EEG Artifacts, Type, Identification and elimination

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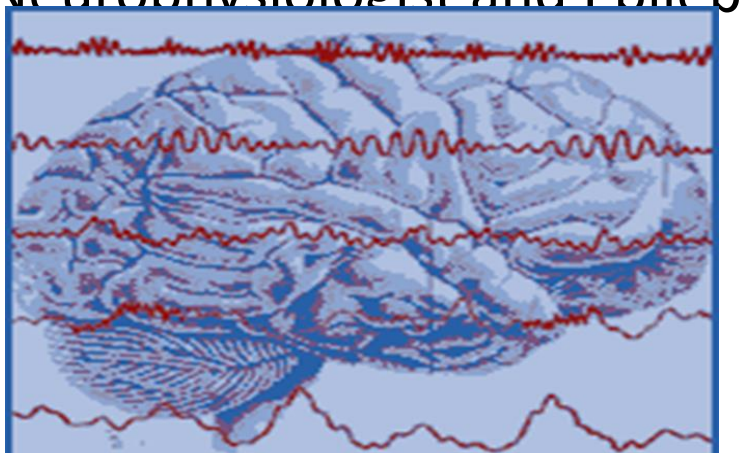
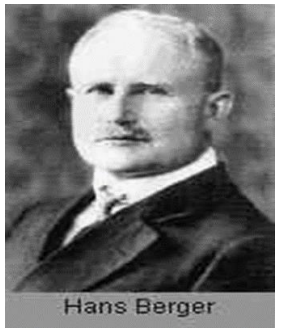


28th March 2021

1. Introduction, basics, electrode placement
2. Artefact classification
3. Who to eliminate during recording & during reviewing



- Human Brain signals recorded by German psychiatrist Hans Berger in **1929**
- **he published 14 reports** about his studies of qualitative EEGs, **1929-1938**
- **G. Dietsch** applied Fourier analysis to seven records of EEG and became the first researcher of what is called **QEEG** (quantitative EEG) **1932**
- Calibration and 10-20 electrode placement system: introduced in **1958** by the int. federation of EEG and Cl NP(Ref. 1.Jasper, H. H. (1958). The ten-twenty electrode system of the International Federation. Electroencephalography and Clinical Neurophysiology, 10, 371–375. 2.Teplan, M. (2002). FUNDAMENTALS OF EEG MEASUREMENT,)

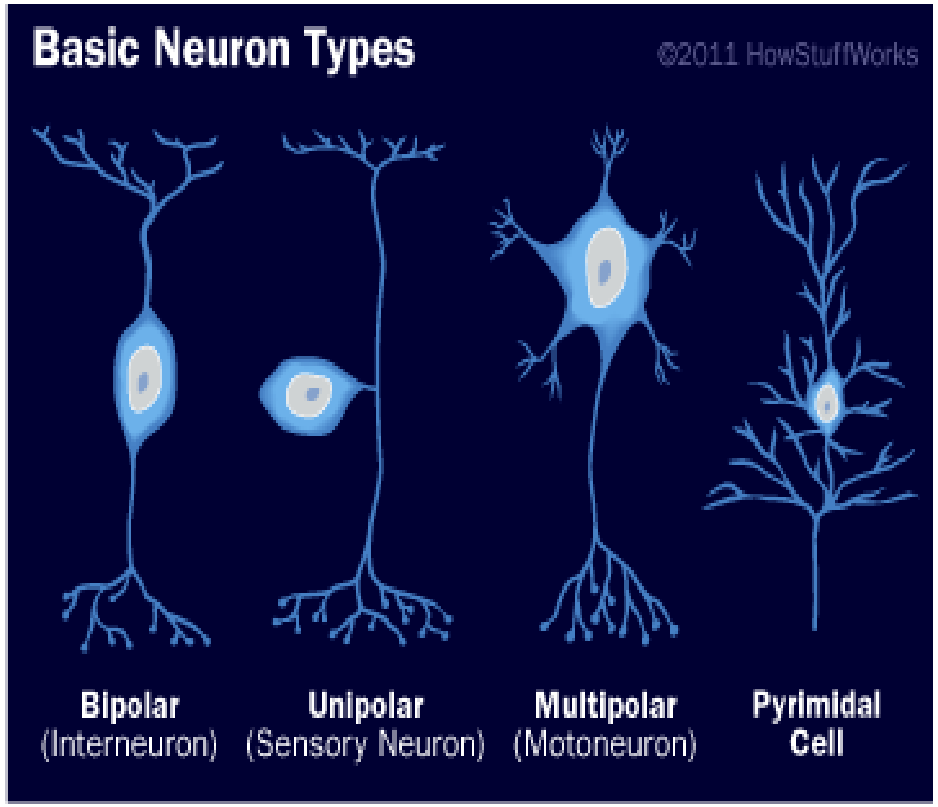
Introduction & artefact

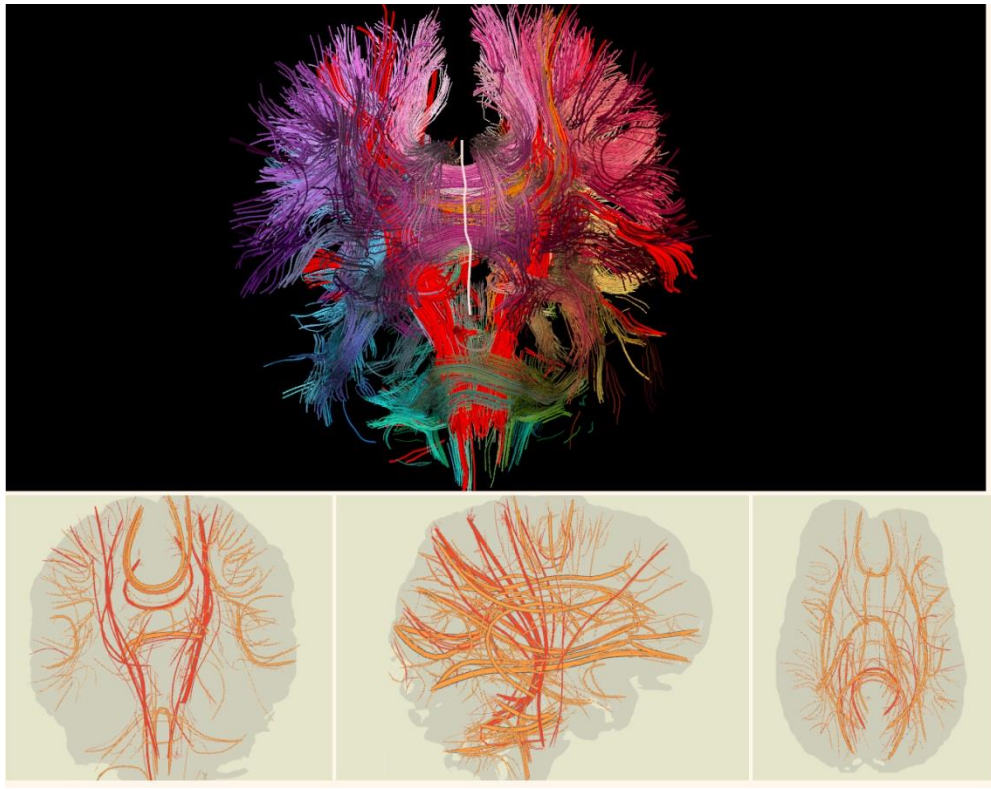
- Human Brain is divided into different lobes (F,C,T,P,O) electrode placement accordingly.
- Left and right sided electrodes: Odd and Even number
- **EEG records**:
  - action potential, activities of the brain from its different areas.
- It also records
  - noise from within and out of the body- artefacts/ artifacts
- Physiologycal artefacts
  - Body of the subject is the main source
- Non-physiological or External artefacts

- Recognition, identification and elimination of artefacts is an important process to minimize the chance of misinterpretation of EEG
- Clinical and non-clinical fields such as brain computer interface, intelligent control system robotics etc. all require removal of artefacts.
- Artefacts can be removed very easily using manual and filtering methods because of their morphology and electrical characteristic.

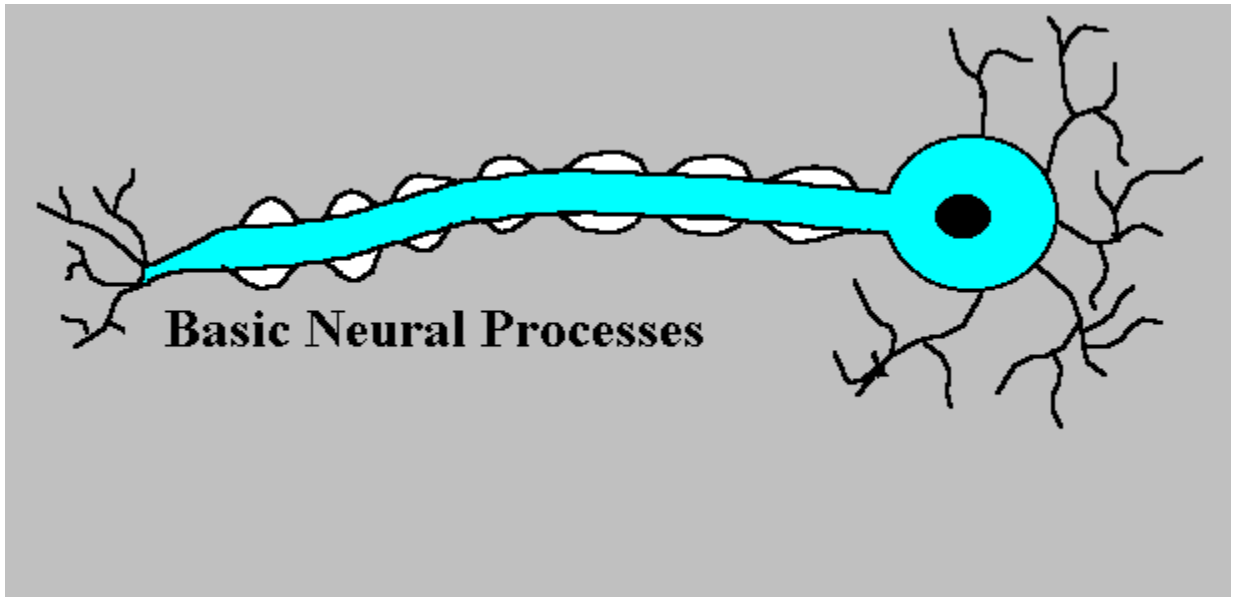
What is the effect?

- Artefacts can imitate nearly all types of EEG patterns and as such, artefacts included in automatic analysis can seriously affect the results, eventually leading to mistaken interpretations.
- Substantial amount of artefacts render the analysis of EEG unacceptable.
- Several times artefacts themselves may contain valuable information as in sleep study where eye movement and muscle artefacts in the EEG recordings might expedite sorting of sleep stages





2D neuronal map image



<u>Brain wave recordings</u>

<u>Extra-cellularly</u>

- Scalp (EEG)
- Cortical surface – ECOG
- Deep structure: electroneurogram

What does the EEG record?

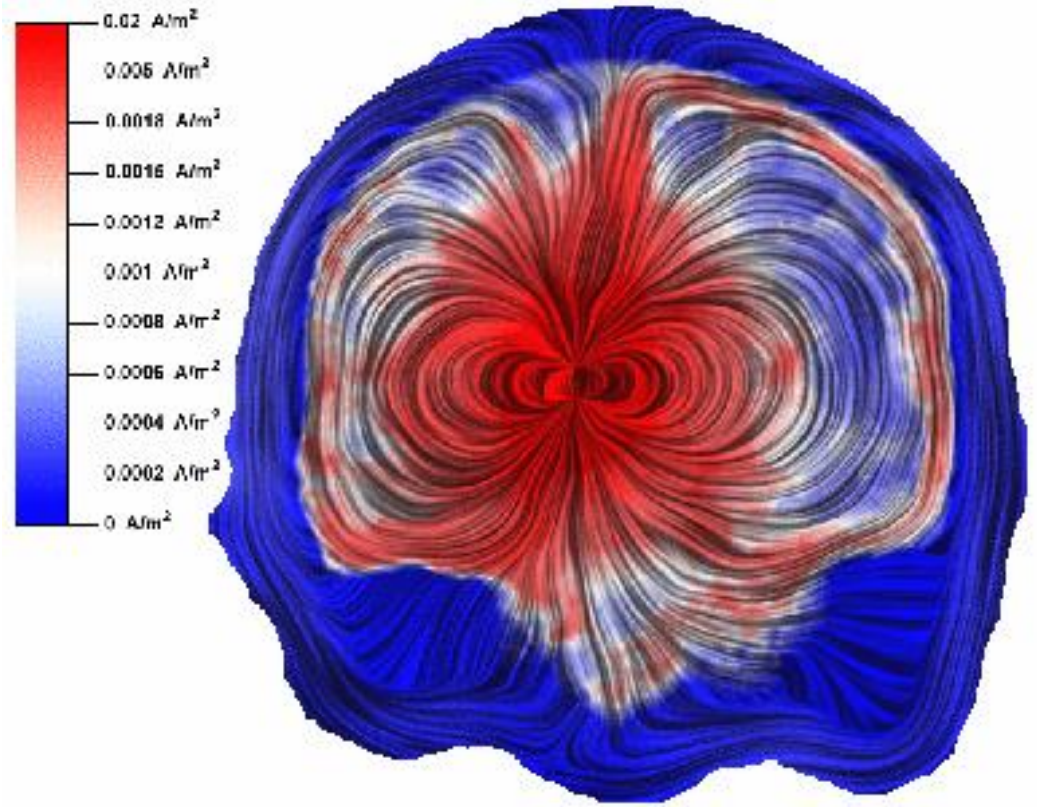
Mainly NOISE!!

Volume Conduction

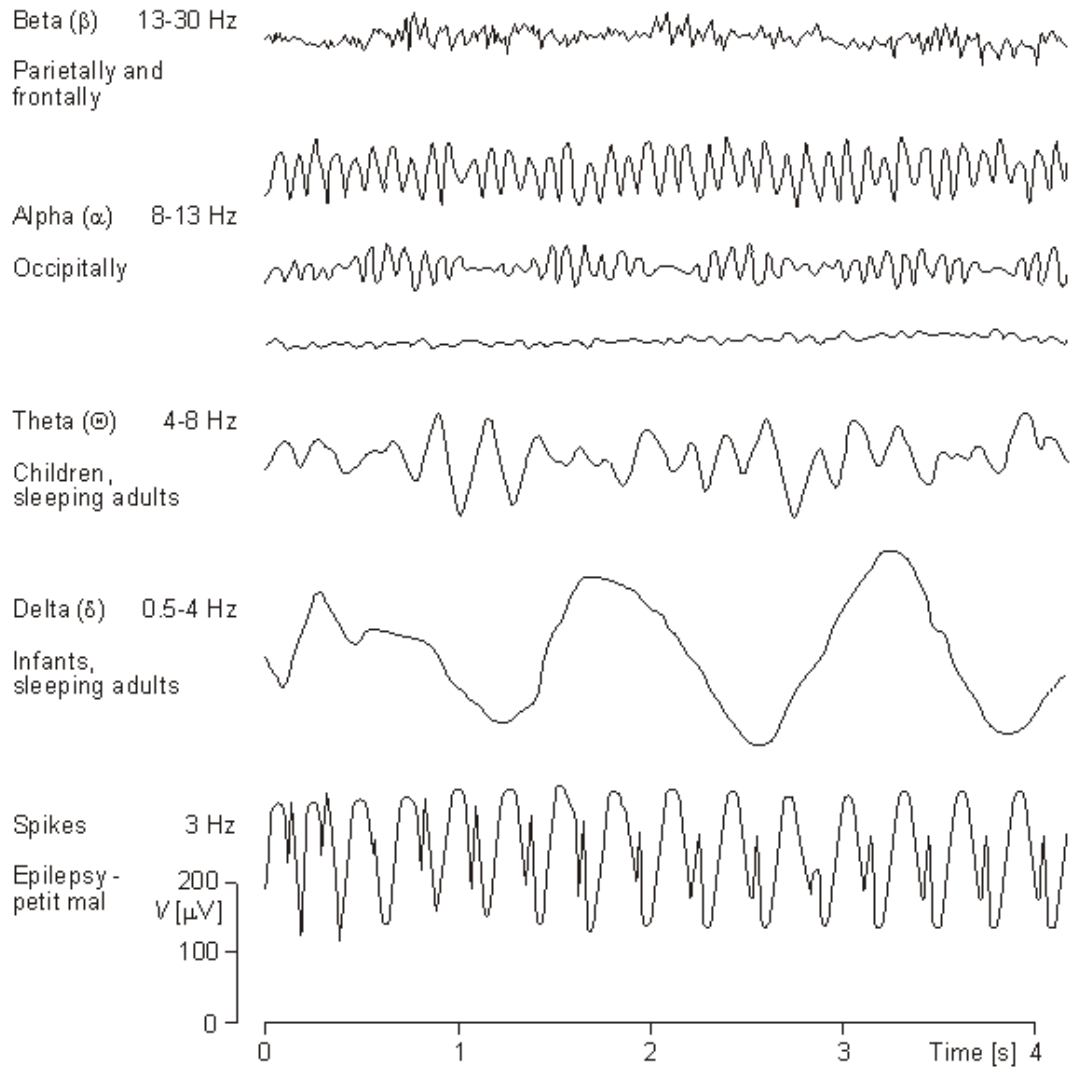
The electrical activity flows through the tissue between the electrical generator and the recording electrode.

Thus, the EEG is a 2-D representation of a 3-D reality, which poses a problem in localizing the sources of the electrical activity

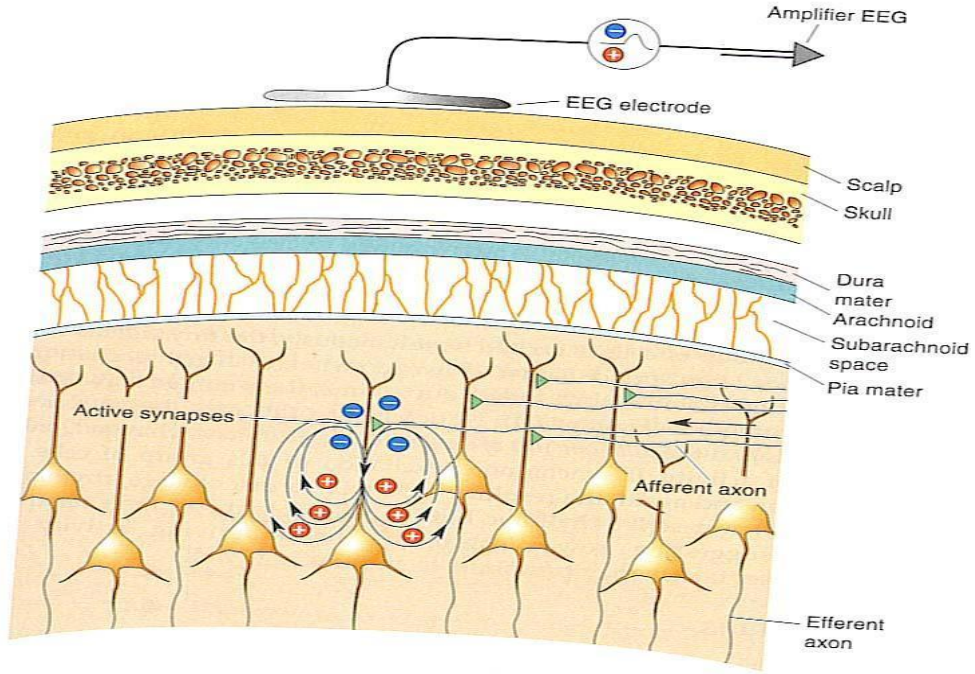
Inverse problem



EEG Rhythms


Beta (β) 13-30 Hz
Parietally and frontally
Alpha (α) 8-13 Hz
Occipitally
Theta (Θ) 4-8 Hz
Children, sleeping adults
Delta (δ) 0.5-4 Hz
Infants, sleeping adults
Spikes 3 Hz
Epilepsy - petit mal
200
V [μV]
100
0
0
1
2
3
Time [s] 4

EEG, fallacy



1.**Brain is no a sphere**, Its surface is not directly parallel to the overlying structure where electrodes are placed

2. Each small electrode is averaging the activity within 1inch area, limit of such region depends on many factors

3. **Slight alteration of electrode placement would result in the electrode averaging the activity from a different region of the brain**

4. **Appropriate electrode placement and Montage setting is important for localizing the disturbed area**

5. **All EEG record are practically bipolar event when theoretically unipolar**

For optimum output

- Equipment setting
  - Sensitivity, paper speed, HFF, LFF
- Accessories:
- Appropriate montage setting
- Bio-calibration
- Impedance testing
- Electrode placement
- Recording technique, patient's position, age & state
  - Consider patient's clinical problems and clinical question
- Reviewing with appropriate montage
- Reporting with full description
- Clinical correlation

Artefact during recording

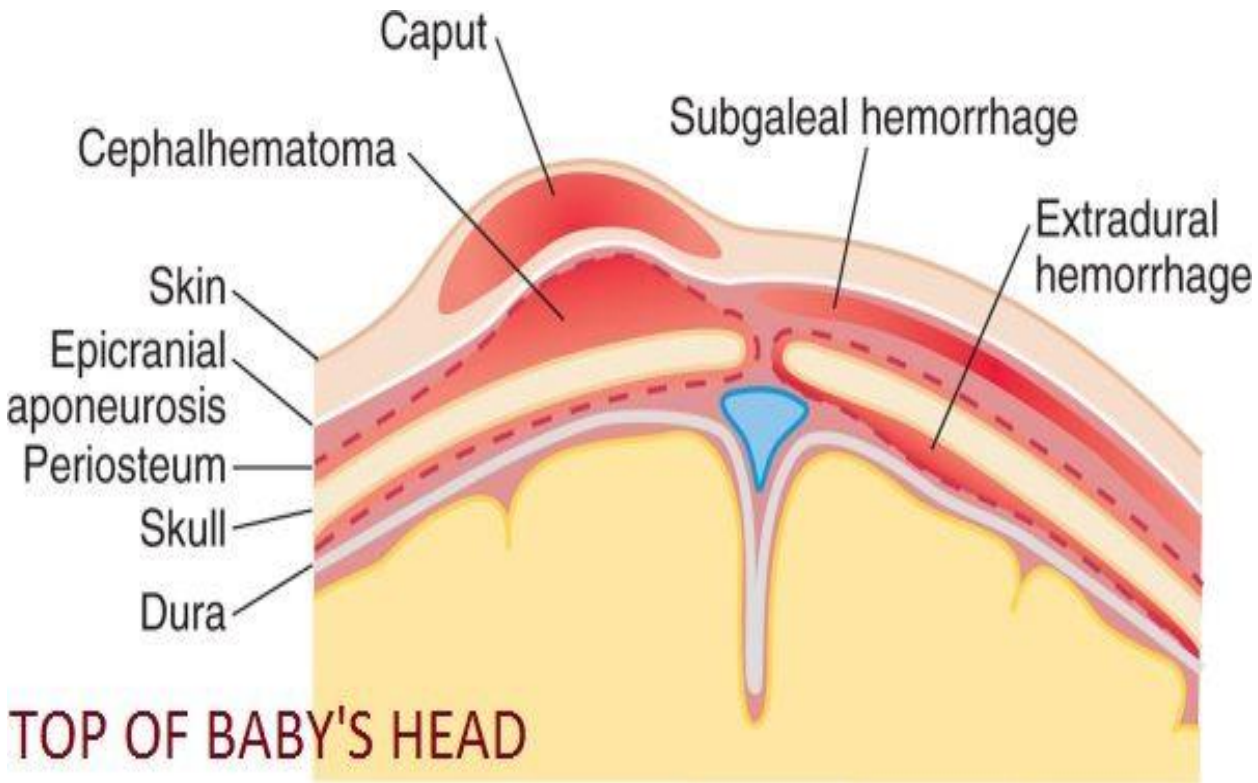
How EEGs can be contaminated?

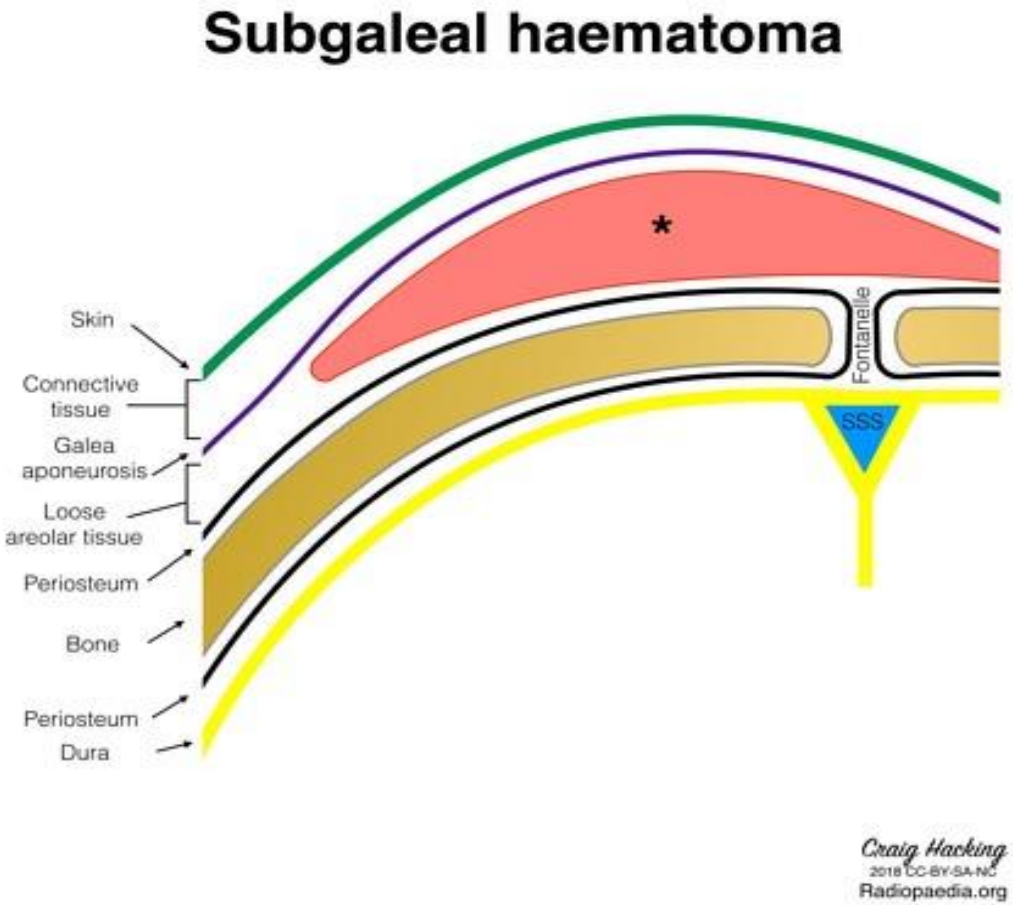
- **Physiological artifacts**
- Ocular activity: eye blinking, eye ball side to side movement
- Muscle activity, chewing, stiffening, talking,
- Cardiac activity
- Perspiration
- Respiration
- **Non-physiological / Technical artifacts/ environmental**
- Electrode pop
- Cable movement
- Incorrect reference placement
- AC electrical and electromagnetic interferences, Phone
- Body movements, Body part attached to mom
- Transmission-line artefact: bandwidth of EEG is 0.5Hz-60/70Hz and the frequency of transmission lines is 50Hzor 60Hz, the signal easily mixes with beta band of EEG signal. This artefact can be removed by using notch filter 50-60Hz

- EKG,
- pulse,
- pacemaker,
- eye movements,
- myogenic,
- shivering,
- sniffling,
- hiccupping,
- glossokinetic and
- sway artifact as well as
- non-physiologic artifacts such as loose electrodes, 60 Hz artifact, and bed movements.

What are the skin artifacts?

- Biological processes and/or defects may alter impedance and cause artifacts.
  - Sweat is a common cause. Sodium chloride and lactic acid from sweating reacting with metals of the electrodes may produce huge slow baseline sways.
- Subgaleal haematoma under skin
- Skull defect
- Operation mark
- Wide open font.


Caput
Cephalhematoma
Subgaleal hemorrhage
Extradural hemorrhage
Skin
Epicranial aponeurosis
Periosteum
Skull
Dura
TOP OF BABY'S HEAD


Subgaleal haematoma
*
Skin
Connective tissue
Galea aponeurosis
Loose areolar tissue
Periosteum
Bone
Periosteum
Dura
Fontanelle
SSS
Craig Hacking
2018 CC-BY-SA-NC
Radiopaedia.org

Artefact detection and Elimination

- Laboratory arrangement
  - Lighting
  - AC
  - External sound and noise
  - Far away from X-ray dept
  - Crowd, external noise
- Good recording protocol
  - Instruction to the patient and family
  - Phone to keep out of the EEG recording room
  - Good skin prep
  - Measuring and electrode placement
  - Biocalibration
  - VIDEO, and annotation
- Experience
  - Visual analysis
  - Re-montaging
  - Digital filtering
  - Check recheck electrode impedance

Muscle artefacts

Table 1. Electrical characteristics of artefacts and Morphology with actual EEG

Artefact	Source/ Cause	Frequency range	Amplitude	Morphology
cardiac	Heart	>1Hz	1-10mv	Epilepsy
Transmission line noise	Transmission line	50-60Hz	low	Beta or gamma wave
Muscle Artefact	Body Muscle	<=35Hz	low	Beta frequency
EOG	Eye	0.5-3 Hz	100mV	Tumor , delta wave
Phone Artefacts	Mobile and landline phone	high	high	Morphology different from actual EEG
Electrode artefact	Electrode and sweating	Very low	High	Morphology different from actual EEG
Physical movement artefact	Physical movement	Very low	Very high	Morphology different from actual EEG

Ref: Classification of Artefacts in EEG Signal Recordings and EOG Artefact Removal using EOG Subtraction. Communications on Applied Electronics (CAE)–ISSN: 2394-4714Foundation of Computer Science FCS, New York, USA Volume4–No.1, January 2016–www.caeaccess.org12

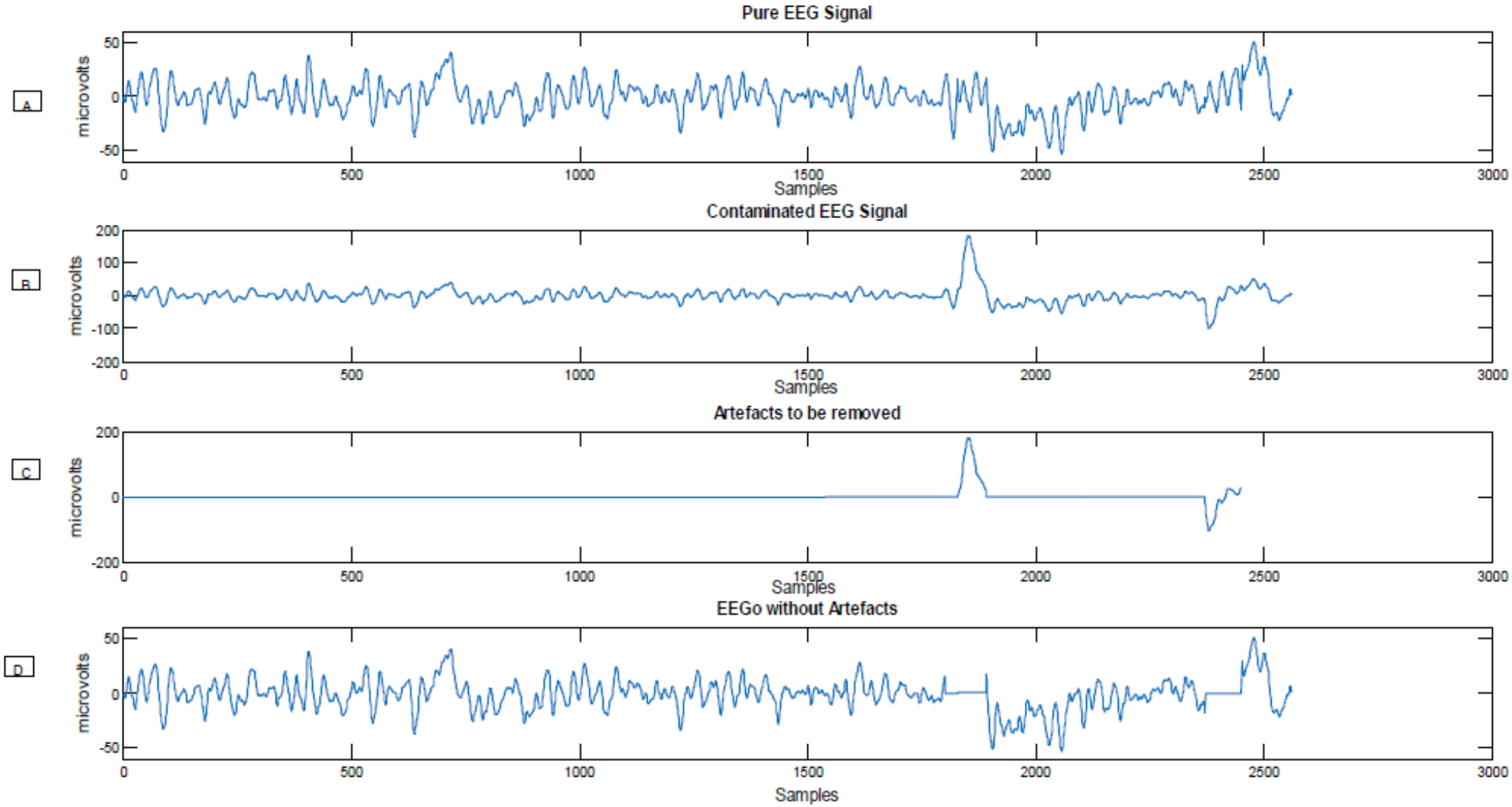
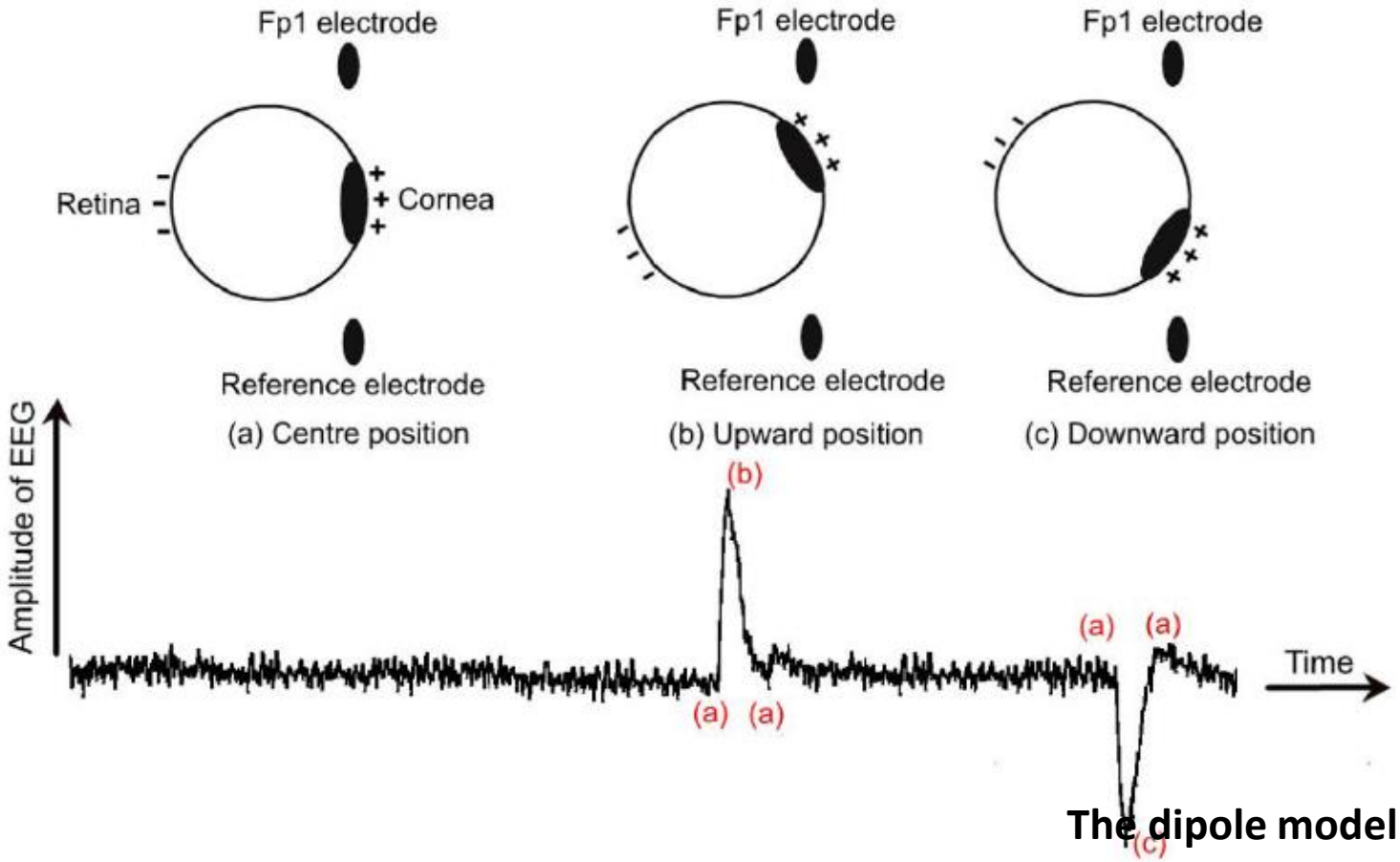
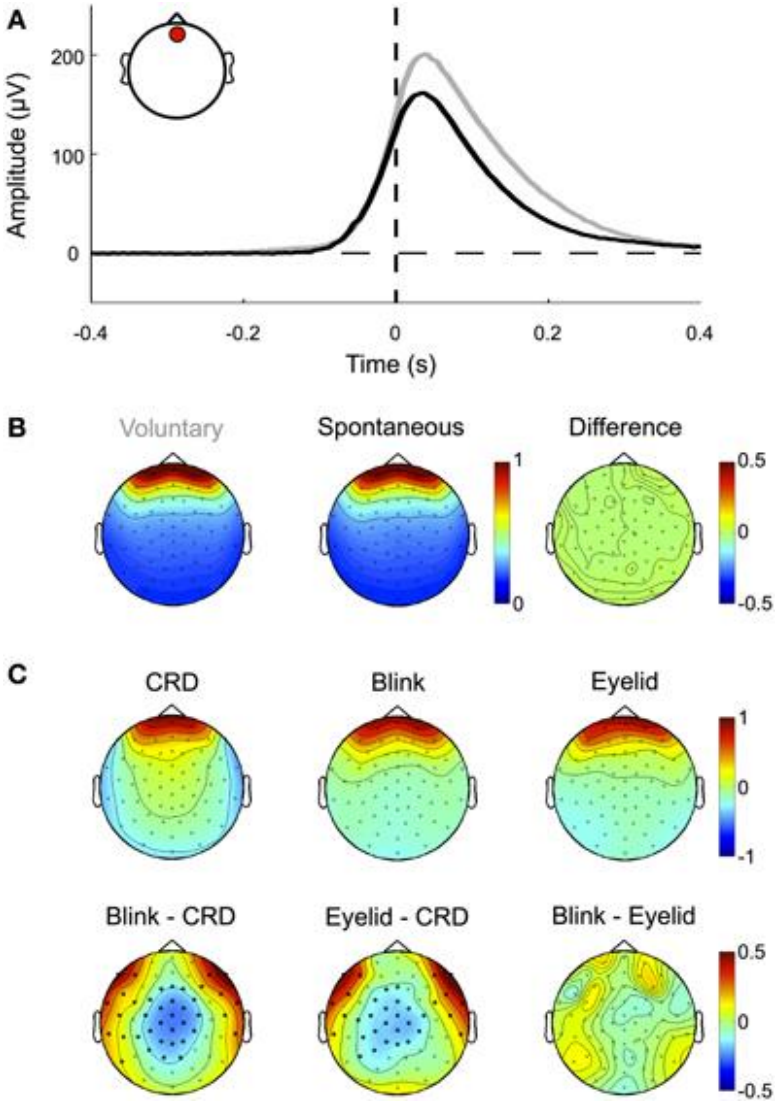


Fig4:- A) EEG signal without EOG artefact B) EEG signal with EOG artefact C) EOG signal to be remove D) Recovered signal

Eye blinks are one of the most common artifacts you'll see, and are marked by very high amplitude negative waveforms in the bifrontal regions. They arise due to **Bell's Phenomenon**. The eyes' cornea is positively charged and retina is negatively charged; when you blink, the eyes roll up slightly, and the cornea moves closer to the frontal electrodes Fp1 and Fp2, which thus see a positive signal that is reflected on EEG.

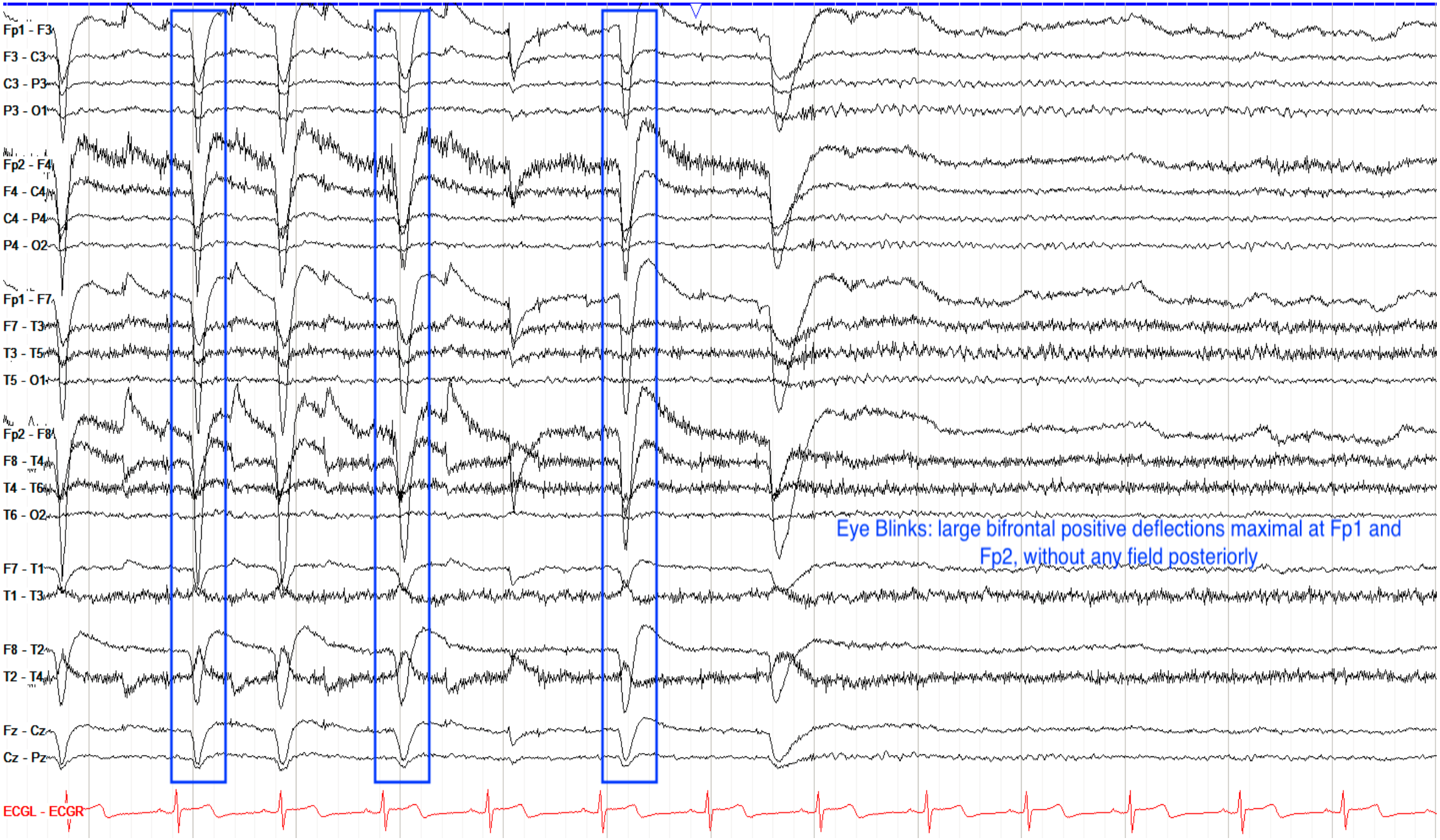


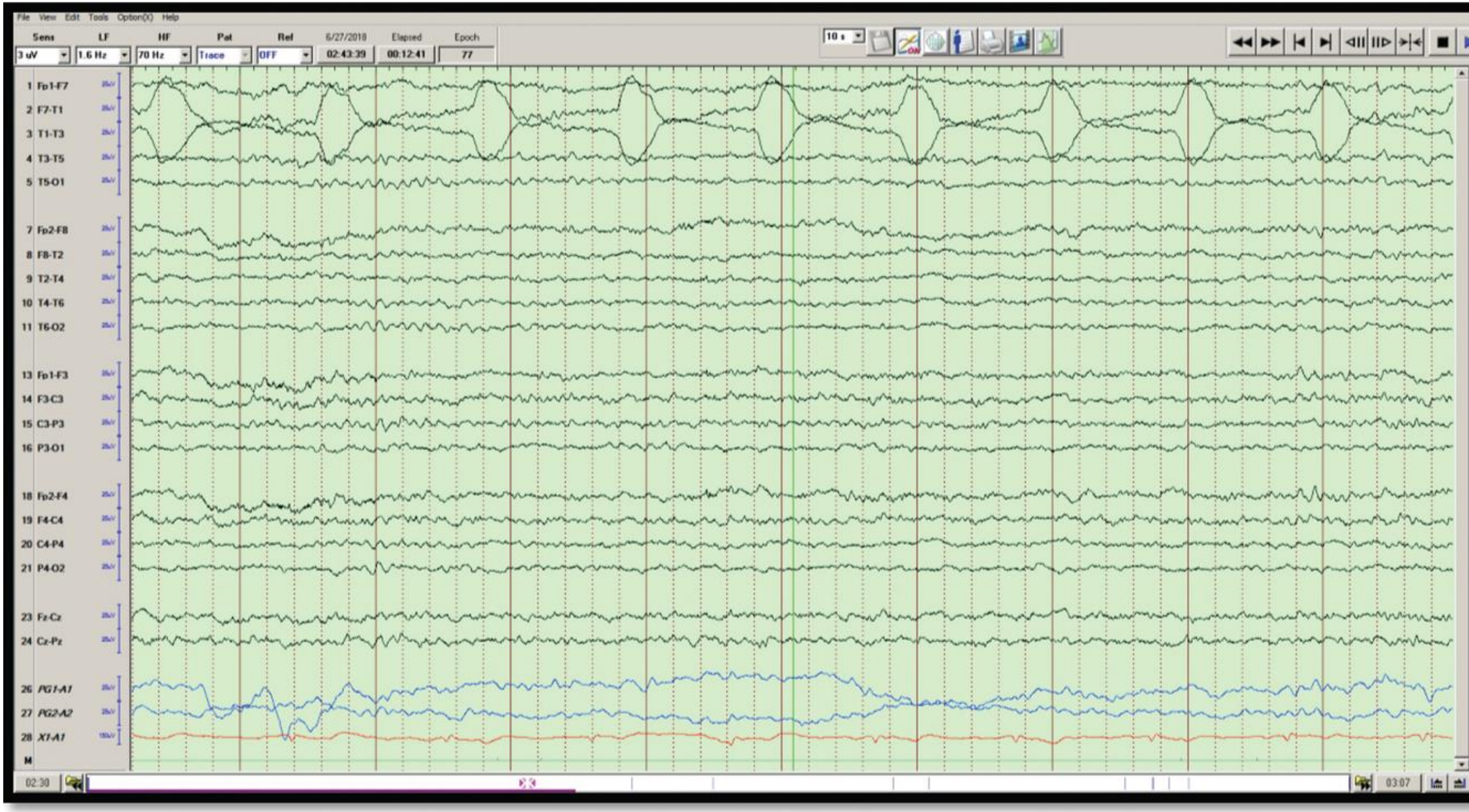
The dipole model of eyeball with waveform of EEG signal when the cornea in the center (a), rotating upwards (b), and downwards (c)



During blinking the eyelid slides down over the cornea, which is positively charged with respect to the forehead. Thereby the lid acts like a "sliding electrode," short-circuiting the cornea to the scalp and producing artifacts in the EEG signal (Barry and Jones, 1965; Matsuo et al., 1975; Antervo et al., 1985; Lins et al., 1993a,b).

Figure 5. Eyelid-induced signal changes. (A) ERP traces for voluntary (gray) and spontaneous (black) blinks measured at a frontal electrode (inset, red circle). Voluntary blinks are of longer duration and result in higher amplitudes than involuntary blinks. Note that blink onset as defined by the eye tracker (time 0, vertical dashed line) corresponds to the point at which the pupil is not visible anymore. The actual eyelid movement already starts around 100 ms earlier, when the signal deflects from the zero line (horizontal dashed line). **(B)** Although spontaneous and voluntary blinks differ in amplitude and duration, they share the same topographic pattern (i.e., the normalized amplitude distribution across the scalp). **(C)** Topographic patterns of corneo-retinal dipole offsets related to upward saccades, blinks, and post-saccadic eyelid movements (upper row) and the differences between them (lower row). Bold black dots indicate electrode sites with statistical significant


Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fp1 - F7
F7 - T3
T3 - T5
T5 - O1
Fp2 - F8
F8 - T4
T4 - T6
T6 - O2
F7 - T1
T1 - T3
F8 - T2
T2 - T4
Fz - Cz
Cz - Pz
ECGL - ECGR
Eye Blinks: large bifrontal positive deflections maximal at Fp1 and Fp2, without any field posteriorly


File View Edit Tools Option(X) Help
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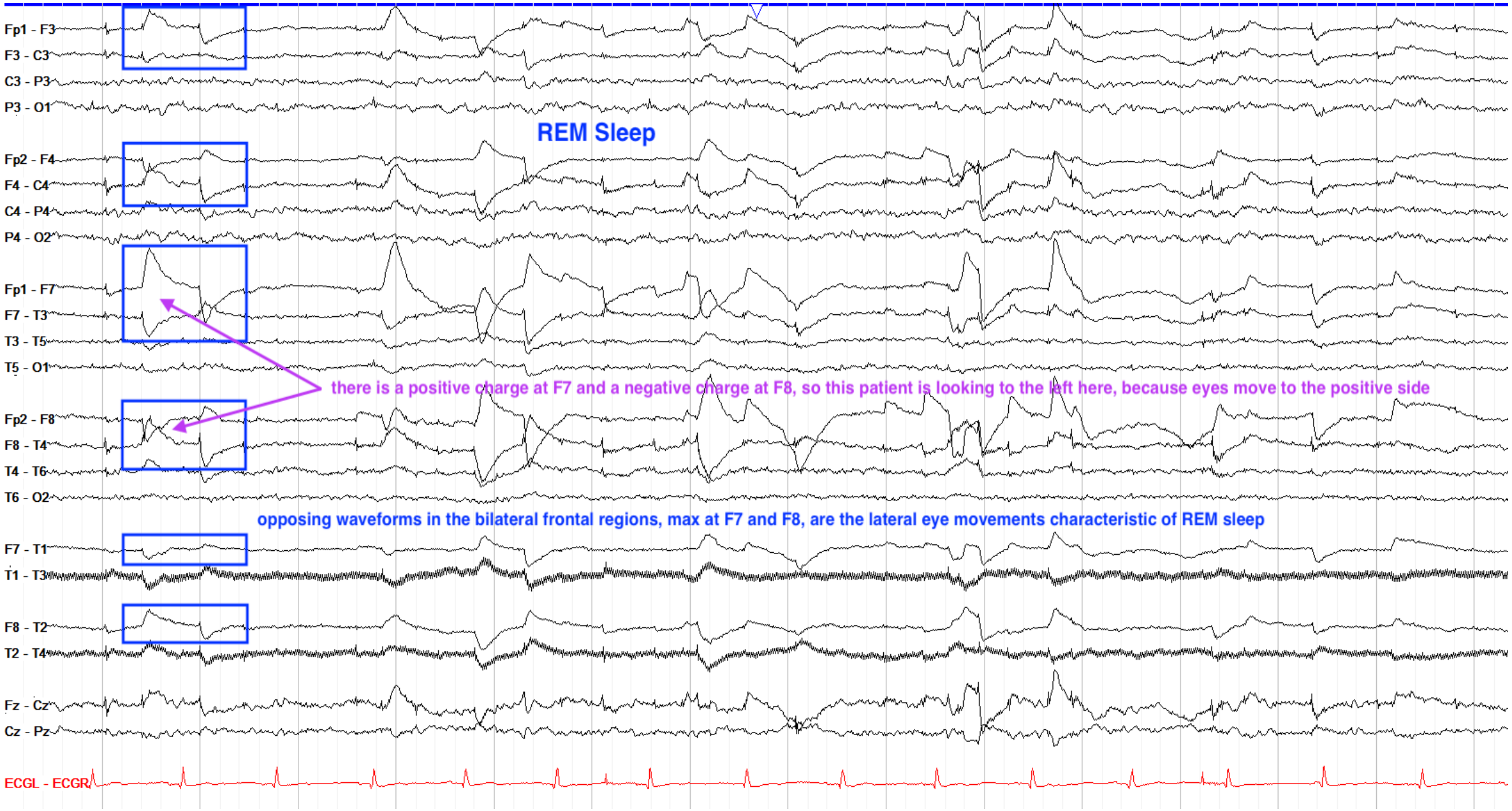
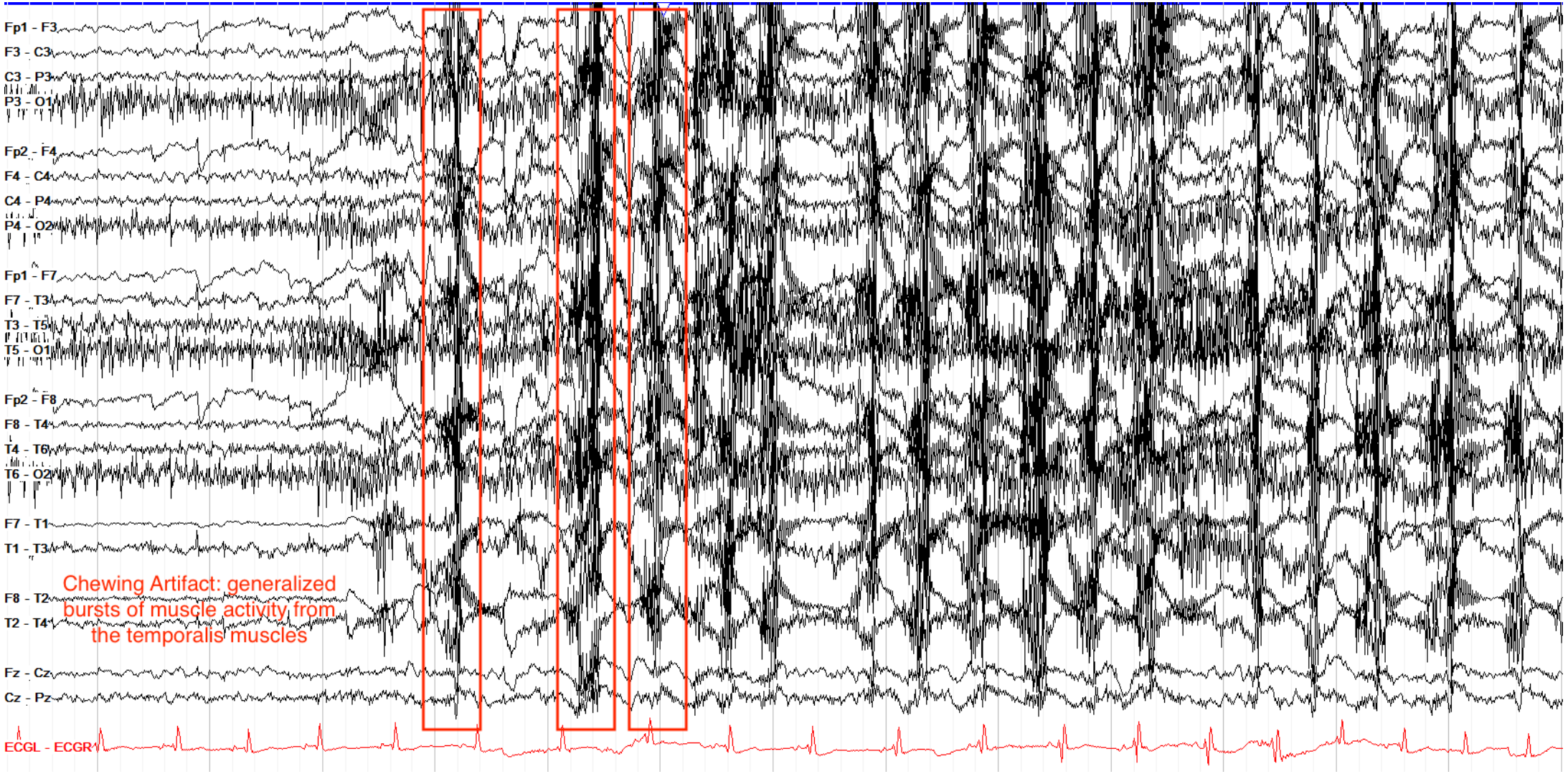
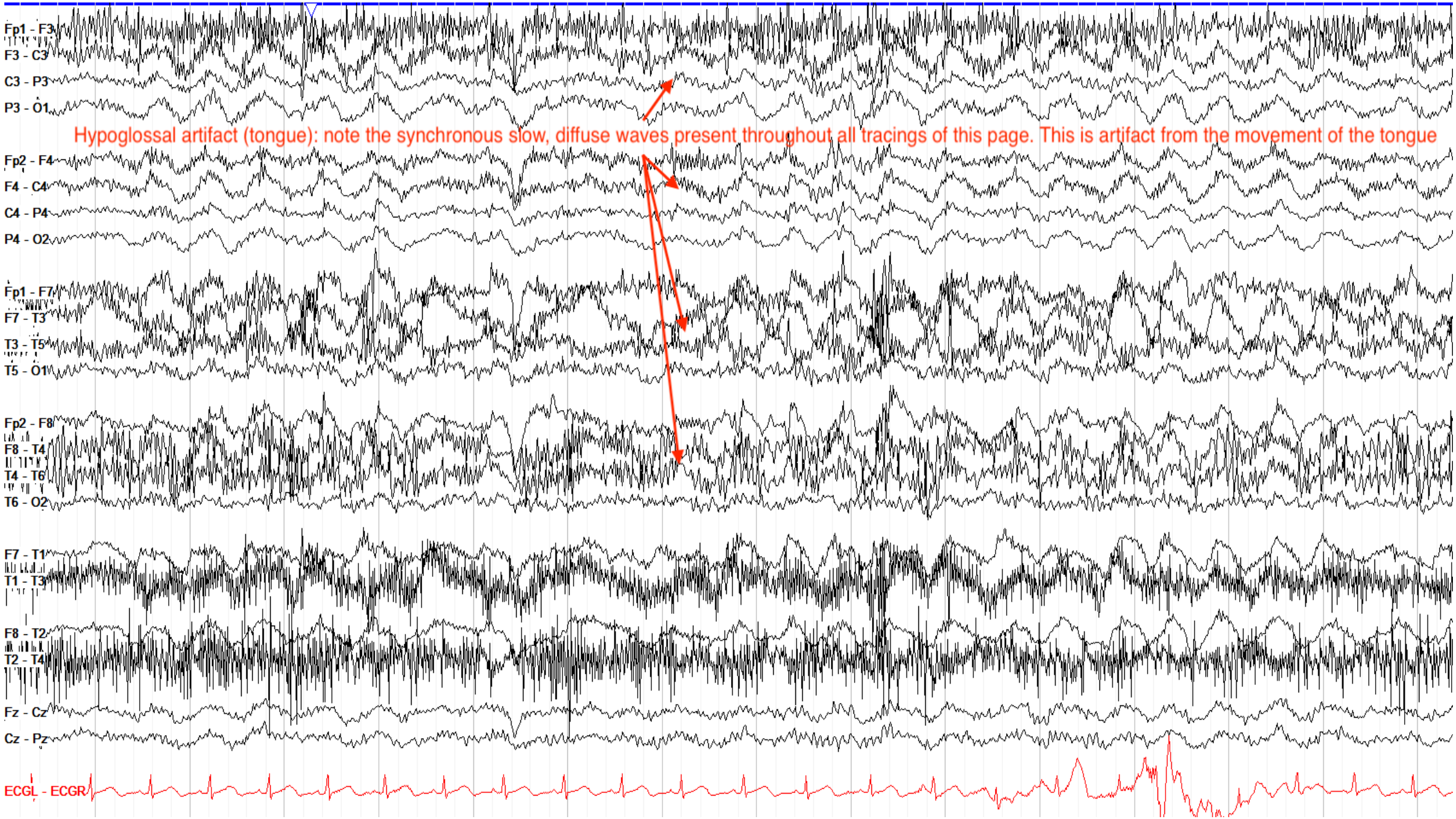
02:43:39
00:12:41
77
10 s
1 Fp1-F7
2 F7-T1
3 T1-T3
4 T3-T5
5 T5-O1
7 Fp2-F8
8 F8-T2
9 T2-T4
10 T4-T6
11 T6-O2
13 Fp1-F3
14 F3-C3
15 C3-P3
16 P3-O1
18 Fp2-F4
19 F4-C4
20 C4-P4
21 P4-O2
23 Fz-Cz
24 Cz-Pz
26 PG1-A1
27 PG2-A2
28 X1-A1
M
02:30
03:07

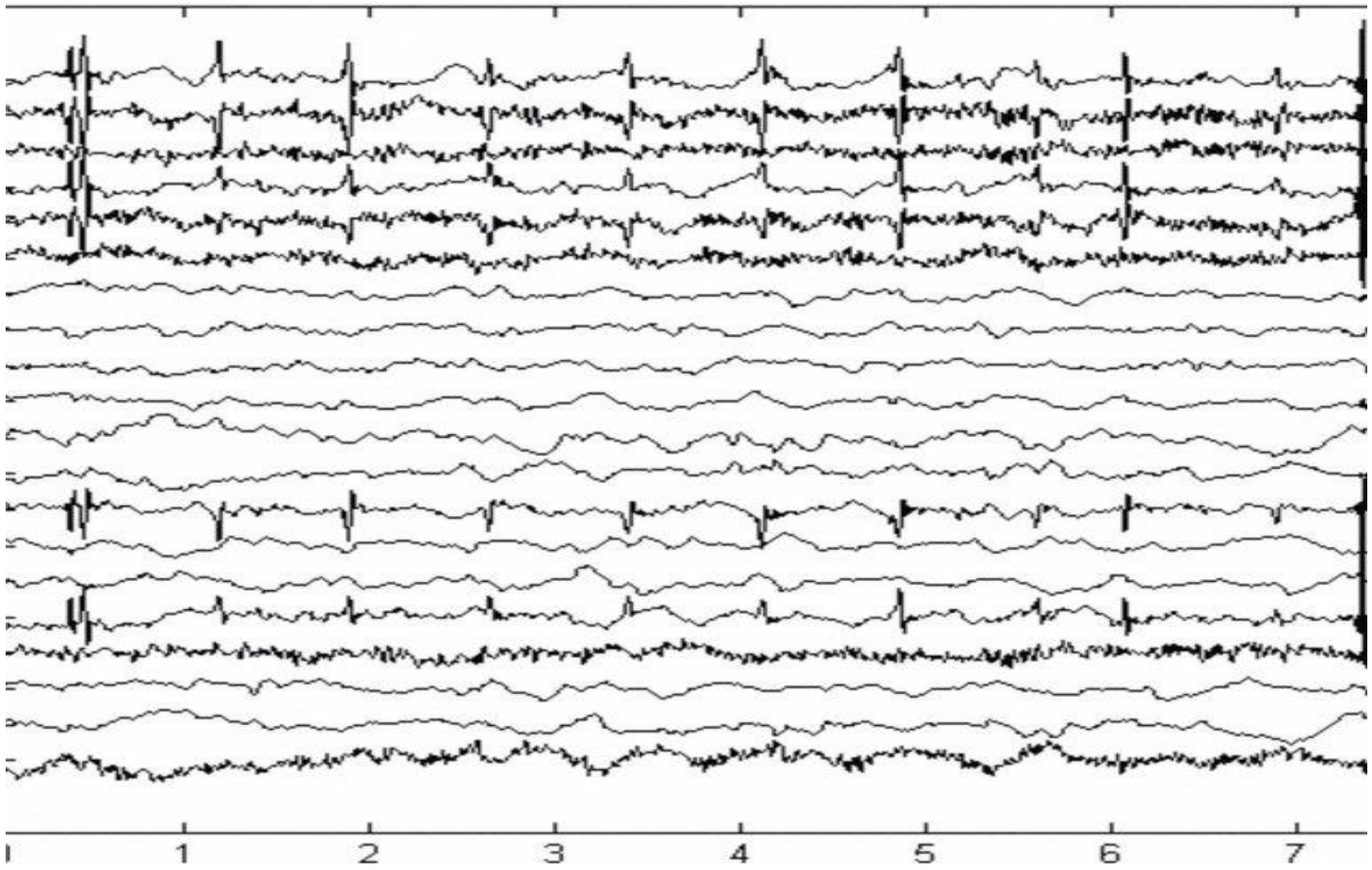

Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
REM Sleep
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fp1 - F7
F7 - T3
T3 - T5
T5 - O1
there is a positive charge at F7 and a negative charge at F8, so this patient is looking to the left here, because eyes move to the positive side
Fp2 - F8
F8 - T4
T4 - T6
T6 - O2
opposing waveforms in the bilateral frontal regions, max at F7 and F8, are the lateral eye movements characteristic of REM sleep
F7 - T1
T1 - T3
F8 - T2
T2 - T4
Fz - Cz
Cz - Pz
ECGL - ECGR



Chewing and tongue (hypoglossal) artifact are rather hard to miss on EEG.

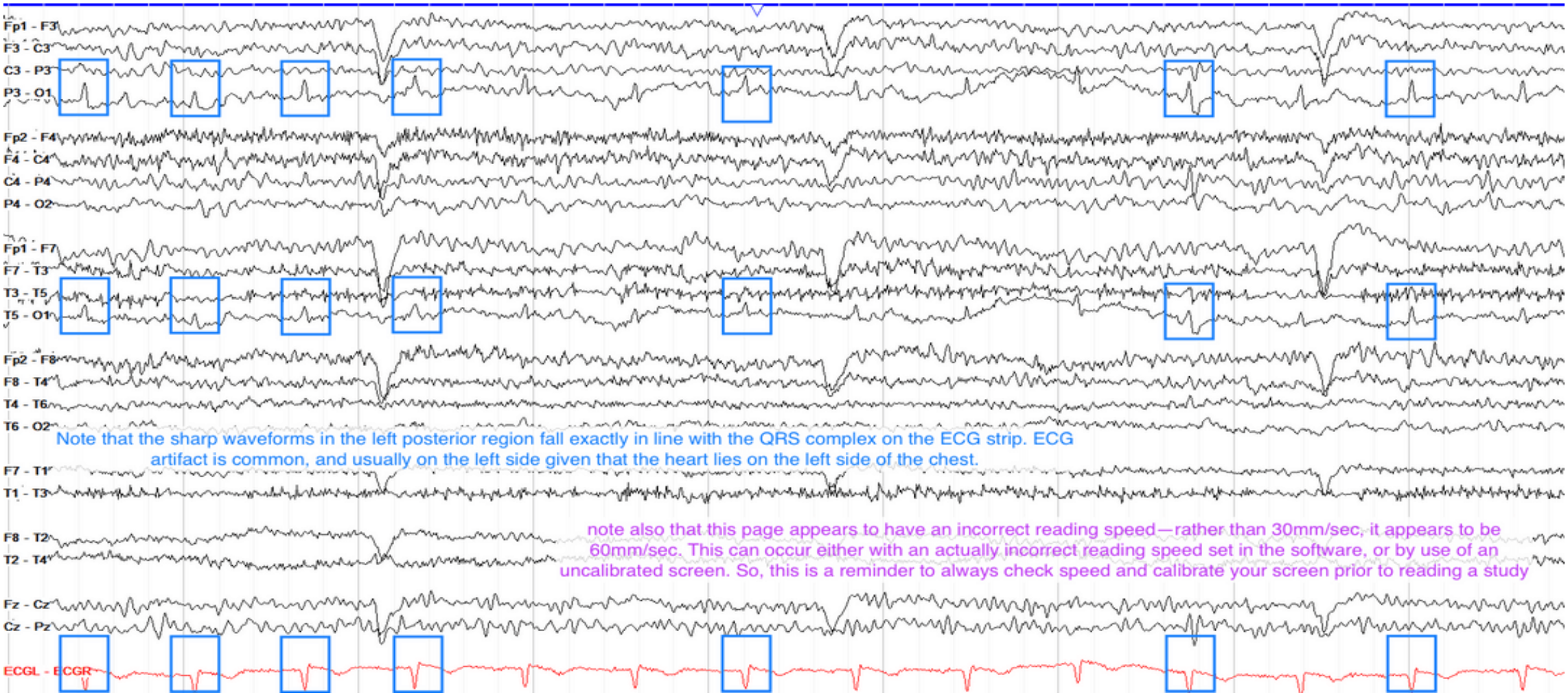

Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
Hypoglossal artifact (tongue): note the synchronous slow, diffuse waves present throughout all tracings of this page. This is artifact from the movement of the tongue
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fp1 - F7
F7 - T3
T3 - T5
T5 - O1
Fp2 - F8
F8 - T4
T4 - T6
T6 - O2
F7 - T1
T1 - T3
F8 - T2
T2 - T4
Fz - Cz
Cz - Pz
ECGL - ECGR


F1C3
F2C4
C3O1
C4O2
F1T3
F2T4
T3C3
C3C2
C2C4
C4T4
50 µV
1 sec
F2C2
C2P2
EOG
EMG
RESP
EKG

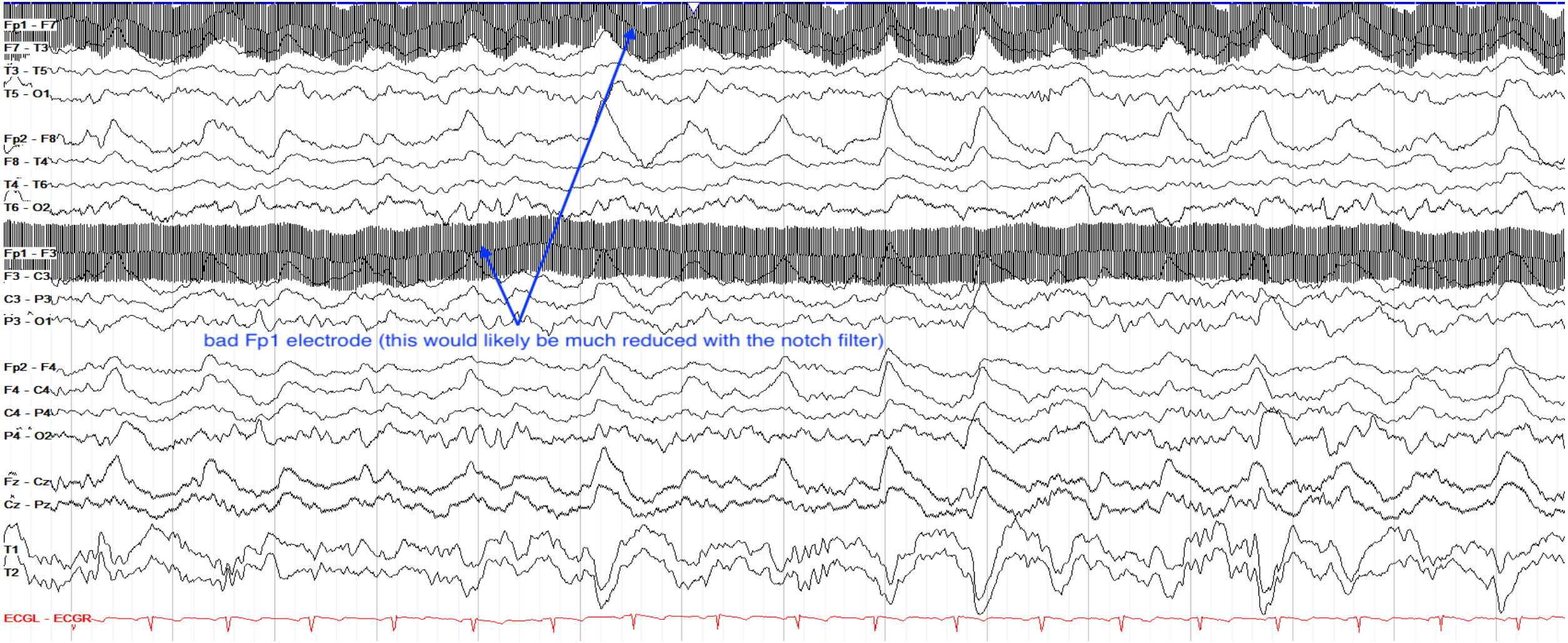


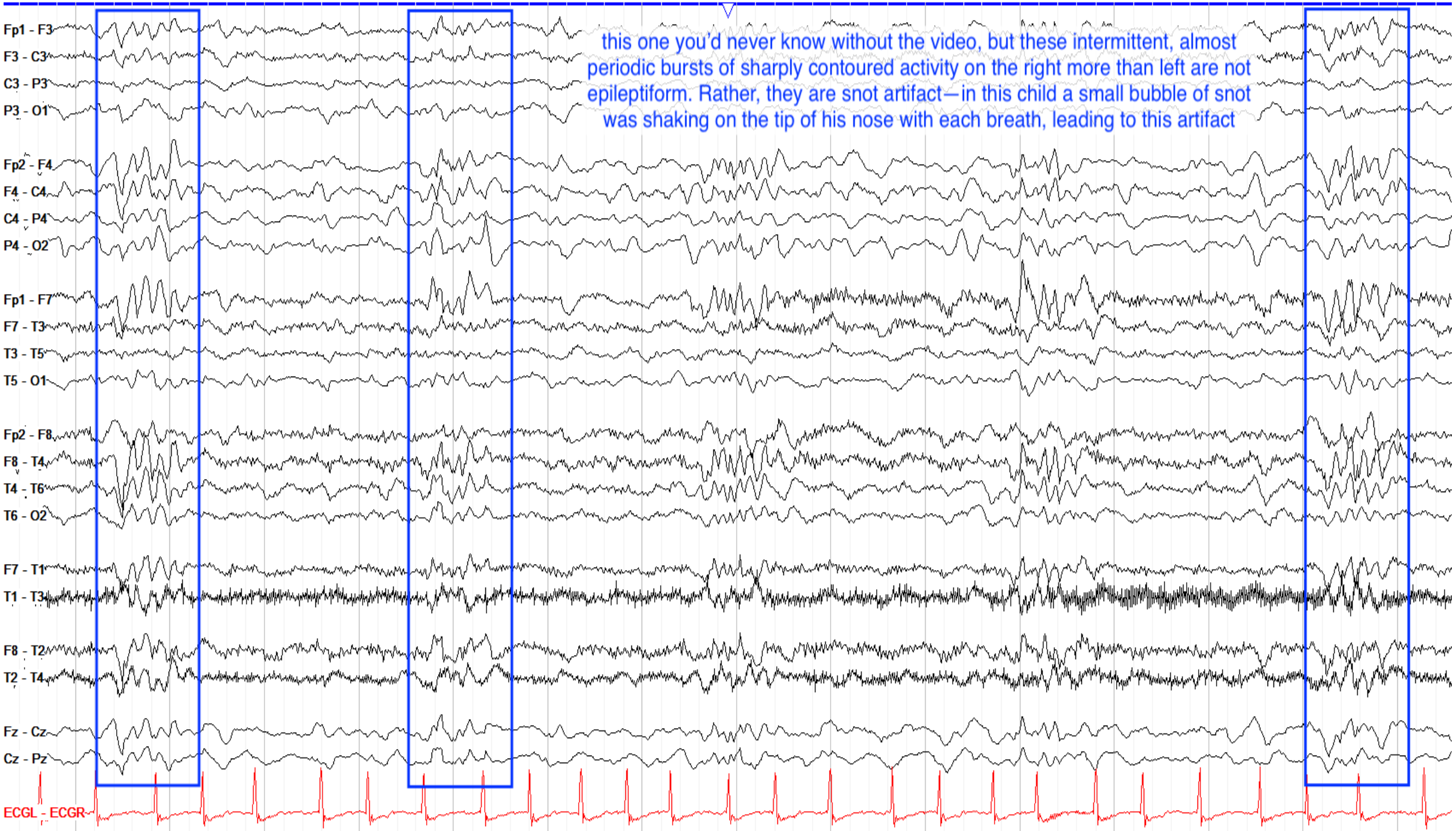
Low frequency EMG artifact, due to sucking, appears symmetricall

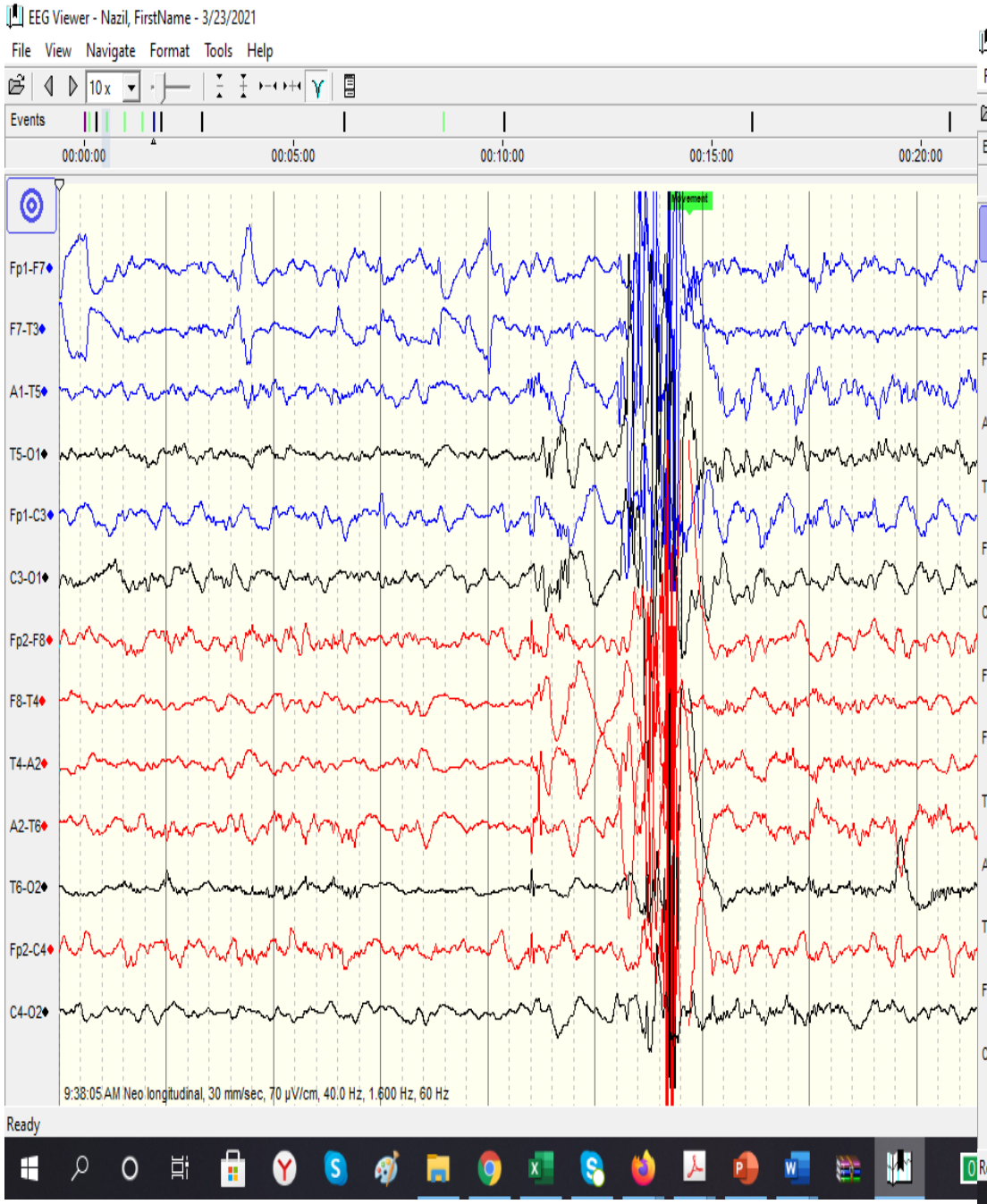
ECG artifact is marked by waveforms that are **time locked to the QRS complex** on the ECG tracing. They tend to be present more so or entirely on the left side, because the heart is in the left half of the chest, and tend to be relatively low amplitude. However, as the example below shows, they can at times be quite prominent, but don't mistake them for posterior discharges or POSTS (which are not time locked to the QRS).



Electrical artifact most commonly arises from interference from the 60 Hz electrical activity (in the USA; 50 Hz in Europe and elsewhere) that that runs through wires; so, it can be caused by anything from an electrical appliance to a cell phone charging, though most modern EEG equipment is quite good at minimizing it. Electrical artifact is a very fast, very monotonous activity, and you can use the **notch filter** to selectively remove all the EEG activity at 60Hz (this won't affect your interpretation of the signal, as no cerebral activity is that fast on scalp EEG). In the example below, the notch filter is not on, and the Fp1 electrode is likely not on quite right, leading to a lot of electrical interference




this one you'd never know without the video, but these intermittent, almost periodic bursts of sharply contoured activity on the right more than left are not epileptiform. Rather, they are snot artifact—in this child a small bubble of snot was shaking on the tip of his nose with each breath, leading to this artifact
Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fp1 - F7
F7 - T3
T3 - T5
T5 - O1
Fp2 - F8
F8 - T4
T4 - T6
T6 - O2
F7 - T1
T1 - T3
F8 - T2
T2 - T4
Fz - Cz
Cz - Pz
ECGL - ECGR


EEG Viewer - Nazil, FirstName - 3/23/2021
File View Navigate Format Tools Help
10 x
Events
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Fp1-F7
F7-T3
A1-T5
T5-O1
Fp1-C3
C3-O1
Fp2-F8
F8-T4
T4-A2
A2-T6
T6-O2
Fp2-C4
C4-O2
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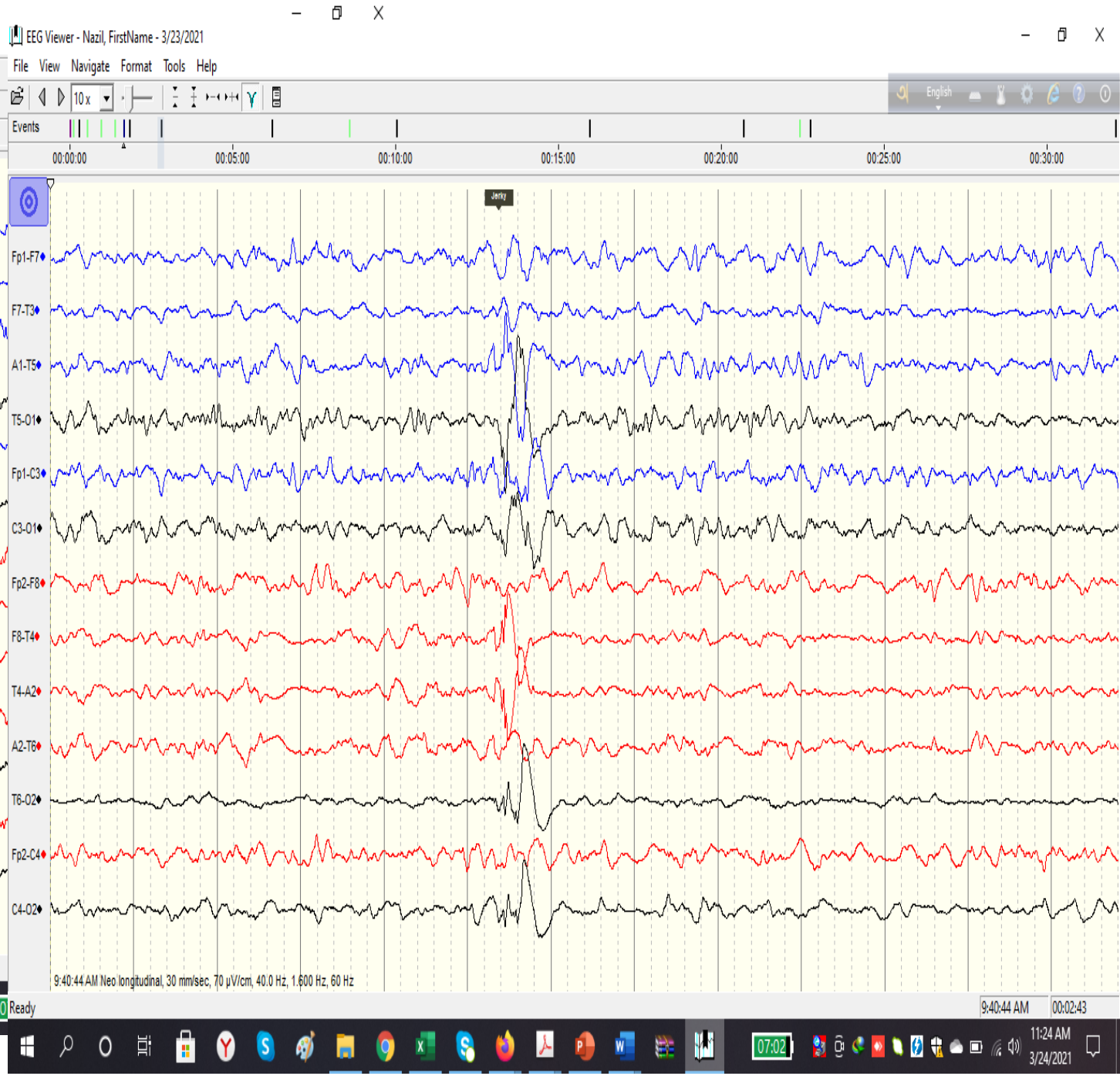
EEG Viewer - Nazil, FirstName - 3/23/2021
File View Navigate Format Tools Help
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F7-T3
A1-T5
T5-O1
Fp1-C3
C3-O1
Fp2-F8
F8-T4
T4-A2
A2-T6
T6-O2
Fp2-C4
C4-O2
9:40:44 AM Neo longitudinal, 30 mm/sec, 70 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
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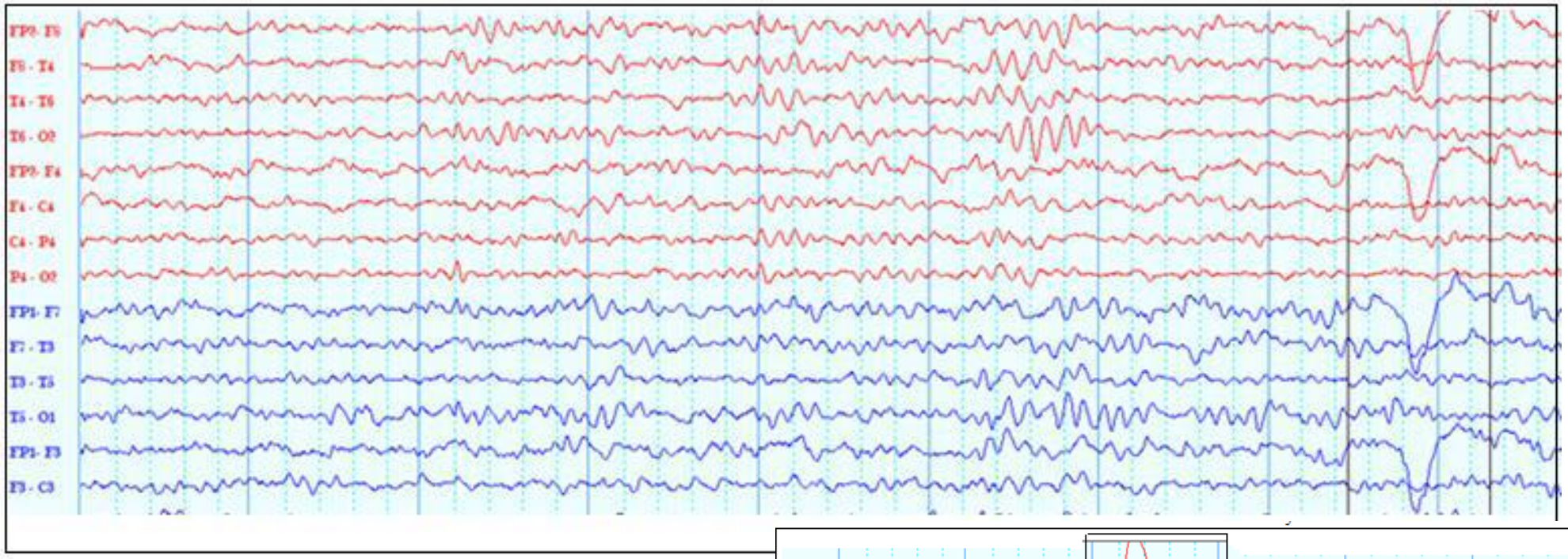
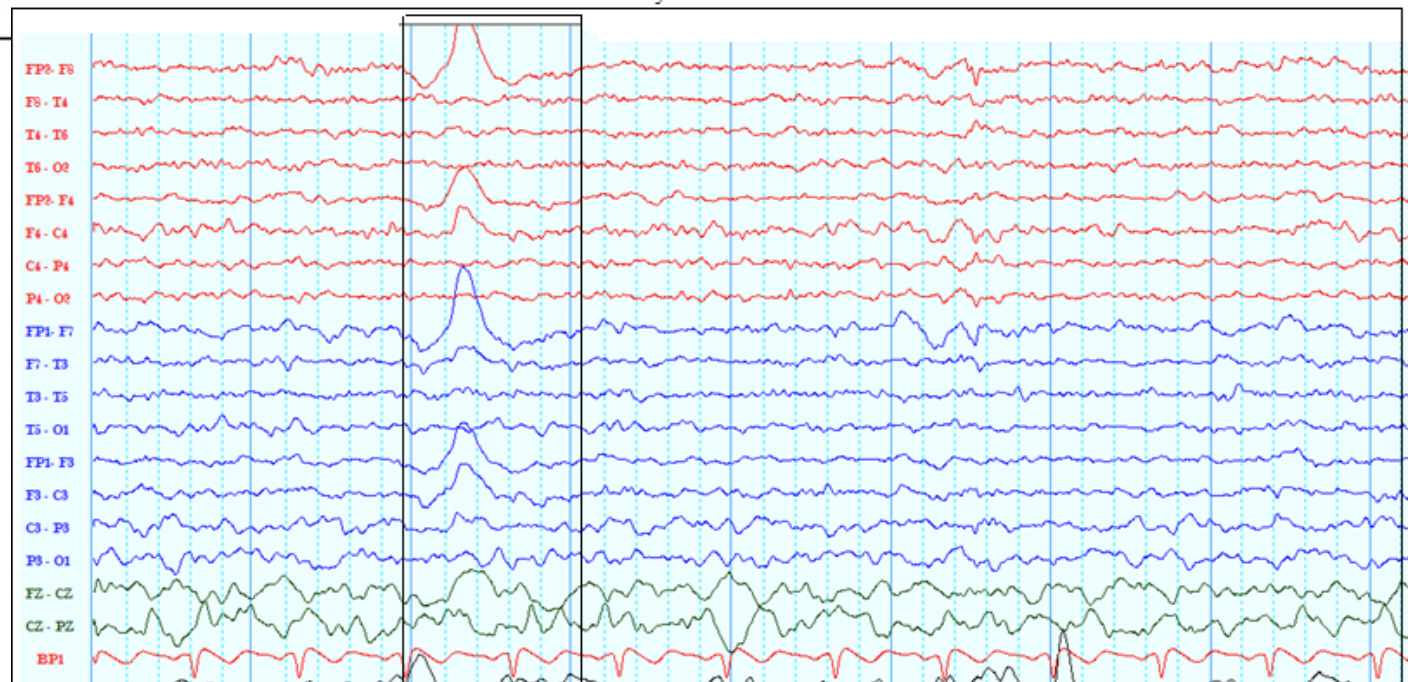
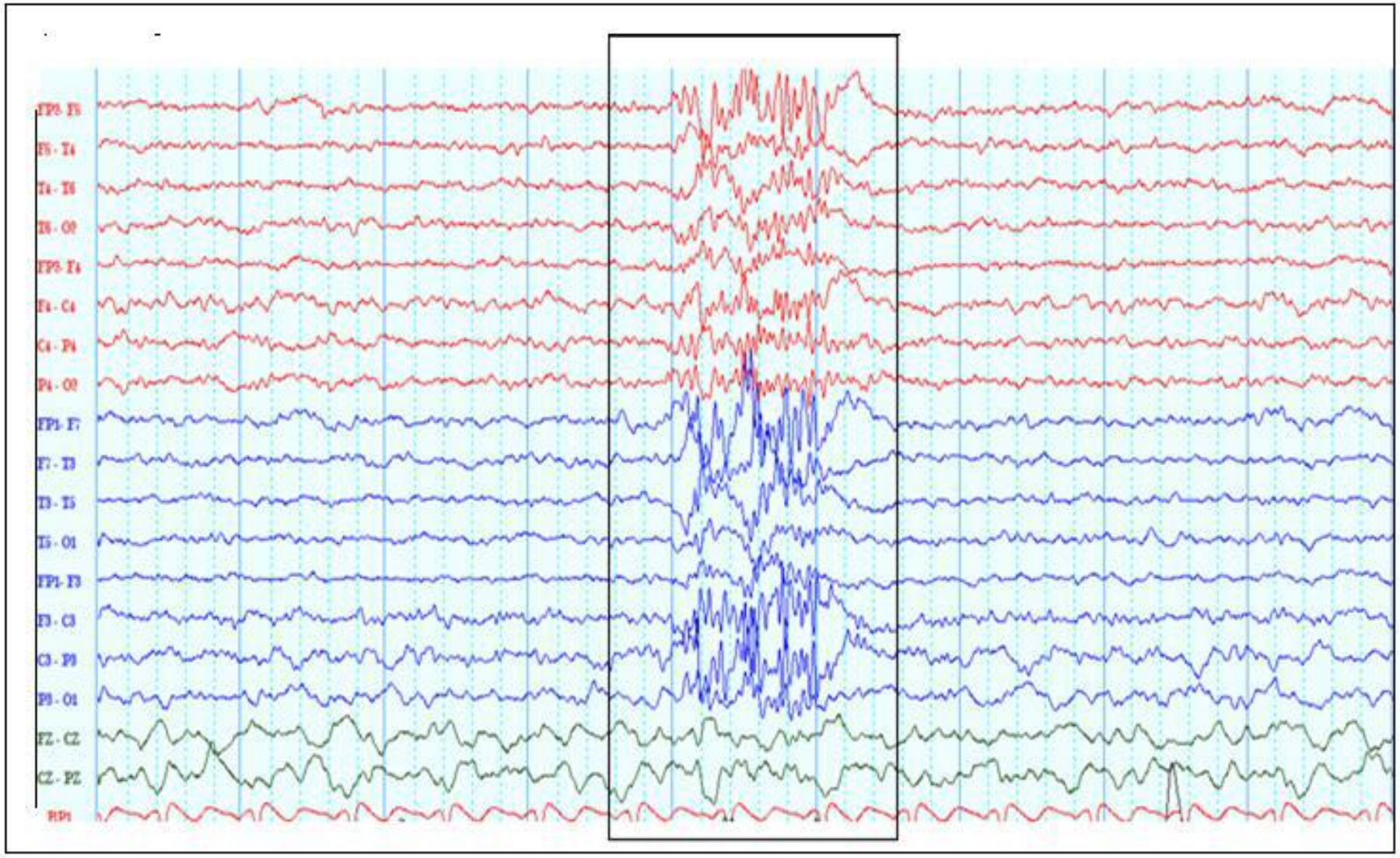
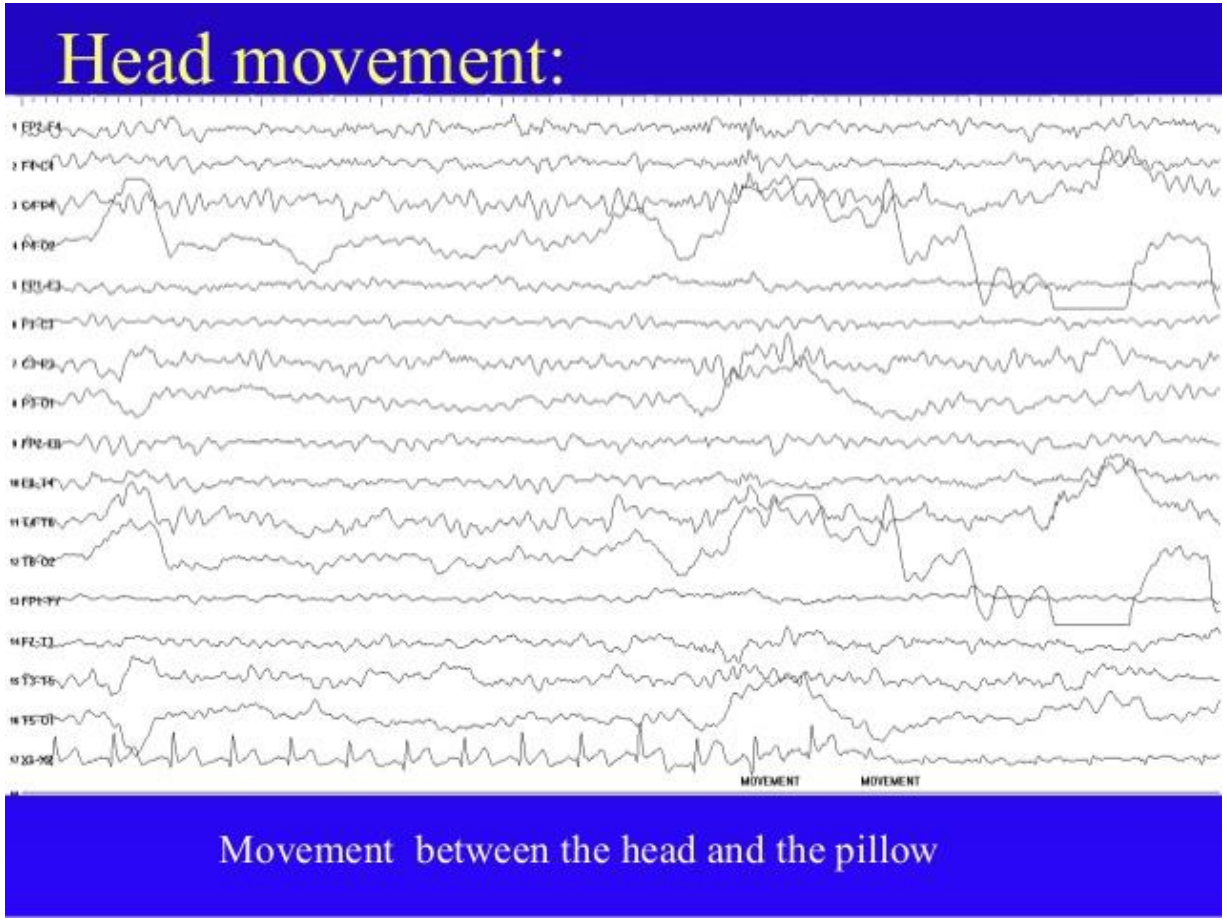

FP2- F8
F8 - T4
T4 - T6
T6 - O2
FP2- F4
F4 - C4
C4 - P4
P4 - O2
FP1- F7
F7 - T3
T3 - T5
T5 - O1
FP1- F3
F3 - C3

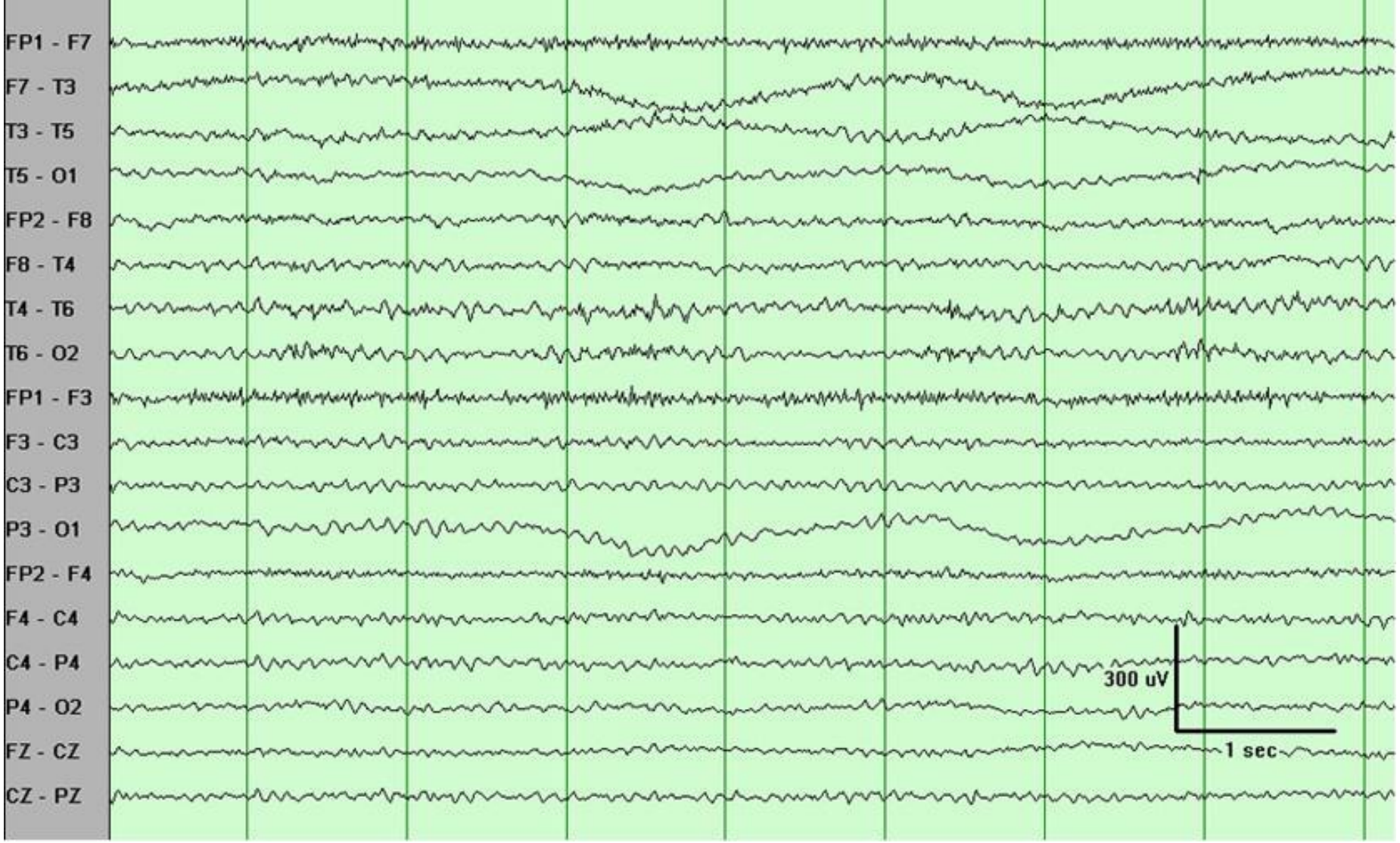

FP2- F8
F8 - T4
T4 - T6
T6 - O2
FP2- F4
F4 - C4
C4 - P4
P4 - O2
FP1- F7
F7 - T3
T3 - T5
T5 - O1
FP1- F3
F3 - C3
C3 - P3
P3 - O1
FZ - CZ
CZ - PZ
BP1

Muscle artefact

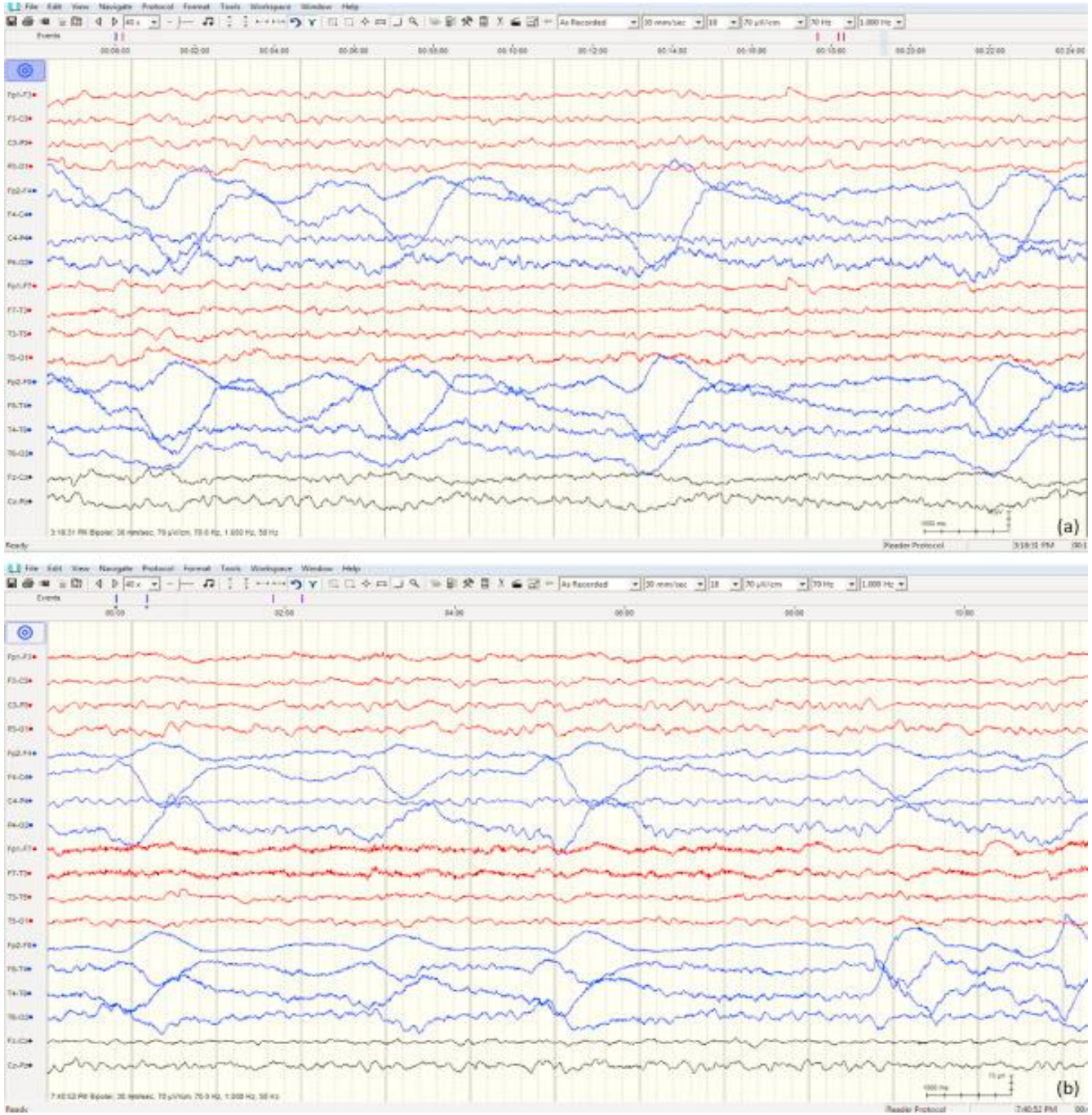


Motion artifact

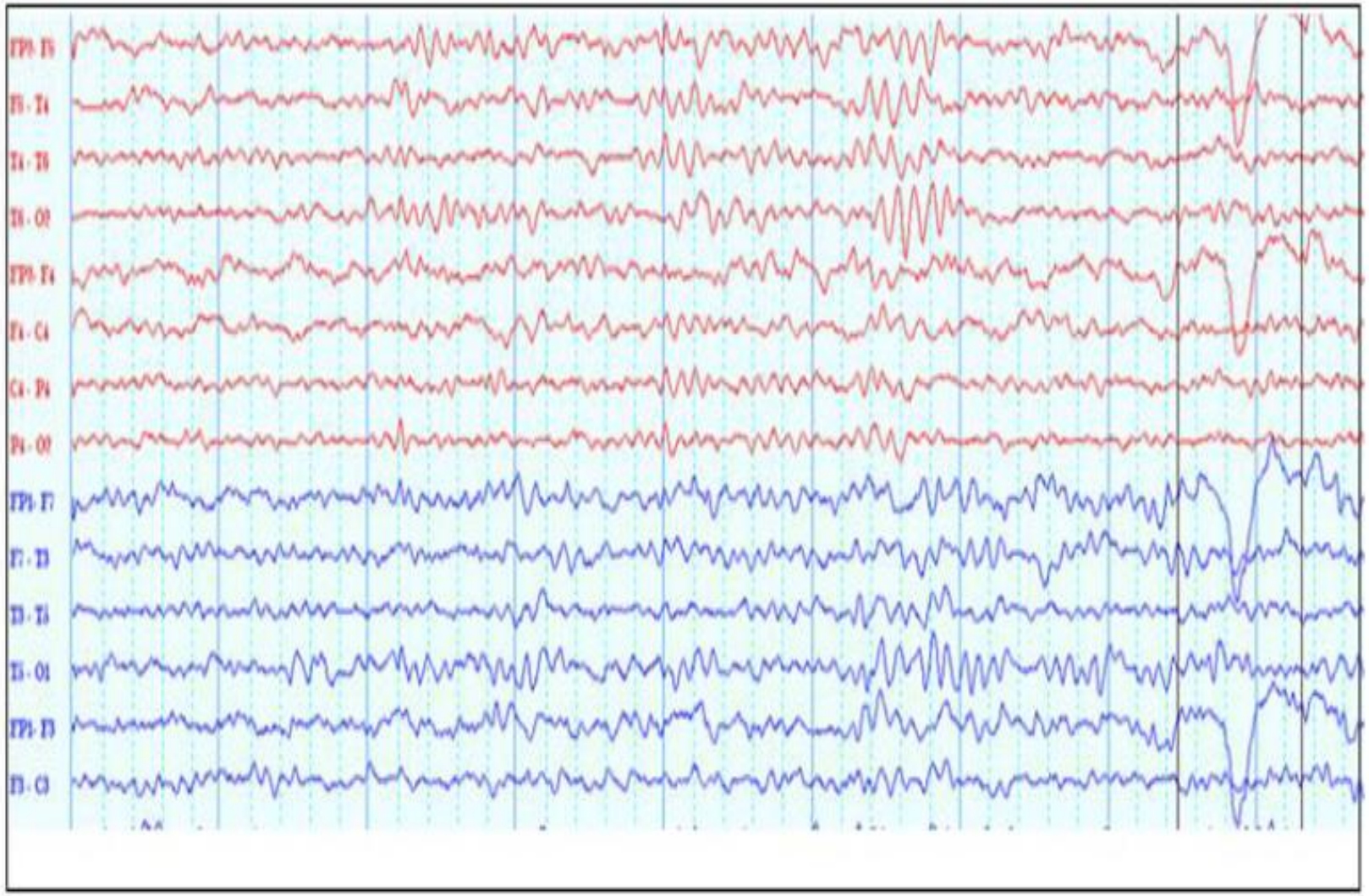




Sweat artifact. This is characterized by very low-frequency (here, 0.25- to 0.5-Hz) oscillations. The distribution here (midtemporal electrode T3 and occipital electrode O1) suggests **sweat** on the left side. ... The morphology is very unusual for any cerebral waveform, and the distribution is limited to a single electrode.



- We present an interesting EEG finding of persistent unilateral sweat artifacts in a 47 years old male patient with right hemiplegia secondary to left thalamic bleed with extension of hemorrhage into the left internal capsule, the left midbrain and ventricles. The EEG was done for altered sensorium. It showed unilateral (right sided) sweat artifacts throughout the EEG recording. The anhydrosis on left side of the face was due to left sided Horner's syndrome because of involvement of first order neurons in the left midbrain. This EEG finding is highlighted because of it being relatively less common but interesting finding.



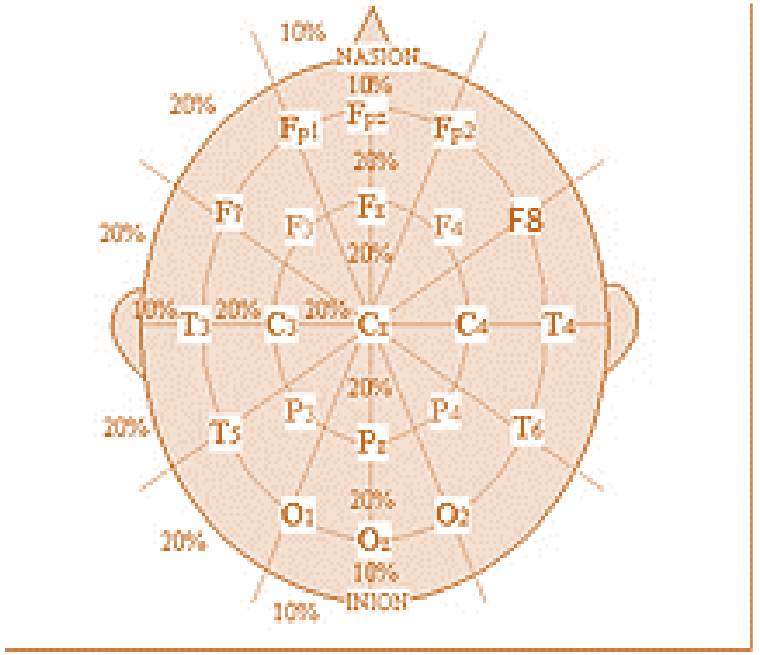
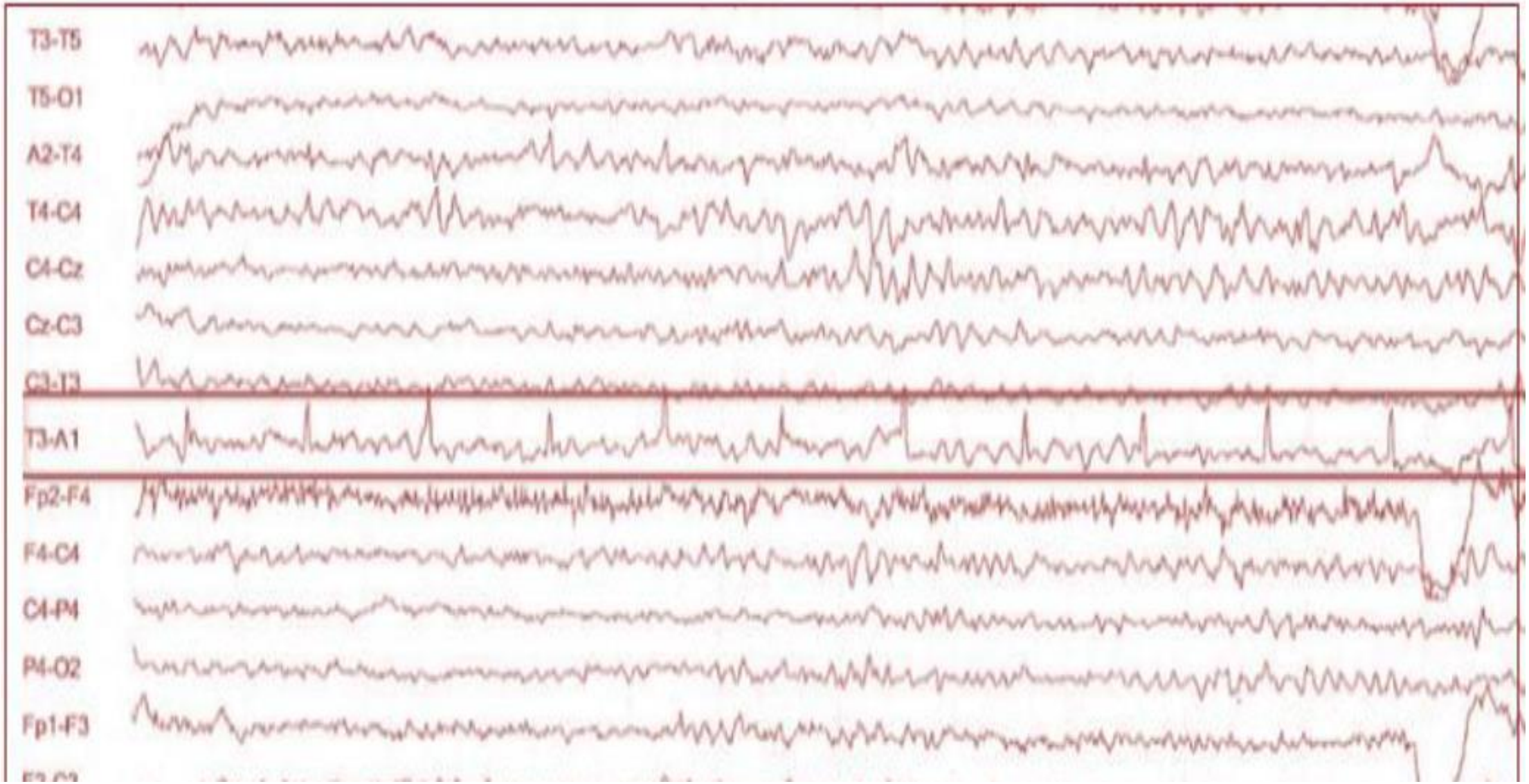


Fig 5: Eye movement artefact shown in window


T3-T5
T5-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3

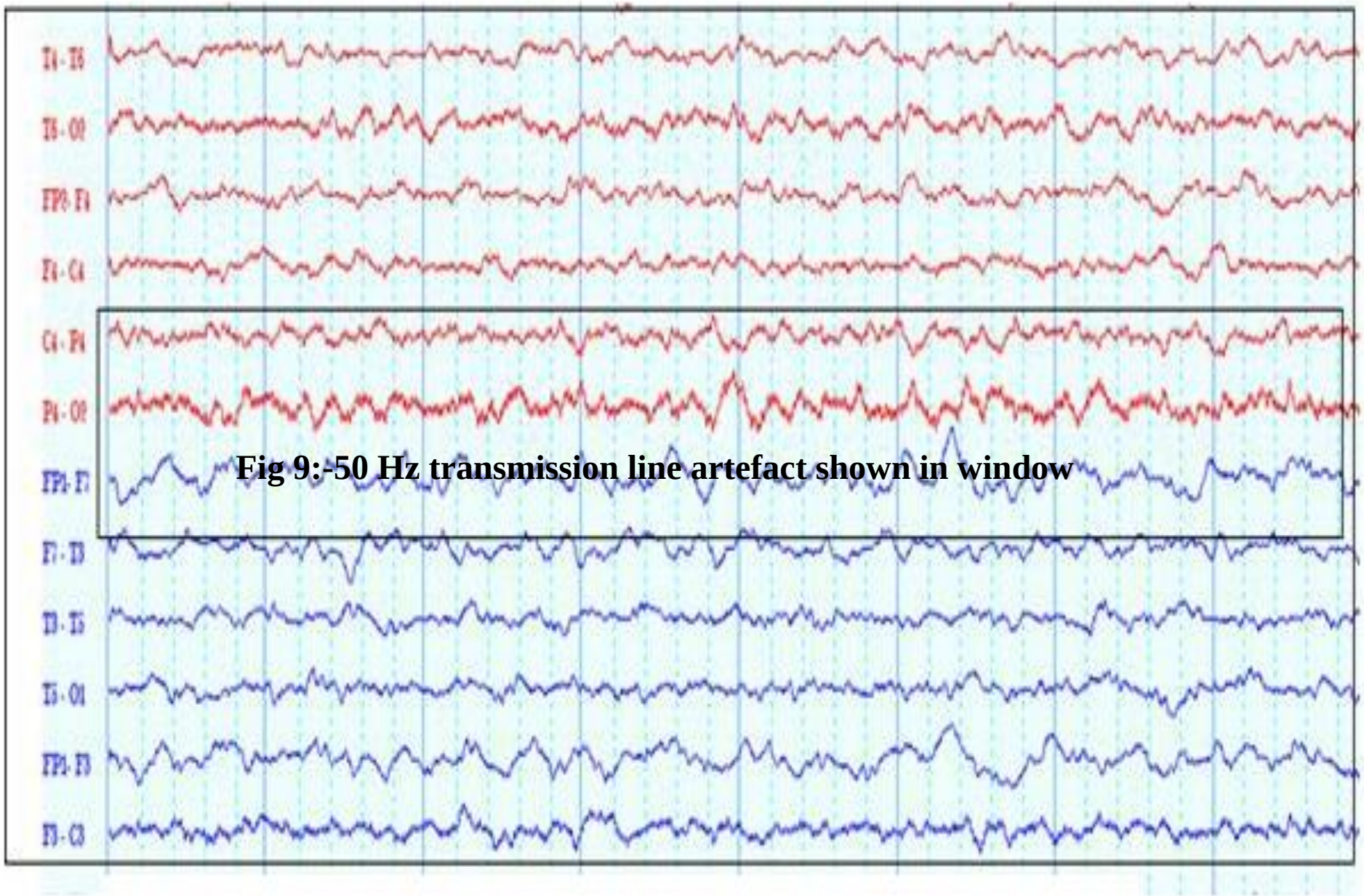
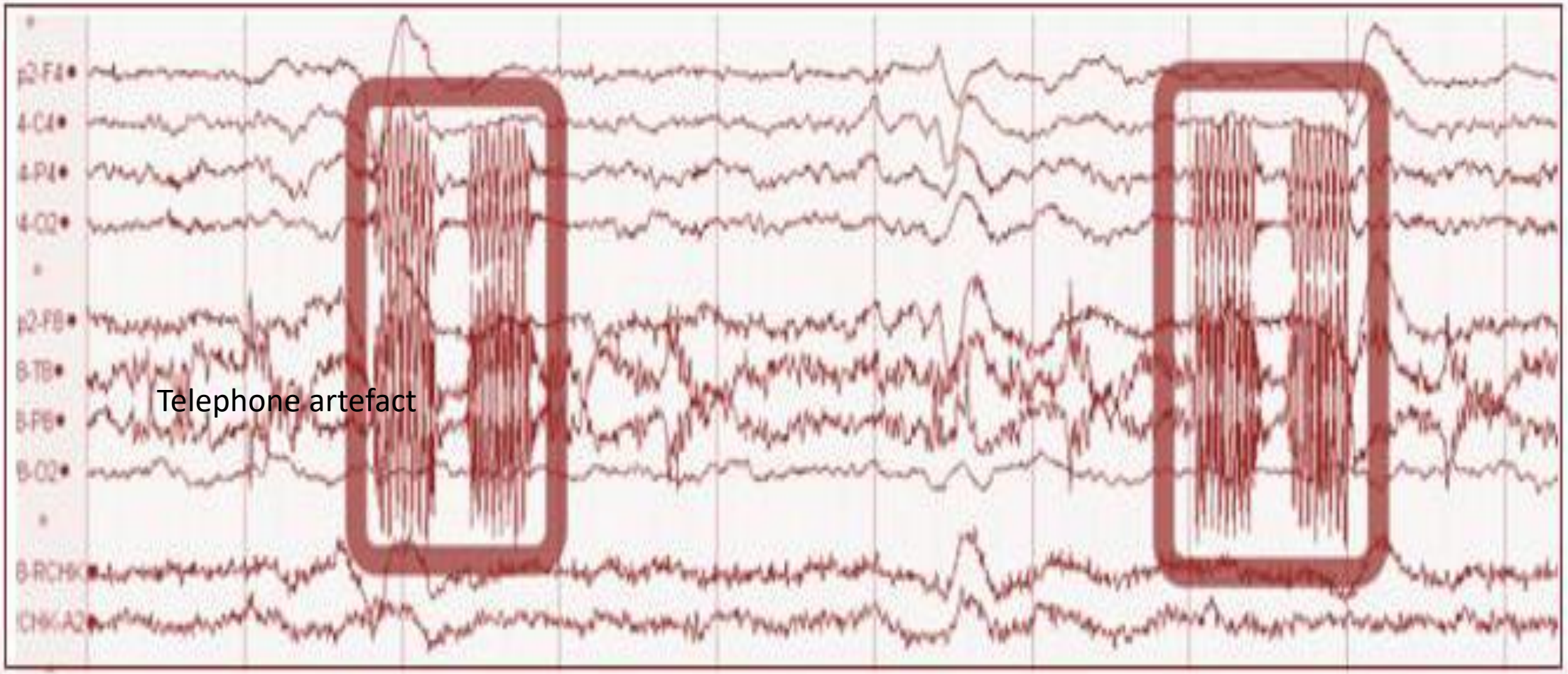
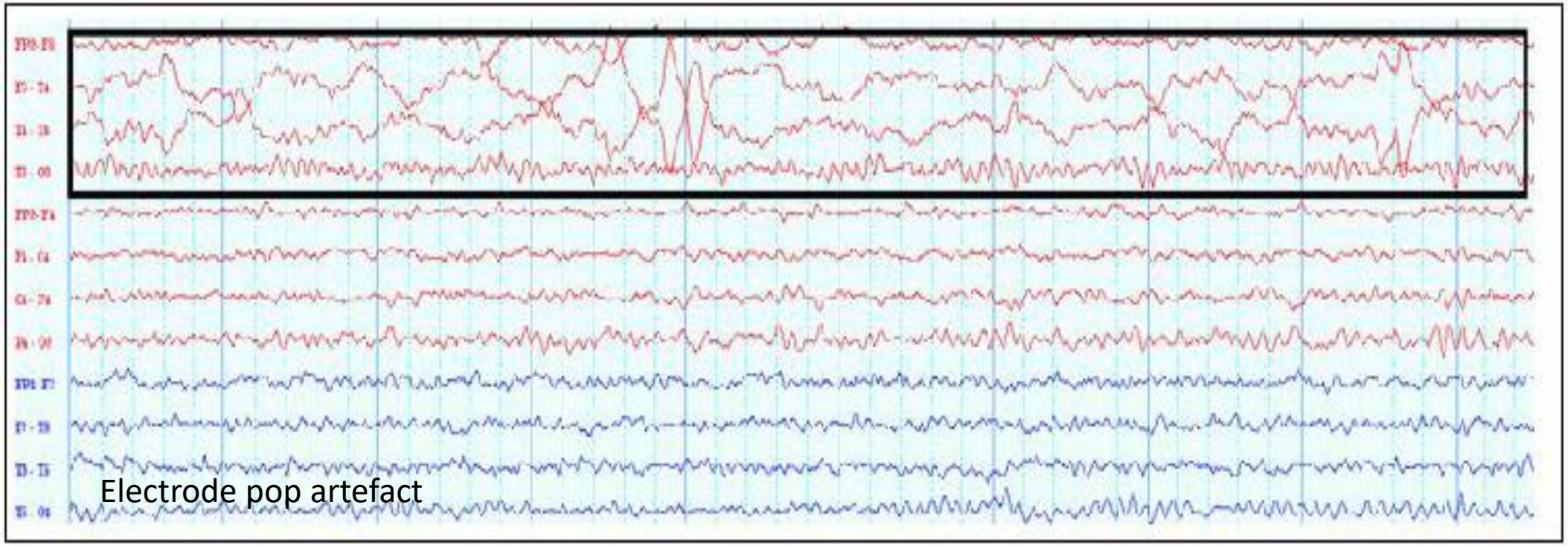
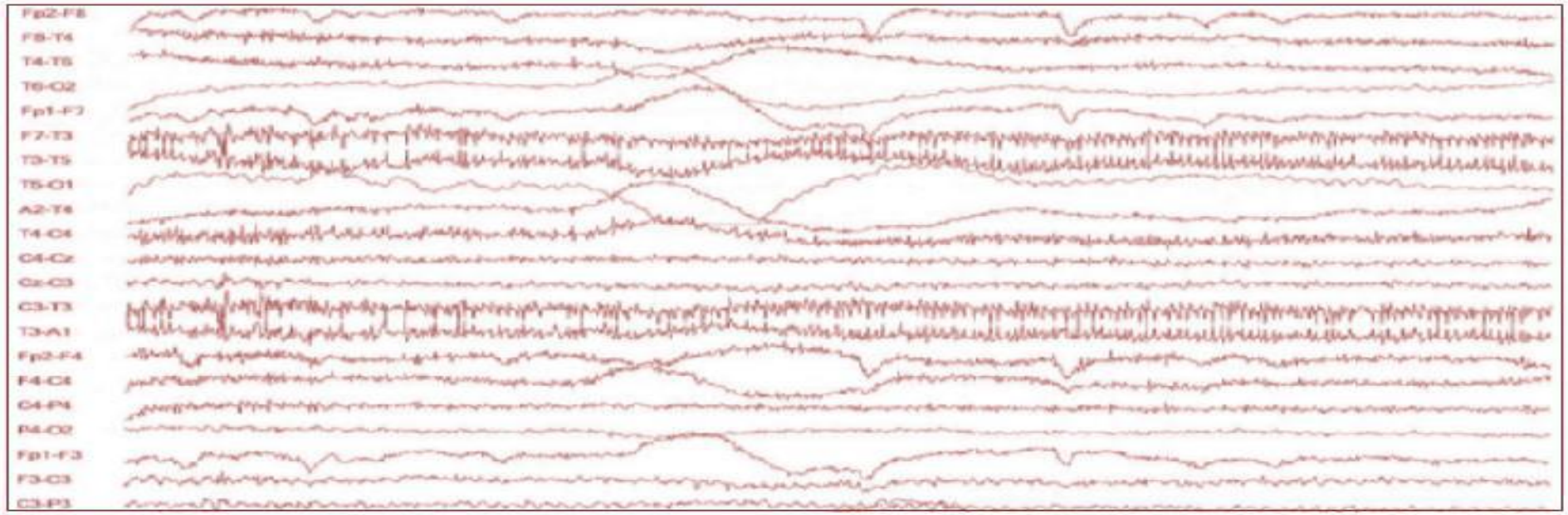


Fig 9:-50 Hz transmission line artefact shown in window


Telephone artefact

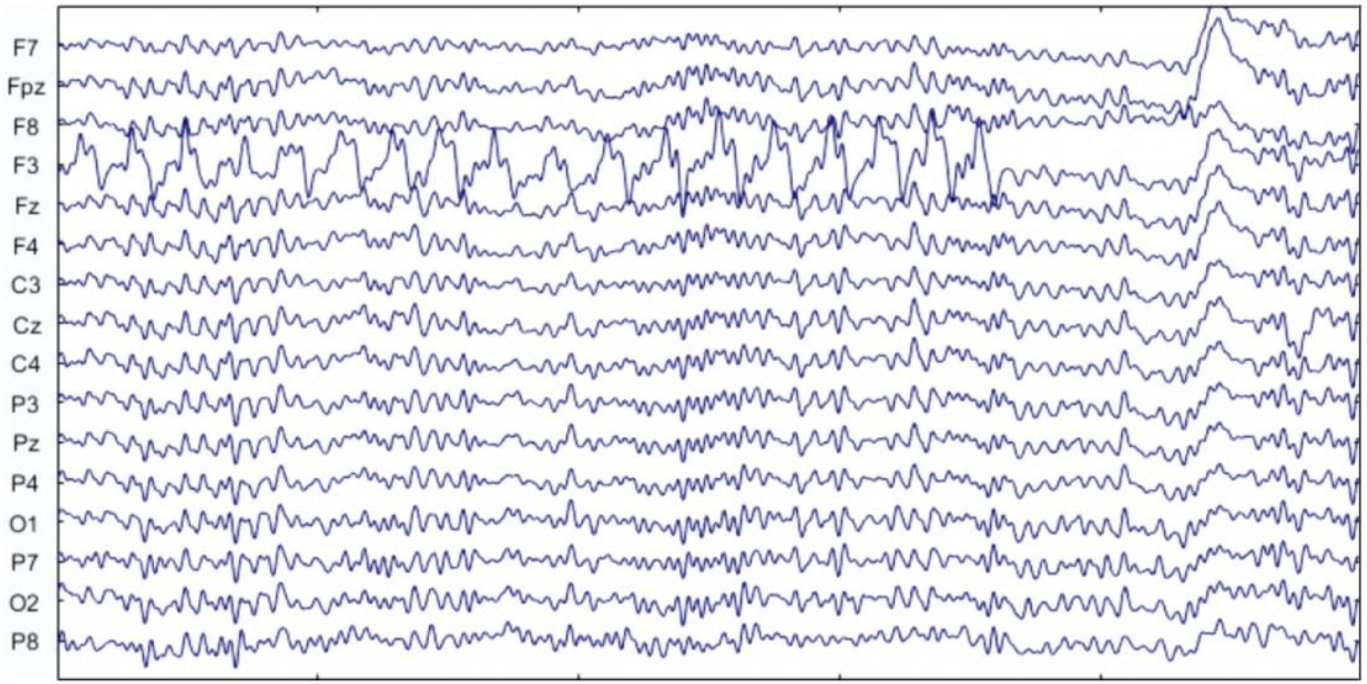


Lead moves artefact



NON-PHYSIOLOGICAL / TECHNICAL ARTIFACTS

Electrode pop



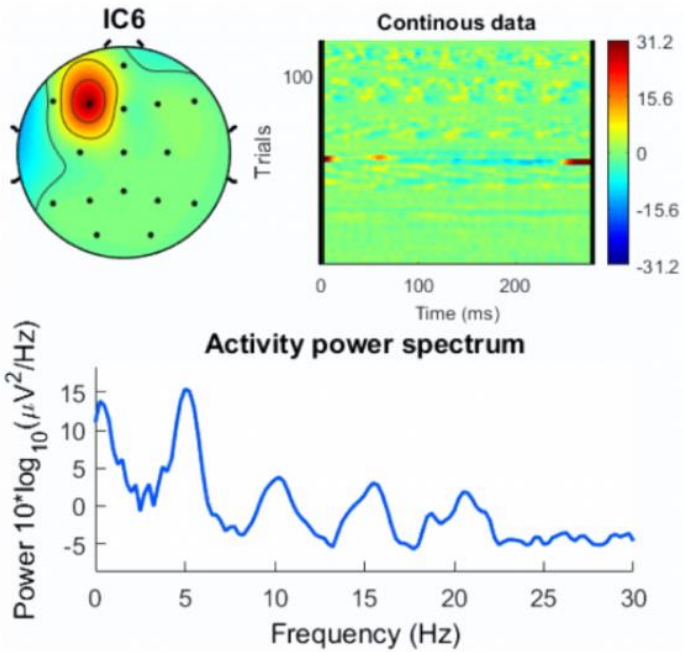
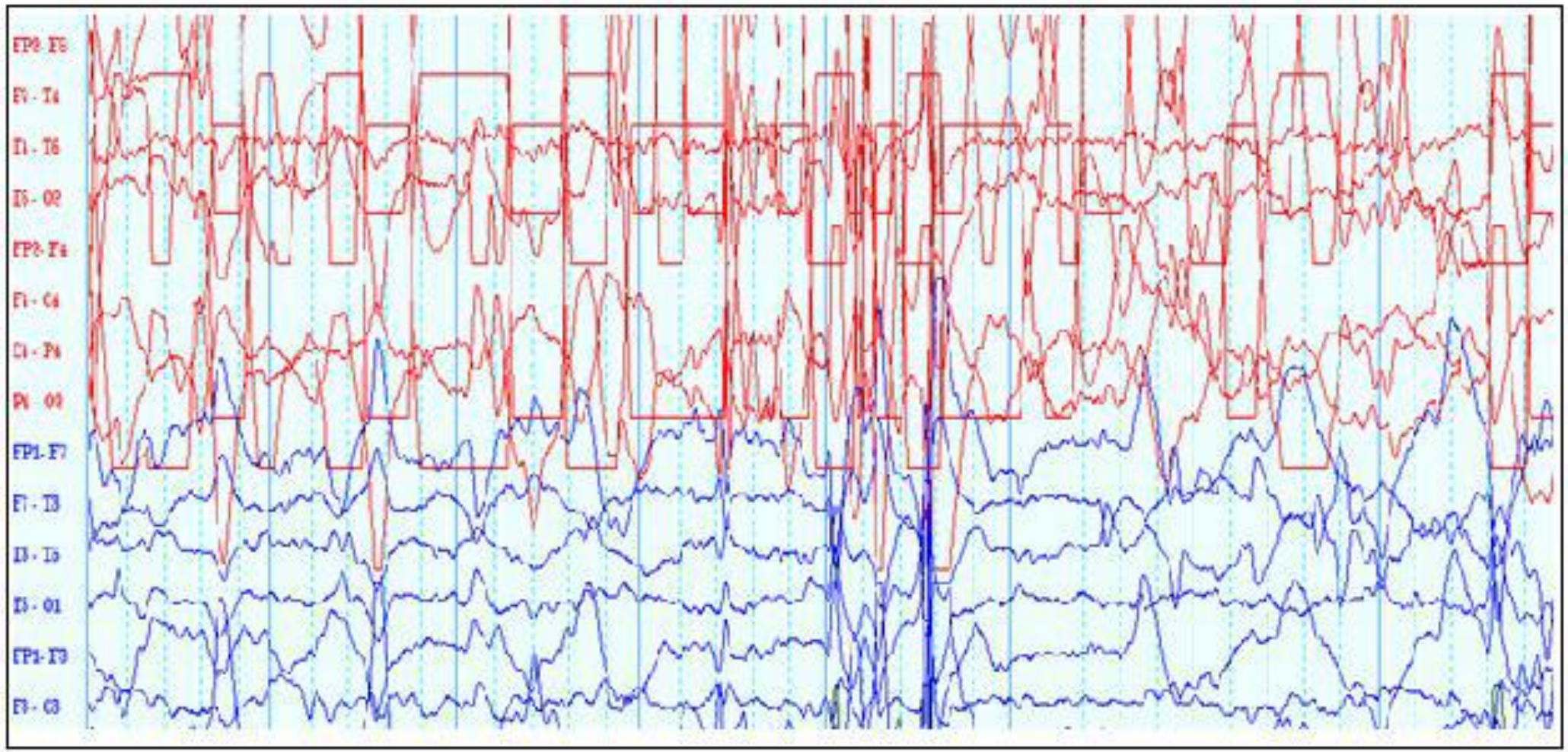
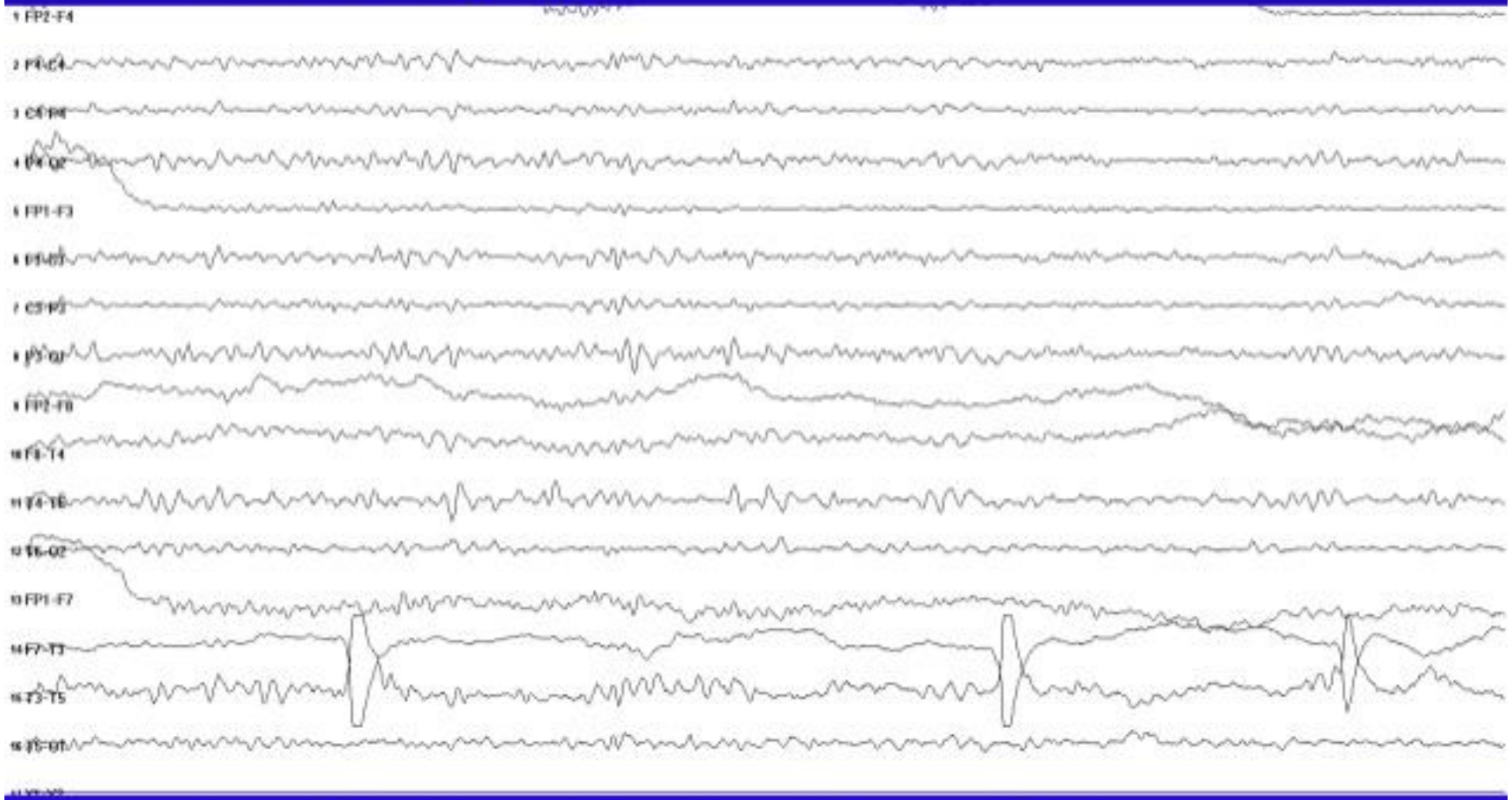


Figure. Notice the distortion in F3 produced by touching the sensor. The effect in time and frequency depends on the type of popping (touching, spontaneous,...). In this case we can see the frequencies of the touching artifact on F3.


FP2-F8
F4-T4
T4-T6
T6-O2
FP2-F4
F4-C4
C4-P4
P4-O2
FP1-F7
F7-T3
T3-T5
T5-O1
FP1-F3
F3-C3

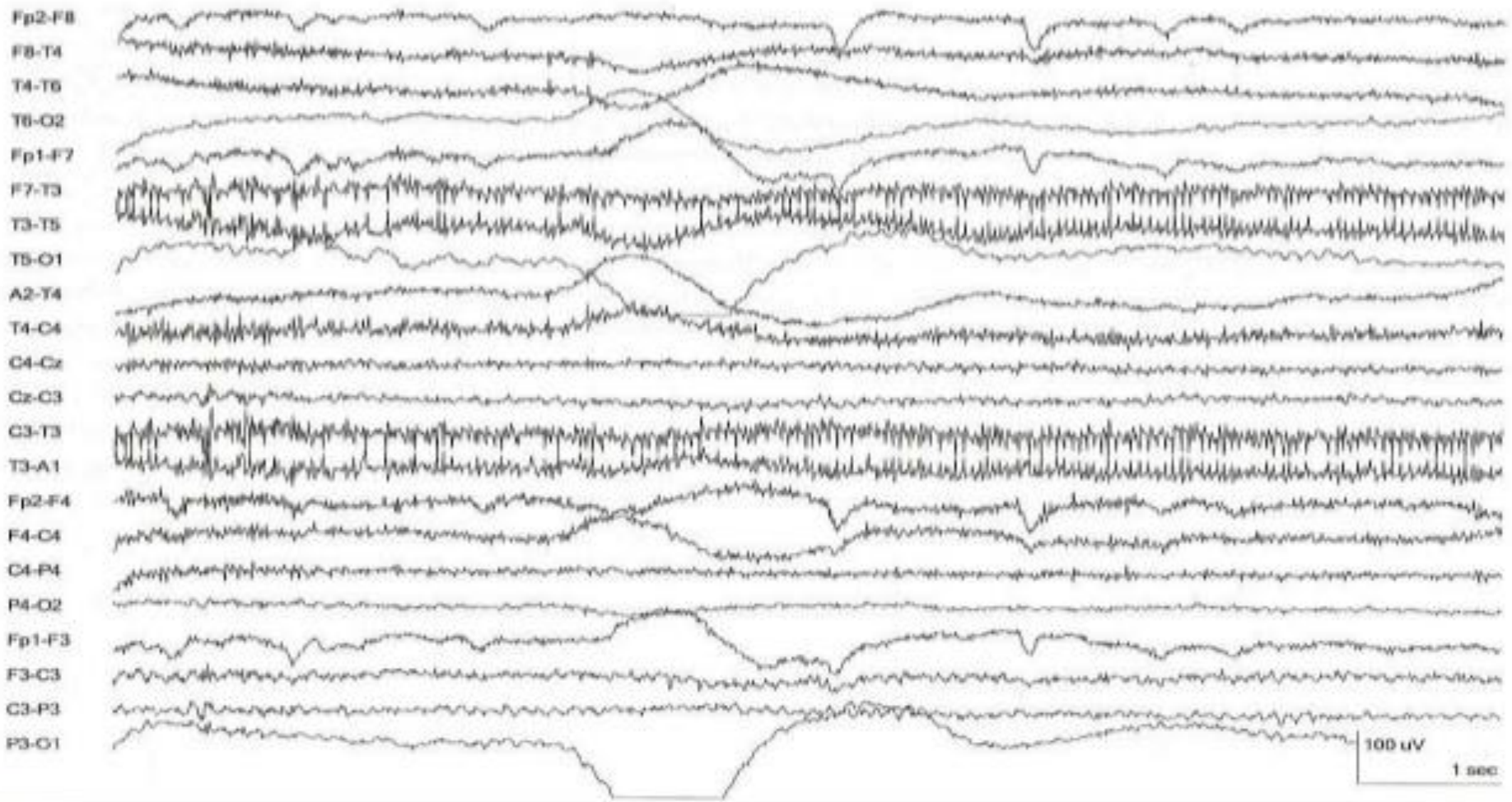

Laptop unplugged
Touched
Power Cable
FP1-F7
F7-T7
T7-P7
P7-O1
FP1-F3
F3-C3
C3-P3
P3-O1
FP2-F4
F4-C4
C4-P4
P4-O2
FP2-F8
F8-T8
T8-P8
P8-O2
FZ-CZ
CZ-PZ
P7-T7
T7-T1
150uV
1 sec
Scroll
<<
>>
<
>
<1/2
1/2>
-
+
5.0p/s
View-As-Rec=On

Electrode pop:



A sudden change in the electrical potential between the electrode and scalp gives rise to the ‘pop’

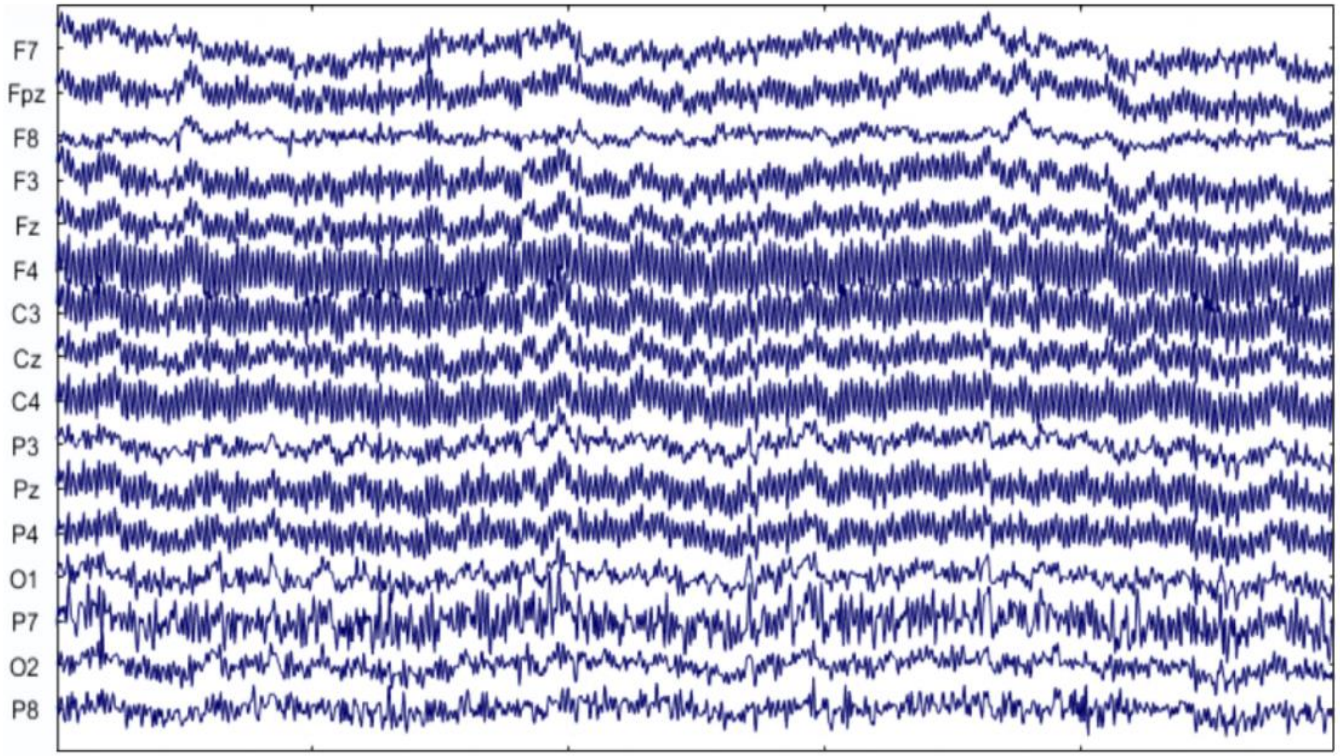
Lead movement



Multiple channels demonstrate the artifact through activity that is both unusually high amplitude and low frequency and also disorganized without a plausible field

NON-PHYSIOLOGICAL / TECHNICAL ARTIFACTS

Powerline interference



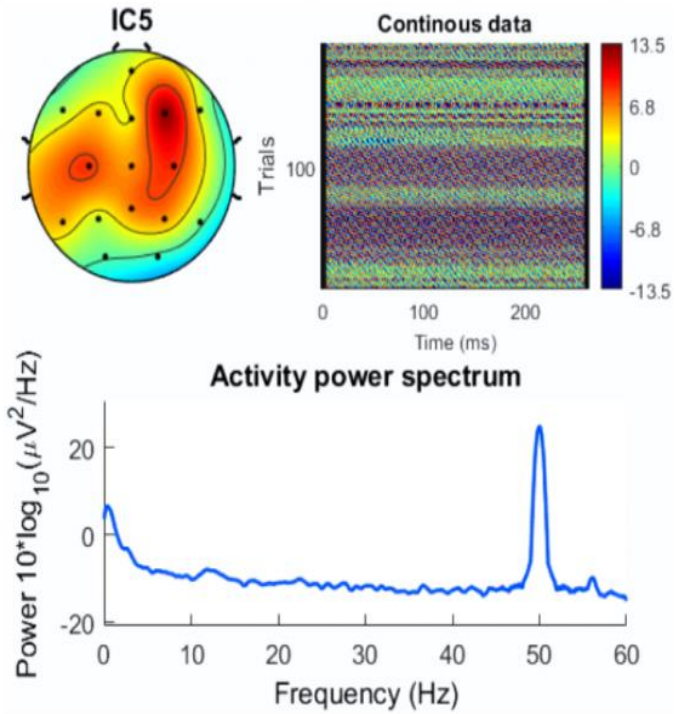
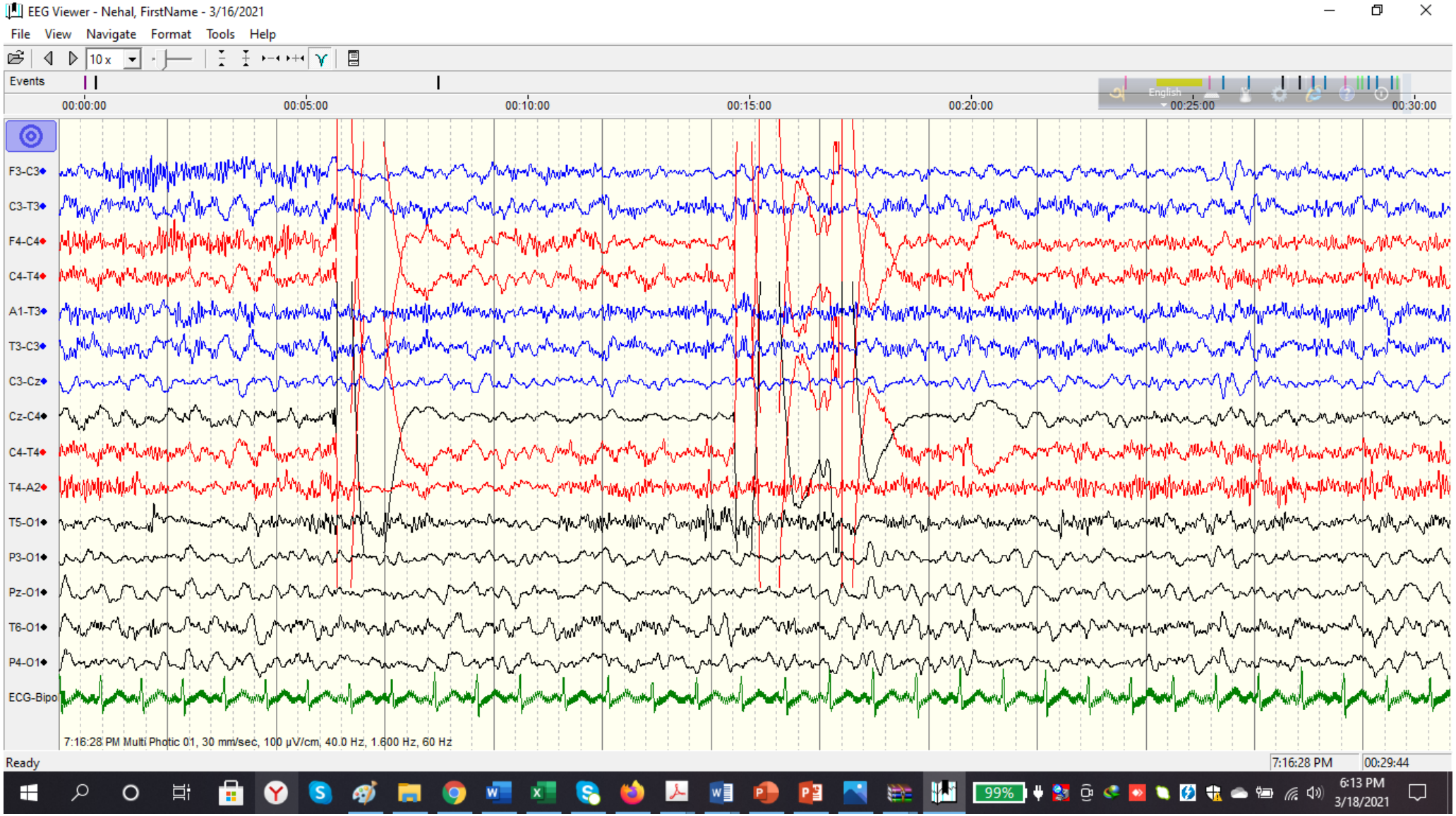
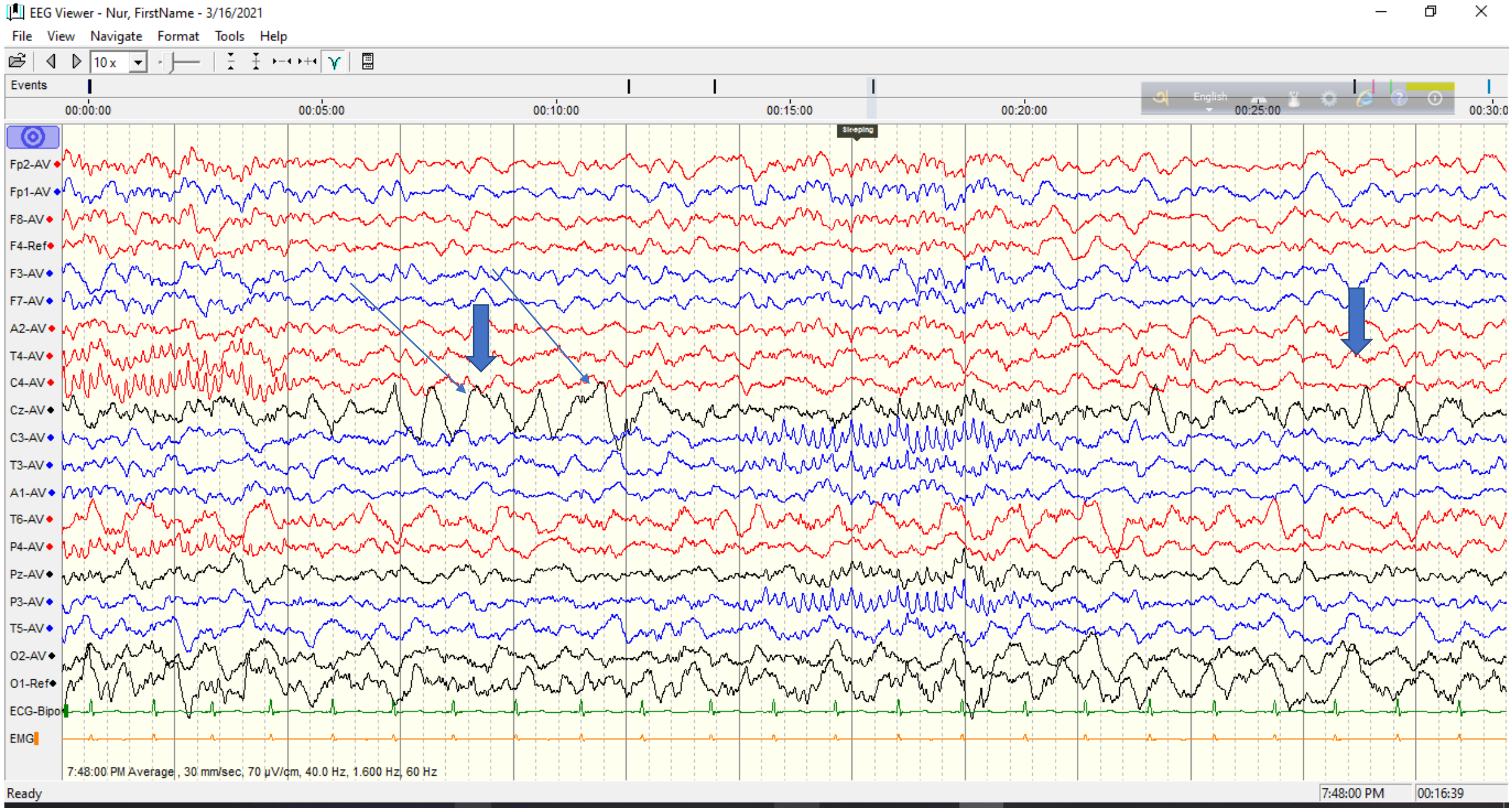
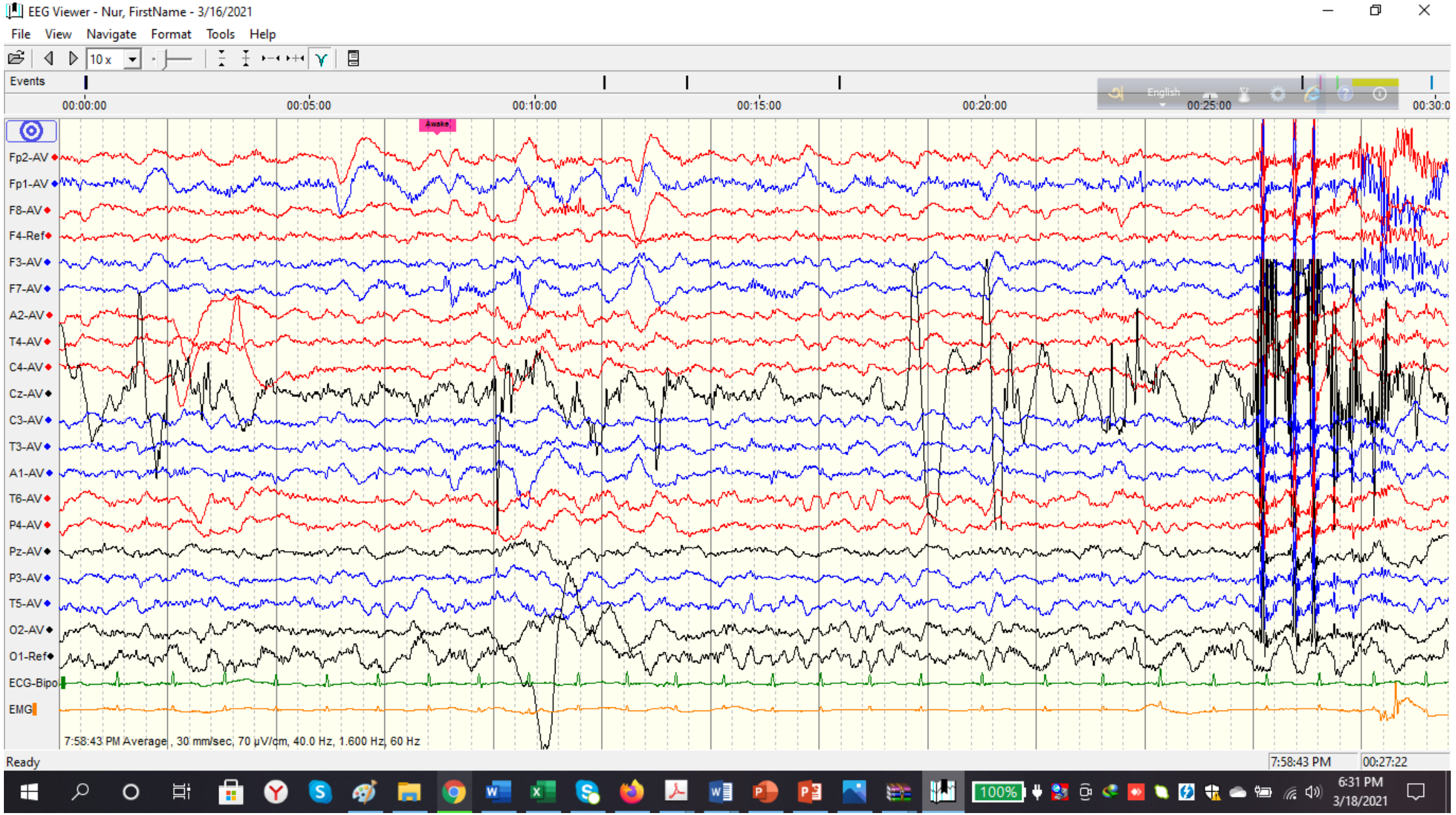


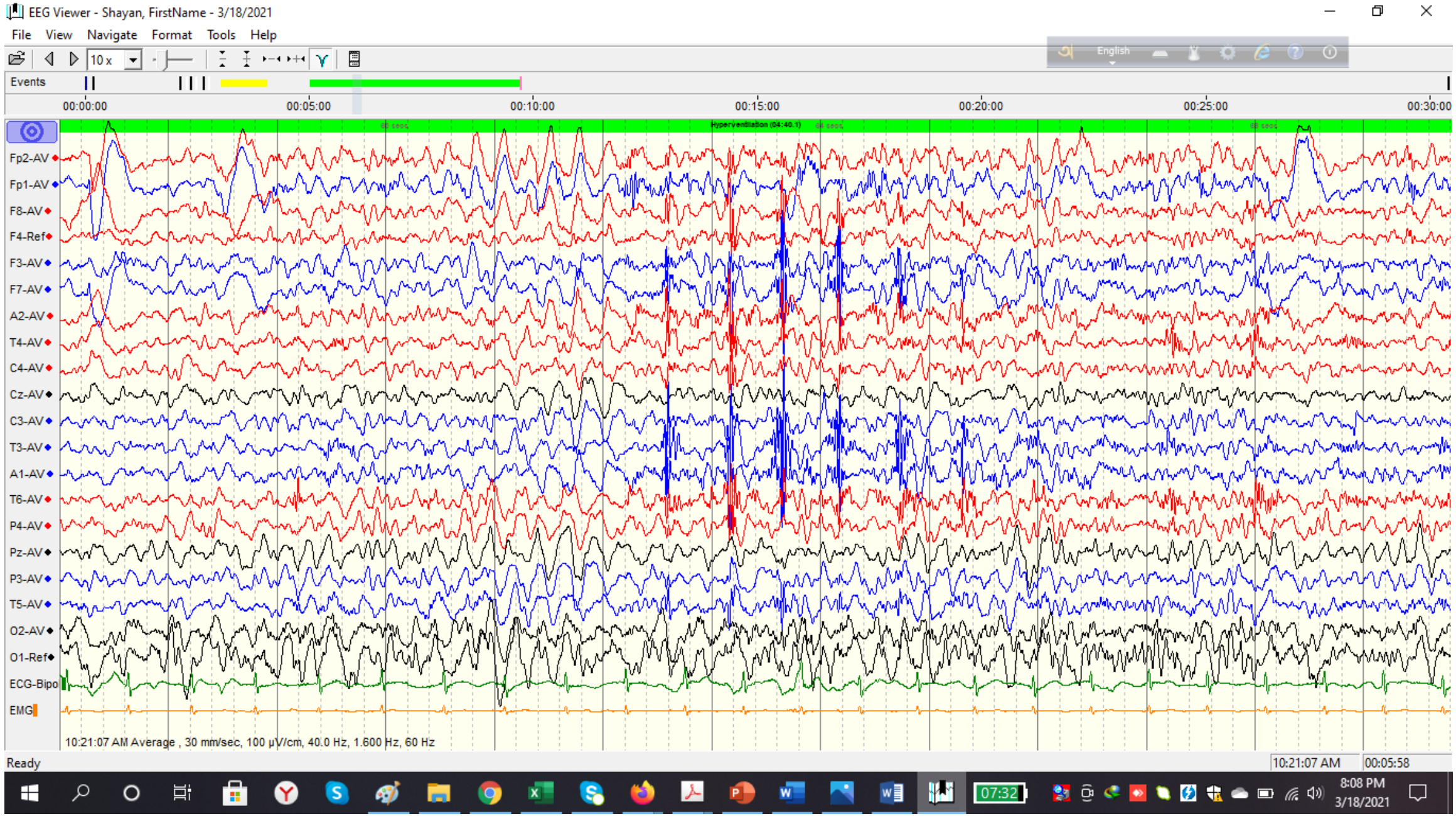
Figure. Notice the high frequency signal overlapping the eeg data in all channels. A clear peak appears in 50 Hz. The eeg was recorded in Spain and the powerline frequency is 50 Hz.


EEG Viewer - Nehal, FirstName - 3/16/2021
File View Navigate Format Tools Help
10 x
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:00
F3-C3
C3-T3
F4-C4
C4-T4
A1-T3
T3-C3
C3-Cz
Cz-C4
C4-T4
T4-A2
T5-O1
P3-O1
Pz-O1
T6-O1
P4-O1
ECG-Bipo
7:16:28 PM Multi Photic 01, 30 mm/sec, 100 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Ready
7:16:28 PM
00:29:44
99%
6:13 PM
3/18/2021

Have to review the whole record before making any comment on this

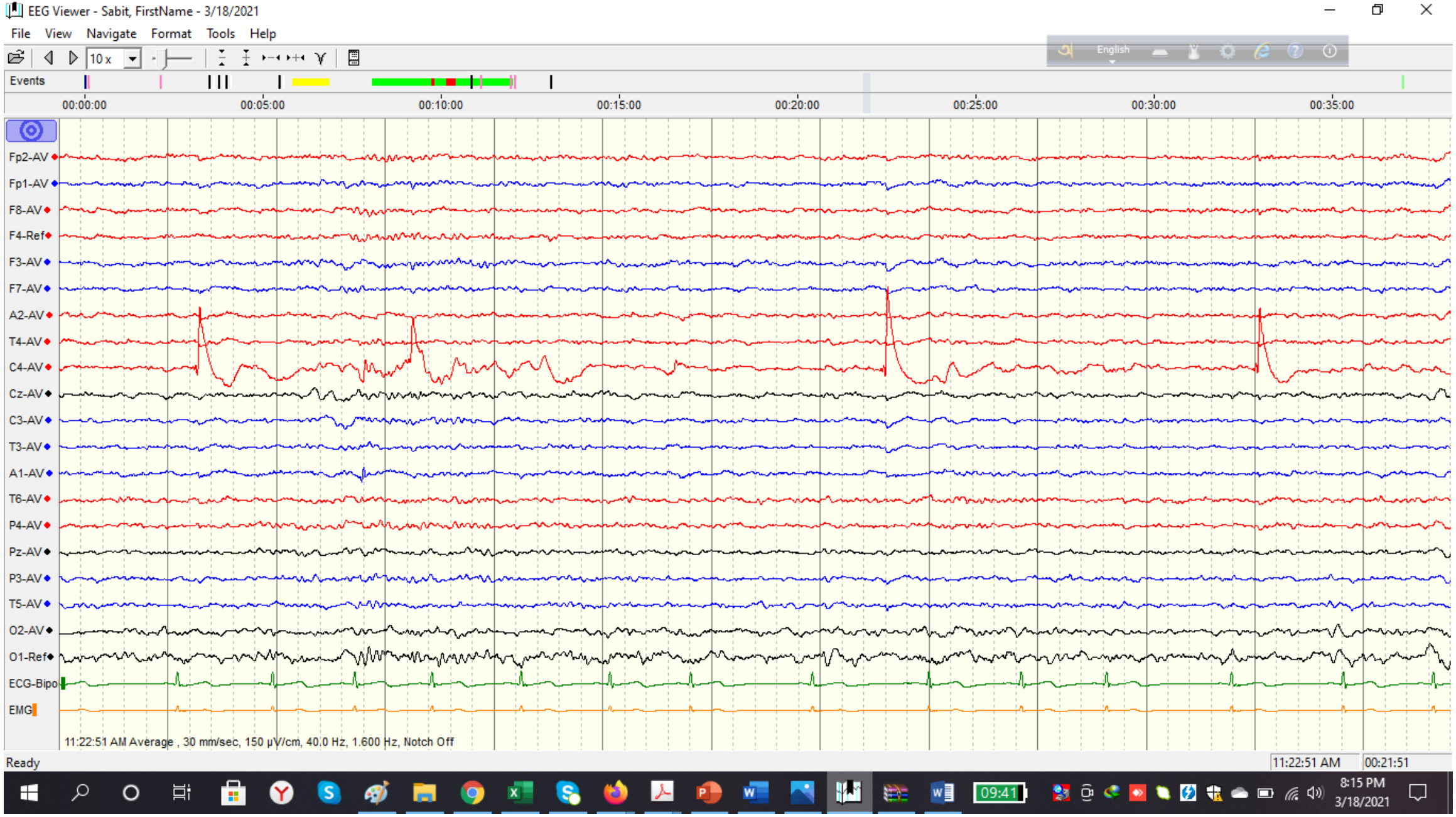


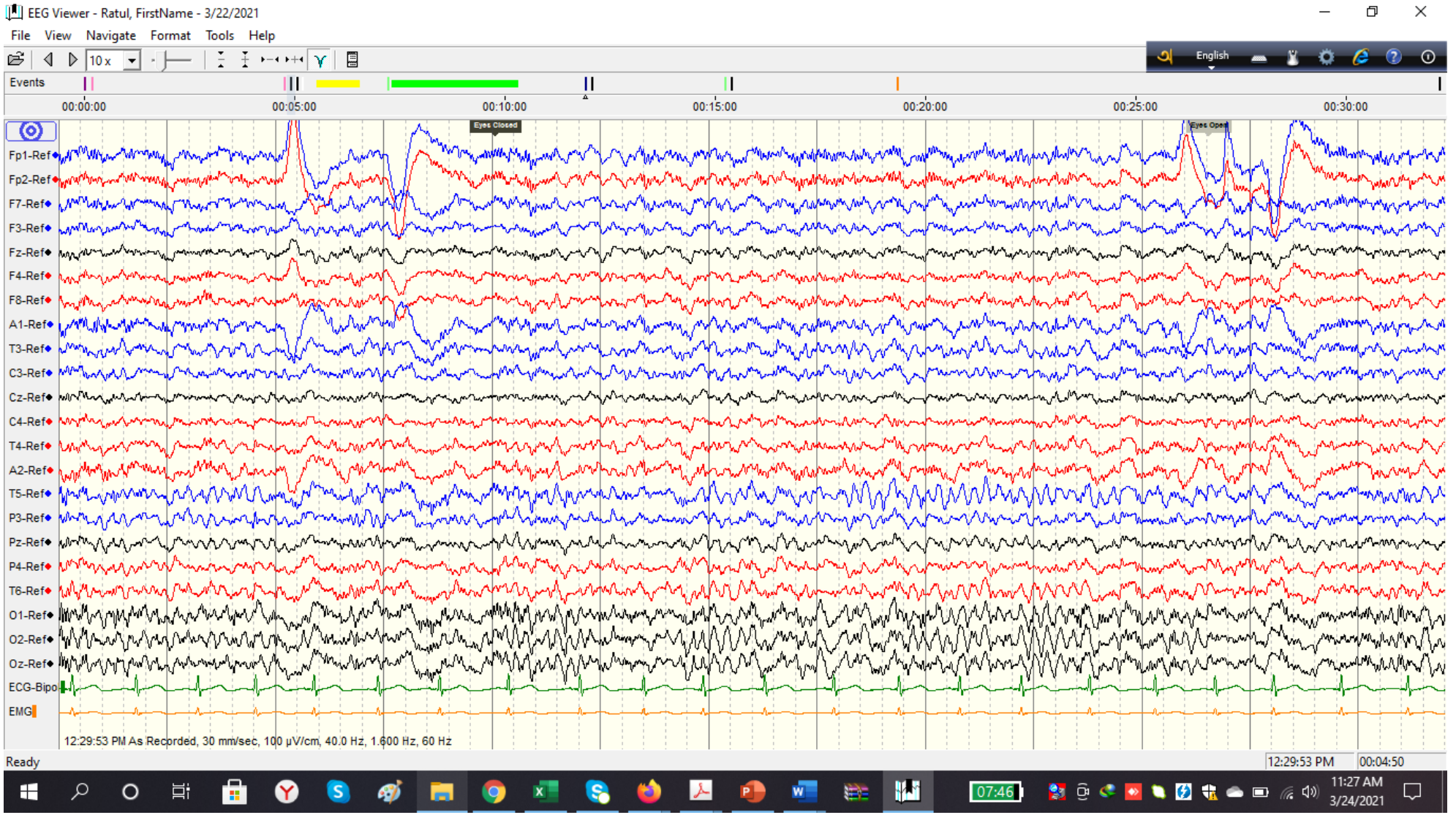

EEG Viewer - Nur, FirstName - 3/16/2021
File View Navigate Format Tools Help
10 x
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:0
Awake
Fp2-AV
Fp1-AV
F8-AV
F4-Ref
F3-AV
F7-AV
A2-AV
T4-AV
C4-AV
Cz-AV
C3-AV
T3-AV
A1-AV
T6-AV
P4-AV
Pz-AV
P3-AV
T5-AV
O2-AV
O1-Ref
ECG-Bipo
EMG
7:58:43 PM Average , 30 mm/sec, 70 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Ready
7:58:43 PM
00:27:22
100%
6:31 PM
3/18/2021


EEG Viewer - Shayan, FirstName - 3/18/2021
File View Navigate Format Tools Help
10 x
English
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:00
Hyperventilation (04:40.1)
Fp2-AV
Fp1-AV
F8-AV
F4-Ref
F3-AV
F7-AV
A2-AV
T4-AV
C4-AV
Cz-AV
C3-AV
T3-AV
A1-AV
T6-AV
P4-AV
Pz-AV
P3-AV
T5-AV
O2-AV
O1-Ref
ECG-Bipo
EMG
10:21:07 AM Average , 30 mm/sec, 100 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Ready
10:21:07 AM
00:05:58
07:32
8:08 PM
3/18/2021

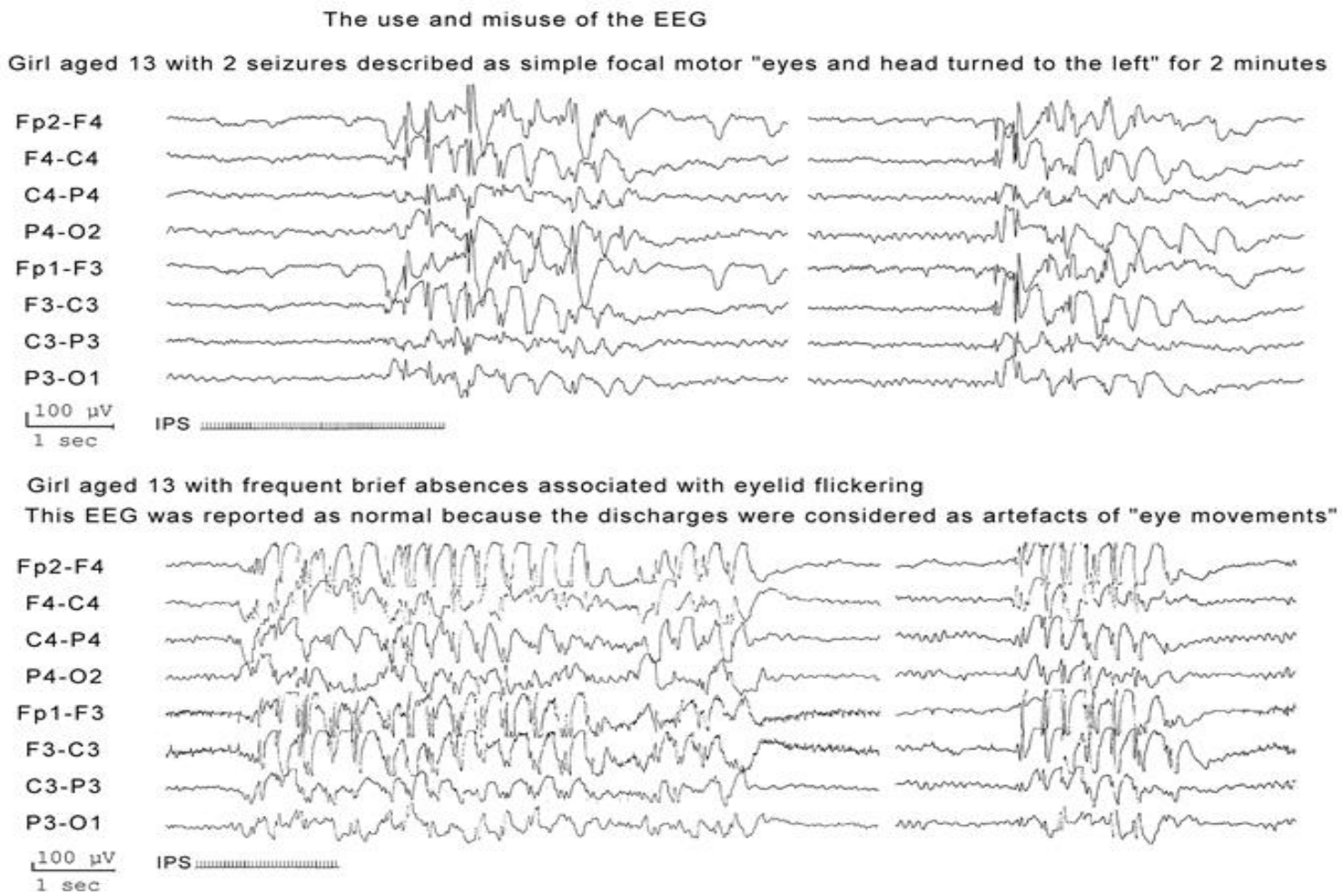
Question Answer session

- Q
- A


EEG Viewer - Sabit, FirstName - 3/18/2021
File View Navigate Format Tools Help
10 x
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:00
00:35:00
Fp2-AV
Fp1-AV
F8-AV
F4-Ref
F3-AV
F7-AV
A2-AV
T4-AV
C4-AV
Cz-AV
C3-AV
T3-AV
A1-AV
T6-AV
P4-AV
Pz-AV
P3-AV
T5-AV
O2-AV
O1-Ref
ECG-Bipo
EMG
11:22:51 AM Average , 30 mm/sec, 150 µV/cm, 40.0 Hz, 1.600 Hz, Notch Off
Ready
11:22:51 AM
00:21:51
09:41
8:15 PM
3/18/2021


EEG Viewer - Ratul, FirstName - 3/22/2021
File View Navigate Format Tools Help
10 x
English
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:00
Eyes Closed
Eyes Open
Fp1-Ref
Fp2-Ref
F7-Ref
F3-Ref
Fz-Ref
F4-Ref
F8-Ref
A1-Ref
T3-Ref
C3-Ref
Cz-Ref
C4-Ref
T4-Ref
A2-Ref
T5-Ref
P3-Ref
Pz-Ref
P4-Ref
T6-Ref
O1-Ref
O2-Ref
Oz-Ref
ECG-Bipo
EMG
12:29:53 PM As Recorded, 30 mm/sec, 100 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Ready
12:29:53 PM
00:04:50
07:46
11:27 AM
3/24/2021

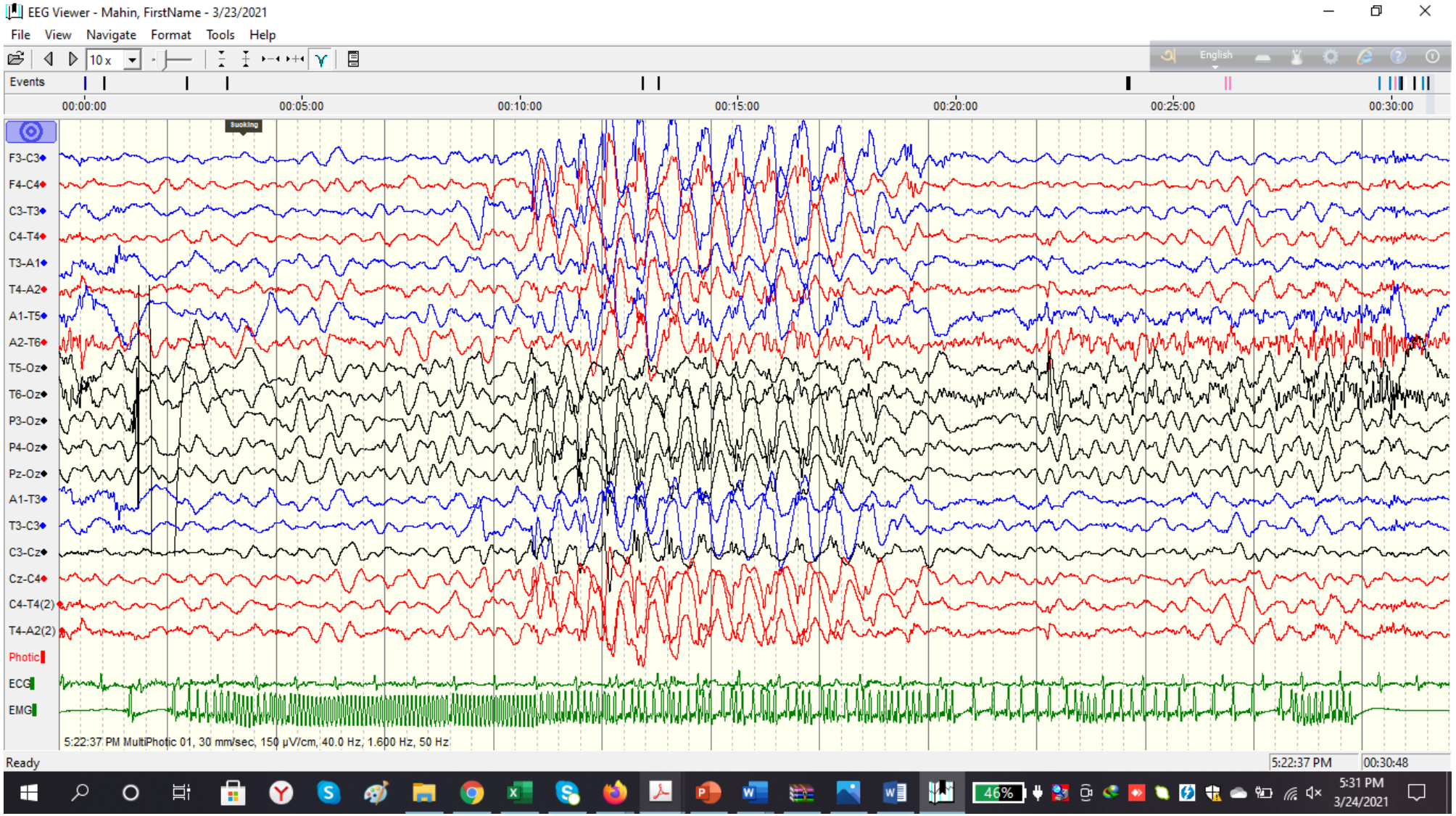
The Use and misuse of EEG

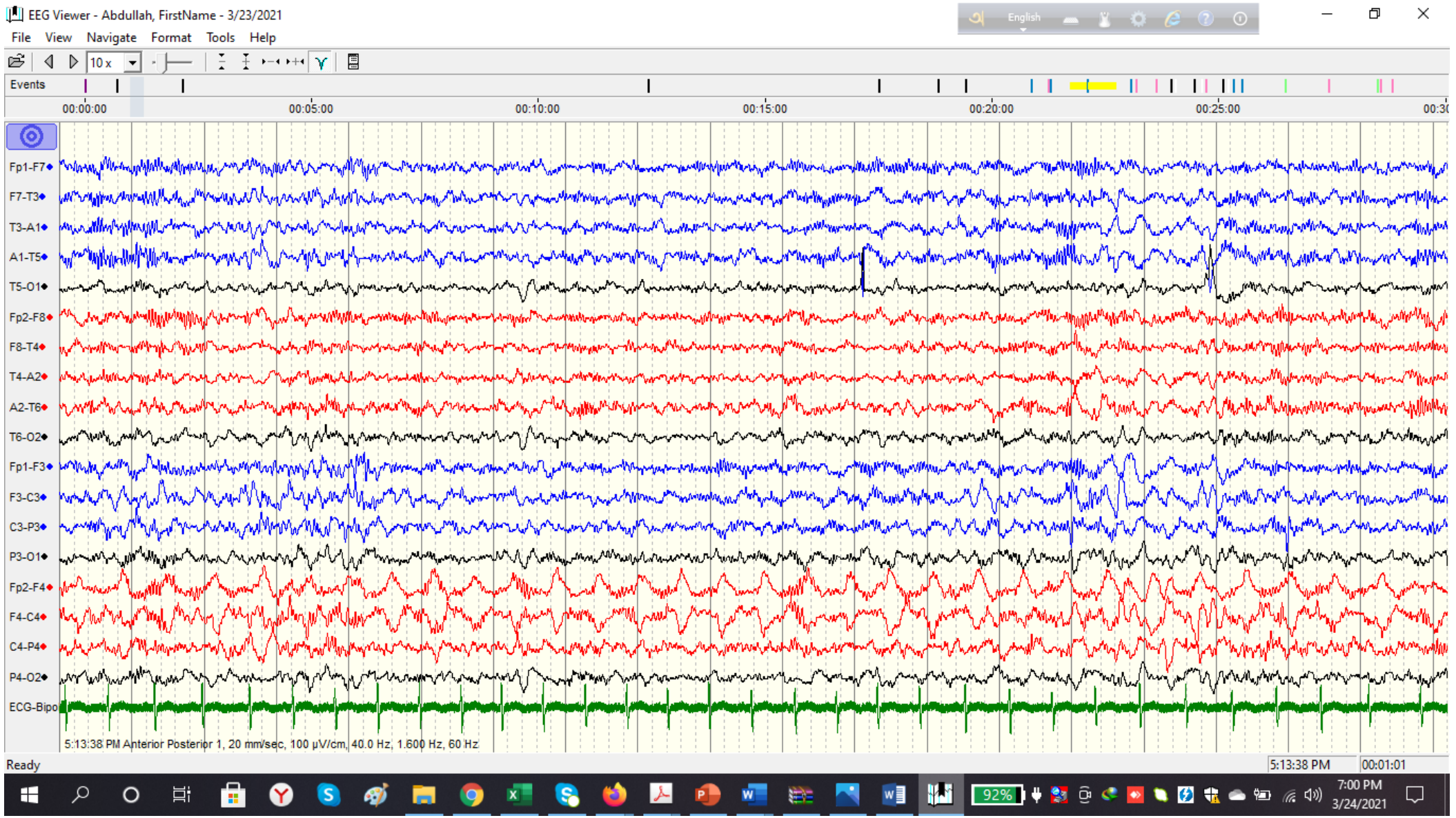


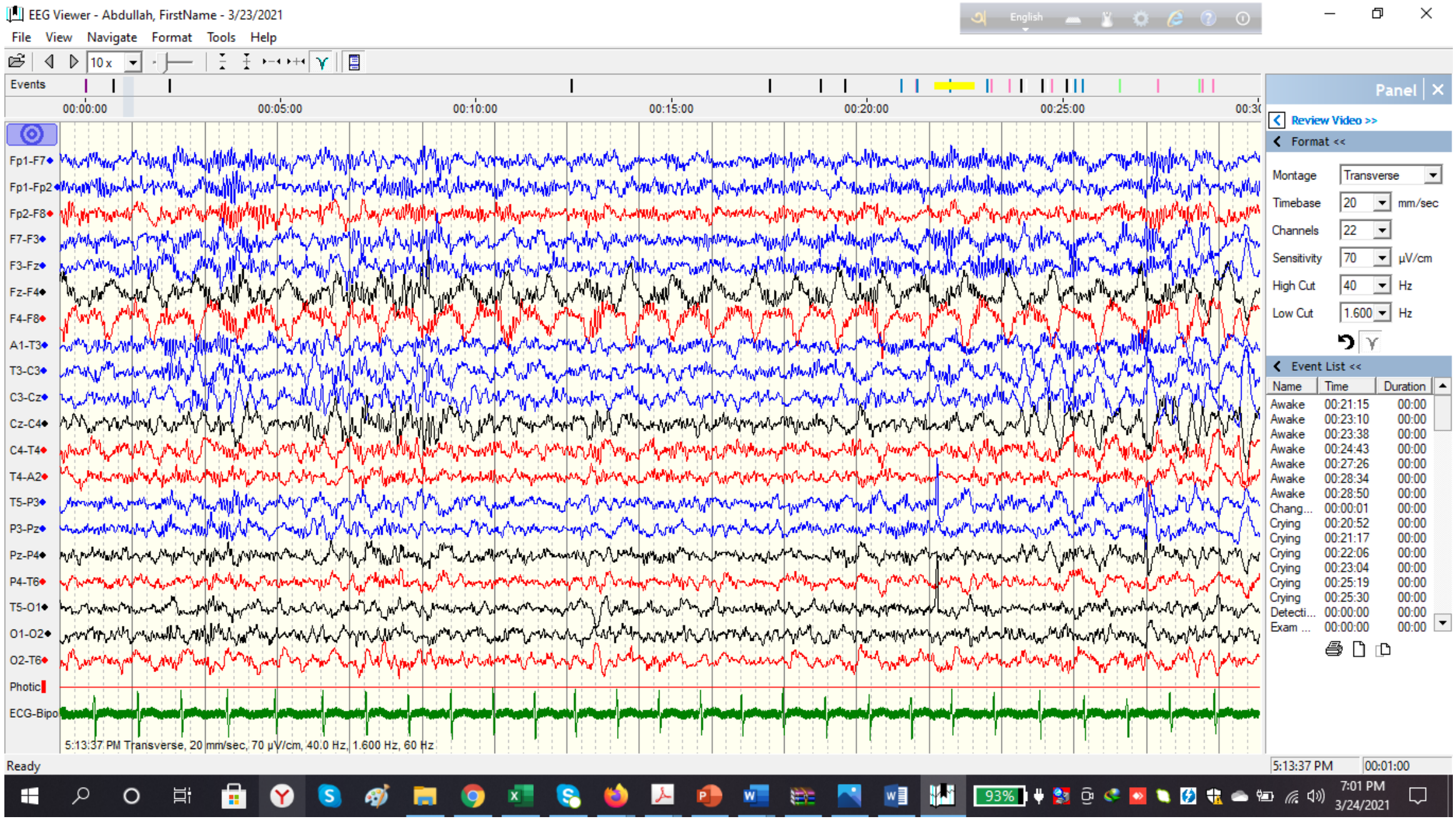
1Use and misuse of EEGs. Two girls with similar EEG abnormalities of generalised spike/multiple spike and slow wave discharges either spontaneous or elicited by intermittent photic stimulation

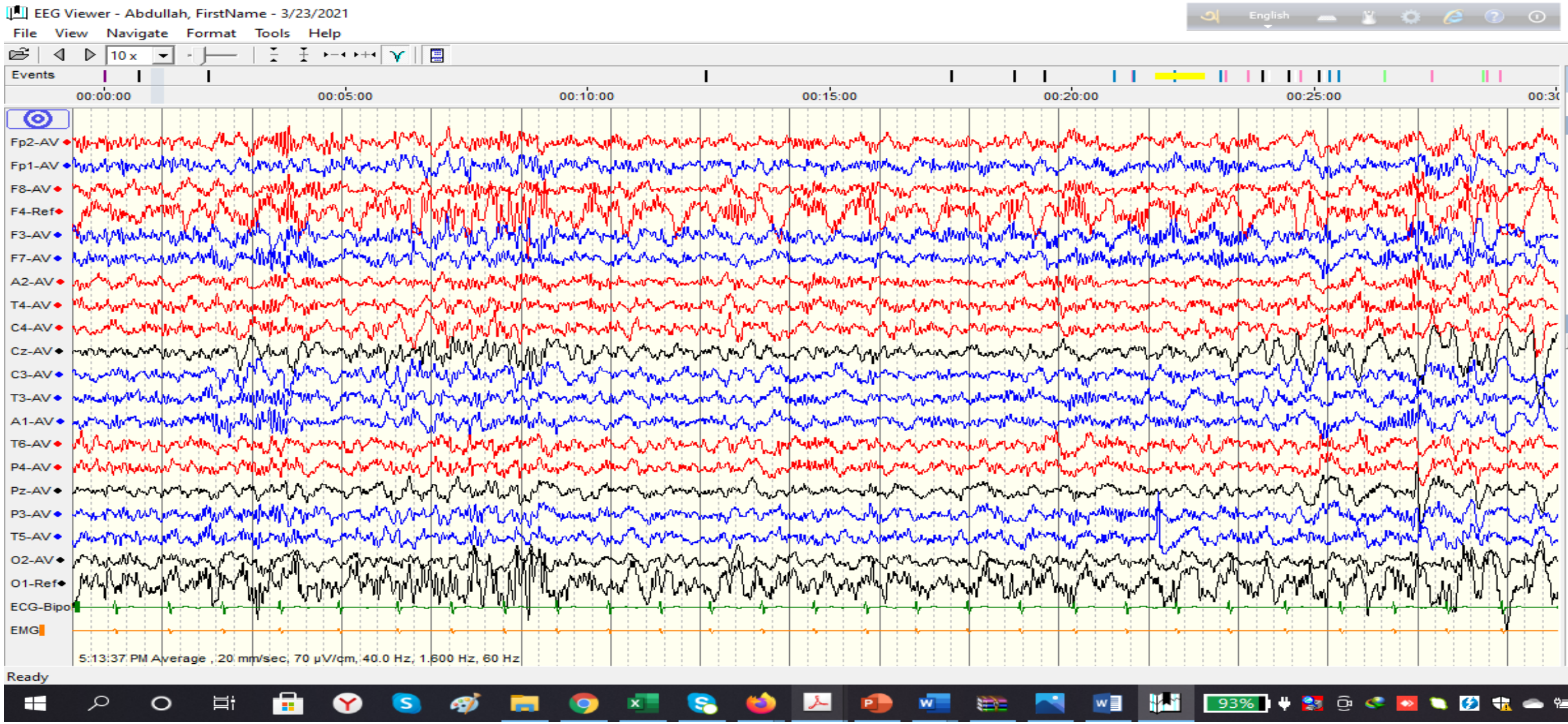
Top: proper use of EEGs. This girl gave a clear-cut history of two seizures that, on clinical grounds, had all the elements of focal motor seizures. Her eyes first and then her head turned to the left and 'I could not bring them back to normal' for 2 min. The EEG clearly documented that she had generalised not focal epilepsy.

Bottom: misuse of the EEG. A 26-year-old woman with JME had the onset of seizures at age 13 years. These consisted of brief absences with eyelid jerking. Her first EEG documented the epileptic nature of the attacks, but the reporting physician and the EEG technologist considered the discharges as artefacts produced by the concurrent eyelid jerking. The EEG was erroneously reported as normal.


EEG Viewer - Mahin, FirstName - 3/23/2021
File View Navigate Format Tools Help
10 x
English
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:00
Sucking
F3-C3
F4-C4
C3-T3
C4-T4
T3-A1
T4-A2
A1-T5
A2-T6
T5-Oz
T6-Oz
P3-Oz
P4-Oz
Pz-Oz
A1-T3
T3-C3
C3-Cz
Cz-C4
C4-T4(2)
T4-A2(2)
Photic
ECG
EMG
5:22:37 PM MultiPhotic 01, 30 mm/sec, 150 µV/cm, 40.0 Hz, 1.600 Hz, 50 Hz
Ready
5:22:37 PM
00:30:48
46%
5:31 PM
3/24/2021

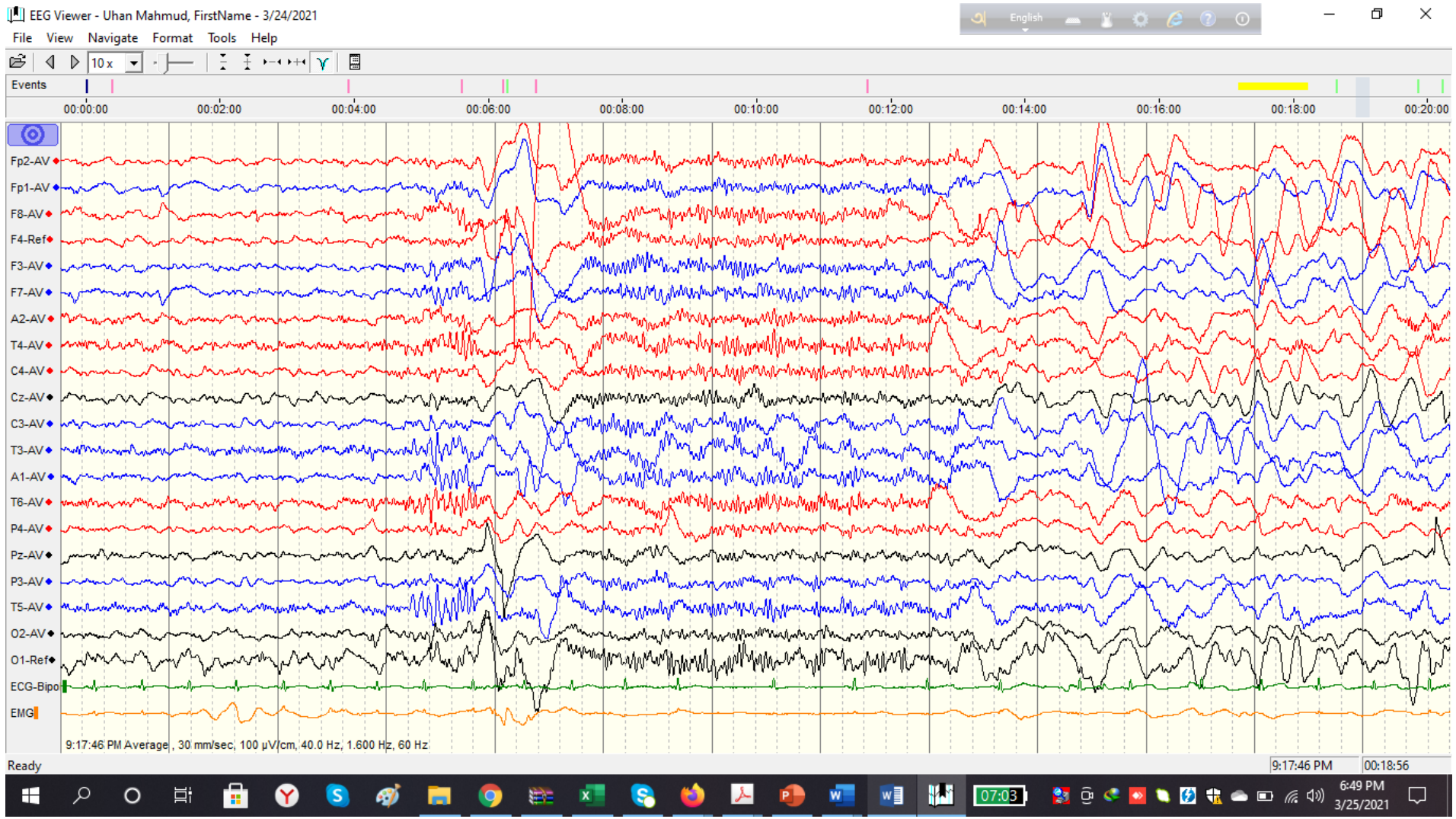

EEG Viewer - Abdullah, FirstName - 3/23/2021
File View Navigate Format Tools Help
English
10 x
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
Fp1-F7
F7-T3
T3-A1
A1-T5
T5-O1
Fp2-F8
F8-T4
T4-A2
A2-T6
T6-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
Fp2-F4
F4-C4
C4-P4
P4-O2
ECG-Bipo
5:13:38 PM Anterior Posterior 1, 20 mm/sec, 100 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Ready
5:13:38 PM
00:01:01
92%
7:00 PM
3/24/2021


EEG Viewer - Abdullah, FirstName - 3/23/2021
File View Navigate Format Tools Help
English
10 x
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
Fp1-F7
Fp1-Fp2
Fp2-F8
F7-F3
F3-Fz
Fz-F4
F4-F8
A1-T3
T3-C3
C3-Cz
Cz-C4
C4-T4
T4-A2
T5-P3
P3-Pz
Pz-P4
P4-T6
T5-O1
O1-O2
O2-T6
Photic
ECG-Bipo
5:13:37 PM Transverse, 20 mm/sec, 70 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Panel
Review Video >>
Format <<
Montage Transverse
Timebase 20 mm/sec
Channels 22
Sensitivity 70 µV/cm
High Cut 40 Hz
Low Cut 1.600 Hz
Event List <<
Name Time Duration
Awake 00:21:15 00:00
Awake 00:23:10 00:00
Awake 00:23:38 00:00
Awake 00:24:43 00:00
Awake 00:27:26 00:00
Awake 00:28:34 00:00
Awake 00:28:50 00:00
Chang... 00:00:01 00:00
Crying 00:20:52 00:00
Crying 00:21:17 00:00
Crying 00:22:06 00:00
Crying 00:23:04 00:00
Crying 00:25:19 00:00
Crying 00:25:30 00:00
Detecti... 00:00:00 00:00
Exam ... 00:00:00 00:00
Ready
5:13:37 PM
00:01:00
93%
7:01 PM
3/24/2021


EEG Viewer - Abdullah, FirstName - 3/23/2021
File View Navigate Format Tools Help
English
10 x
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
Fp2-AV
Fp1-AV
F8-AV
F4-Ref
F3-AV
F7-AV
A2-AV
T4-AV
C4-AV
Cz-AV
C3-AV
T3-AV
A1-AV
T6-AV
P4-AV
Pz-AV
P3-AV
T5-AV
O2-AV
O1-Ref
ECG-Bipo
EMG
5:13:37 PM Average , 20 mm/sec, 70 µV/cm, 40.0 Hz, 1.600 Hz, 60 Hz
Ready
93%

Technician informs, the child was restless, movement artifact?

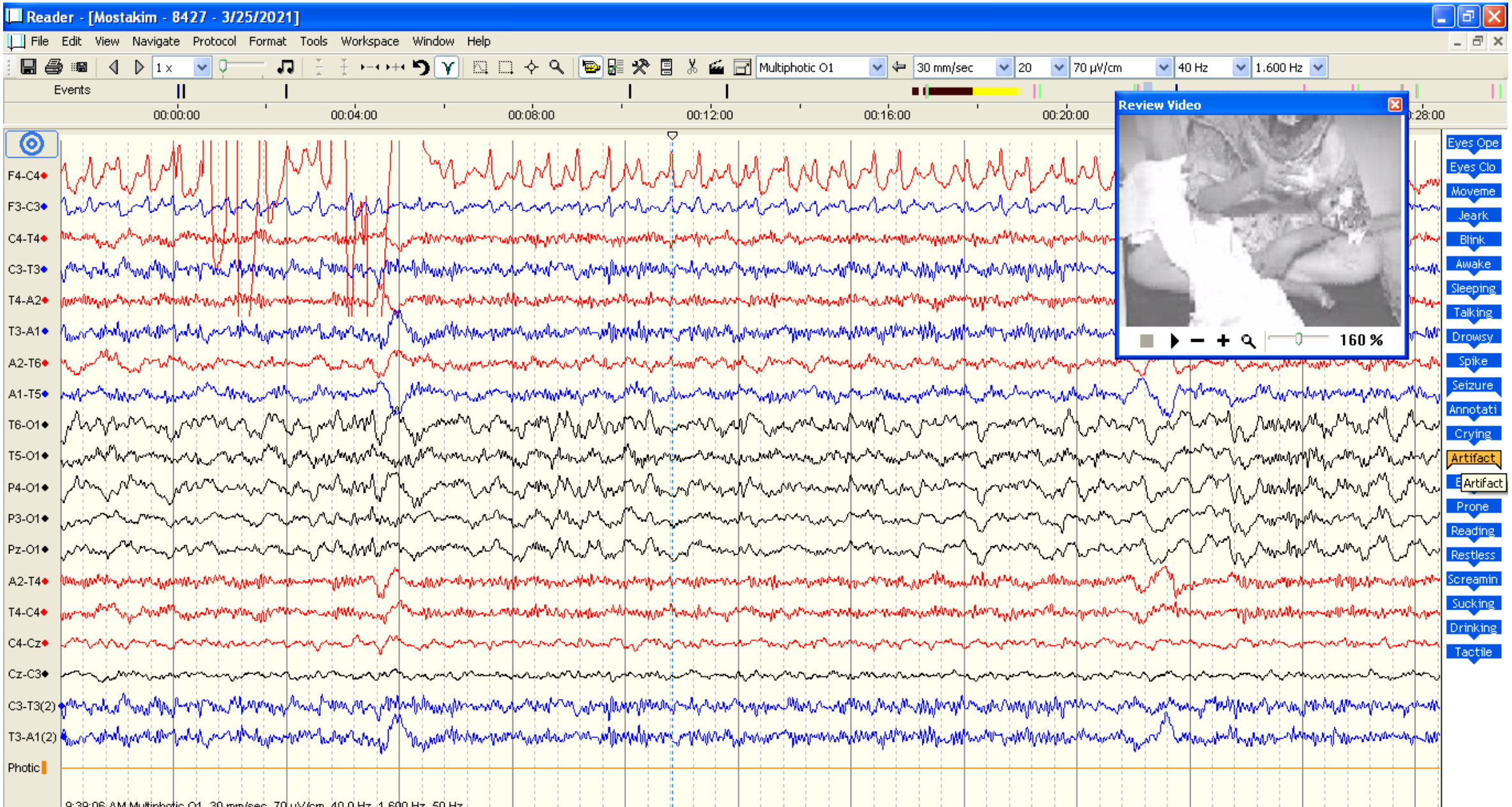
Why not movement artifact?



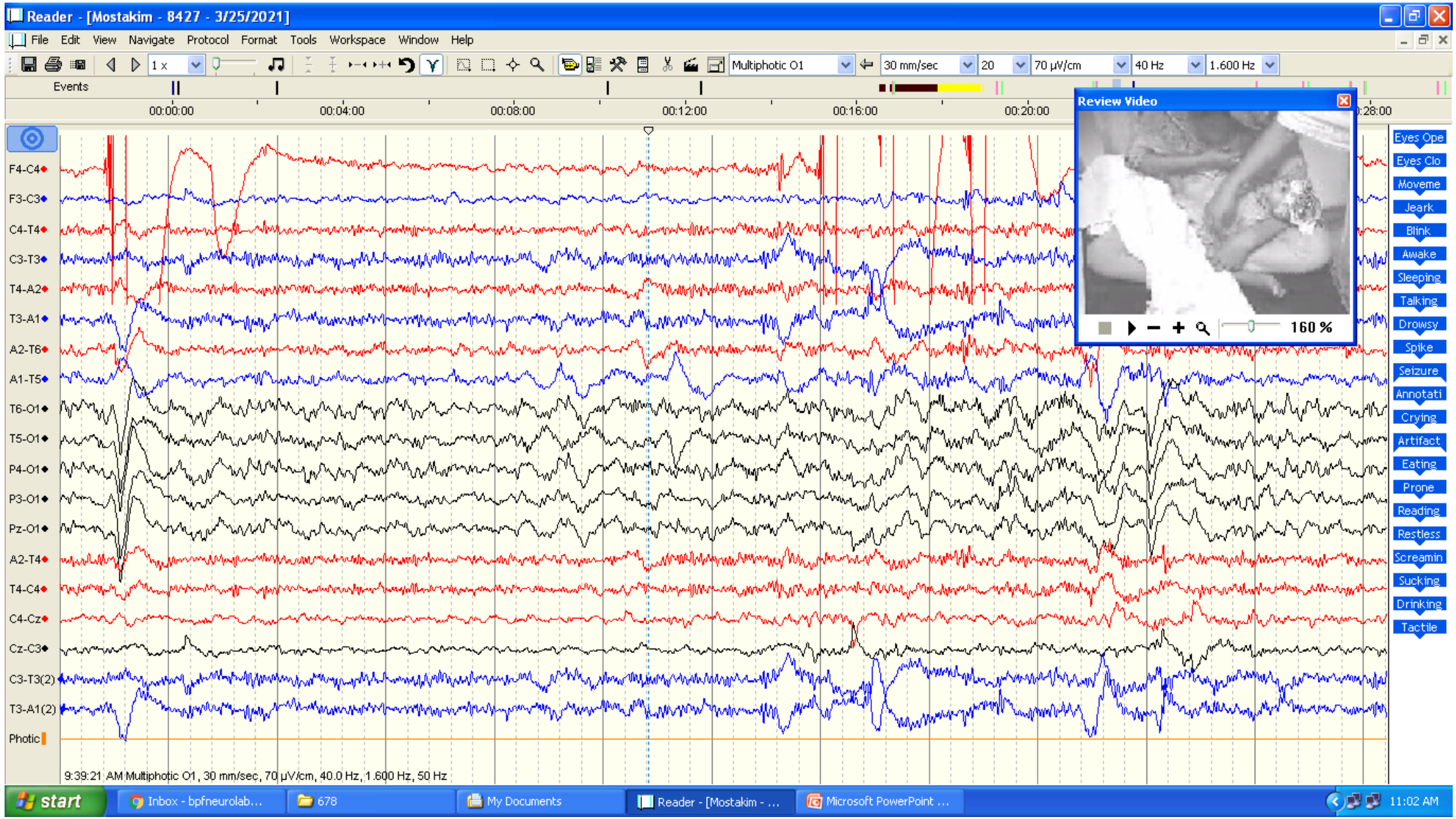
Why technicians need to get training on childhood epilepsies?

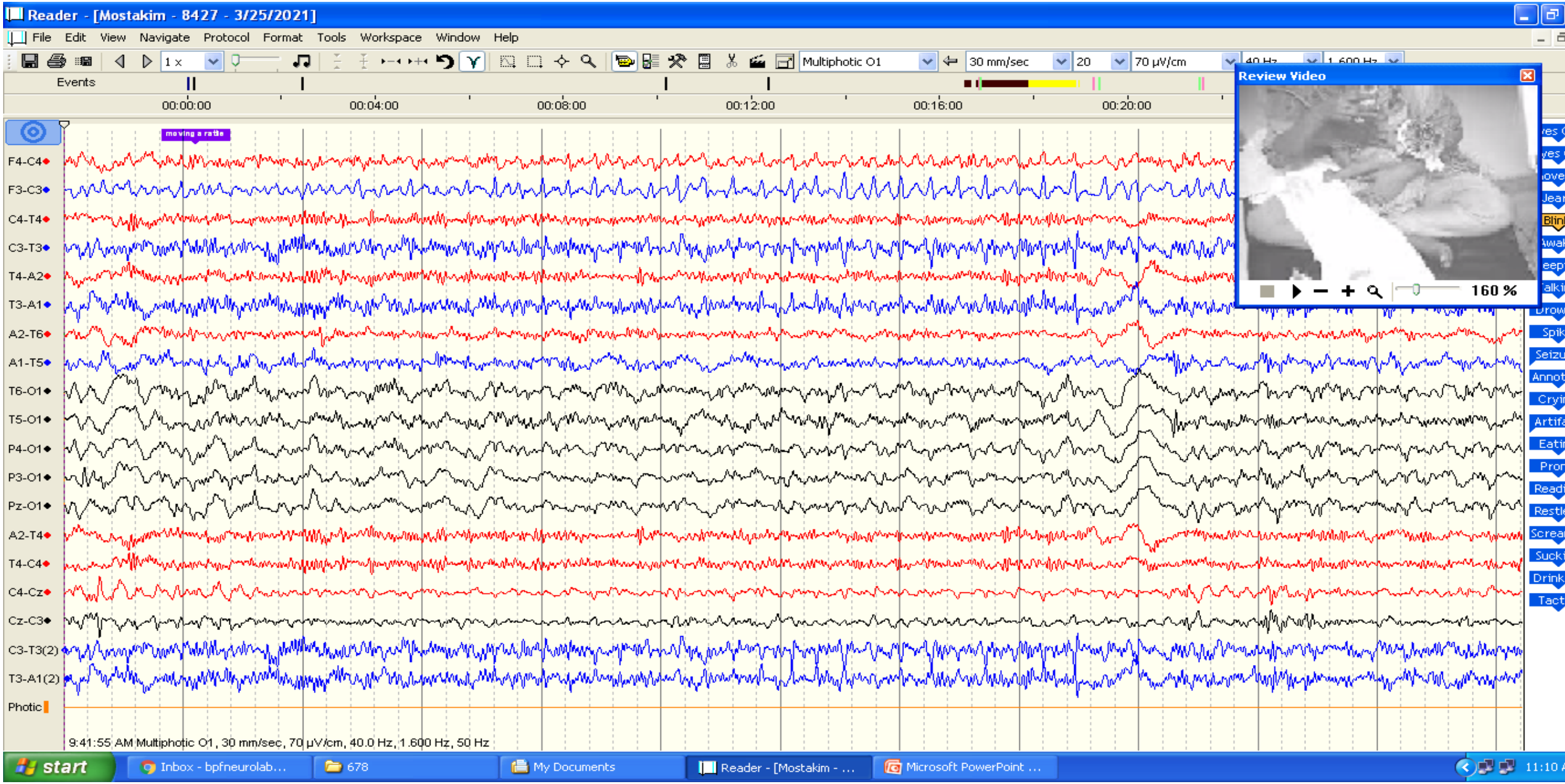
Why not movement artifact?

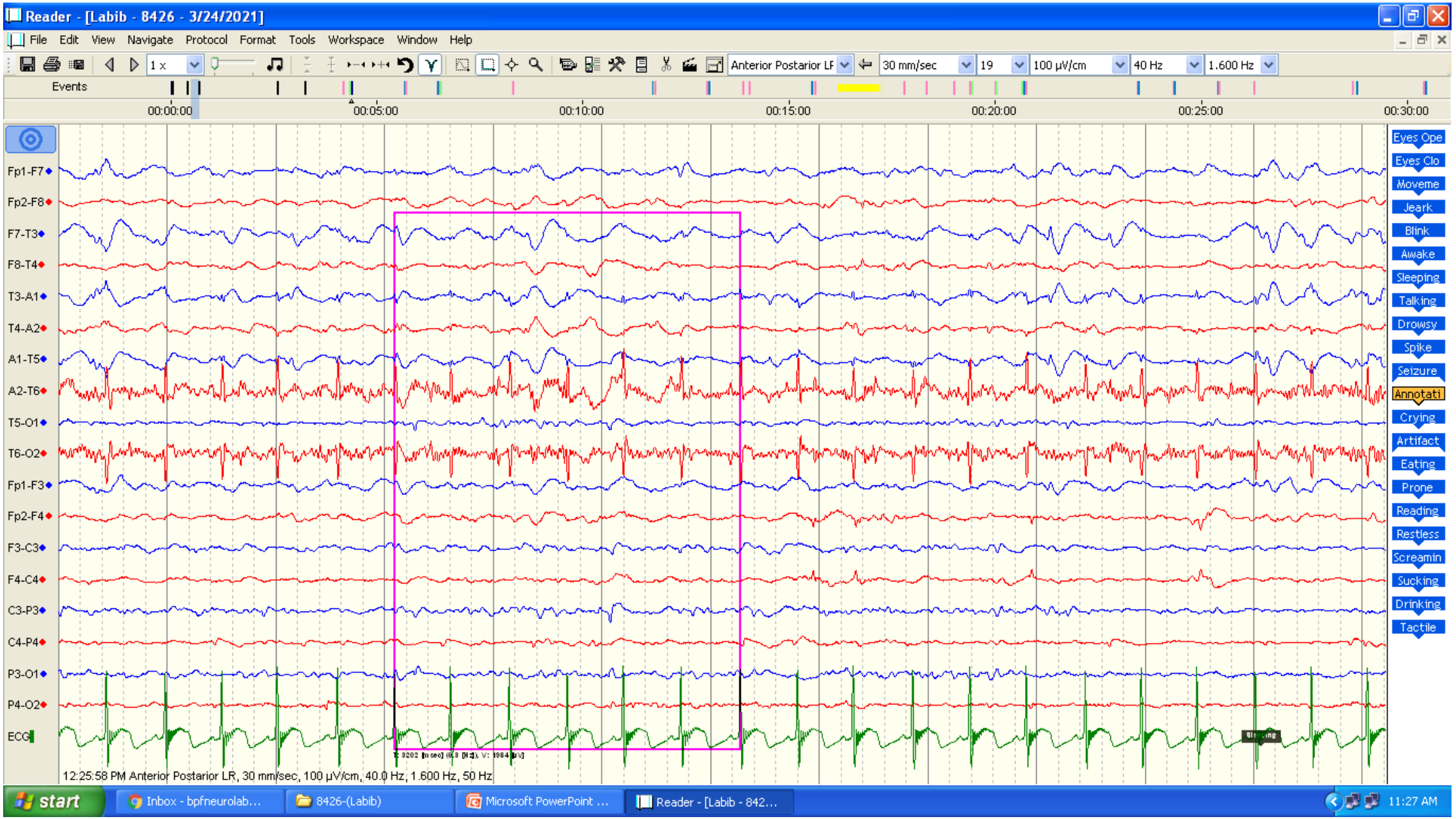
What do you notice? What is happening here?



Technician is trying to fix the artifact on channel 1




Reader - [Mostakim - 8427 - 3/25/2021]
File Edit View Navigate Protocol Format Tools Workspace Window Help
Multiphotic O1
30 mm/sec
20
70 µV/cm
Events
00:00:00
00:04:00
00:08:00
00:12:00
00:16:00
00:20:00
moving a ratle
F4-C4
F3-C3
C4-T4
C3-T3
T4-A2
T3-A1
A2-T6
A1-T5
T6-O1
T5-O1
P4-O1
P3-O1
Pz-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3(2)
T3-A1(2)
Photic
9:41:55 AM Multiphotic O1, 30 mm/sec, 70 µV/cm, 40.0 Hz, 1.600 Hz, 50 Hz
Review Video
160 %
start
Inbox - bpfneurolab...
678
My Documents
Reader - [Mostakim - ...
Microsoft PowerPoint ...
11:10


Reader - [Labib - 8426 - 3/24/2021]
File Edit View Navigate Protocol Format Tools Workspace Window Help
Anterior Postarior LF
30 mm/sec
19
100 µV/cm
40 Hz
1.600 Hz
Events
00:00:00
00:05:00
00:10:00
00:15:00
00:20:00
00:25:00
00:30:00
Fp1-F7
Fp2-F8
F7-T3
F8-T4
T3-A1
T4-A2
A1-T5
A2-T6
T5-O1
T6-O2
Fp1-F3
Fp2-F4
F3-C3
F4-C4
C3-P3
C4-P4
P3-O1
P4-O2
ECG
Eyes Ope
Eyes Clo
Moveme
Jeark
Blink
Awake
Sleeping
Talking
Drowsy
Spike
Seizure
Annotati
Crying
Artifact
Eating
Prone
Reading
Restless
Screamin
Sucking
Drinking
Tactile
12:25:58 PM Anterior Postarior LR, 30 mm/sec, 100 µV/cm, 40.0 Hz, 1.600 Hz, 50 Hz
start
Inbox - bpfneurolab...
8426-(Labib)
Microsoft PowerPoint ...
Reader - [Labib - 842...
11:27 AM

At ICU

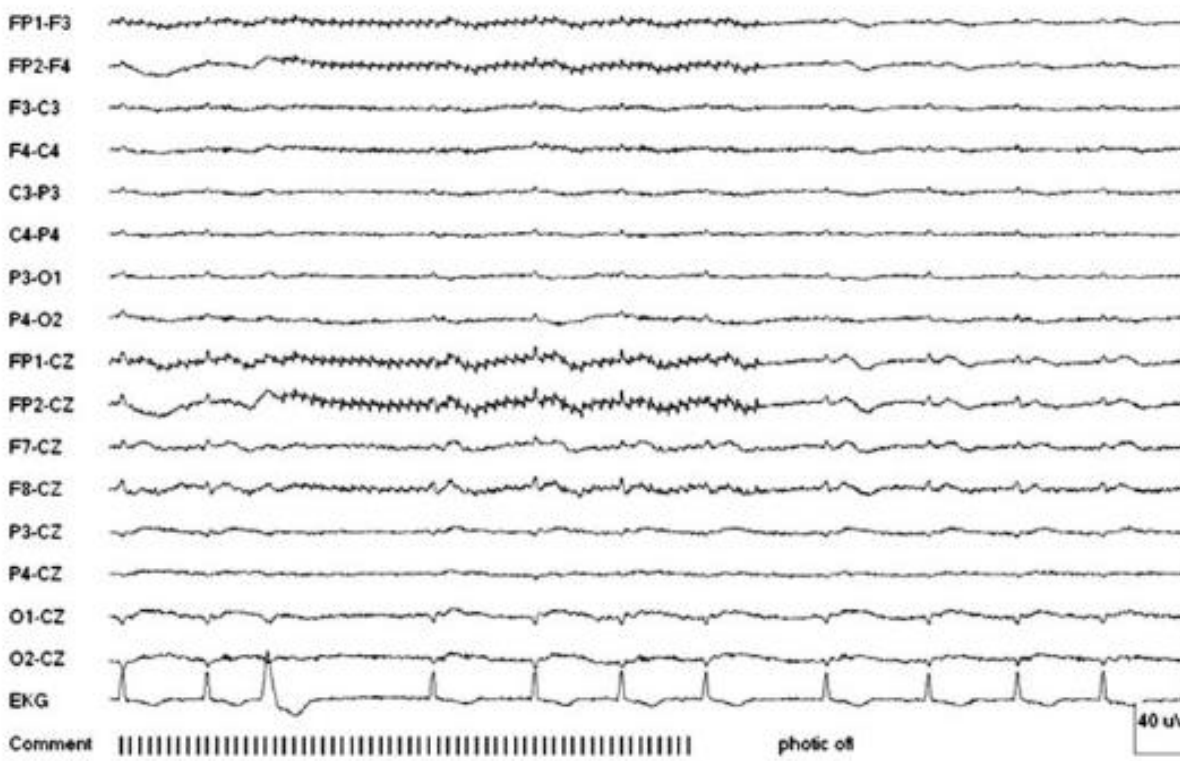


FIG. 7. Electroretinogram (ERG) artifact, maximal in channels with Fp1 an electrodes, is time locked to photic stimulation in an EEG with marked back suppression.

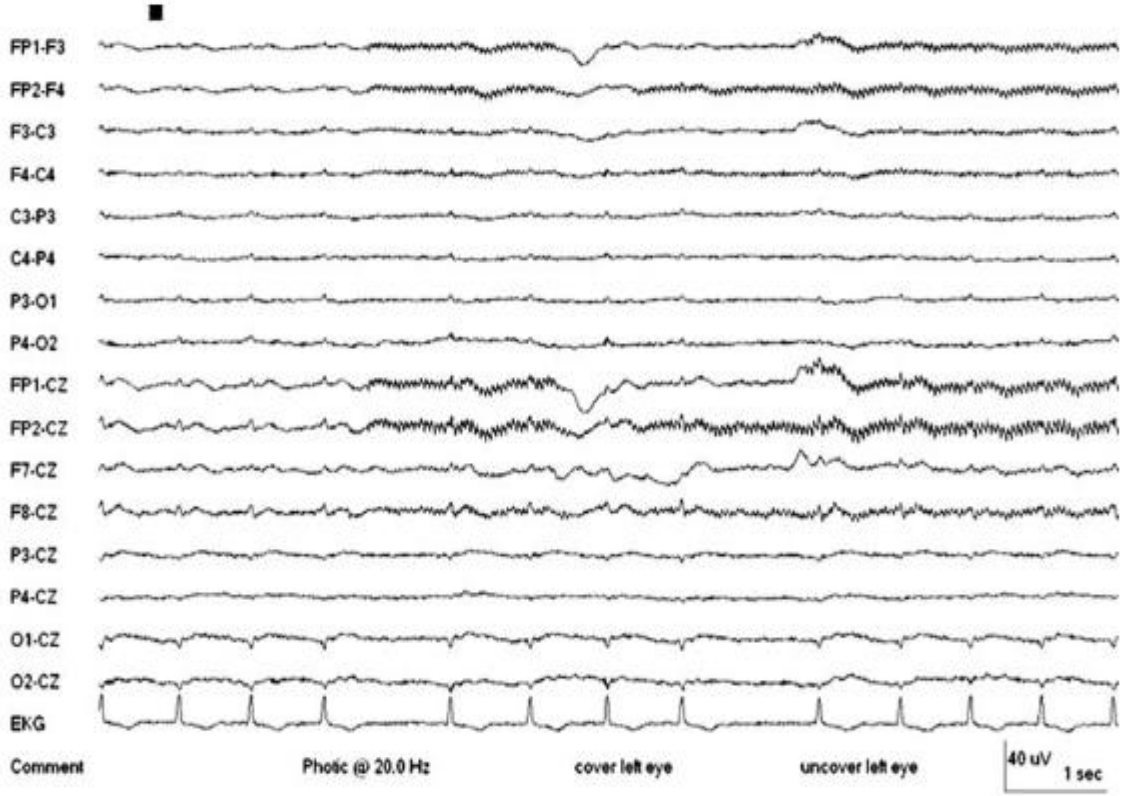


FIG. 8. Electroretinogram (ERG) artifact is eliminated in channels with the Fp1 electrode by covering the left eye and returns when the left eye is uncovered.

EMG artifact often occurs when the patient is tense or anxious and has difficulty relaxing or holding still. In the ICU this type of artifact is commonly caused by the patient biting down on the endotracheal tube which connects the patient to the ventilator. EMG artifact can simulate fast mid-voltage irregular single or serial spikes (Figure 1). This activity can simulate cerebral beta activity with the use of the high frequency filter, especially when used in combination with the 60 Hz notch filter.

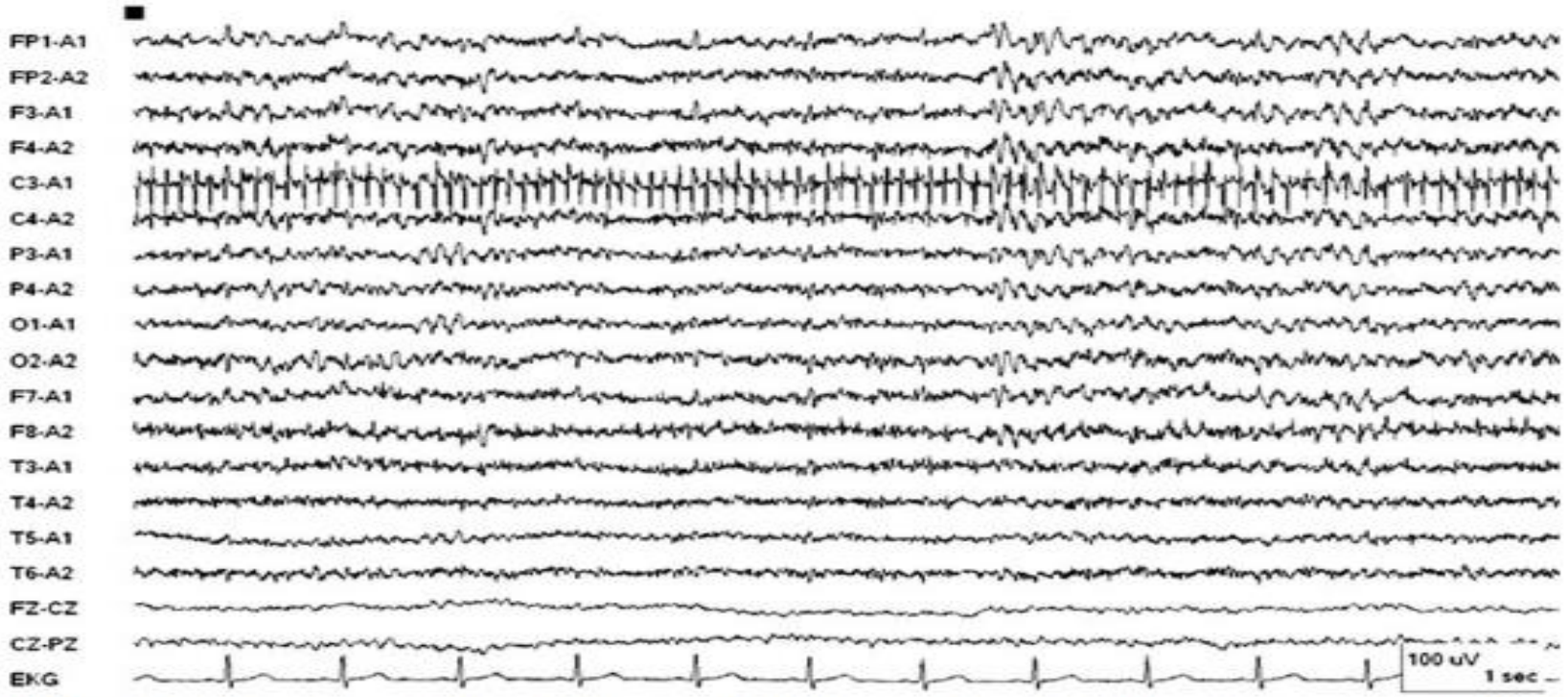


FIG. 1. Muscle spikes, especially prominent in the C3 electrode, on a referential montage.

In wake pt:

- **less interaction**
- **Relax**
- **Jaw drop**

Sleep/ unconscious?

Attempts to eliminate muscle artifact are often futile, especially when the patient is not able to follow commands. The technologist should make sure the patient is not cold and that his/her head is resting comfortably. Try to interact as little as possible with the patient. In some cases relaxation will come eventually, so be patient and record as long as needed to get an interpretable recording. Occasionally sleep

Thank you

Next class:
EEG reviewing technical aspect
4th April at 4pm