Adult Scoliosis: How common is it?

Age > 50: 6-9%
LBP: 7.5%
Both: 15-68%
Impact of Degenerative Scoliosis

Studies in the Modified Scoliosis Research Society Outcomes Instrument in Adults: Validation, Reliability, and Discriminatory Capacity

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<table>
<thead>
<tr>
<th></th>
<th><strong>Lumbar Degenerative</strong></th>
<th><strong>Adult Idiopathic</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&gt;50y</td>
<td>30s-50s</td>
</tr>
<tr>
<td>Etiology</td>
<td>Disc/facet degeneration</td>
<td>Idiopathic</td>
</tr>
<tr>
<td>Reason for presentation</td>
<td>Leg pain, back pain</td>
<td>Deformity, back pain</td>
</tr>
<tr>
<td>Curve magnitude</td>
<td>20-30 degrees</td>
<td>50-60 degrees</td>
</tr>
<tr>
<td>Stenosis</td>
<td>84%</td>
<td>7%</td>
</tr>
</tbody>
</table>
Natural History

Table 1. Risk Factors for Curve Progression

<table>
<thead>
<tr>
<th>Factor</th>
<th>Curve Progression</th>
<th>No Curve Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients 41 (100%)</td>
<td>30 (73%)</td>
<td>11 (27%)</td>
</tr>
<tr>
<td>Cobb angle</td>
<td>&gt;30°</td>
<td>&lt;30°</td>
</tr>
<tr>
<td>Rotation</td>
<td>Grade 2 or 3</td>
<td>Grade 1 or 2</td>
</tr>
<tr>
<td>Intercrest line</td>
<td>Through L5</td>
<td>Through L4</td>
</tr>
<tr>
<td>Vertebral translation</td>
<td>≥6 mm</td>
<td>&lt;6 mm</td>
</tr>
</tbody>
</table>

- Curve progression averaged 3.3 degree per year.
- Those with progression had increased back and leg pain.
Clinical Assessment

History

Physical

Imaging
  • X-rays
  • Bending & Traction films
  • MRI
  • CT scan +/- myelogram
  • Discogram
History

Pain
- Back – more prevalent
- Leg – more commonly the reason for presentation
  - Radicular or Neurogenic claudication

Postural Imbalance/Deformity Progression
- Stooped Posture
- Coronal imbalance may be painful, fatiguing
- Convexity is the area of greatest pain in 75%
  - 2nd most common is concavity
Physical Examination

Overall spine alignment

Neurological examination
- Many patients have a normal exam

Other joint pathology
- Hip/Knee – contractures
  - The hip may be maximally extended to compensate for a loss of lordosis
- Cervical spinal stenosis – altered gait
Plain Radiographs

- Standing PA/lateral full-length spine films
  - 14 x 36”
- Lateral supine bending films
- Traction films in curves > 60 degrees
- Push-prone films
- Flexion/Extension for lumbar flexibility and sagittal instability

- Non-weightbearing imaging (supine radiographs, MRI) tend to underestimate curve magnitudes by approximately 10 degrees

Dynamic Radiographic Studies

Lateral Bending
• Less flexible than adult idiopathic scoliosis

Traction
• Can reveal extent of autofusion from degeneration
Traction Films

Standing PA

Supine PA with Traction
Advanced Imaging and further testing

Cross-sectional imaging
  • MRI
  • CT +/- myelography

?Discography

PFTs
  • For thoracic curves > 70 degrees
  • Pulmonary symptoms
  • Hx of pulmonary disease
  • Thoracoplasty: 27% decline in PF at 3 months
The Cone of Economy
Coronal and Sagittal Balance

Positive sagittal balance most reliable predictor of clinical symptoms and poor functional outcome in operative and non-operative patients.

Glassman SD, et al. Spine, 2005
Pelvic Parameters: Sagittal Plane
Pelvic Parameters

\[ PT + SS = PI \]
Compensation with Pelvic Retroversion

Similar functional outcome improvements in compensated and uncompensated flatback deformities following surgical correction

Pelvic Compensation

COMPENSATORY EFFECTS
- Pre-surgical condition without compensatory effects

C7

plumline

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Created by Dr. Chris Ames and A. Bokelman, K. X. Probst / Xavier Studio
Reciprocal Changes around the Hip and Pelvis

Standing

SS

PI

PT

AA

Sitting

SS

PI

PT

AA
Reciprocal Changes around the Hip and Pelvis
Reciprocal Changes: *Pelvic Compensation*

- Retroversion
- Anteversion

Anterior Impingement
Posterior Impingement
Knee Flexion Contractures
Case Example

75F

Back and leg pain

Unable to stand upright

Prior ACDF C3-7
PI = PT + SS

PT < 25

PI = LL

Treatment???

- PI - LL = 62 - 26 = 36
## Surgical Decision Making

<table>
<thead>
<tr>
<th>General Indications</th>
<th>Surgical Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Decompression</td>
</tr>
<tr>
<td>Neuro deficit</td>
<td>Stabilization</td>
</tr>
<tr>
<td>Deformity</td>
<td>Deformity correction</td>
</tr>
</tbody>
</table>
Stand-Alone Decompression

Rarely indicated
- No back pain
- No up-down foraminal stenosis
- No gross instability at selected levels

Stability preserving
- Laminotomy
- Unilateral approach for bilateral decompression
  - McCullough laminoplasty, Spinous process osteotomy
Minimally Disruptive Approaches
Decompression/Limited Fusion

Limited fusion with decompression
  Short segment
  Interbody for height restoration

Fusion w/o correction if balanced in coronal and sagittal plane
  Especially below a rigid or fused curve

Risk of adjacent segment disease
Risk of progression of deformity
Deformity Correction

Addresses all anatomical causes of pain – deformity, degeneration, and neural element compression

Decreases likelihood of revision to address problems within the deformity

May still have risk of adjacent segment disease

Higher amount of overall morbidity
85 patients with degenerative scoliosis and radiculopathy

Treated by decompression, decompression and limited fusion, decompression and curve correction

All 3 had good and poor results

- D: fewest complications, most would not have done again
- DCC: highest complications, most successful
- DLF: in between
The Good News

Leg pain is reliably treated operatively when compared with non-operative treatment
Smith, et al. Spine 2009

Back pain is reliably treated operatively when compared with non-operative treatment

Good deformity correction can be achieved surgically
Functional Improvement

Results of Surgical Treatment of Painful Adult Scoliosis

Stephen A. Grubb, MD, Hester J. Lipscomb, MPH, and Paul B. Suh, MD

Patients consistently walk and stand better than pre-op

They usually tolerated sitting the same or better than pre-op

Pain was consistently reduced in patients w/ successful fusion

Figure 1. Activity tolerance change (pre- to postop) by scoliosis type.
### The Bad News

**Major Complications**

- **Residual pain**: 5-15%
- **Neurologic injury**: Up to 5%
- **Infection**: 1-5%
- **Pseudarthrosis**: 5-27%
- **Thromboembolism**: 1-20%
Rates of Complications, by Age Group, SRS Database

• Studies found surgical complications for scoliosis ranging from 10-40%

• 25-44 years (n = 47 cases) = 17% developed complications
  – Highest major complication: deep wound infection (25% major complications)
• 45-65 years (n = 121) = 42%
  – Highest minor complications:
    • cerebrospinal fluid leak (8% minor complications)
    • symptomatic pulmonary effusion (8%)
    • prolong ileus (6%)
  – Highest major complications:
    • excessive blood loss (22% major complications)
    • deep wound infection (22%)
    • nerve root injury, quad weakness (17%)

Source: (Smith, Shaffrey, Glassman, et al., 2011)
Rates of Complications, by Age Group, SRS Database

- 65-85 years (n = 38) = 71%
  - **Highest minor complications:**
    - superficial infection (25% minor complications)
    - deep venous thrombosis (19%)
    - prolonged ileus (19%)
  - **Highest major complications:**
    - excessive blood loss (37% major complications)
    - deep wound infection (18%)
    - pulmonary embolism (18%)

The Evolution of Scoliosis Treatment

Orthopaedic

“Straight child”
The Evolution of Treatment

Hippocrates

Paré

Hibbs
The Instrumentation Era

Harrington

Cotrel

Dubousset

Suk

Lenke
Techniques of Correction

- **Compression**
  - on convexity creates lordosis

- **Distraction**
  - on concavity creates kyphosis

- **M/L Translation**

- **Rod Rotation**
Unique Considerations in Adults

Stenosis

Disc Degeneration

Joint Ankylosis

Osteoporosis

Risk of Nonunion

Medical Comorbidities
Adult Deformity Techniques for Sagittal Imbalance

Lengthen the front
   - Interbody fusion (TLIF, XLIF, ALIF)

Shorten the back
   - Facetectomy, SPO
     - PSO or VCR (for significant or focal deformity)

Or Both!! (anterior and posterior)

Asymmetric Corrections for Coronal Deformity
Interbody Fusions
Posterior Shortening Procedures

Osteotomies
Smith-Peterson Osteotomy (SPO)

Facetectomy with resection of posterior elements through foramina
  Hinges on PLL
  Shortens the neuroforamen
  Opens at the disc space

Requires a mobile disc!!!

10-15 degrees per level

Better for global correction

Can be done at multiple levels
Pedicle Subtraction Osteotomy (PSO)

Resection of posterior elements including bilateral pedicles of a single vertebral body

Closing wedge osteotomy of a vertebra
Hinges on anterior column

Can be done through rigid spine

35-50 degrees per level (L-spine)
Vertebral Column Resection (VCR)

Resection of entire vertebra with discs above and below from posterior approach
Typically requires insertion of interbody device
   Hinges on anterior column which may be lengthened
Can be done through rigid spine
40-60 degrees per level
Most destabilizing = highest risk complications
Approach to Deformity Correction

Plane of deformity
sagittal, coronal, axial

Global vs. Focal deformity

Rigid vs. Flexible

Mild vs. Severe

Bone Quality

Choosing the ends of the construct
Case Example

75F

Back and leg pain

Unable to stand upright

Prior ACDF C3-7
Pl = PT + SS
PT < 25
Pl = LL

• Pl-LL = 62-26 = 36
Case Example

Stage 1: L1-L5 XLIF

Stage 2: T10-P PSF
Case – 68M

Parkinson’s

Previous L4-5 Decompression

Progressive kyphosis

*Camptocormia*

Postlaminectomy kyphosis
Case – 81F

- Hx of Degen Scoliosis

- Underwent MIS Scoliosis correction
  - L1-L5 XLIF
  - Bilateral Wiltse Fusion L1-S1
  - MIS TLIF @ L5-S1

- After surgery:
  - Increased back pain
  - Unable to stand straight
Case – 81F
Case – 81F

- L3 PSO
- Revision L5-S1 TLIF
- Dual Iliac screws
- T10-Pelvis PSF
Case – 81F
Case – 61F

Prior surgery x 2

T7-S1 PSF

Can’t stand up straight

Back and leg pain

Using a walker to ambulate

Smoker

Heavy dose narcotics
Diagnosis

Sagittal and Coronal Imbalance

Spinal Stenosis

Pseudarthrosis

Broken rod

S/P T7-S1 PSF
L4 Asymmetric PSO with TLIF cage, T4-Pelvis PSF
Post-op
Summary

Important to understand how to:

• Recognize and Assess Adult Spinal Deformities (Coronal, Sagittal, Combined) and understand the burden of disease

• Quantify Magnitude and Planes of Deformity to Plan for appropriate correction

• Anticipate potential for reciprocal changes after correction

• Minimize Complications while Achieving Treatment Goals
Thank You!