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Differentiating Parkinson's disease from advanced essential tremor using EMG

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Objective: The primary objective of this study is to find out the appropriate spectral parameter from the electromyography (EMG) signals which quantitatively classify PD from ET tremor.

Background: Essential tremor (ET) and the tremor in Parkinson's disease (PD) are the two most common pathological tremor forms encountered in clinical practice. Differential diagnosis between the two tremors is usually achieved clinically. There is a certain overlap in the presentation of these tremor forms while the clinical differentiation on purely clinical grounds might be challenging.

Methods: EMG recordings on the more affected side of 194 age (60.84 ± 8.9 years) and sex matched (M=120; F=74) ET and PD patients were analyzed. Postural tremor was recorded from the more affected side, while subjects extended their hands and fingers actively to a 0° position with the resting forearm. This posture was held against gravity, and in this condition the tremor was recorded for a period of 30 seconds. The parameters from the power spectra of the EMG were tremor frequency, peak power, number of harmonic peaks, waveform asymmetry (autocorrelation decay), mean peak power of all harmonic peaks, coherence (antagonistic muscles), frequency-frequency coupling, phase-phase coupling and power-power coupling were estimated on the basic and harmonic frequencies. The reliable parameter for the classification was quantified with a support vector machine (SVM) classifier (50% training; 50% testing).

Results: Tremor frequency, peak power, number of harmonic peaks showed less than 50% classification accuracy for the testing data. Whereas mean peak power of all harmonics showed 93% classification accuracy for the discrimination (PD>ET), frequency-frequency coupling showed 95% (ET>PD), phase-phase coupling showed 96% (ET>PD), power-power coupling showed 98% (PD>ET) respectively.

Conclusions: The relation between the basic and harmonics peak frequencies play a major role in distinguishing ET from PD tremor. The mean peak power of all harmonics and the three coupling estimates are applicable measures to separate by the aid of artificial learning algorithms clinical difficult entities of ET from PD tremor cases with a very high reliability.