Variations in Sagittal Spino-Pelvic alignment between different curve patterns of Adolescent Idiopathic Scoliosis: Is the evolution of thoracic scoliosis different than lumbar?

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Introduction: “The Concept”

- Scoliosis can only occur in **backwards inclined areas of the spine** (Castelein et al. 2005)
- Backward inclination -> posterior shear load -> rotational instability (Kouwenhoven et al. 2007)
Rotated segments in Adolescent Idiopathic Scoliosis (AIS) correspond to backwardly inclined segments.

- Reduced rotational stability
- Increased rotational stability
Hypothesis: Different types of scoliosis develop on different sagittal profiles

Thoracic scoliosis  Lumbar scoliosis
Design: Cross-sectional study of sagittal profile at onset of AIS

- Thoracic AIS Cobb 10-20°
- Lumbar AIS Cobb 10-20°
- Control
Methods: Population

ICD-9-code: Idiopathic scoliosis
Standard X-spine AP+lat
10-16yrs old

1389 AIS patients

Exclusion:
- Other spinal or hip pathology (n=151)
- Cobb >20° (n=703)
- Not full visualization of C7-femoral heads (n=54)
- X-ray from outside facility (n=287)
- Lenke III, IV, VI (n=2)

Thoracic AIS
n=128

Lumbar AIS
n=64

Screening for scoliosis
X-spine AP+lat
10-16yrs old

198 screenings

Exclusion:
- Spinal or hip pathology (n=2)
- Scoliosis during follow-up (n=2)
- Not full visualization of C7-femoral heads (n=29)
- X-ray from outside facilities (n=70)

Controls
n=95
Semi-automatic measurement of all standard sagittal parameters and vertebral inclination of each individual spinal level
Demographics: no differences between cohorts

<table>
<thead>
<tr>
<th>Demographic parameter</th>
<th>Thoracic scoliosis (n=128)</th>
<th>Lumbar scoliosis (n=64)</th>
<th>Controls (n=95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>13.0 (±1.8)</td>
<td>13.6 (±1.7)</td>
<td>13.0 (±1.8)</td>
</tr>
<tr>
<td>Women</td>
<td>95 (74%)</td>
<td>48 (75%)</td>
<td>58 (61%)</td>
</tr>
</tbody>
</table>
# Results: Differences in general sagittal alignment

<table>
<thead>
<tr>
<th>General spinal parameters</th>
<th>Sagittal spinopelvic parameter</th>
<th>Thoracic scoliosis (n=128)</th>
<th>Lumbar Scoliosis (n=64)</th>
<th>Controls (n=95)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>TK (°)</td>
<td>27.6 (±8.0)</td>
<td>41.9 (7.5)</td>
<td>34.9 (9.4)</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>LL (°)</td>
<td>53.9 (10.1)</td>
<td>56.7 (11.3)</td>
<td>53.7 (10.1)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>C7HA (ratio)</td>
<td>11 (12)</td>
<td>7 (12)</td>
<td>5 (9)</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>T4HA (ratio)</td>
<td>18 (11)</td>
<td>17 (10)</td>
<td>14 (8)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>T9SO (°)</td>
<td>7.8 (5.9)</td>
<td>9.4 (4.3)</td>
<td>7.8 (3.6)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>PT (°)</td>
<td>8.5 (8.2)</td>
<td>5.0 (8.8)</td>
<td>5.6 (8.3)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>PI (°)</td>
<td>47.0 (11.8)</td>
<td>41.9 (10.6)</td>
<td>43.3 (12.9)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>SS (°)</td>
<td>39.1 (7.9)</td>
<td>36.9 (8.4)</td>
<td>37.7 (8.6)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>DL (ratio)</td>
<td>79 (9)</td>
<td>67 (10)</td>
<td>68 (10)</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>DI (°)</td>
<td>13.8 (4.4)</td>
<td>17.9 (4.0)</td>
<td>15.4 (4.9)</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>#DV (median)</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>.001</td>
<td></td>
</tr>
</tbody>
</table>
MANOVA: P<0.001

Thoracic scoliosis more posteriorly/less anteriorly inclined

Lumbar scoliosis more posteriorly/less anteriorly inclined
1. Different curve types have different sagittal profile ALREADY early on
2. Backwardly inclined segment corresponds to rotated segment and differs between thoracic and lumbar scoliosis
Disclosure:

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Shah: DePuy Synthes Spine, Globus Medical, Setting Scoliosis Straight Foundation