Analysis of Tapping Test Results in a Test Battery for Advanced PD Patients

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Introduction

Status assessment in patients with motor fluctuations, such as in advanced Parkinson’s disease (PD), is a difficult task. Paper diaries are problematic since they may not be filled in at designated times [1]. This is overcome by electronic diaries, which can have a good compliance in PD patients [2]. However, patients’ own assessment of function may not correlate well with their actual performance in motor tasks [3]. This was observed when further analyzing the data from [4] (unpublished analysis). Therefore, more ‘objective’ motor tests are warranted. Tapping tests are widely used in assessment of motor function and have been implemented on touch screens in a test battery [5].

A test battery was constructed and implemented on a hand computer with a touch screen and built-in mobile communication. Selection of diary questions was based on the questions from a previous pilot study [2] and a clinical trial [4]. Tapping tests (both without visual cueing, described in Table 1) were added. A photo of this device is shown in Figure 1.

The objective of this work was to analyze tapping test results from this test battery in patients with advanced PD.

Figure 1. The test battery has interfaces for the patient to answer questions and perform motor tasks and gives an audible signal when it is time to enter. Entry is only possible during a limited time slot. There is an interface for clinical staff to assign hand units to patients, define test periods and demonstrate the patient interface. Data is transmitted over the mobile net to a central database and there is a web application that presents summaries of the test results per patient and test period graphically.

The diary questions were:
1. Ability to walk (q1)
2. Time in ‘off’, ‘on’, and ‘dyskinetic’ by placing two lines in a rectangle (q2)
3. ‘Off’ at worst (q3)
4. ‘Dyskinetic’ at worst (q4)
5. Painful cramps (q5)
6. Satisfied with function (q6)
7. Self-assessment (q7)

Questions 1 to 6 relate to the previous four hours, or this morning. Question 7 relates to ‘right now’ and allows seven steps from -3 (very off) to +3 (very dyskinetic). Question 2 gives three answers in percent, whereas questions 1, 3, 4, 5, and 6 are of verbal descriptive scale type between 1 (worst) and 5 (best).

Methods

65 patients (currently on duodenal levodopa/carbidopa infusion (Duodopa®), or candidates for this treatment) entered diary responses and performed tapping tests four times per day during one to six periods of seven days’ length. In total there were 224 test periods and 6039 test occasions. Pearson correlation coefficients between speed and accuracy (percent correct) in tapping tests and diary responses were calculated. Speed for tapping test 10 was discarded (system-generated) and tests 8 and 9 were combined by taking means. To assess the internal consistency of the test battery, Cronbach’s Alpha for the test variables was calculated. For this purpose, off time and dyskinetic time according to question 2 were inverted to have the same scale direction as the other responses (high scores represent good function). Descriptive statistics were used to present the variation of the test variables in relation to a) self-assessment (question 7) and b) time-of-day. In order to study the learning effect, tapping results from the first three days in a test period were compared to results from the remaining days in the period.

Table 1. Descriptions of the tapping tests

<table>
<thead>
<tr>
<th>#</th>
<th>Test explanation</th>
<th>Test area</th>
</tr>
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<tbody>
<tr>
<td>8</td>
<td>Alternately tapping two fields (en-caed) using right hand in 20 seconds</td>
<td>8/9 accuracy, 10 accuracy</td>
</tr>
<tr>
<td>9</td>
<td>Same as 8 but using left hand</td>
<td>8/9 accuracy, 10 accuracy</td>
</tr>
<tr>
<td>10</td>
<td>Tapping an active field (of 4), following a system-generated rhythm (increasing speed), using dominant hand</td>
<td>8/9 speed</td>
</tr>
<tr>
<td>11</td>
<td>Tapping an active field (of 4), as fast as possible. The active field changes location when tapped, dominant hand</td>
<td>8/9 speed</td>
</tr>
</tbody>
</table>

Table 2.

| 1 | Overall satisfied (q6) |
| 2 | Dyskinesia severity (q4) |
| 3 | Painful cramps (q5) |
| 4 | “Dyskinetic” at worst (q4) |
| 5 | Satisfied with function (q6) |
| 6 | “Off” at worst (q3) |

Results

Mean compliance (percentage completed test occasions per test period) was 83% and the median was 93% (two missed occasions). See Figure 2 for a histogram. Correlation coefficients (Table 2) between diary responses and tapping results were small. Among the tapping tests, correlations were larger and were all positive. Cronbach’s Alpha was 0.81, suggesting good internal consistency. There were large differences in both mean tapping speed and accuracy between the different self-assessed states (Figure 3). Tapping test results did not differ significantly between different times-of-day, although many diary responses indicated an optimal function around noon (Figure 4). The learning effect between the three first days and the remaining days in a test period was not detectable (Figure 5).

Conclusions

The tapping results provided different information as compared to the diary responses. All correlations between tapping test results were positive, meaning that both speed and accuracy probably reflect motor symptoms. Internal consistency of the test battery was good and learning effects in tapping tests were small.

Ongoing work includes combining test items into an overall score per patient and test period that has good agreement with clinical rating scales. This score is being evaluated in a validation study, assessing test-retest reliability and agreement with UPDRS.

References