### Localization – a quick look

### Covering the basics

- Differential amplifiers
- Polarity convention
- 10-20 electrode system
- Basic montages: bipolar and referential
- Other aspects of displaying the EEG
- Localization

## 10-20 International electrode system

## The widely used longitudinal bipolar montage





### Bipolar method

- Chains of electrodes: front to back or transverse (right to left or left to right)
- Displays local potential gradients between adjacent electrodes
- Good for:

localization of discrete foci general topography of background activity identification and suppression of artefacts

- Not so good for:
  - local reduction in amplitude asymmetries waveform of diffuse events



#### Epileptiform focus – standard bipolar montage

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#### Epileptiform focus – common reference montage

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#### Patient's history

- Referring doctor
  - "Absent" (sic) seizures for 2 years
- Patient's mother

Pt's eyes turn upwards, mouth pulls to the right, drools, arms and legs become stiff and body shakes slightly. Pt doesn't react properly, is very tired afterwards.

#### A fronto-polar focus

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## Artefacts and the EEG

The MAULSBY Guidelines for Assessing Spikes (1971) Be cautious and conservative:

1. Every spike-like wave is a normal variant or artefact unless there are good reasons to suspect otherwise.

**2.** Spikes of cerebral origin always occupy a definable electrical field - appear in two or more nearby electrode sites.

## Artefacts

#### • Perspective

Southern Florida surveys of incorrectly analyzed EEGs – artefacts - relatively innocent

#### • Problem

Do sometimes get classified as an epileptiform discharge

When excessive – slows down analysis – causes doubts - becomes a pain

#### • Procedure of dealing with artefacts:

Technologist/EEG technician is trained to identify, then to eliminate/reduce where possible and even to record with non-cerebral electrodes when appropriate The analyzer has to learn to recognize them

#### Annotations by the technologist



## **Essential artefacts**

- 1) Eye opening and closure
- 2) Eye movements blinks
- 3) Eye movements flutter
- 4) Muscle/body movements
- 5) Tremor
- 6) ECG
- 7) Environmental electrical noise
- 8) Electrode artefacts



## Eye movements – blinks. Large downward deflections (V-shaped) in fronto-polar derivations.



## Eye movements – flutter. Frontal rhythmic activity varying from the delta to the alpha frequency range. Here, in the alpha range



#### Eye movements – flutter in the delta frequency range.



#### Eye movements – lateral rectus spikes. Muscle spikes in frontopolar derivations. Can appear as spike and slow wave complexes.



#### Eye movements – several types.



#### EMG spikes.

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#### Muscle/body movements on a major scale



#### Slight, subtle movements



### Monitoring muscle/movement



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#### High frequency filter settings The threat of diminishing epileptiform spikes

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12 <i>P3-01</i> Scale 83%	MMMMM HFF = 70 Hz	MMMMMMMMMM HFF = 35 Hz	HFF = 15 Hz

Muscle artefacts misinterpreted as epileptiform events. (Hernandez-Frau and Benbadis 2011)



## Tremor. Rhythmic activity usually in the delta or theta frequency ranges.



A tremor artefact inducing head movements and causing a rhythmical artefact maximal in posterior temporal derivations.

## ECG. Commonly involves recording of the QRS complex in the form of spikes.



These periodic spikes in the EEG can be attributed to contamination by the ECG on the grounds of being time-locked to the R wave.

### Pulse artefact – channel 12

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6 <i>F8-T4</i>										
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8 <i>T6-02</i>			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~*~***********************************		······································		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
9 Fp1-F3										
10 <i>F3-C3</i>							~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~
11 <i>C3-P3</i>										
12 <i>P3-01</i>	m	h		m	hand	m	m	m	m	~~~~
13 <i>Fp1-F7</i>										~
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17 Fz-Cz								~~~~~		
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19 ROC-A2						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
20 LOC-A2										
21 X1-*A2	h	hor	Ant	Ant	hoh	h	h	show	how	hard
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## Environmental electrical noise. Appears in EEG recordings as 50 Hz rhythmical activity.



-	DEINO	09:22:53[0000:22:01]	I ISENS Z HE	70 TC 0.3 CAL 50	1	Date:	09:22:53[0000:22:01	J [SENS 2 HF	*/0 TC *0.3 CAL *50		Date:
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		neaucin			mencici	ice by u					

recorded in ICU. Residual high frequency contamination is probably mostly muscle artefact.

# Electrode artefacts. Appear in various forms including focal spikes or sharp waves, with or without slow components.



### Electrode artefact. Which electrode is poorly applied?

10 uV	0.1 s	70 Hz	1	OFF	-10/4/2014	Elar Fast	Slow	
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### High impedance and electrode artefact.

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