**MOVEMENT AND THE BRAIN'S ELECTRICAL ACTIVITY (EEG)**

Prof. Pekcan Ungan, PhD
Koç University School of Medicine, Dept. Biophysics
Member, Science Academy, Turkey

While we perform a cognitive or motor function, synchronization or desynchronization occurs among the electrical activities of neurons in some cortical regions of the brain related to that function. These events which cause dendritic or basal depolarization and hyperpolarization of the cortical pyramidal neurons, are reflected in the scalp-recorded electroencephalogram (EEG) as certain spatio-temporal patterns. The EEG can be recorded non-invasively by attaching a number of electrodes each picking potentials from a different scalp location. We can therefore monitor and study, with a temporal resolution at the order of milliseconds, the dynamics of the neural systems responsible for movements of extremities.

The movement-related cortical potential, which is recorded with larger amplitudes at central electrodes (Cz, C3, C4), includes two components; the "Readiness Potential" (Bereitschaftspotential), which is a gradual negative shift starting around 2 second prior the movement onset and increasing its slope 0.5 second before the movement, and the "Motor Potential" around the movement onset. The initial slow phase of the former is associated with movement preparation and its main neural generators are the supplementary motor area and pre-motor cortex. The steeper negative shift in its late phase is generated with an increased contribution from the primary motor cortex. There are studies reporting a proportional relationship between the amplitude of this negative shift and the muscular force level. The motor potential, which is recorded above the contralateral motor area, is the final EEG signal related to triggering of the neuronal discharge into the pyramidal tract, descending to activate the spinal cord.

The other important EEG phenomenon related to movement is called event-related desynchronization/synchronization (ERD/ERS), which is observed as amplitude decreases or increases in the alpha and/or beta frequency bands of the $\mu$-activity generated in the somatosensory (Rolandic) cortex. This movement-related ERD/ERS can best be measured at the bilateral central electrode contralateral to the moving extremity (C3 or C4). Because it occurs not only before, during, and immediately after an actual movement but also when a motor act is imagined, the ERD/ERS phenomenon is being used to build EEG-based brain-computer interfaces (BCI), which will hopefully provide a new communication channel between the human brain and a computer.