

# Normal awake and sleep EEG

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### EEG : electroencephalogram

- Detect brain wave by scalp electrodes
- Summation of postsynaptic potentials (EPSP & IPSP) -> brain wave

#### Electrode placement

- International 10-20 system
  - Minimum 21 electrodes
  - Odd-numbered electrodes = left side of the head
  - Even-numbered electrodes = right side of the head
  - Specific letters designate the anatomical area : F = frontal, T = temporal, P = parietal, O = occipital, C = central





### Basic EEG terminology

- Rhythm
- Amplitude
- Frequency
- Timing
- Wave form
- Distribution
- Persistence
- Reactivity

# Rhythm

Rhythmic : EEG activity composed of recurring waves of equal duration

- Arrhythmic : EEC activity composed of recurring waves of unequal duration
- Irregular : waves are not uniform

### Amplitude

- Low amplitude < 20  $\mu$ V
- Moderate amplitude 20-50  $\mu V$
- High amplitude > 50  $\mu$ V
- How high on EEG depend upon sensitivity used e.g.
  7.5 μV per 1 mm.



### Frequency

- Beta activity >13 Hz
- Alpha activity 8-13 Hz
- Theta activity 4-7 Hz
- Delta activity < 4 Hz



# Timing

- The temporal relationship of the activity in different regions
- Activity occur in two regions simultaneously = <u>synchronous</u> or bilateral synchronous
- Activity occur at the different time in two or more region = <u>asynchronous</u>



### Distribution

- The degree of involvement of the activity
- Regional = one region



• Lateralized = one hemisphere



• Generalized = both hemisphere



#### Persistence

- The continuity of the activity
- Intermittent



• Continuous



• Periodic



### Reactivity

• The change of the activity in response to activations e.g. PDR reactive to eyes opening.





# Normal awake EEG



https://eegatlas-online.com/index.php/en/normal/awake



https://eegatlas-online.com/index.php/en/normal/awake

### Posterior dominant rhythm (PDR)

- Frequency 8-13Hz in adult. 3-4 Hz in newborn, upto 8 Hz by 8 years
- Voltage: depends on age, higher voltage in children
- Waveform: regular, waxing and waning in amplitude in adult
- Occurrence : continuous during awake
- Location: occipital regions, symmetric
- Reactivity: reduced with eye opening.

### Posterior dominant rhythm (PDR)

- Age dependence
- Term newborn : Chronological age
- Pre-term newborn : conceptional age

PDR										
Frequency in Childr	en									
3-4 months:	4 Hz									
12 months:	5-6 Hz									
2 years:	7 Hz									
3 years:	8 Hz									
9 years:	9 Hz									
15 years:	10 Hz									

4 Hz x 6 months6 Hz x 4 years8 Hz x 8 years



Neurophysiologie Clinique/Clinical Neurophysiology (2013) 43, 35–65



Disponible en ligne sur

SciVerse ScienceDirect

Elsevier Masson France

EM consulte www.em-consulte.com/en



#### **REVIEW/MISE AU POINT**

# Normal EEG in childhood: From neonates to adolescents

L'EEG normal chez l'enfant : du nouveau-né à l'adolescent

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Received 11 January 2012; accepted 30 September 2012 Available online 30 October 2012



https://eegatlas-online.com/index.php/en/normal/awake

### Beta frequency

- Frequency > 13Hz (most common 18-25 Hz)
- Voltage : low voltage
- Occurrence: irregular but continuous during awake, maybe more prominent with drowsiness
- Location : fronto-central region, symmetrical

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### Theta frequency

- Frequency 4-7Hz (most common 6-7Hz)
- Voltage : similar to alpha rhythm
- Occurrence: irregular, occur randomly intermized with other frequencies
- Location : frontal, fronto-central region, symmetric, enhance with drowsiness/light sleep



# Normal sleep EEG

- Stage I (N1) : 5-10%
- Stage II (N2): 45-55%
- Stage III (slow wave sleep: N3) : 20-40%
- REM (rapid eyes movement) : 15-25%



- Slow eye movement (SEM)
- Low-amplitude, mixed frequency EEG activity (LAMF)
- Vertex sharp transient : sharply contoured waves with duration < 0.5 sec, maximal over the central region and distinguishable from the background activity. They are most often seen during transition stage N1 sleep but can occur in either stage N1 or N2 sleep. These waveforms typically first appear at 4-6 months post term.

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- K complex : a well-delineated, negative, sharp wave immediately followed by a positive component standing out from the background EEG, with total duration ≥ 0.5 sec, usually maximal in amplitude when recorded using frontal derivations.
- Sleep spindle: a train of distinct sinusoidal waves with frequency 11-16Hz (most commonly 12-14Hz) with a duration ≥ 0.5 sec, usually maximal in amplitude in the central derivations.





 Slow wave activity : waves of frequency 0.5-2Hz and peak to peak amplitude > 75µV, ≥ 50 % of tracing



## Sleep stage REM



### Sleep stage REM

- Rapid eye movement (REMs): conjugate, irregular, sharply peaked eye movements with an initial deflection usually lasting <500 msec.</li>
- Sawtooth waves: An EEG pattern consisting of trains of sharply contoured or triangular, often serrated, 2-6Hz waves maximal in amplitude over the central head regions and often, but not always, preceding a burst of REM
- LAMF EEG activity

