

EASYCAP**Minimizing impedances and using the right electrolyte gel saves time and makes research more effective**

A guidance from Falk Minow, General Manager EASYCAP GmbH, for EASYCAP electrode caps.



Despite recent improvements in EEG and electrode technology, most research applications still require low skin impedance levels: optimum signal quality makes artifact detection easier, data reliability increases, and groups can be kept smaller to get significant differences. In EEG combined with other technologies, such as EEG and fMRI, EEG and TMS, EEG in MEG, impedance level multiplies with artifact amplitude, quickly obscuring any EEG signal, so here too impedances should be kept as low as possible.

The only effective method to achieve low impedances is still to abrade the area of skin underneath each electrode, and then to apply an electrolytic gel or paste. This is very time-consuming, and any contribution to save even the tiniest amount of time should be exploited. Some general measures are listed and then the pros and cons of the different features of electrolyte gels are discussed.

Why degreasing?

Normally, skin which is exposed to light, wind, and weather, e.g. the face, arms, or a bald head, has an impedance of around 200 kOhm, compared with around 120 kOhm for protected skin, e.g. covered by hair. The higher level is partly due to the corneation of the outer skin layers, but even more so to the natural skin grease. By removing the grease, impedances are reduced by two thirds. For still lower impedances, the corneated skin needs to be removed by abrasion. Therefore, degreasing should always be the first step, either by hair-washing (and -drying) just before electrode mounting, or by applying alcohol directly under the electrode site.

How to abrade?

Corneated skin can be abraded through the opening of the mounted electrode either with a blunted needle, or with abrasive gel. Using the blunted needle is rather imprecise, it can hurt, but it yields low impedances quickly in most cases. In contrast, twirling abrasive gel with a cotton swab takes longer, but allows you to be very gentle and to control precisely the intended impedance level.

Properties of electrolyte gels

Technically, any conductive gel could be used to bridge the gap between skin and electrode sensor. In practice, different gels are more or less suited for certain EEG applications.

The gels may be

- clear (only conductive) vs. abrasive (conductive AND abrasive)
- liquid vs. viscous
- salty vs. free-of-salt

and have different types of packaging.

Clear vs. Abrasive

For most cases a rule of thumb is:

- When using active electrodes, a clear gel applied with blunted needle will yield good signal quality.
- When using passive electrodes, the skin underneath the electrode should be abraded additionally with an abrasive gel.

If an abrasive electrolyte gel is used, the same gel can be used to fill the electrode after abrasion. Abrading with blunted needle yields impedances below 20 kOhm. Abrading with abrasive gel yields impedances well below 10 kOhm.

For very small effects like mismatch negativity or laterality differences, results are better if all electrodes have equal impedances. This is easier to achieve with abrasive gel and cotton swab than with a blunted needle. In this case abrasive gel instead of clear gel should be considered even when using active electrodes.

The corneation of the skin increases with age. For babies and infants no abrading is necessary and therefore clear gel can be used.

liquid vs. Viscous

Although a liquid gel will easily drip between the hairs it will also trickle away from the electrode over time. Therefore only gels of at least medium viscosity can be used in EEG recording caps.

The ample application of gel can cause gel bridges between adjacent electrodes. Thus at least from 64 channels onwards a high-viscosity gel is recommended.

Salty vs. Free-of-Salt

In the human body the salt content is 0.9%. Salty electrolyte gels have 3% to 10% salt concentration. After abrading, the electrolyte comes in contact with body liquids such as sera, and the difference in salt concentration leads to a gradual improvement in skin-to-electrolyte contact. This effect can be seen during the impedance check: after some minutes impedances decline “all by themselves”.

Therefore we would normally prefer to use salty electrolytes. However, when the salty electrolyte comes into contact with the abraded skin this can be experienced as unpleasant itching.

In terms of conductivity there is no difference between salty and free-of-salt electrolytes, but the latter lack the self-improving effect, and free-of-salt electrolytes cannot be used for DC-recordings and very slow potentials (because the same ion must be present in electrolyte and electrode, e.g. chlorine ions in the case of Ag/AgCl-electrodes).

If there may be a need for free-of-salt electrolyte, we recommend starting with these, because you can always switch to salty gels later.

Type of packaging

Electrolyte gels are typically applied onto the skin and into the cap's electrodes by a syringe with or without blunted needle. Electrolyte gels either come in large-volume jugs, in cartouches or tubes, or in pre-filled syringes. The decision between these types of packaging is purely financial.

In relation to volume, the large jugs are the cheapest solution, but the gel needs to be drawn up into the syringes. Afterwards, excess gel will have to be wiped off the syringes.

From tubes, gel can be filled into the syringes after removing the piston. Cartouches even come with a special adaptor to squeeze the gel bubble-free into the syringe with the help of a skeleton gun.

Both jugs and cartouches/tubes require advance preparation and cleaning afterwards. The most convenient method therefore is with pre-filled syringes which are disposed of when empty. But this is the most expensive method.

So in the end it comes down to what is cheaper, working time or pre-filled syringes.

Conclusion / Decision Tree

- Always degrease the skin by washing the hair directly before cap mounting for normal requirements, and degrease with alcohol for high requirements.

EASYCAP

New: Electrolyte gels in pre-filled syringes and cartouches
by Falk Minow, General Manager EASYCAP GmbH

What is new?

All electrolyte gels supplied by Brain Products and Easycap are either from a salty or a free-of-salt family. All variants of the salty gels can be used within the same recording against the same reference, and also the free-of-salt gels can be interchanged.

Filling the gels into syringes can take up precious working time. Therefore we now offer the important gels not only in large jugs, but also in pre-filled, disposable syringes, or in cartouches for easy and bubble-free self-filling of syringes.



Fig. 1: Pre-filled syringe



Fig. 2: Pre-filled syringes come in packages of 50 syringes

- Always abrade the skin with blunted needle for active electrodes, or with abrasive gel for passive electrodes. The only exception is for babies and infants.

- Use clear gel when blunted needles are used or when no abrading takes place, and use abrasive electrolyte gel when abrading with a cotton swab.

- Do not use liquid gels. Use medium-viscosity gels for 21 channels, and high-viscosity gels for 32 or more channels.

- Use salty electrolytes unless you may have children or anxious subjects.

Use only salty electrolytes if you are recording DC-EEG or potentials slower than 3 Hz.

- If you have more time than money buy gel in jugs. If you have more money than time buy pre-filled syringes. As a compromise buy cartouches / tubes.

Postscript

Electrolyte gels are the method of choice for EEG recordings with caps for up to 4 hours. For long-term and sleep-recordings, gels are not suitable as they dry up after some time. Here, electrolyte pastes will have to be considered although they are both more difficult to apply and to remove and clean off afterwards. The use of pastes is also recommended for EEG during movements. ●



The pre-filled syringes come in packages of fifty (Fig. 1, Fig. 2).

Gel in cartouches come with a special adaptor so that the gel can be filled bubble-free directly into the syringe (Fig. 3).



Fig. 3: By using a skeleton gun and the special adaptor, the gel can be filled bubble-free into the syringe. The adaptor fits syringes with or without thread.

Electrolyte gels from Brain Products / EasyCap**Salty Electrolyte Gels**

SuperVisc: Clear, high-viscosity, salty

V16 SuperVisc, 1000g jug

V16-300 SuperVisc, 300g cartouche, with adaptor

V16-10KT SuperVisc, 50 pre-filled Luer-lock syringes, with 4 blunted needles

Lectron III-10: Clear, medium-viscosity, salty

V15 Lectron III-10, 250g tube

Abralyt HiCl: Abrasive, high-viscosity, salty

V19 Abralyt HiCl, 1000g jug

V19-300 Abralyt HiCl, 300 g cartouche, with adaptor

V19-10KT Abralyt HiCl, 50 pre-filled syringes

Free-of-Salt Electrolyte Gels

Abralyt 2000: Abrasive, high-viscosity, free-of-salt

V17 Abralyt 2000, 1000g jug

V17-300 Abralyt 2000, 300 g cartouche, with adaptor

V17-10KT Abralyt 2000, 50 pre-filled syringes

Lectron II: Clear, medium-viscosity, free-of-salt

V14 Lectron II, 250g tube

**News in brief: Downloads, Programs and Updates****Sept. 30th, 2013 / New Software Versions available**

BrainVision Analyzer 2.0.4, BrainVision Recorder 1.20.0601, BrainVision RecView 1.4.3 and actiCAP ControlSoftware 1.2.5.3 are available now and can be downloaded from our website (<http://www.brainproducts.com/downloads.php>).

Aug 1st, 2013 / Montages & Workspaces for actiCHamp Caps

The actiCHamp usually comes along with our open-source recording software BrainVision PyCorder. However BrainVision Recorder is also compatible with the actiCHamp. Standard Montages as well as Standard BrainVision Recorder Workspaces for actiCHamp Caps are now available in the Electrode Caps Downloads Section (<http://www.brainproducts.com/downloads.php?kid=29>).

Jul 29th, 2013 / Update for BrainVision Recorder 1.20.0506

A new update for BrainVision Recorder 1.20.0506 (V-Amp/actiCHamp) can be downloaded in the Recorder Download Section (<http://www.brainproducts.com/downloads.php?kid=2&tab=2>) of our website.

Jul 10th, 2013 / Brain Products is hiring

We are currently looking for a Software Developer. For more details please check the official postings the Jobs Section (<http://www.brainproducts.com/jobs.php>).

All Updates and New Modules can be downloaded on our website at www.brainproducts.com/downloads.php. If you'd like us to keep you posted on any new Update for BrainVision Analyzer 2, please register for our Analyzer 2 Newsflash at www.brainproducts.com/a2_newsflash.php

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