Tremor, Spirals & Handwriting

National Tremor Foundation
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Tremor severity can be documented by a simple (0-10) clinical rating scale or spiral score.
Reference book with examples of ET spirals with different tremor severities, scored from 0-10
Effect of DBS on tremor in a spiral

Stimulation ‘off’

Stimulation ‘on’
What else can we find out from a spiral?

M Knobel & PG Bain

- 103 Parkinsonism
  - 76M, 27F
  - Mean age: 71yrs (range 40-85)

- 41 Essential tremor
  - 25M, 16F
  - Mean age: 58yrs (range 17-84)

- 7 Dystonic tremor
  - 1 M, 6F
  - Mean age: 58yrs (range 20-77)
Spiral severity at first clinic appointment

Significant differences:

1. ET v PD (p=0.0003)
2. DT v PD (p=0.01)

But not: ET v DT
Spiral diameters (3 or 5 turns)

Significant difference: ET > PD diameter

ET v PD Spiral Diameter

PD mean: 2.6cm & 3.6cm
ET mean: 3.0 cm & 4.4 cm

3 turns: p=0.03
5 turns: p=0.01
Spiral density
Completed turns per cm

PD v ET Spiral density
Initial spiral density: PD mean: 7.3 > ET mean 3.3: (p=0.013)
First affected hand: $p = 0.003$; Most affected hand: $p = 0.0003$
Writing Length by Condition

‘Mary had a little lamb’
Difference between ET & PD Spirals

ET Spiral

PD Spiral
Can spirals be used to distinguish Parkinson’s tremor from SWEDDs?

NPS Bajaj, M Knobel, V Gontu, PG Bain

- Patient’s with Parkinson’s disease have abnormal DaTSCANs
- About 5-15% of people thought to have Parkinson’s disease (by MDS) were found to have normal DaTSCANs
  - These patients probably do NOT have PD
  - They are termed ‘SWEDDs’:
    - ‘Subjects Without Evidence of Dopamine Deficits’
    - Some SWEDDs patients are thought to have dystonic tremor
Can spirals be used to distinguish Parkinson’s tremor from SWEDDs?
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Blinded assessment of 65 patients’ R & L hand spirals from Nottingham:

- 24 Patients: tremor dominant Parkinson’s disease
  - All 24 had abnormal DaTSCAN
- 41 Patients: tremor but do not have Parkinson’s
  - All 41 had normal DaTSCAN (SWEDDs)

Measured:
- Tremor severity (0-10 scale)
- 3-turn spiral diameter (cm)
- Spiral density (turns/cm)
Can spirals be used to distinguish Parkinson’s tremor from SWEDDs?
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Results:

- Tremor Dominant PD Spirals were:
  - Smaller diameter than those of other tremor patients
    \( p=0.029 \)
  - Greater spiral density than those of other tremor patients
    \( p=0.0082 \)
  - Similar tremor severity
    \( P=0.11 \)
Can spirals be used to distinguish Parkinson’s tremor from SWEDD’s?  

NPS Bajaj, M Knobel, V Gontu, PG Bain

Results:

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tremor severity</td>
<td>63%</td>
<td>65%</td>
</tr>
<tr>
<td>Spiral density</td>
<td>30%</td>
<td>83%</td>
</tr>
<tr>
<td>3-turn diameter</td>
<td>75%</td>
<td>57%</td>
</tr>
<tr>
<td>2 MDS experts (videotape)</td>
<td>86%</td>
<td>81%</td>
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Can handwriting be used to distinguish Parkinson’s tremor from SWEDDDs?
NPS Bajaj, L Wang, V Gontu, PG Bain

<table>
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<th></th>
<th>Micrographia</th>
<th>Normal</th>
<th>Large</th>
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</thead>
<tbody>
<tr>
<td>Parkinson’s disease</td>
<td>11</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>SWEDDDs: Dystonic</td>
<td>3</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>SWEDDDs: Indeterminate</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Conclusions:
1. Micrographia: Not specific for Parkinson’s
2. Large writing: Probably dystonic tremor
Does handwriting differ in different types of Parkinson’s Disease?
NPS Bajaj, W Lei, V Gontu, PG Bain

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<td>0</td>
</tr>
<tr>
<td>Tremor Dominant PD</td>
<td>6</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Postural instability &amp; gait disorder</td>
<td>5</td>
<td>0</td>
<td>0</td>
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</table>

**Conclusions:** Micrographia significantly more frequent in PIGD than TDPD, \( P=0.0063 \)
**TECHNOLOGY assisted diagnosis**

**New IPhone Application Revolutionizes ET Diagnosis and Management**

The diagnosis and assessment of ET and other tremor disorders, as well as the working relationship between doctor and patient are — potentially — going to be revolutionized through the use of smartphone technology applications currently used in cell phones such as iPhone and Blackberry smartphones.

**Touch Diagnostics**, the leading developer in the new field of mobile medical health (mHealth) recently introduced *TremorTracer*, their new IPhone application. According to CTO Brent Gutekunst, tremorTracer provides a way for a physician to accurately, easily and conveniently measure, transmit and record standard tremor assessments that help in diagnosing the cause of tremor and managing it.

This is exciting news for people affected by ET. Because there is currently no diagnostic test for ET, many people are at first misdiagnosed with Parkinson’s disease and other conditions causing tremor. If a condition cannot be accurately diagnosed, it cannot be correctly treated.

“The potential of a tool like this to monitor and manage ET is huge,” says International Essential Tremor Foundation’s (IETF) Executive Director, Catherine Rice. “I can speculate that this will have implications in the medical management of medications, medical record keeping, monitoring of ET progression, and in reduced patient costs through the elimination of unnecessary office visits. It is exciting to see where this type of technology will take us. But the most important thing about this is that it brings ET out into the open into the forefront of medicine.”

“I would consider this a diagnostic aid and personally would welcome something that we (doctors) really could use objectively to measure change. Our eyes only do so much and we tend to forget,” says Sara Salles, DO, University of Kentucky, Physical Medicine and Rehabilitation and IETF Medical Advisory Board member.

According to Gutekunst, the TremorTracer application includes the following three tests developed with the help of two movement disorder specialists:

- **The Archimedes Spiral Test** — This test is widely used in differentiating ET from Parkinson’s disease. A patient traces a spiral pattern on the IPhone screen, which is then recorded.
- **The Writing Test** — An extension of the tracing test, this test requires pen to write characters on the screen.
- **The Straight Line Test** — A time-based test where persons trace straight lines across the screen.

“We’re very excited about this,” says Gutekunst. And so are persons with ET. He says, “It’s is immediate enthusiasm. They thank us and then ask when the application will be available for their Blackberry.”

And he has an answer for them. Later this year TremorTracer will be available for other smartphones, including Blackberry smartphones, and for Apple’s new iPad. As revolutionary as all this sounds, Gutekunst says that this medical revolution is not limited to technology. He also sees the response he has received from the ET community as validating his belief that there is a revolution taking place in medicine.

“IT is a change came from the top down, physician to patient, but now the revolution is from the bottom up — patient to physician.” Gutekunst continues, “This also revolutionizes the relationship between doctor and patient from being limited to a ‘one point in time’ appointment every six months to a continuous ongoing relationship.”

“We are at the forefront of change. Where it will lead — no one can predict — but the change will go far and it is coming on fast,” says Gutekunst.

Founded in 2006, Touch Diagnostics (www.TouchDX.com), located in Del Mar, CA, uses smartphone technology to provide convenient ways of improving medical diagnostic methods that help maintain better health for patients worldwide. The TremorTracer application is now available fordownload to IPhones at www.TouchDX.com for $3.99.
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