Phramongkutklao Comprehensive
Pediatric Epilepsy Center of Excellence

Integration • Passion • Wisdom

Interictal and Ictal patterns in focal seizures

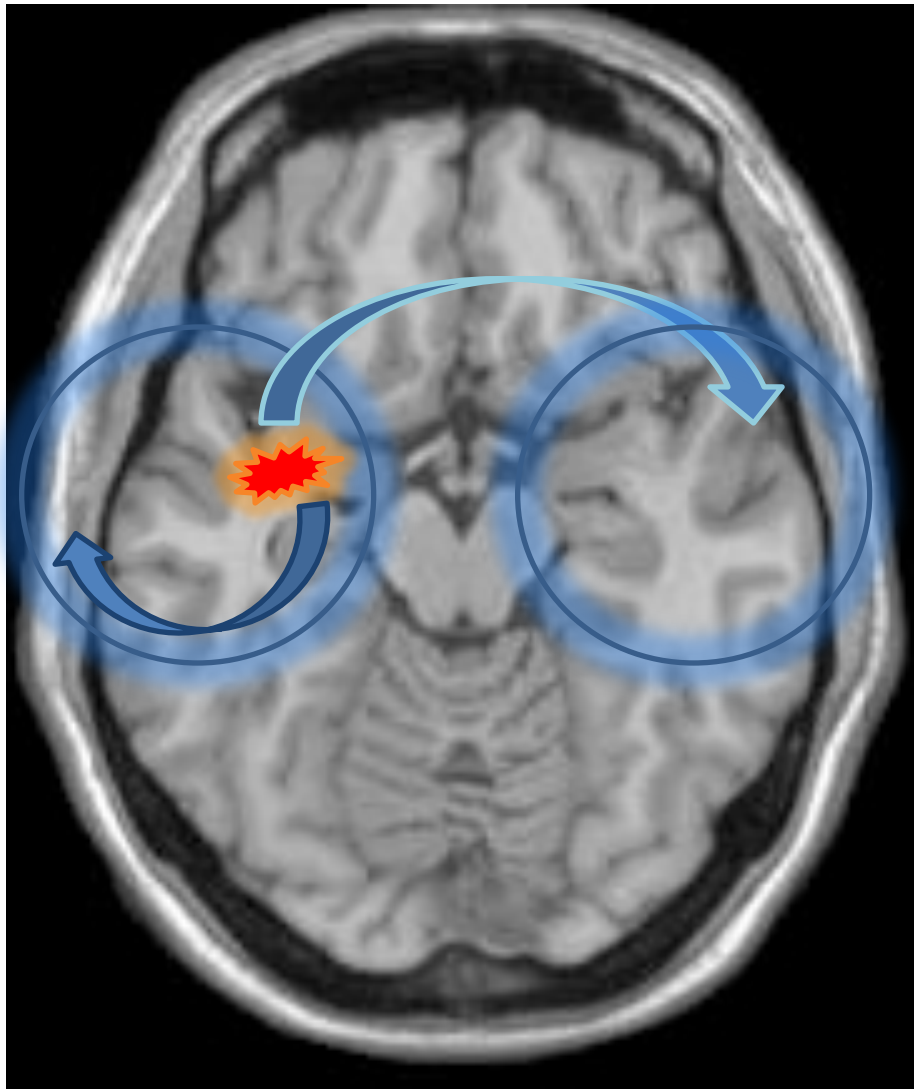
Piradee Suwanpakdee, MD
Division of Neurology
Department of Pediatrics
Phramongkutklao Hospital and College of Medicine

Outline

- Recognize various patterns of interictal EEG
- Identify ictal pattern of focal seizures based on lobar involvement
- Recognize seizure semiology of focal seizures

Focal seizures

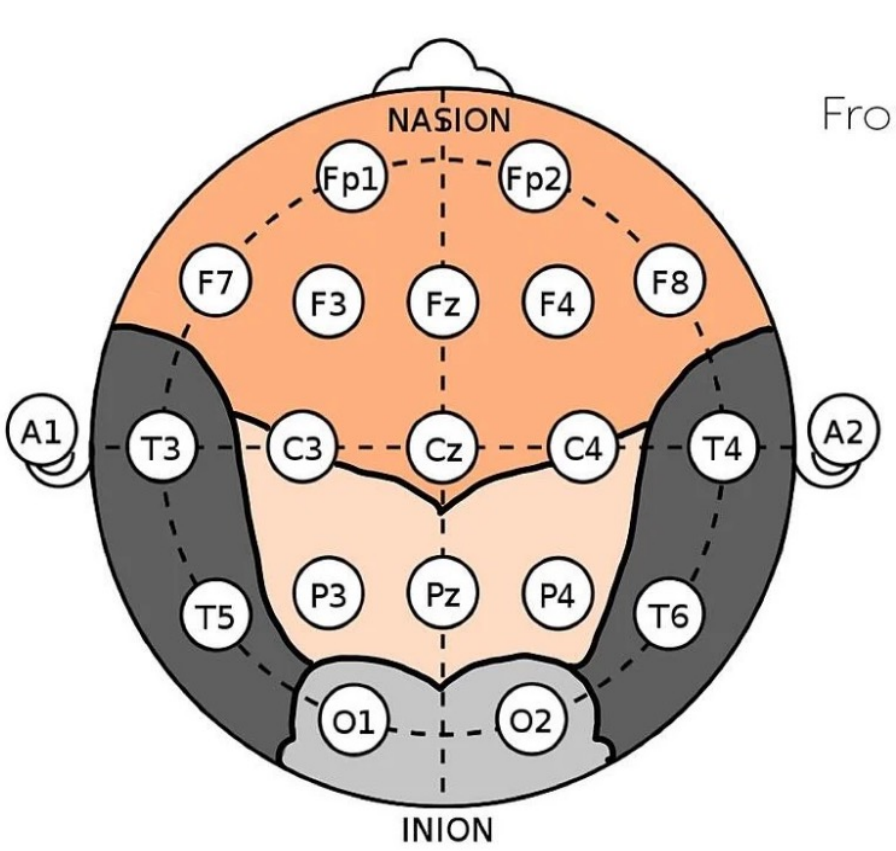
- Originate within networks limited to one hemisphere
- May be discretely localized
  or more widely distributed….

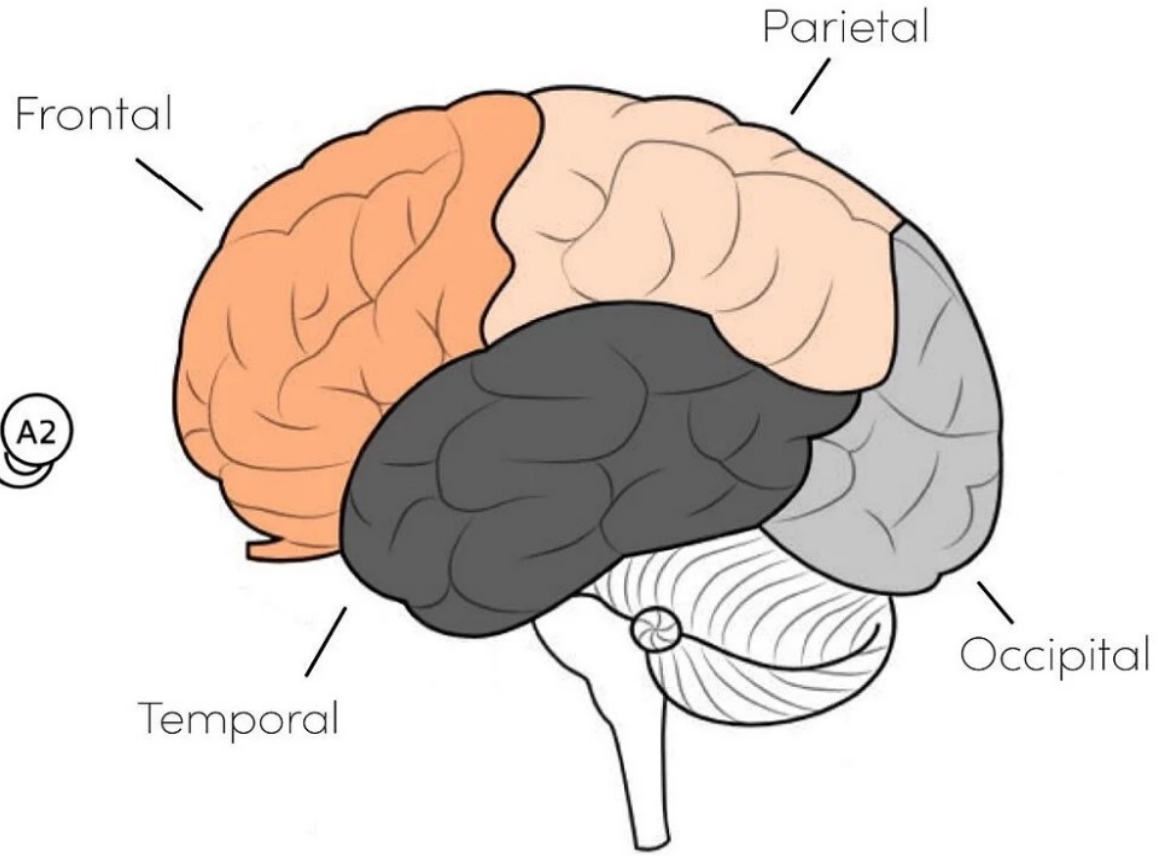


www.ILAE.org

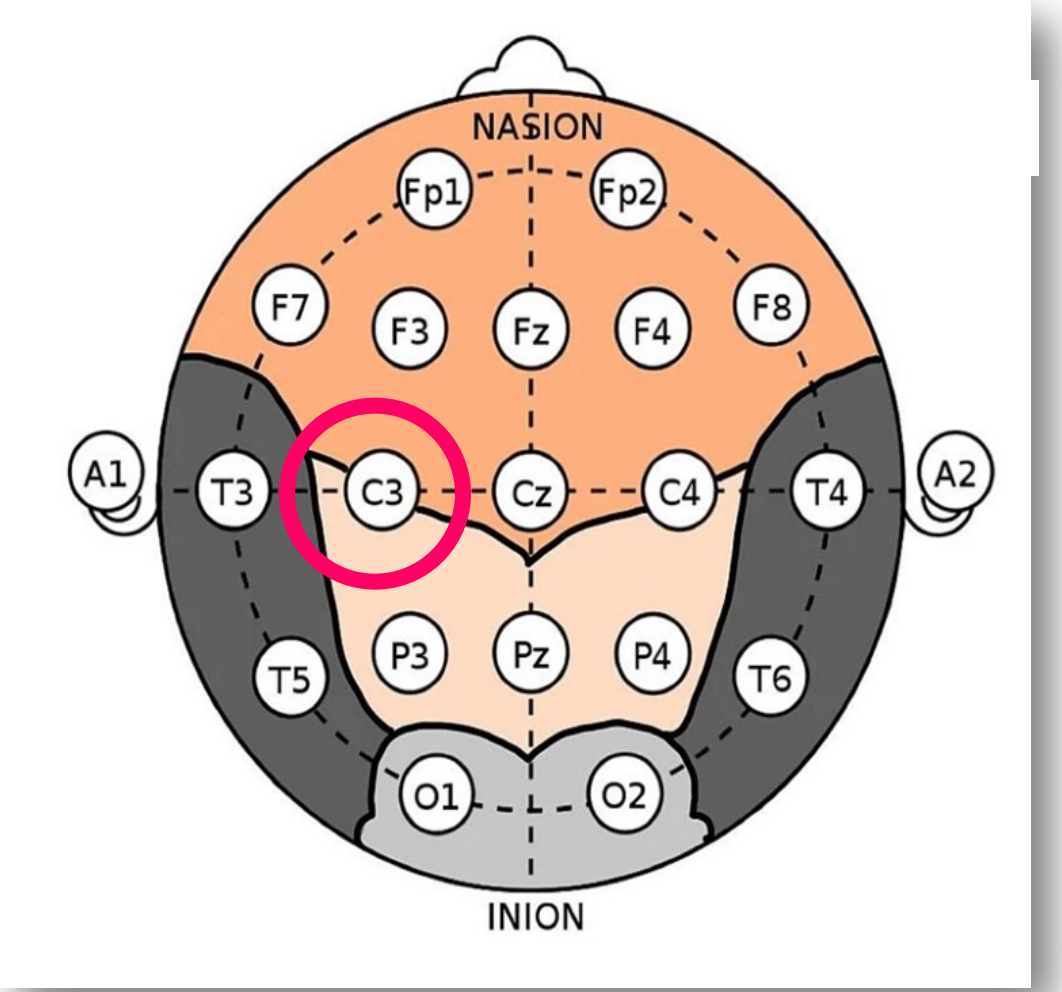
EEG Electrode placement

The 10-20 System



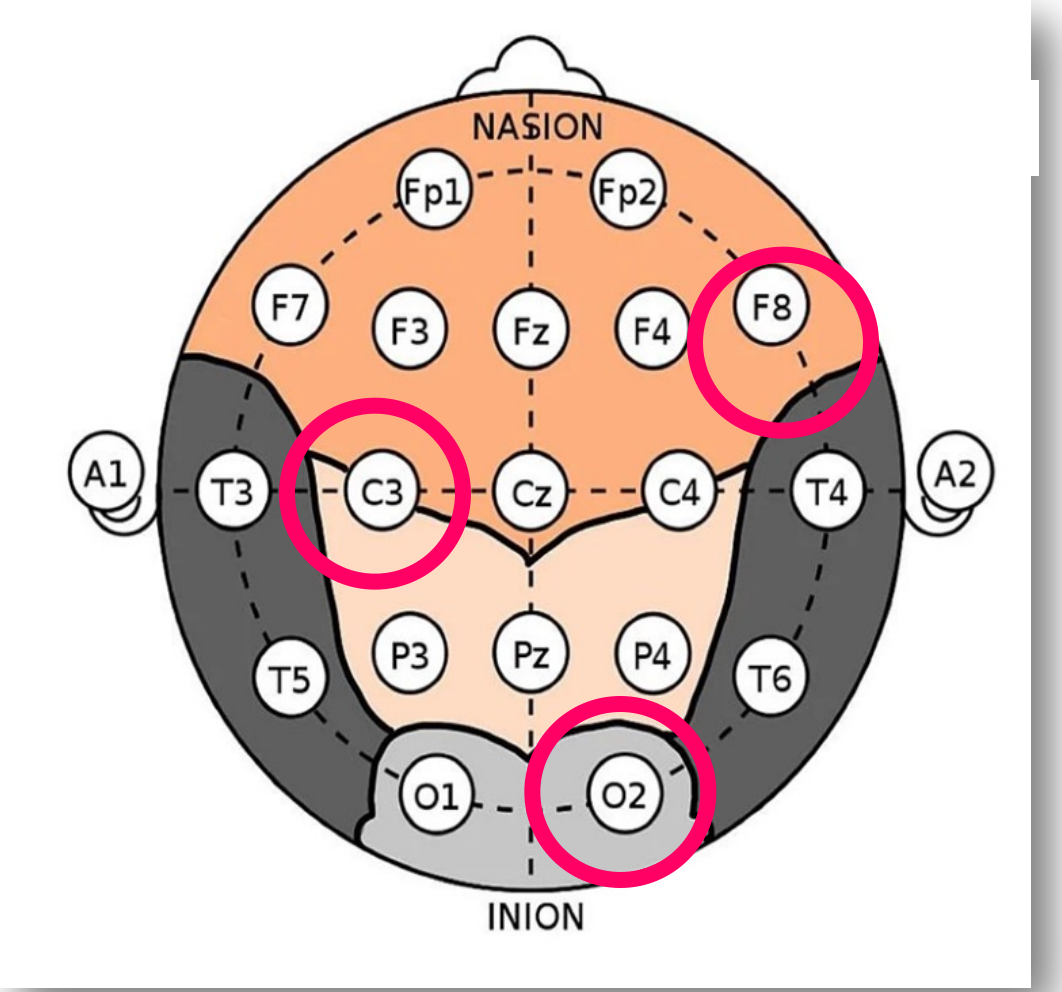


Localization of EEG abnormalities



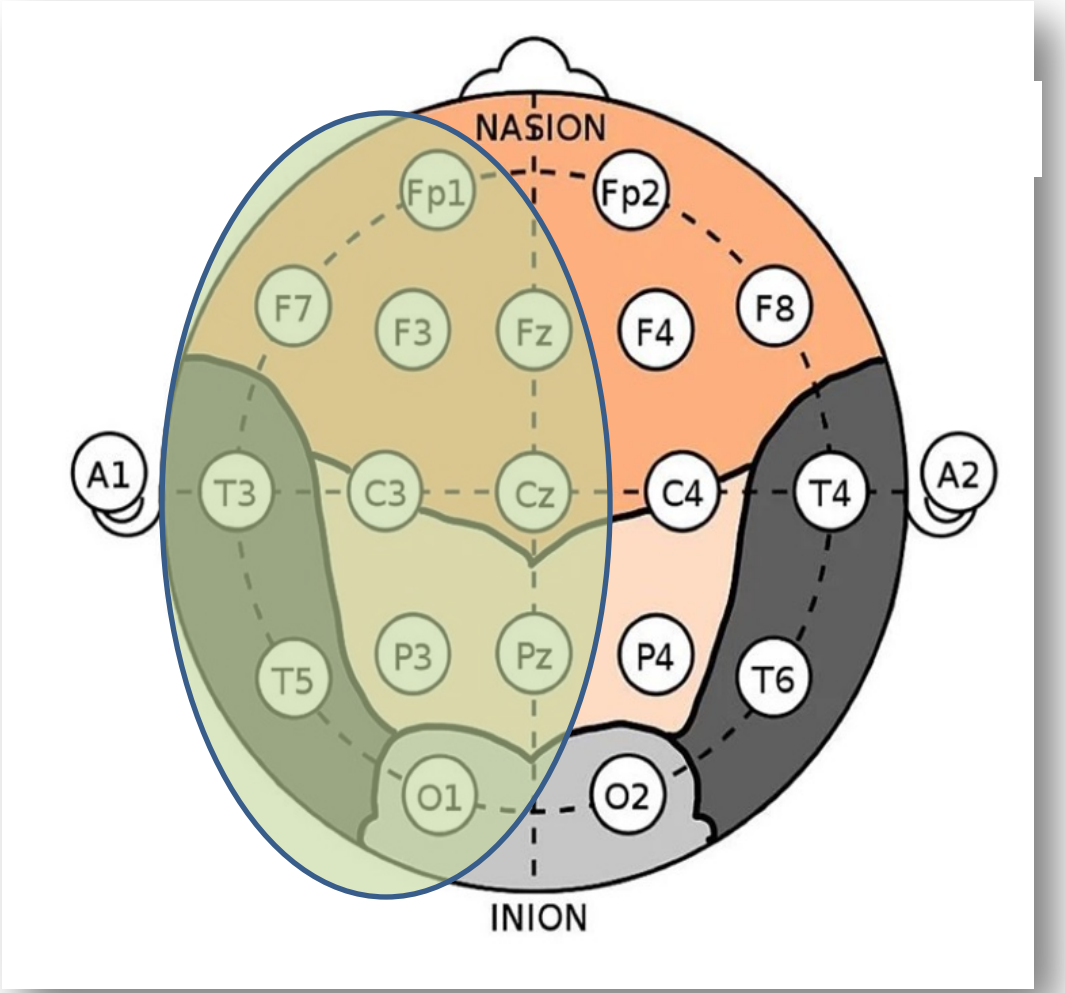
- Regional: One lobe or less

Localization of EEG abnormalities



- Multiregional: Three or more independent regional foci

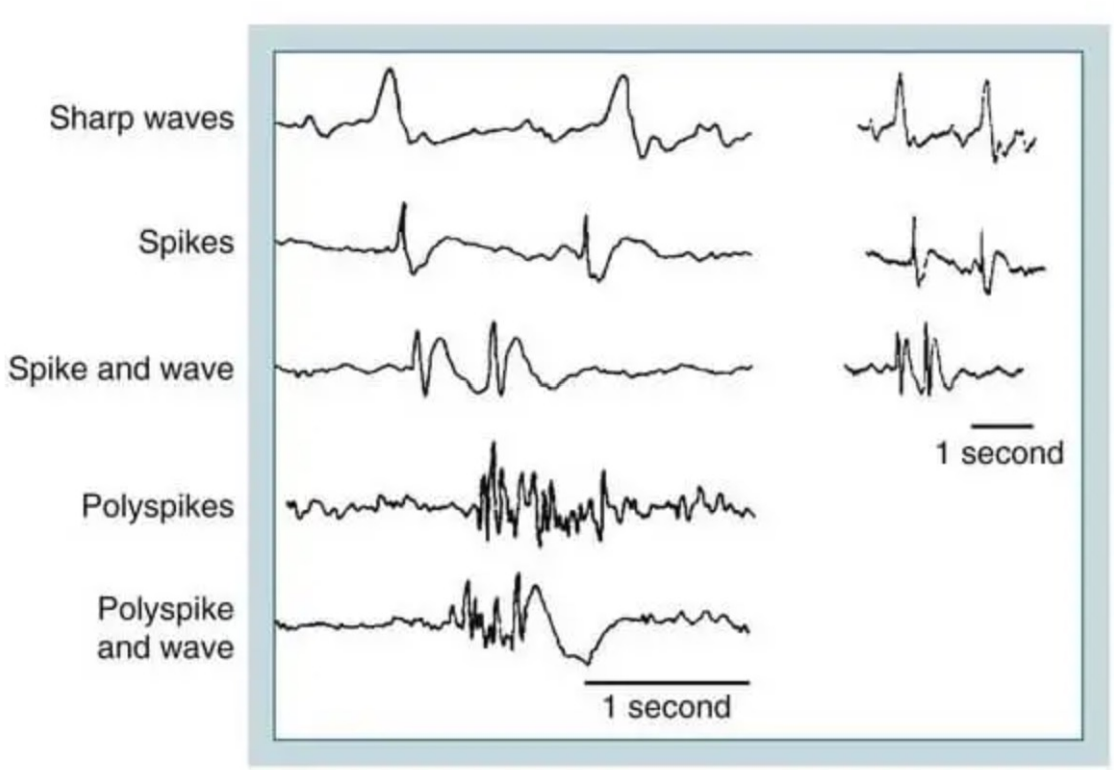
Localization of EEG abnormalities



- Lateralized: One hemisphere

Interictal EEG

- Interictal EEG is defined as an electroencephalographic recording that does not contain seizures or ictal manifestations and is therefore obtained in the intervals between clinical attacks



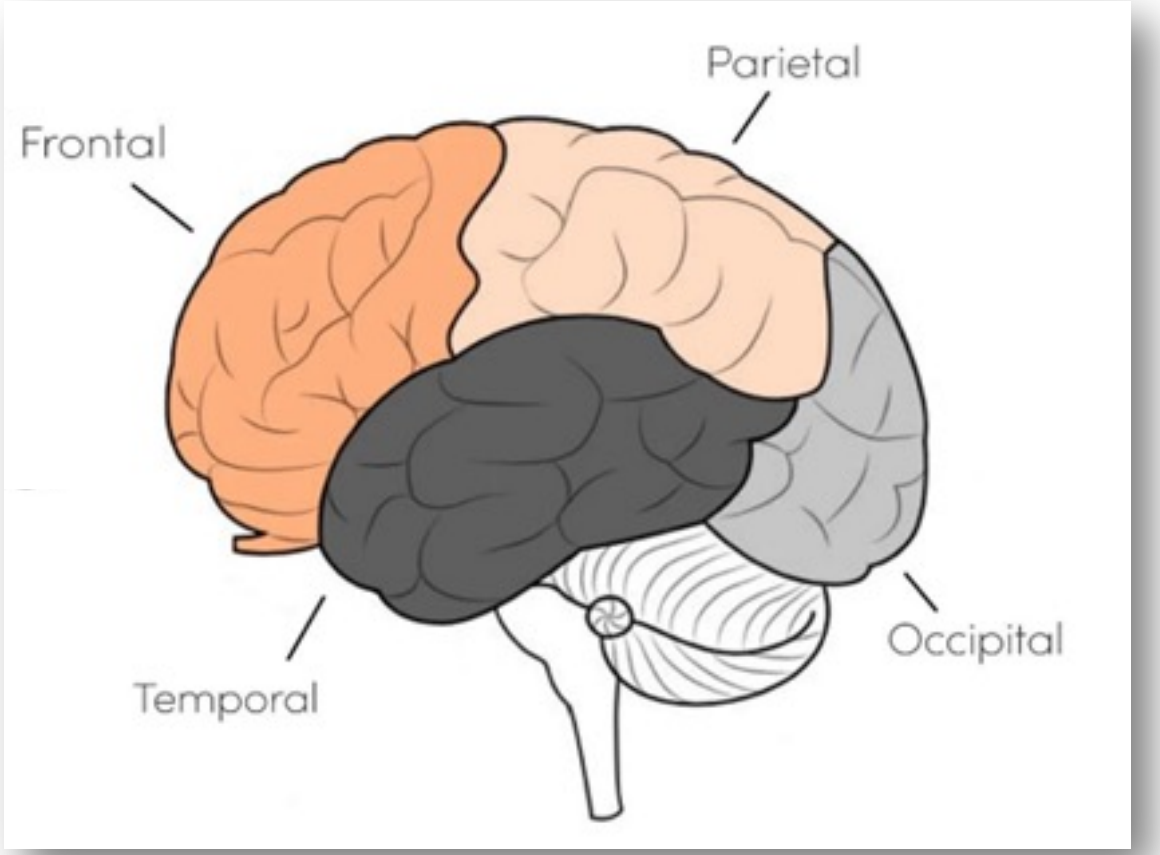
Ictal EEG patterns

- A prolongation of a well-defined interictal pattern
- Completely different from preceding interictal discharges

Ictal EEG patterns

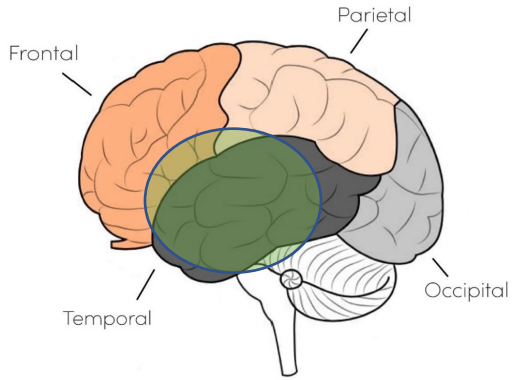
- Abrupt cessation of interictal epileptiform abnormalities immediately before ictal onset
- Rhythmic repetitive discharges that evolve in frequency, field or amplitude in focal seizures
- Isomorphic patterns such as repetitive interictal discharges in some of the IGE (not observed in focal epilepsy)
- Sudden generalized or lateralized attenuation of amplitude

Focal seizures based on specific lobular involvement

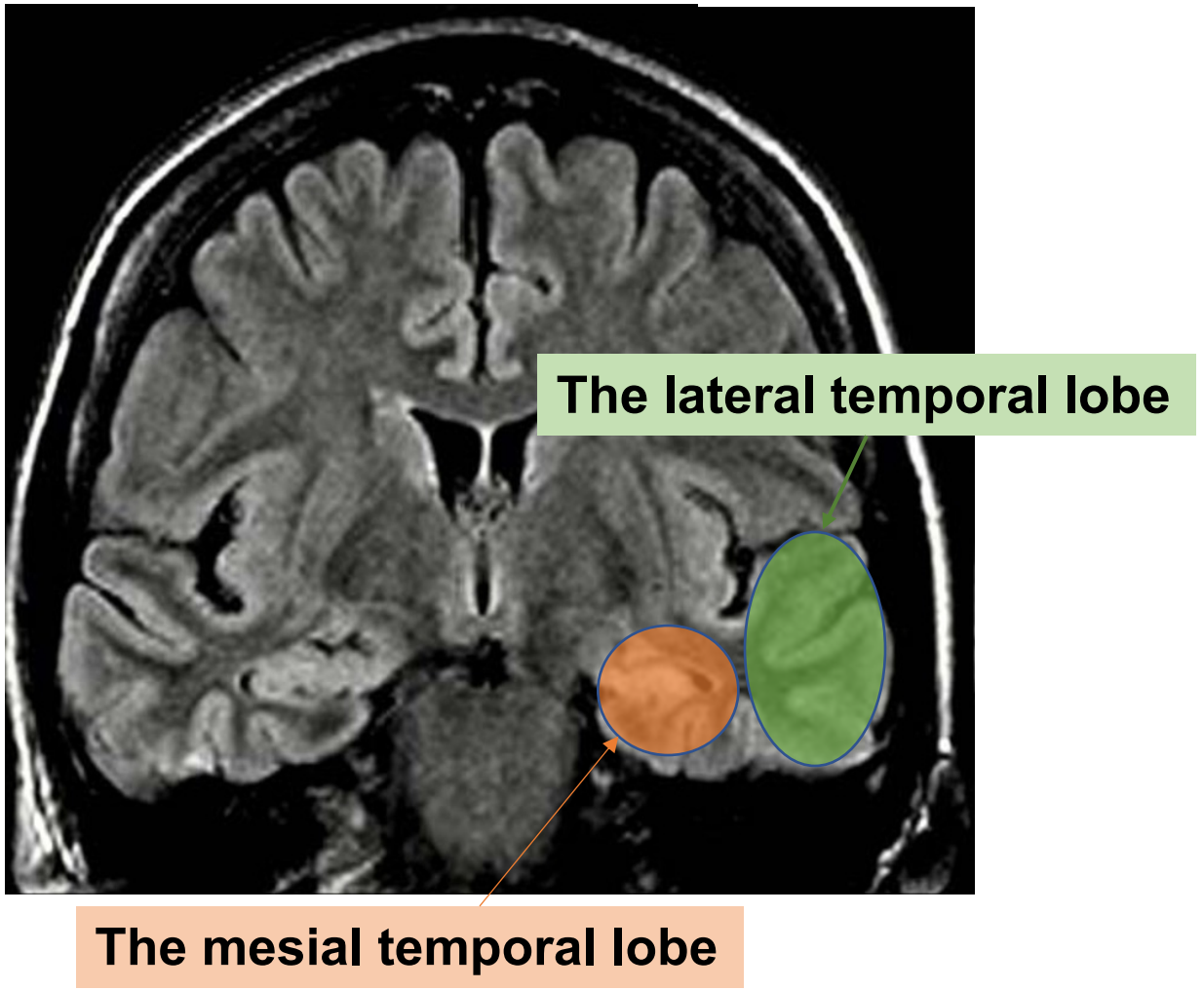


Seizure semiology + EEG data

Temporal lobe epilepsy



- Temporal lobe epilepsy is the most common
- Two-thirds of epilepsies originate from **the mesial temporal lobe regions**
- One-third orginate from **the lateral temporal lobe regions**
- Hippocampal sclerosis is common up to 65% of cases



Seizure semiology of mesial temporal lobe epilepsy

- 80% of patients report an aura with experiential and viscero-sensory symptoms
  - Psychic aura: anxiety, deja vu, and fear, and in addition viscerosensory auras with a nausea, “butterflies,” or rising indescribable sensation from the epigastrium commonly occur[1]

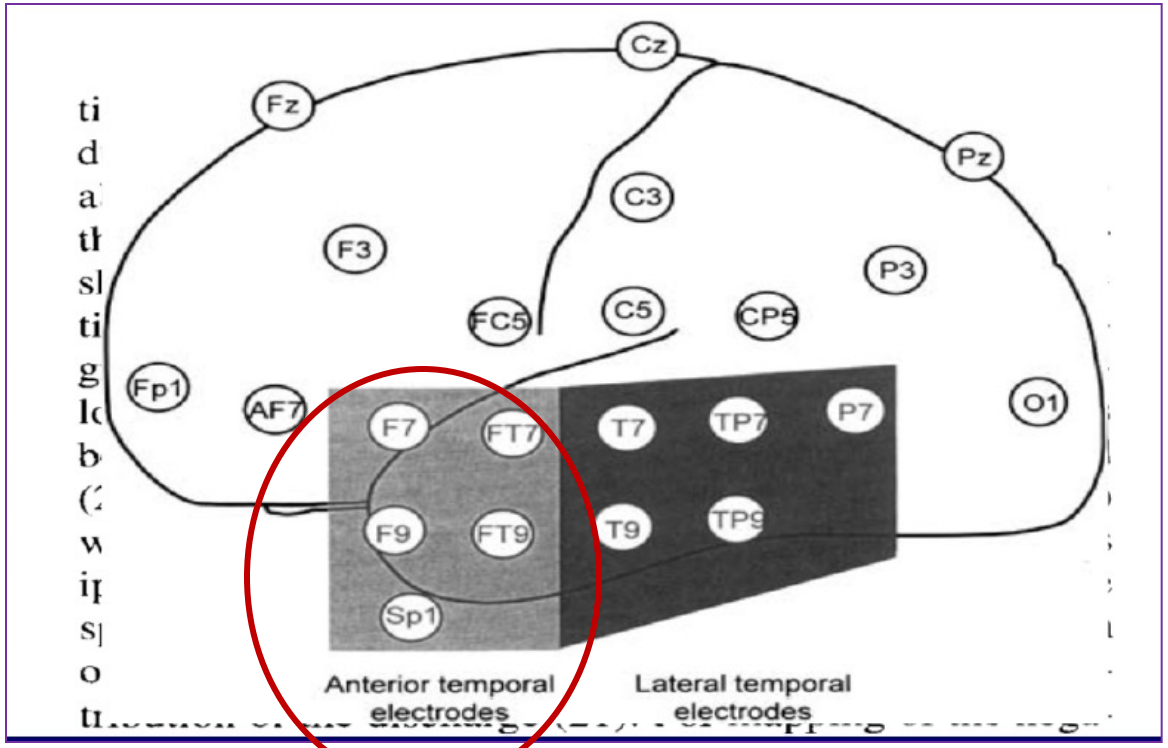
- Behavioral arrest that is observed as a blank facial expression along with loss of awareness. This change is followed by oral, facial, or alimentary automatisms

- Dystonic posturing contralateral to the hemisphere of seizure origin with ipsilateral automatisms during the seizure are lateralizing signs[2]

[1]Thompson et al, 2000
[2] So, 2006

Mesial temporal lobe seizure

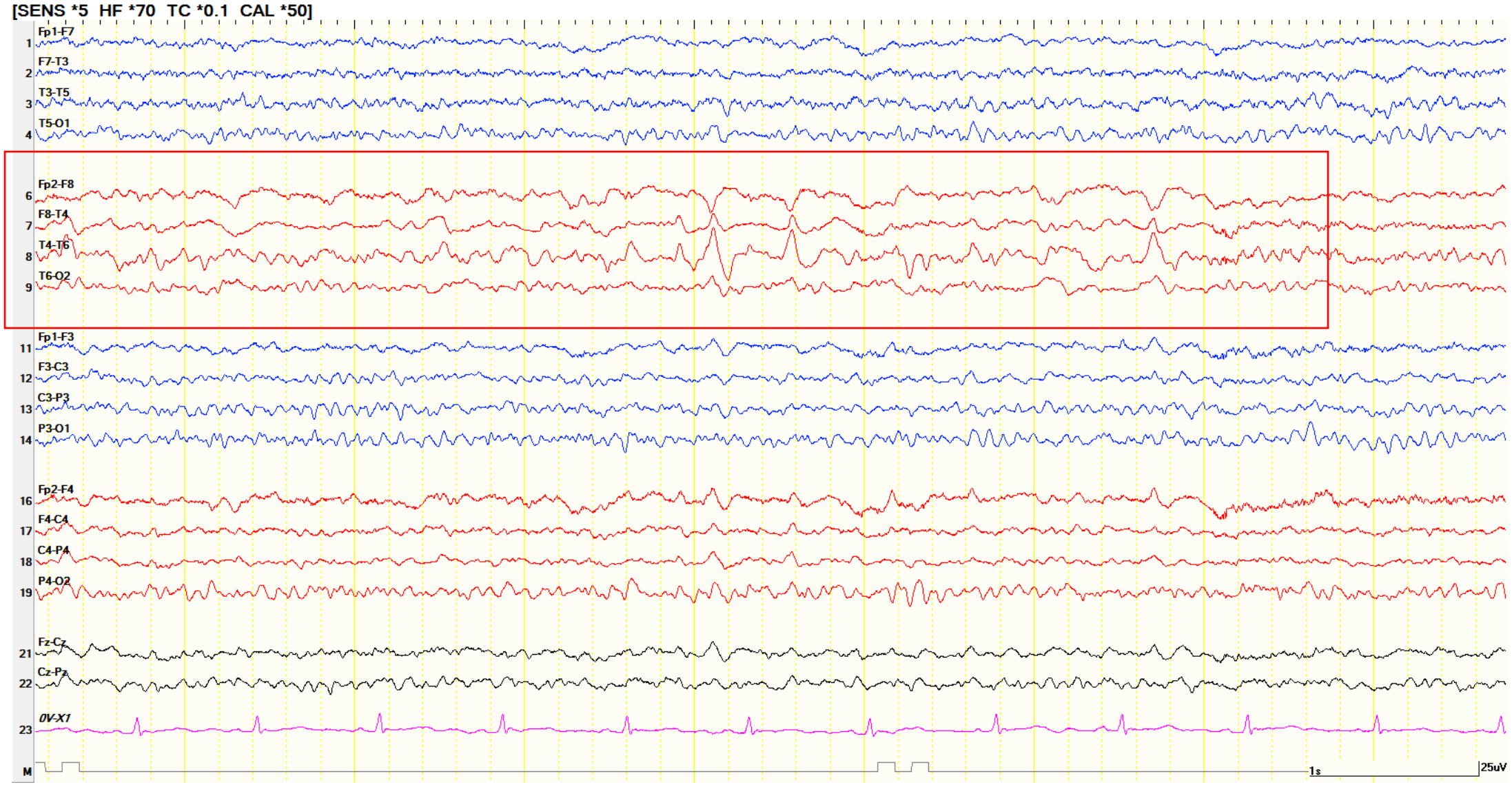
- Interictal spike: spike or sharp wave over the anterior temporal region



Hamer, et al. Epilepsia 1999

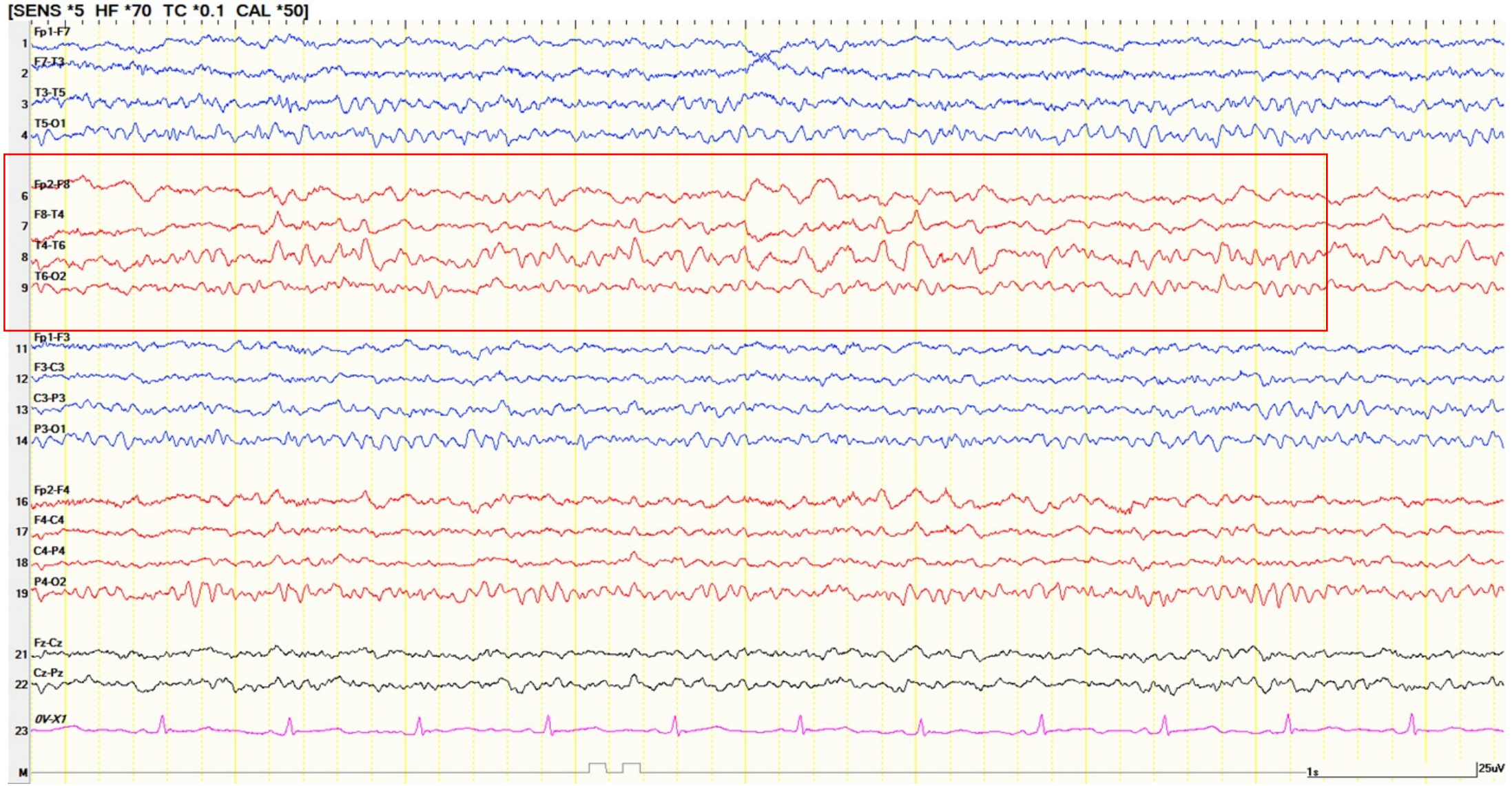
Focal sharp waves F8

A 15-year-old female presents with fear

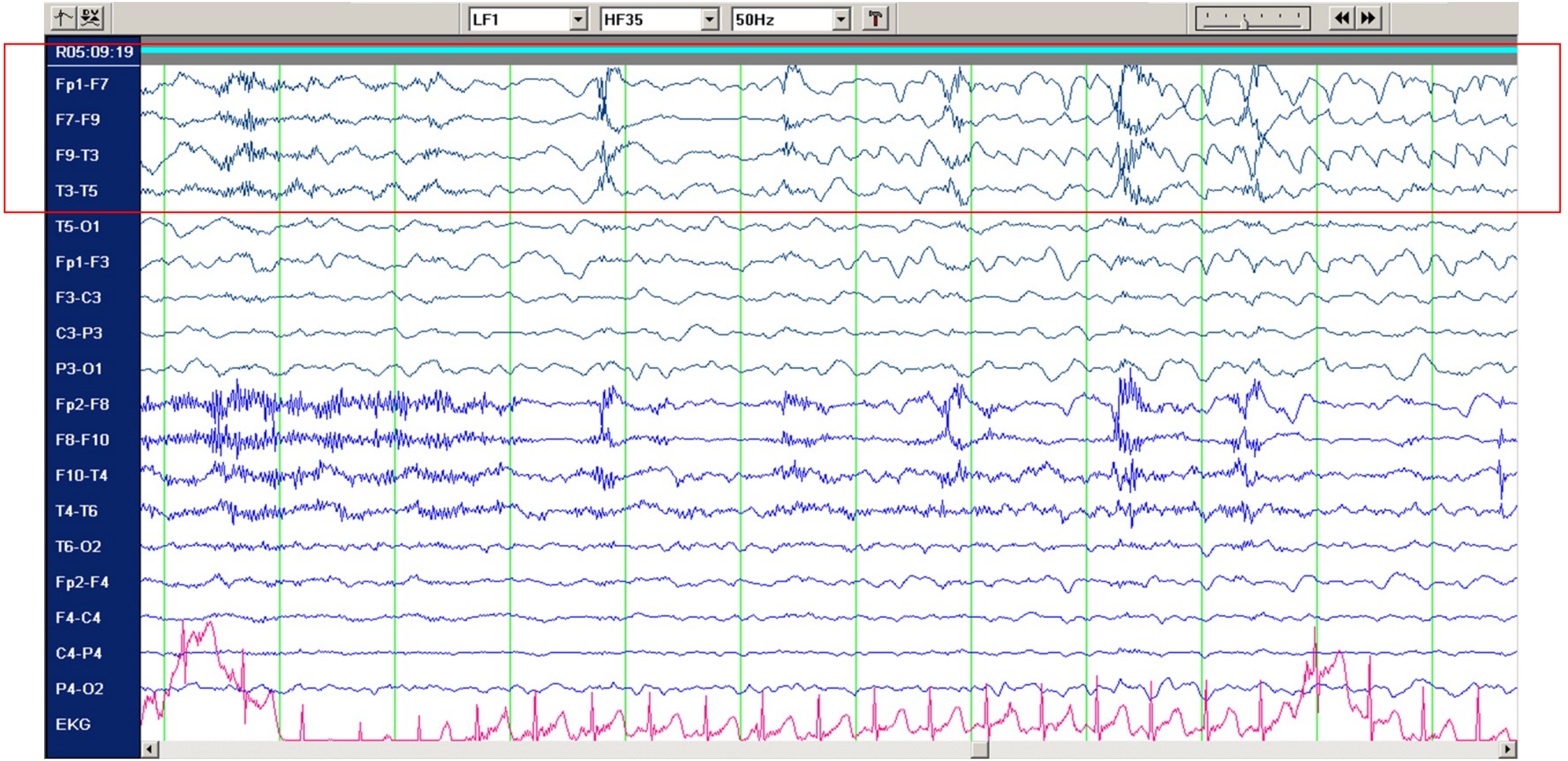


A sharply contoured activity in the temporal region is more likely to be epileptic if:

Associated with delta/rhythmic slowing in same distribution



Ictal EEG pattern of MTLE



- Rhythmic 5-7 Hz theta activity that slowly evolves and remains localized to the mesial temporal or sub-temporal regions

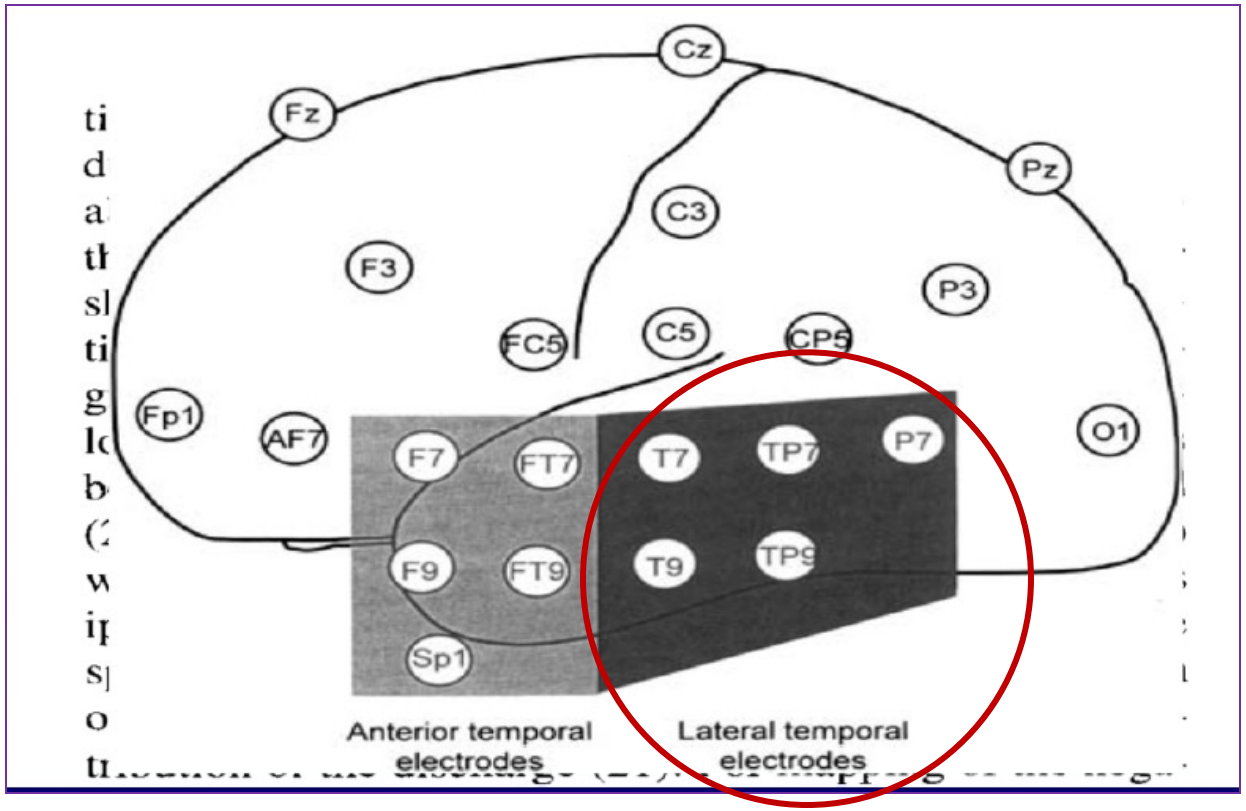
Seizure semiology of neocortical temporal lobe epilepsy

Sign/symptom	mTLE	nTLE
Seizure duration	>1 minute	<1 minute
Ambiguous onset/offset	No	Yes
Visceral/epigastric sensation	More likely	Less likely
Nonspecific auras	Less likely	More likely
Auditory hallucination	Less likely	More likely
Oral automatism	More likely	Less likely
Manual automatism	More likely	Less likely
Leg movements	Yes	No
Dystonic posturing	Yes	No
Clonic movement	Less likely	More likely
Body shifting	More likely	Less likely
Hyperventilation	Yes	No
"Dreamy state"	Yes	No
Fear	Yes	No
Searching	More likely	Less likely
Postictal cough/sigh	More likely	Yes

Bercovici et al, 2012

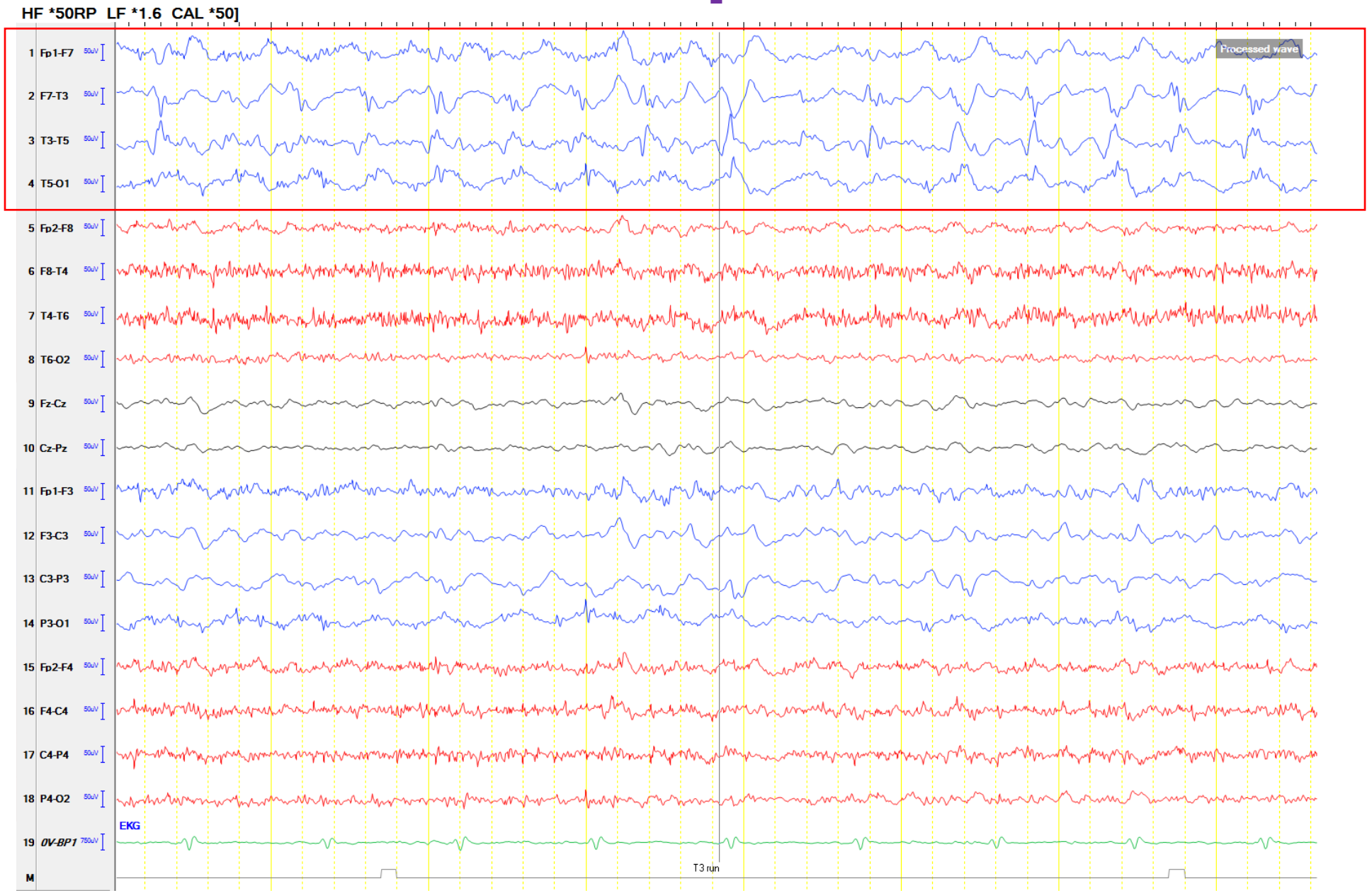
Lateral/neocortical temporal lobe seizure

- Interictal spike: spike or sharp wave over the lateral temporal region

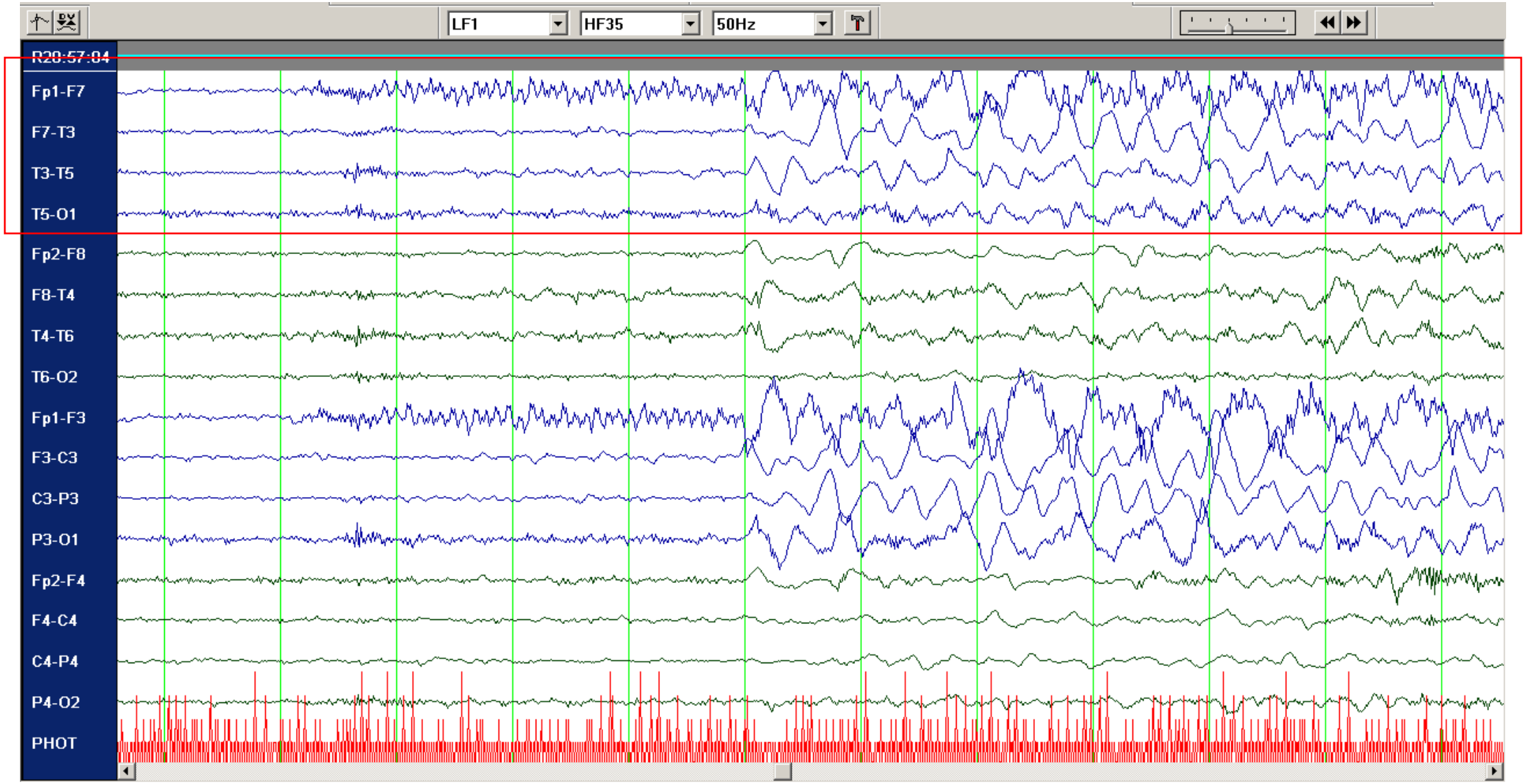


Hamer, et al. Epilepsia 1999

Focal sharp waves T3

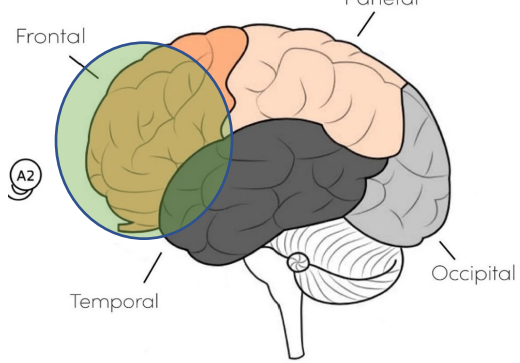


Ictal EEG pattern of nTLE



- Rhythmic slow activity (2-5 Hz) with widespread temporal distribution

Frontal Lobe Epilepsy (FLE)



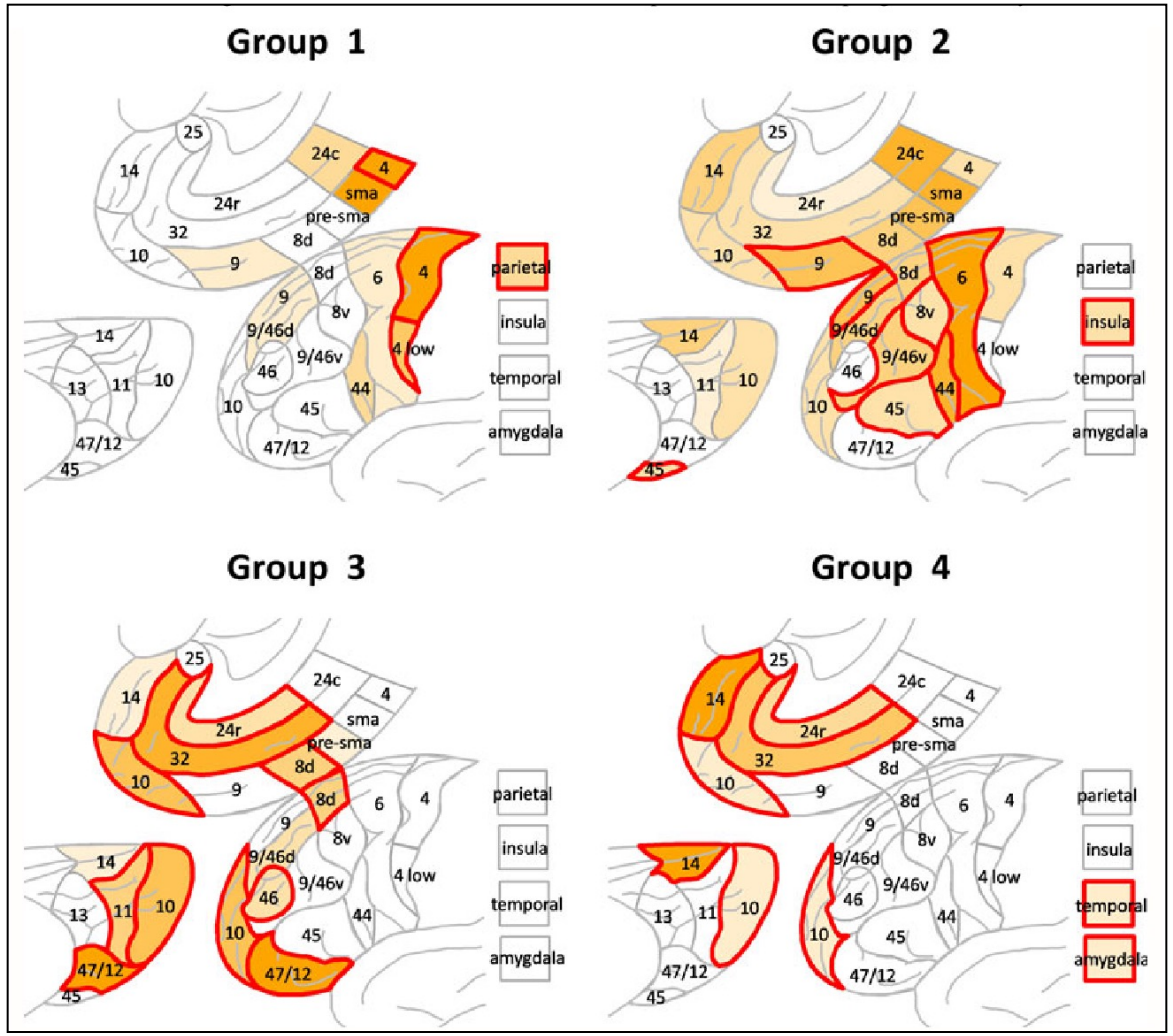
- FLE is the second most common type of focal epilepsy[1]
- The clinical and EEG manifestations vary depend on the origin and spread[2]
- General Characteristics of FLE:
  - Generally short seizures
  - Nocturnal circadian distribution
  - Complex partial seizures arising from the frontal lobe, often with minimal or no postictal confusion
  - Rapid secondary generalization
  - Prominent motor manifestations which are tonic or postural
  - Complex gestural automatisms frequent at onset

[1]Vaessen MJ, PLoS One 2014
[2]Blume WT, Epilepsia 2001

Semiology according to specific areas

Group 1
Elementary motor signs
With no gestural behaviour

Group 3
Distal stereotypies,
Integrated appearance,
No elementary signs



Group 2
Association of elementary motor signs and Proximal gestural motor
Beh; non-integrated appearance

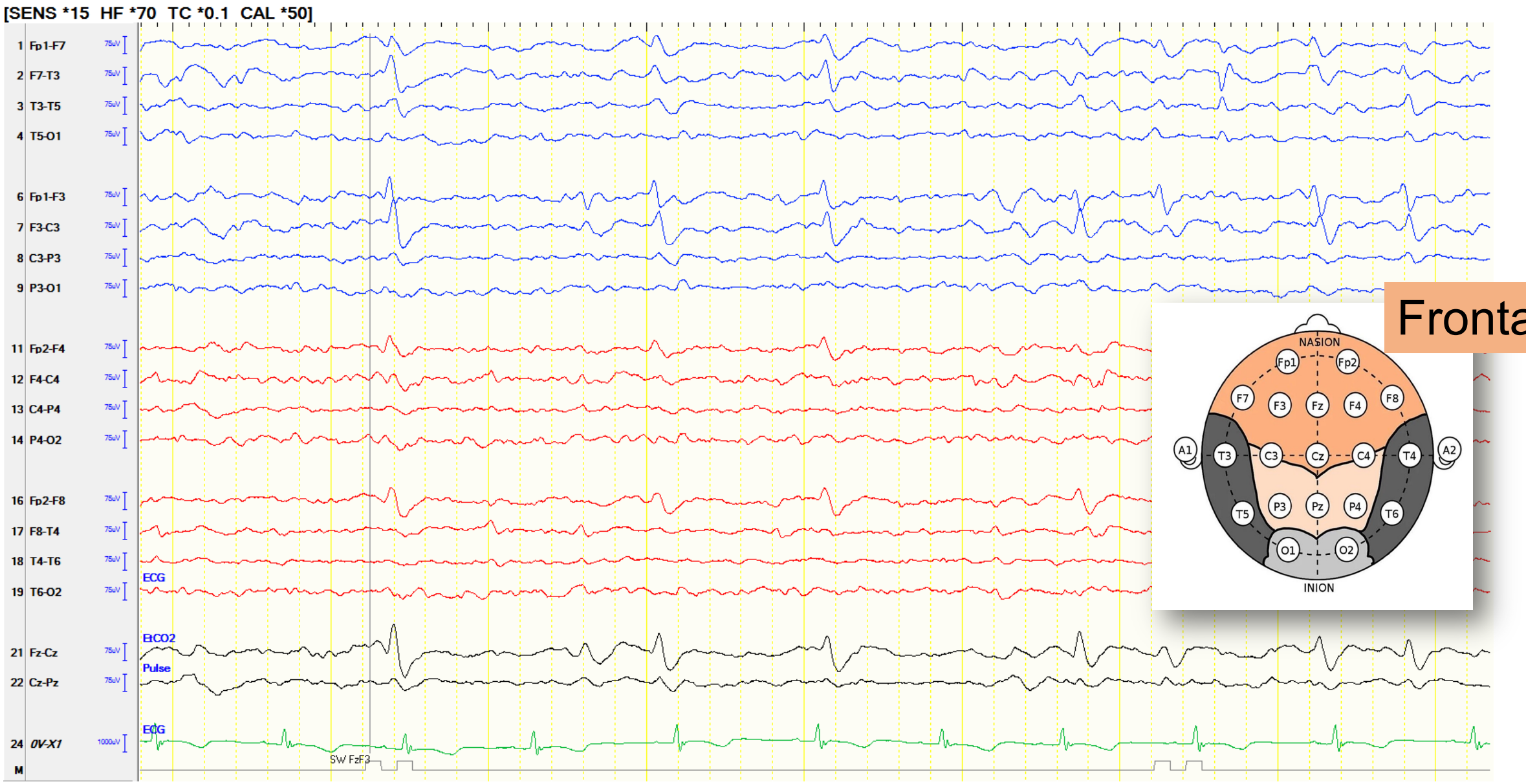
Group 4
Fear-related behaviour, no elementary motor signs

Bonini F, Epilepsia 2014

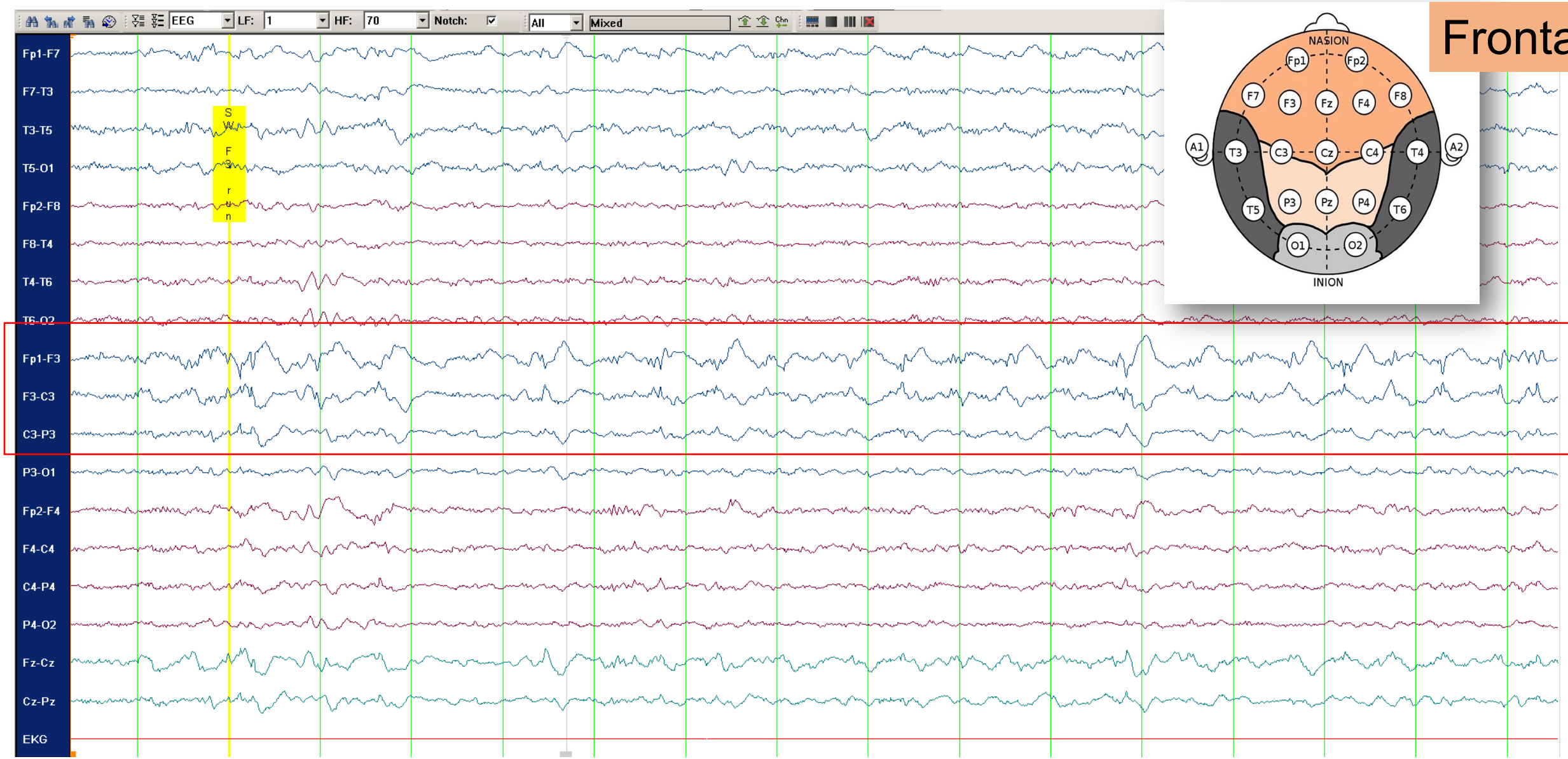
Interictal EEG of FLE

- No abnormality (particularly when seizures originate from the mesial frontal regions)
- Frontal spikes or sharp waves
  - Unilateral
  - Bilateral
  - Unilateral multilobar
- +/- background asymmetry
- Focal seizure with secondary bilateral synchrony

Focal sharp waves

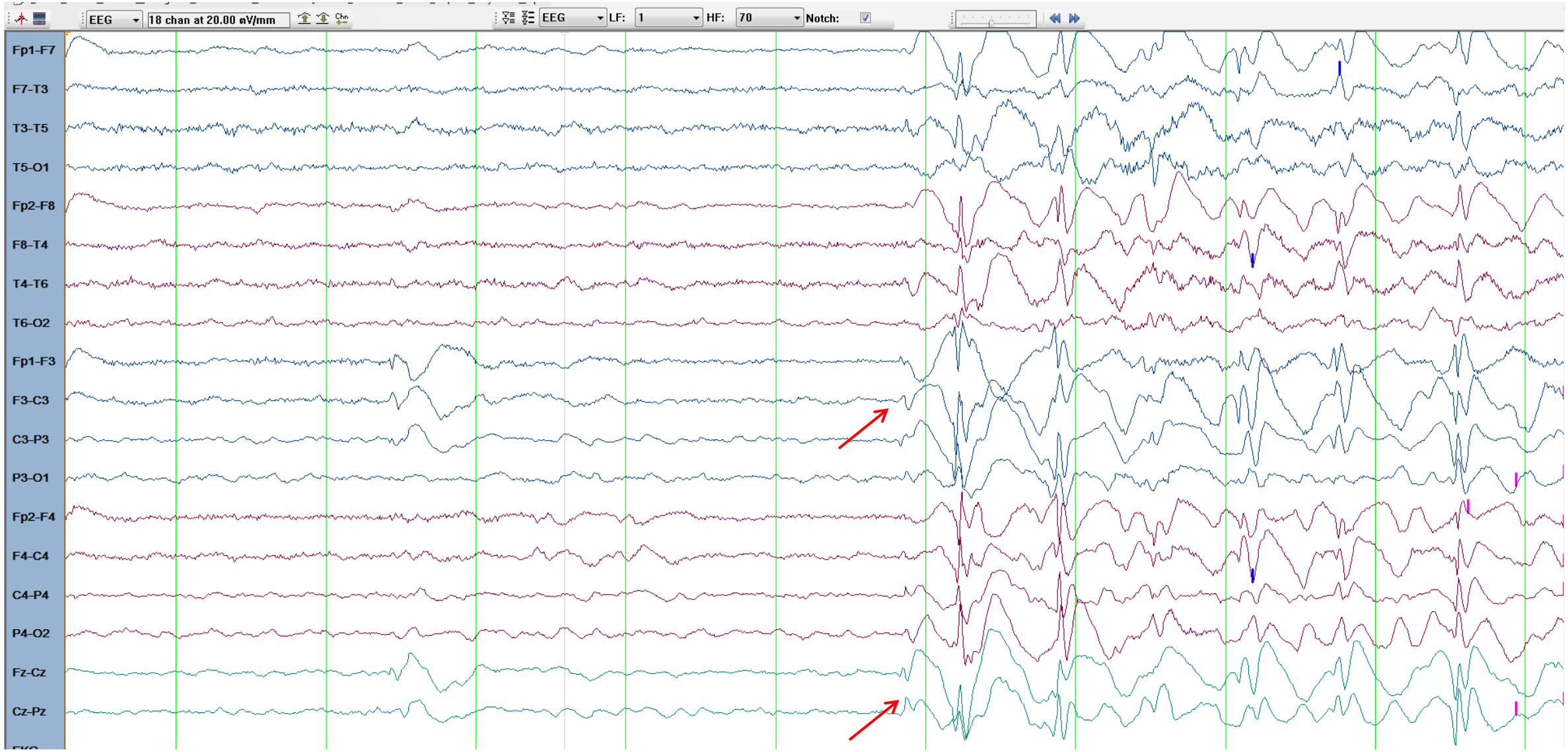


Spikes/Polyspikes and BG asymmetry



Frontal

Focal seizure with secondary bilateral synchrony from frontomesial region

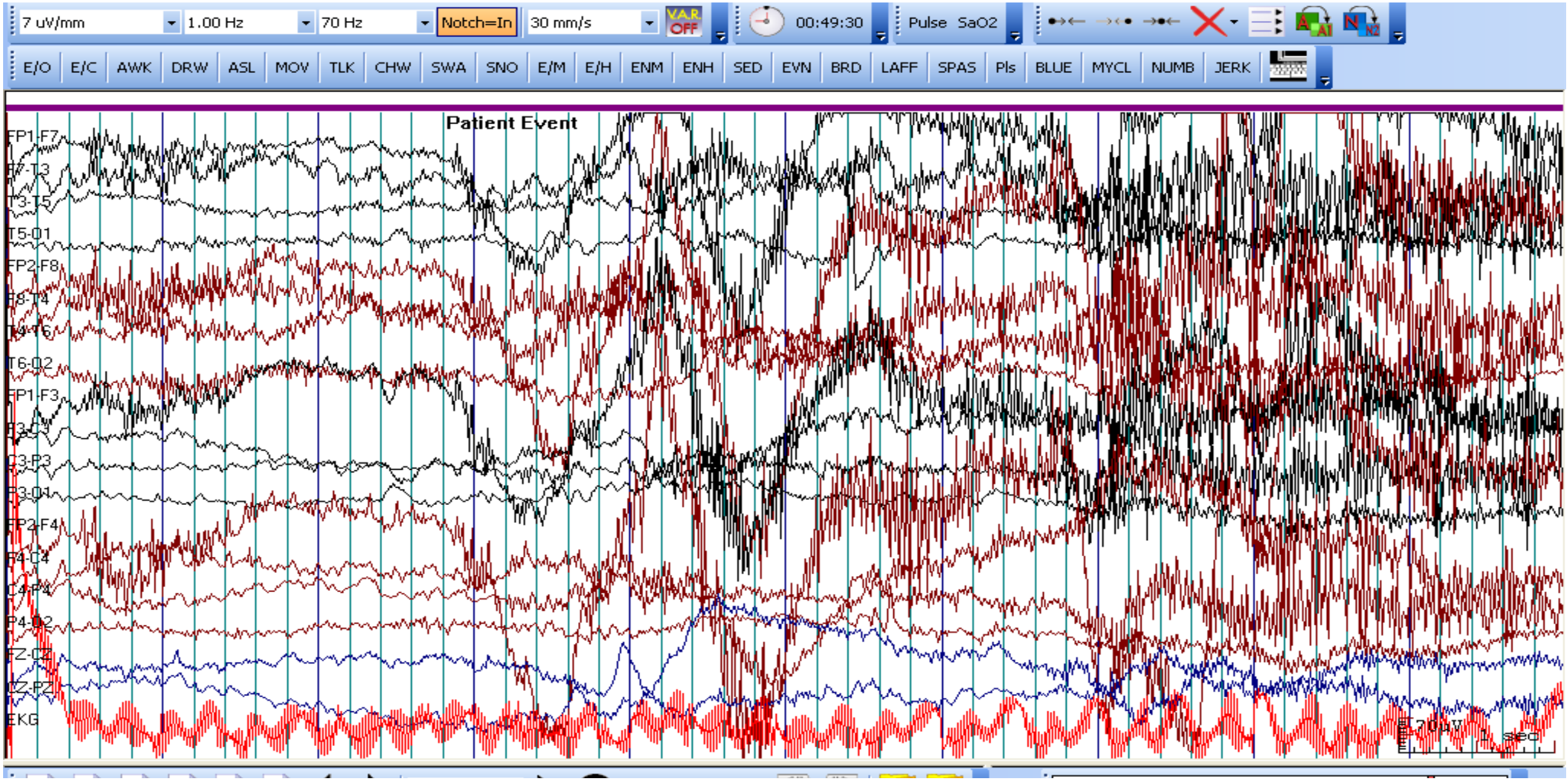


Bilaterally synchronous discharge which can be shown to arise from a unilateral cortical focus *(Tukel and Jasper 1952)*

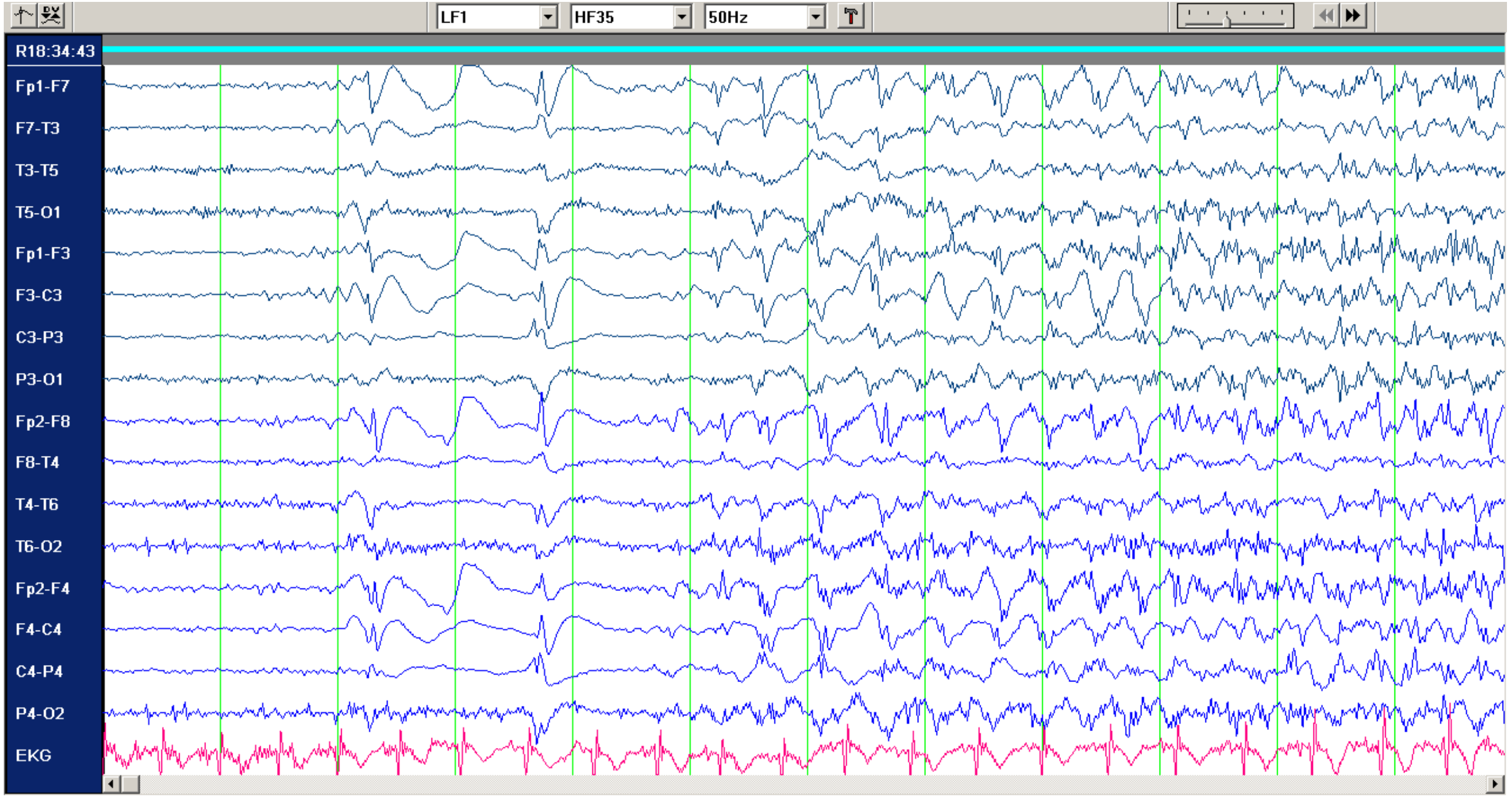
Ictal EEG patterns of FLE

- Scalp ictal EEG changes are difficult to appreciate with most of the FLE due to the movement artifacts obscuring the waveform
- Frontal, often bilateral, low amplitude, fast activity, mixed rhythmic spikes, spike waves, or slow waves
- Bilateral high amplitude single sharp waves followed by diffuse flattening. (high localising information)
- No abnormality ((particularly from the mesial frontal regions)

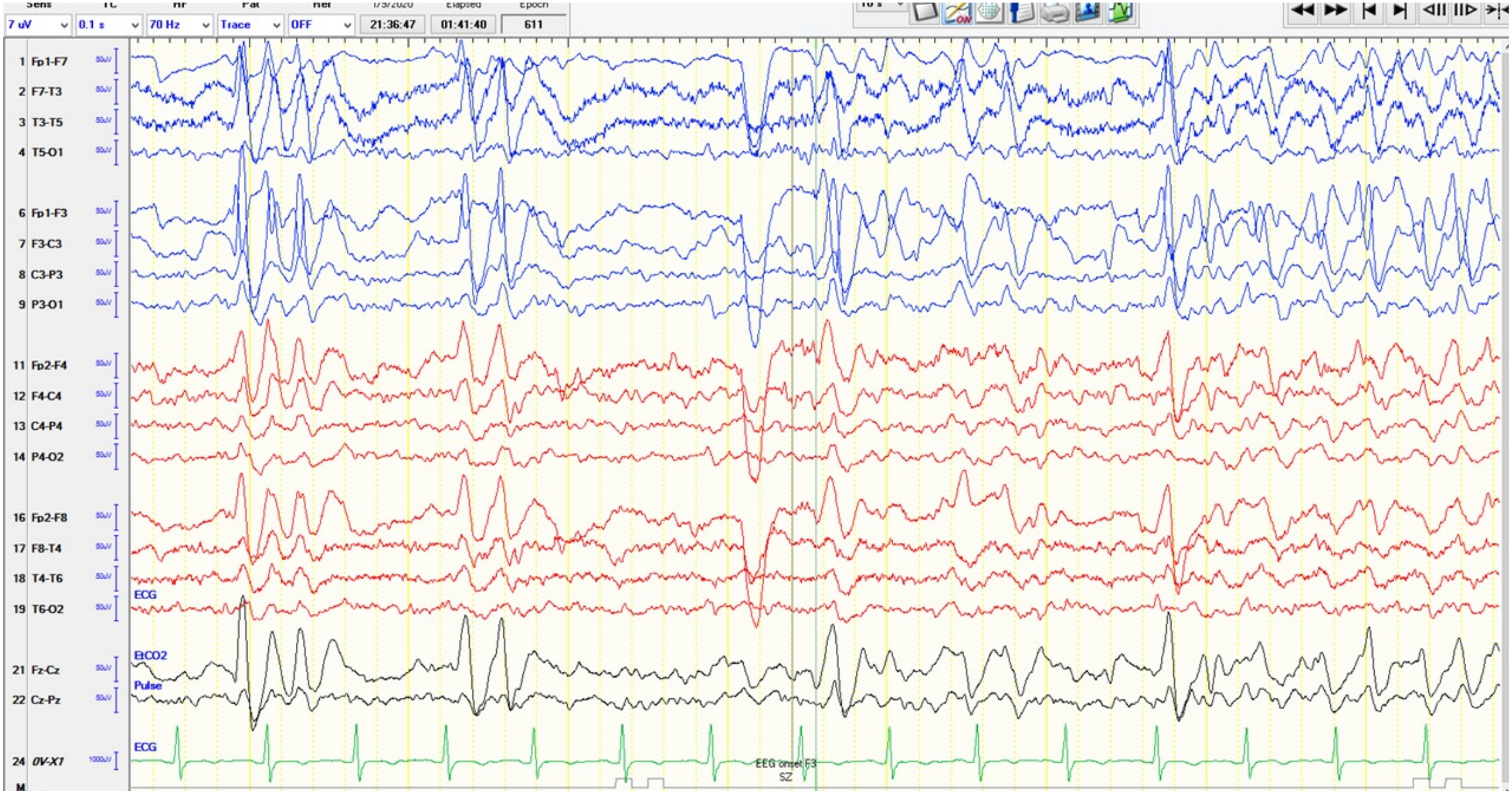
Hypermotor Frontal Lobe Seizure



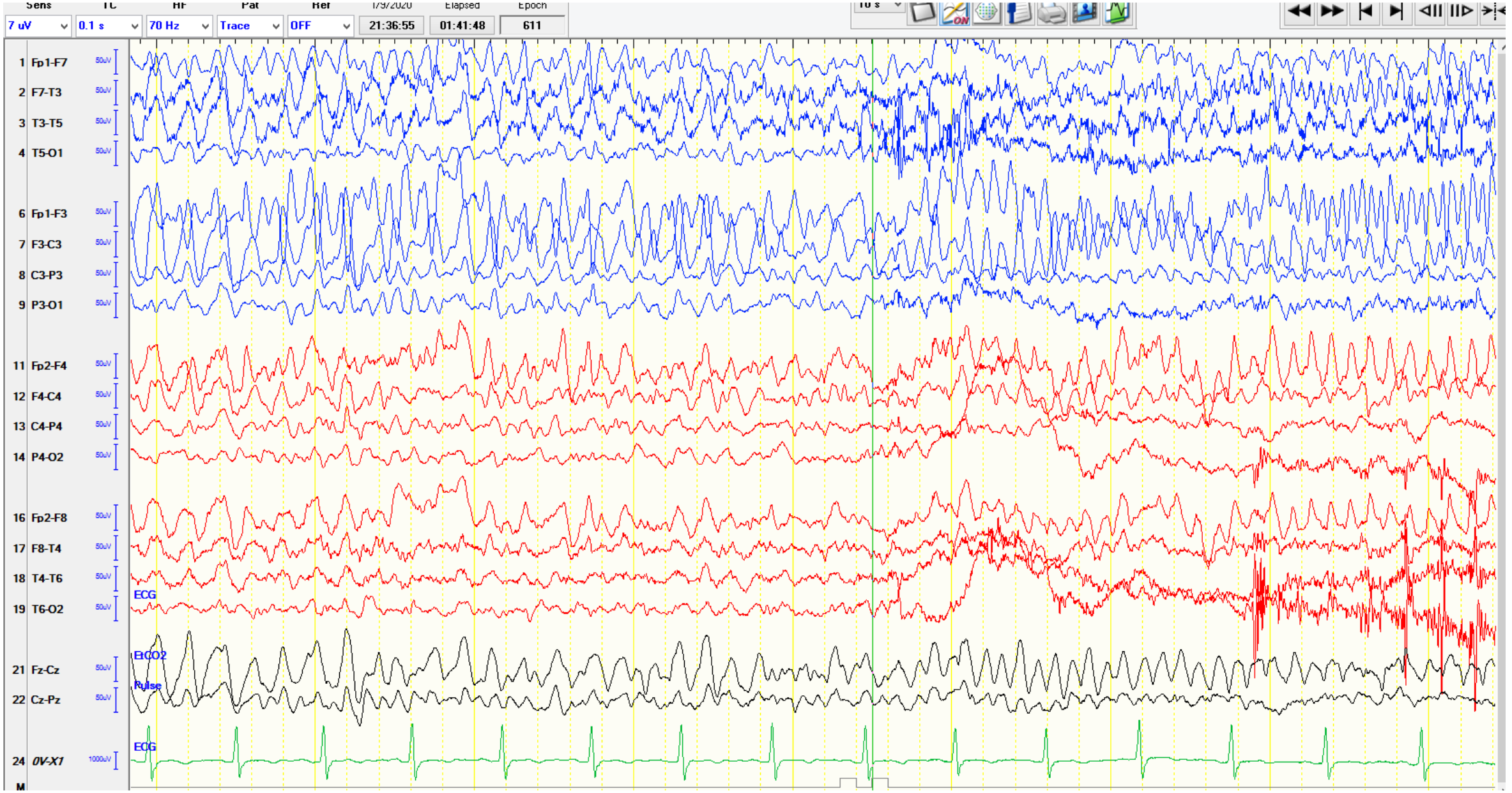
Ictal pattern of FLE



Ictal pattern of FLE



+10 sec


Sens
TC
HF
Pat
Ref
1/9/2020
Elapsed
Epoch
7 uV
0.1 s
70 Hz
Trace
OFF
21:36:55
01:41:48
611
1 Fp1-F7
2 F7-T3
3 T3-T5
4 T5-O1
6 Fp1-F3
7 F3-C3
8 C3-P3
9 P3-O1
11 Fp2-F4
12 F4-C4
13 C4-P4
14 P4-O2
16 Fp2-F8
17 F8-T4
18 T4-T6
19 T6-O2
ECG
21 Fz-Cz
22 Cz-Pz
EtCO2
Pulse
24 0V-X1
ECG

Parietal lobe Epilepsy (PLE)

Scalp EEG: Interictal

Original article

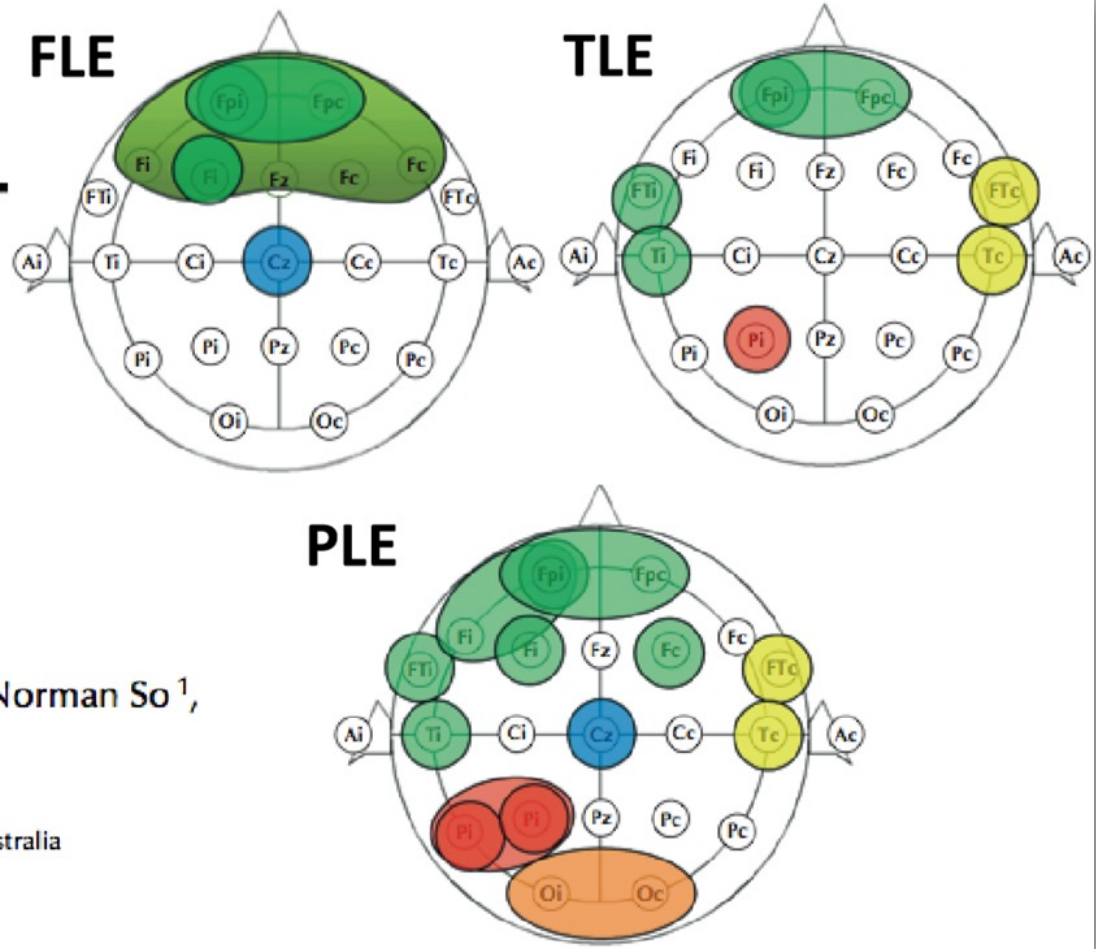
Epileptic Disord 2012; 14 (1): 22-31

Parietal lobe epilepsy: the great imitator among focal epilepsies

Aleksandar J Ristić [1,2], Andreas V Alexopoulos [1], Norman So [1], Chong Wong [1,3], Imad M Najm [1]

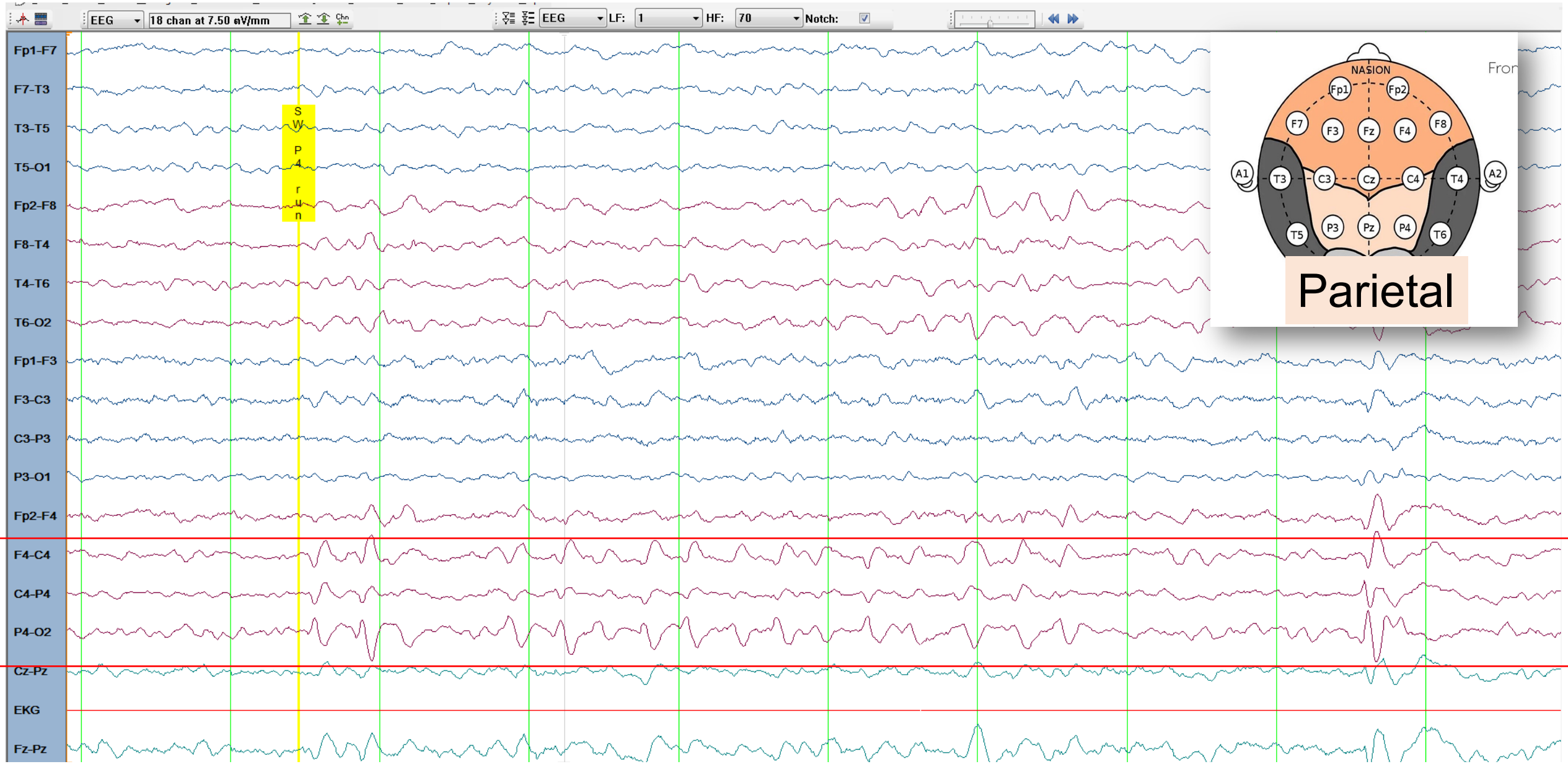
[1] Epilepsy Center, Cleveland Clinic, Cleveland, OH, USA
[2] Epilepsy Center, Clinic of Neurology CCS, Belgrade, Serbia
[3] Department of Neurology, Westmead Hospital, Westmead, NSW, Australia

Received October 23, 2011; Accepted February 14, 2012



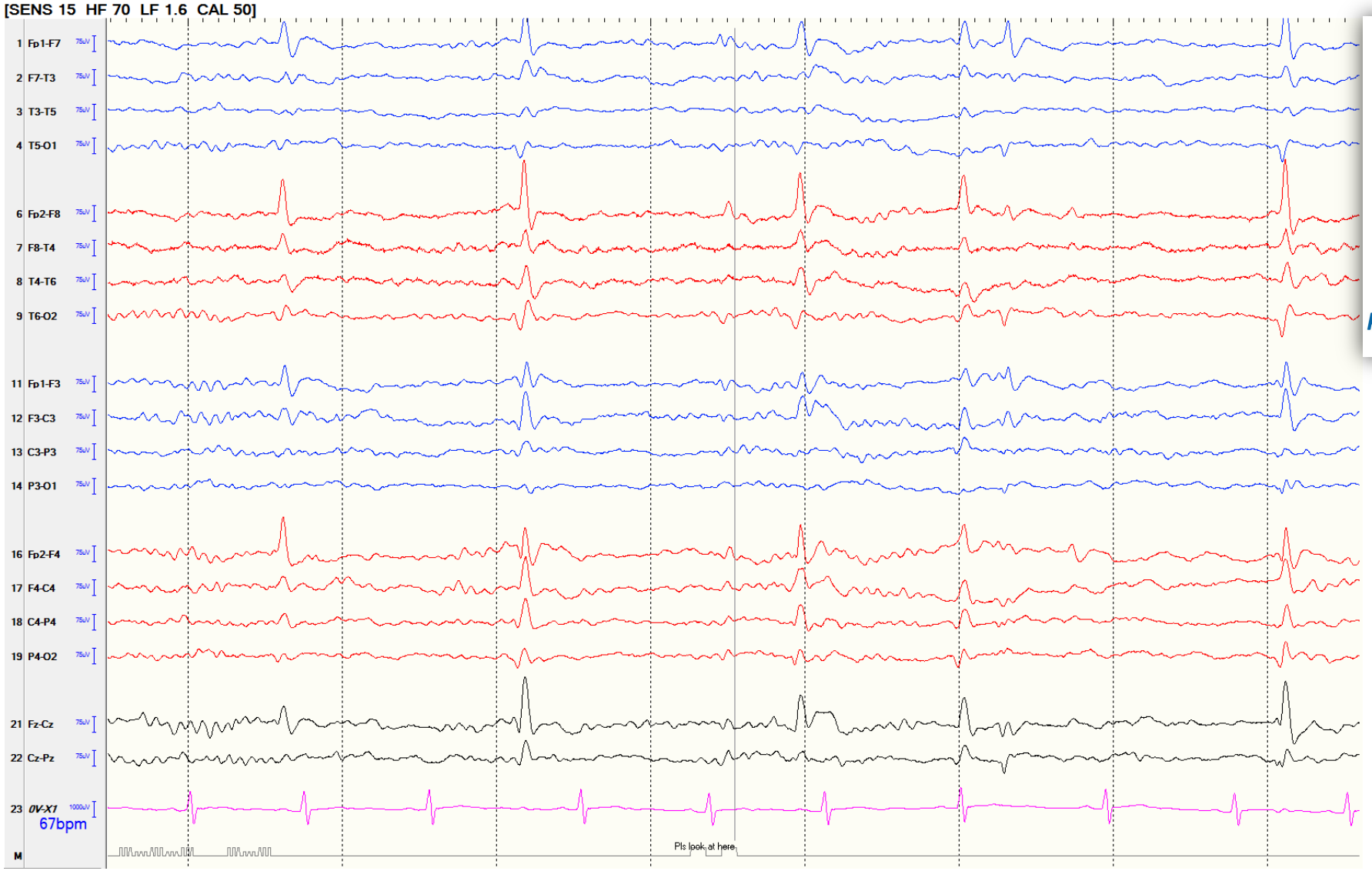
- It is common to encounter multifocal and multiregional IEDs with cortical involvement, making it difficult to localize

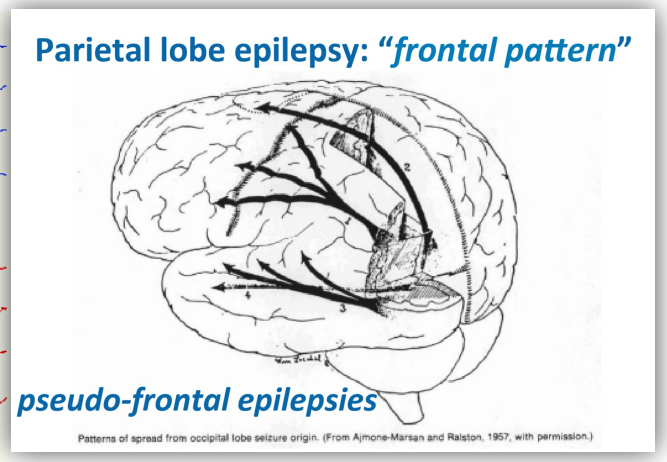
Focal sharp wave P4

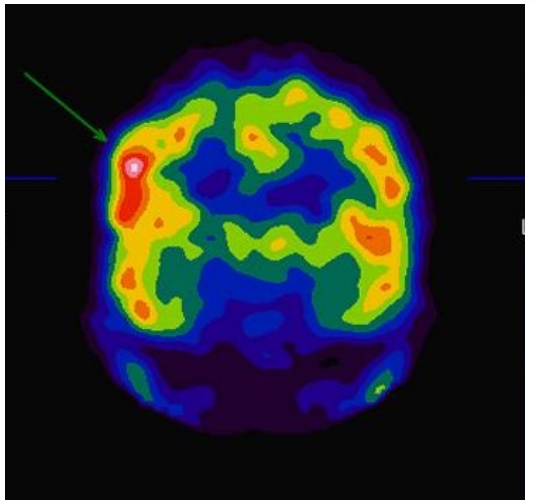


Interictal EEG of PLE

A 10-year-old boy with nonversive head turning to the right



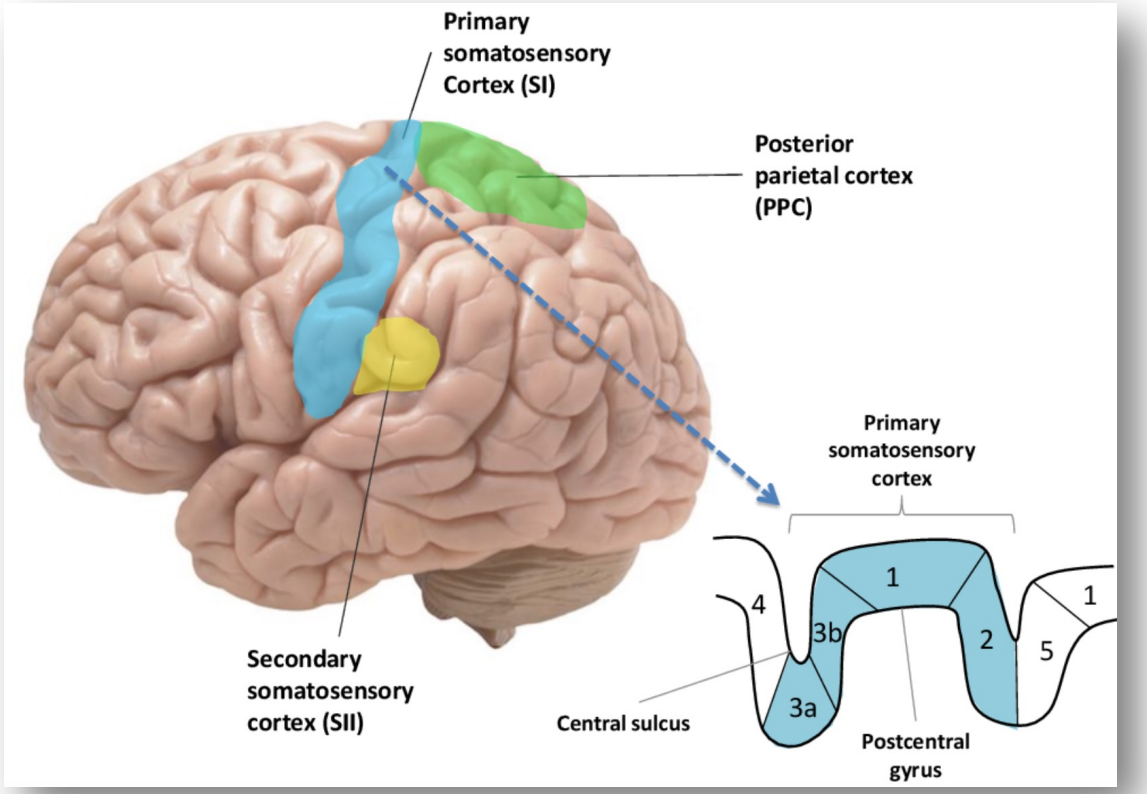




Ictal SPECT: Increased perfusion at **right parietal**

Seizure semiology of PLE

- Most patients with parietal lobe seizures have focal aware seizure
- Somatosensory symptoms
  - Paresthesias (SI)
  - Pain (SII)
- Vertiginous
- Visual illusions or complex formed visual hallucinations

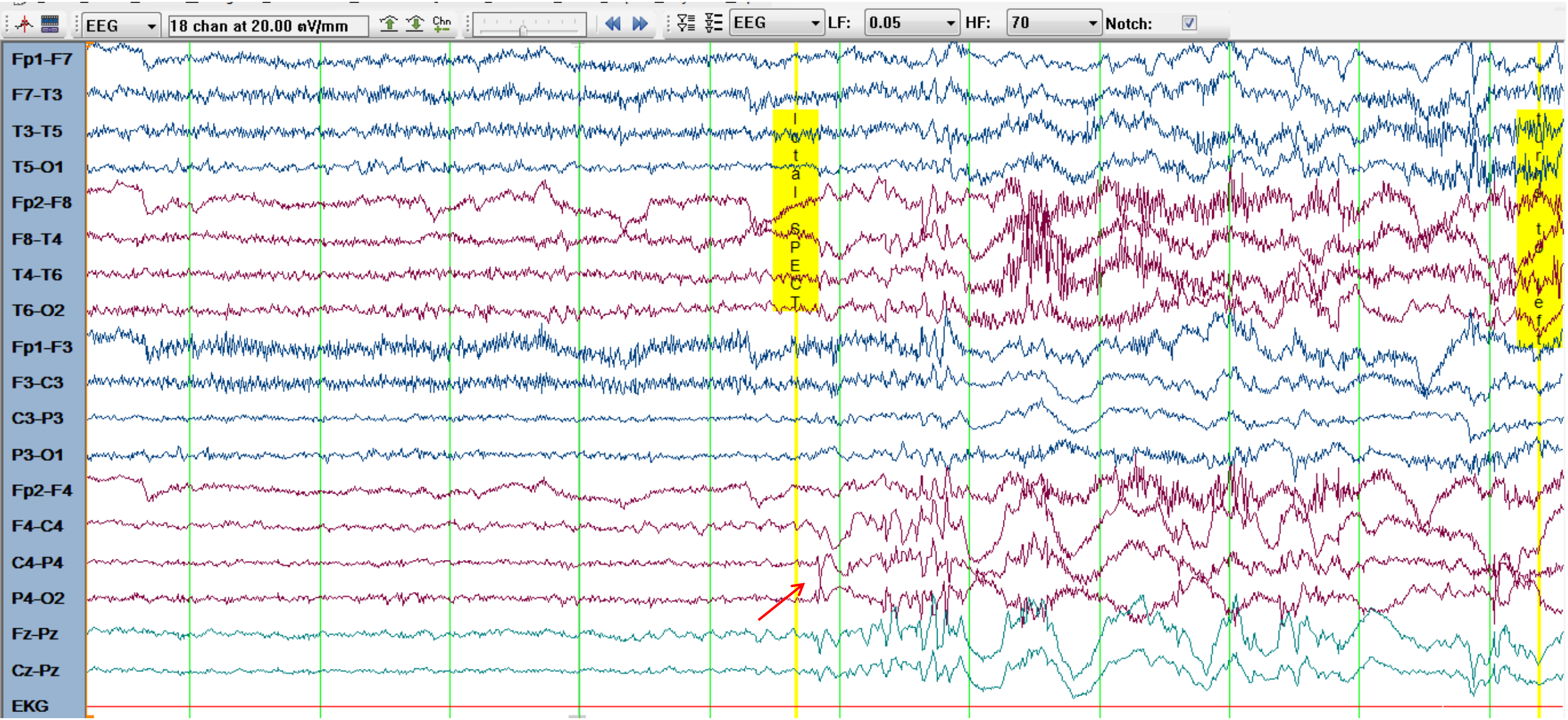


Ictal pattern of PLE

- The ictal EEG may be normal in 80% of simple focal sensory seizures[1]
- Localised parietal seizure onset is rare (11%)[2]
- Postictal EEG may help when focal wave attenuation or spike activation occur[3]

[1]Tuxhorn I, Epileptic seizures 2000
[2]Salanova V, Brain 1995
[3]Kaibara M, Electroencephalogr Clin Neurophysiol 1988

Ictal EEG of PLE



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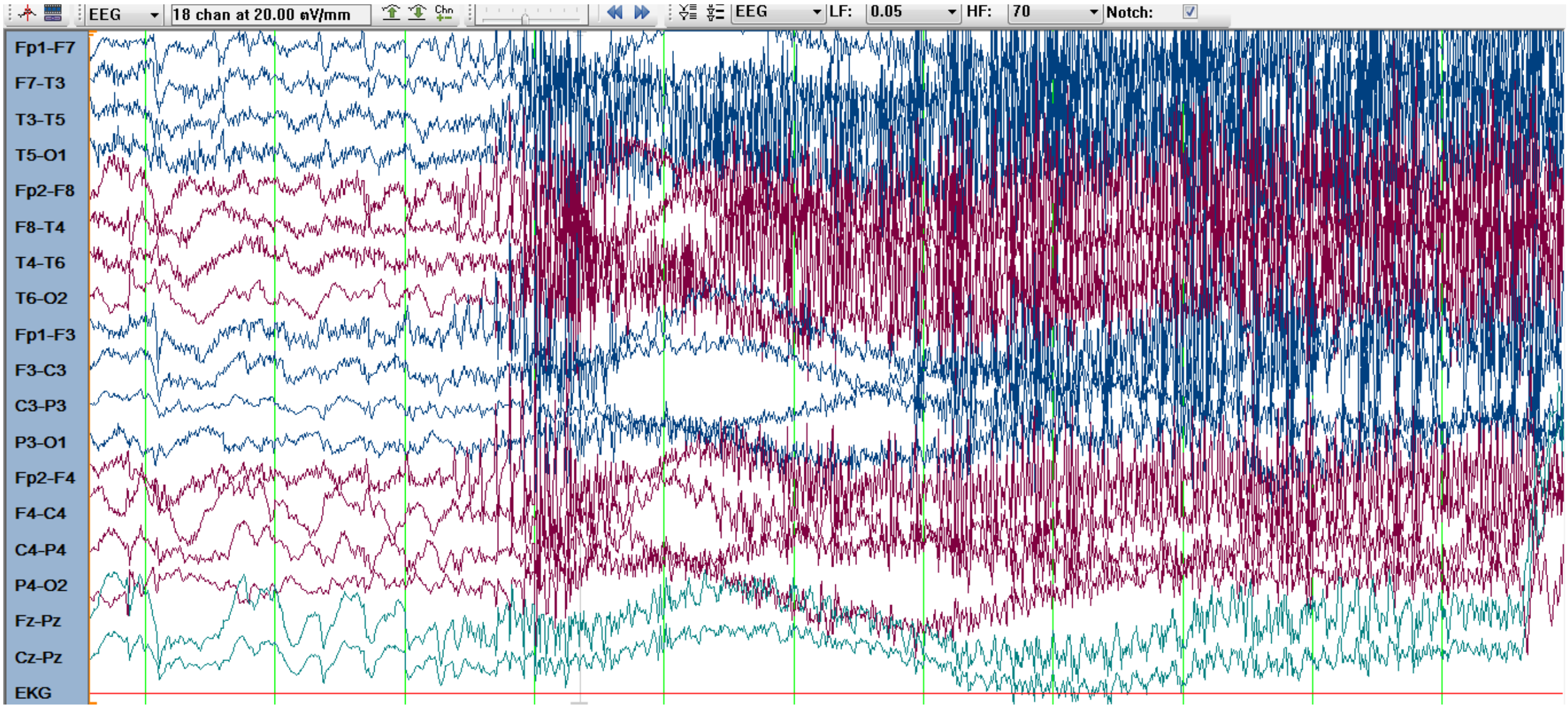

EEG
18 chan at 20.00 uV/mm
EEG
LF:
0.05
HF:
70
Notch:
Fp1-F7
F7-T3
T3-T5
T5-O1
Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fz-Pz
Cz-Pz
EKG

Ictal EEG of PLE

- Ictal scalp EEG is rarely localizing in PLE

Occipital Lobe Epilepsy (OLE)

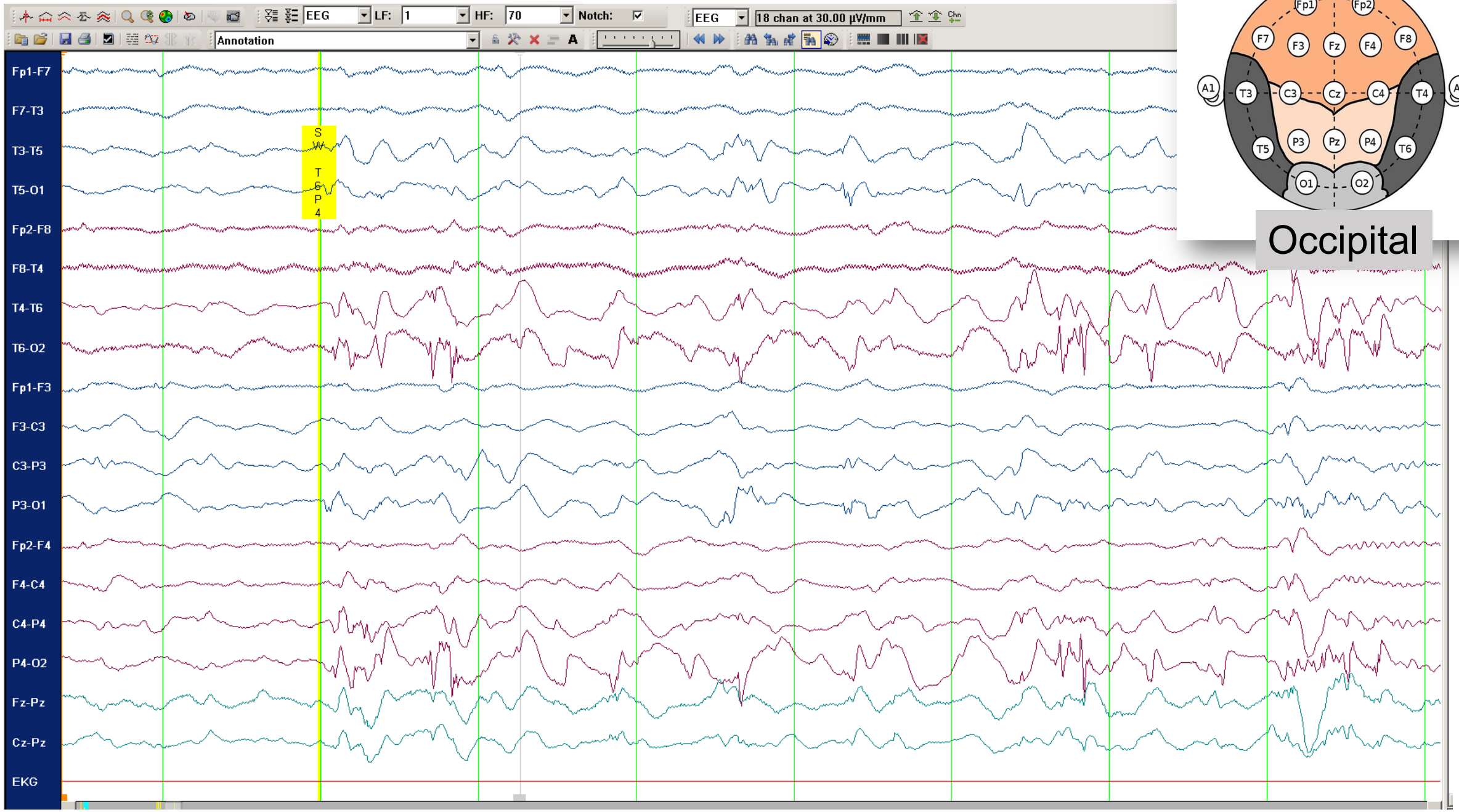
- OLE account around 5-10% of all epilepsies[1]
- These epilepsies may be idiopathic, symptomatic or probably symptomatic
  - Symptomatic OLE may start at any age
  - Idiopathic OLE usually starts in late childhood

[1]Panayiotopoulos CP, 1999

Interictal EEG of OLE

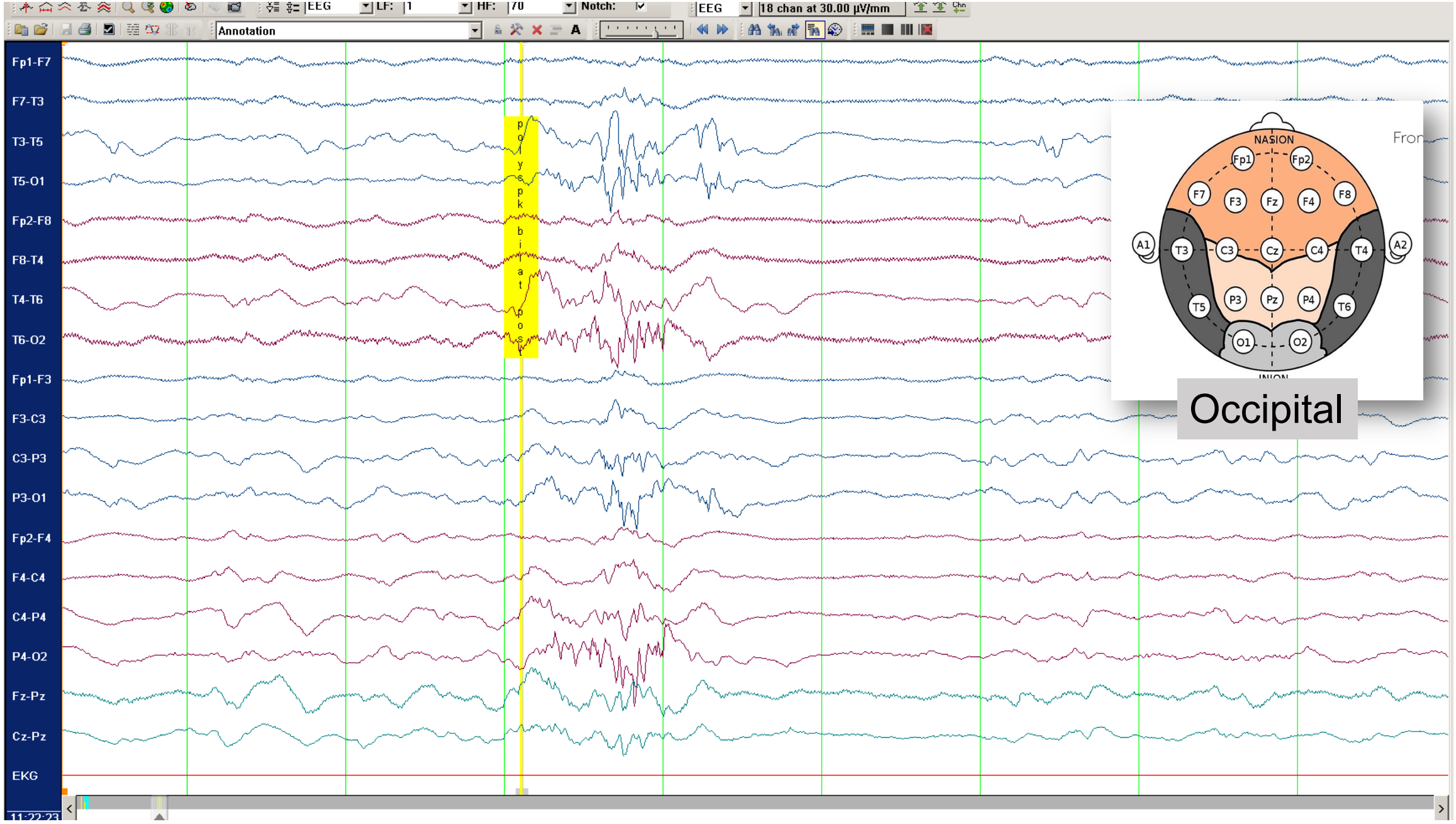
- IEDs can occur either spontaneously or following photic stimulation
- Unilateral occipital spikes
- Fast multiple spikes
- Photosensitive OLE requires photic stimulation to elicit IEDs

Focal occipital spikes



Occipital

Polyspikes


Annotation
Fp1-F7
F7-T3
T3-T5
T5-O1
Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fz-Pz
Cz-Pz
EKG
polyspk bi at post
NASION
Fp1
Fp2
F7
F3
Fz
F4
F8
A1
T3
C3
Cz
C4
T4
A2
T5
P3
Pz
P4
T6
O1
O2
Occipital

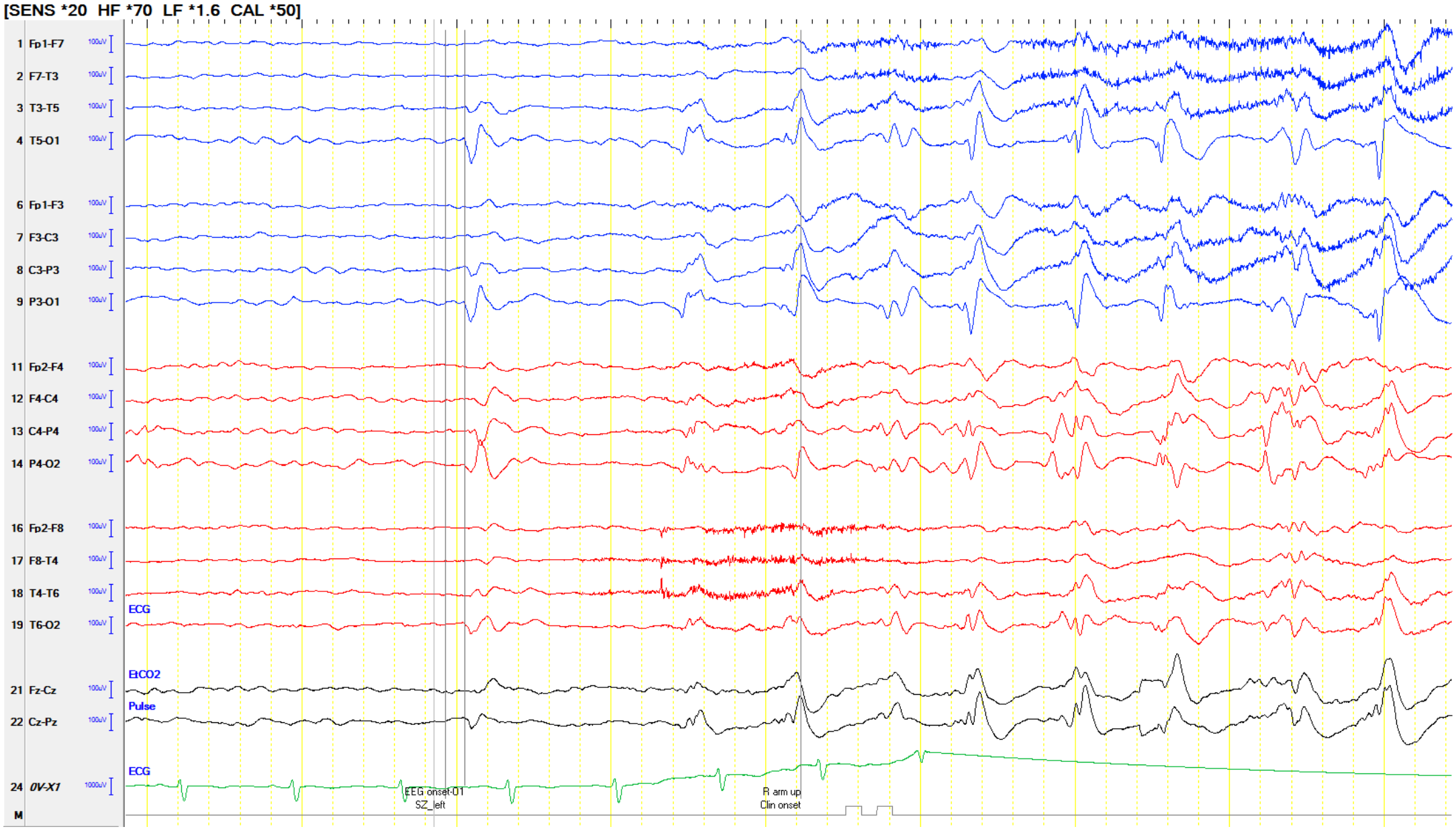
Seizure semiology of OLE

- OLE often presents with visual symptoms
  - Elementary visual hallucinations (primary visual cortex)
  - Complex visual hallucinations (visual association cortex)
  - Visual illusions (occipito-parietal)
  - Blindness
- Ictal objective oculomotor symptoms
  - Tonic deviation of the eyes (pursuit-like)
  - Nystagmus
  - Repetitive eyelid closure or eyelid fluttering
- Rarely, it presents as a generalized tonic-clonic seizure and impaired consciousness

Ictal EEG of OLE

- Paroxysmal fast activity, fast spiking or both, localized in the occipital region
- In patients with symptomatic occipital lobe epilepsy, the ictal discharge is more widespread rather than localize in occipital region

Repetitive spikes localized in the occipital region



Summary

- The clinical and EEG manifestations vary depend on the lobar involvement

- Careful interpretation of EEG results with clinical semiology will help to enhance focal seizure localization

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Pediatric Epilepsy Center of Excellence

Integration • Passion • Wisdom

Thank you for your attention