Correlation between Kinesia™ System Assessments and Clinical TETRAS Scores in Patients with Essential Tremor

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Background

The Kinesia™ (CleveMed) motor assessment system is a portable, patient-worn wireless device integrating triaxial accelerometers and gyroscopes shown to accurately assess tremor in patients with Parkinson’s disease. The quantitative motion variables processed by this system have not yet been compared with Essential Tremor (ET) clinical rating scales. Recently, a new scale, The Essential Tremor Rating Assessment Scale (TETRAS), was developed by the Tremor Research Group (TRG) for the assessment of action tremor in ET, utilizing a half-point interval, zero to four scale². The scale measures the peak-to-peak amplitude range, which captures the level of excursion of a body part due to tremor.

There are no previous studies correlating TETRAS with quantitative measurements detected by motion transducers. The objective of this study was to determine whether Kinesia system assessments correlate with TETRAS clinical scores for postural and kinetic upper extremity tremor in patients with ET.

Methods

Population Study.

The research protocol was approved by the Institutional Review Board for Human Research at Baylor College of Medicine. We enrolled subjects who satisfied the diagnostic criteria formulated by the TRG for definite or probable ET².

Kinesia recording.

The Kinesia system consists of a finger sensor unit connected to a wrist-worn module (Fig.1). The device was attached to the wrist and subjects were instructed to hold their arms in an outstretched position and then touch their nose while data were wirelessly transmitted to a computer which stored the acquired data.

Clinical assessment.

All subjects were tested on the arm where the system was placed; clinical TETRAS scores for postural (r = 0.569; p = 0.009) and kinetic (r = 0.62; p = 0.004) tremor.

Signal processing and statistical analysis.

A linear regression model was constructed for both tasks using the logarithmic values of the TETRAS scores detected during the clinical examination and the objective motion data parameters (the RMS amplitude or the peak-PDS of selected data vectors). The Kinesia scores for both tasks were computed using the exponential function of the predicted values. Normal distribution of the analyzed scalar variables was tested and correlation analysis was run comparing the outcome measures.

Results

Twelve subjects performed upper extremity postural and kinetic tremor tasks while symptom severity measures were captured both by TETRAS and Kinesia (Fig.2).

Table 1. Clinical data of the enrolled patients:

<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
<th>Gender</th>
<th>Age (years)</th>
<th>Disease duration (years)</th>
<th>Clinical TETRAS score (max 32.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>4</td>
<td>60%</td>
<td>49.5 ± 7.5</td>
<td>11.3 ± 4.8</td>
<td>1.65 ± 0.76</td>
</tr>
</tbody>
</table>

The TETRAS scores detected by the blinded rater using the videos significantly correlated with the scores detected during the clinical examination for postural (r = 0.569; p = 0.009) and kinetic (r = 0.62; p = 0.004) tremor.

The postural tremor regression model was obtained using linear acceleration spectral data. The peak power spectral density provided the greatest correlation with the postural tremor task while the RMS amplitude provided the greatest correlation for the kinetic tremor task. Peak frequencies were not significantly correlated to either tremor tasks.

The postural tremor regression model was obtained using linear acceleration spectral data. The model explained 44.2% of the variation of the dependent variable, with a good correlation between observed and predicted values (r = 0.67). Statistical variation in the dependent variable accounted for by the model was significant (ANOVA: F = 4.26; p = 0.001), as well as coefficients model values.

For the kinetic tremor regression model, the largest correlation to subjective clinical scores was obtained using the RMS values of both linear acceleration and angular velocity. The model explained about 35.3% of the variation of the dependent variable, with a good correlation between observed and predicted values (r = 0.59). Statistical variation in the dependent variable accounted for by the model was significant (ANOVA: F = 4.83; p = 0.025), as well as coefficients model values.

Conclusions

This study demonstrates a significant correlation between two different methods of evaluating action tremor severity in patients with ET: the clinical TETRAS score and the quantitative variables processed by the Kinesia system. Our findings provides evidence that Kinesia assessments are correlated to clinical TETRAS scores, therefore the system may provide a useful adjunct to supplement data from more subjective clinical rating scales.

References


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