Benign epileptiform variants

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EEG Course, CNSF, Quebec City, QE
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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.**

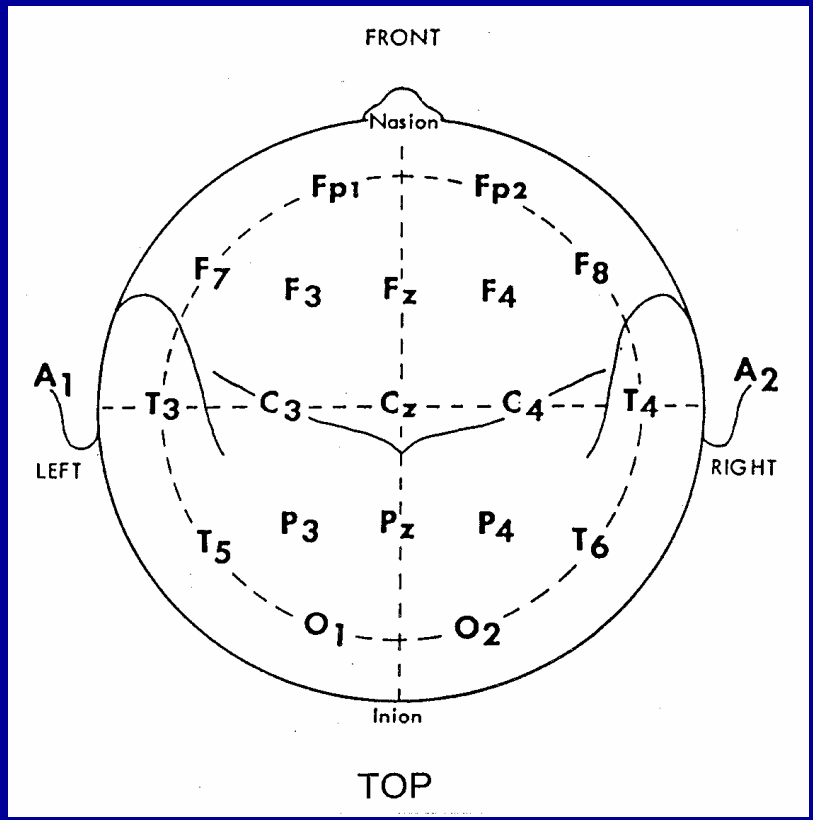
Definition of a Benign Epileptiform Variant in the EEG

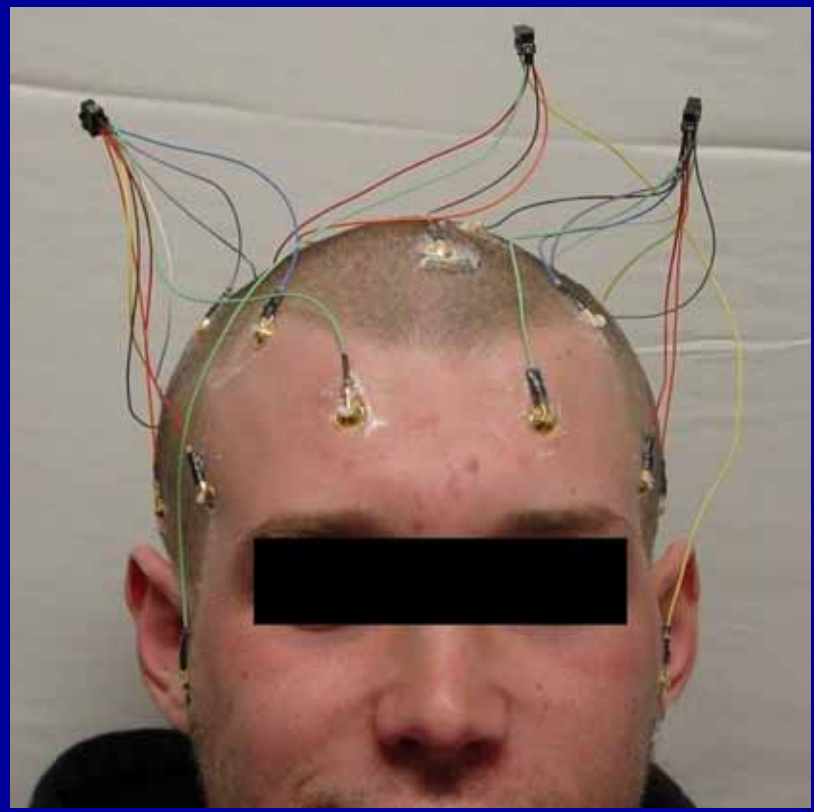
- EEG pattern that is morphologically epileptiform but is not associated with epilepsy.

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

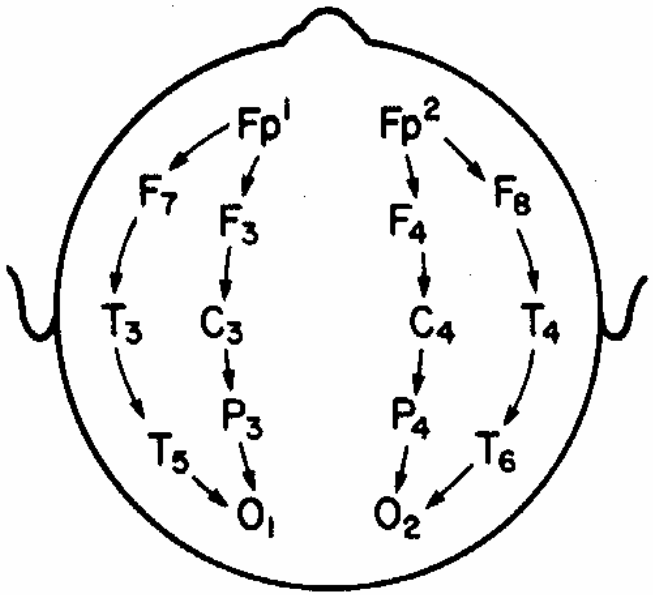




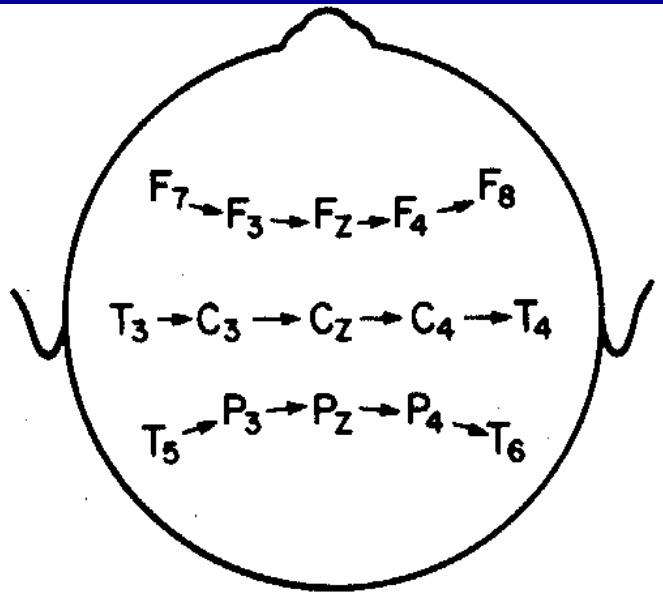
Jasper HH.The ten-twenty electrode system of the International Federation. Electroenceph Clin Neurophysiol 1958;10:371- 5.

EEG montages

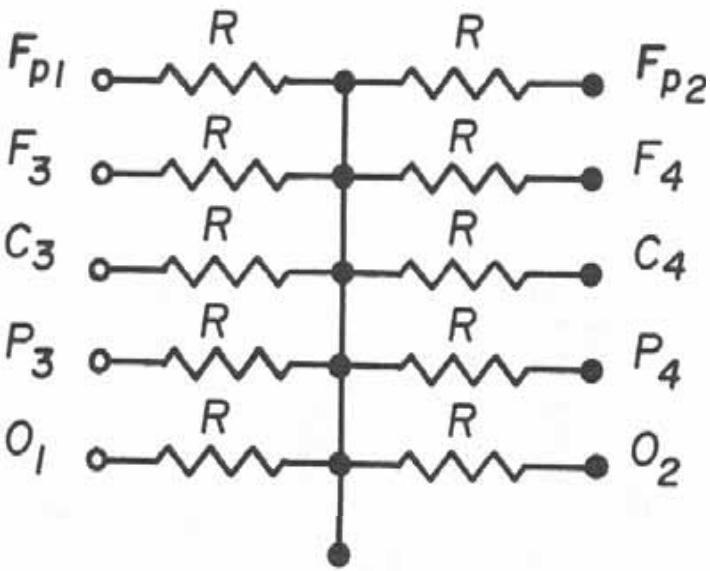
Bipolar



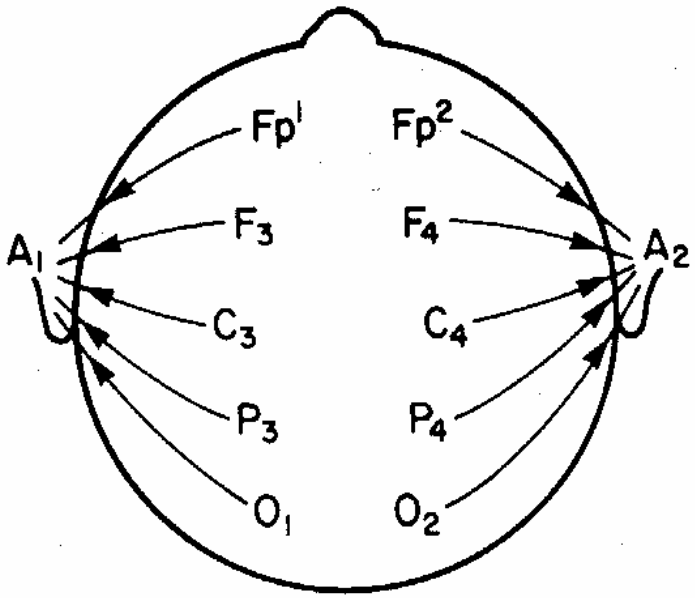
Coronal



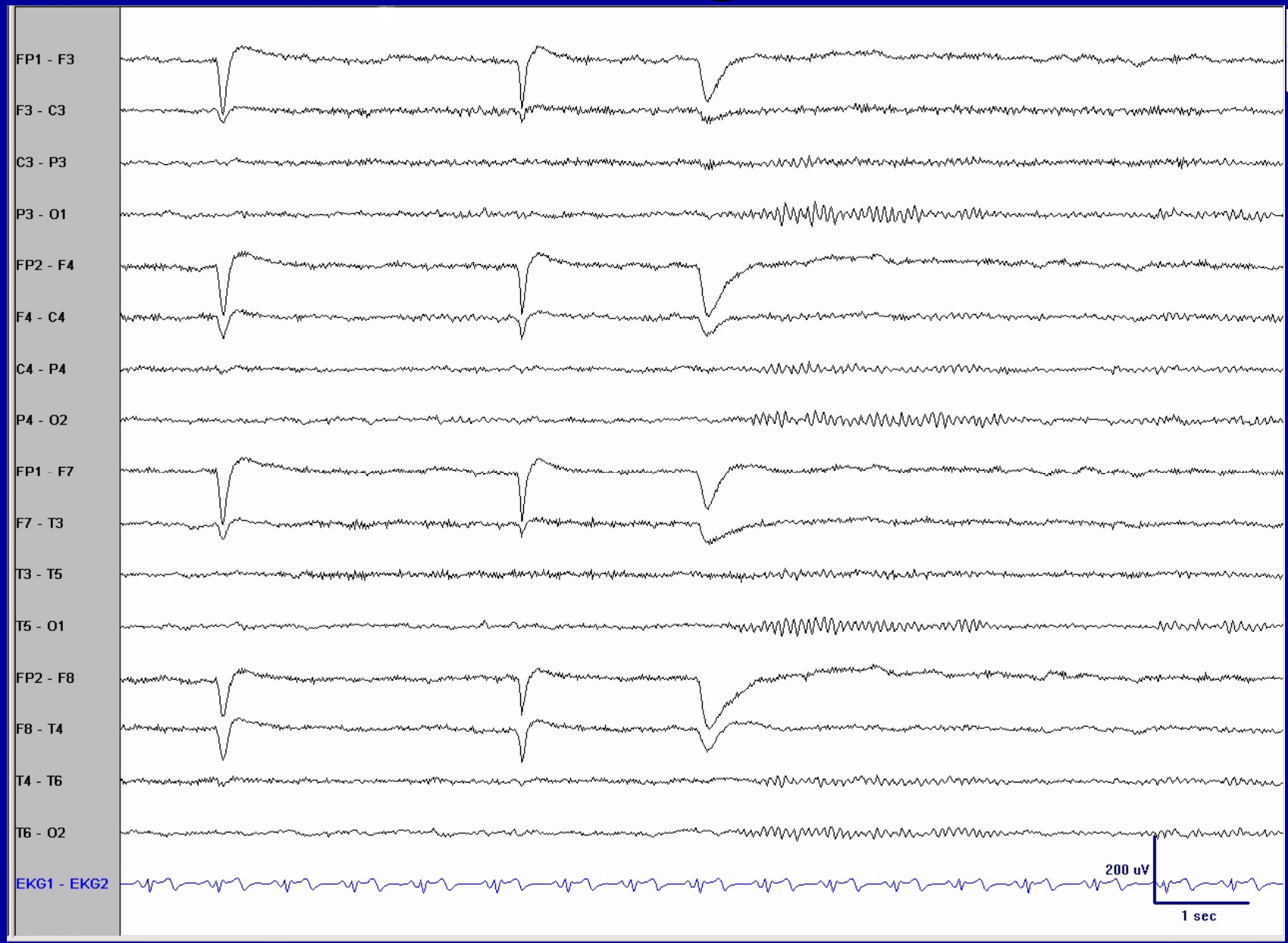
Common Average Reference Point = CAR



Referential



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

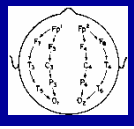
Sharply contoured BEVs

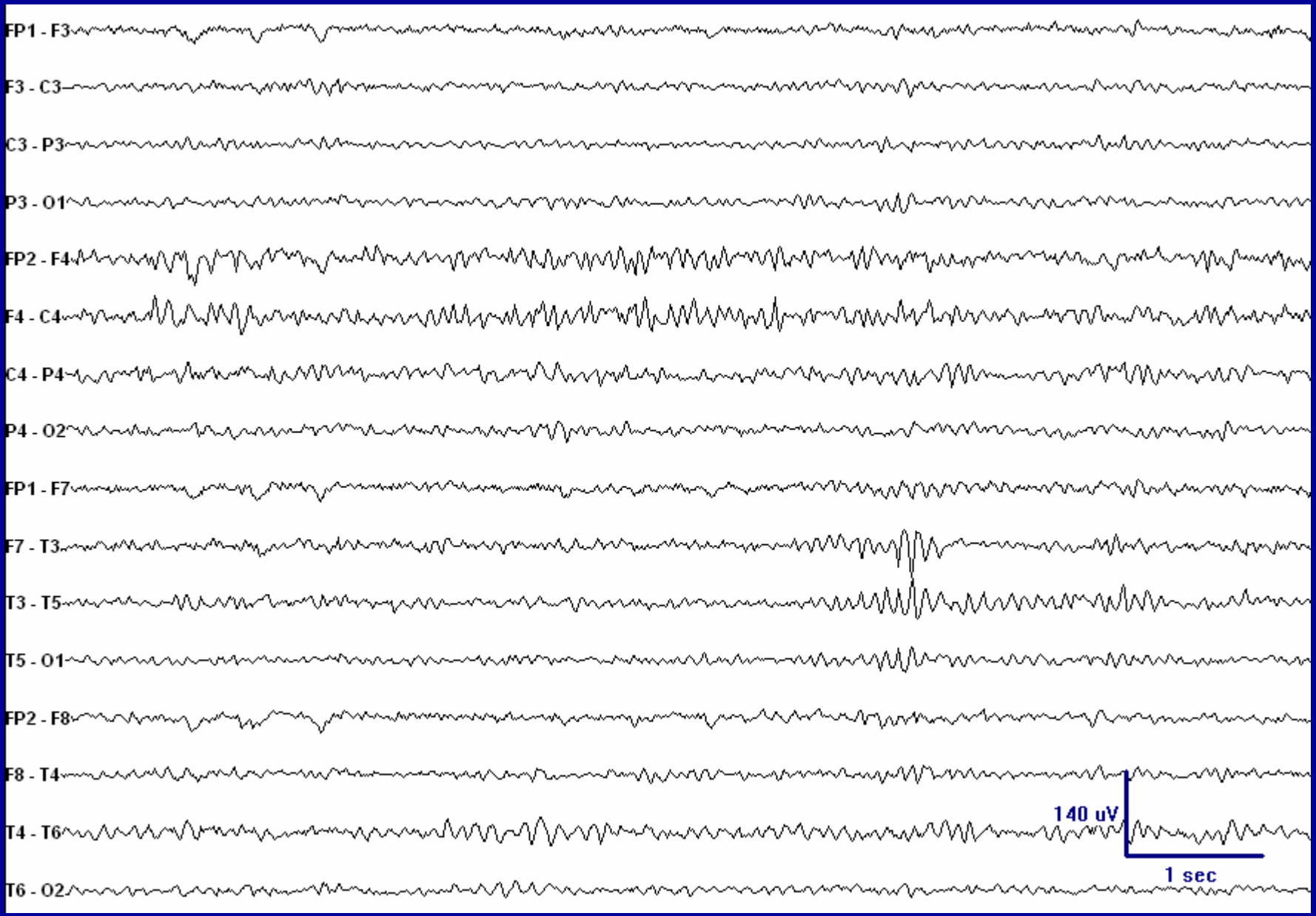
- Wicket waves
- Benign sporadic sleep spikes (BSSS)

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
- ↑ in drowsiness or sleep
- Unilateral or independent bilateral

Wicket waves





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

Sharply contoured BEVs

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

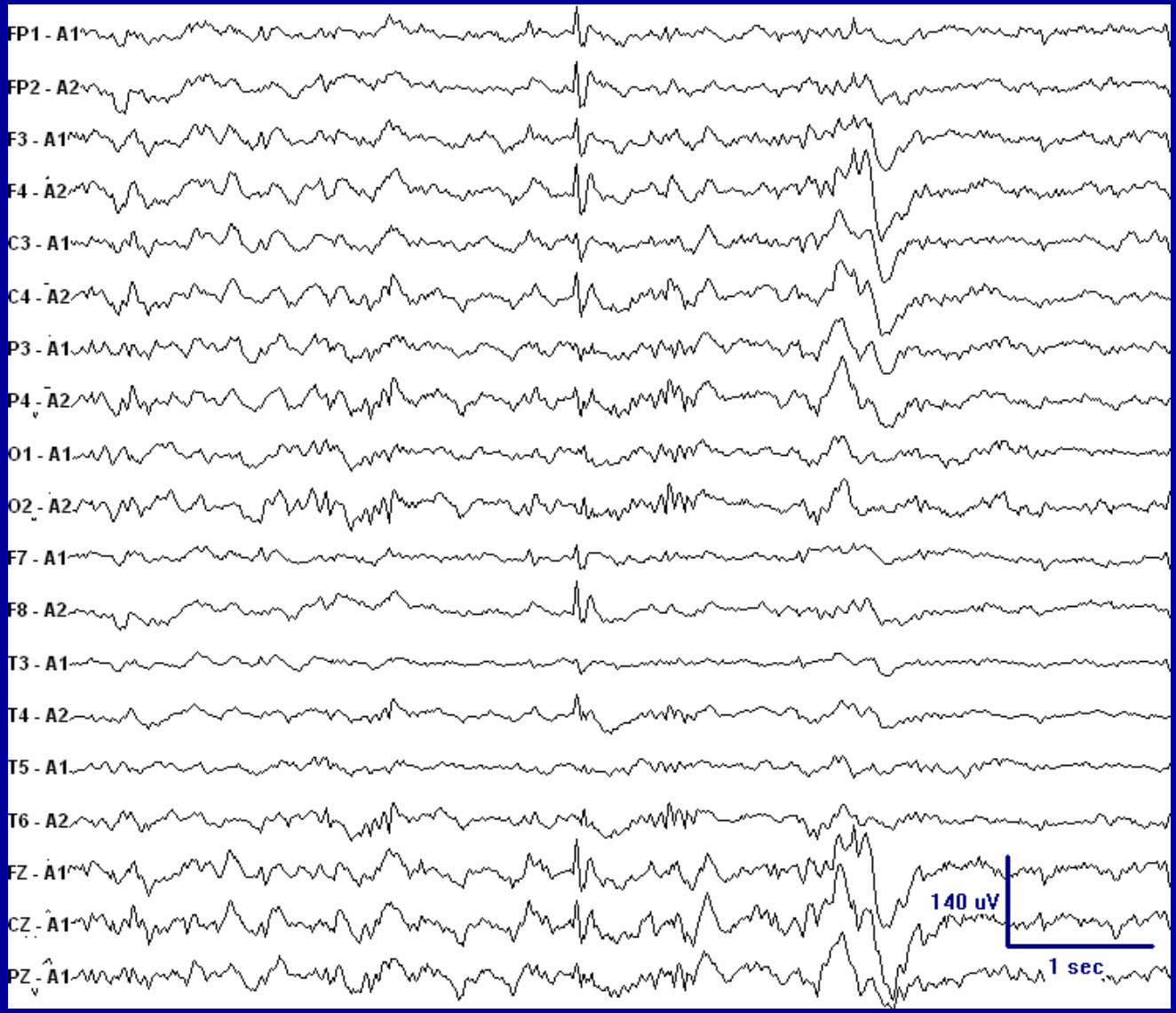
Benign Sporadic Sleep Spikes

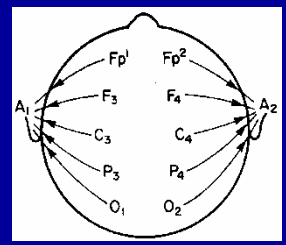
BETS – Benign Epileptiform Transients of Sleep

- 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





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

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)

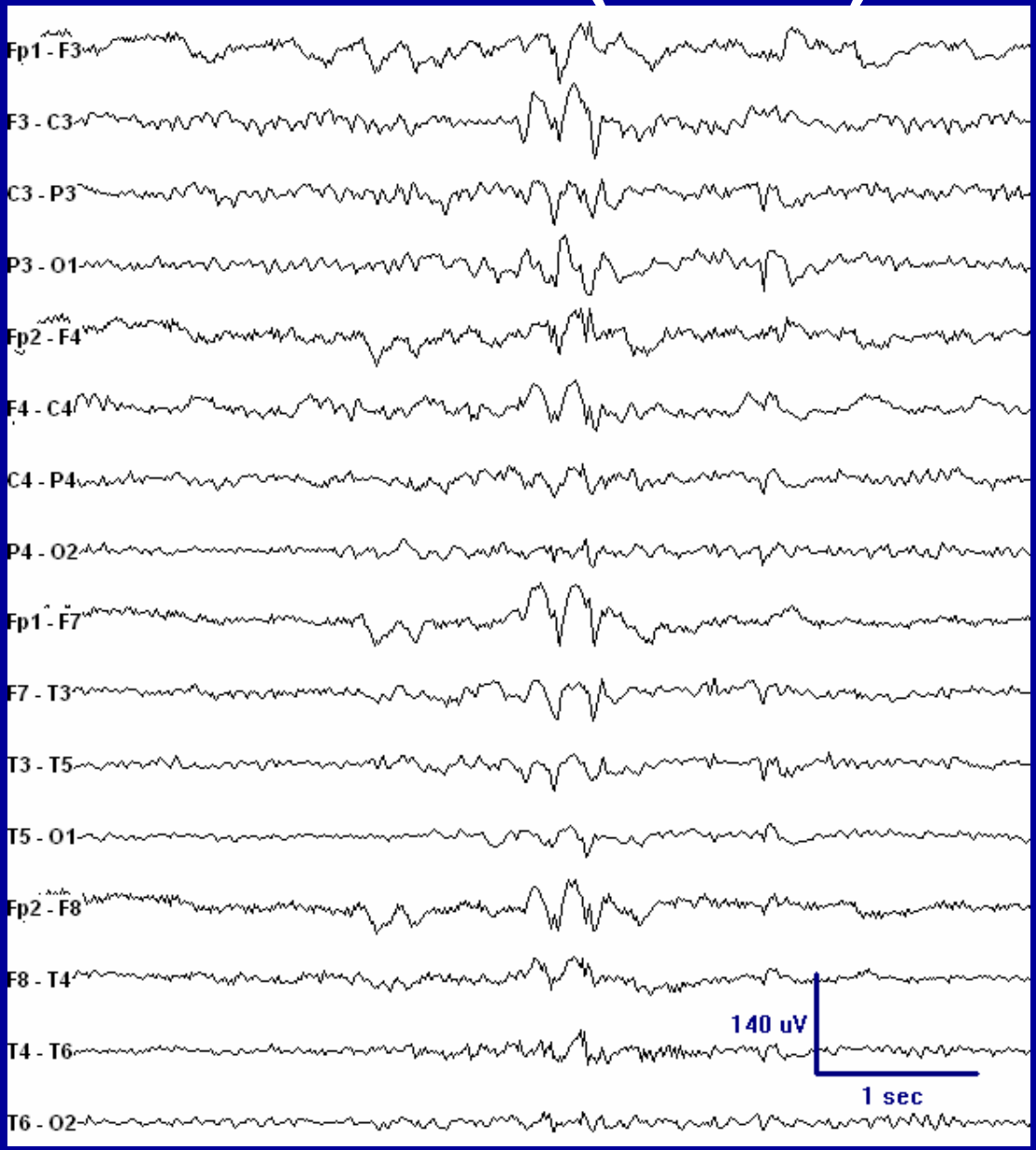
6 per second spike-waves (Phantom Spike and Wave)

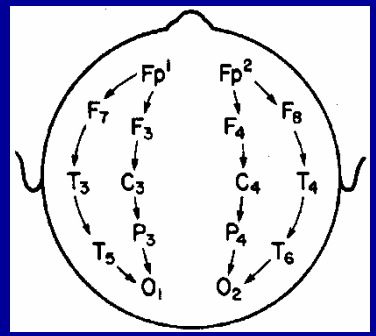
- 5 – 7 Hz
- Brief low amplitude spike
- Slow wave has wider field than spike
- Adolescents and adults
- Awake, drowsiness, not sleep
- Bisynchronous
- <1 sec duration

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.)



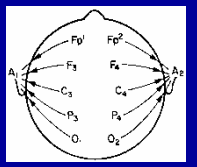


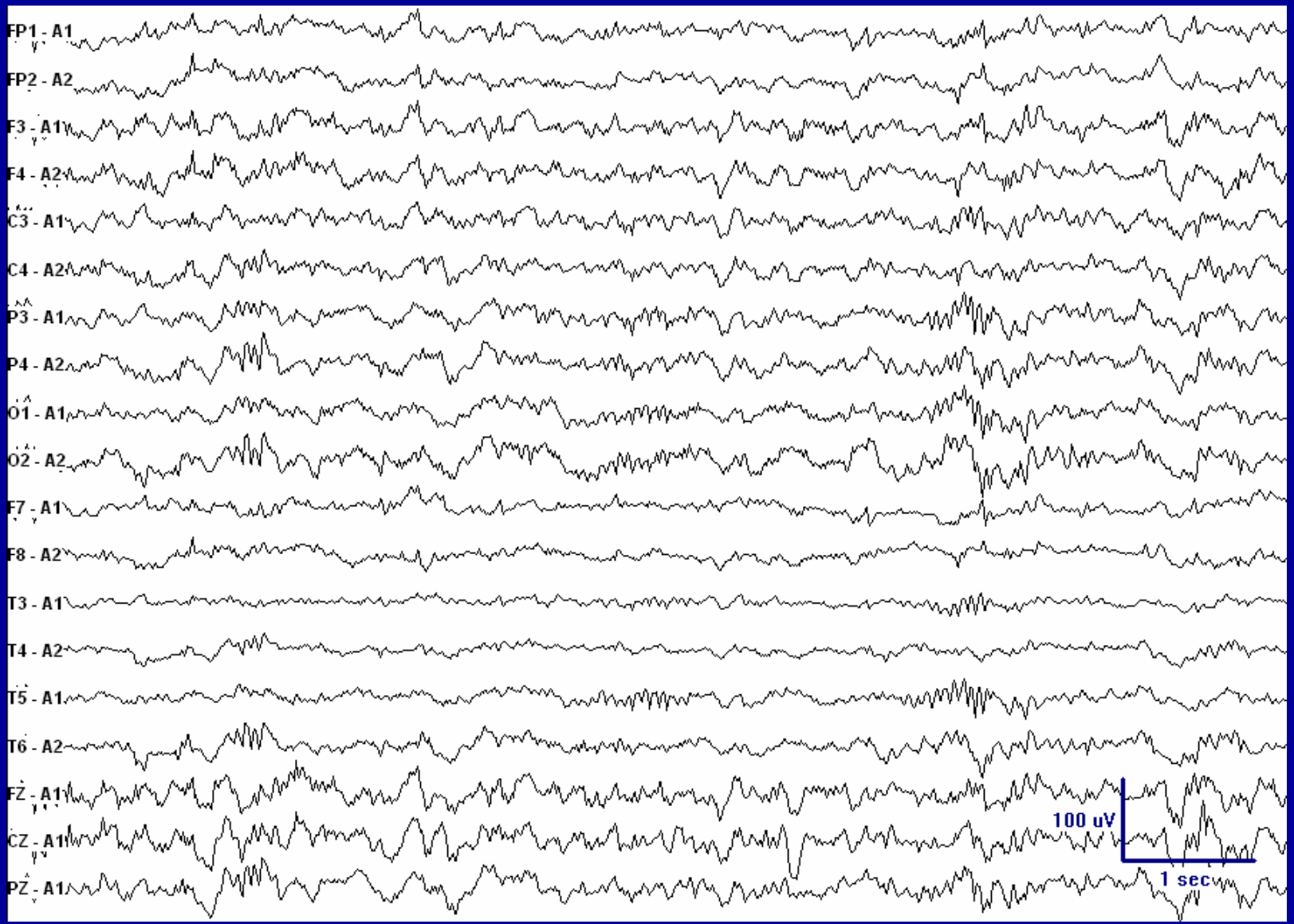
Santoshkumar et al. Clin Neurophysiol 2009;120:856-61.

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





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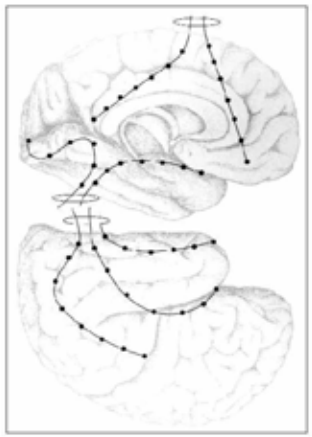
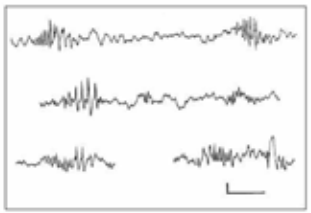
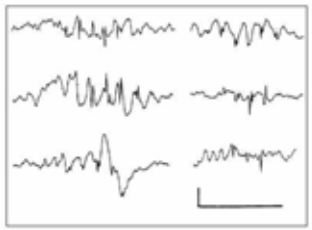
Cortical Location of Benign Paroxysmal Rhythms in the Electrocorticogram

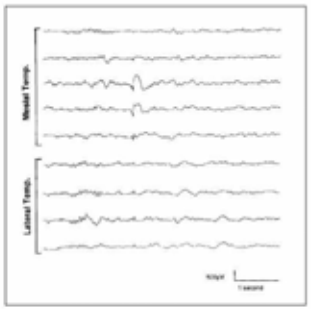




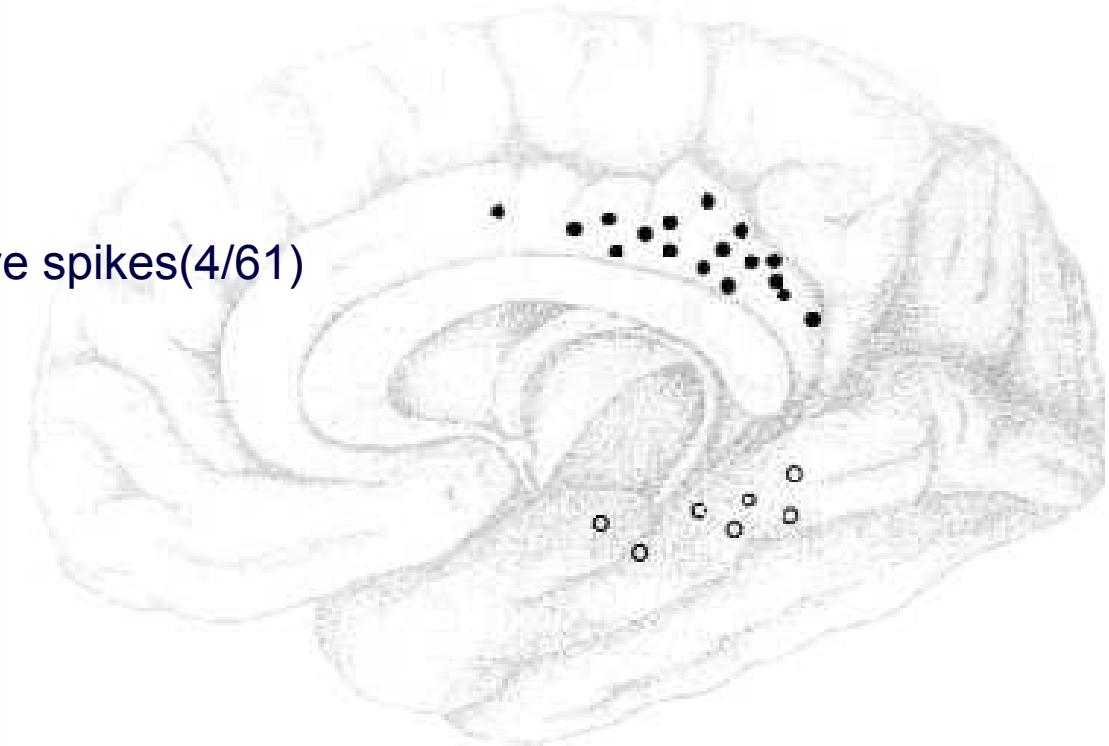
o14&6 Hz positive spikes(4/61)

•6 Hz SW(8/61)





oBETS(3/61)

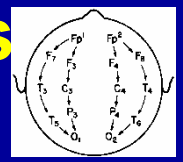


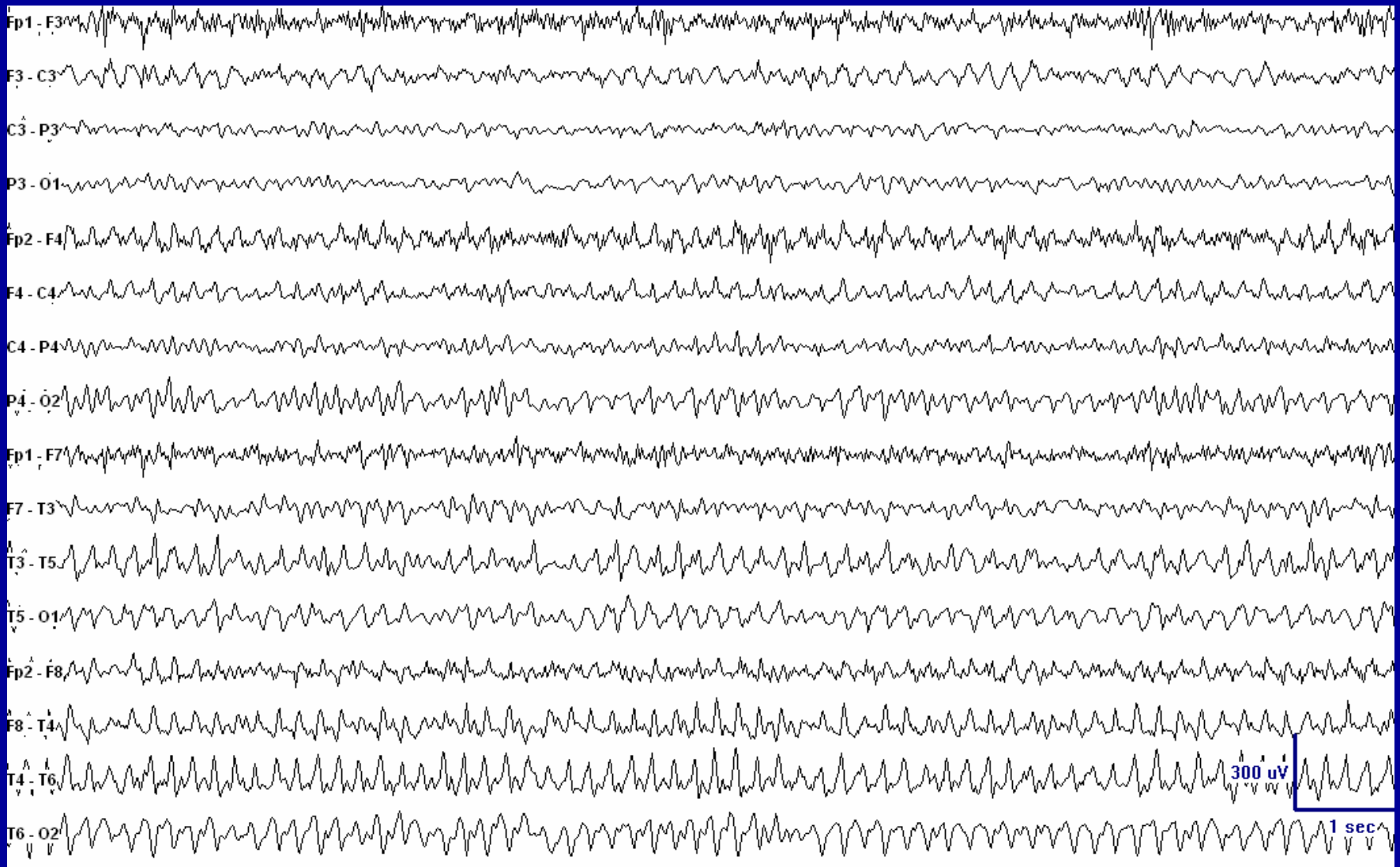
McLachlan RS, Luba N. Can J Neurol Sci 2002;29:154-158

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)





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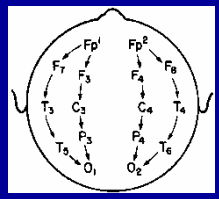
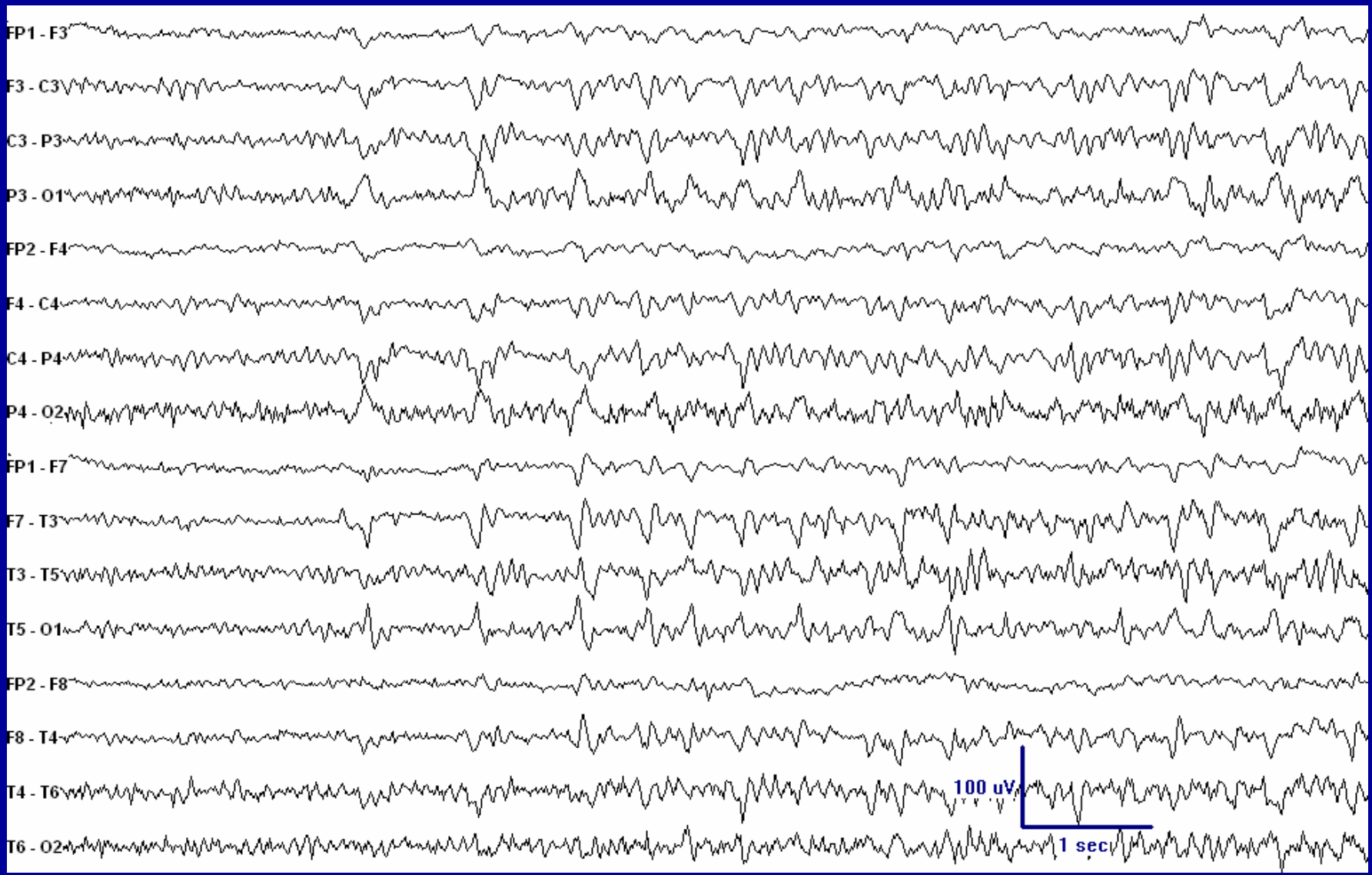
Subclinical Rhythmic Electrographic Discharge of Adults (SREDA)

- 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





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

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

Westmoreland BF and Klass DW. Clin Neurophysiol 1981;51:186-91.

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

Westmoreland BF and Klass DW. Electroenceph Clin Neurophysiol 1997;102:1-4.

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

Nagarajan L, et al. Pediatr Neurol 2001;24:313-6.

SREDA in REM sleep

- Case report
- 48 YO M
- CAD, high Chol, HTN, Obstructive sleep apnea

Fleming WE, et al. Sleep Medicine 2004;5:77-81.

SREDA and acute brain insults

- 4/340 patients
- Syncope
- TGA
- GTC
- R TLE

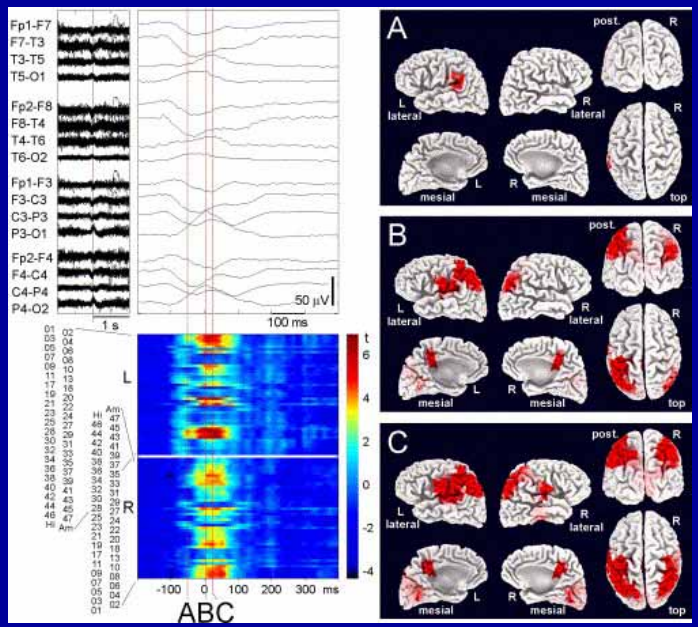
Begum T, et al. Internal Medicine 2005;45:141-4.

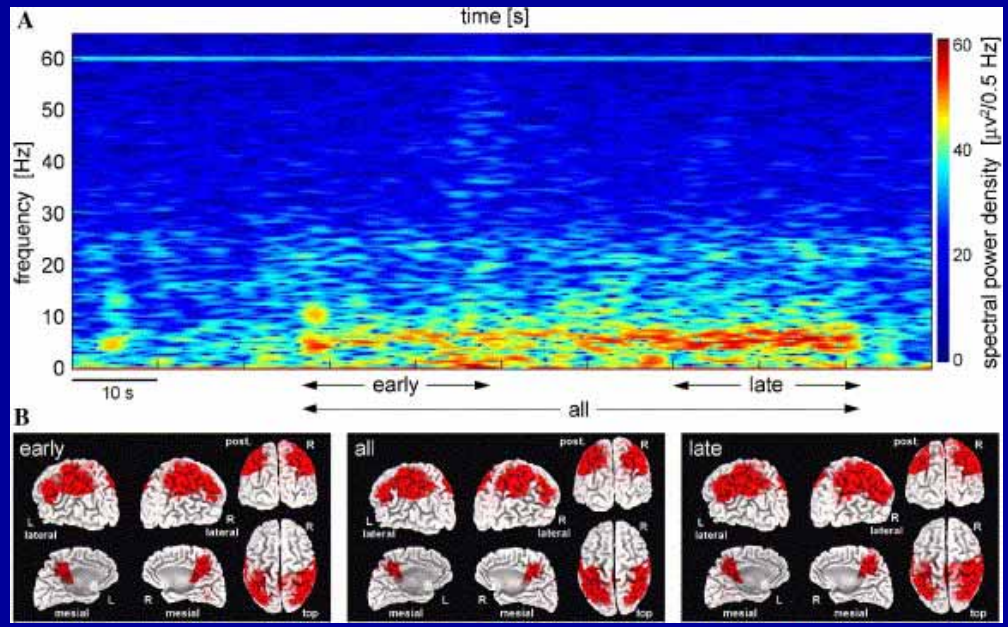
SREDA

- 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

Zumsteg D, et al., Clin Neuophysiol 2006; 117:2257-63.

Parietal lobe source localization in a patient with SREDA





Zumsteg D, et al., Clin Neuophysiol 2006; 117:2257-63.

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

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Prevalence of benign epileptiform variants

Balagopal Santoshkumar [a,b], Jaron J.R. Chong [c], Warren T. Blume [a,b], Richard S. McLachlan [a,b], G. Bryan Young [a,b], David C. Diosy [a,b], Jorge G. Burneo [a,b,d], Seyed M. Mirsattari [a,b,e,f,g,*]

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Prevalence & Demographics

BEVs	Frequency			Age (years)**	Gender
	N	% 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.