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A Novel, Inexpensive Electrode and Cap System for Dry Multichannel EEG

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Introduction

Innovative fields of application for electroencephalography (EEG), such as home care, ambient assisted living and computer interfaces, require measurement systems with high spatial resolution but simple, reliable application and feasibility for long-time measurements. Conventional Silver/Silver-Chloride (Ag/AgCl) electrodes involve too complex and time-consuming preparation as well as limited long-time stability. Current concepts for dry electrodes include electrical conductive, capacitive and opto-electric sensor materials. These concepts are inappropriate due to high complexity, electronic requirements and overall costs. The aim of our current study is a novel, inexpensive concept for dry multichannel EEG and comparison of signal quality to conventional Ag/AgCl technology.

Methods

We developed a novel, cost-saving electrode based on multiple, gold-coated precision strips and integrated 64 electrodes into a flexible, textile cap structure. The electrode design enables interfusion of the hair layer as well as a reliable, stable contact between electrode and scalp. Moreover the gold-coated electrodes enable long-time EEG due to biocompatibility and electrochemical stability. We compared the novel cap system with a commercial Ag/AgCl-based cap using sequential recordings of spontaneous EEG and visual evoked potentials (VEPs) of two volunteers. Subsequently, characteristic parameters, including signal variance, Root-Mean-Square-Deviation and Root-Mean-Square-Deviation of the normalized signals (RMSDN), were calculated.

Results

The recorded VEPs showed no significant differences between signals of the dry and conventional electrodes. Global field power and global potential mapping of the VEPs conform to each other. Furthermore, the signals of resting EEG and alpha activity exhibit good qualitative and quantitative congruence in time and frequency domain for a frequency range of 3-30 Hz. The variances are in the same order of magnitude and mean RMSDN values are below 15%.

Conclusion

We propose a novel, inexpensive and easy applicable EEG electrode and cap concept. Our results prove applicability for multichannel EEG acquisition as the signal quality conforms to conventional electrodes.