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# 10-20 system EEG Placement

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# 10-20 EEG Placement

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## AIMS

- Demonstrate the International 10-20 EEG system
- Understand steps required to set-up a 10-20 EEG montage for a Polysomnography sleep study.
- Give each delegate a practical experience setting up a Sleep EEG montage using the 10-20 EEG system.

# 10-20 EEG Placement

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## Workshop Plan

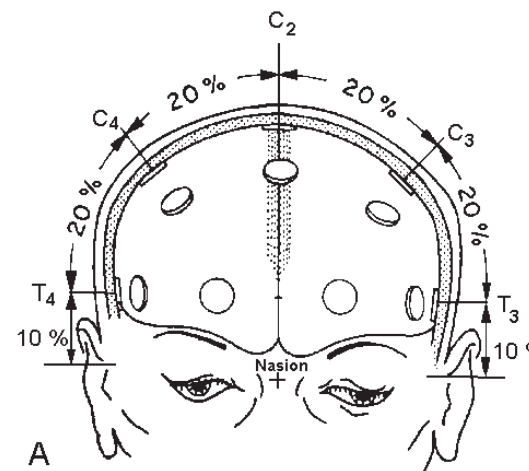
- This session is going to be a mainly *practical session.*
- Brief presentation : 10-20 basics
- Split into pairs and have a go.
- Slides from the session are available as part of the workshop materials – via website



# 10-20 EEG Placement

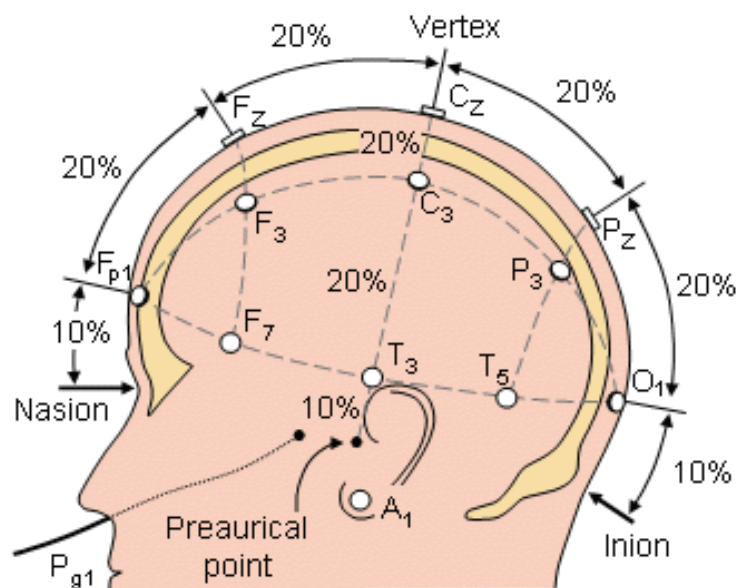
## Focus

- Head measuring
- Location of EEG, EOG, EMG
- Skin preparation / application (incl. differing techniques)



# 10-20 EEG Placement

What is the 10-20 system?



# 10-20 EEG Placement

## What is the 10-20 system?

- An internationally recognised method that allows EEG electrode placement to be standardised.
- Ensures inter-electrode spacing is equal
- Electrode placements proportional to skull size & shape
- Covers all brain regions

F = Frontal

P = Parietal

T = Temporal

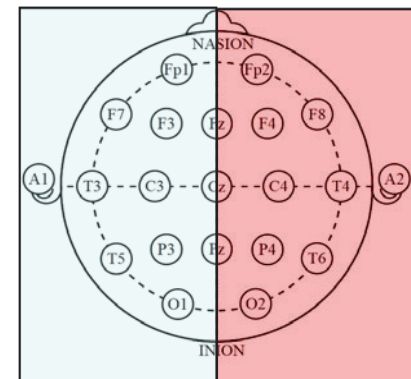
O = Occipital

- Numbering system

Odd = left side,

Even = right side,

Z = midline

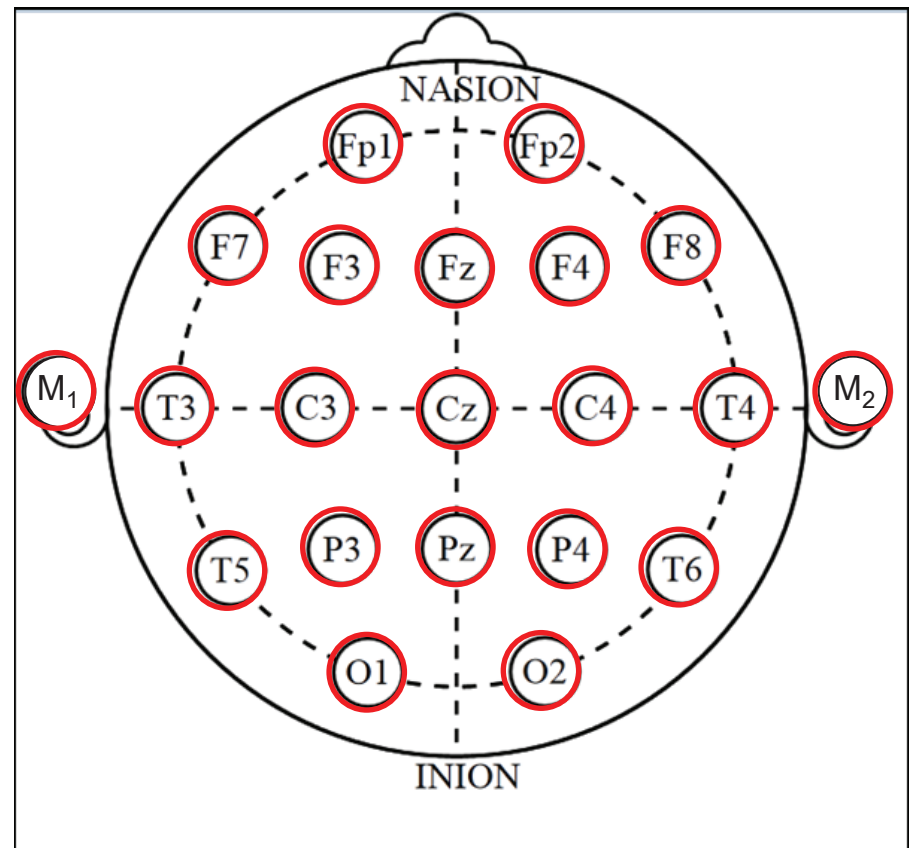




# 10-20 EEG Placement

## Routine EEG Montage

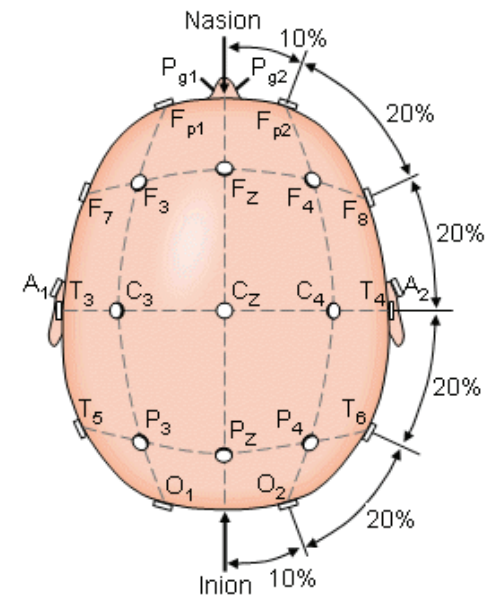
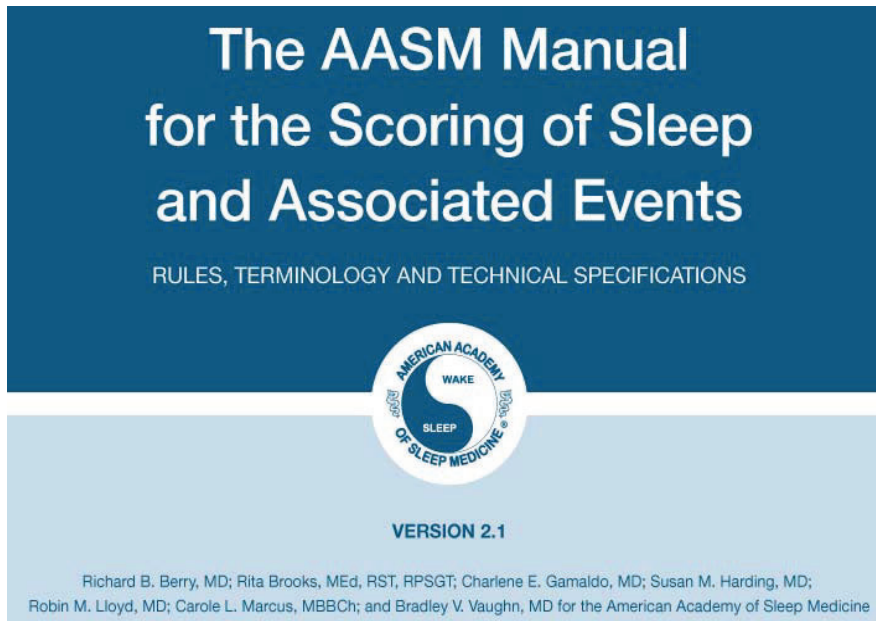
- 16 Channel (+ references e.g. Cz, Ground)



# 10-20 EEG Placement

## American Academy of Sleep Medicine

- Utilises 10-20 for polysomnography studies



# 10-20 EEG Placement

## Sleep Montage

Sleep PSG montage  
(8 Channels + References & ground)

### Recommended

- F3-M2
- C3-M2
- O1-M2

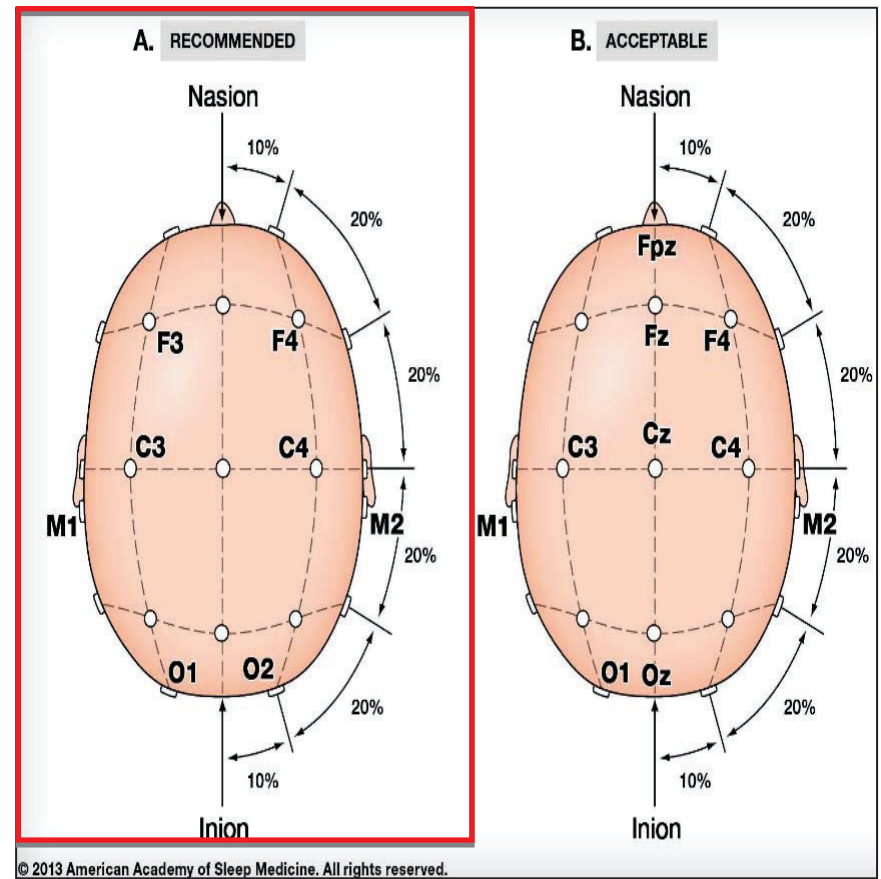
### Back-up

- F4-M1
- C4-M2
- O2-M1

(There are other acceptable derivations.)

“A minimum of 3 EEG derivations are required in order to sample activity from the frontal central and occipital regions”

The AASM Manual for the Scoring of Sleep and Associated Events. Version 2.0



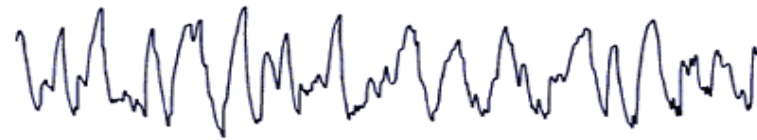
# 10-20 EEG Placement

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## Why a minimum of 3 EEG derivations?

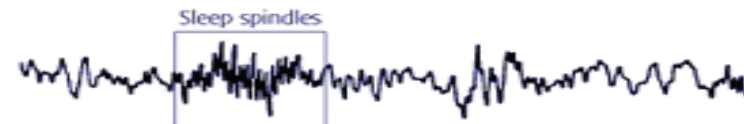
F4-M1 – best for slow waves

0.5-2.0hz



C4-M1 – best for spindles

11-16hz (most common 12-14hz)



O2-M1 – best for alpha rhythm

(8-13hz)



# 10-20 EEG Placement

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## Preparation



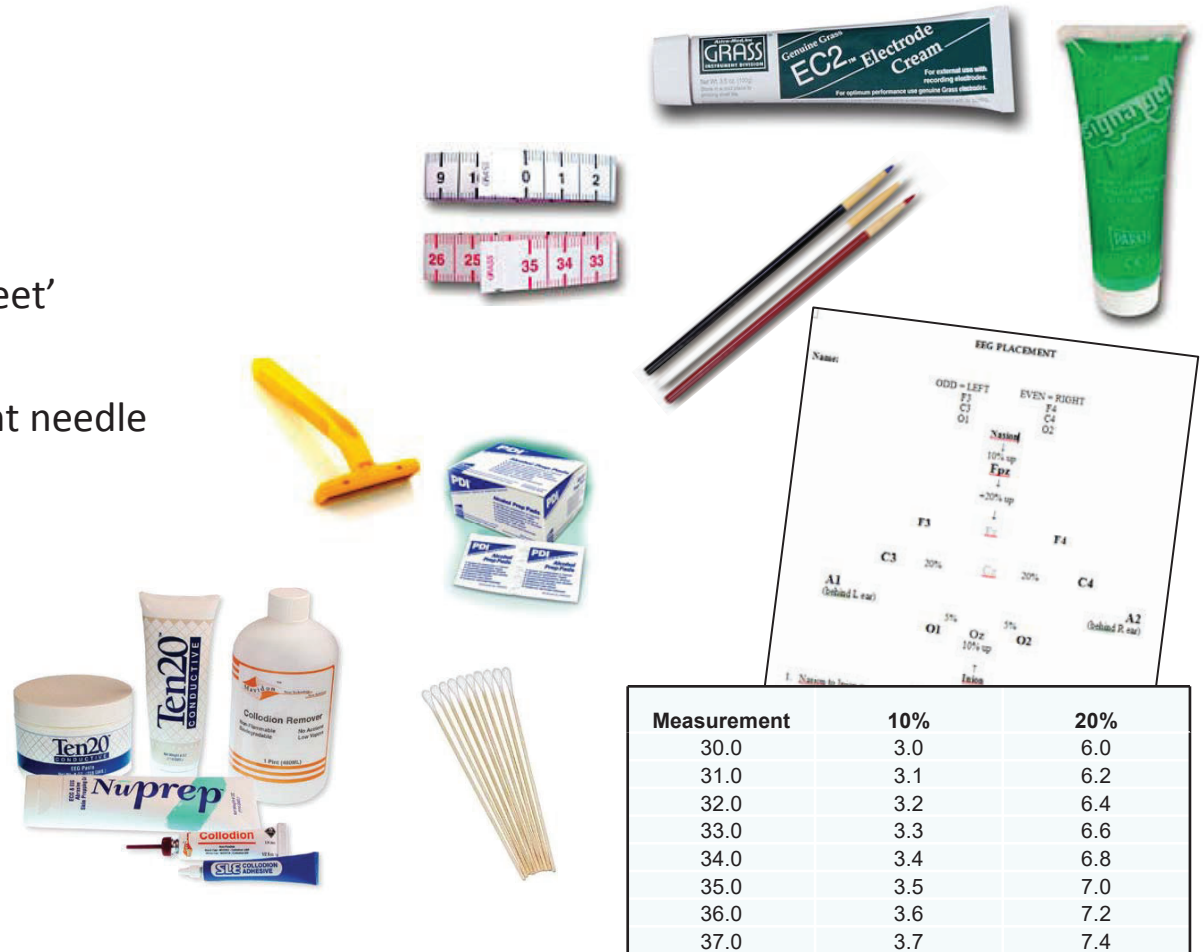
*Be prepared*

# 10-20 EEG Placement

## Preparation

You will need:

- Measuring tape
- Wax pencil
- Measurement 'cheat sheet'
- Alcohol wipes
- Scarify skin – Stick / blunt needle
- Abrasive paste
- Conductive paste/gel
- Collodion glue
- Hypafix
- Razor?



# 10-20 EEG Placement

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## Skin Preparation

### How ?

- Isopropyl alcohol wipes to clean (removes grease)
- Abrasive paste & cotton tip to reduce skin impedance (removes dead skin cells)



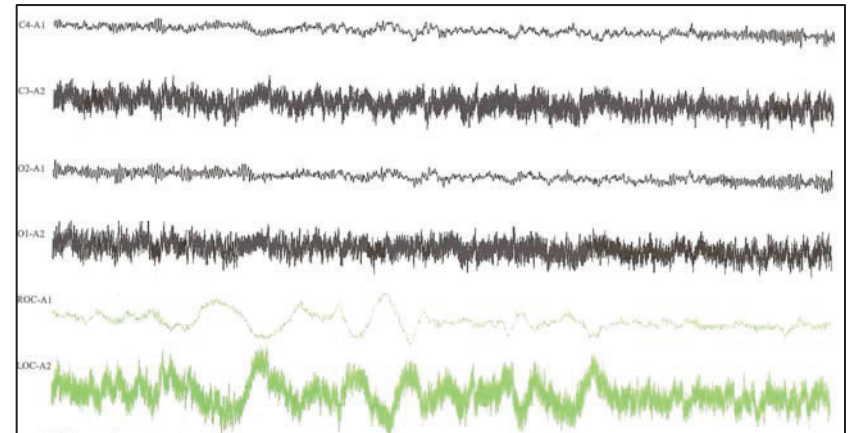
# 10-20 EEG Placement

## Why is it important

Need to have good electrical contact  
Impedance < 5kOhms

## Consequences of poor placement

- ECG artifact
- Movement artifact
- High impedance
- Electrode popping
- Movement artifact
- Sweat sway



High impedance



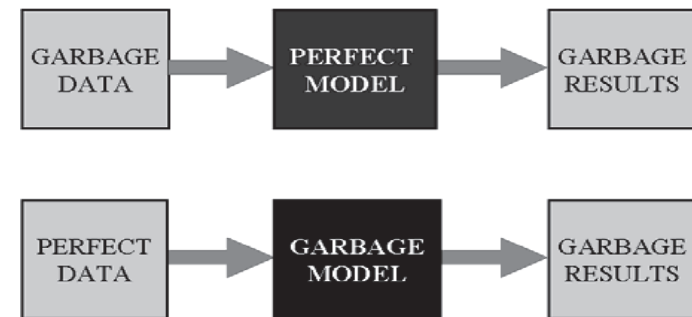
# 10-20 EEG Placement

## Why bother?

### "Garbage In, Garbage Out"

Computers will unquestioningly process the most nonsensical of input data (**garbage in**) and produce nonsensical output (**garbage out**).

#### MODEL CALCULATIONS "Garbage In-garbage Out" Paradigm

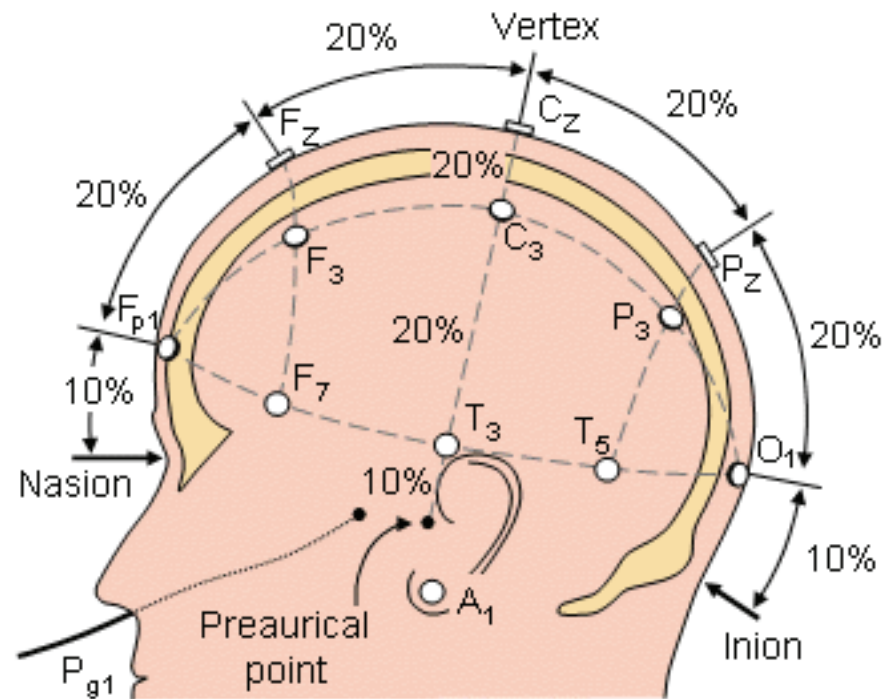


#### Sleep study signal pathway



# 10-20 EEG Placement

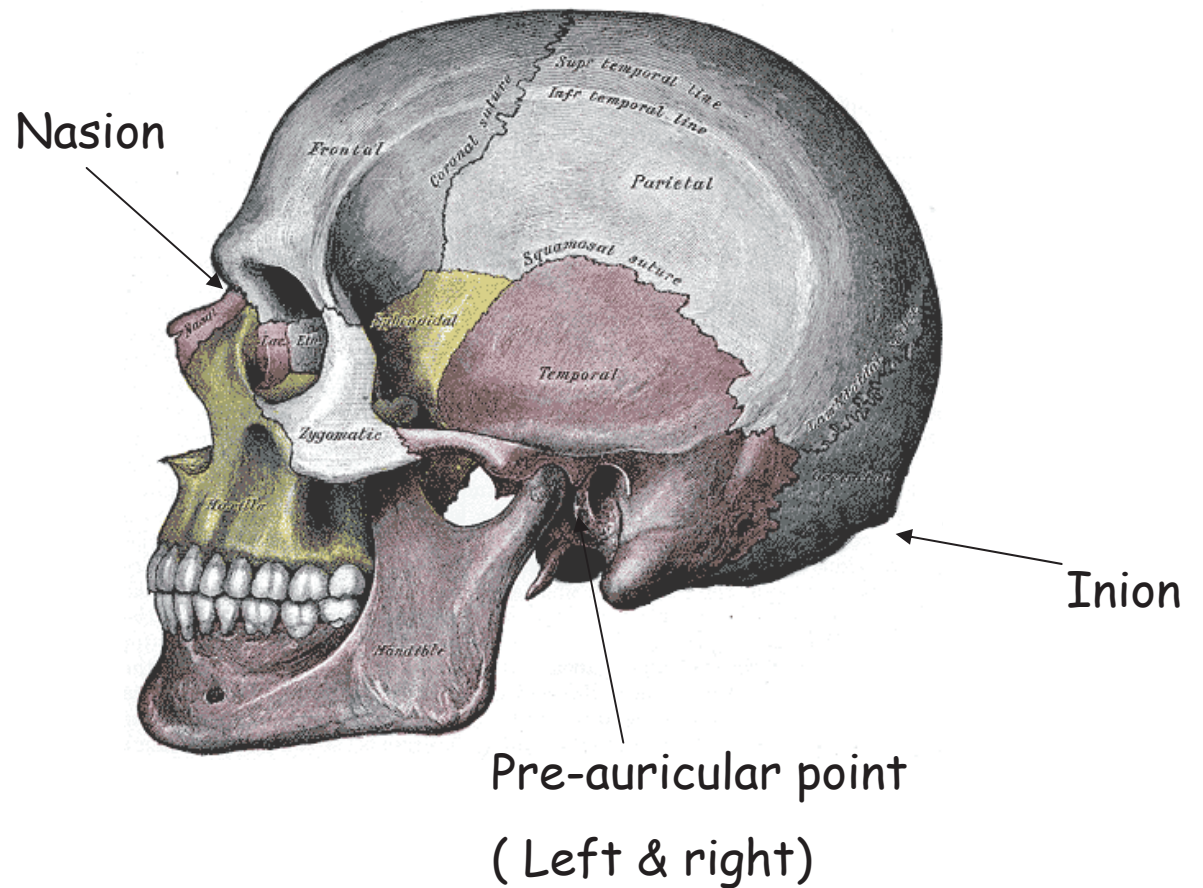
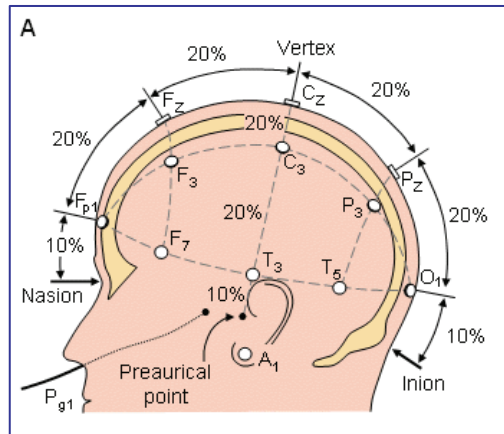
What is the 10-20 system?



# 10-20 EEG Placement

## Four Skull Landmarks

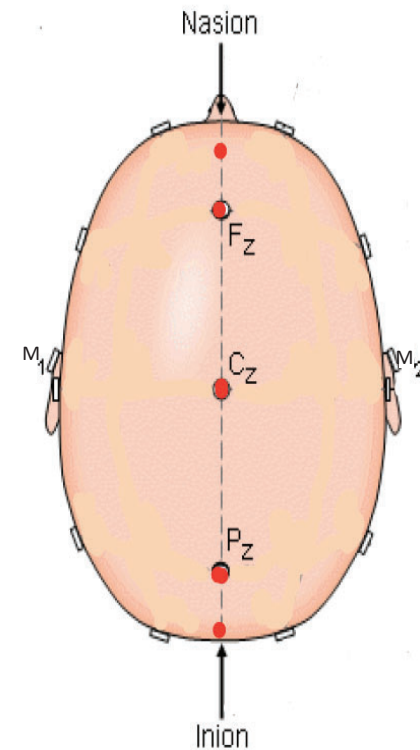
- Nasion
- Inion
- Left Pre-auricular point
- Right Pre-auricular point



# 10-20 EEG Placement

## Measurement of Cz

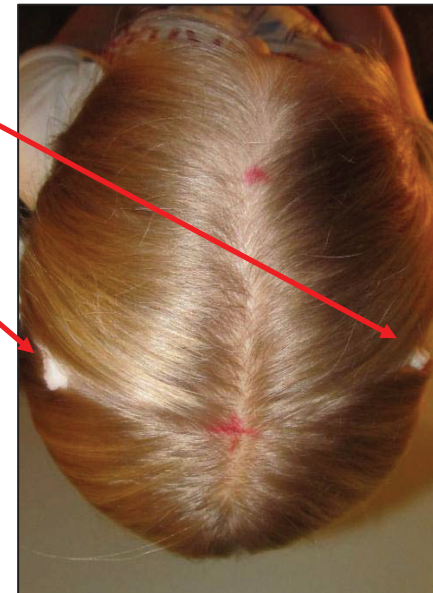
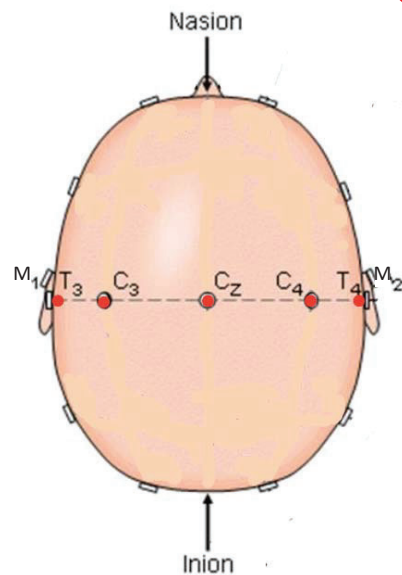
- Measure the distance from pre-auricular point to pre-auricular point
- Mark the midpoint (50%) with a vertical line
- This cross represents Cz which has been correctly aligned in the horizontal & vertical planes



# 10-20 EEG Placement

## Measurements - T3, C3, Cz, C4, T4

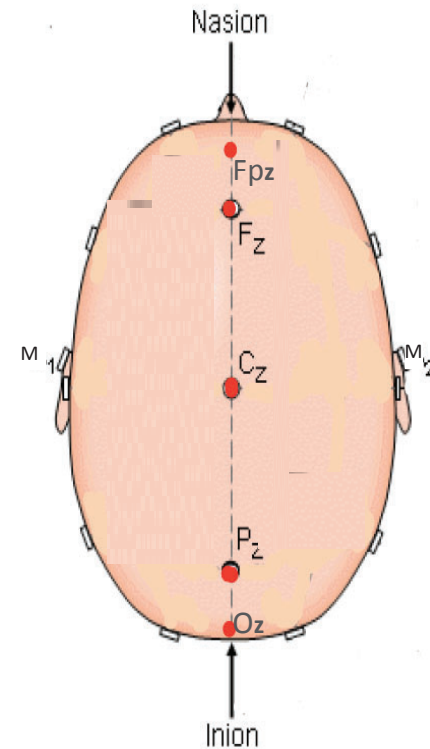
- Reapply the tape transversally between the pre-auricular points
- The midpoint (50%) should cross with previous point marking for Cz, confirming its location.
- Mark 10%, 20%, 20%, 20%, 10% = T3, C3, Cz, C4, T4



# 10-20 EEG Placement

## Measurements - Fpz, Fz, Cz, Pz, Oz

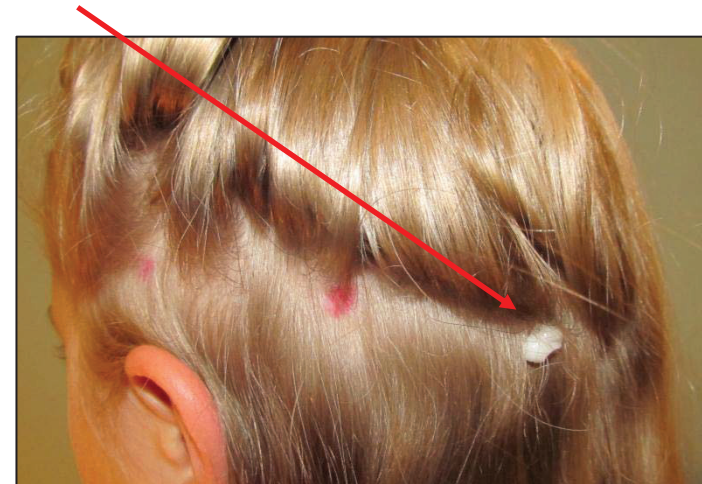
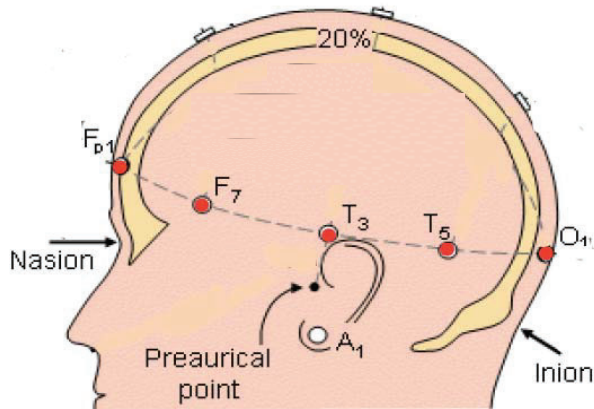
- Reapply the tape along the midline from nasion toinion
- Mark 10%, 20%, 20%, 20%, 10% = Fpz, Fz, Cz, Pz, Oz



# 10-20 EEG Placement

## Measurements - Fp1, F7, T3, T5, O1, Oz

- Measure the distance between Fpz & Oz by applying the tape around the head via T3.
- Mark at 10%, 20%, 20%, 20%, 20%, 10% = Fp1, F7, T3, T5, O1, Oz

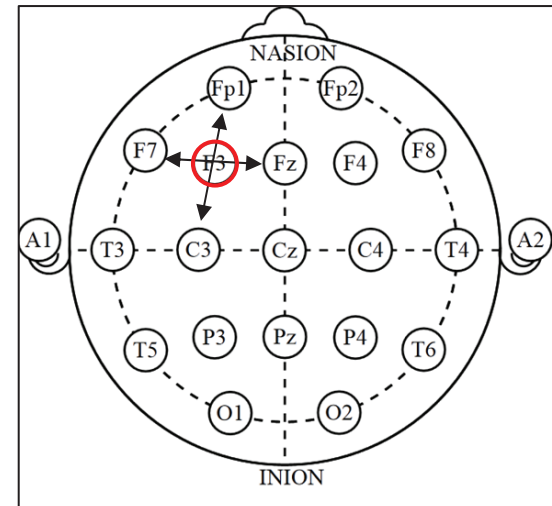


*(Repeat the process using T4 to mark O2)*

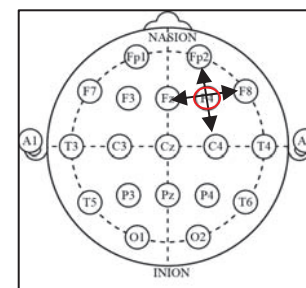
# 10-20 EEG Placement

## Measurement - F3

- Measure Fp1 to C3 and mark midpoint
- Measure Fz to F7 and mark midpoint
- Mark 50% = **F3**



(Repeat the process using Fp2 to C4 & Fz to F8 to mark **F4**)



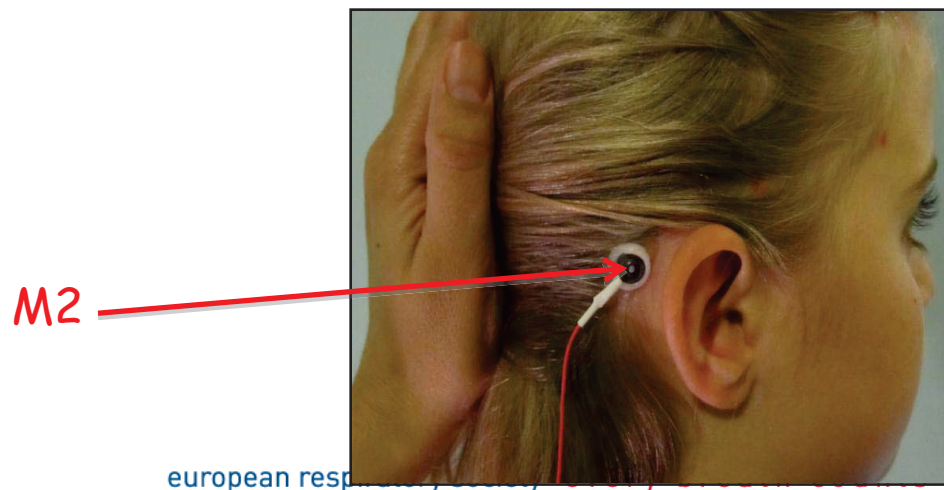


# 10-20 EEG Placement

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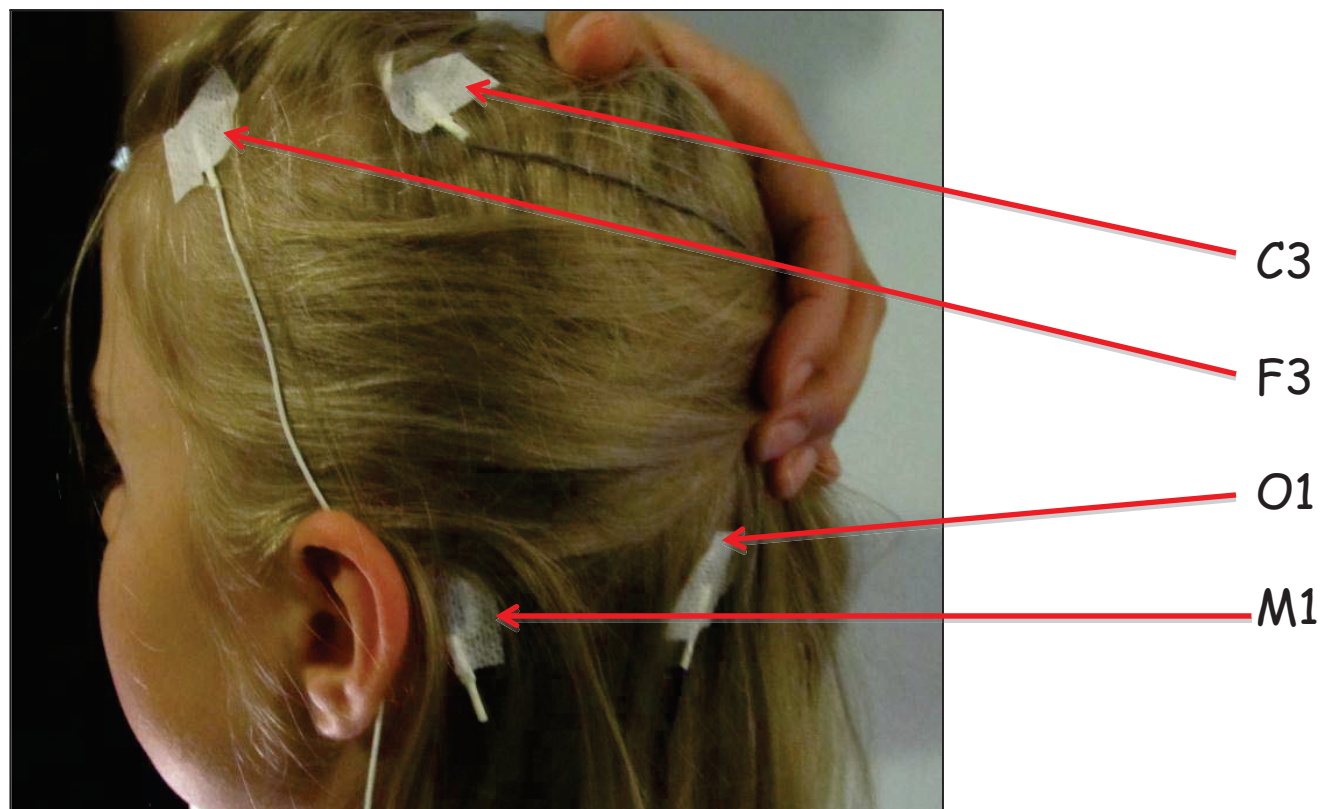
## Measurements M1 & M2

- M1 & M2 are the reference electrodes (formally known as A1 & A2)
- M1 & M2 are placed on the mastoid (M) process.
- These are the bony prominences behind the ears.



# 10-20 EEG Placement

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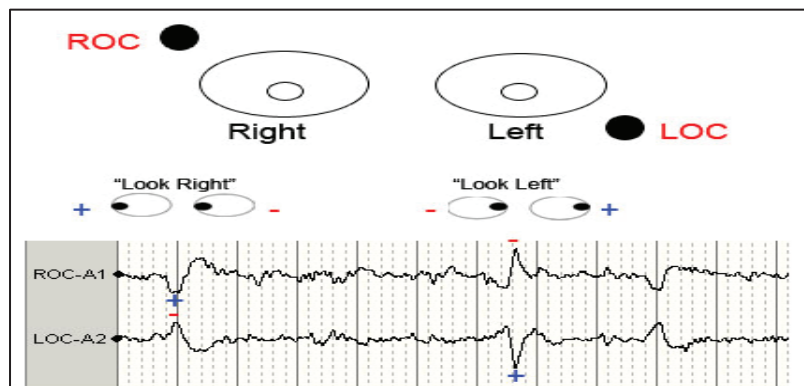


You have now completed a 10-20 EEG montage !!

# 10-20 EEG Placement

## Electro-oculogram

- Recording of the movement of the corneo-retinal potential difference, not the movement of eye muscle.
- Electrodes are placed at outer canthus of eyes offset 1cm above/below the horizontal
- Right out and up / Left out and down



# 10-20 EEG Placement

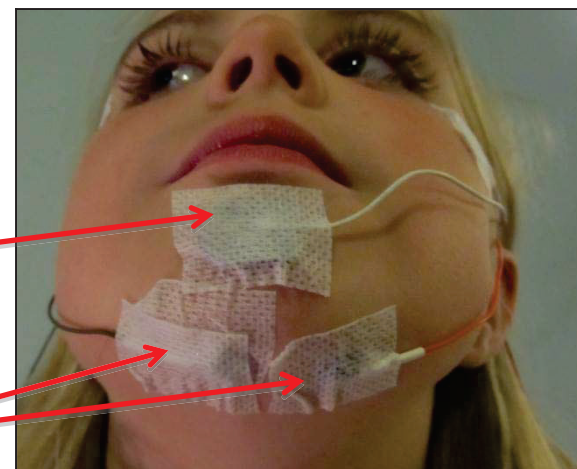
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## Electromyogram (Chin EMG)

- 3 electrodes
- 1 on mentalis
- 2 on submentalalis – 2 cm apart (1cm in Paediatrics)

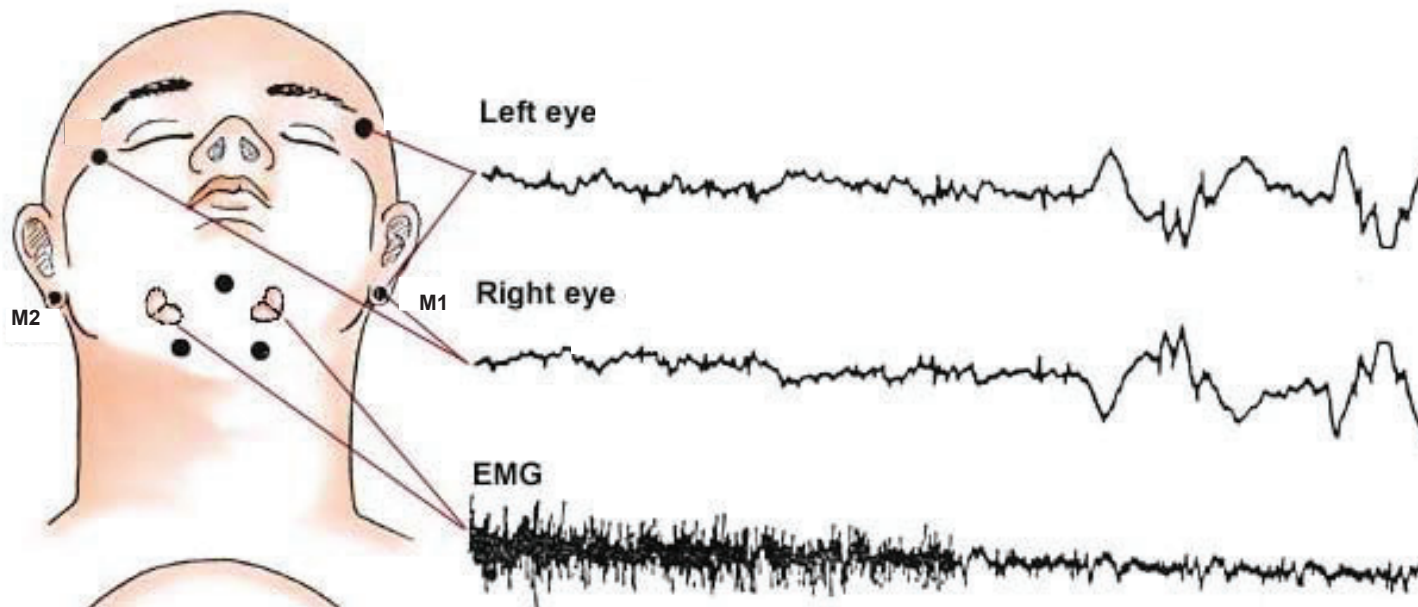
1 Mentalis

2 Submentalalis



# 10-20 EEG Placement

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You have now completed the EOG & EMG elements of a sleep montage setup !!

# 10-20 EEG Placement

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## Calibration (Checking the signals)

- Eyes closed for 30 seconds  
Ask the patient to close his/her eyes & lie quietly.
- Eyes open for 30 seconds  
Ask the patient to open his/her eyes & look straight ahead.
- Look right & left  
Ask the patient without their head to look to the right then to the left several times.
- Look up & down  
Ask the patient without moving their head to look up then down several times.
- Blink eyes  
Ask the patient to blink their eyes 5 times.
- Clench jaw  
Ask the patient clench their jaw.
- Flex foot  
Ask the patient to point & flex their foot. Repeat for other foot. Repeat for each leg and document
- Breathe in & out  
Ask the patient to breathe normally, and then take a breath in and out. Check polarity and mark IN & OUT on study.
- Snore sound  
Ask the patient to imitate a snore sound.



# 10-20 EEG Placement

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## Practical Session

**Your turn !!!**



# Further Reading

*The AASM annual for the Scoring of Sleep and Associated Events: Rules, Terminology and technical Specifications. Version 2.1*  
American Academy of Sleep Medicine (2014)

*Sleep Medicine Textbook* (European Sleep Research Society (ESRS))  
Claudio Bassetti, Zoran Dogas, Philippe Peigneux, Regensburg, (2014)

*Essentials of Polysomnography.*  
William H. Spriggs; Jones & Bartlett Publishers (2008)

*Essentials of Sleep Technology*  
Richard S. Rosenberg; American Academy of Sleep Medicine (2010)

*Atlas of Clinical Polysomnography Second Edition (Two-volume Set)*  
Nic Butkov Media matrix , (2011)

*The ten twenty system of the International Federation. Electroencephalography and Clinical*  
Jasper, H.H. , Neurophysiology, 1958, 10:371-375.

*Polysomnographic technique: An overview. In: Sleep disorders medicine, 2nd ed. Boston*  
Chokroverty S. Butterworth Heinemann (1999)

*Fundamentals of EEG technology, Volume 1: Basic concepts and methods.*  
Tyner F, Knott J, Mayer W Jr. New York: Raven Press; (1983).

*Sleep medicine.*  
Lee-Chiong T, Sateia M, Carskadon M, (Hanley & Belfus, 2002)



## Further Training

- Practical Polysomnography – Edinburgh, UK
  - Various dates
- Edinburgh Sleep Medicine Course – Edinburgh, UK
  - March 2016
- European Sleep School – Orihuela Costa, Spain
  - Various dates
- International Sleep Medicine Course – Cardiff, UK
  - June 2016

## Any Questions?



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