Correlation Between Clinical Rating of Parkinsonian and Essential Tremor and Quantitative Assessments

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Introduction

Tremor in Parkinson's disease (PD) is described as a resting tremor of low amplitude with frequency of 4-6 Hz. Besides resting tremor, PD patients may concurrently present with action and postural tremor. Essential tremor (ET) is usually monosymptomatic, and predominantly action and postural. The current methods for evaluating motor symptoms are the Unified Parkinson's Disease Rating Scale (UPDRS) for Parkinson's disease (PD) and the Essential Tremor Rating Assessment Scale (TETRAS*) for Essential Tremor (ET). Both are subjective assessments completed during an office visit. Motor symptoms are rated on a scale from 0 – 4 corresponding to normal, slight, mild, moderate, and severe. However, interpretation of a single examination is limited, particularly in patients with motor fluctuations. Periodic, objective monitoring of symptoms may therefore aid in evaluating the efficacy of treatment protocols and improve overall patient management. The aim of this study is to correlate clinical tremor rating scales including the UPDRS and TETRAS with quantitative assessments using the Kinesia™ motor assessment system.

Methods

Kinesia™ (CleveMed) is a user-worn, compact wireless system that uses three orthogonal accelerometers and three orthogonal gyroscopes to monitor three-dimensional motion (Fig 1). Nineteen patients with PD (13) and ET (5) and one patient with both PD and ET were recruited from the Parkinson's Disease Center and Movement Disorders Clinic, Baylor College of Medicine and signed an informed consent approved by the Baylor IRB.

Figure 1. Kinesia™ consists of a finger worn sensor unit that contains three accelerometers and three gyroscopes, and a wrist worn command module that wirelessly transmits data to a computer.

The Kinesia system (finger worn sensor and wrist worn command module) was attached to the patients who then followed on screen video instructions while data was wirelessly transmitted to a computer. The instructions automatically guided each patient through an evaluation for rest tremor, postural tremor, and kinetic tremor while the tasks were videotaped (fig 2).

Figure 2. The Kinesia software uses clinical videos to automatically guide patients through motor tasks while motion data are recorded.

Data Collection

The video taped sessions were scored by a clinician using either the UPDRS or TETRAS. Correlative analyses between clinical rating scores and the quantitative variables were performed.

Table 1 PD – 14 patients	Mean	SD	Range
UPDRS-III score	28.1	13.2	3 - 58
Rest tremor	0.79	0.89	0-2
Postural tremor	0.75	0.64	0-2
Kinetic tremor	0.55	0.60	0-2

Table 2 ET – 6 patients	Mean	SD	Range
TETRAS score	19.3	6.4	10.5 - 30
Postural tremor	1.3	0.4	0-2
Kinetic tremor	1.8	0.8	0-2

Results: Parkinson's Disease

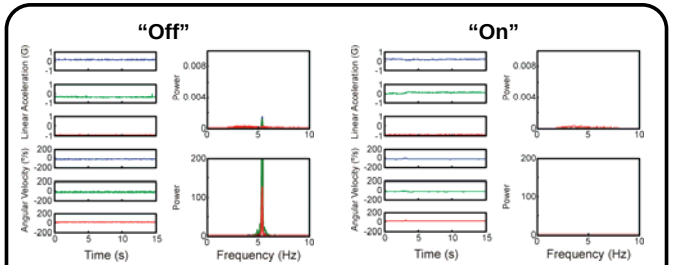

Figure 3. Kinematic data was recorded during both the "Off" and "On" states for a patient with PD during the postural tremor task. The left side of each plot show the six kinematic signals recorded (3 accelerometers, 3 gyroscopes). The right side shows their corresponding power spectra. The peaks in the power spectra are significantly larger in the "Off" state than in the "On" state.

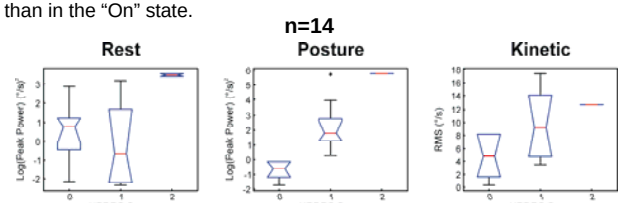

Figure 4. Quantitative features extracted from the signals recorded on the gyroscopes are plotted versus the average clinician score for each of the three tasks (logarithm of the peak power for rest and postural tremor; root-mean-square for kinetic tremor. The tops and bottoms of each "box" are the 25th and 75th percentiles of the samples, respectively.

Results: Essential Tremor

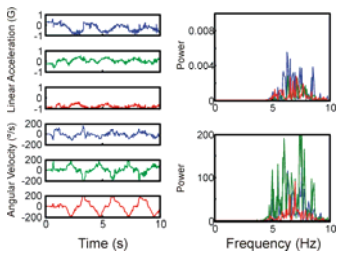

Figure 5. Six channels of kinematic data (3 accelerometers, 3 gyroscopes) recorded from a patient with ET. The subject was instructed to reach out directly in front of himself and then touch his nose repeatedly. The slow moving waves, indicating that the subject reached to and from his nose three times, are super imposed with smaller amplitude, higher frequency waves that indicate kinetic tremor. The signals were band pass filtered to remove slow frequency volitional components. The power spectra of the filtered signals are shown on the right.

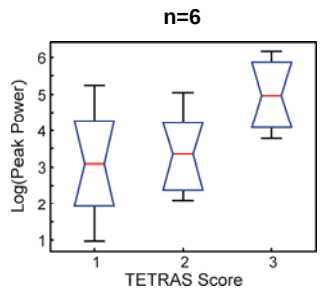

Figure 6. The logarithm of the peak power increases with increasing TETRAS scores for postural and kinetic tremor.

Conclusions

Improving quantitative measurement of tremor with the goal of obtaining objective and standardized data, is of clinical importance in determining changes in tremor characteristics before and after therapeutic interventions. The Kinesia™ system is a portable, movement disorder monitor that objectively quantifies the kinematics of movement disorder motor symptoms. Quantitative data collected with this system correlates well to subjective clinician rating scale scores and shows quantitative difference between on and off states. Kinesia provides a standardized platform for objective monitoring of motor symptoms associated with Parkinson's disease and essential tremor that can be used as an assessment of existing and novel therapeutic interventions.

References

* Elble R et al. for the Tremor Research Group. The Essential Tremor Rating Assessment Scale (TETRAS) Mov Disord 2008;23(S1): S357 [abstract]

Acknowledgements

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