

PERFORM Operating Document

Applying EEG Cap Systems Using the Ten-Twenty System

PC-POD-FA-005-v01

Revision History

| Version | Reason for Revision | Date |
|---------|---------------------|---------------|
| 01 | New POD | April/15/2015 |

Summary

The content of this PERFORM Operating Document (POD) provides guidelines for:

- Applying EEG Cap systems.
- Cleaning Electrode Sites with abrasive gel & a blunt-tip needle
- Alternative: Cleaning Electrode Sites with Abrasive Paste

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I. Definition of Terms

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| EEG | Electroencephalography |
| Instructor | Person that has attained an adequate level of certification and expertise which qualifies them to supervise and teach students. |
| International Ten-Twenty System of Electrode Placement | An internationally recognized method to apply the location of scalp electrodes in the context of an electroencephalogram. |
| Internship student | An internship student is a current student or recent graduate that is undergoing supervised practical training supervised by PERFORM employees. |
| Impedance | It is defined as the measure of the opposition that a circuit presents to a current when a voltage is applied. It is the AC (alternating current) equivalent to resistance. |
| K Ohms | 1 ohm is equal to 0.001 kilo ohms, K Ohms. |
| Ohm (symbol: Ω) | The ohm is the unit of measure for electrical resistance. It is the resistance between two points of a conductor when a constant potential difference of 1 volt produces in the conductor a current of 1 amp (ampere). |
| PERFORM operating document (POD) | Operating documents that are specific to an instrument or technique that require approval by area managers. |
| Project Lead | The project lead is the person who is responsible for all aspects of a given project at PERFORM |
| User | Person using space or equipment at the PERFORM Centre that has received adequate technical and safety training. |

2. Introduction

2.1 Background

When the EEG electrodes are properly applied/placed according the International Ten-Twenty (10-20) System, the coverage of the two hemispheres is symmetrical. If electrodes are not symmetrically placed on the scalp, voltage asymmetries may occur during the recording.

Skin preparation differs depending on the type of electrode. In general, cleaning of the scalp surface from oil and removing dried skin is recommended. With disc type of electrodes, abrasive paste is used to remove the oil and dry skin from the scalp. With cap systems, an abrasive conductive paste or a blunt-tip needle is used for scraping the scalp surface. The disc type of electrode is filled with conductive paste. With the cap systems, there is a small hole to inject conductive gel with a blunt-tip needle.

High impedance can lead to a distortion in the EEG signal and it may allow interference from changes outside the brain (interference of the recording equipment) and changes produced by biological activity (eye movements, heart beat and scalp muscle). In order to prevent signal distortions from high impedances, it should kept between <10 Ohms.

2.2 Purpose

To establish a POD for the application of EEG cap systems according to the the International 10-20 System of Electrode Placement (Jasper H. The '10-20' system. *Electroenceph Clin Neurophysiol* 1958;10:371-375; American Electroencephalographic Society. Guideline thirteen: Guidelines for standard electrode position nomenclature. *J Clin Neurophysiol*, 11:111-113, 1994).

2.3 Scope

This POD applies to all users and supervisors using EEG cap systems at the PERFORM Centre, Concordia University.

2.4 Responsibility

It is the responsibility of user to apply the electrode cap properly with acceptable impedances and to be trained in EEG measurements and application of electrodes.

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2.5 Equipment

2.5.1 For applying the EEG Cap

- Cap with equidistant EEG electrode positions (10-20 System)
- 2 Ear-lobe electrodes (optional)
- Chest belt set (optional)
- Conducting electrolyte gel
- Abrasive conductive gel (e.g. **Abralyt 2000** - *Chloride-free, abrasive gel*)
- ♦ Cotton-tipped applicators
- ♦ Blunt-tip disposable needles
- ♦ Alcohol
- ♦ Gauze squares
- ♦ Non-sterile, non latex powderless gloves
- ♦ Lab coat, if desired
- ♦ Impedance meter (optional)

3.0 General Considerations

- Hair should be dry and all hair pins, barrettes and earrings must be removed.
- Before applying the EEG cap, **MEASURE THE HEAD** (refer to PC-POD-FA-003 'Placement of Standard Scalp Electrodes Using the International Ten-Twenty System').
- Measure and Mark the following sites:
 - frontal sites (FPZ, Fp1 and Fp2),
 - central (CZ)
 - occipital sites (Oz, O1, O2).
- Proper size cap is based on the measured head circumference.
 - Large fits 58-62cm head circumference
 - Medium fits 54-58cm head circumference
 - Small fits 50-54cm head circumference
 - Extra Small fits 46-50cm head circumference

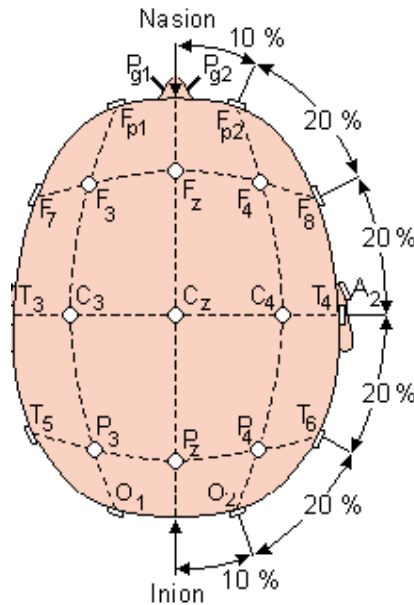
4.0 Procedure

1. Have subject prepare for electrode application (e.g., wear shirt they would like to wear for duration of the recording).
2. Seat subject in set-up area

Slip the proper size cap onto the subject's head using both hands from front to back. Align the holes in Fp1 and Fp2 on the forehead marks, the Cz on the vertex mark and the O1 & O2 marks in the back of the head. (refer to PC-POD-FA-003-v01, 'Placement of Standard Scalp Electrodes').

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Figure 1: Superior or above the head view of the scalp showing left/right frontal (Fp1/Fp2), central (Cz) and left/right occipital (O1/O2) sites.



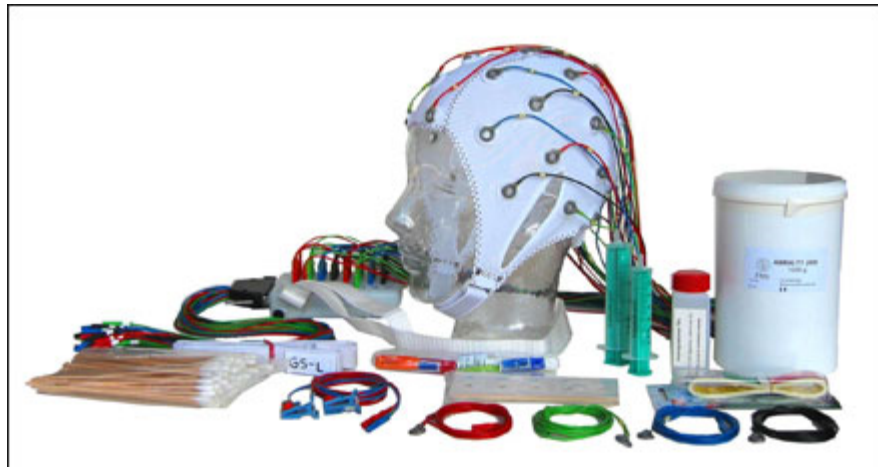
3. **Attached the body harness** under the armpits and around the chest.
[Alternative: If other devices (e.g. chin strap) are being used, the body harness is not necessary].
IF THE CAP IS NOT PULLED TIGHT, NUMEROUS ARTIFACTS WILL RESULT.
4. Determine if the cap is centered on the head and that the subject is comfortable
5. **Fill each electrode cup with electrolyte gel using a blunt tip needle** until a small amount comes out of the hole in the mount.
6. Holding the syringe with the first finger of the right hand on the syringe plunger, **rock the syringe/needle back and forth**. Wipe off excess gel with a gauze square. **DO NOT USE EXCESSIVE AMOUNTS OF GEL. AS A FLAT CHANNEL WILL RESULT.**
7. Check the impedances of each electrode.

Alternative to using blunt-tip syringe to reduce impedance:

In some instances, abrasion with the blunt-tip needle may not be desirable (children, elderly, adults with a fear of needles or if requested by the Project Leader). In these situations, try using the wooden end of a cotton swab to reduce impedances.

- After filling each electrode with gel, place the wooden end of the cotton swab through the hole in the mount and twirl it between your fingers.

Figure 1: Electrode Cap System and products



Electrode and Electrode in harness.

APPENDIX I

POD Training Record Form

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POD Title

Application of Standard Scalp Electrodes

SOP Code

| Ownership | Document type | Area | SOP Number | Version |
|-----------|---------------|------|------------|---------|
| PC | POD | FA | 005 | 01 |

Training Record

| | |
|------------------------------------|--|
| Full Name | |
| Institution | |
| Contact (email or phone number) | |

Signature

Sign here

Date