesial temporal semiology

- Aura: epigastric; autonomic; fear; déjà vu; olfactory
- Seizure: automatism (esp. oral); behavioral arrest; late dystonic; postictal aphasia

Symptomatogenic zone (seizure semiology)

Lateral temporal semiology

- Aura: auditory hallucination
- Seizure: early simple motor seizure; more frequent BTC; hyperkinetic seizure (temporal pole)

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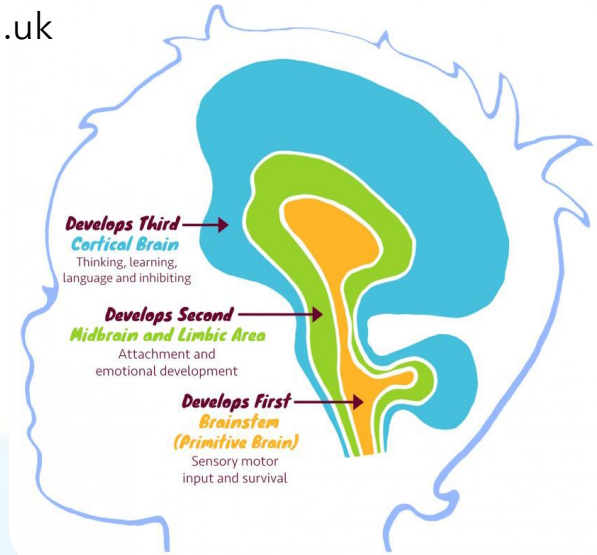
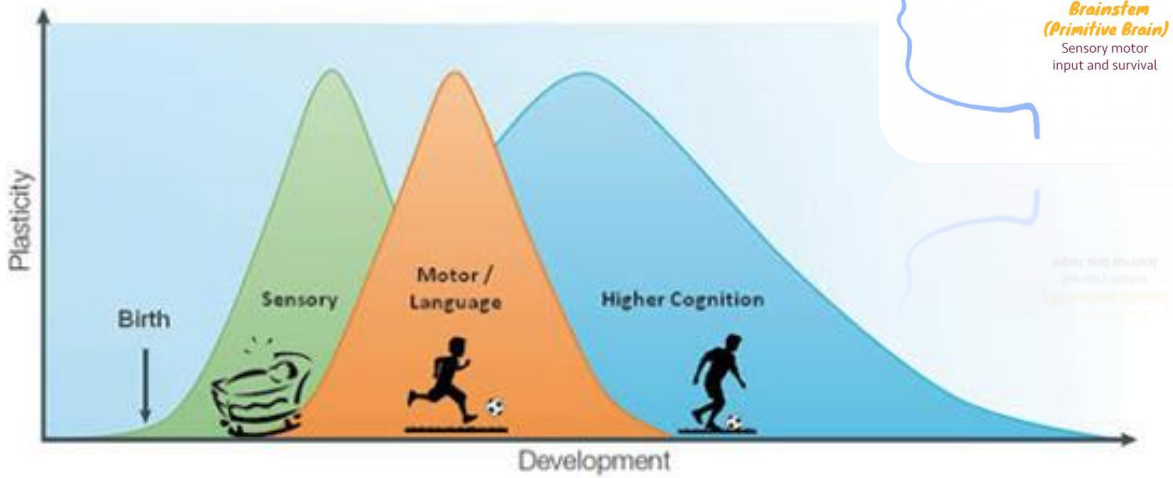


"Bottom up"

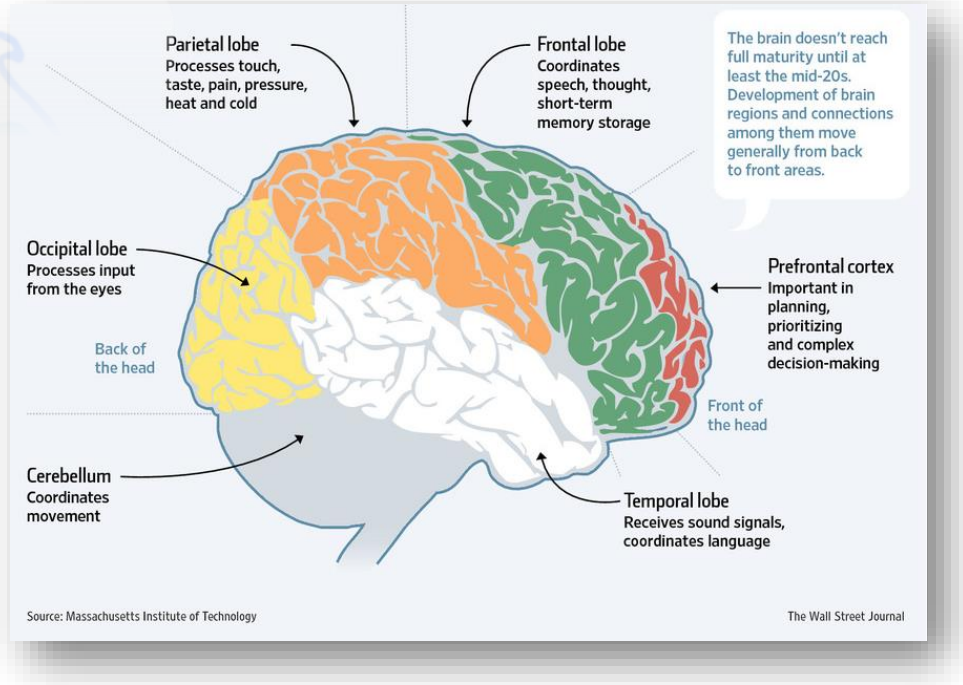
"Primary motor/sensory → higher-order regions"

Myelination (posterior to anterior)

Fig 1: Windows of plasticity in brain development



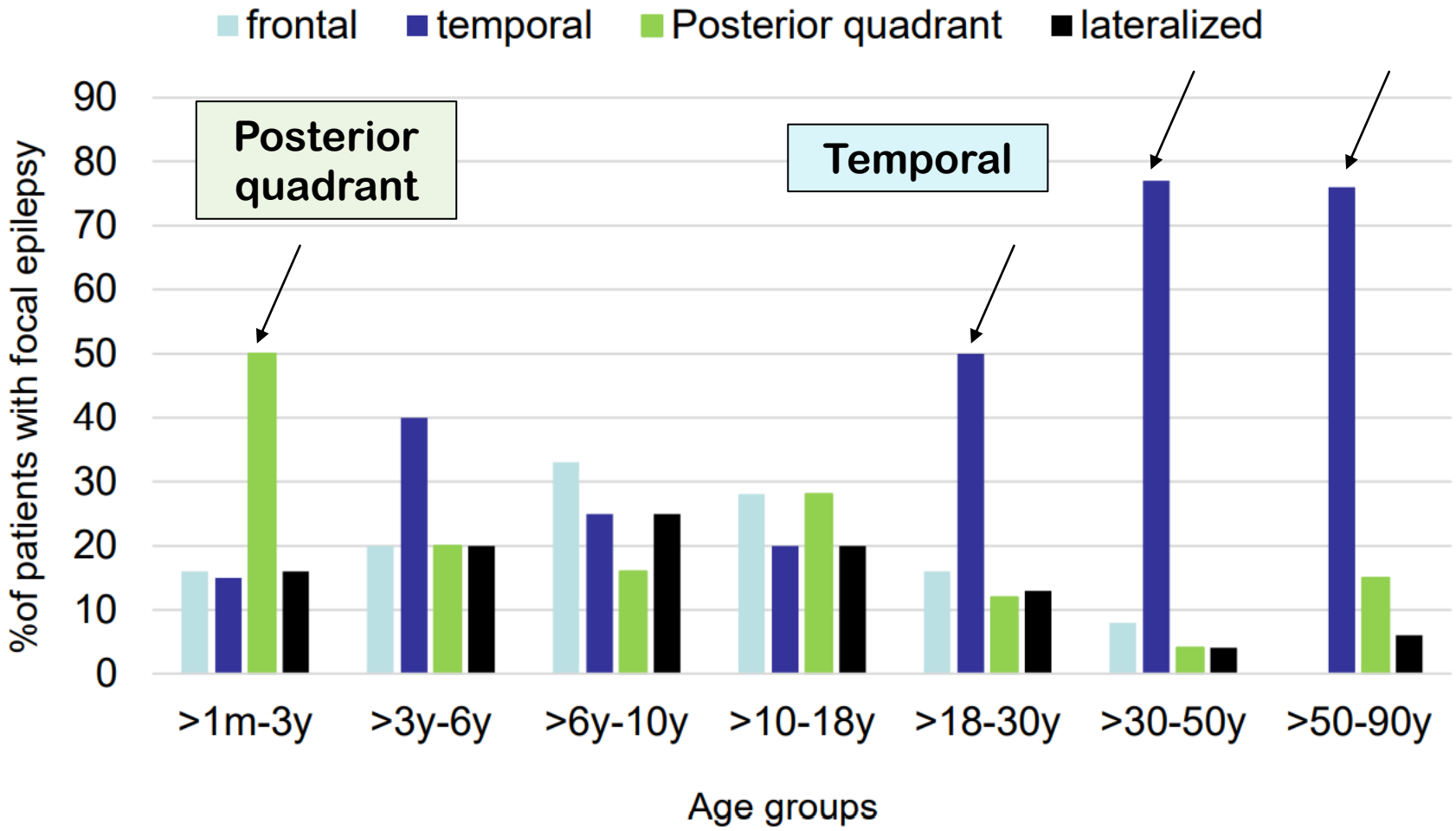
Adapted from Hensch, T. K. (2005). Critical period plasticity in local cortical circuits. *Nature Reviews Neuroscience, 6*(11), 877–888.



PATIENTS > 6 YEARS HAVE, IN GENERAL, SIMILAR SEIZURES TO THOSE OF ADULTS

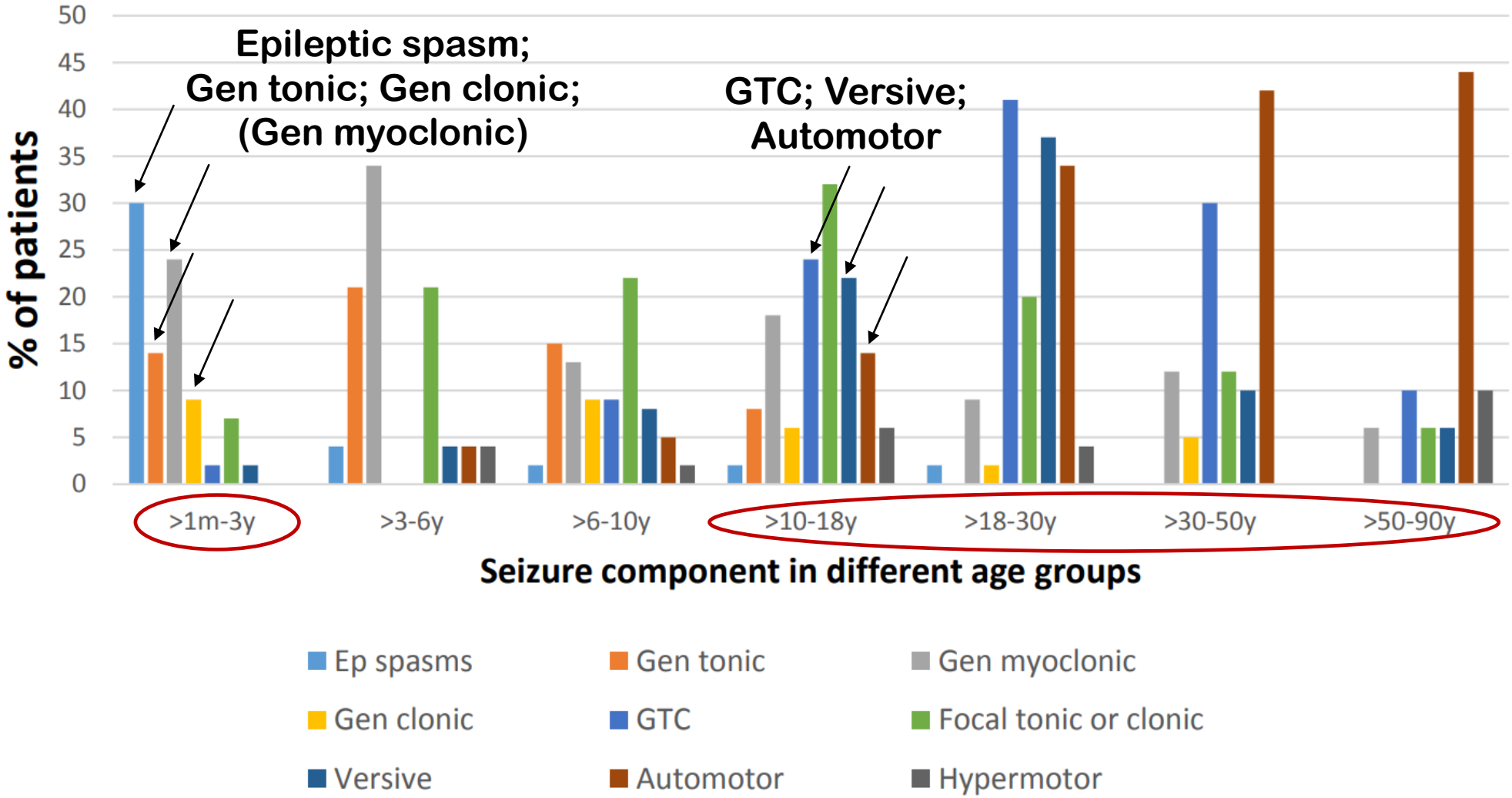
(YAMAMOTO ET AL., 1987; WYLLIE ET AL., 1993; BROCKHAUS AND ELGER, 1995; MOHAMED ET AL., 2001; TERRA-BUSTAMANTE ET AL., 2005)

Figure 1 supplementary: Focal Epilepsy at different age groups



Fernandez-Baca Vaca G et.al.; Epileptic Disorder 2018

Figure 3 supplementary: Motor seizures in different age groups



Fernandez-Baca Vaca G et.al.; Epileptic Disorder 2018

Simple motor seizure
in Infancy and Early Childhood

Semiology:
Bilateral asymmetric tonic → bilateral asymmetric clonic → Lt clonic

Lateralizing signs:
Lt clonic

Lüders H et.al.; Epileptic Disorder 2019

Complex motor seizure
in Adults

Semiology:
Emotional hypermotor

Lateralizing signs:
None

Lüders H et.al.; Epileptic Disorder 2019

Seizure semiology changes with age

Increases with age

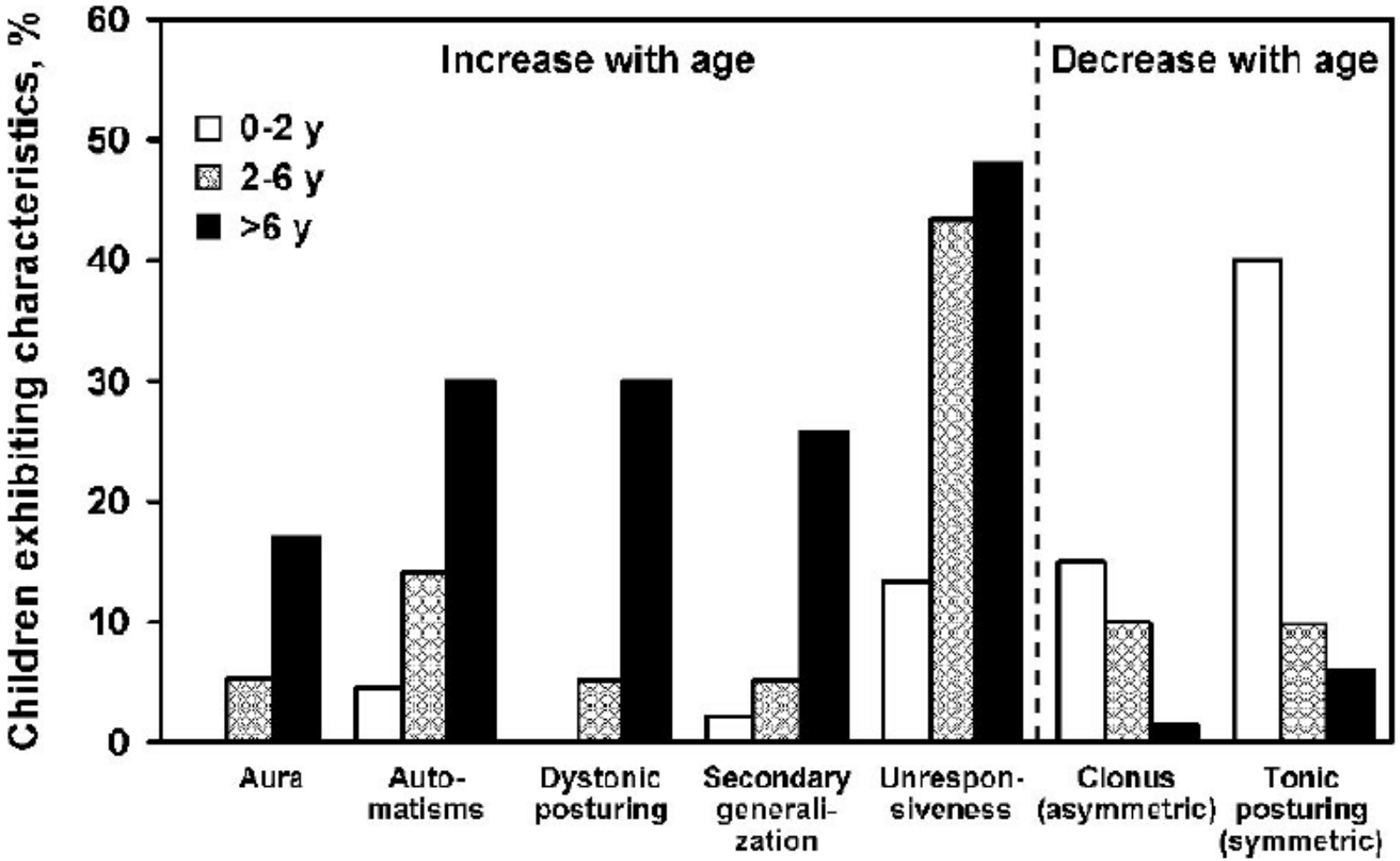
Aura

Automatism

Dystonic

Secondary generalization

Unresponsiveness



Decreases with age

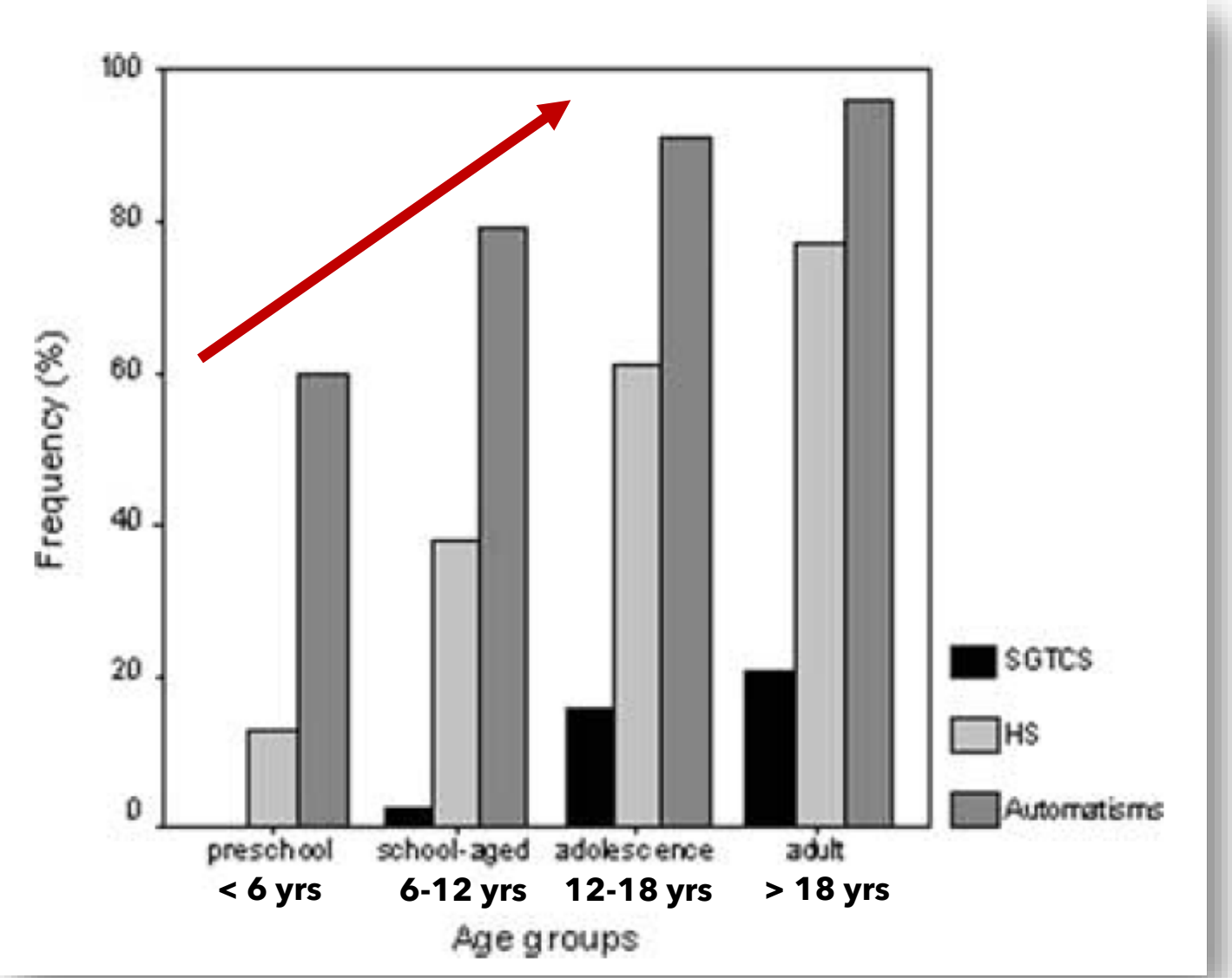
Asym clonic

Sym tonic posturing

FIGURE 2. Seizure characteristics that change with age. (Modified from Nordli et al., 2001. Used with permission.)

So EL.; J Clin Neurophysiol 2006

Children vs Adult TLE

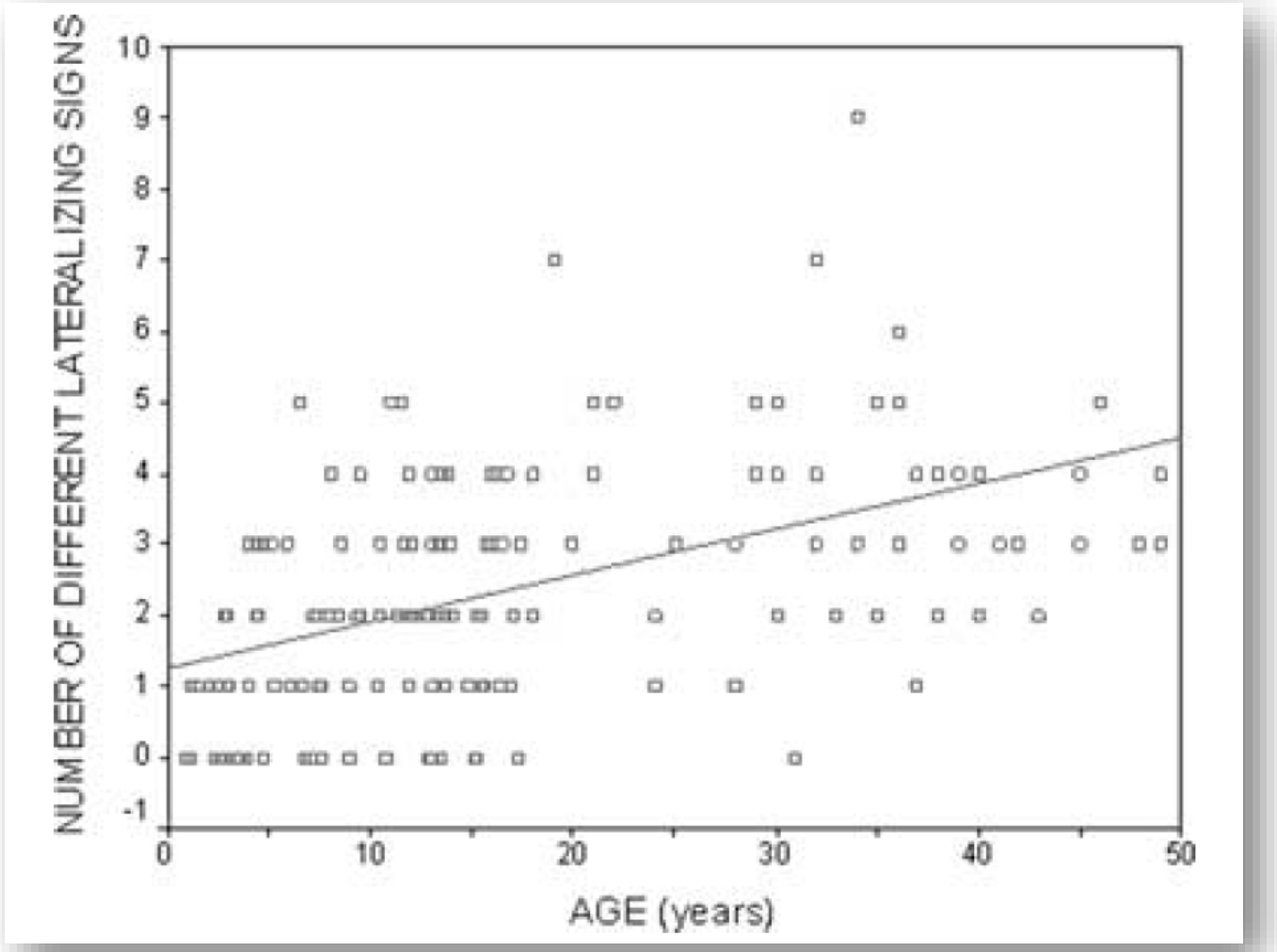


- Age 10 months to 49 years
- 605 seizures from 155 consecutive patients
- Seizure freedom after temporal lobectomy

Findings:

- Age-dependent semiology
  - **Secondarily GTC** ($p = 0.003$)
  - **Automatisms** ($p < 0.001$)
- Age-dependent etiology
  - **Hippocampal sclerosis** ($p < 0.001$)

Fogarasi A et al., Epilepsia 2007



Number of different lateralizing signs in a certain patient showed a linear correlation with age ($p < 0.001$)

Fogarasi A et al., Epilepsia 2007

Dystonic hand posturing

Unnatural tonic posturing with a **rotatory** component

Rt hand dystonic seizure

CONTRALATERAL SOZ (92-100%)

Mesial temporal > Lateral neocortical temporal

Versive seizure

Forceful, sustained, unnatural head positioning

Lt versive→ bilat tonic-clonic seizure

Symptomatogenic zone: FEF

CONTRALATERAL SOZ (>90%)

Complex Partial Seizures of Temporal Lobe Origin in Children of Different Age Groups

Anke Brockhaus and Christian E. Elger

Department of Epileptology, University of Bonn, Bonn, Germany

- Aged 18 mo to 16 yrs (mean 11 years)
- Had undergone presurgical evaluation for medically intractable TLE
- Seizure-free outcome or a marked reduction in seizure frequency after surgery

Findings:

- Children aged > 6 years had TLS with features similar to those of adults
- In younger children, typical semiology included symmetric motor phenomena of the limbs, **postures similar to frontal lobe seizures in adults**, and head nodding as in infantile spasms.

Versive movements were not clearly lateralizing and could be either **ipsiversive** (30%) or **contraversive** (70%) with respect to the epileptogenic temporal lobe

Epilepsia 1995

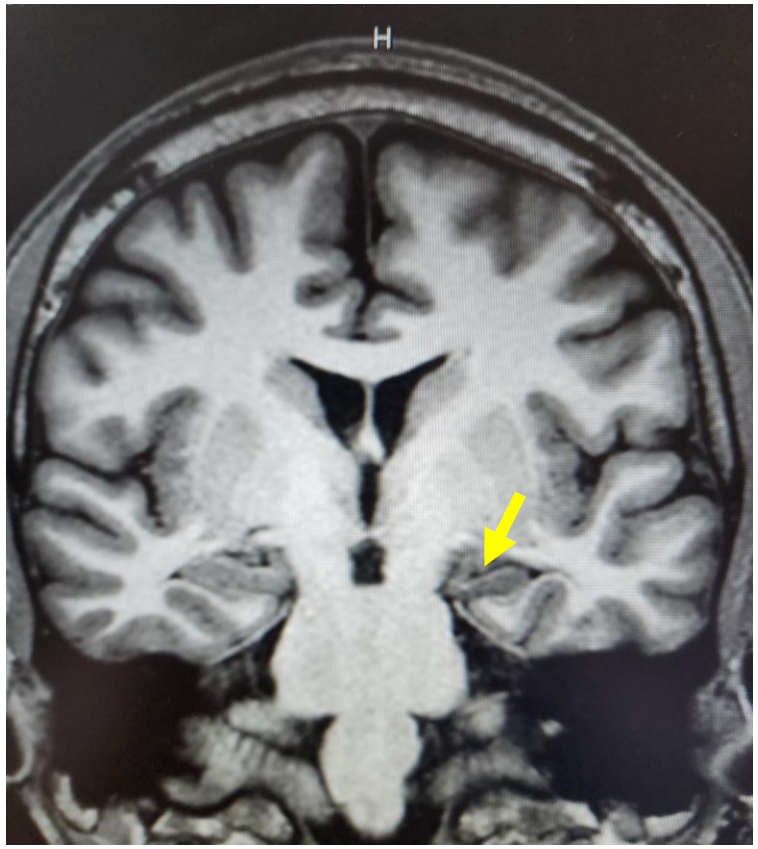
ETIOLOGY IN ADULT TLE

Common pathologies in adult TLE

- Hipppocampal sclerosis (HS)
- Low-grade tumor
- Abnormal vessels: Cavernoma
- Focal cortical dysplasia (FCD)
- Neurocysticercosis

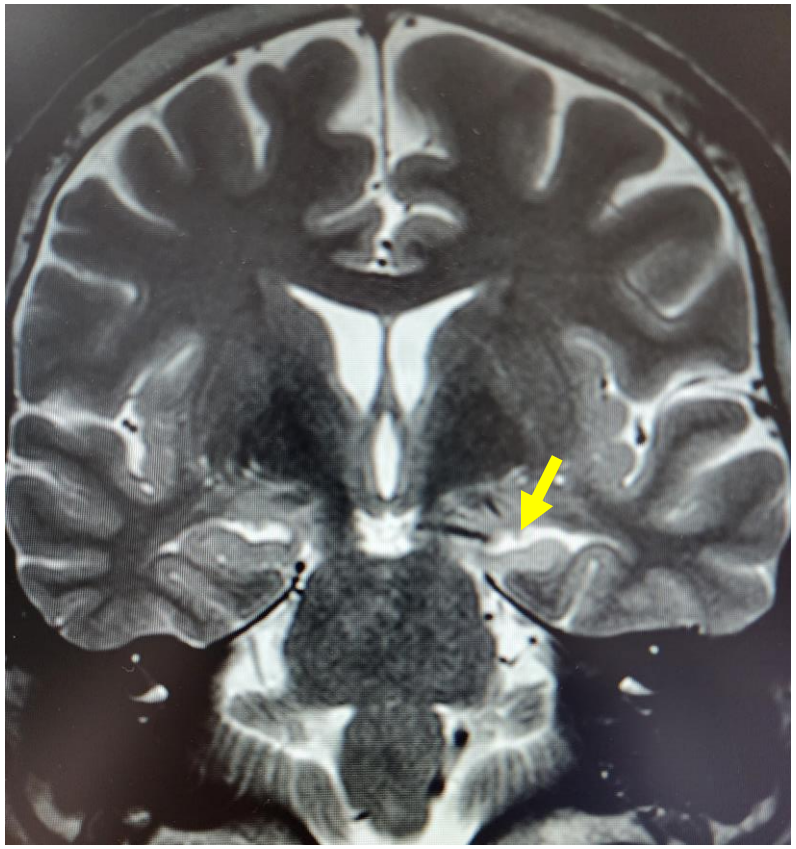
MRI

T1WI



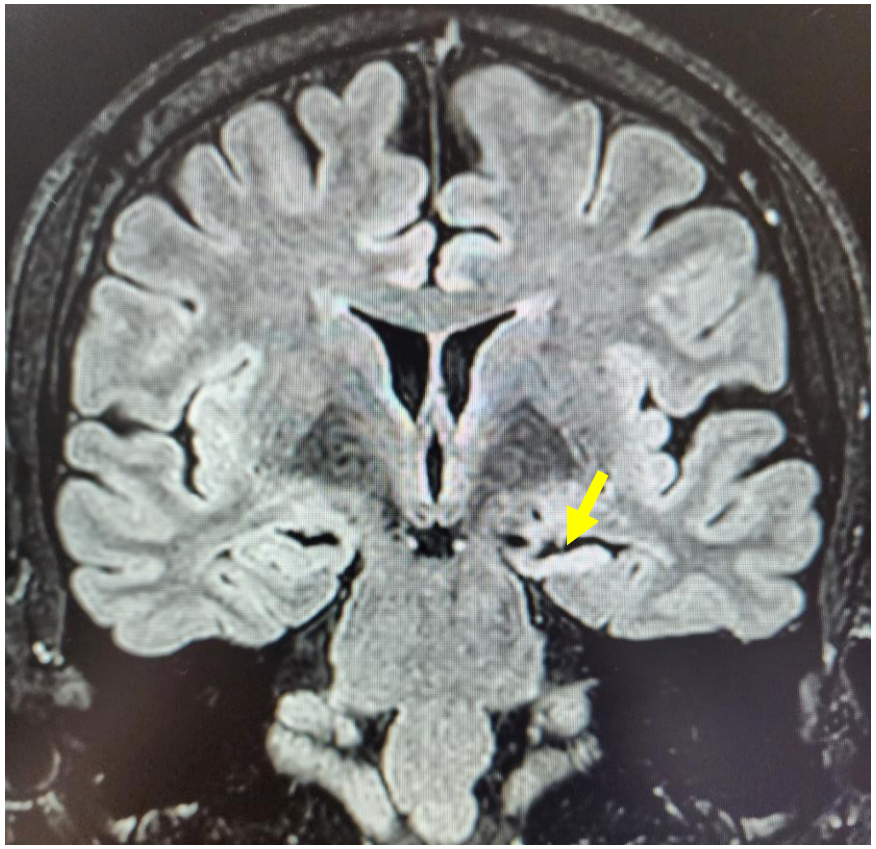
Left HC atrophy

T2WI



- Increased SI
- Loss of internal architecture

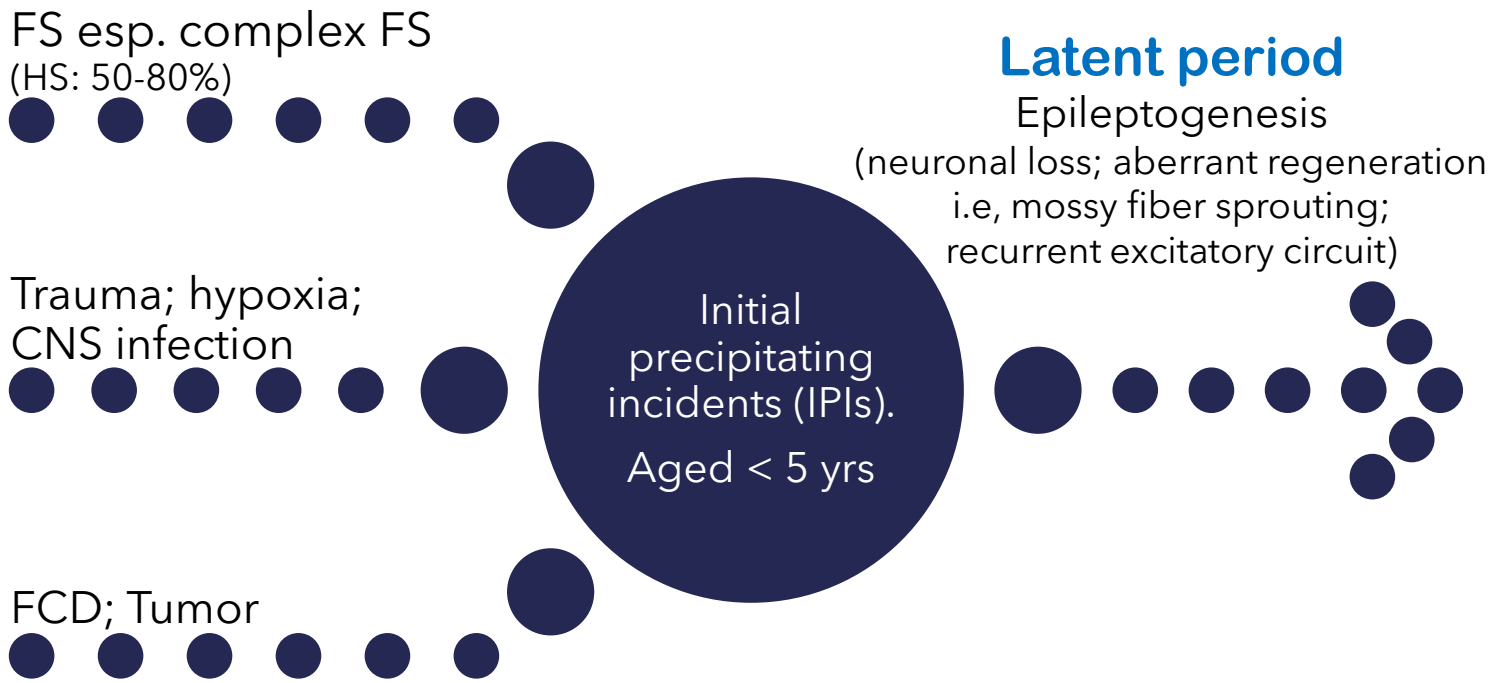
FLAIR



Increased SI

Natural history of MTLE-HS

ILAE Commission on Neurosurgery of Epilepsy; Epilepsia 2004



Epilepsy
Onset of first afebrile seizure:
Late childhood – early adulthood
(4 -16 yrs)

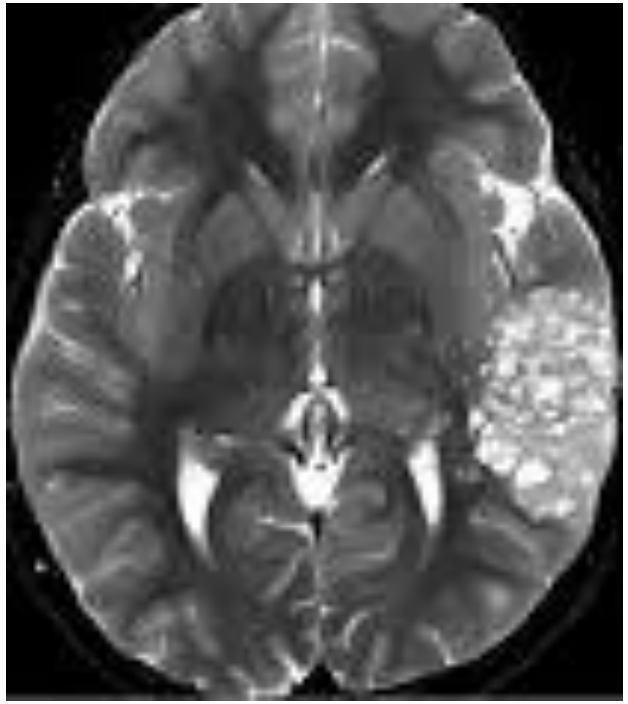
Semiology:

Aura
- Epigastric
- Autonomic
- Mnemonic i.e., déjà vu
- Fear
- Olfactory

Seizure
- Automatism esp. oral
- Behavioral arrest
- Late dystonic seizure
- Postictal aphasia (dominant)

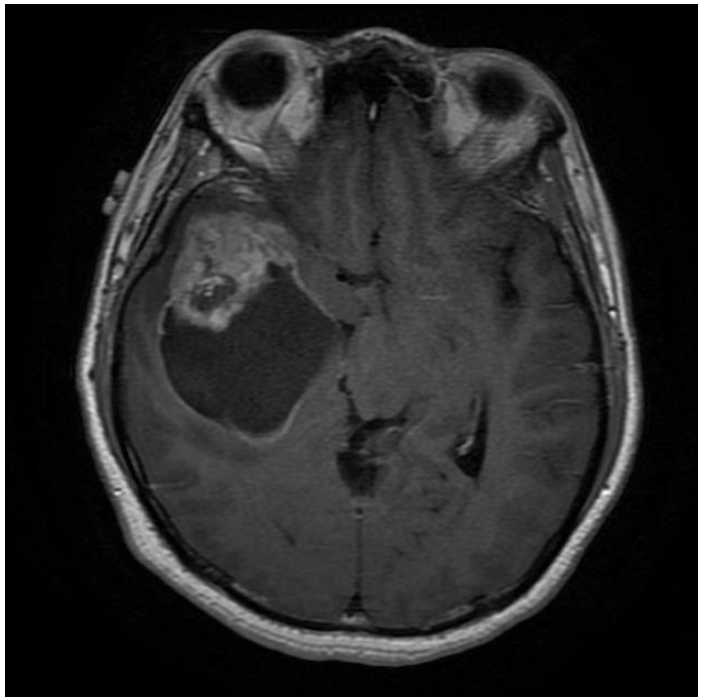
Red flags
- Auditory/visual hallucination
- Somatosensory aura
- Early simple motor seizure

Common temporal tumor causing epilepsy



Dysembryoplastic neuroepithelial tumor (DNET)

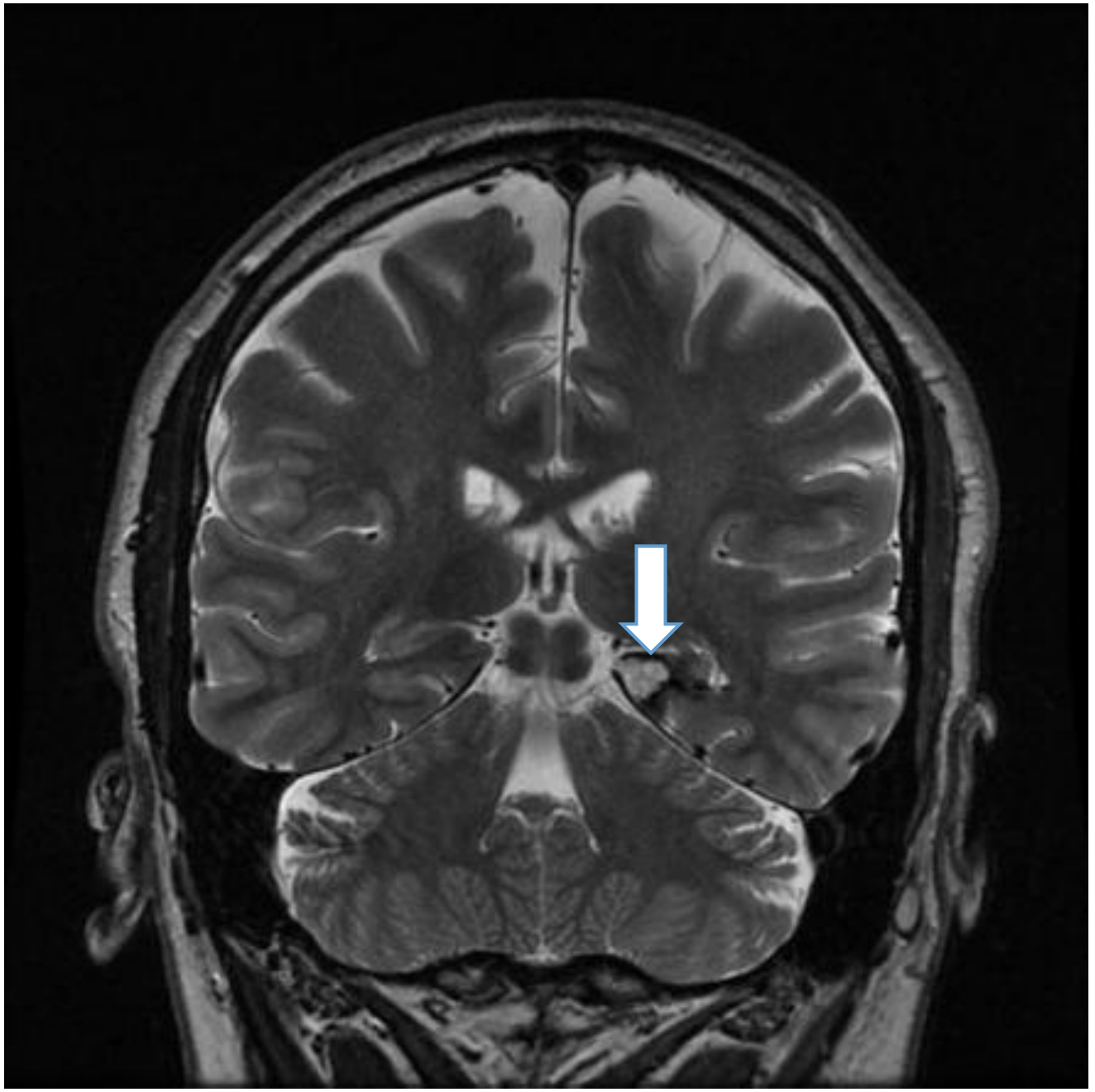
- WHO grade I
- 65% temporal lobe
- associated with cortical dysplasia (up to 80%)
- "**Bubbly appearance**" on T2WI



Ganglioglioma

- WHO grade I
- 70% temporal lobe
- A **partially cystic mass** with an enhancing mural nodule is seen in ~45% of cases

www.neurosurgicalatlas.com
www.radiopaedia.org

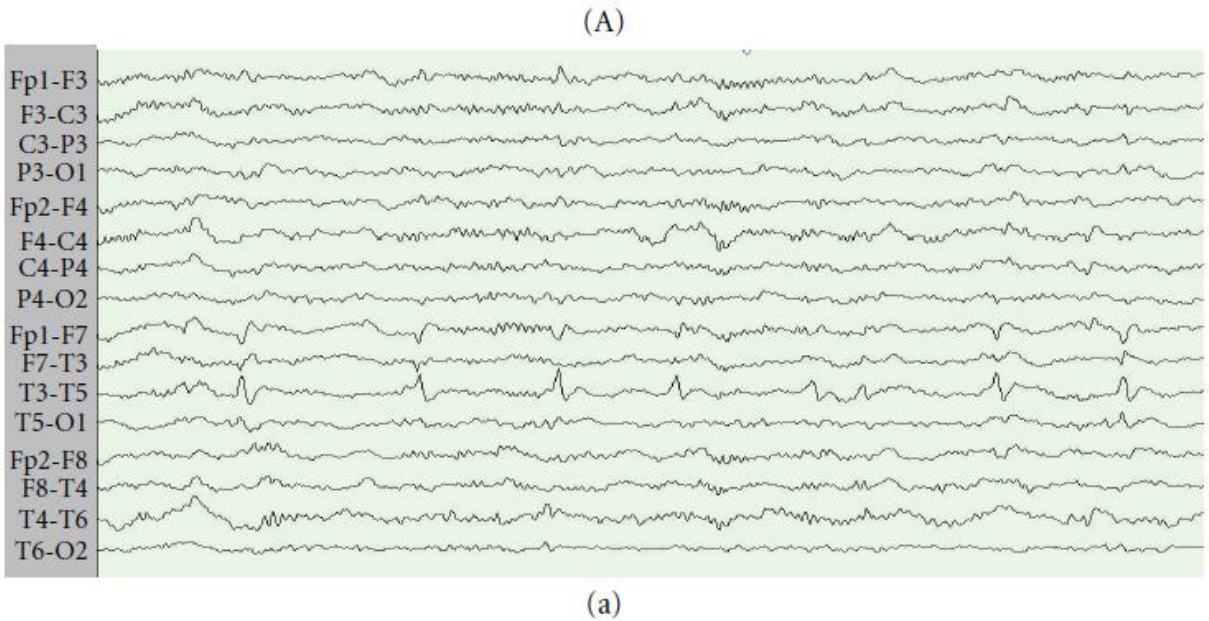


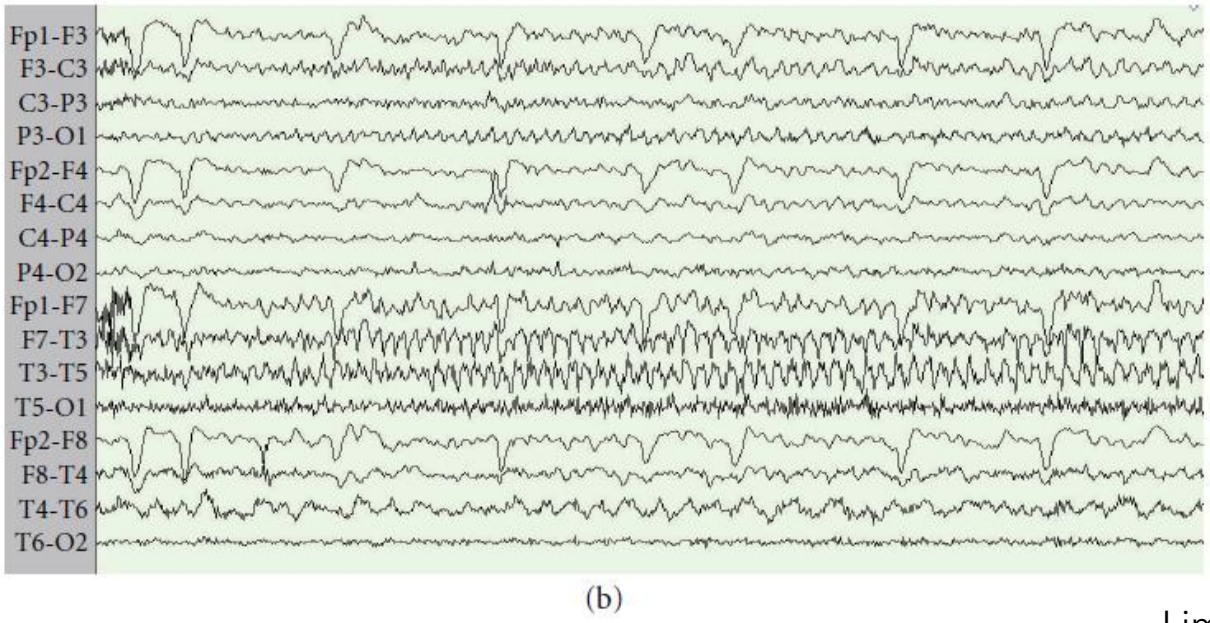
Cavernoma

"**popcorn**" or "**berry**" appearance with a rim of signal loss due to hemosiderin On T2WI

www.radiopaedia.org

ELECTROPHYSIOLOGY





Interictal epileptiform discharges (IEDs)

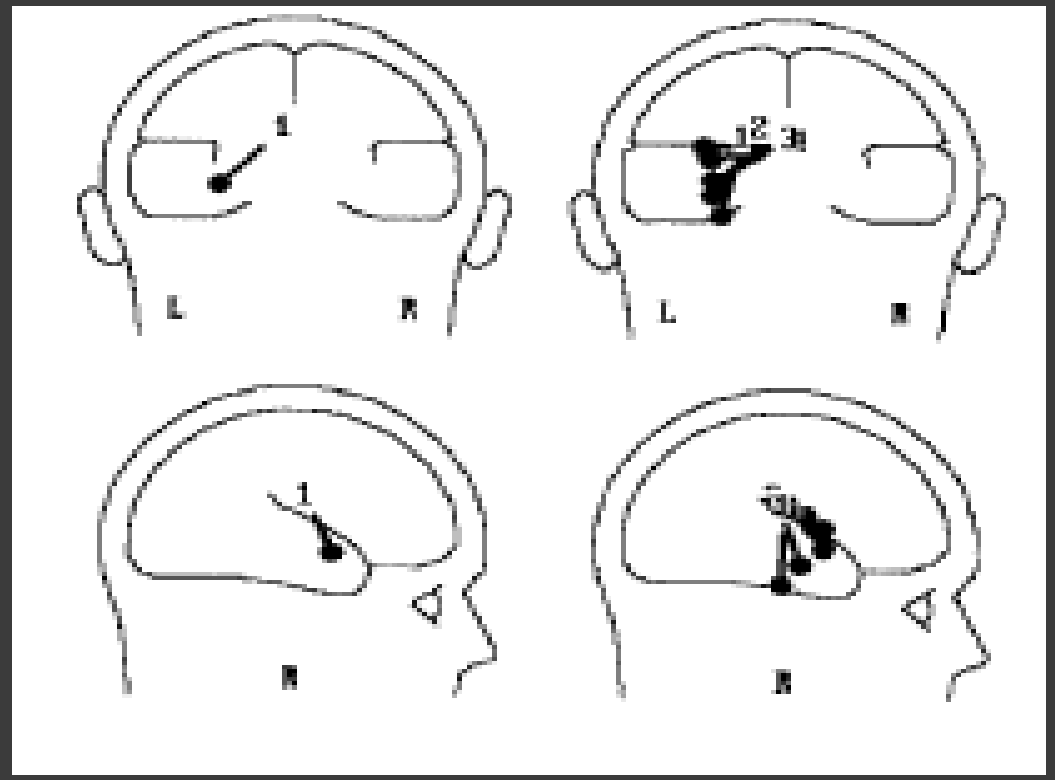
Focal, max negativity F7T3

Ictal discharges

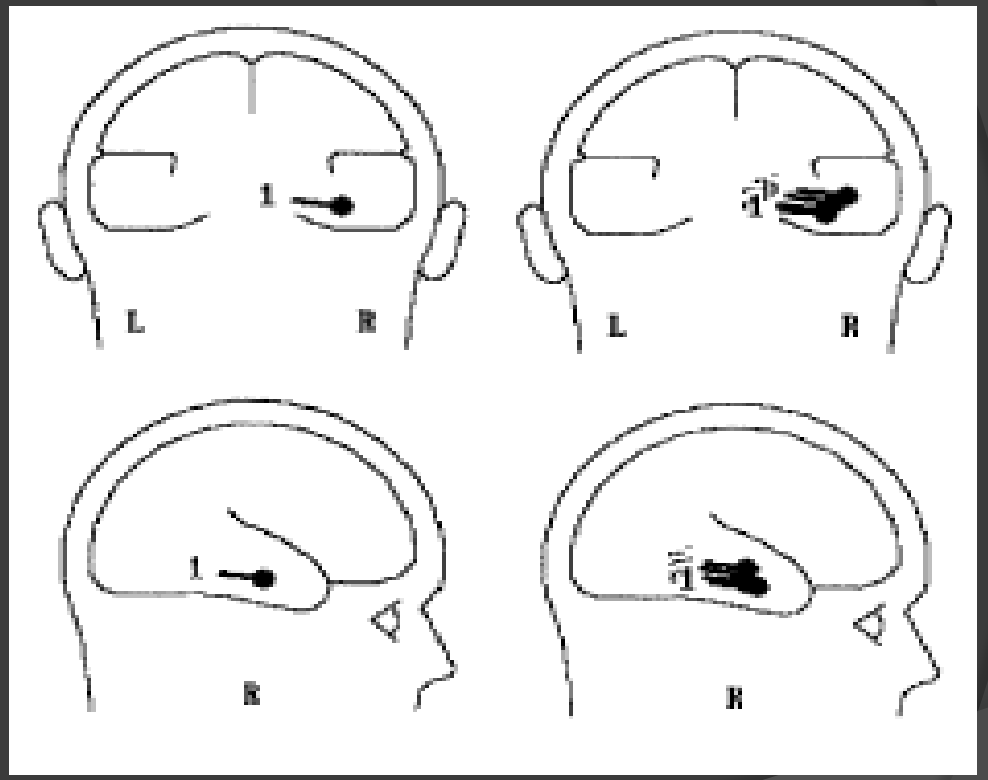
Focal, temporal lobe

Limotai C & and Mirsattari SM; Epilepsy Research and Treatment 2012

Temporal IED voltage topography



Type 1
Mesial temporal source



Type 2
Lateral temporal source

Ebersole JS and Wade PB; Neurology 1991

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Pillar of the Kingdom

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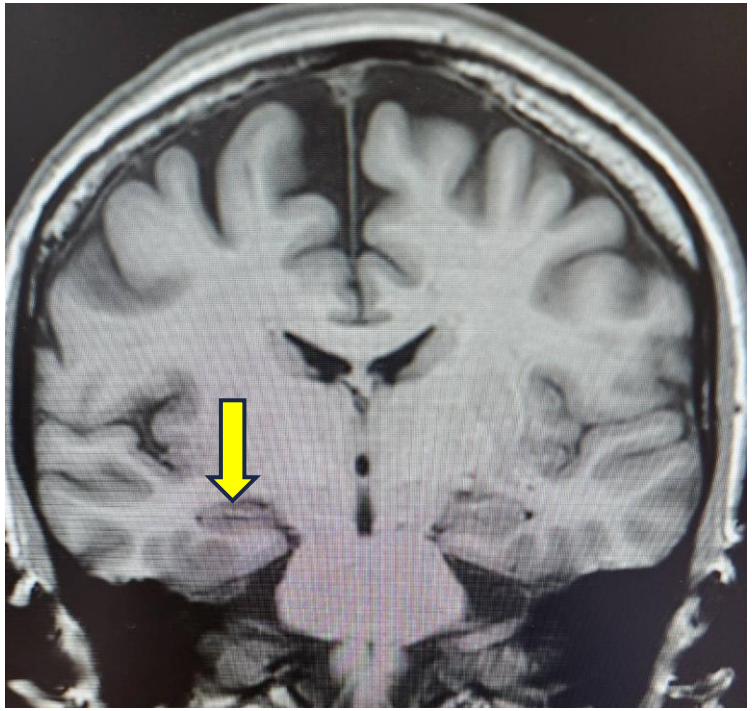
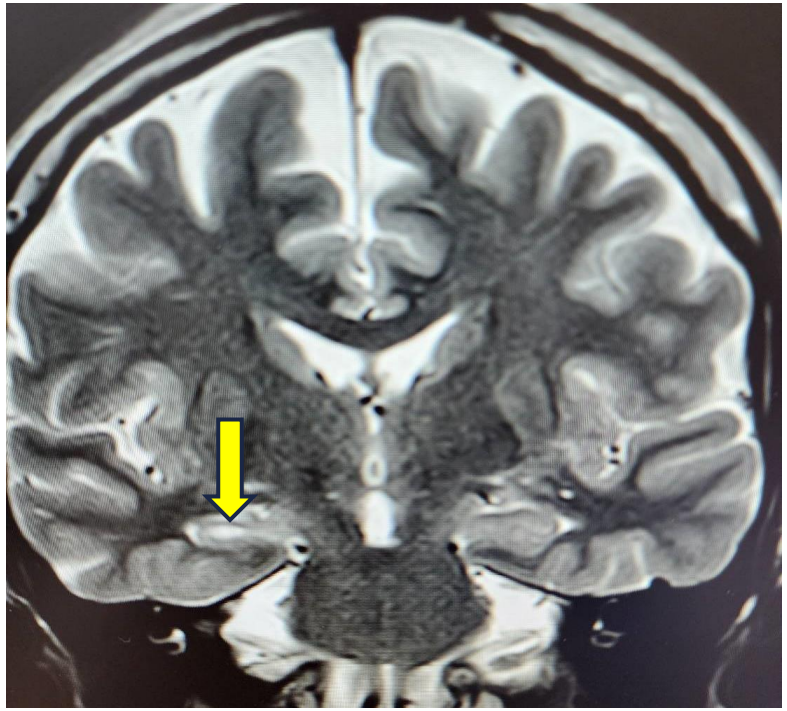
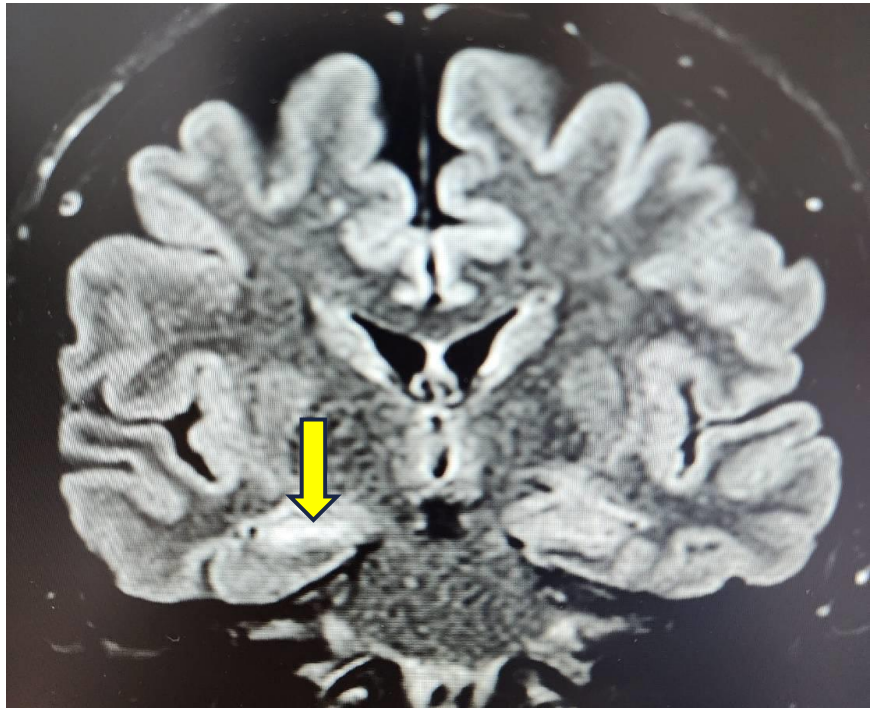
High-resolution EEG in TLE

Seizure-free patient: 32-yo F with Rt. HS
Unitemporal IEDs (FT10>F8T10)







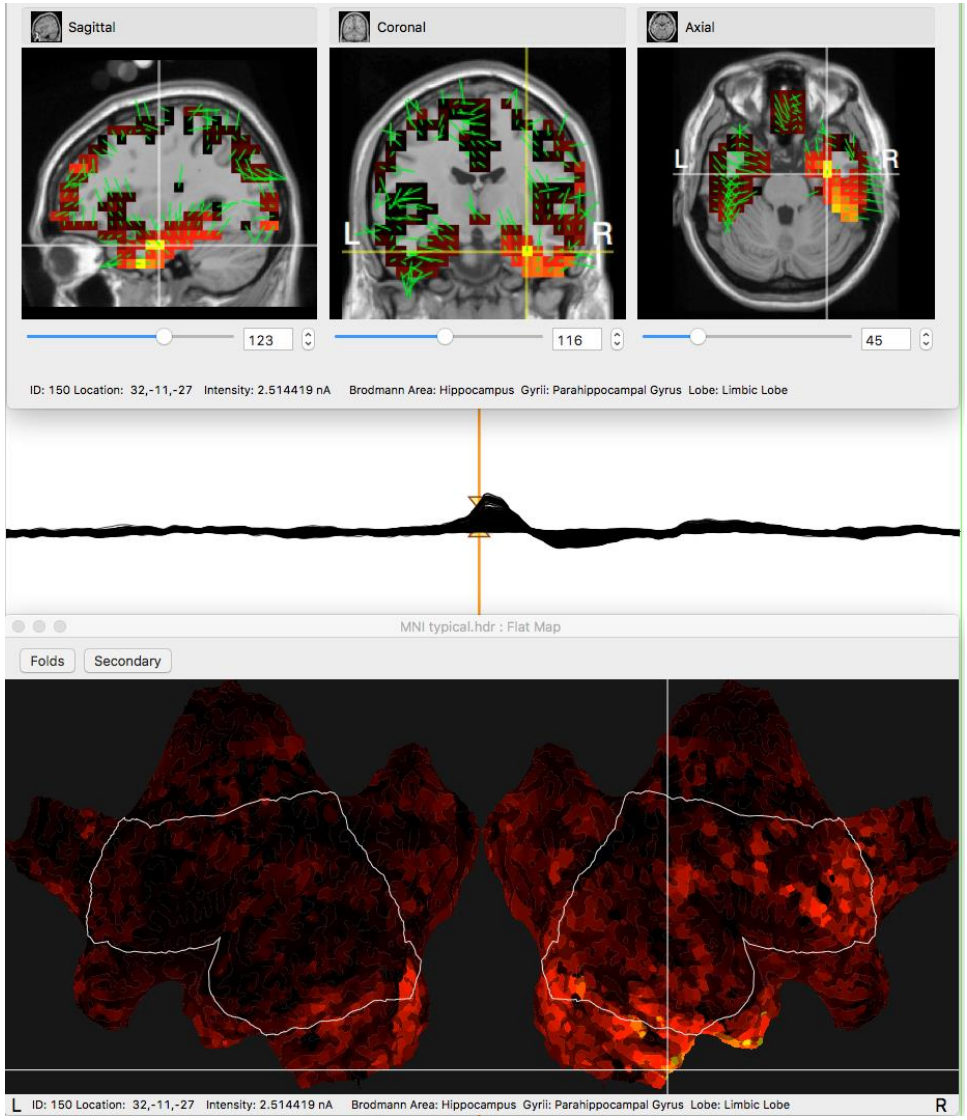
HR-EEG

Surgery:
Rt.ATL

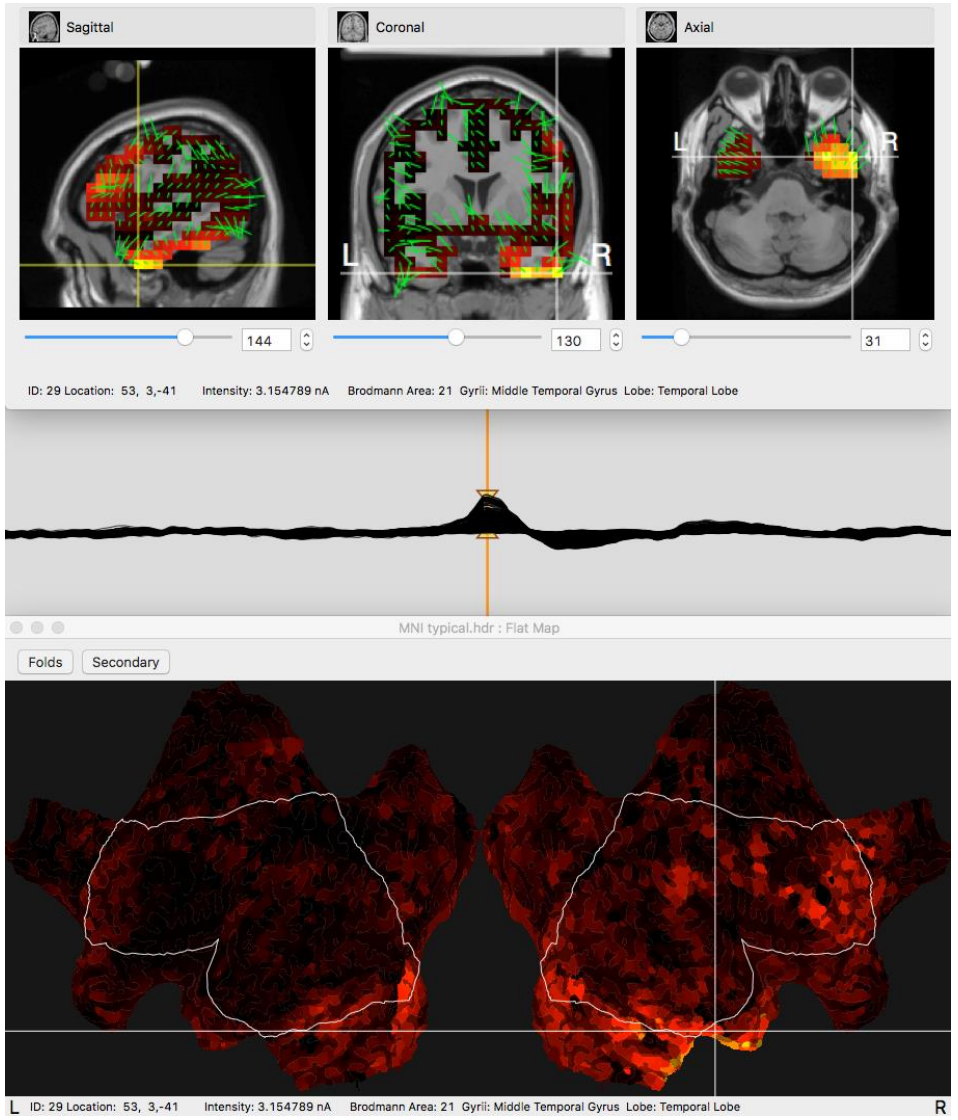
Pathology: HS
ILAE type I

Outcome:
6 yrs, Engel Ia

FT10>F8T10
50% rising phase: HC



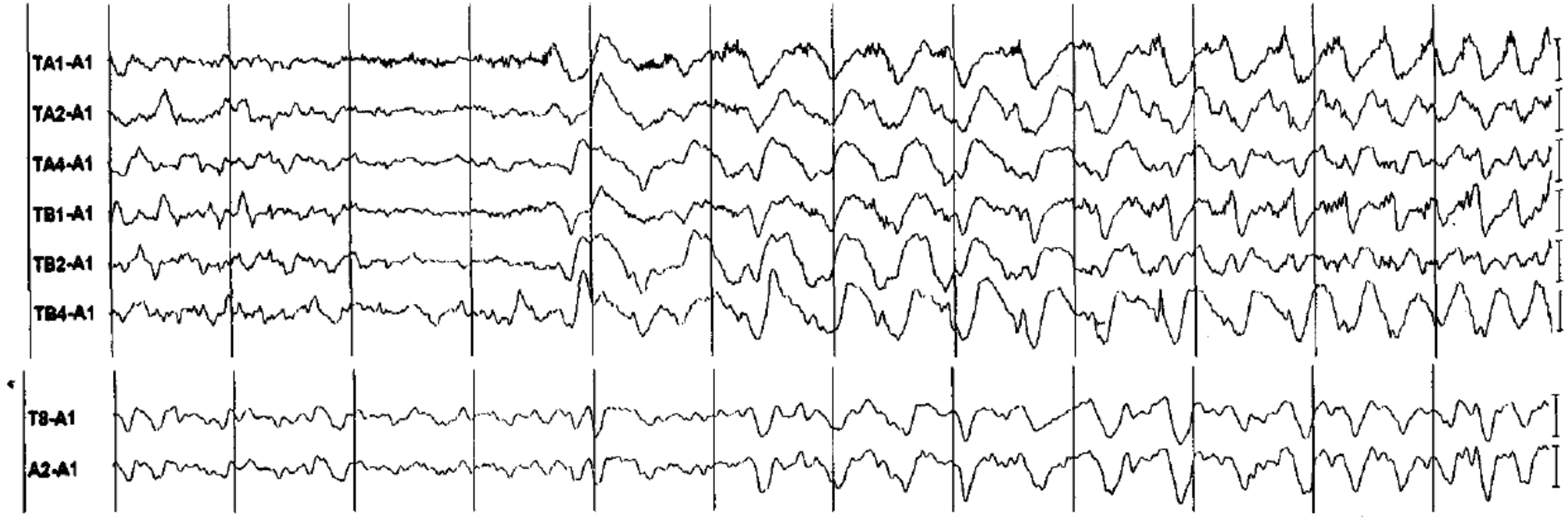
FT10>F8T10
spike peak: BA 21



Ictal EEG (mesial temporal SOZ)

Rhythmic discharge of 5 Hz or faster within the first 30 seconds of the ictal recording (i.e., clinical onset)

Risinger MW et al.; Neurology 1989



Ictal EEG (lateral temporal SOZ)

Irregular 2-Hz delta rhythms

Pacia SV & and Ebersole JS; Epilepsia 1997

	Children (< 6 yrs)	Adults
Interictal epileptiform discharges (IEDs)	▪ Focal spike/sharp ▪ **Only 1/3 strictly temporal**	▪ **Focal spike/sharp** ▪ Unitemporal or bitemporal
Ictal EEG	▪ Recognizable temporal onset ▪ **Generalized discharges** of epileptiform potentials were observed during the motor convulsions without clear localizing predominance in the scalp EEG	▪ Recognizable temporal onset

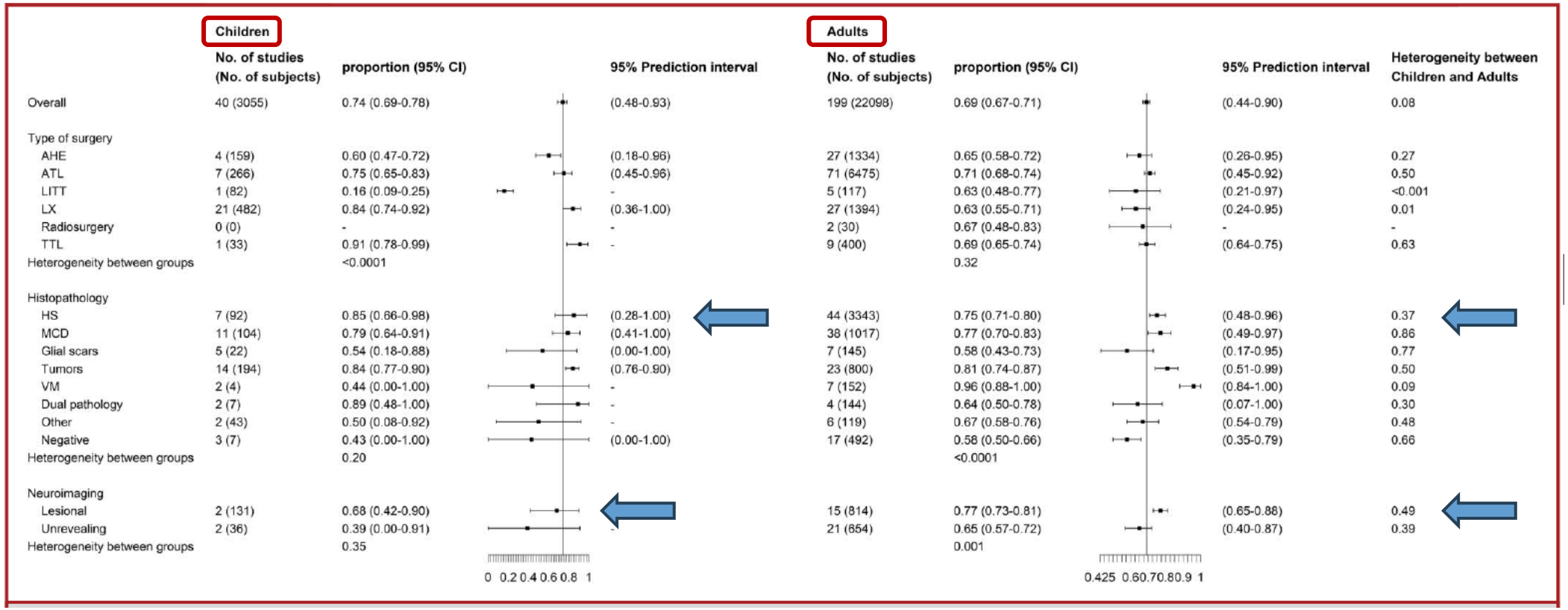
Children should be referred for presurgical evaluation even if their seizure semiology suggests generalized or nontemporal seizures

Fontana E et al., Epilepsia 2006
Brockhaus A & Elger CE; Epilepsia 1995

SURGICAL OUTCOME

Seizure Outcome of Temporal Lobe Epilepsy Surgery in Adults and Children: A Systematic Review and Meta-Analysis

Barba C et al., Neurosurgery 2022



	Children			Adults			
	No. of studies (No. of subjects)	proportion (95% CI)	95% Prediction interval	No. of studies (No. of subjects)	proportion (95% CI)	95% Prediction interval	Heterogeneity between Children and Adults
Overall	40 (3055)	0.74 (0.69-0.78)	(0.48-0.93)	199 (22098)	0.69 (0.67-0.71)	(0.44-0.90)	0.08
Type of surgery							
AHE	4 (159)	0.60 (0.47-0.72)	(0.18-0.96)	27 (1334)	0.65 (0.58-0.72)	(0.26-0.95)	0.27
ATL	7 (266)	0.75 (0.65-0.83)	(0.45-0.96)	71 (6475)	0.71 (0.68-0.74)	(0.45-0.92)	0.50
LITT	1 (82)	0.16 (0.09-0.25)	-	5 (117)	0.63 (0.48-0.77)	(0.21-0.97)	<0.001
LX	21 (482)	0.84 (0.74-0.92)	(0.36-1.00)	27 (1394)	0.63 (0.55-0.71)	(0.24-0.95)	0.01
Radiosurgery	0 (0)	-	-	2 (30)	0.67 (0.48-0.83)	-	-
TTL	1 (33)	0.91 (0.78-0.99)	-	9 (400)	0.69 (0.65-0.74)	(0.64-0.75)	0.63
Heterogeneity between groups		<0.0001			0.32		
Histopathology							
HS	7 (92)	0.85 (0.66-0.98)	(0.28-1.00)	44 (3343)	0.75 (0.71-0.80)	(0.48-0.96)	0.37
MCD	11 (104)	0.79 (0.64-0.91)	(0.41-1.00)	38 (1017)	0.77 (0.70-0.83)	(0.49-0.97)	0.86
Glial scars	5 (22)	0.54 (0.18-0.88)	(0.00-1.00)	7 (145)	0.58 (0.43-0.73)	(0.17-0.95)	0.77
Tumors	14 (194)	0.84 (0.77-0.90)	(0.76-0.90)	23 (800)	0.81 (0.74-0.87)	(0.51-0.99)	0.50
VM	2 (4)	0.44 (0.00-1.00)	-	7 (152)	0.96 (0.88-1.00)	(0.84-1.00)	0.09
Dual pathology	2 (7)	0.89 (0.48-1.00)	-	4 (144)	0.64 (0.50-0.78)	(0.07-1.00)	0.30
Other	2 (43)	0.50 (0.08-0.92)	-	6 (119)	0.67 (0.58-0.76)	(0.54-0.79)	0.48
Negative	3 (7)	0.43 (0.00-1.00)	(0.00-1.00)	17 (492)	0.58 (0.50-0.66)	(0.35-0.79)	0.66
Heterogeneity between groups		0.20			<0.0001		
Neuroimaging							
Lesional	2 (131)	0.68 (0.42-0.90)		15 (814)	0.77 (0.73-0.81)	(0.65-0.88)	0.49
Unrevealing	2 (36)	0.39 (0.00-0.91)	-	21 (654)	0.65 (0.57-0.72)	(0.40-0.87)	0.39
Heterogeneity between groups		0.35			0.001		

- **The proportion of seizure freedom after TLE surgery was higher in children, although not significantly**
- The proportions of patients achieving Engel I/ILAE 1 and Engel IA/ILAE 1A outcomes were 0.74 (95% CI, 0.69-0.78) and 0.61 (0.48-0.74) for **children** and 0.69 (0.67-0.71) and 0.56 (0.52-0.60) for **adults**

Summary

	Children (< 6 yrs)	Adults
Semiology	▪ Simple motor seizure ▪ Mostly without aura	▪ Complex motor seizure ▪ Secondarily BTC ▪ Aura ▪ Dystonic seizure ▪ > 1 seizure component
Etiology	▪ FCD ▪ HS + FCD	▪ HS ▪ Low-grade tumor
Electrophysiology	▪ Focal, less confined to temporal lobe ▪ Generalized	Focal, mostly confined to temporal lobe
Surgical outcome	Depends upon ▪ Pathology: HS (good outcome) ▪ Lesional (good outcome)	

Thank you for your attention