Anatomic determinants of sacral dysmorphism and implications for safe iliosacral screw placement

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Disclosures:
M Gardner: consultant for Synthes, Stryker, RTI Biologics, DGIMED Ortho, Lippincott
Other authors: none

Background

• Qualitative Characteristics:
1. Sacrum NOT recessed in the pelvis
2. Presence of mamillary processes
3. An acute alar slope
4. A residual disc between S1/S2
5. Non-circular sacral foramena


• Quantitative Characteristics:
1. Narrower corridor
2. Increased angulation

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Hypothesis
• Pelves can be quantitatively grouped by anatomic measurements.

Methods: 104 CT scans
• Qualitative characteristics from outlets
• Quantitative characteristics from CT reformats:
  • Coronal and axial angulation of the safe corridor
  • Cross sectional area of the safe corridor
  • Length of safe osseous corridor for iliosacral screw placement

Results
• Cluster analysis

CLUSTERING BY LENGTH OF CORRIDOR

LENGTH OF S1 CORRIDOR (MM) vs. LENGTH OF S2 CORRIDOR (MM)

Frequencies of Characteristics by Cluster

- Sacrum Recessed
- Mamillary Processes
- Dysplastic upper sacral foramina
- Acute Alar Slope
- Residual disc

P < 0.0001  P < 0.0001  P = 0.001  P < 0.0001  P < 0.0001
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Results

• Principal components Analysis (PCA):
  • Main component: S1 coronal angulation, S1 axial angulation

![Image](image)

74% correctly classified.

Conclusions

• Sacral Dysmorphism is best defined by a short safe S1 osseous corridor.

• Dysmorphic pelves DO have a higher incidence of the classic characteristics of dysmorphism on the outlet image.

![Image](image)

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Results

• Sacral Dysmorphism Score = (S1 coronal angle) + 2(S1 axial angle)

<table>
<thead>
<tr>
<th>Quintile</th>
<th>% Trans-sacral</th>
<th>Min Score</th>
<th>Max Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>95%</td>
<td>1.8</td>
<td>18.0</td>
</tr>
<tr>
<td>2</td>
<td>80%</td>
<td>18.6</td>
<td>32.3</td>
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<tr>
<td>3</td>
<td>45%</td>
<td>34.3</td>
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<tr>
<td>4</td>
<td>15%</td>
<td>44.6</td>
<td>70.4</td>
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<tr>
<td>5</td>
<td>0%</td>
<td>72.2</td>
<td>116.5</td>
</tr>
</tbody>
</table>

![Image](image)

Conclusions

• Pelves can be distributed along the spectrum of morphology best by measuring the coronal and axial angulation of the S1 osseous corridor.

• The Sacral Dysmorphism Score \( (\theta + 2\alpha) \)

• Predicts the absence of a safe long corridor, and can help plan safe ISS placement.

![Image](image)
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Thank You!

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Abbot Society