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10-20 system EEG Placement

Andrew Morley (BSc Hons, RPSGT), Lizzie Hill (EST RPSGT)
Chief Respiratory (Sleep) Physiologist, Royal Hospital for Children, Glasgow
Specialist Respiratory Clinical Physiologist, Royal Hospital for Sick Children, Edinburgh

& Prof. Dr Athanasios G. Kaditis
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10-20 EEG Placement

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

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
Focus

- Head measuring
- Location of EEG, EOG, EMG
- Skin preparation / application (incl. differing techniques)
What is the 10-20 system?
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 | T = Temporal |
| P = Parietal | 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)
American Academy of Sleep Medicine

• Utilises 10-20 for polysomnography studies

The AASM Manual for the Scoring of Sleep and Associated Events
RULES, TERMINOLOGY AND TECHNICAL SPECIFICATIONS

VERSION 2.1
Richard B. Berry, MD; Rita Brooks, MEd, RSt, RPSGk; Charlene E. Gamaldo, MD; Susan M. Harding, MD; Robin M. Lileyd, MD; Carola L. Marcus, MSiSc; and Bradley V. Vaughn, MD for the American Academy of Sleep Medicine

european respiratory society every breath counts
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

european respiratory society every breath counts
10-20 EEG Placement

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

Preparation
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?

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<th>20%</th>
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</tr>
<tr>
<td>37.0</td>
<td>3.7</td>
<td>7.4</td>
</tr>
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</table>
Skin Preparation

How?

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

“Garbage In, Garbage Out”

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

Sleep study signal pathway

Patient → Sensor → Headbox → Amplifier → Computer
What is the 10-20 system?
10-20 EEG Placement

Four Skull Landmarks

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

Inion

Pre-auricular point (Left & right)
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%, 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 to inion

• Mark 10%, 20%, 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)
**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)
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

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

Electromyogram (Chin EMG)

• 3 electrodes

• 1 on mentalis

• 2 on submentalis – 2 cm apart (1cm in Paediatrics)
You have now completed the EOG & EMG elements of a sleep montage setup!!
**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 on study.

- 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

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.

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

Nic Butkov Media matrix , (2011)

The ten twenty system of the International Federation. Electroencephalography and Clinical

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.

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?

Andrew.morley@ggc.scot.nhs.uk

Lizzie.hill@nhs.net