Simultaneous Recording of intra-cerebral EEG, surface EEG and MEG during Visual Stimulation

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Résumé

Electroencephalography (EEG), magnetoencephalography (MEG), and intracerebral stereotaxic EEG (SEEG) are three neurophysiological recording techniques thought to capture the same type of brain activity. Still, the relationship between surface (EEG, MEG) and depth (SEEG) signals remains largely unknown. Previous investigations based on separate recording sessions could not compare and integrate signals stemming from the same neural events. Here we present the first simultaneous recording of these three signals, along with a detailed analysis of their relationships. A patient with intractable epilepsy had intracerebral electrodes implanted for presurgical evaluation purposes and was presented a visual stimulation paradigm. In a first step, our analysis characterized the MEG artefact caused by the SEEG equipment. In a second step, the average evoked activities were computed at the sensor level and cortical source activations were estimated for both EEG and MEG. These were shown to be compatible with the spatiotemporal dynamics of the SEEG signals. Finally, a fine-grained coupling between the amplitudes of the three recording modalities was detected at the level of single evoked responses. These findings reveal that trimodal EEG-MEG-SEEG recordings can be used to investigate brain signals and brain functions at a newly obtained level of specificity.

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