Discrepancy between radiographic shoulder balance and cosmetic shoulder balance in adolescent idiopathic scoliosis patients with double thoracic curve

Xu-sheng Qiu · Wei-wei Ma · Wei-guo Li · Bin Wang · Yang Yu · Ze-zhang Zhu · Bang-ping Qian · Feng Zhu · Xu Sun · Bobby K. W. Ng · Jack C. Y. Cheng · Yong Qiu

How Well Does Radiological Measurements Correlate With Cosmetic Indices in Adolescent Idiopathic Scoliosis With Lenke 5, 6 Curve Types?

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- Radiographic parameters could only partially reflect cosmetic parameters for AIS patients
- How about CS?
Methods

Subjects: **Inclusion Criteria**

- Diagnosed as CS with right thoracic curve as the main curve (apex T5 - T12),
- With normal sagittal profile (TK < 50°)
- Age 10 - 18y
- BMI < 25
- AIS patients who were well matched to the CS group in terms of age, sex, apex and Cobb angle of main curve (≤ 5°)
Radiographic parameters

- **SHD**
- **T1 tilt**
- **AVT**

#22563 F 13y T6-8 分节不良
Cosmetic parameters

#14485 M 14y
T7-8T7-8 segmentation defects

SAI1

SAI2

SA

AA
Cosmetic parameters

Thoracolumbar area index (TLAI)

Right and left waist angle difference (RLWAD)

Hump index

#14485 M 14y
T7-8 segmentation defects
## Results

<table>
<thead>
<tr>
<th></th>
<th>CS (n=17)</th>
<th>AIS (n=17)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (y)</strong></td>
<td>13.8±1.8</td>
<td>14.7±2.1</td>
<td>0.171</td>
</tr>
<tr>
<td><strong>Sex (M/F)</strong></td>
<td>2/15</td>
<td>2/15</td>
<td>-</td>
</tr>
<tr>
<td><strong>Radiographic data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cobb (°)</strong></td>
<td>56.4±9.0</td>
<td>55.8±11.0</td>
<td>0.804</td>
</tr>
<tr>
<td><strong>CB</strong></td>
<td>-4.8±15.0</td>
<td>0.2±21.7</td>
<td>0.435</td>
</tr>
<tr>
<td><strong>AVT</strong></td>
<td>42.4±21.4</td>
<td>43.1±20.8</td>
<td>0.919</td>
</tr>
<tr>
<td><strong>SHD</strong></td>
<td>-10.0±14.5</td>
<td>-11.6±10.0</td>
<td>0.713</td>
</tr>
<tr>
<td><strong>T1 tilt (°)</strong></td>
<td>-0.3±7.0</td>
<td>-0.3±7.1</td>
<td>0.983</td>
</tr>
<tr>
<td><strong>CA (°)</strong></td>
<td>-9.0±8.6</td>
<td>-7.4±7.0</td>
<td>0.501</td>
</tr>
<tr>
<td><strong>CRCI</strong></td>
<td>-9.0±8.6</td>
<td>-7.4±7.0</td>
<td>0.566</td>
</tr>
<tr>
<td>Cosmetic</td>
<td>CS (n=17)</td>
<td>AIS (n=17)</td>
<td>$P$ value</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td>SAI1</td>
<td>0.91±0.10</td>
<td>0.98±0.10</td>
<td>0.027</td>
</tr>
<tr>
<td>SAI2</td>
<td>0.87±0.16</td>
<td>0.96±0.13</td>
<td>0.041</td>
</tr>
<tr>
<td>SA</td>
<td>-1.3±2.8</td>
<td>-0.5±3.0</td>
<td>0.435</td>
</tr>
<tr>
<td>AA</td>
<td>-3.6±2.8</td>
<td>-3.5±2.7</td>
<td>0.952</td>
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<tr>
<td>Hump index (°)</td>
<td>-9.8±4.6</td>
<td>-7.6±5.3</td>
<td>0.205</td>
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<tr>
<td>TLAI</td>
<td>0.69±0.15</td>
<td>0.75±0.11</td>
<td>0.158</td>
</tr>
<tr>
<td>RLWAD (°)</td>
<td>-2.1±12.9</td>
<td>-0.8±8.3</td>
<td>0.732</td>
</tr>
</tbody>
</table>
## Correlation analysis

### Correlations between cosmesis and the radiographic measurements in CS

<table>
<thead>
<tr>
<th></th>
<th>Cobb</th>
<th>CB</th>
<th>AVT</th>
<th>SHD</th>
<th>T1PA</th>
<th>CA</th>
<th>CRCI</th>
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</thead>
<tbody>
<tr>
<td>SAI1</td>
<td>Correlation</td>
<td>0.252</td>
<td>0.019</td>
<td>-0.135</td>
<td>0.235</td>
<td><strong>0.697</strong></td>
<td>0.366</td>
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<tr>
<td></td>
<td>P value</td>
<td>0.329</td>
<td>0.942</td>
<td>0.604</td>
<td>0.364</td>
<td>0.002</td>
<td>0.148</td>
</tr>
<tr>
<td>SAI2</td>
<td>Correlation</td>
<td>0.340</td>
<td>0.112</td>
<td>-0.281</td>
<td>0.219</td>
<td><strong>0.698</strong></td>
<td>0.366</td>
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<td></td>
<td>P value</td>
<td>0.181</td>
<td>0.669</td>
<td>0.275</td>
<td>0.398</td>
<td>0.002</td>
<td>0.148</td>
</tr>
<tr>
<td>SA</td>
<td>Correlation</td>
<td>0.200</td>
<td>-0.133</td>
<td>-0.025</td>
<td>0.474</td>
<td>0.096</td>
<td><strong>0.580</strong></td>
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<tr>
<td></td>
<td>P value</td>
<td>0.443</td>
<td>0.612</td>
<td>0.923</td>
<td>0.054</td>
<td>0.715</td>
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<tr>
<td>AA</td>
<td>Correlation</td>
<td>0.054</td>
<td>0.119</td>
<td>0.126</td>
<td><strong>0.612</strong></td>
<td>-0.162</td>
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<td>0.630</td>
<td>0.009</td>
<td>0.535</td>
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<tr>
<td>Hump index</td>
<td>Correlation</td>
<td>-0.114</td>
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<td>-0.217</td>
<td>0.152</td>
<td>0.297</td>
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<tr>
<td></td>
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<td>0.662</td>
<td>0.215</td>
<td>0.403</td>
<td>0.561</td>
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<tr>
<td>LAI</td>
<td>Correlation</td>
<td>-0.125</td>
<td>-0.360</td>
<td><strong>-0.734</strong></td>
<td>0.244</td>
<td><strong>0.572</strong></td>
<td>0.264</td>
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<tr>
<td></td>
<td>P value</td>
<td>0.633</td>
<td>0.156</td>
<td>0.001</td>
<td>0.345</td>
<td>0.016</td>
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<tr>
<td>RLWAD</td>
<td>Correlation</td>
<td>0.448</td>
<td>0.433</td>
<td>0.383</td>
<td>-0.359</td>
<td>0.257</td>
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<td></td>
<td>P value</td>
<td>0.071</td>
<td>0.082</td>
<td>0.129</td>
<td>0.157</td>
<td>0.320</td>
<td>0.293</td>
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</tbody>
</table>
## Correlation analysis

### Correlations between cosmesis and the radiographic measurements in AIS

<table>
<thead>
<tr>
<th></th>
<th>Cobb</th>
<th>CB</th>
<th>AVT</th>
<th>SHD</th>
<th>T1PA</th>
<th>CA</th>
<th>CRCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAI1</td>
<td>Correlation</td>
<td>-0.022</td>
<td>0.204</td>
<td>-0.201</td>
<td><strong>0.699</strong></td>
<td><strong>0.753</strong></td>
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<td></td>
<td>P value</td>
<td>0.932</td>
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<tr>
<td>SAI2</td>
<td>Correlation</td>
<td>-0.019</td>
<td>0.049</td>
<td>-0.286</td>
<td><strong>0.691</strong></td>
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<tr>
<td></td>
<td>P value</td>
<td>0.942</td>
<td>0.851</td>
<td>0.265</td>
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<td>0.001</td>
<td>0.001</td>
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<tr>
<td>SA</td>
<td>Correlation</td>
<td>0.086</td>
<td>0.112</td>
<td>-0.261</td>
<td><strong>0.489</strong></td>
<td><strong>0.488</strong></td>
<td><strong>0.704</strong></td>
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<tr>
<td></td>
<td>P value</td>
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<td>0.669</td>
<td>0.311</td>
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<td>0.047</td>
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<tr>
<td>AA</td>
<td>Correlation</td>
<td>-0.184</td>
<td>-0.059</td>
<td>-0.432</td>
<td><strong>0.569</strong></td>
<td>0.395</td>
<td><strong>0.561</strong></td>
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<tr>
<td></td>
<td>P value</td>
<td>0.481</td>
<td>0.822</td>
<td>0.083</td>
<td>0.017</td>
<td>0.116</td>
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<tr>
<td>Hump index</td>
<td>Correlation</td>
<td>-0.091</td>
<td>0.263</td>
<td>-0.054</td>
<td><strong>0.530</strong></td>
<td>0.468</td>
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<tr>
<td></td>
<td>P value</td>
<td>0.729</td>
<td>0.308</td>
<td>0.838</td>
<td>0.029</td>
<td>0.058</td>
<td>0.087</td>
</tr>
<tr>
<td>LAI</td>
<td>Correlation</td>
<td>-0.372</td>
<td>-0.445</td>
<td><strong>-0.798</strong></td>
<td><strong>0.581</strong></td>
<td><strong>0.563</strong></td>
<td>0.437</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.141</td>
<td>0.074</td>
<td>0.000</td>
<td>0.014</td>
<td>0.019</td>
<td>0.079</td>
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<tr>
<td>RLWAD</td>
<td>Correlation</td>
<td>0.204</td>
<td>-0.081</td>
<td>-0.142</td>
<td>-0.001</td>
<td>-0.156</td>
<td>-0.044</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.432</td>
<td>0.758</td>
<td>0.586</td>
<td>0.997</td>
<td>0.551</td>
<td>0.866</td>
</tr>
</tbody>
</table>
Demo case

SAI1=1.19     SA=1°
SAI2=1.18     AA=-5.1°
LAI=0.93      RLWAD=7°

#17264 M 15y
Lenke 1

#14485 M 14y
T7-8 分节不良

SAI1=0.71     SA=-6.1°
SAI2=0.60     AA=-7.5°
LAI=0.49      RLWAD=-13°
Conclusion

➢ Despite adolescents with idiopathic right-thoracic scoliosis and those with congenital right-thoracic scoliosis shared comparable radiographic patterns, CS patients showed **poorer** cosmesis and **worse** general areal balance.
How well do radiographic parameters correlate with patients’ cosmesis in congenital thoracic scoliosis?

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