Differentiation Between Movement Disorders By Cortical Activity

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Objective:
Movement disorders, including Parkinson's disease (PD) and essential tremor (ET), have overlapping symptoms, which hamper diagnostics. To improve diagnostics, objective parameters may help to differentiate PD from ET. Therefore, this study aims at differentiating between PD, ET and healthy controls (HC) by comparing $\alpha$- (8-13Hz) and $\beta$-band (13-40Hz) scalp EEG power during rest and arm movements.

Background:
Changes in power of specific EEG frequency bands are often described as either desynchronization (power decrease) or synchronization (power increase). Studies in HC have shown desynchronization in the $\alpha$- and $\beta$-bands around 10 and 18-22Hz during movement. Studies also have shown altered synchronization in PD and ET, using subdural electrodes. Whether altered EEG synchronization in PD and ET, can be used for diagnostics has not been demonstrated, yet.

Methods:
This pilot study included, 2 PD, 4 ET patients (off medication) and 3 HC. Subjects performed 2 tasks with eyes open, while 64-channel EEG (10-20 system) was recorded: 1) rest (3 min) and 2) self-paced elbow flexion/extension (1 min). Subjects were seated on a bed with the head fully supported. EEG derivations across the motor cortex (C5-C6) were analyzed by segmenting it into 3s epochs and estimating the power spectral density (PSD) using a periodogram, with 50% epoch overlap.

Results:
The mean PSD at C5, Cz, and C6 are depicted in Figure 1. During rest (A), PD and ET had an increased synchronization in the $\alpha$-band compared to HC with a peak around 9Hz (with PD>ET). This has been described in literature for PD. Furthermore, ET showed increased synchronization in the $\beta$-band, with a peak around 22Hz. During movement (B) the peak around 9Hz remained in PD (at all analyzed electrodes) and at the most lateral ones (C5, C6) in ET. Again, ET showed increased $\beta$-band synchronization, compared to PD and HC. Compared to the rest task, a desynchronization of the $\alpha$- and $\beta$-band occurred at all electrode positions and in all groups.

Conclusions:
This pilot study found altered synchronization in PD, ET and HC using scalp EEG, indicating that non-invasive scalp EEG might be a useful diagnostic tool to differentiate between movement disorders. These findings will be evaluated with larger group sizes.
References:

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