

Cortical localization of scalp electrodes on three-dimensional brain surface using frameless stereotactic image guidance system

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Background and Objective: Cortical localization of EEG signals provides critical information regarding evaluation and management of patients with partial epilepsy. This localization method require the knowledge of the precise position of scalp electrodes with respect to the anatomical structures.¹ We evaluated the position of scalp electrodes of 10 patients to determine their cerebral cortical anatomy, using frameless stereotactic image guidance system.

Methods: We studied 10 patients with epilepsy (5 males, mean age 29.7 years old). Thin slice coronal T1 weighted MR images were obtained using a 1.5 Tesla General Electric SIGNA system. Scalp EEG electrodes were placed based on the international 10-20 system. Cortical locations of scalp electrodes were determined using a real-time frameless stereotactic image guidance system, *Brainsight*, which utilized infrared position sensor camera and photo-reflecting trackers.

Results: The locations of 19 scalp electrodes in each patient were determined with respect to sulcal and gyral anatomy. Determined locations were marked on one representative three-dimensional surface rendering of the brain. We found Fp1 (Fp2) on the anterior pole of left (right) frontal lobe; Fz on the midline, adjacent to the mid-point of the frontal lobes anterioposteriorly; F3 (F4) on left (right) middle frontal gyrus, between posterior 1/3 and 1/2; F7 (F8) on pars triangularis of left (right) inferior frontal gyrus; Cz on the midline adjacent to the precentral gyrus; C3 (C4) on left (right) precentral or postcentral sulcus, or just posterior to postcentral sulcus between upper 1/4 and upper 1/2 of central sulcus; T7 (T8) on mainly left (right) middle temporal gyrus but also superior or inferior temporal gyrus, midportion anteroposteriorly; Pz on the midline, mainly midportion between central sulcus and parieto-occipital sulcus; P3 (P4) on mainly angular gyrus of left (right) inferior parietal lobule just below the intraparietal sulcus but also just above the intraparietal sulcus; P7 (P8) on the posterior temporal area just anterior to the temporo-occipital margin of left (right) inferior temporal gyrus but also middle temporal gyrus; O1 (O2) on left (right) occipital pole.

Discussion: According to our results, real locations of scalp electrodes were well concordant to the conventional concepts of their locations. However, their detailed anatomic positions vary from person-to-person. For example, the cortical location of T7 electrode was middle temporal gyrus in some patients and superior temporal gyrus in others. The variations of cortical locations of scalp electrodes were greater in posterior regions of the brain and this observation was consistent with previous reports of asymmetries in human cortical anatomy.² The individual differences of the scalp electrode locations may be due to the different size and morphology of brain in each patient. A precise cortical localization of scalp electrodes is even more important in patients with intractable partial epilepsy, when epileptic focus is localized for epilepsy surgery.

References

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