

Benign epileptiform variants

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Learning Objectives

- **To define Benign Epileptiform Variants (BEVs)**
- **To be able to classify BEVs into broad major categories**
- **To know the prevalence of BEVs**



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Disclosure Statement

Dr. Mirsattari has nothing to disclose.

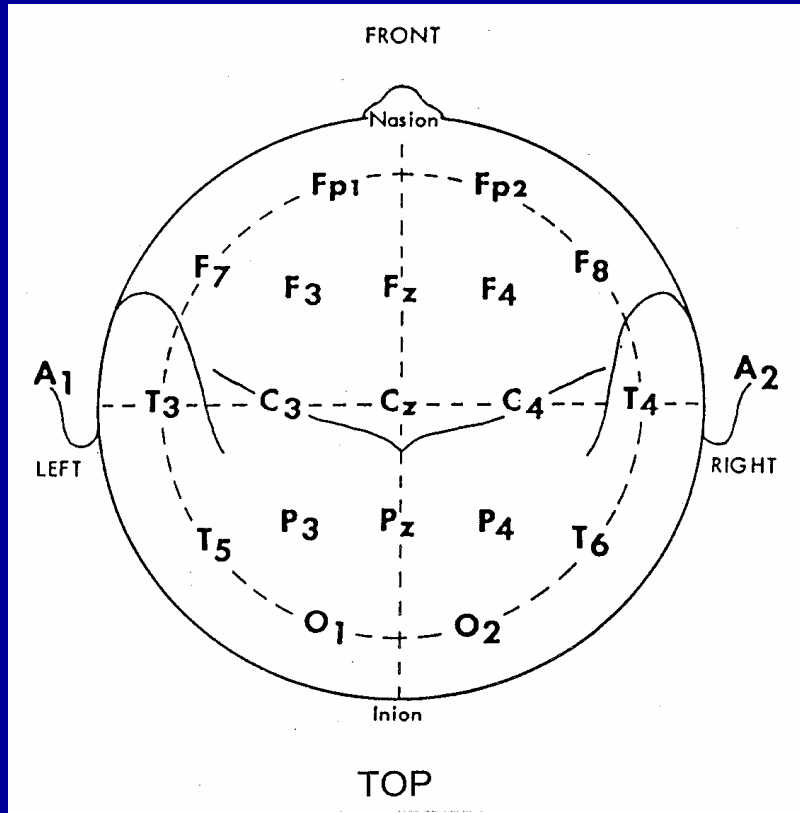
Definition of a Benign Epileptiform Variant in the EEG

- EEG pattern that is morphologically epileptiform but is not associated with epilepsy.

Significance of correctly identifying the BEVs in the EEG

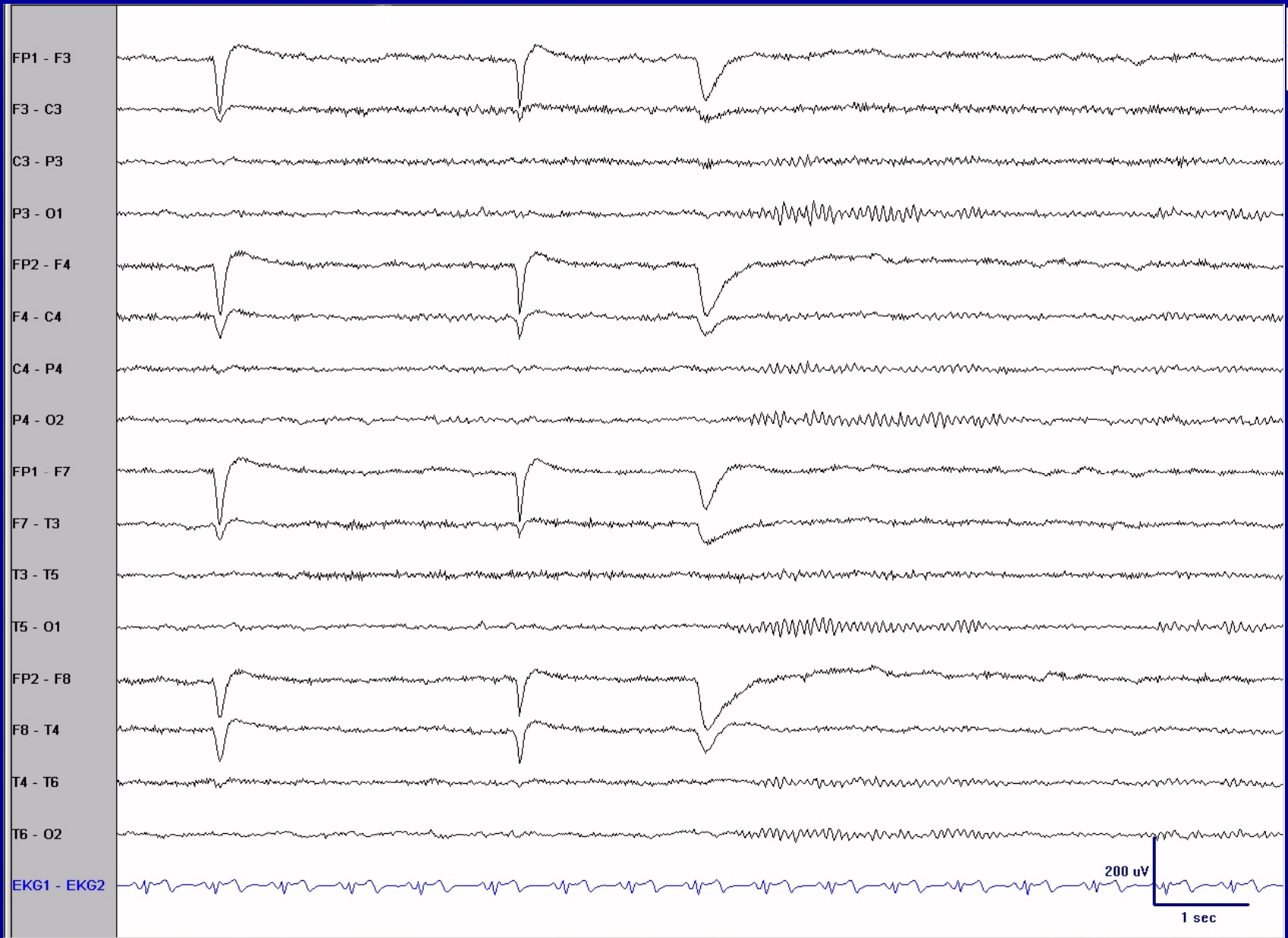
- **To avoid misdiagnosis of the subjects with epilepsy based on these waveforms**
- **To avoid unnecessary treatments of these subjects with anti-epileptic drugs or epilepsy surgery.**
- **To avoid other negative impact of epilepsy on the lives of these individuals, e.g. driving**

International 10-20 system of electrode placements



Jasper HH. The ten-twenty electrode system of the International Federation. *Electroenceph Clin Neurophysiol* 1958;10:371- 5.

EEG scalp recording: normal, awake



Classification of BEVs

- **Two major categories**

- **Sharply contoured BEVs:**

- **Wicket waves**

- **Benign sporadic sleep spikes (BSSS)**

- **BEVs occurring in bursts or trains:**

- **6 Hz spike-waves**

- **14 & 6 Hz positive spikes**

- **Rhythmic temporal theta bursts of drowsiness (RTTD)**

- **Subclinical rhythmic electrographic discharge of adults (SREDA)**

- **To know the prevalence of BEVs**

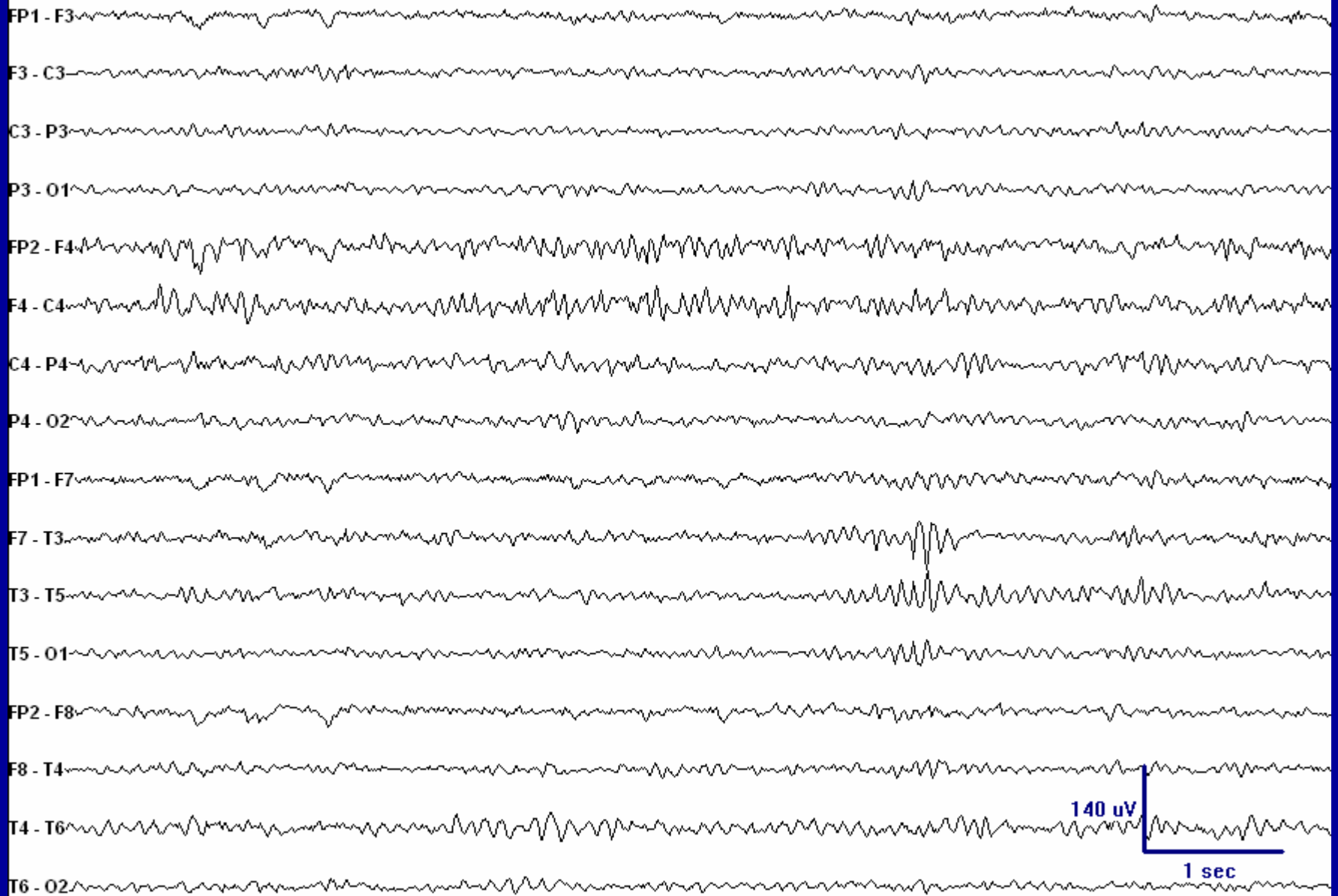
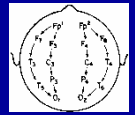
Sharply contoured BEVs

- **Wicket waves**
- **Benign sporadic sleep spikes (BSSS)**

Wicket waves

- Arciform, resembles Greek letter μ
- Negative phase apiculate
- Positive phase rounded
- Single or clusters
- T3,4 or T3,4 & F7,8
- No after-coming slow wave
- No distortion of background rhythms
- \uparrow in drowsiness or sleep
- Unilateral or independent bilateral

Wicket waves



Sharply contoured BEVs

- **Wicket waves**
- **Benign sporadic sleep spikes (BSSS)**
 - a.k.a “small sharp spikes” (SSS)

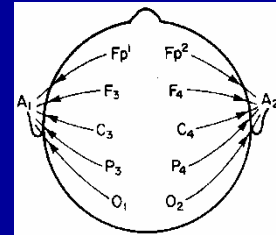
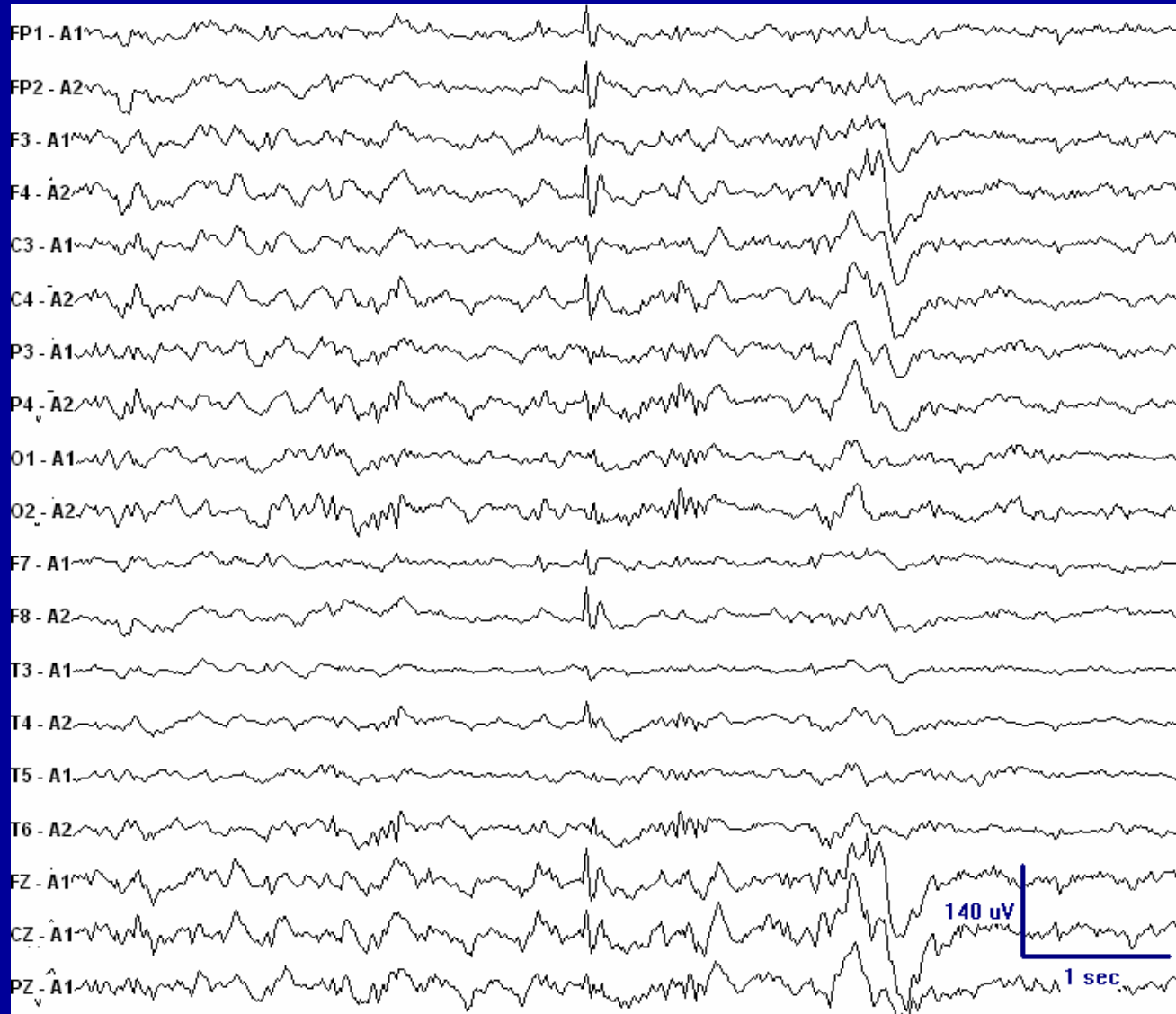
Benign Sporadic Sleep Spikes

BETS – Benign Epileptiform Transients of Sleep

- **Abrupt ascending slope**
- **Steeper descending slope**
- **Usually short duration <50 msec**
- **Single after coming slow wave or dip in background**
- **Do not occur in trains**
- **Broad field → seen best in long inter-electrode distances**
- **Often bilateral, with max amplitude on 1 hemisphere**
- **Cancellation A1,2, and posterior temporal T5-6**
- **Oblique dipole with opposite polarity both sides of head**
- **Do not disturb background**
- **Light NREM sleep; diminishes with deeper sleep**
- **Adults and adolescents**

Benign Sporadic Sleep Spikes

BETS – Benign Epileptiform Transients of Sleep



BEVs occurring in bursts or trains

- 6 Hz spike-waves
- 14 & 6 Hz positive spikes
- Rhythmic temporal theta bursts of drowsiness (RTTD)
- Subclinical rhythmic electrographic discharge of adults (SREDA)

6 per second spike-waves

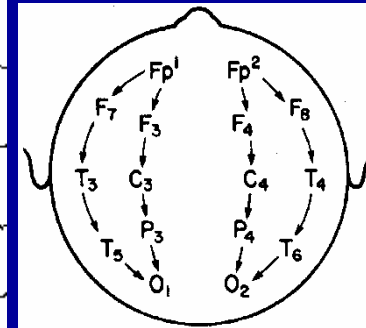
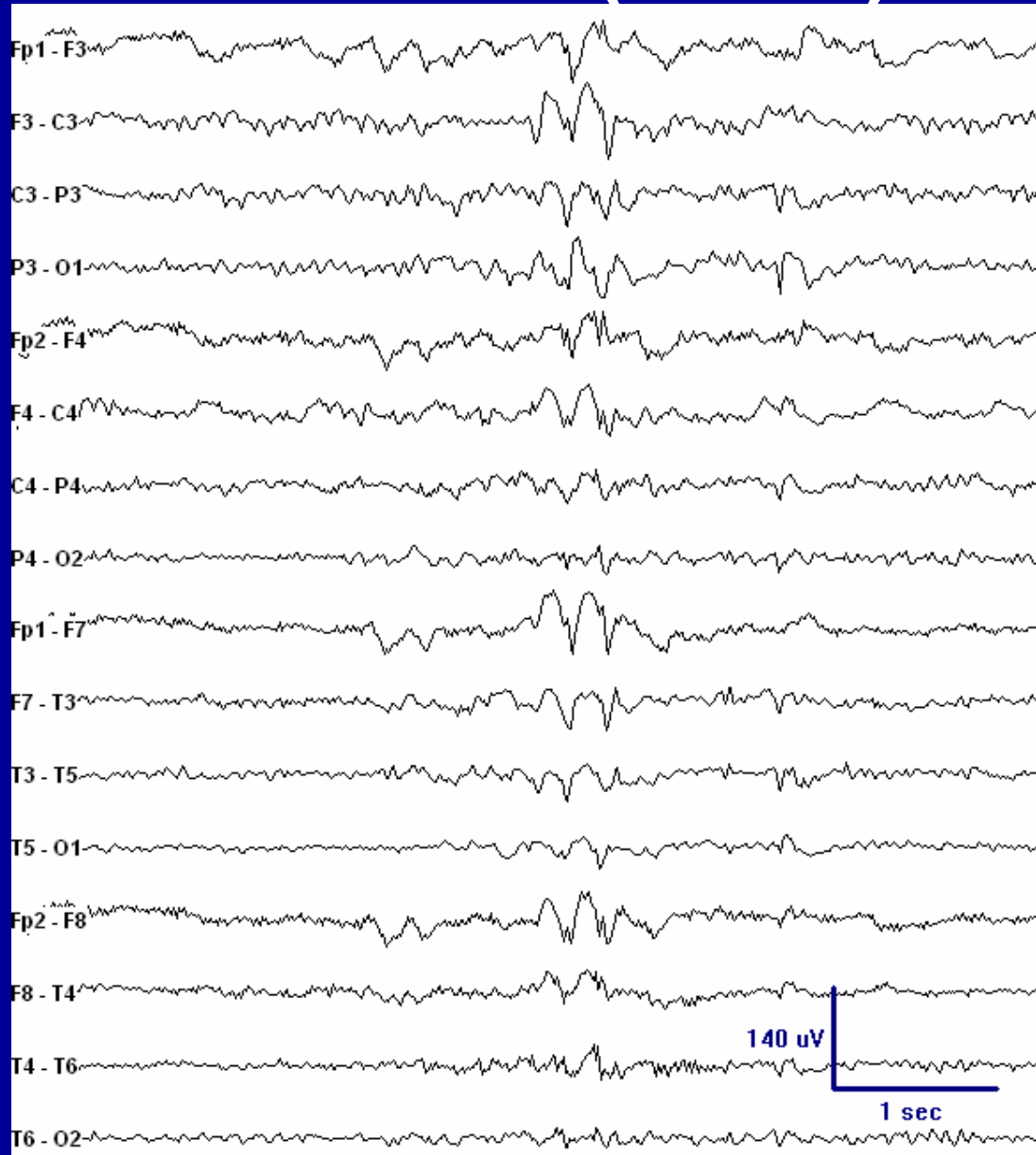
(Phantom Spike and Wave)

- **5 – 7 Hz**
- **Brief low amplitude spike**
- **Slow wave has wider field than spike**
- **Adolescents and adults**
- **Awake, drowsiness, not sleep**
- **Bisynchronous**
- **<1 sec duration**

6 Hz SW (cont.)

- **FOLD – Female Occipitally-predominant Low-amplitude Drowsiness**
- **WHAM – Wake High-amplitude Anterior Male**
- **FOLD appearance more benign**
- **WHAM appearance more suggestive of underlying generalized seizure disorder**
- **Benign 6 Hz SW should disappear in sleep, whereas pathological SW is often enhanced by sleep**

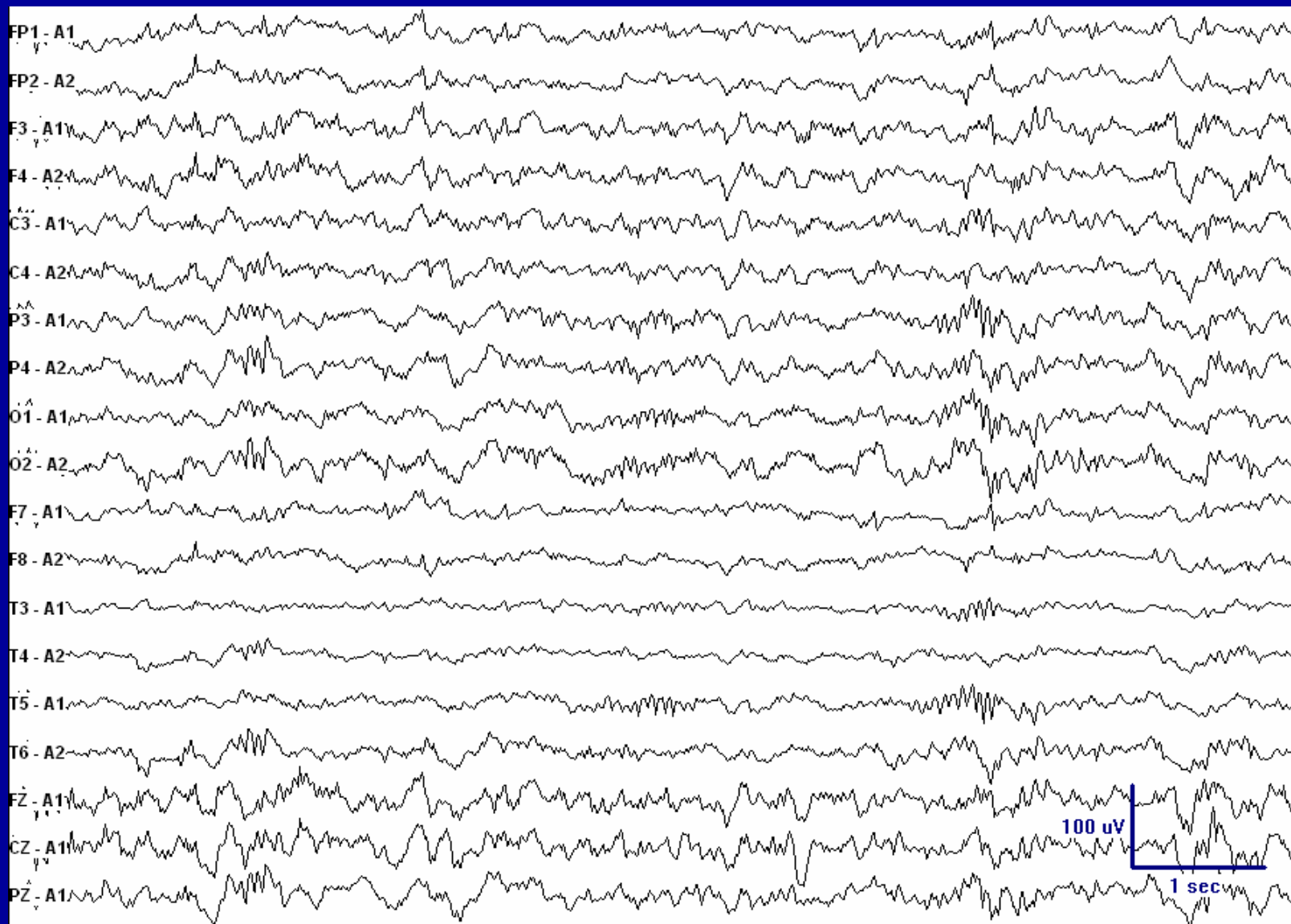
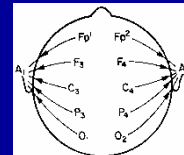
6 Hz SW (cont.)



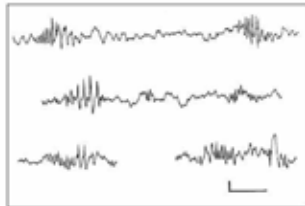
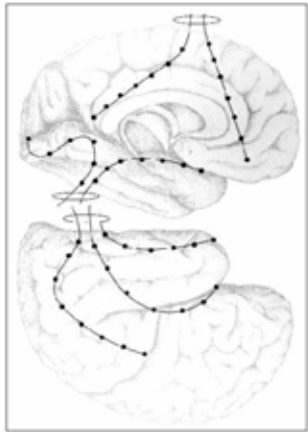
14 & 6 Hz positive spikes

- Positive component apiculate or arciform
- Negative component smooth
- 13-17 Hz or 6-7 Hz; principally 14 or 6Hz
- Drowsiness and light sleep
- Posterior temporal and adjacent areas
- Widespread field
- Best recorded: coronal or referential montages
- Adolescents, young adults

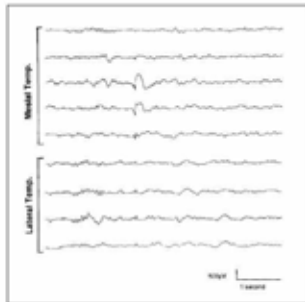
14 & 6 Hz positive spikes



Cortical Location of Benign Paroxysmal Rhythms in the Electrocorticogram

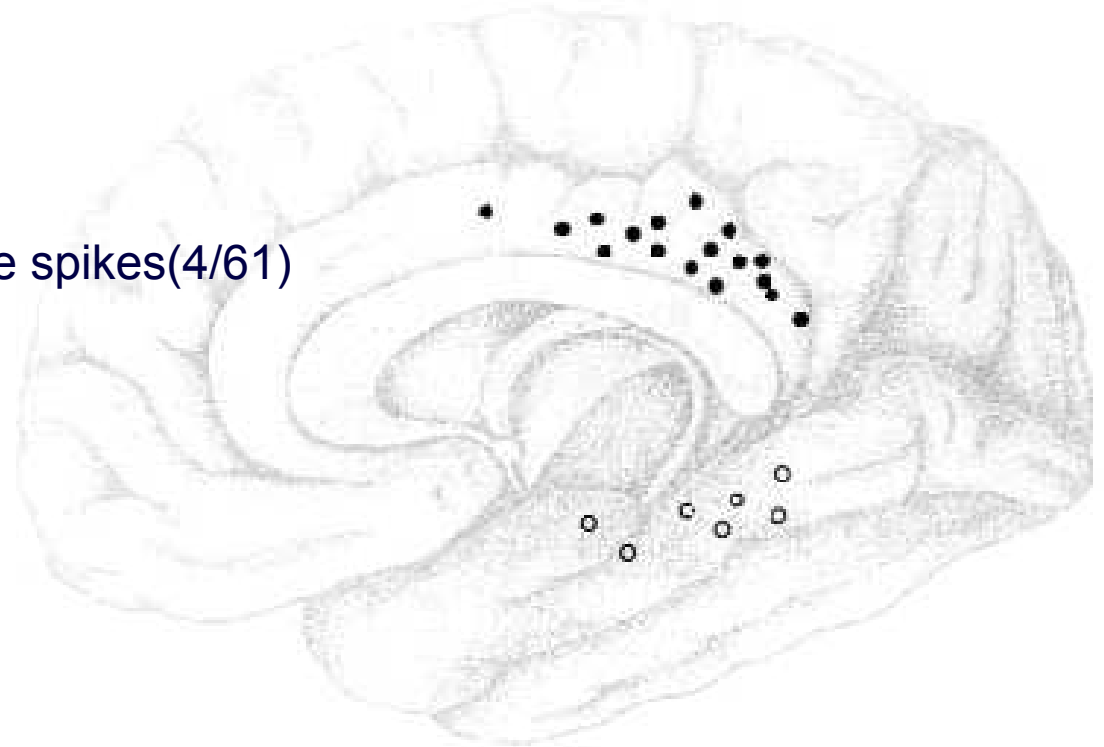
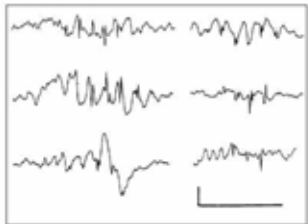


○ 14 & 6 Hz positive spikes (4/61)



○ BETS (3/61)

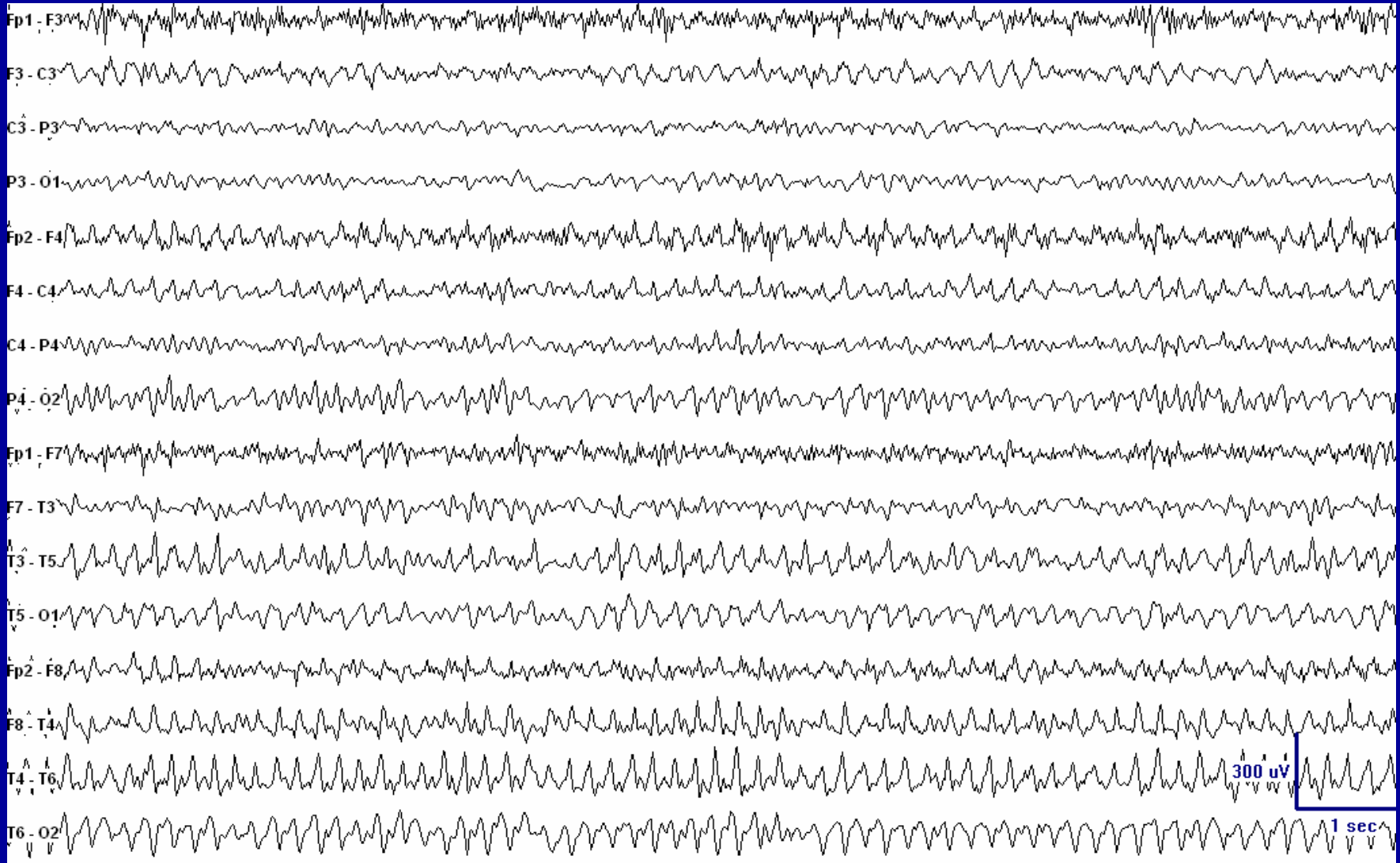
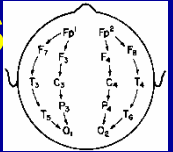
• 6 Hz SW (8/61)



Rhythmic Temporal Theta of Drowsiness (Psychomotor Variant)

- **5-7 Hz**
- **Sharply contoured, often notched**
- **Mid-anterior temporal regions**
- **Parasagittal spread**
- **Bursts or runs**
- **Bilateral or independent either side or shifting emphasis side to side**
- **Can have a gradual onset and offset**
- **Monomorphic (no evolution)**
- **During relaxed wakefulness and drowsiness**
- **Mainly adolescent and adults**

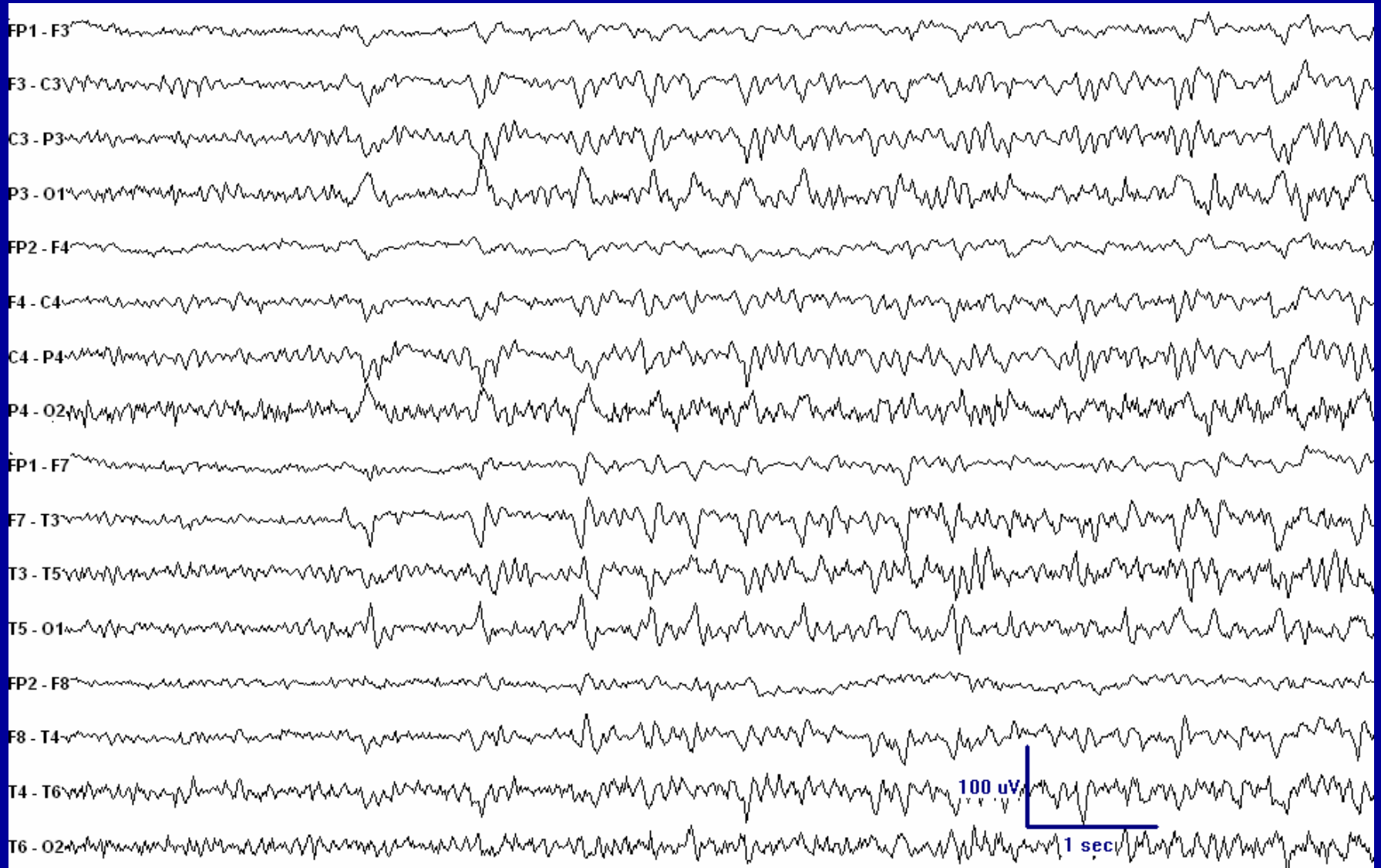
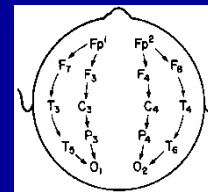
Rhythmic Temporal Theta of Drowsiness (Psychomotor Variant)



Subclinical Rhythmic Electrographic Discharge of Adults (SREDA)

- **Sequential monophasic or biphasic apiculate waves mixed with rhythmic theta or delta**
- **No evolution**
- **Abrupt onset and gradual offset**
- **Usually in wakefulness, occasionally in sleep**
- **May occur during HV**
- **Principally parietal, posterior temporal**
- **Bisynchronous or unilateral**
- **Duration ~ 20 sec to a few minutes**
- **Occurs elderly or middle age**

SREDA



SREDA

- **First described by Westmoreland BF and Klass DW (1981)**
- **65 patients (37 F; 28 M) between 1959 & 1978**
- **Mean age 61 years (42-80 years)**
- **Non-evolving θ rhythm**
- **Widespread, maximal over the P-post T**
- **Duration: few seconds to a minute**

Unusual variants of SREDA

- Study interval= 1959-1995
- N=108 patients (191 EEGs)
- 49 Males; 59 Females
- Mean age=62 years (range= 35-89 years)
- Prevalence=1/2500 recordings
- 89 with typical SREDA pattern
- Unusual variants (19/108)
 - 10 Males; 9 Females
 - mean age 61 (range= 35-89 years)
 - Predominant Δ frequencies
 - Frontal or more focal distribution
 - Notched waveforms
 - Longer duration
 - Atypical evolution
 - Presence in younger individuals
 - Occurrence in sleep

Decharges paroxystiques

- Naquet et al. 1961
- Paroxysmal discharges of the parieto-temporo-occipital junction
- Reliably induced by:
 - HV
 - pure relative hypoxia associated with nitrogen inhalation
 - Mild relative ischemia from carotid artery compression
- Postulated that it was associated with cerebrovascular disease

Naquet R et al., Rev Neurol 1961;105:203-7.

Naquet R et al., Zentralbl Neurochir 1965;25:153-80.

SREDA in Children

- **Case report**
- **N=2**
- **11 YO F presenting with HUS**
- **10 YO F with learning difficulties and HA**

SREDA in REM sleep

- **Case report**

- **48 YO M**

- **CAD, high Chol, HTN, Obstructive sleep
apnea**

SREDA and acute brain insults

- 4/340 patients

- Syncope

- TGA

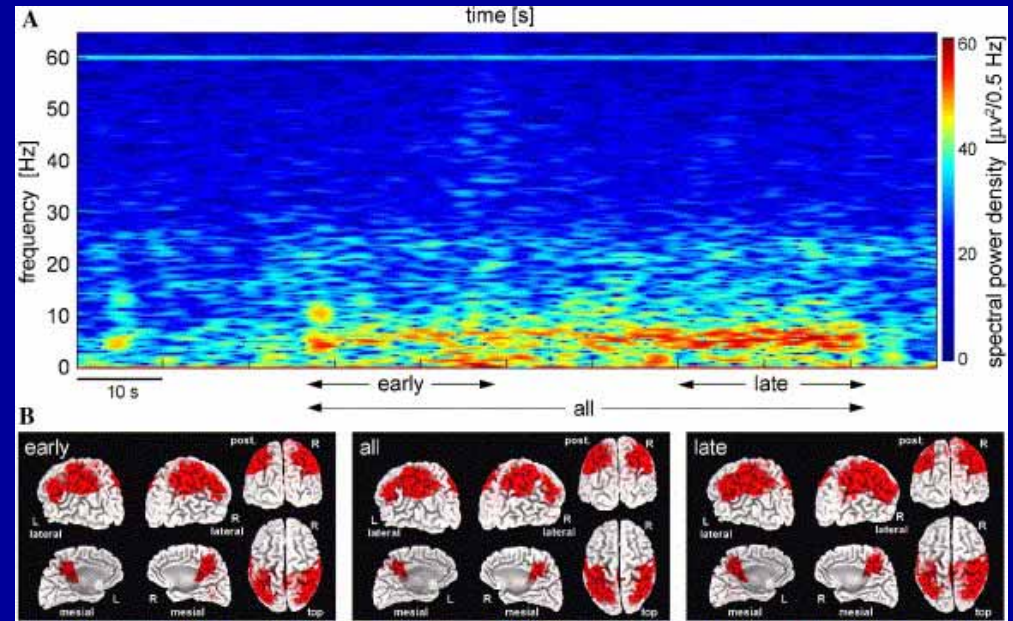
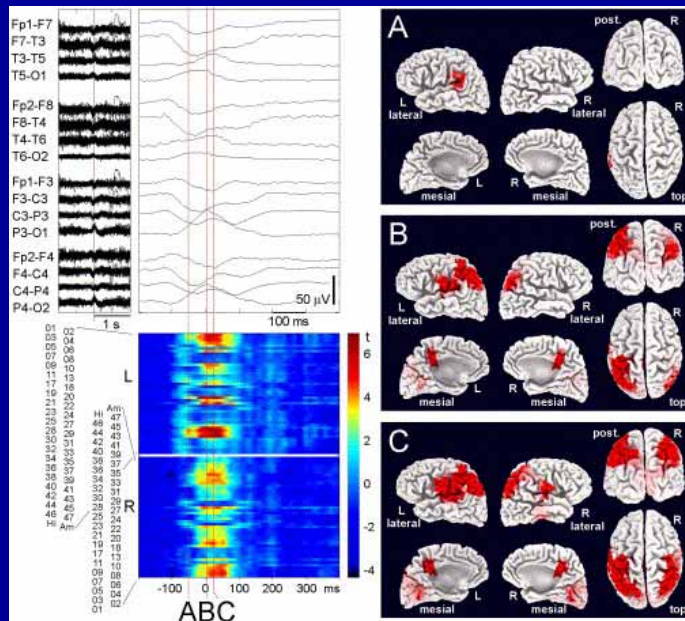
- GTC

- R TLE

SREDA

- **Case report (65 YO M)**
- **Posterior hemisphere source localization using statistical non-parametric mapping (SNPM) of low resolution electromagnetic tomography (LORETA)**
- **Localized to the vascular watershed between MCA, ACA and PCA**

Parietal lobe source localization in a patient with SREDA



Prevalence of benign epileptiform variants observed in an EEG laboratory from Canada

Santoshkumar et al. Clin Neurophysiology 2009;120:856-61.

Clinical Neurophysiology 120 (2009) 856–861



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Prevalence of benign epileptiform variants

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Prevalence & Demographics

BEVs	Frequency			Age (years)**	Gender
	<i>N</i>	% of BEVs (N = 1279)	% of total (N = 35249)	Range, mean +/- SD	(male:female)
				0 - 100	
All Outpatients	35249			35.87 +/- 21.37	17492 : 17757
				4 - 94	
BSSS	652	50.977	1.850	39.76 +/- 17.78	345 : 307
				31 - 76	
Wicket waves	13	1.016	0.037	55.36 +/- 13.31	5 : 8
				4 - 67	
14 and/or 6 Hz positive spikes	185	14.464	0.525	23.31 +/- 10.48	82 : 103
				5 - 78	
6 Hz spike-waves	360	28.147	1.021	28.84 +/- 13.04	159 : 201
				8 - 71	
RTTD	43	3.362	0.122	27.52 +/- 15.82	19 : 24
				10 - 80	
SREDA	26	2.033	0.074	52.25 +/- 16.28	9 : 17
Total BEVs	1279	100.000	3.628		

Conclusions

- **The prevalence of BEVs among Canadian subjects is not too different from those reported from other developed countries.**
- **Their mere presence in a record does not justify the diagnosis of epilepsy or the institution of anticonvulsant therapy.**
- **Suitable candidates should not be denied epilepsy surgery due to the misinterpretation of these benign variants.**