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Functional Localization and Functional Connectivity with LORETA

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Functional Localization and Functional Connectivity with LORETA: Comparison of Normal Controls and First Episode, Drug Naive Schizophrenics

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Two important general questions arise when studying the human brain: what function does each part have, and how do these different parts interact. Answers to both questions can be obtained with an EEG-based functional imaging technique: low-resolution brain electromagnetic tomography (LORETA). This method provides high time-resolution information on the three-dimensional distribution of electric neuronal activity in the brain.

In this report, nine acute, neuroleptic-naive, first-episode, productive schizophrenics were compared to 36 normal controls. Nineteen-channel EEG was recorded during resting condition.

In a first step, the neuronal generators of different EEG frequency

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For a complete discussion of LORETA and other examples plus literature references and reprints see: <http://www.unizh.ch/keyinst/NewLORETA/LORETA01.htm#WhatsLORETA>)

bands were examined, with the purpose of identifying brain regions with deviant activity of different functional significance. Patients showed an excess of Delta frequency band generators (inhibitory pattern) in anterior brain areas; deficit of Theta, Alpha 1 (8-10 Hz) and 2 (10-12 Hz) (normal resting pattern) in anterior-inferior areas for Theta, and in anterior left for Alpha 1 and 2; excess of Beta 1, 2 and 3 (excitatory pattern) in posterior-superior right hemisphere areas.

In a second step, “interactions between parts” were investigated. Functional connection between two brain regions was quantified by the correlation between current density signals computed at those sites. The spatial correlation structure was modeled in terms of contributions from isotropic connections (short range connections between any two neighboring regions in the brain), and from long-range connections. Patients exhibited significantly decreased functional connections in the Theta band for the following features: the global whole-brain functional connectivity, and the spatial extent of short-range connectivity. In particular, connections between anterior brain regions were impaired in the patients, as shown in Figure 1.

FIGURE 1. Impaired Functional Connectivity in Drug Free Schizophrenics (See text for explanation.)

