Localized Movement Related Potential Recording Using a Laplacian Tri-polar Concentric Ring Electrode

Introduction-Brain activity generates electrical potentials that are spatio-temporal in nature. EEG is the most widely used non-invasive technique for diagnosing many brain-related problems. The EEG has good temporal resolution but lacks the spatial resolution.

Background-The surface Laplacian, the second spatial derivative of the potential, can significantly enhance the spatial resolution and selectivity of EEG. The concentric ring tri-polar electrode (nine-point method) has been shown to better approximate the Laplacian compared to bipolar (five-point method) and quasi-bipolar electrodes (quasi-bipolar method).

Methods-A unique low impedance tri-polar electrode was built based on the nine-point method. The movement related potential (MRP) signals were recorded using 1cm gold disc electrodes and concentric ring electrodes, at FP1 of the international 10/20 system. The MRP signals were generated by pressing a micro switch with the right index finger. The MRP signals from disc electrodes, and bipolar, quasi-bipolar, and tri-polar concentric ring electrode configurations were compared.

Results-The tri-polar electrode was shown to better localize MRP activity compared to other electrode systems. The tri-polar electrode had improved spatial filter characteristics and spatial selectivity than the disc electrodes and other concentric ring electrodes.

Conclusion-Our new Laplacian tri-polar electrode system allows recording of more localized MRP signals compared to other electrodes.

Keywords: Surface Laplacian, nine-point method, tri-polar, and spatial selectivity.