High similarity between EEG from subcutaneous and proximate scalp electrodes in patients with temporal lobe epilepsy

Subcutaneous recording using electro encephalography (EEG) has the potential to enable ultra-long-term epilepsy monitoring in real-life conditions because it allows the patient increased mobility and discreteness. This study is the first to compare physiological and epileptiform EEG signals from subcutaneous and scalp EEG recordings in epilepsy patients. Four patients with probable or definite temporal lobe epilepsy were monitored with simultaneous scalp and subcutaneous EEG recordings. EEG recordings were compared by correlation and time-frequency analysis across an array of clinically relevant waveforms and patterns. We found high similarity between the subcutaneous EEG channels and nearby temporal scalp channels for most investigated electroencephalographic events. In particular, the temporal dynamics of one typical temporal lobe seizure in one patient were similar in scalp and subcutaneous recordings in regard to frequency distribution and morphology. Signal similarity is strongly related to the distance between the subcutaneous and scalp electrodes. On the basis of these limited data, we conclude that subcutaneous EEG recordings are very similar to scalp recordings in both time and time-frequency domains, if the distance between them is small. As many electroencephalographic events are local/ regional, the positioning of the subcutaneous electrodes should be considered carefully to reflect the relevant clinical question. The impact of implantation depth of the subcutaneous electrode on recording quality should be investigated further.

NEW & NOTEWORTHY This study is the first publication comparing the detection of clinically relevant, pathological EEG features from a subcutaneous recording system designed for out-patient ultra-long-term use to gold standard scalp EEG recordings. Our study shows that subcutaneous channels are very similar to comparable scalp channels, but also point out some issues yet to be resolved.