



Chulalongkorn University
จุฬาลงกรณ์มหาวิทยาลัย
Pillar of the Kingdom



Chulalongkorn
Comprehensive
Epilepsy
Centre

HOW TO WRITE AN EEG REPORT

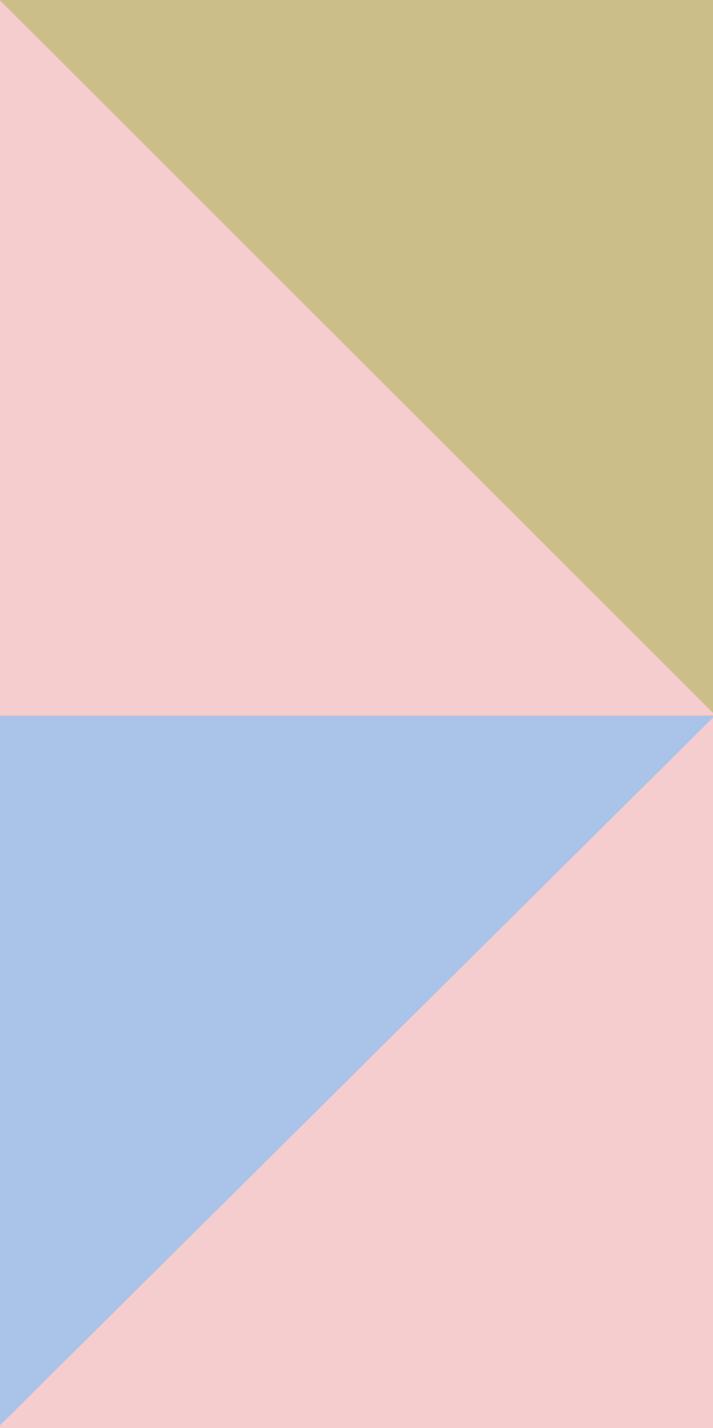
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The background features a dark blue circle on the left and a larger light pink circle on the right. The pink circle contains several thin, white, concentric curved lines that resemble a stylized fingerprint or a series of ripples.

**"EEG reporting is
like trying to
translate a picture
into words"**

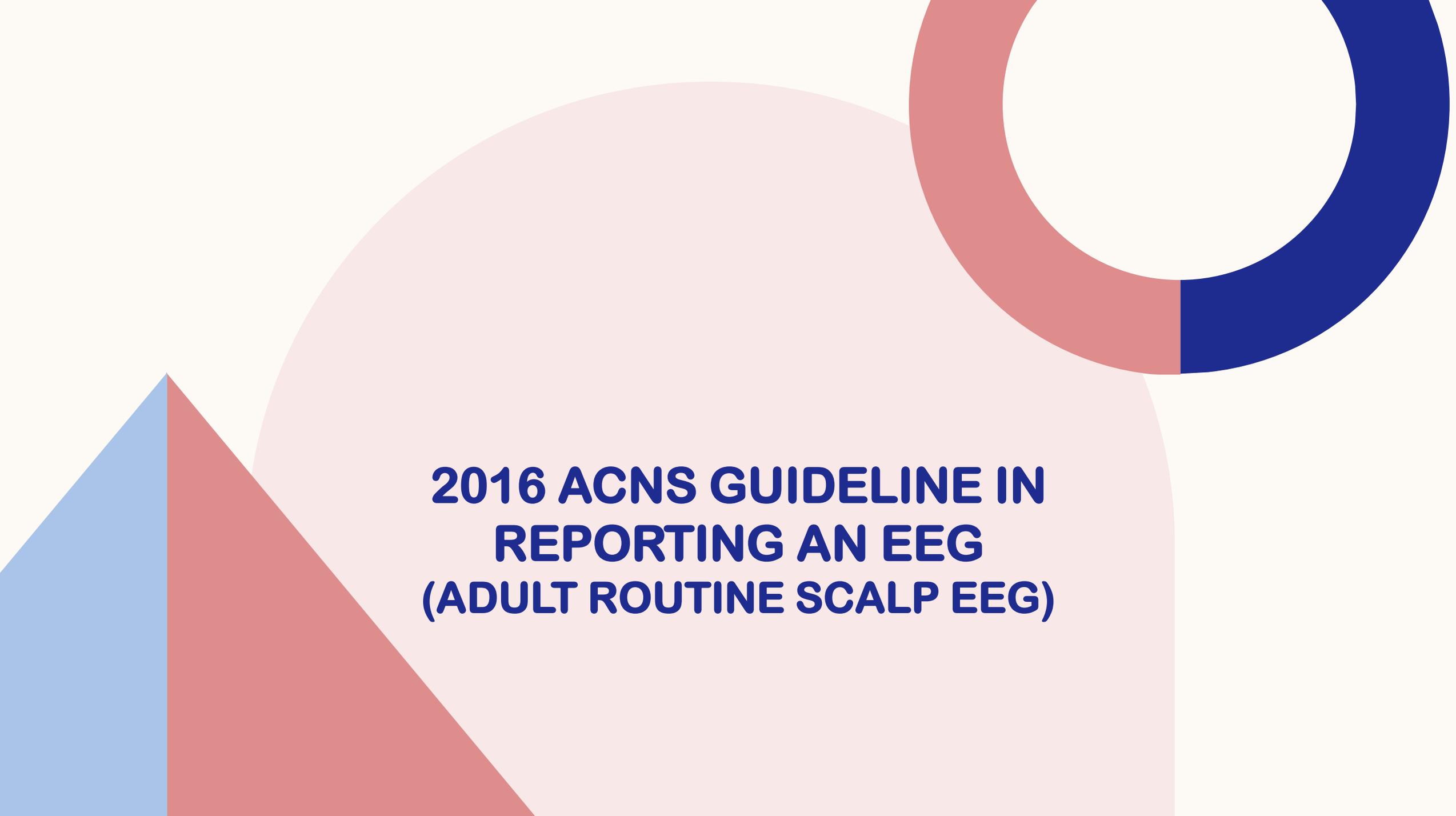
TALK OVERVIEW

- 2016 ACNS (American Clinical Neurophysiology Society) guideline
- Principal 5 Reporting Parts
- "Do" and "Don't" in EEG Reports
- Standardized Computer-based EEG Report (SCORE)



WHY WE SHOULD KNOW GUIDELINE ?

Guideline is not only to **convey clinically relevant information**, but also to **improve interrater reliability for clinical and research use** by standardizing the format of EEG reports.



**2016 ACNS GUIDELINE IN
REPORTING AN EEG
(ADULT ROUTINE SCALP EEG)**

KEEP IN MIND !!!

Proper interpretation of the results reported depends on minimum technical standards for the performance of an EEG

“Minimum Technical Requirements for Performing Clinical EEG”

<https://www.acns.org/practice/guidelines>

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AMERICAN CLINICAL NEUROPHYSIOLOGY SOCIETY

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Practice

- COVID-19 Resources
- Guidelines and Consensus Statements**
- Introduction
- Electroencephalography
- Evoked Potentials
- Neurophysiologic Intraoperative Monitoring
- Long Term EEG Monitoring for Epilepsy
- Long Term EEG Monitoring in Neonates
- Continuous EEG Monitoring in Critical Care
- Quantitative EEG
- Technical Standards for Digital EEG Formats
- Neurodiagnostic Personnel
- Magnetoencephalography
- Practice-Related Resources

Guidelines and Consensus Statements

Guidelines

Please direct all questions regarding these guidelines and consensus statements to info@acns.org.

Title	Guideline	#	Date Revised
Electroencephalography - Introduction			
	Minimum Technical Requirements for Performing Clinical EEG	1	August 2016
	Guidelines for Standard Electrode Position Nomenclature	2	August 2016
	Proposal for Standard Montages to be Used in Clinical EEG	3	August 2016
	Guidelines for Recording Clinical EEG on Digital Media	4	August 2016
	Minimum Technical Standards for Pediatric EEG	5	August 2016
	Minimum Technical Standards for EEG Recording in Suspected Cerebral Death	6	August 2016
	Guidelines for EEG Reporting	7	August 2016
	Minimum Technical Requirements for Performing Ambulatory EEG		July 2022
Evoked Potentials			
	Guidelines on Evoked Potentials	9A	Feb. 2006
	Guidelines on Visual Evoked Potentials	9B	Feb. 2006
	Guidelines on Short-Latency Auditory Evoked Potentials	9C	Feb. 2006
	Guidelines on Short-Latency Auditory Evoked Potentials	8C	Feb. 2006
	Guidelines on Visual Evoked Potentials	8B	Feb. 2006
	Guidelines on Evoked Potentials	8A	Feb. 2006



PRINCIPAL 5 REPORTING PARTS

FIVE PARTS

HISTORY

**TECHNICAL
DESCRIPTION**

**EEG
DESCRIPTION**

IMPRESSION

**CLINICAL
CORRELATION**

FIVE PARTS

HISTORY

TECHNICAL
DESCRIPTION

EEG
DESCRIPTION

IMPRESSION

CLINICAL
CORRELATION

HISTORY

PATIENT'S IDENTIFICATION

First/ Last name;
HN/ AN; Age;
Gender; DOB

THE PURPOSE OF THE EEG

e.g.,

1. To evaluate patients with spells of altered consciousness
2. To document and classify epileptiform discharges in patients with recurrent seizures and epilepsy
3. To evaluate patients for nonconvulsive seizures and for status epilepticus

RELEVANT CLINICAL INFORMATION

1. Relevant medical history
2. Neuroactive medications including sedatives and antiseizure drugs
3. Neuroimaging results
4. Note of any cranial operations
5. Whether previous EEGs have been performed

FIVE PARTS

HISTORY

**TECHNICAL
DESCRIPTION**

EEG
DESCRIPTION

IMPRESSION

CLINICAL
CORRELATION

TECHNICAL DESCRIPTION

TECHNICAL PARAMETERS

"This is a 21-channel digital EEG recording with time-locked video and single-channel electrocardiogram. Electrodes are placed according to the 10-20 (or 10-10) International System. Portions of this record are reviewed using bandpass filters of 1 to 70 Hz and sensitivity of 7 mV/mm."

1. Additional electrodes
2. Modification of 10-20/10-10 system ("prime" electrode)

THE CONDITIONS OF RECORDING

1. Premedication
2. Others;
 - ✓ Sleep deprivation
 - ✓ Potential dietary influence (fasting or NPO status)
 - ✓ Modality used (routine; continuous EEG)
3. The patient's state of consciousness

**DATE &
LOCATION OF
ACQUISITION
AND
INTERPRETATION**

FIVE PARTS

HISTORY

TECHNICAL
DESCRIPTION

EEG
DESCRIPTION

IMPRESSION

CLINICAL
CORRELATION

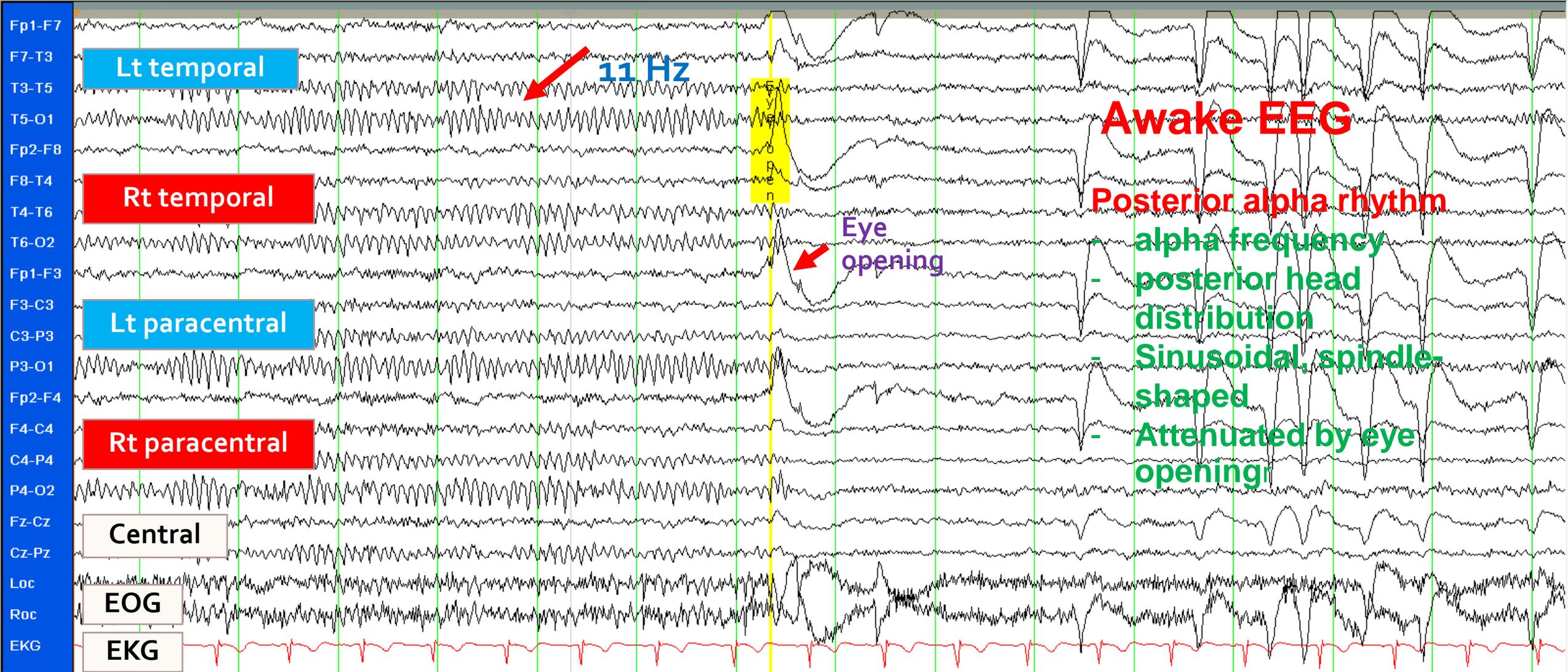
EEG DESCRIPTION

BACKGROUND ACTIVITY

- 1. Posterior dominant rhythm**, additional features of the background, and special features
- 2. Reactivity** of the background
- 3. Nondominant background activity** (beta, theta and delta activity)
- 4. Sleep features**

- ❖ **HV and IPS** and their effects (When omitted, the reason for their omission should be stated; documentation of poor effort)
 - ✓ Augmentation of slowing or any epileptiform abnormalities

- ❖ **Any special characteristics present in the background**
 - ✓ Voltage attenuation/ Augmentation
 - ✓ Suppression-burst
 - ✓ Electrocerebral inactivity



Awake EEG

Posterior alpha rhythm

- alpha frequency
- posterior head distribution
- Sinusoidal, spindle-shaped
- Attenuated by eye opening

Eye opening

11 Hz

Lt temporal

Rt temporal

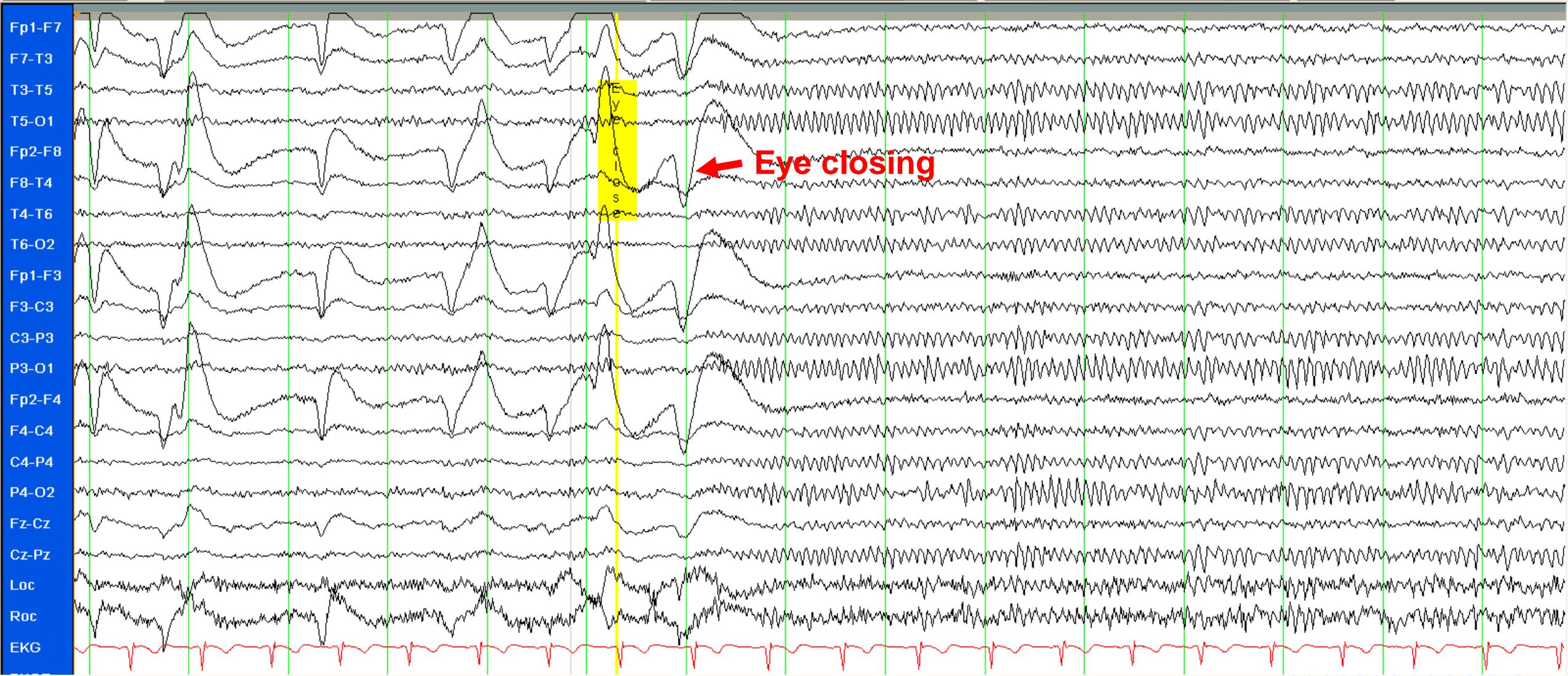
Lt paracentral

Rt paracentral

Central

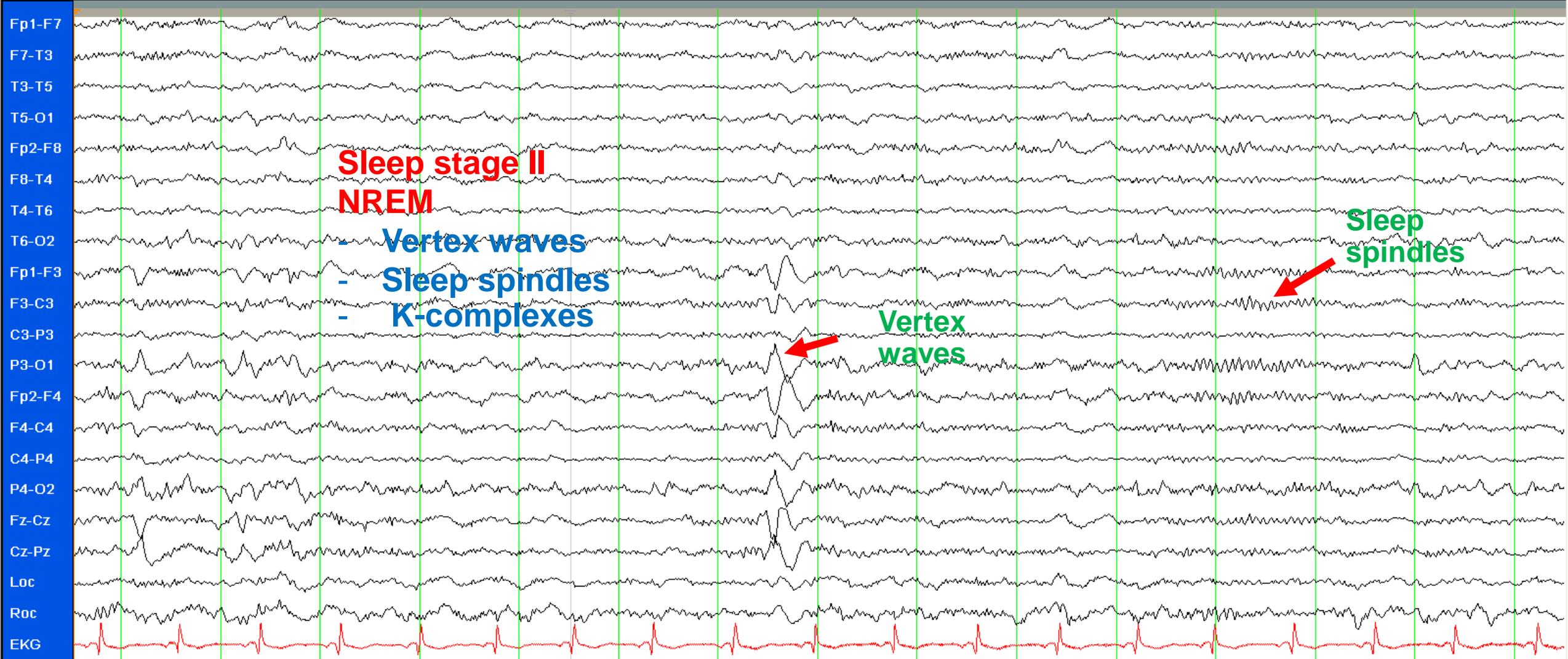
EOG

EKG



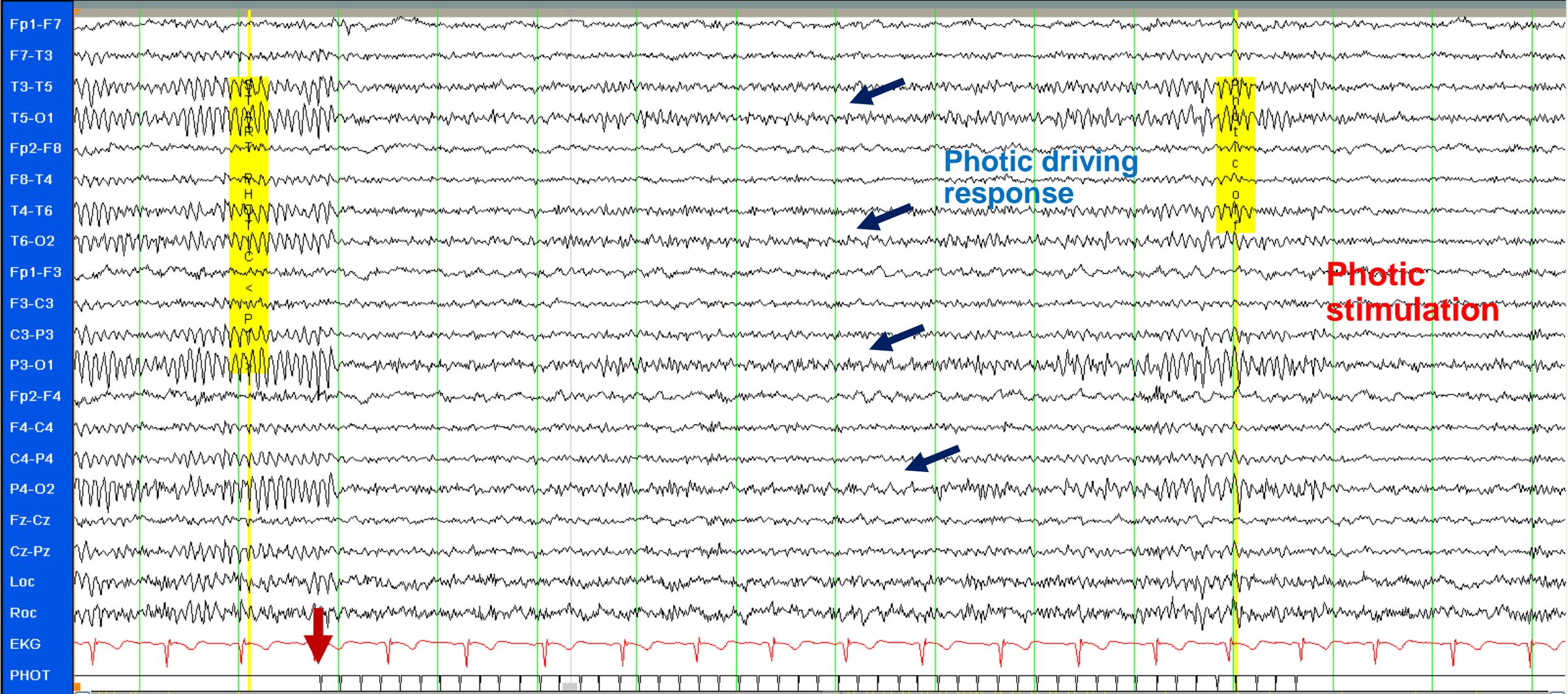
EXAMPLE 1: EEG BACKGROUND DESCRIPTIONS (AWAKE)

- **The EEG background activity consisted of well-developed and well-sustained, medium-amplitude, 11-Hz posterior dominant rhythm which was symmetric and reactive to eye opening and closing during wakefulness**



EXAMPLE 2: EEG BACKGROUND DESCRIPTIONS (SLEEP)

- **Symmetric sleep features including vertex waves, sleep spindles and K-complexes were seen.**



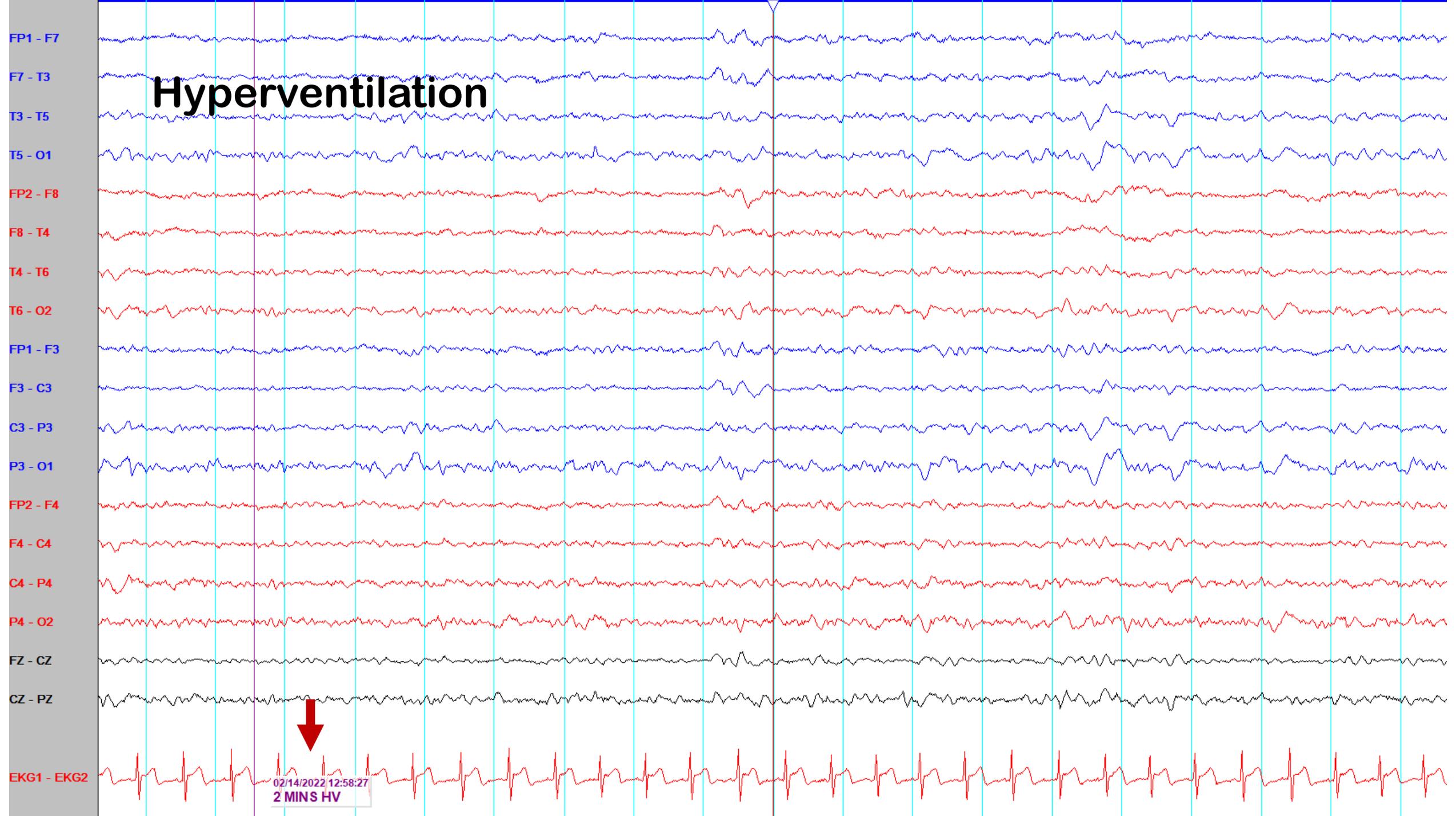
Photic driving response

Photic stimulation

EXAMPLE 3: INTERMITTENT PHOTIC STIMULATION (IPD)

- Intermittent photic stimulation elicited symmetric photic driving response, but did not provoke abnormalities.

Hyperventilation



EXAMPLE 4: HYPERVENTILATION

- **Hyperventilation elicited diffuse slowing (which is a normal physiological response), but did not provoke abnormalities.**

EEG DESCRIPTION

ABNORMALITIES

Non-epileptiform abnormalities

- ✓ **Slow waves:** note morphology; rhythmicity; voltage; continuous vs intermittent; laterality; region of involvement

Epileptiform abnormalities

- ✓ **Interictal epileptiform discharges (IEDs):** note morphology; locations; pattern; amount
- ✓ **Ictal discharges:** note EEG onset; propagation and postictal period; associated clinical change

Artifacts: should be reported when

- ✓ Mimic cerebral activity
- ✓ Unusual or excessive
- ✓ Interfere with interpretation
- ✓ Provide valuable diagnostic information e.g., nystagmus

Electrocardiogram findings

Morphology of slow waves

- Polymorphic (arrhythmic, irregular)

- Rhythmic (monomorphic, monorhythmic)

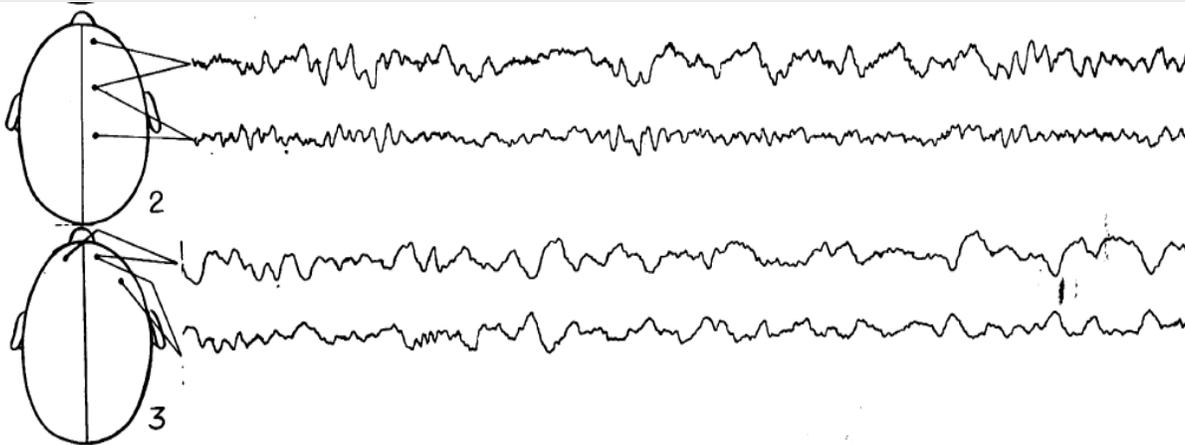


FIG. 4.—Case 3. (1) Showing 16/sec. Alpha-rhythm and 5-7/sec. frontal Theta rhythm. (2) The same position 4 months later showing increased amplitude of 5/sec. rhythm, and also frontal Delta activity. (3) Same date as (2): phase reversal of Delta rhythm over Right frontal pole.

**Irregular, inconstant, slightly
different wave duration**

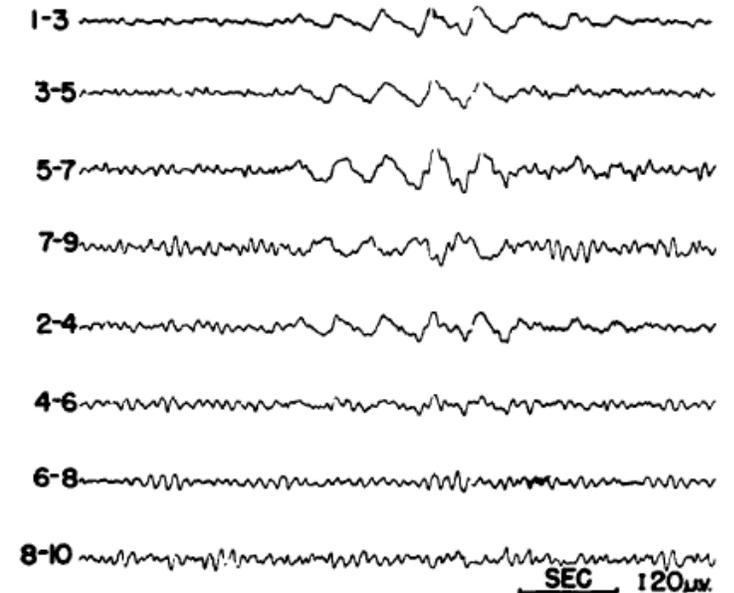
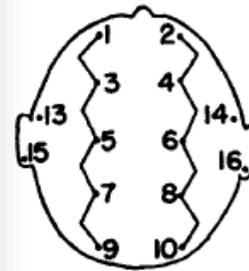
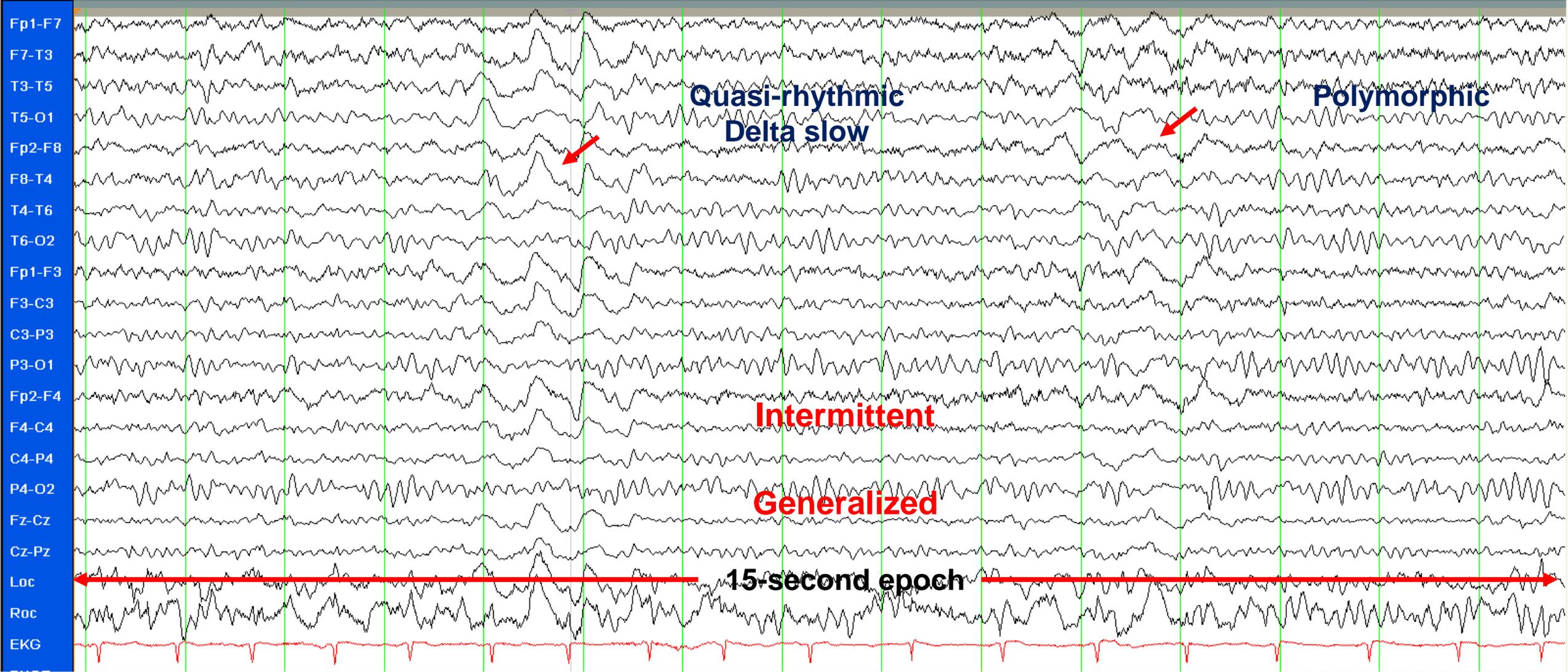


Fig. 1

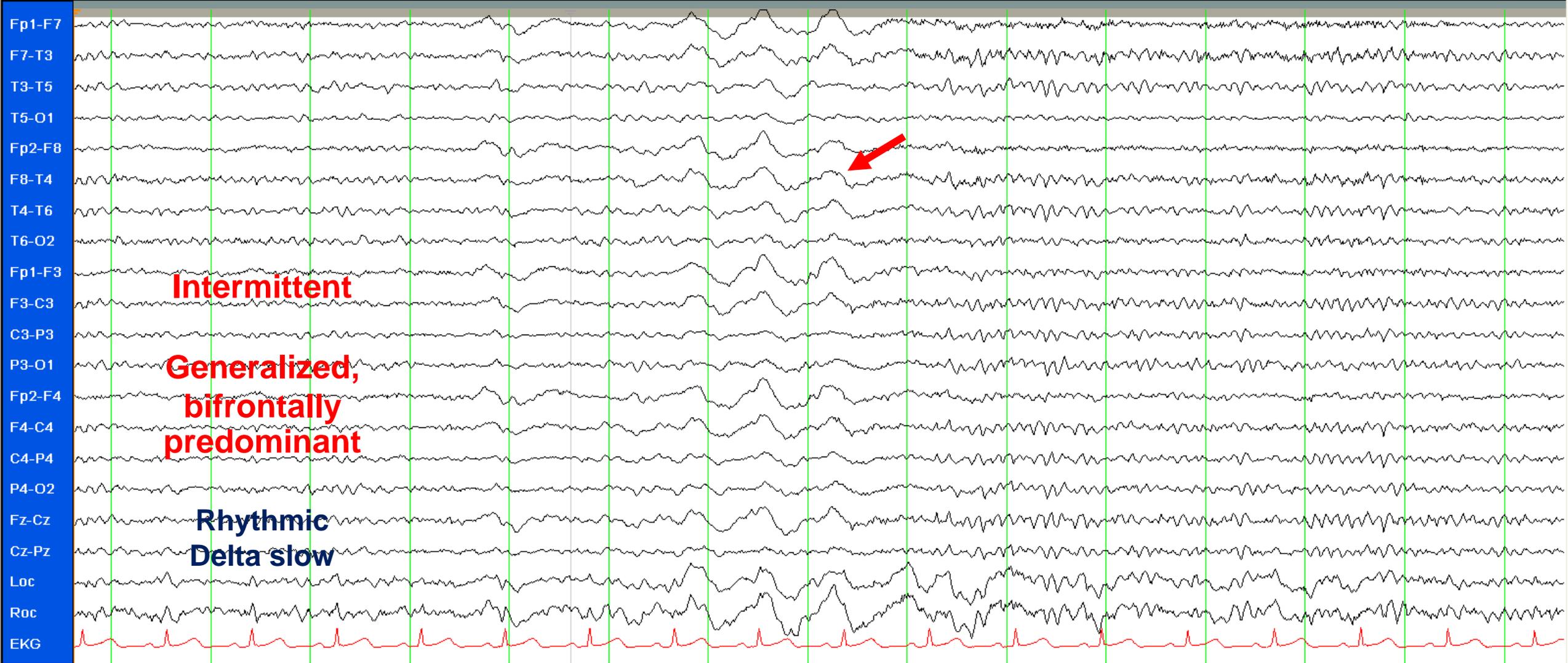
Paroxysmal 2 c/sec. dysrhythmia maximal on the left side. Fifty-four-year-old man with progressive mental deterioration, nausea and vomiting. No papilledema. Ventriculography showed symmetrical hydrocephalus of lateral and third ventricles. Cyst of left cerebellar hemisphere.

**Sinusoidal, stereotyped,
identical wave form**



EXAMPLE 5: NON-EPILEPTIFORM ABNORMALITIES (INTERMITTENT SLOW WAVES)

- **Frequent** 2-3 second intermittent bursts of **generalized**, bifrontally predominant, high-amplitude, **quasi-rhythmic/polymorphic** 1.5-2 delta activity



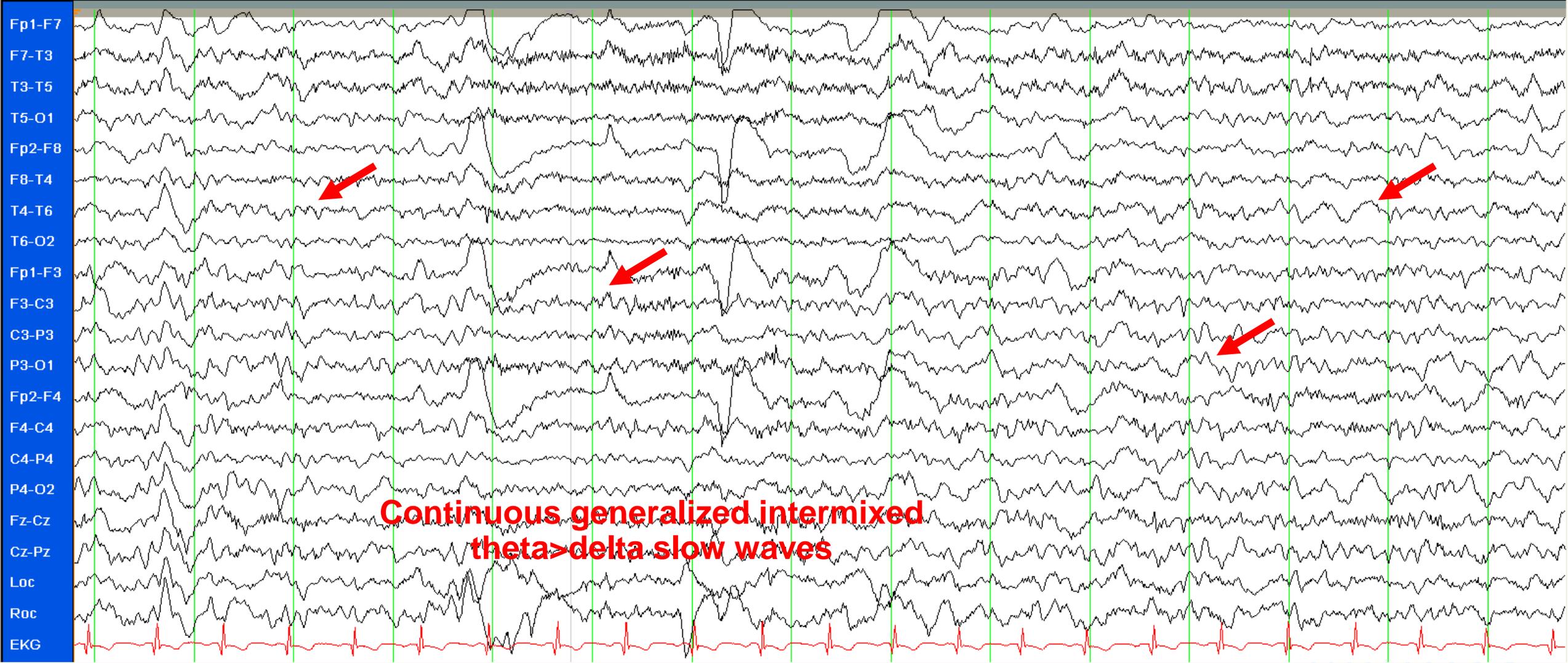
Intermittent

**Generalized,
bifrontally
predominant**

**Rhythmic
Delta slow**

EXAMPLE 6: NON-EPILEPTIFORM ABNORMALITIES (INTERMITTENT SLOW WAVES)

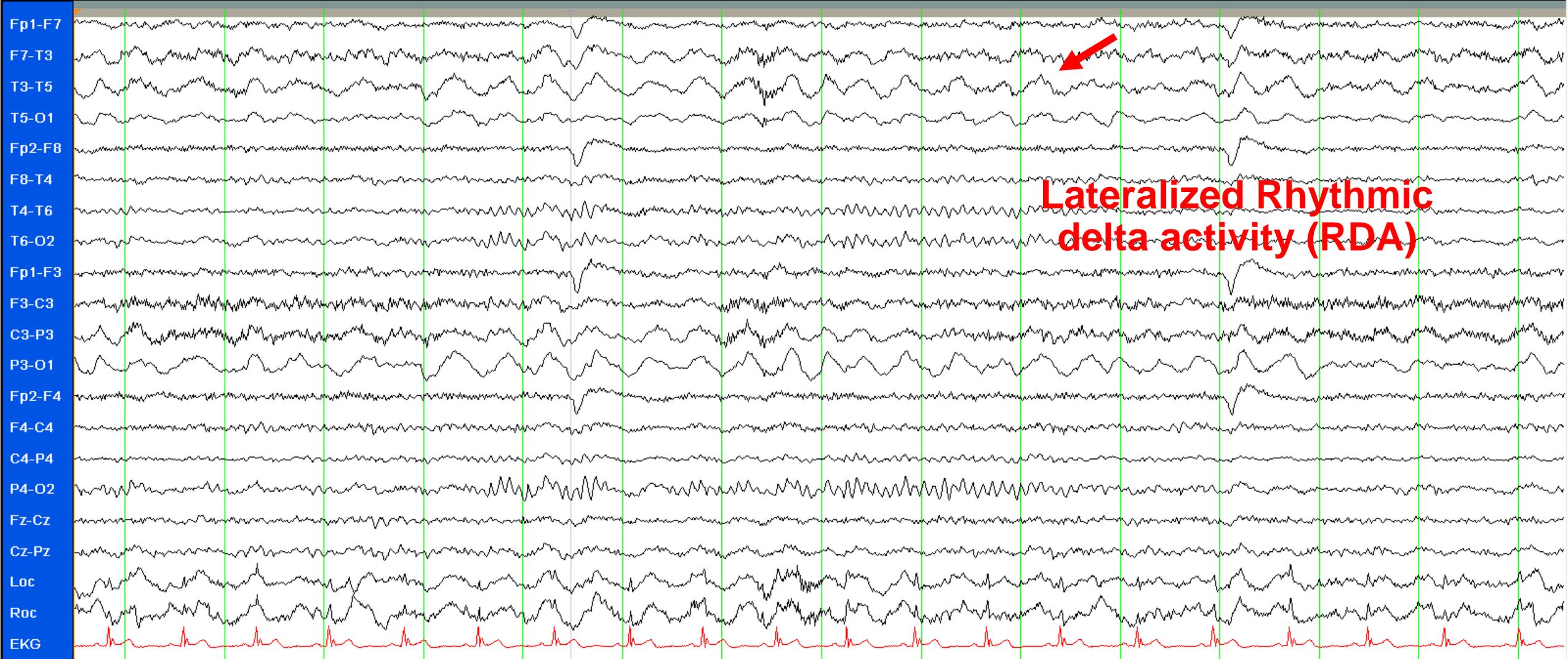
- **Occasional** 2-3 second intermittent bursts of **generalized**, bifrontally predominant, high-amplitude, **rhythmic** 1.5-2 delta activity



**Continuous generalized intermixed
theta > delta slow waves**

EXAMPLE 7: NON-EPILEPTIFORM ABNORMALITIES (CONTINUOUS SLOW WAVES)

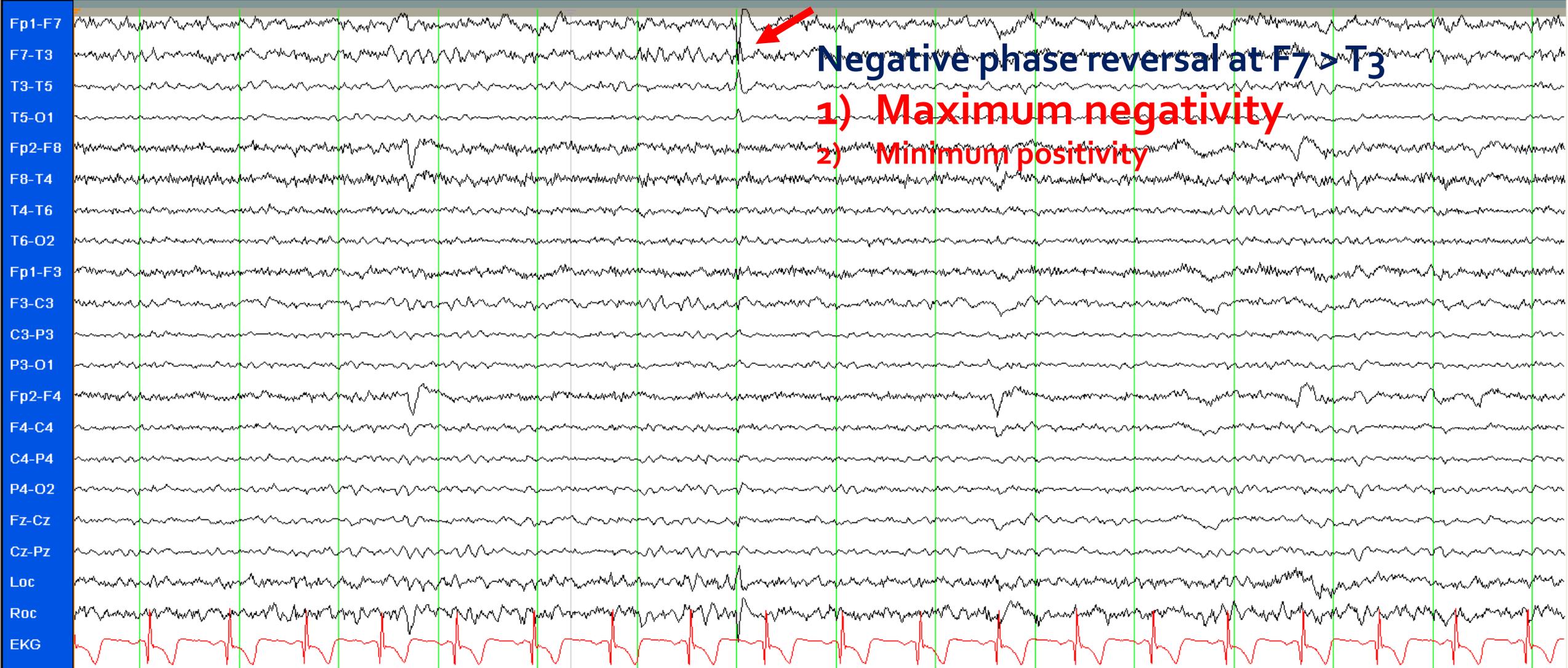
- **Continuous generalized**, medium-amplitude, monomorphic 6-7 Hz **theta** activity **intermixed with** medium- to high-amplitude polymorphic 2-3 **delta** activity



**Lateralized Rhythmic
delta activity (RDA)**

EXAMPLE 8: NON-EPILEPTIFORM ABNORMALITIES (CONTINUOUS SLOW WAVES)

- **Continuous** medium-amplitude, rhythmic 2.5-3 Hz delta activity (LRDA) over left cerebral hemisphere, maximum over left temporal region



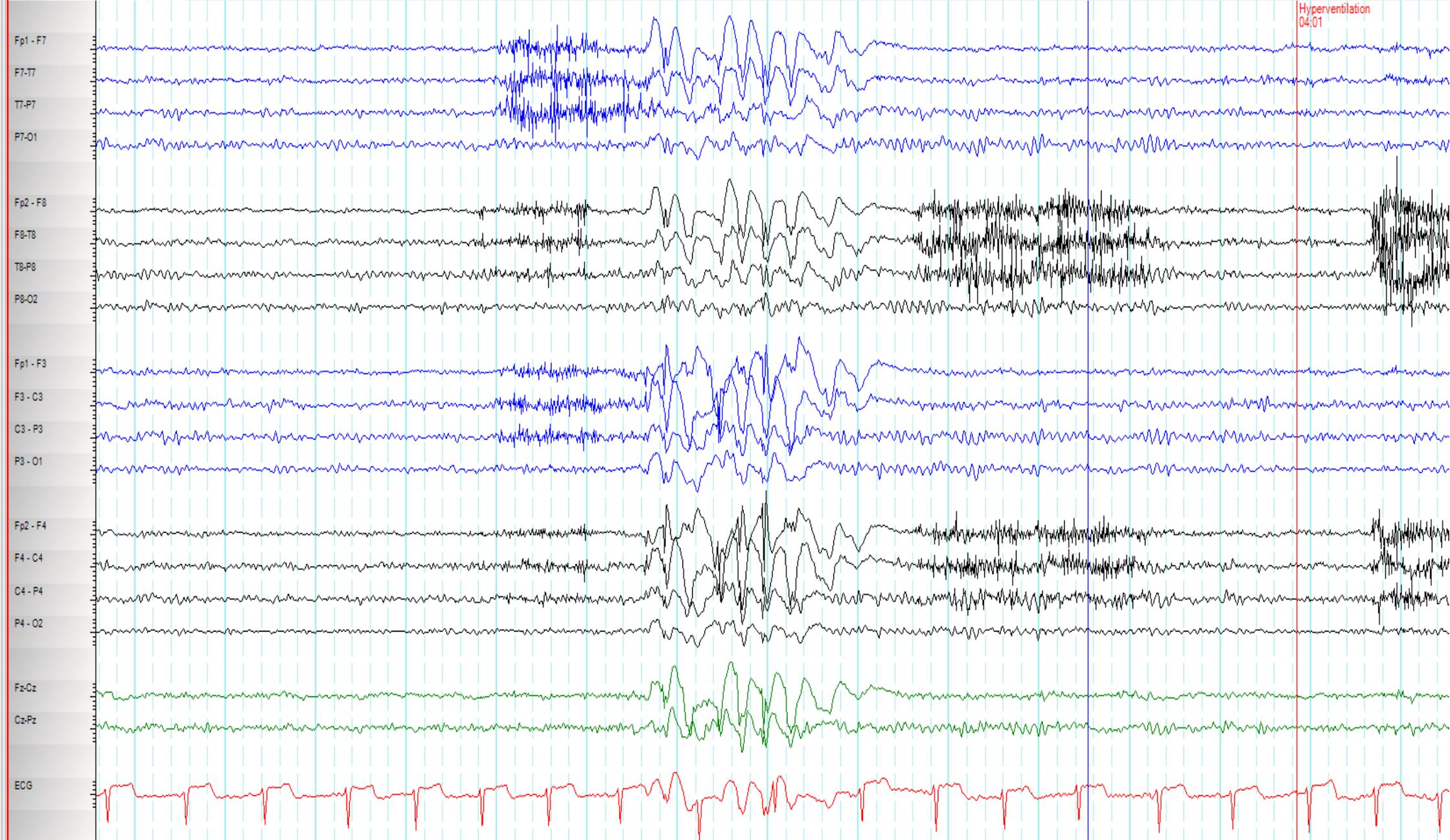
Negative phase reversal at F7 > T3

1) Maximum negativity

2) Minimum positivity

EXAMPLE 9: EPILEPTIFORM ABNORMALITIES (FOCAL IEDS)

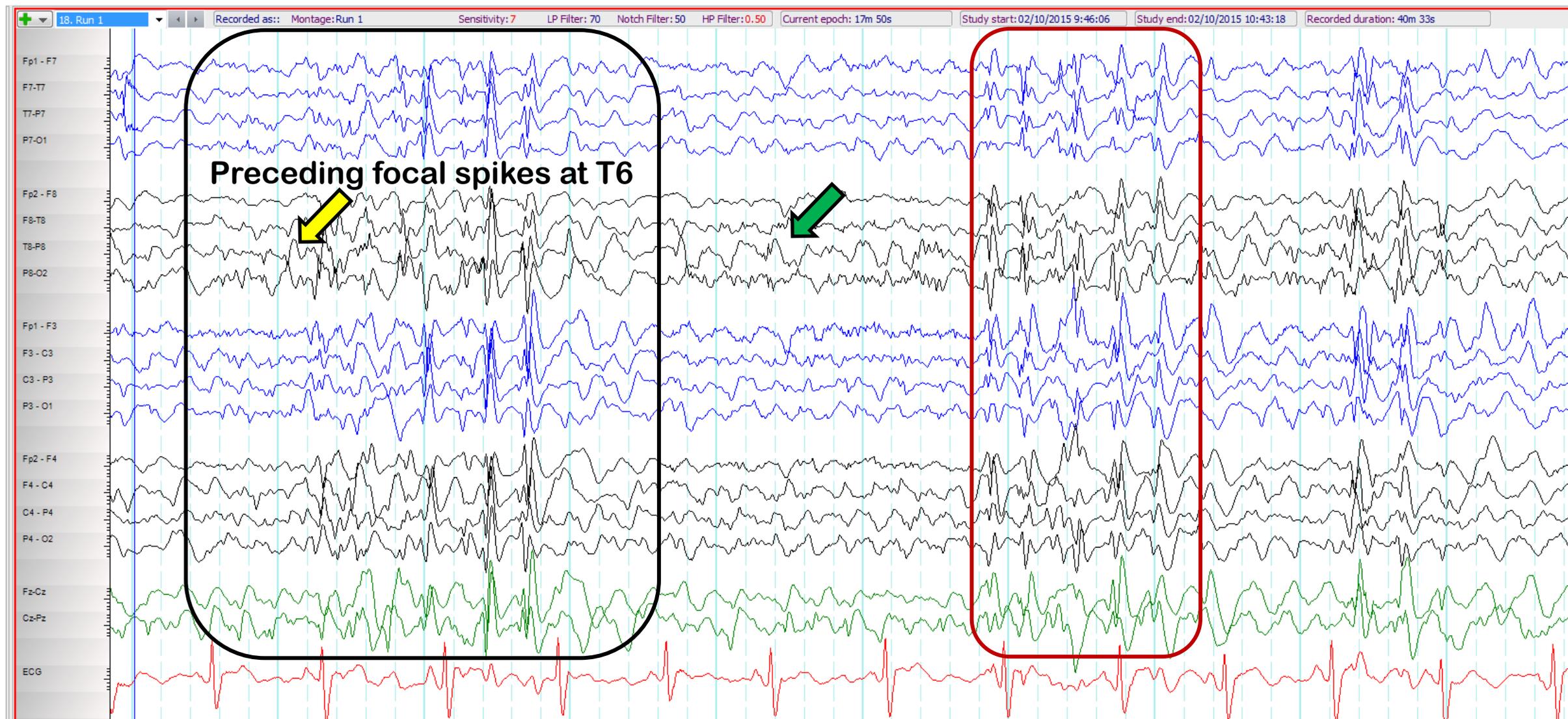
- **Rare** spike-and-slow wave epileptiform discharges **over left fronto-temporal region, maximally at F7T3**



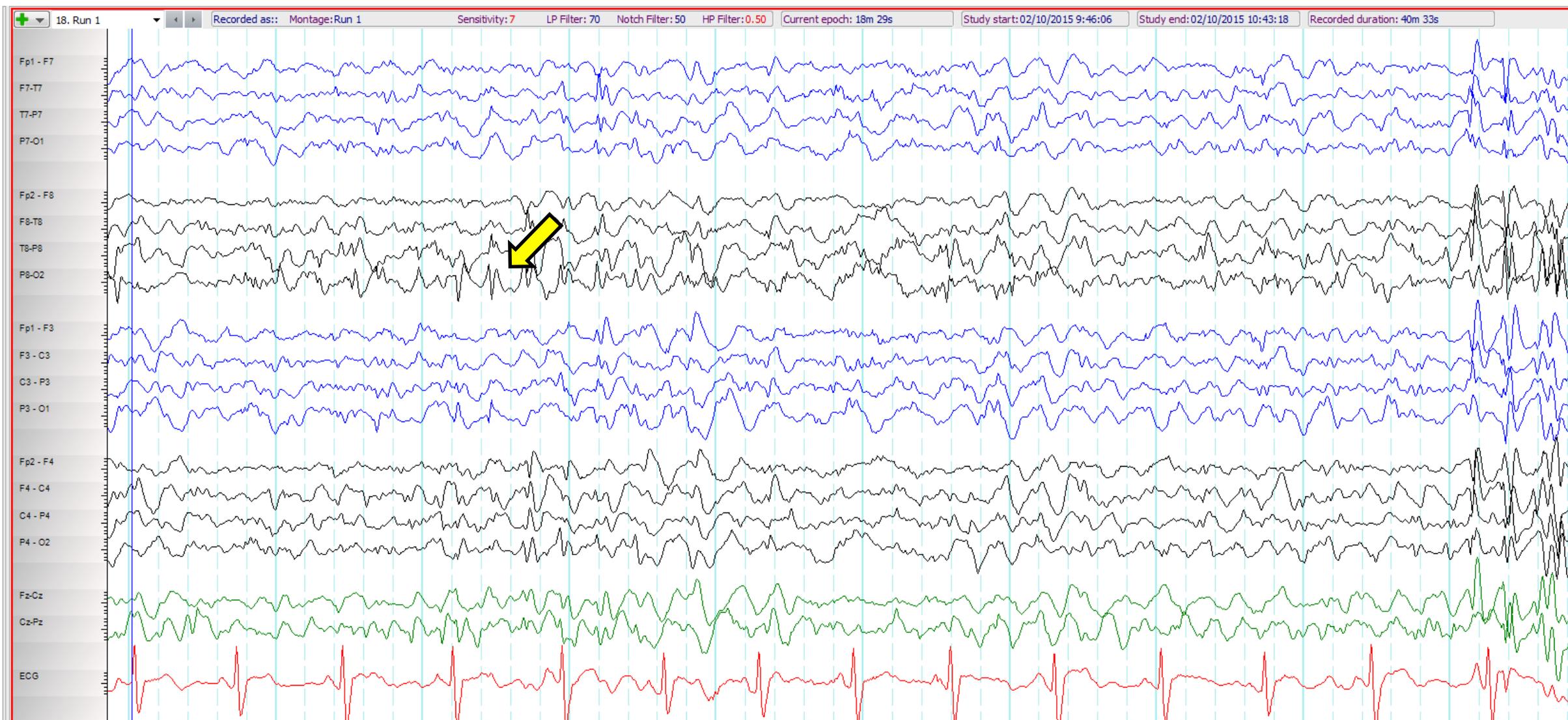
EXAMPLE 10: EPILEPTIFORM ABNORMALITIES (GENERALIZED IEDS)

- **Occasional** 2-3 second bursts of **irregular and asymmetric**, generalized, bilaterally synchronous, left hemispheric predominant, 3.5-4 Hz spike-and-wave epileptiform discharges

Prominent focal slow waves at right posterior head region (T6O2)

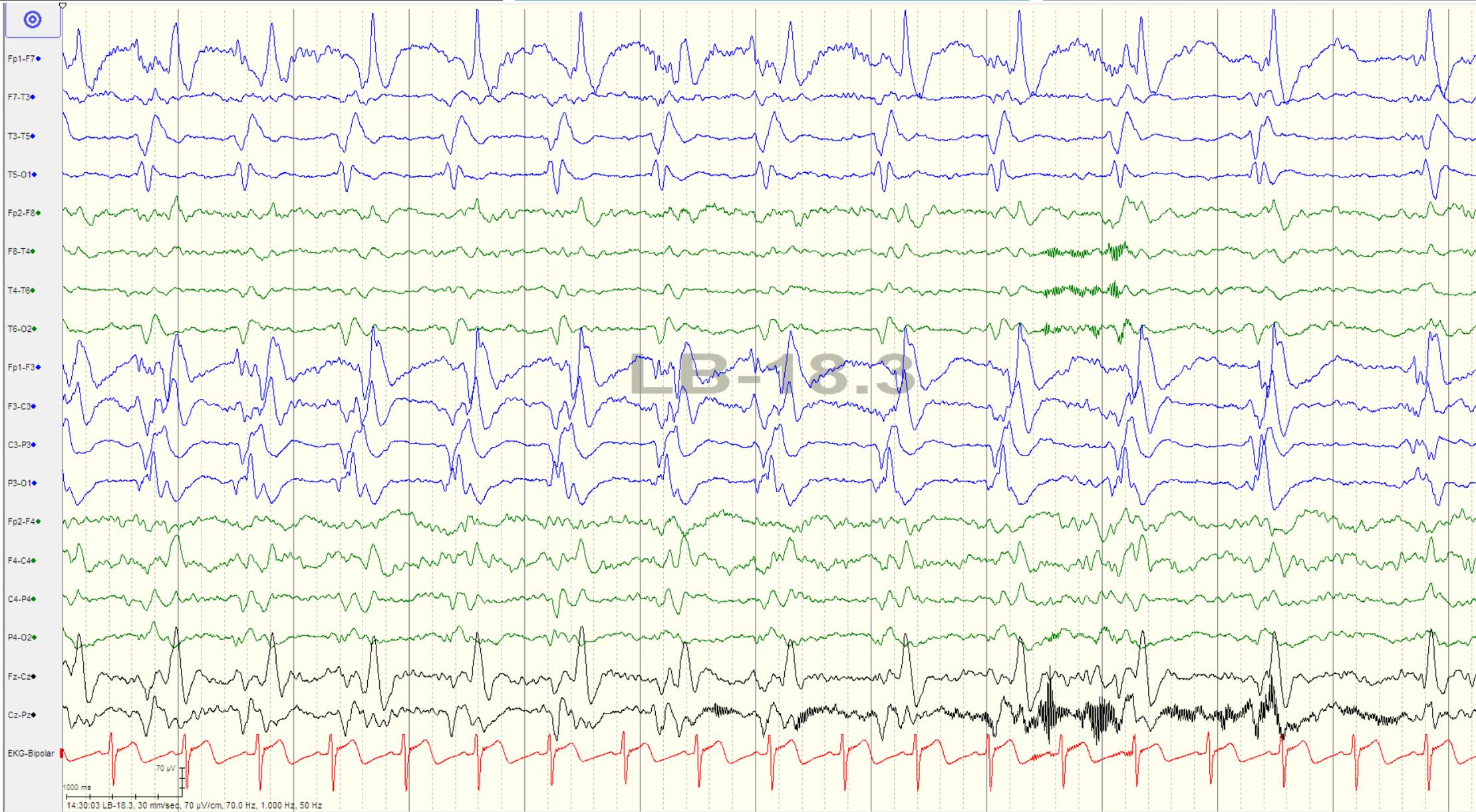


Focal spike-and-slow wave epileptiform discharge at right occipital region (O2)



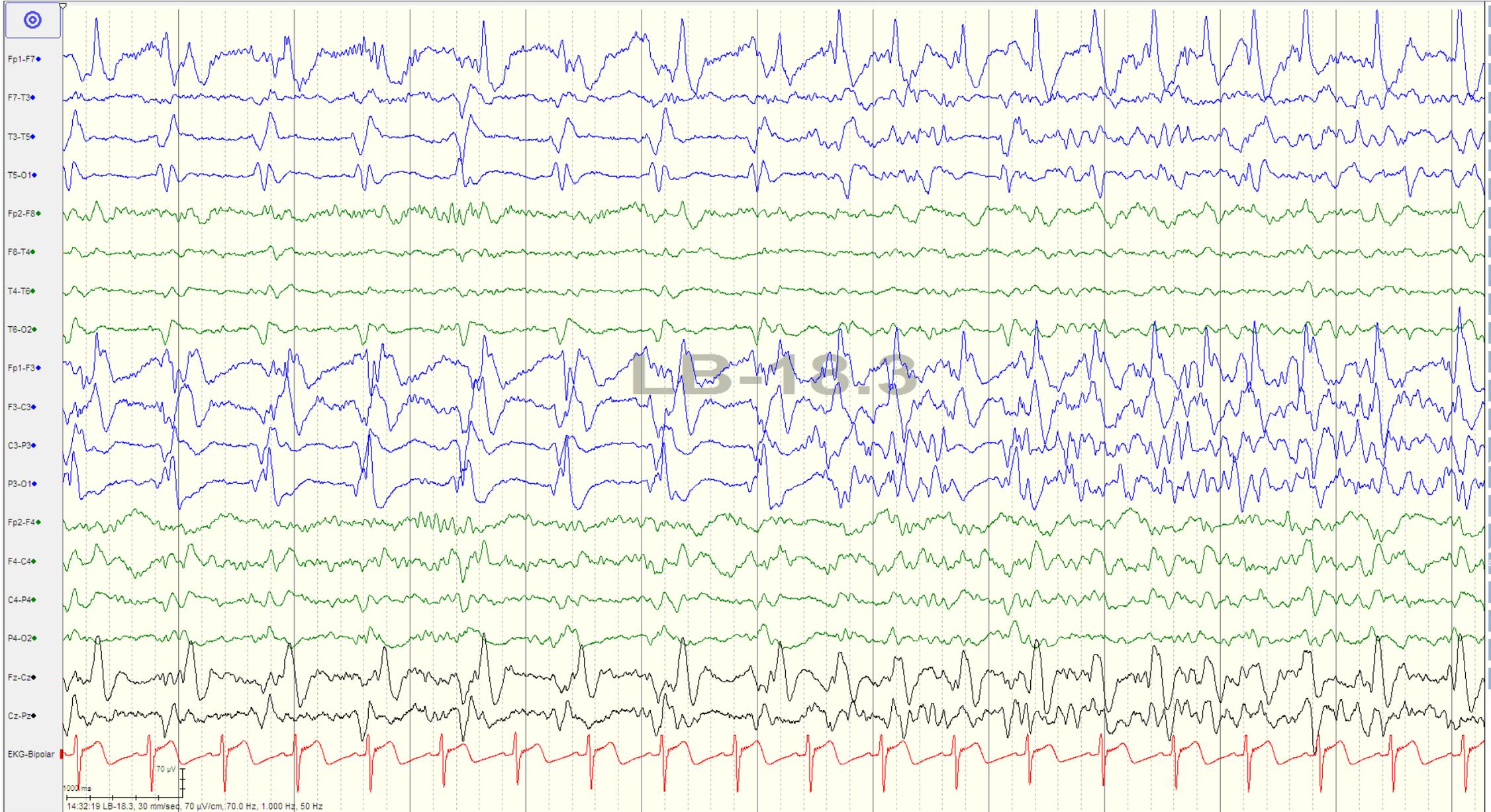
EXAMPLE 11: EPILEPTIFORM ABNORMALITIES (GENERALIZED IEDS)

- **Abundant 2-3 second bursts of irregular and asymmetric, generalized, bilaterally synchronous, posterior head region predominant, 2.5 Hz polyspike-and-wave epileptiform discharges with preceding focal spikes identified over right posterior head region maximally at T6, representing secondary bilateral synchrony pattern**



- Eyes Open
- Eyes Close
- Blink
- Eyes Held
- Movement
- Awake
- Drowsy
- Sleeping
- Alert Pt
- Swallow
- Coughing
- Talking
- Clench Fis
- Fix Electr
- Spike
- Seizure
- NC
- Annotation
- Annotation
- Excellent Eff
- Good Effor
- Poor Effor
- Lighthede
- Tinging





- Eyes Open
- Eyes Close
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- Poor Effor
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- Tingling





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- NC
- Annotation
- Annotation
- Excellent Eff
- Good Effor
- Poor Effor
- Lighthead
- Tingling



EXAMPLE 12: EPILEPTIFORM ABNORMALITIES (ICTAL/SEIZURE)

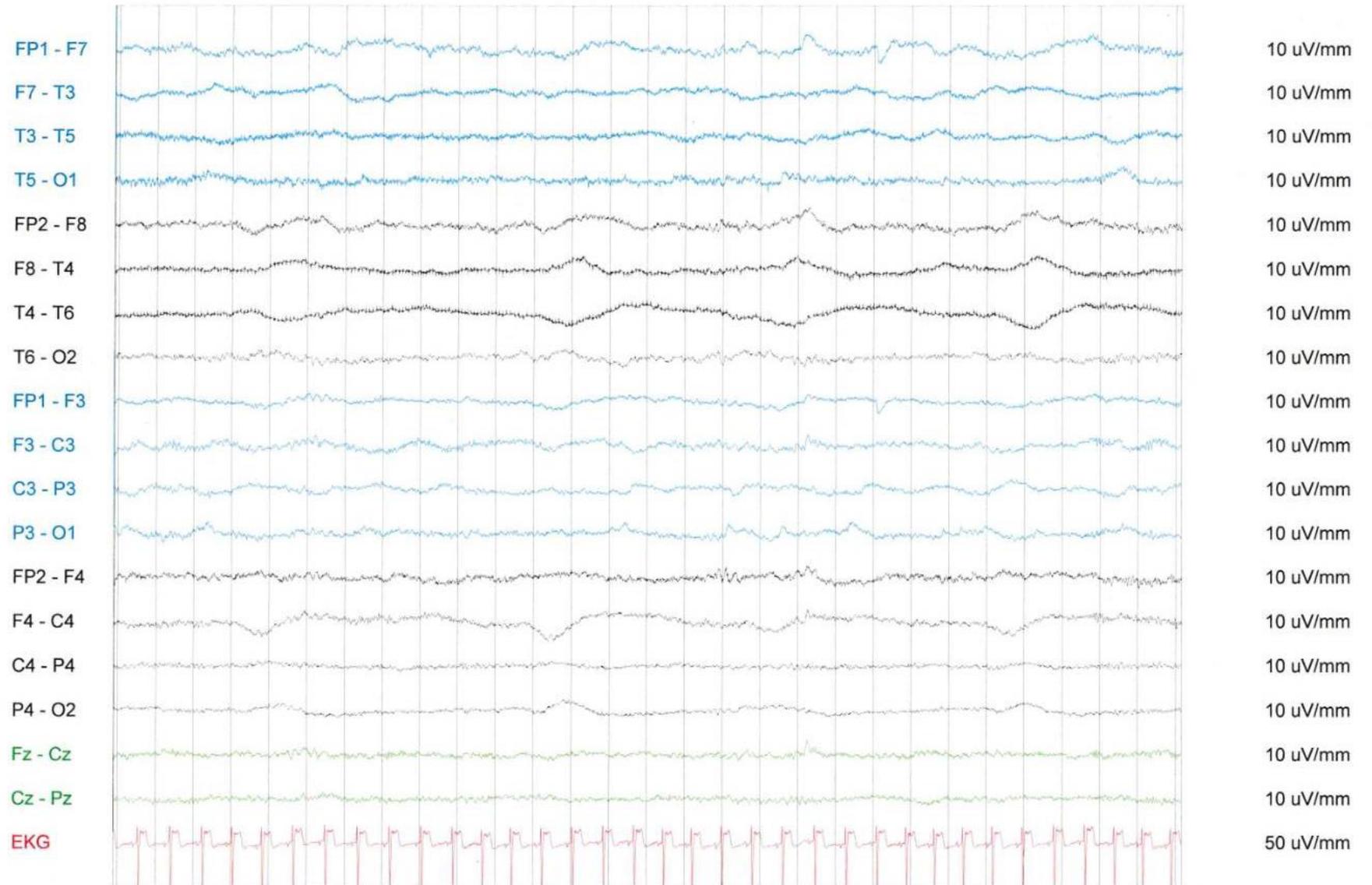
- One electroclinical seizure characterized by **clinical** right facial clonic activity associated with **ictal EEG change** of increased rhythmic alpha and fast activity over left cerebral hemisphere maximally over left centro-parietal region (C3P3) with subsequent evolving over the same area. This **lasted** for 30 seconds.

**Example 1:
Artifacts
that should
be reported**

**Mimic
cerebral
activity**

**Mimic
diffuse
slowing**

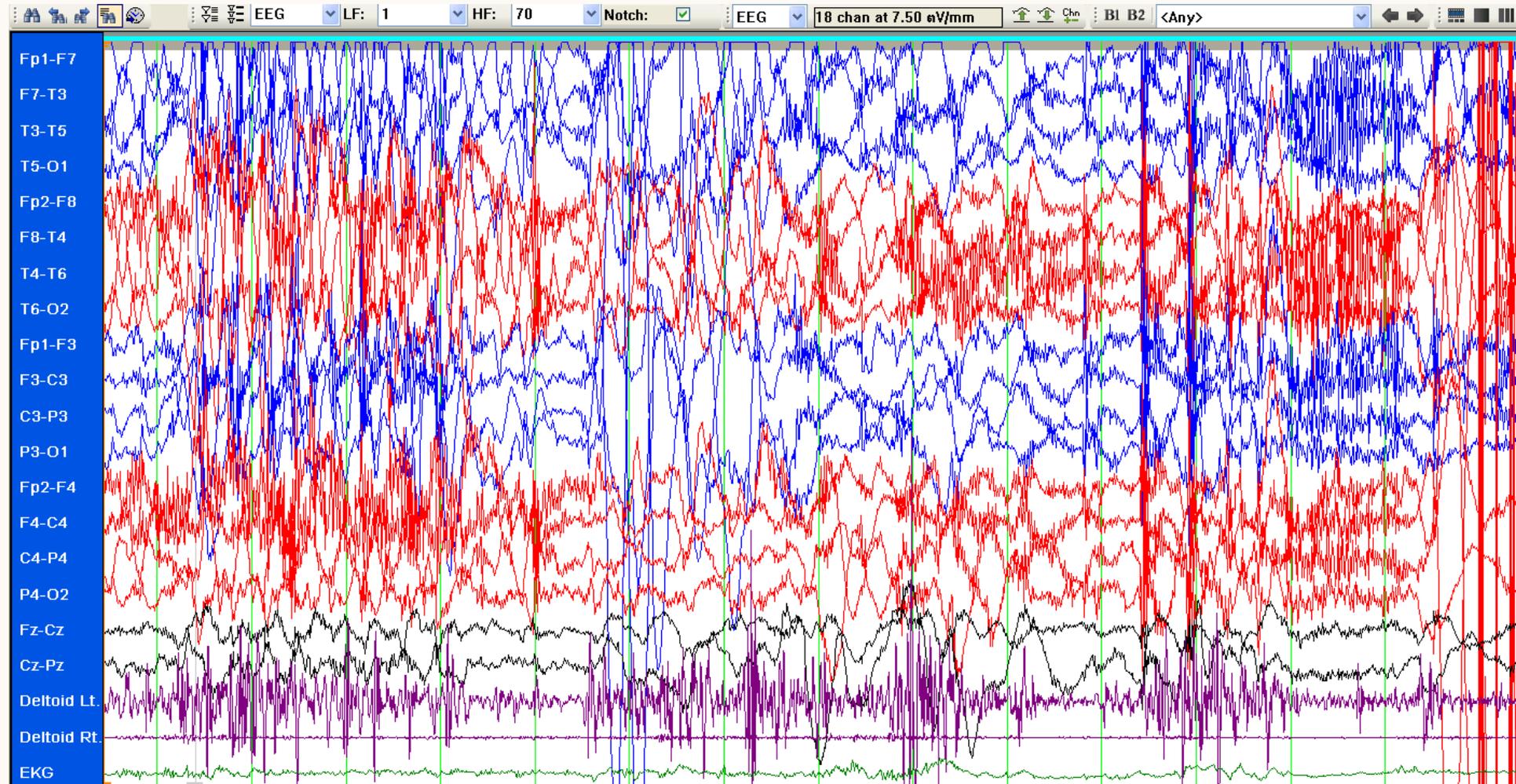
**"Sweat
artifacts"**



**Example 2:
Artifacts
that should
be reported**

**Interfere
interpretation**

**"Technical
difficulty"**



FIVE PARTS

HISTORY

TECHNICAL
DESCRIPTION

EEG
DESCRIPTION

IMPRESSION

CLINICAL
CORRELATION

IMPRESSION

NORMAL/ ABNORMAL

1. Normal or Abnormal
2. If abnormal, specify reasons why
 - Lists the abnormalities by degrees of importance
 - ❖ Seizure
 - ❖ IEDs
 - ❖ Slow waves
 - ❖ Abnormalities of the background activities

- The summary of the findings should be stated succinctly in layman's terms
- Preferably no more than 3 or 4 abnormalities

FIVE PARTS

HISTORY

TECHNICAL
DESCRIPTION

EEG
DESCRIPTION

IMPRESSION

CLINICAL
CORRELATION

CLINICAL CORRELATION

INTEGRATE EEG FINDINGS WITH THE
CLINICAL INFORMATION

- The clinical correlation should clearly express the relevance of the findings to the clinician

- Avoiding technical terminology is helpful to convey the message to the least experienced clinician on the team caring for the patient
 - ❖ **should be understandable to a general practitioner or nurse**

CLINICAL CORRELATION

EXAMPLE I

- “**A normal** interictal EEG does not exclude nor support the diagnosis of epilepsy.”
- “**Focal slowing** suggests an underlying lesion involving the white matter of the ipsilateral hemisphere.”
- “**Diffuse slowing** of the background activity reflects a (include degree: mild, moderate, and severe) diffuse cortical dysfunction, which can be seen with toxic-metabolic or systemic causes, or neurodegenerative disorders, and also with cortical injury.”

CLINICAL CORRELATION

EXAMPLE II

- “The **generalized spike-and-waves** seen in this tracing imply a generalized mechanism in a patient with a clinical diagnosis of epilepsy but may also represent an inherited trait independent of clinical seizures

- “The **left anterior temporal spikes** suggest focal hypersynchrony in a patient with a clinical diagnosis of epilepsy and carry a heightened risk for focal-onset seizures of temporal lobe origin.

CLINICAL CORRELATION

EXAMPLE III

- ““The **suppression-burst pattern** following normothermic cardiac arrest (in the absence of anesthetic drugs) suggests a poor prognosis for neurologic outcome.”
-

Examples of words/ phrases

- Cerebral dysfunction: **More than mild**
Mild: minor irregularities in cerebral function
- **IEDs: suggest potential epileptogenesis**
- **EEG abnormality fit with the clinical information:
is consistent with, is supportive the diagnosis**
- **Clinical manifestation present at the time of the recording:
is diagnostic of**

CLINICAL CORRELATION

SUGGESTIONS FOR FURTHER INVESTIGATIONS

- May suggest
 - ✓ A repeat EEG with sleep-deprivation, ambulatory EEG, video-EEG monitoring,
 - ✓ Referral to a sleep laboratory when sleep apnea is suspected
 - ✓ Further cardiologic evaluation when the electrocardiogram is abnormal

When previous EEGs are available, comparison of the current record to previous tracings should be included



**"DO" AND "DON'T"
IN EEG REPORTS**

"DO" IN EEG REPORT

Kaplan PW & Benbadis SR;
Neurology 2012

Table 1 Items to include in an EEG report

Introduction

- Medical conditions and clinical question
- Whether sleep-deprived
- Medications
- If sedation was used
- Fasting or not
- Level of consciousness at the beginning, and changes during the recording
- Eyes open or closed at the beginning of the recording. Further changes in eye closure, deviation, nystagmus are noted in the description of the record, below
- Number of scalp electrodes; International 10-20 System
- Extra recording electrodes and their purpose, e.g., ECG, EMG, respiration
- Duration; time started and ended

Description of record

- Dominant background activity (alpha rhythm or posterior dominant rhythm): response to eye opening; to limb movement
- Comment on all frequencies (beta, theta, delta); note whether they are symmetric, and sustained or not. Note and comment on the sleep patterns
- Note symmetry, distribution, persistence, and amplitude of activity in microvolts
- Comment whether this activity is continuous or intermittent. Qualitative modifiers alone, such as "medium voltage," provide a less-precise documentation
- Mention how particular stimulating or arousal procedures affect the record, change frequencies or amplitude, or produce epileptiform activity
- Note any seizures and their morphologic, frequency, localization, and temporal characteristics

Interpretation

- Normal or abnormal EEG, and, e.g., "this EEG shows an encephalopathy" or "this EEG shows status epilepticus"
- Use wording that can be understood by the referring person, e.g., general physician, nurse practitioner
- Note whether the findings support, or do not support, the clinical question
- If abnormal, provide reasons why this is so
- Compare with other EEGs available; suggest if further EEGs may help, e.g., with sleep if the referral event occurred during sleep; or with activation if this specific activity triggered the event in question

Clinical correlation

- If possible tie in EEG with the clinical question

FREQUENTLY SEEN THINGS TO AVOID

Table 2 Some don't's: Frequently seen things to avoid^a

- Mixing advice or recommendation in a report. An EEG report only reports on the EEG and should not make management recommendations.
- Merging a SOAP (Subjective, Objective, Assessment, Plan in clinical formatting) note with an EEG report. The EEG is only part of the clinical picture.
- Using the phrase "phase reversal" as if it implied epileptic phenomenon or even abnormality. Phase reversals in themselves only indicate location (S.R. Benbadis in this supplement).
- Reciting a "laundry list" of possible differential diagnoses that obscure rather than clarify.
- Inconclusive reporting that does not commit to the findings. The report should be succinct and clear.
- Stating that "clinical correlation is warranted" or recommended is obvious and unnecessary.
- Avoid being vague when it is possible to be more specific. Go beyond general terms such as "seizure disorder" if possible, and classify the seizure type or epilepsy. If the history describes staring, myoclonus, and tonic-clonic seizures, and the EEG shows runs of generalized 3- to 4-Hz polyspike wave, then this "strongly suggests a genetic generalized epilepsy." Seizures that include staring, and have clear temporal sharp waves on EEG provide strong support for a clinical diagnosis of focal (temporal lobe) epilepsy.
- Using noncommittal phrases such as "consistent with" or "compatible with" a particular condition is not helpful, because many EEGs are consistent (normal or not) with many conditions (and a normal EEG is certainly "consistent with" epilepsy). If, however, the EEG is strongly suggestive of a condition, then the wording could be "... these findings are found in association with ..., but not necessarily indicative of..."

WHAT TO AVOID IN EEG REPORT

- ✓ Avoid criticism of the referring physician
- ✓ Refrain from suggesting treatment
- ✓ Avoid, if possible, classification systems that are not widely used
- ✓ Do not mix therapeutic advice in the report
- ✓ If EEG strongly supports a particular diagnosis, say so
- ✓ Avoid a laundry list of possible differential diagnoses in the clinical correlation



**STANDARDIZED COMPUTER-
BASED EEG REPORT
(SCORE)**

SPECIAL REPORT

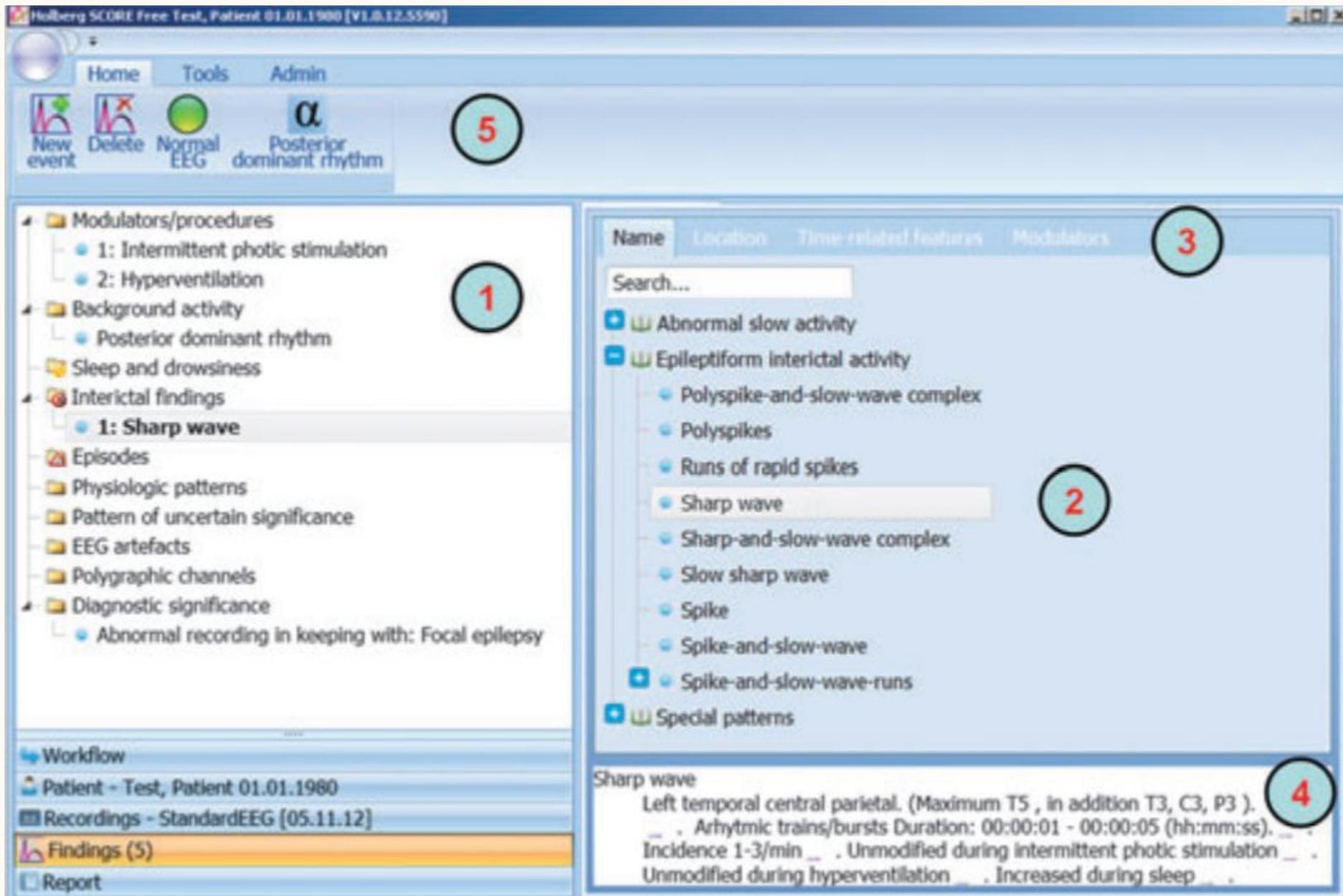
Standardized Computer-based Organized Reporting of EEG: SCORE

*†Sándor Beniczky, ‡Harald Aurlien, ‡Jan C. Brøgger, †Anders Fuglsang-Frederiksen,
§António Martins-da-Silva, ¶Eugen Trinká, #Gerhard Visser, ***Guido Rubboli, *Helle Hjalgrim,
††Hermann Stefan, ‡‡Ingmar Rosén, §§Jana Zarubova, ¶¶Judith Dobesberger, *Jørgen Alving,
¶¶##Kjeld V. Andersen, ¶¶Martin Fabricius, *Mary D. Atkins, ***Miri Neufeld, †††Perrine Plouin,
‡‡‡Petr Marusic, §§§Ronit Pressler, ¶¶¶Ruta Mameniskiene, ††Rüdiger Hopfengärtner,
#Walter van Emde Boas, and ###Peter Wolf

- Computer-based system for EEG assessment and reporting, where the physicians would construct the reports by choosing from predefined elements for
 - ✓ Each relevant EEG feature
 - ✓ The clinical phenomena (for video-EEG recordings)

It will make possible the build-up of a multinational database, and it will help in training young neurophysiologists

First Version



Second Version

The screenshot displays a clinical software interface with a navigation tree on the left and a detailed view of a finding on the right. The navigation tree includes categories like 'Modulators/procedures', 'Background activity', 'Interictal findings', and 'Diagnostic significance'. The 'Posterior dominant rhythm' finding is selected, and its details are shown in the main panel. The details include a 'Finding summary' and several property groups with radio buttons and checkboxes for selection.

Home **Tools** **Admin**

Help Support Normal EEG Delete New finding: Background activity Posterior dominant rhythm

Modulators/procedures (2)

- 1: Hyperventilation
- 2: Intermittent photic stimulation

Background activity (1)

- Posterior dominant rhythm**

Sleep and drowsiness

Interictal findings (1)

- Epileptiform interictal activity (1)

Rhythmic & periodic patterns in critical ill patients

Episodes (1)

- Generalized seizure - Absence - Typical

Physiologic patterns

Pattern of uncertain significance

EEG artefacts

Polygraphic channels

Trend analysis

Diagnostic significance (1)

- Abnormal recording supporting: Generalized idiopathic epilepsy

Workflow

Patient - Test, Patient 11/10/2009

Recordings - StandardEEG [11/10/2016]

Findings (9)

Report (14/10/2016)

Search

Finding details

Finding summary

Posterior dominant rhythm

Properties: Normal activity _ . 9.0 - 10.0 Hz _ . Medium amplitude (20-70 μ V) _ . Symmetrical amplitude _ . Reactive to eye opening _ . Normal organization _ . Symmetrical frequency _ .

Name Properties

Significance

- Not scored
- Normal [Free text](#)
- No definite abnormality
- Abnormal
- Not possible to determine

Frequency

- Not scored
- Frequency [Free text](#) [Frequency 9.0-10.0](#)

Amplitude

- Not scored
- Low (<20)
- Medium (20-70) [Free text](#)
- High (>70)
- Not possible to determine

Amplitude asymmetry

- Not scored
- Symmetrical [Free text](#)
- L<R
- R<L
- Asymmetry not possible to determine

Reactivity to eye opening

- Not scored
- Yes [Free text](#)
- Reduced left side reactivity
- Reduced right side reactivity
- Reduced reactivity both sides
- Not possible to determine

Organization

- Not scored
- Normal [Free text](#)
- Poorly organized
- Disorganized
- Markedly disorganized

Frequency asymmetry

- Not scored
- Symmetrical [Free text](#)
- #Hz lower left
- #Hz lower right

Caveat

- Not scored
- No
- Only open eyes during the recording
- Sleep-deprived
- Drowsy

Absence of posterior dominant rhythm (PDR)

- Not scored
- Artefacts
- Extreme low voltage
- Eye-closure could not be achieved
- Lack of awake period
- Lack of compliance
- Other causes (+ free text)

**THANK YOU FOR
YOUR ATTENTION**

