Dr. Gilles de la Tourette

- Georges Gilles de la Tourette
  - born in 1857, was a French physician
  - first reported case of Tourette's syndrome (TS)
  - by another French doctor named Itard in 1825.
  - 1885: Dr. de la Tourette described nine
    patients with the syndrome of multiple motor and
    vocal tics.

Cardinal Symptoms of TS

- neurological disorder, becomes evident in early
  childhood or adolescence (~3 – 15)
- Affects ~3% of population
- By age 18, 90% report remission, 40%
  symptom-free (Freeman et al., 2000)
- characterized by tics -- involuntary, rapid, 
  sudden movements or vocalizations that occur
  repeatedly in the same way (both motor and
  vocal)
- many people report premonitory urges

Simple vs Complex Tics

<table>
<thead>
<tr>
<th>Simple Tics</th>
<th>Complex Tics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocal:</td>
<td>Vocal:</td>
</tr>
<tr>
<td>throat clearing</td>
<td>echolalia</td>
</tr>
<tr>
<td>sneezing</td>
<td>coprolalia</td>
</tr>
<tr>
<td>sniffing</td>
<td>phrases out of context</td>
</tr>
<tr>
<td>Simple Tics</td>
<td>Complex Tics</td>
</tr>
<tr>
<td>Motor:</td>
<td>Motor:</td>
</tr>
<tr>
<td>eye blinking</td>
<td>jumping</td>
</tr>
<tr>
<td>head jerking</td>
<td>smelling</td>
</tr>
<tr>
<td>shoulder shrugging</td>
<td>touching people</td>
</tr>
<tr>
<td>facial grimacing</td>
<td>self-injurious actions</td>
</tr>
</tbody>
</table>

Comorbidities

- associated conditions can include ADHD, usually a family history of tics, TS, 
  ADHD, OCD
- occurs in all ethnic groups
- males affected 3 to 4 times more often than females

Pathophysiology of TS

- Believed to be a cortico-striato-thalamo-cortical dysfunction

Thinning of sensorimotor cortices in children with Tourette syndrome

Elizabeth R Sowell, Eck Kan, Jane Yoshii, Paul M Thompson, 
Kori Banas, Donghun Xu, Anthony Toga, & Bradley S Petersen

Imaging Rounds
September 9th 2008
Premonitory Urge

- Involuntary aspect of TS
- Urge to tic just before
- Analogy: urge to itch
- Estimate: 79 - over 95% experience premonitory urge (Cohen & Leckman, 1992; Leckman et al., 1993)
- Mean age of awareness: 10.0 years (3.1 years after onset of tics) (Leckman et al., 1993)

"A need to tic is an intense feeling that unless I tic or twitch I feel as if I am going to burst. Unless I can physically tic, all of my mental thoughts center on ticking until I am able to let it out. It’s a terrible urge that needs to be satisfied."

Introduction & Hypothesis

- Motor tics most commonly affect musculature of face, neck and shoulders (inferior sensorimotor strip)
- Vocal tics affect skeletal muscles of the larynx, abdomen and upper respiratory system

Hypothesis

- TS: thinning in sensorimotor cortices, the portions of CSTC circuits that control movement and vocalization, in direct proportion to the severity of tic symptoms.

Methods

- TS: 25 children and adolescents (mean age 12.4 years, 7 to 18 years, 7 female) recruited from Tic Disorder Clinic at the Yale Child Study Center.
- CON: 35 children and adolescents (mean age 12.3 years, 7 to 21 years, 10 female).
- YGTSS, YBOCS
- TS/ADHD n = 5
- TS/OCD n = 4
- At time of imaging: 11 of 25 TS subjects on alpha agonists, typical neuroleptics, SSRIs, or some combination.
Methods – cont’d
• Yale Global Tic Severity Scale (YGTSS)
  – Simple facial and body tics were also evaluated separately (with novel scoring scheme):
  • large proportion of the ventral sensorimotor strip dedicated to controlling muscles of face and neck (most commonly affected by tics).
  • dorsal portion of sensorimotor strip controls the muscles of the body and extremities (less commonly affected by tics).

Image Acquisition
• 1.5 Tesla superconducting MRI magnet (Signa; General Electric, Milwaukee, WI) located at Yale University.
• MRI Protocol: whole–brain 3D gradient–echo (SPGR) T1–weighted series reconstructed in sagittal plane
  • TR = 24 ms, TE= 5 ms, NEX= 2, flip angle = 45°, FOV = 30 cm
  • matrix = 256 x 192, 124 slices with slice thickness of 1.2 mm, no gaps, acquisition time, 19 minutes.

Cortical Thickness Analysis
• Used cortical pattern matching – relies on manually defined sulcal and gyral landmarks as anchors to a surface-warping algorithm to relate homologous features of cortical anatomy across subjects
• Permutations used
• Correlations

Permutation test results for cortical thickness analyses
<table>
<thead>
<tr>
<th>ROI</th>
<th>Lateral</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventral Frontal</td>
<td>0.0039</td>
<td>0.0082</td>
<td></td>
</tr>
<tr>
<td>Parietal</td>
<td>0.0739</td>
<td>0.0291</td>
<td></td>
</tr>
<tr>
<td>Occipital</td>
<td>ns</td>
<td>ns</td>
<td>0.0086</td>
</tr>
<tr>
<td>Temporal</td>
<td>0.0953</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

Note: P values reflect the likelihood of observing the number of significant (@ P = 0.05) surface points in each ROI by chance on 10,000 randomizations.
Summary of findings

- **Cortical thinning in TS in sensorimotor portions of CSTC circuits in children** – most prominent in ventral portions. (Recall, ventral regions of sensorimotor cortex controls muscles of face, mouth & larynx).
- **Dorsal regions exhibited greater thinning in overall tic severity** (recall, this area of M1 controls muscles of trunk and extremities).
- **Ventral regions exhibited greater thinning in simple facial tics** (ie –ve r)

Thank you!