A Novel Method for Measuring Cobb Angles

Christopher Kestner, MD
Patrick Cahill, MD
James Reed, PhD
Introduction

- Cobb angles: used to measure degree of curvature in scoliosis
  - Measure from vertebral endplates above and below the peak of the curve
- Goniometer
- Computer angle measuring device
- Error: 3-5 degrees
Introduction

- iPhone accelerometer technology allows angle measurements to be taken using the iPhone itself as a reference.
- This device could be used to measure angles on X-rays.
- Hypothesis: measuring Cobb angles with the iPhone will give equal or improved accuracy, interobserver and intraobserver reliability.
Methods
Methods

- Six examiners: resident, fellow and attending level.
- Measured variable cobb angles on 20 hard copy X-rays with goniometer, then iphone.
- Measured 20 cobb angles from digital X-rays using the computer angle measuring tool, and repeated using the iphone.
- All measurements were repeated two weeks later.
- All X-rays were randomly ordered to prevent bias.
- Measurements were taken from pre-selected vertebral endplates.
- Statistical analysis performed to investigate accuracy, intraobserver reliability and interobserver reliability.
## Results

Table 1: Mean cobb angle measurements (Mean +/- Standard Deviation)

<table>
<thead>
<tr>
<th></th>
<th>Goniometer</th>
<th>iPhone</th>
<th>Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobb angle</td>
<td>40.9 ± 21.7</td>
<td>41.2 ± 21.7</td>
<td>0.39 ± 2.65 (0.05 – 0.73)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Computer</th>
<th>iPhone</th>
<th>Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobb angle</td>
<td>30.6 ± 17.1</td>
<td>31.1 ± 16.9</td>
<td>0.44 ± 4.8 (0.19 – 1.08)</td>
</tr>
</tbody>
</table>
# Results

Table 2: Intraclass Correlation Coefficient

<table>
<thead>
<tr>
<th></th>
<th>Goniometer/iphone</th>
<th>Computer/iphone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrarater ICC</td>
<td>0.997 (0.986 – 0.992)</td>
<td>0.960 (0.947-0.971)</td>
</tr>
<tr>
<td>Interrater ICC</td>
<td>0.993 (0.990 – 0.994)</td>
<td>0.961 (0.949-0.970)</td>
</tr>
</tbody>
</table>
Discussion

- Accuracy of iPhone angle measurement app is within the +/- 3-5 degrees variability for measuring Cobb angles.
- The inter and intrarobserver reliability is excellent.
- This iPhone app is a reliable alternative for measuring Cobb angles.
- Potentially could be used for measuring any angle on an X-ray.
- Sources of Error: More measurements.
References

- Beekam C.E. et al Variability of Scoliosis Measurements from Spinal Roentgenograms Phys. Ther., 59; 1979
- Morrisy, Raymond et al Measurements of the Cobb Angle on Radiographs of Patients Who Have Scoliosis JBJS 72-A; 1990
Thank You!