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Dipole Versus Distributed EEG Source Localization for Single Versus Averaged Spikes in Focal Epilepsy

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Abstract: The aim of this study is to characterize and compare dipole and distributed EEG source localization (ESL) of interictal epileptiform discharges (IEDs) in focal epilepsy. Single and averaged scalp IEDs from eight patients - four with benign focal epilepsy of childhood with centrotemporal spikes (BFEC) and four with mesial temporal lobe epilepsy (MTLE)- under went independent component analysis (ICA) from IED onset to peak. The boundary element method forward model was applied to one of four inverse models: two dipolar- moving regularized, rotating nonregularized and two distributed- standardized low-resolution electromagnetic tomography with rotating cortical sources or with fixed extended sources. Solutions were studied at IED onset, midupswing, peak; ESL strength maxima; ESL residual deviation minima (best fit). From 11,040 ESL parameter points and 960 ESL maps, best-fit dipole and distributed solutions fell at the IED midupswing in BFEC and MTLE when the dominant ICA component typically peaked, localizing to the lower Rolandic sulcus in BFEC and to basolateral or anterior temporal cortex in MTLE. Single-to-averaged ESL variability was high in MTLE. Dipole and distributed ESL are complementary; best-fit solutions for both occupy the IED midupswing and not the IED peak. ICA, a "blind" statistical operation, aids clinical interpretation of ESL fit quality. Single-to averaged IED localization discordance can be high, a problem warranting further scrutiny if ESL is to earn a place in routine epilepsy care.

KeyWords: EEG source localization, Dipole, Distributed, Focal epilepsy.

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