Temporal and Spatial Congruence of Components of Motion-Onset Evoked Responses Investigated by Whole-Head Magneto-Electroencephalography

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The technique of electroencephalography (EEG) is traditionally used in Medicine to study cerebral electrophysiological processes. It is however difficult to determine with precision the location of neuronal sources concerning cerebral activity to be studied using EEG. This is due to the fact that electrical currents are strongly distorted by the skull which is a strong isolator of the electrical activity.

Magnetoencephalography (MEG) is a recent technique that enables the non-invasive measurement of the magnetic fields associated to the cerebral electrical activity. Since cerebral magnetic fields are almost not influenced by the conductivity of the biological tissues, MEG is a very powerful technique in the study of brain, allowing a very precise location of the cerebral neuronal sources by applying mathematical models.

As the information provided by MEG and EEG is not exactly the same, the combined use of the two techniques can be of great advantage in the study of brain processes. MEG and EEG can, in this way, be very useful in the understanding of the sensory systems. In the present communication, MEG and EEG were applied to the study of some aspects of the processing of visual signals by the visual cortex which is a very complex and relatively unknown system.

Motion-onset related components in averaged whole-head co-recorded MEG and EEG responses of 24 adults to a low-contrast checkerboard pattern were studied. The aims were to identify these components, to characterize quantitatively their maps and to localize the underlying sources by equivalent-current-dipole (ECD) analyses with a sphere model.

In the EEG response, after a weak positive P1, a large start-elicited negativity arises, comprising the novel N2a (occipital positive and parieto-central negative, peak-latency 140 ms) and the N2 like N2b (bilateral parieto-temporal, 173 ms) component. It is followed by a large positive stop-related component, P2 (239 ms). The corresponding MEG components N2am and N2bm showed bilateral dipole fields with considerable overlap. P1m has a single dipole field around the midline. N2a(m) and N2b(m) can be described with 2 bilateral ECDs. The study shows that accurate mapping and ECD analyses can distinguish respectively. The study shows that accurate mapping and ECD analyses can distinguish these two neighbouring sources (in the MEG 16±3 mm separated) which activity is reflected in spatio-temporally closely related N2(m) components. The analysis suggests that N2b(m) results from the activity of the source that arises N2a(m). N2a(m) and N2b(m) originate extrastriate, possibly close to or in V3A and in the motion specific area MT/V5 respectively.